Flathead Watershed Sourcebook
Educators' Guide

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Photo Credit on cover page: North Fork of the Flathead River, Michael Gallacher, Missoulian http://missoulian.com/news/local/daines-introduces-north-fork-protection-act-in-u-s-house/article_2df11b98-ce1b-11e2-b843-001a4bcf887a.html

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About the Educators' Guide

The Flathead Watershed Sourcebook Educators' Guide was developed to provide educators with place-based interdisciplinary lessons focusing on the Flathead Watershed. The objective is to teach about the natural and social components of the watershed and to help learners develop positive values of stewardship towards the Flathead Watershed.

This development of the Flathead Watershed Sourcebook Educators' Guide (the "Guide") was a collaboration of the Flathead Community of Resource Educators and the Department of Education at Montana State University – Bozeman. The development of the Guide was coordinated by Lori Curtis (lori@whitefishlake.org) Whitefish Lake Institute, Whitefish, Montana , and Valerie Kurth (vkurth@flatheadcd.org) Flathead Conservation District, Kalispell, MT. The authors of the Guide are Michael Brody (brody@montana.edu) Department of Education, Montana State University, Bozeman, MT and Rose Vallor (rvallor@gmail.com), Department of Education, Montana State University, Bozeman, MT.

The Guide is complementary to the Flathead Watershed Sourcebook (2010), written by Lori Curtis and available online at http://www.flatheadwatershed.org/. Together, the Sourcebook and the Guide provide detailed natural and social science content with hands-on experiential learning activities. The Guide provides supplementary curriculum materials that correlate with national and Montana state standards. Both formal and informal educators can use these lessons with learners throughout the watershed.

Rather than developing the Guide in isolation, the authors conducted a research study with educators, resource managers, and scientists to ascertain the essential understandings that project partners concluded should be included in the Guide. The report on the Flathead Watershed Delphi Study can be found at http://www.informalscience.org/flathead-watershed-educators-guide-phase-1-delphi-survey-project-report.

Educators' Guide Components

The Guide was written to reflect a sense of place, that is, lessons are based on places and events in the Flathead Watershed. Lessons are intended to help learners connect with the environment around them. Most lessons are interdisciplinary, integrating various combinations of natural and social sciences, humanities, arts and language. The lessons were developed for middle level curriculum, but can be adapted for earlier and later grade levels.

In each chapter we have included lessons which require students to read and write about the watershed, with an emphasis on deep reading for meaning. In Appendix A we have

correlated the lessons with the Next Generation Science Standards and the Common Core. In Appendix B we have organized lessons across various topics and themes that might be taught as curriculum units. These thematic units include themes such as water quality and community action.

About the Educators' Guide Lessons

The Guide lessons have standardized formats. Each lesson includes an interesting title, an essential question, lesson summary, objectives addressing cognitive, skill and affective outcomes, materials list, background content for the educator, a detailed procedure for teaching the lesson and suggested assessments of learning outcomes. Included for each lesson are available resources for learning more about the content of the lesson and for teaching the lessons.

About the Educators' Guide Authors

Michael Brody is a professor of science education in the Department of Education in the College of Education, Health and Human Development at Montana State University, Bozeman, Montana. He teaches undergraduate science teaching methods and graduate courses in education research. He has worked on local, state, national and international curriculum projects including the ***Habitable Planet: a Systems Approach to Teaching Environmental Science*** which received the American Association for the Advancement of Science (AAAS) Science Prize for Online Resource in Education (SPORE) https://www.learner.org/courses/envsci/.

Rose Vallor is a doctoral student in the curriculum and instruction program in the Department of Education at Montana State University, Bozeman, MT. Rose has been a Montana certified informal science teacher for over 15 years, teaching natural and physical science in classrooms, museums and nature camps throughout Southwest Montana. She has facilitated state-wide workshops for teachers for environmental education guides based on water and forestry science, and has taught science teaching methods courses at Montana State University. She has written a number of science curriculums and both utilized and taught Montana, NGSS and Common Core standards curriculum correlation. Her Master's thesis research topic was the Delphi survey that gathered the essential understandings the Educator's Guide is founded on.

Acknowledgements

The authors would like to thank the educator and teacher volunteers who field tested the lessons and provided feedback on improving our work. Thank you for your review work and providing inspiration for us to continue our work on this innovative curriculum project.

Chapter 1: What is a Watershed?

Background

American geologist, ethnologist, explorer, and government administrator John Wesley Powell described a watershed as *"...that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community."*

Introduction

This beginning chapter in the Guide is designed to introduce teachers and learners to the concept of a watershed. The lessons will also lay a foundation for future activities that can be conducted as part of any Sourcebook chapters or Guide chapters. For example, the lesson 1-2 Watershed Journals or lesson 1-9 Flathead Field Notes can be used in the natural history section to document plants and animals on watershed field trips. In general, the lessons help students understand what is the Flathead Watershed, develop skills to be used throughout the Flathead Watershed studies and develop an appreciation for the watershed through arts and literature.

Essential Questions

- What is a watershed?
- Where is the Flathead Watershed located?
- Where am I in the Flathead Watershed?
- How does stream and river flow change and affect people within the watershed?
- How have people expressed a sense of place or connection to the Flathead Watershed?

Content

What is a watershed and what are the characteristics that define the Flathead Watershed? The lessons in this unit correspond to the content found in Chapter 1 of the Flathead Watershed Sourcebook, pages 1 – 16, and they are an introduction to the concept of a watershed. There is an emphasis on knowing the physical boundaries of the Flathead Watershed and the location of key water features within the Flathead Watershed.

The major ecological factor described in this section is how the flow of water within the watershed affects human populations, such as, annual changes in water flow and periodic flooding events. Lessons 1-5 Patterns of Stream and River Flow and 1-6 Flooding in the Flathead take advantage of historical and current water flow data to investigate changes over time. In this section there is also an emphasis on map skills, using existing maps and creating local site-based maps.

Lessons 1-7 Watershed Quotes and lesson 1-8 Poetry of Place tie social aspects of the watershed with human perspectives in literature and art to the watershed. This is complimentary to the Sourcebook's treatment of art and the Flathead Watershed pp 14 – 16. These social aspects of the Flathead Watershed express the concept of sense of place. Lessons

in section one and throughout the Guide will help students develop a connection to the watershed and thus a sense of place within the Flathead Watershed.

Learning goals

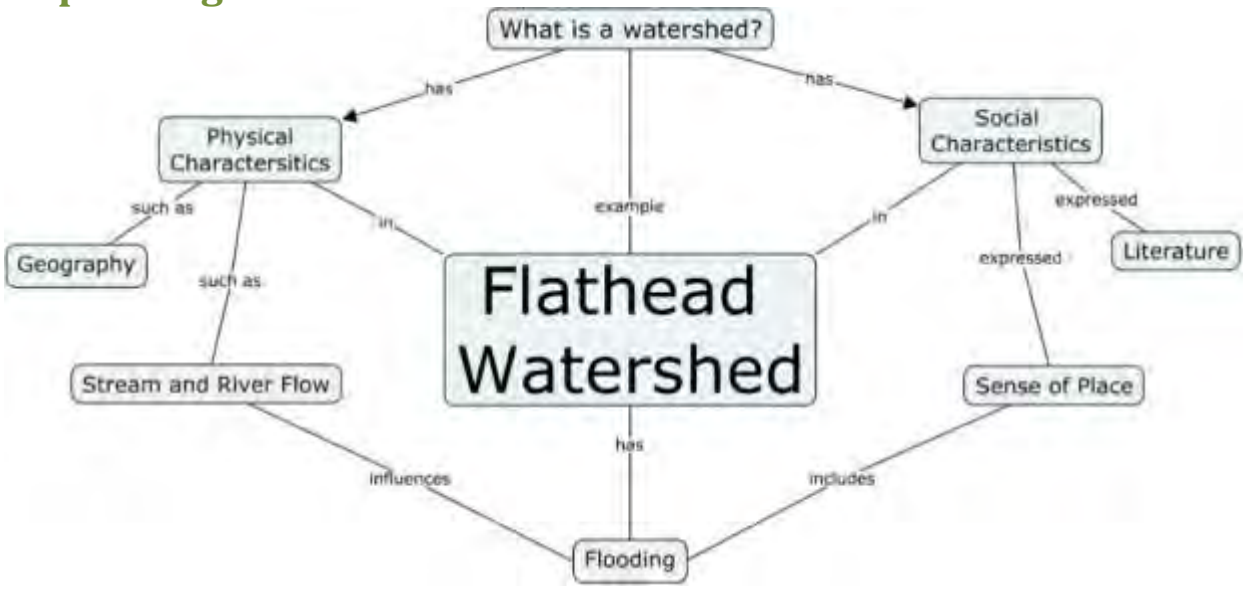
In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
  - The characteristics of a watershed
  - The location and parts of the Flathead Watershed
  - Effects of changes of water flow in the watershed
- Skills
  - How to create a field notebook and watershed journal
  - How to create a site map of a local area
  - Read stream and river flow data tables and graphs
  - Field trip safety
- Dispositions
  - Appreciate different feelings, attitudes and values related to a watershed
  - Express their own feelings, attitudes and values about the Flathead Watershed

Key Concepts

Boundaries
Close Reading
Compass
Direction Readings
Discharge
Distance
Flathead Watershed
Flooding
Flow patterns
Headwaters
Information System
Journals
Mapping
National, State and Local Streams, Rivers, Lakes
National Water
Poetic form: Syntu
Seasonal Changes
Sense of Place
Stream and River Flow
US Geological Survey
Watershed

Graphic Organizer



Introduction Lessons

Intro-1 People in the Flathead Watershed

Who are the stewards of the Flathead Watershed?

SUMMARY

Students will 'closely read' a watershed perspective of their choice from the Flathead Watershed Sourcebook. In their close reading, students will look for the answers to specific questions about the author and their motivations for being 'stewards' of the Flathead Watershed. Students will present their findings to their classmates.

OBJECTIVES

Students will

- Closely read written perspectives about the Flathead Watershed.
- Analyze the writings for identity, engagement and motivation.
- Create a presentation to share with classmates.
- Observe and evaluate classmates' presentations.

MATERIALS

- Copies of the Watershed Perspectives in the Flathead Watershed Sourcebook
- Materials to create presentations: online programs, software, or posterboard

BACKGROUND

Close reading means reading to uncover layers of meaning that lead to deep comprehension. Close, analytic reading stresses engaging with a text of sufficient complexity and examining the author's meaning thoroughly and methodically. This encourages students to read and reread for comprehension. Directing student attention to the text enables students to understand the central ideas and supporting details. It also enables students to reflect on the meanings of individual words and sentences; the order in which sentences unfold; and the development of ideas. This leads students to arrive at an understanding of the text as a whole.

There are over 50 perspective pieces throughout the Flathead Watershed Sourcebook. These story-telling vignettes communicate aspects of the Flathead Watershed from varied points of view. Each one was written by—or as a result of an interview with—an individual contributor. These distinctive and colorful citizen narratives help paint a robust and diverse picture of the watershed, (from the Flathead Watershed Sourcebook, pg. vii).

Flathead CORE: Photo credit: Walt Curtis

PROCEDURE

Warm-up

Ask the class to think about the concept of 'stewardship'. Have students share their thoughts with the class.

Share a definition of the concept:
-the activity or job of protecting and being responsible for something.
(*http://www.merriam-webster.com/dictionary/stewardship*)

Intro-1 People in the Flathead Watershed

Ask the class to consider the idea of stewardship of natural resources – specifically the Flathead Watershed. Ask them to think of how they would define stewardship of the Flathead Watershed. In journals or on the board, write down their ideas of stewardship of the watershed.

Share this definition and see what students think and feel about it:

"Every steward has his or her own definition of what stewardship means to them. Most often, stewardship evokes a sense of personal responsibility for ensuring our natural resources are sustainably managed for our own quality of life, and for future generations."
Alberta Stewardship Network

Lead a discussion with the class about what roles people have in the community when they work as stewards of the watershed. These roles can range from scientists and researchers to environmental activists, educators, commercial loggers, and farmers. Have students discuss the commonalities of each role.

The Activity

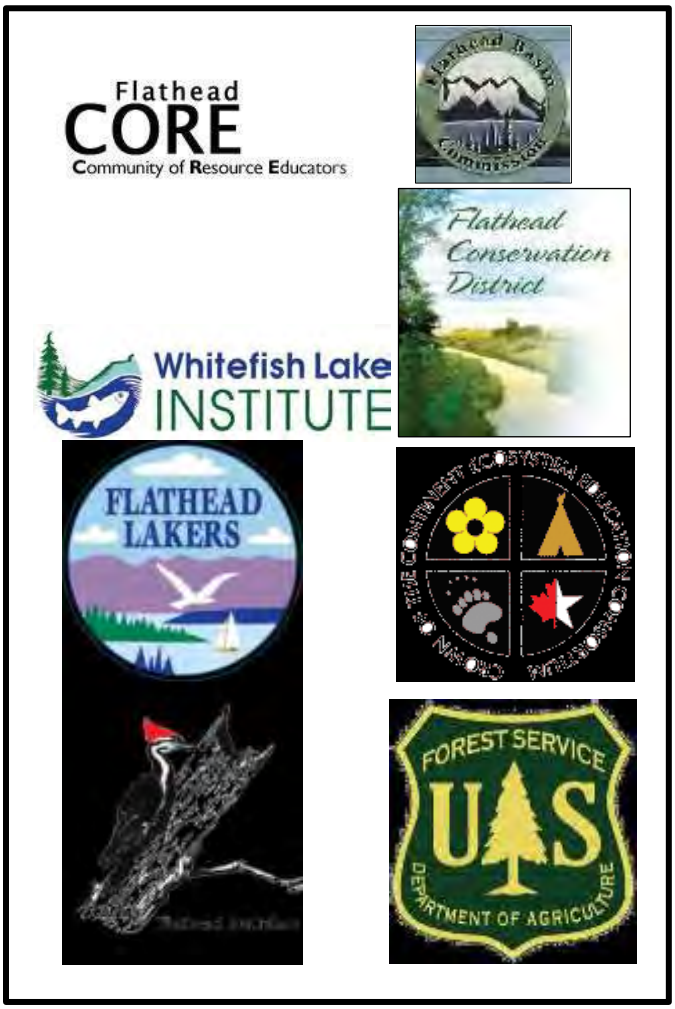
Share with the class the list of perspectives on the Flathead Watershed from the Flathead Watershed Sourcebook (pg. vii). (Hyperlink: http://www.flatheadwatershed.org/introduction/perspectives.shtml)

There are 57 perspectives found throughout the sourcebook. They offer a wide range of viewpoints, roles in the community, and author backgrounds. Perspectives to be studied can be determined through student choice or by design of the teacher. Students can work singly or in pairs.

Have students read their perspective. Ask students to look for the answers to these questions in their reading:

- Who is the author of the perspective?
- What is their role in the community of the Flathead Watershed?
- What are their 'stewardship' actions?
- How has their stewardship sustained or made a difference in the watershed?
- Why did they write or participate in this perspective?
- What is their motivation to be a 'steward' of the watershed?

Students write their answers to the above questions in their journals, in an online word document, or another format. Ask students to record any other thoughts about the perspectives they are reading that they wish to share with the class.



CORE Partners

Wrap-Up

Have each student or pair of students create a presentation to share with the class about the person who wrote the perspective they read. Presentations can be created online with Prezi, PowerPoint, or other software. Presentations can also be drawn on paper and illustrated with markers or colored pencils. Each student or pair can then give their presentation orally, projected on the board, or they can be displayed on the walls of the classroom.

After presentations, ask students to search for common threads in the perspectives that have been analyzed. Ask if there are any generalities that can be discovered among the people who have authored the perspectives.

ASSESSMENT

Discussions in class act as pre-assessments and formative assessments for understanding the role of stewardship in a community and in a watershed. Written work answering the 'close reading' questions can serve as both formative and summative assessments. Student presentations are a summative assessment.

EXTENSIONS

Students can imagine themselves in their own roles as stewards of the watershed. Have students write in their journals or other format what role they see themselves taking as a steward of the watershed in their community. Ask students to list actions they would take in their chosen 'steward' role.

RESOURCES

Information about the perspectives in the Flathead Watershed Sourcebook:
http://www.flatheadwatershed.org/introduction/perspectives.shtml
http://www.flatheadwatershed.org/partners/committee.shtml

Intro-2 Interviewing People in the Flathead Watershed

Who are the people who live and work in the Flathead Watershed and what are their views of the land and its use?

SUMMARY

In this lesson students will interview people who live in and make a living from the land and resources in the Flathead Watershed.

OBJECTIVES

The students will

- Understand the concept of people and their relationship to the land and how that has evolved over time.
- Structure, prepare, conduct and communicate the results of focused interviews.
- Appreciate and value the various perspectives about living and working in the Flathead Watershed.

MATERIALS

- Field notebook
- Poster paper
- Markers
- Audio recorder
- Video recorder
- Digital editing software
- Interviewing guidelines (at end of the lesson)
- Flathead Watershed Sourcebook perspective, pg. 191, Conserving the Land and Preserving the Farming Way of Life

BACKGROUND

Interviewing skills are an important strength for people in general and professionals in particular. In addition to participating in interviews as job candidates, almost everyone will need to conduct interviews of their own in the course of their careers.

Conducting an interview takes careful preparation, relevant questions, good critical thinking skills, good people-reading skills and good behavior. These are all good skills for young people to exhibit as they move beyond school. These skills will supply them with invaluable readiness for the challenges that await them.

Be sure to read the Flathead Watershed Sourcebook chapter on land ownership, agriculture and forest industry, Ch. 6, pg. 179- 214, and at: (http://www.flatheadwatershed.org/land/ownership.shtml).

Conducting an interview: https://mimagazine.net/interview

PROCEDURE

Warm-up

Interviewing family members or friends can be a valuable way for students to learn about themselves and their families while practicing interviewing skills. A family interview does not need to be formal, but a little time spent in preparation will result in a more positive, productive experience for everyone involved.

Have students interview a family member, write a short summary and report briefly in class the results.

Intro-2 Interviewing People in the Flathead Watershed

The Activity

Have the students read Conserving the Land and Preserving the Farming Way of Life, a conversation with Tom Siderius, Siderius Farms, Kalispell, MT. in the Flathead Watershed Sourcebook, pg. 191, and at: (http://www.flatheadwatershed.org/docs/wpPDF/Popout_Siderius.pdf)

Using the guidelines for developing a good interview (attached) work in small groups to determine why this is a good interview.

Use current newspapers in the Flathead Watershed to look for interviews in the news. Use the guidelines to identify why these are good interviews.

In groups of two, have students develop an interview for their partner and conduct the interview. Conduct the interview and then discuss how to use the guidelines to develop a good interview.

Have each student identify a person in the Flathead Watershed and conduct an interview on where they live, work and their use of Flathead resources.

Write all notes and a summary in your field notebook.

Wrap-up

Have the students report back to the class on their interviews. Have the class organize the interviews into relevant categories such as farmers, teachers, home owners, etc. Assign a category to a group of students. For each category list several relevant themes or similarities among the interviews in that category.

ASSESSMENT

Write a summary of who were interviewed in each category and the major themes, ideas, values or beliefs that those people in the single category shared.

EXTENSIONS

Conduct more interviews that are targeted at a specific idea such as wilderness or preservation. Conduct interviews that are targeted at a specific population such as farmers, ranchers or teachers.

Have a reporter from a local news agency come to class and talk about their profession.

RESOURCES

There are many Watershed Perspectives in the Sourcebook that can be used as examples of interviews and the summaries of in depth conversations about the watershed.

How to conduct an interview at: http://work.chron.com/teach-students-conduct-interview-18016.html or http://www.scholastic.com/teachers/lesson-plan/how-conduct-interview.

Guidelines for Developing Good Interviews

Prepare the interview:

- Develop a statement of interest, including what you find interesting about the subject and what you will be able to discover through the interview that you could not otherwise research.
- Research thoroughly whatever you can find on the person, the project, the subject, and/or events.
- Prioritize a set of objectives and questions.
- Discover what is necessary to fit into his/her environment/space; ask advice of others if necessary. Dress neatly and appropriately for the situation. Your objective is to make the interview subject feel comfortable, and willing to share what is important to them.
- Develop a checklist of what "tools" are needed in the interview: notebook, pens, recording device, etc.
- Arrange for the interview "on location" if possible and/or appropriate. It will add to its sense of authenticity, place, voice, and story.

Before the interview:

- Arrive early and observe where your subject works, if possible the office environment, working conditions, co-workers and staff, how he/she is dressed, etc.
- If you tape record the interview, test your recorder, its tape and batteries before you start. Get permission, in writing or on the tape.

Introductions (a "few" minutes)

- Introduce yourself and your project.
- Ask for the person's name, title, business card, photograph or digital image, company logo, etc. as appropriate.
- Try to make the person you interview (and yourself!) comfortable. Some casual conversation is appropriate as ice-breaker: express your appreciation for their time and willingness.
- If this is your first interview, share that you are developing your interviewing technique.
- If you know the person from before, keep in mind that your project may require that you be impartial or neutral to that person's experience.
- Offer a consent form.

Introductory questions:

- Be complimentary to set the tone.
- Demonstrate your interest and preparation.
- Verify a few known selected facts, insights into the person and their work.

The Interview:

- Treat the interview like a conversation with structure! Begin with your list of questions.
- Actively listen to understand and report. Affirm that you understand what they are saying. Do not agree or disagree with the person. Do not debate what they have to say.
- While taking notes, don't hesitate to ask for clarifications or better understanding.
- Know when to be quiet. Listen carefully so that you know when to let your source pause to collect his or her thoughts. Don't feel the need to fill every empty space with conversation.

- Don't be afraid to say you don't understand, or need more explanation. Use your own words to repeat back; ask: "So what you're saying is ..." or "So let me get this straight..."
- Be willing at all times to be surprised; follow chance openings. Don't think you know what the story is about.
- Don't let your own feelings or bias shape the questions you ask.

Follow the order and priority of your questions:

- Transitions: be aware of time constraints and your purpose.
- Look for a convenient jumping off point to engage the subject.
- Develop more depth/complexity as you develop your comfort level, and as the opportunity arises.
- Avoid yes/no questions. Ask some questions that can be only answered with a story. This reinforces your interest in not only getting "facts" but also the role your subject has played. It lends voice to the narrative, and can personalize the story for your readers.

Transition to conclusion:

- Keep aware of the time, and all the topics you need to cover.
- Ask if there are additional points that have not been addressed.
- Summarize a few important points to verify if you understand correctly.
- Ask for references for additional information, sources for data, or advice for further development.

Conclusion:

- Review your timeline toward completing your project.
- Volunteer to provide a copy of your completed report, article, or a summary of the presentation, including any reactions to the interviewee.
- Express sincere appreciation.

Writing an interview essay:

- Organize your notes.
- Label and date notes and tapes for easy reference.
- Transcribe the audio recording, or important sequences and quotes.
- Set your notes aside for a day or two to get a fresh perspective.
- Re-read the assignment! What specifically is the focus of the assignment?
- For each significant theme, find an appropriate quote and cut and paste these into their categories.
- Follow the structure of any writing assignment.
- After completing the substance of the interview, develop an introduction (remember your initial observations?) and conclusion.
- Follow guidelines on proofreading, verifying with and citing your source(s), and spell checking.
- If appropriate, with advice from your teacher, send a copy to your interviewed subject with appreciation inviting feedback.

Chapter One Lessons 15

Ch. 1-1 Boundaries of the Flathead Watershed

What does the Flathead Watershed encompass?

SUMMARY

Students will determine the outline of the Flathead Watershed on a map worksheet. The headwaters, major tributaries and main stems of the Flathead River will be labeled using topographic maps available online as an extension activity. Students will discuss where the water of the Flathead originates, what direction it flows and to what location it flows.

OBJECTIVES

Students will

- Determine the Flathead Watershed boundary.
- Identify the headwater areas, major tributaries and the main stems of the Flathead River.
- Analyze the flow pattern of the Flathead River.
- Recognize and name major landmarks within the Flathead Watershed such as cities, towns, National Parks and lakes.
- Be able to locate their homes and schools within the watershed map.
- Discuss where the Flathead River Watershed fits into the larger geographic area.

MATERIALS

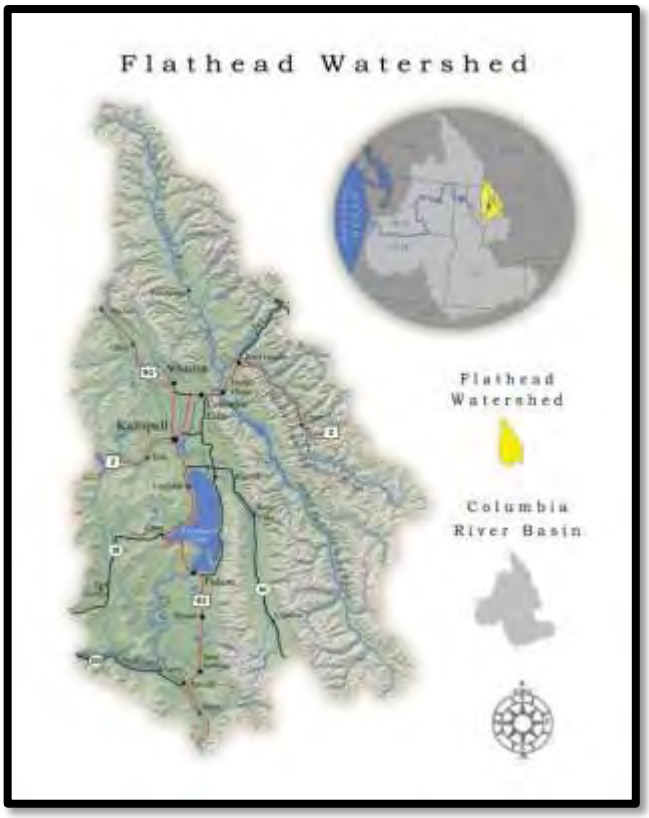
- Flathead Watershed worksheet
- Colored pencils or markers
- Maps of Montana and North America

For extension activities:

- Computers with internet capability

BACKGROUND

The Flathead Watershed includes all the land that drains into the Flathead River and Flathead Lake and beyond the lake to the confluence of the Flathead and Clark Fork Rivers. The area begins across the Canada- U.S. border in the north, reaching down to the Clark Fork drainage in the south, and extends from the Salish Range in the northwest to the Continental Divide in the east including many smaller watersheds, lakes, and drainages.



Flathead Watershed: www.flatheadwatershed.org

The waters of the Flathead, Stillwater, Swan, and Whitefish rivers all unite and join Flathead Lake, the largest natural freshwater lake west of the Mississippi River. The North, Middle, and South Forks of the Flathead River contribute approximately 80% of the water entering Flathead Lake.

The river serves as the headwaters of the Columbia River and is the largest tributary of the Clark Fork River.

Ch. 1-1 Boundaries of the Flathead Watershed

The Whitefish River and Stillwater River together drain the northwest part of the watershed, joining the upper Flathead River just below Kalispell.

The North, Middle, and South Forks of the Flathead River join together upstream of Columbia Falls, forming the upper Flathead River system. Together with the Swan River, they drain the eastern portion of the watershed and serve as the two central tributaries to Flathead Lake, emptying into the northeast portion of the lake.

At the lake's outlet, located at the southwest portion of the lake, the lower Flathead River flows 72 miles (116 km) to where it joins the Clark Fork River. (from Flathead Watershed Sourcebook, pg. 3) http://www.flatheadwatershed.org/watershed/flathead_watershed.shtml

PROCEDURE

Warm-up

Ask the class to identify their nearest natural flowing water. Ask if they know where that river or stream begins and to where it flows. When that information has been correctly established, ask the class if they know that all waters are part of a system of rivers, lakes and streams called a watershed. Ask the class if they have heard of the term 'watershed', and if so, if they can give a definition. (A watershed is an area of land where all the water flowing across or through the land drains to a single location.). Tell the class that the watershed they live in is called the Flathead Watershed, and they are now going to figure out the boundaries of the watershed.

The Activity

Have students get out colored pencils or markers. They will need the colors: blue, brown, green, red, and orange.

Hand out the Flathead Watershed Outline Map worksheet.

Ask the class what the map represents. If it isn't evident to the class, tell them the map is a representation of the major streams, rivers and lakes in the Flathead Watershed.

Ask the class to determine on the map which lines are streams (the smaller ones) and which are rivers (the thicker lines). Ask the class: "what is the relationship between the streams and the rivers?" (The streams flow into the rivers)

Ask everyone to notice where Flathead Lake is. With a pencil, have students make a small mark to indicate where they think they are sitting on the map at that moment. They can talk it over with other students to come to a consensus.

Ask the class to note where north is on the map. Ask the class which way the rivers flow, in general, on the map. (the water flows in general from north to south, though the Middle and South Forks of the Flathead River, and the Swan River, flow north before they join with water that is moving south, and the Jocko River flows west to meet the Flathead River at the town of Dixon).

Ask: "Where on the map does the water flow out of the watershed?" (in the southwest corner of the map – the Flathead River joins with the Clark Fork River just before the town of Plains).

Watershed Boundary:

Have the students draw a red X at the mouth of the Flathead River – the point where it leaves the map.

- *Red X – mouth of the Flathead River*

Tell the class that they are now going to outline the boundaries of the Flathead Watershed.

- With the orange pencil, have the students place an orange dot at the tips of all the streams and rivers except at the red X at the mouth of the Flathead River.
  - *Orange dot= tips of the headwaters – where the streams and rivers begin*

- Next, still using the orange pencil – start at the red X at the mouth of the Flathead and connect the orange dots on the tips of the streams and rivers that end ONLY on the outside edges of the map, ending back at the red X at the Flathead River's mouth. DO NOT connect the dots that are inside the map.

- Everyone should have an orange outline around all the black lines representing the waters of the Flathead Watershed.

    - *Orange line = <u>watershed boundary.</u>*
      *-The orange line marks the **<u>divide</u>** between the Flathead Watershed and adjacent watersheds.*

The class is now going to color in the streams and rivers.

<u>Tributaries:</u>

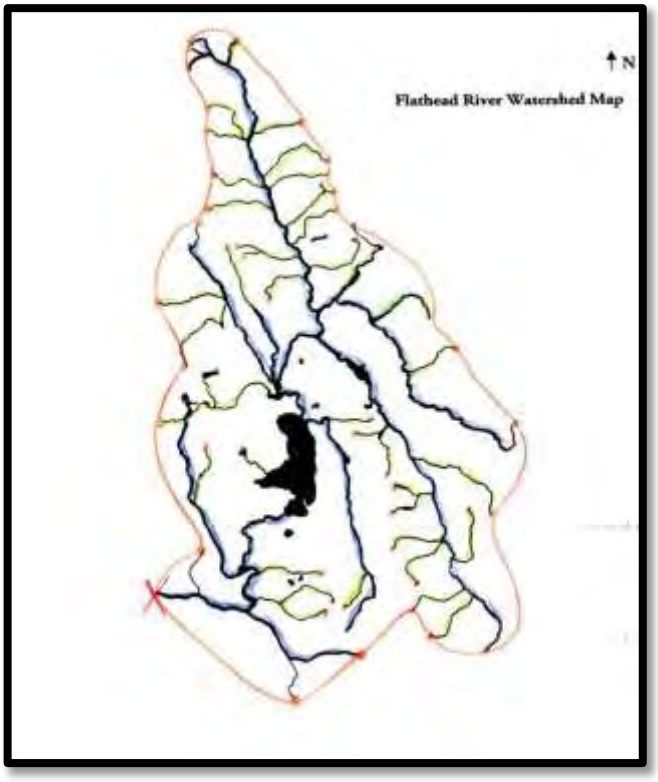
- Using the green pencil – have the class color over the **<u>thin</u>** black lines that represent <u>tributaries.</u>
    - *Green = Tributaries – smaller streams that feed into the rivers*

<u>Main Stems:</u>

- Using the blue pencil – have the class color over the **<u>thick</u>** black lines that represent <u>main stems</u>
    - *Blue = Main stems – rivers that drain water from large areas of land*

Optional: Ask the class: "what separates the different rivers and streams from each other? " (high ground, or higher elevations – called divides - between the streams and rivers).

- Using the brown pencil - have the class **lightly draw** brown lines between both the thin and thick black lines on the map. These represent the ridges and higher elevations that divide the land and create the separate waterways.
    - *Brown = Divides – higher elevations between stream and river valleys*



Example- Flathead Watershed Boundary Map: R. Vallor

<u>Wrap-up</u>

Everyone will now have a colorful map showing the outline of the Flathead Watershed with the tributaries and main stems that create the drainage pattern for water moving through the watershed. Have the class study their maps for a few moments.

Point out to the students that now that they have drawn the boundary around the watershed, they can see that all the water that falls on that area of land flows to the same place – it either stays in the watershed (in glaciers or in the lakes or the ground) or it all eventually flows out of the watershed where the Flathead River meets the Clark Fork River at Dixon.

Discuss with the students some of the uses for this new knowledge – Ask "why would we want to know about what's within the watershed?"
Some ideas that might come up:

- It may be possible to find out how much water is available for fish, farming, houses, cities, etc.
- If some kind of pollution happens, it would be possible to see what areas will be affected downstream
- If water is dammed up, it's possible to see what would be affected downstream
- If the potential for flooding occurs, downstream areas would be more easily identified

For further thought:

Ask: "Are there any patterns to the lines that you notice?" "Turn to your neighbor, compare your maps, and discuss your thoughts about patterns that you see in maps." (Ideas that may be brought up are that some of the streams and rivers are parallel to each other, and some of the rivers flow along the same lines; most of the rivers flow into Flathead Lake, most of the rivers run north/south, and the streams run east/west).

ASSESSMENT

The watershed boundary map can act as a summative assessment for the objectives of the lesson.

EXTENSION

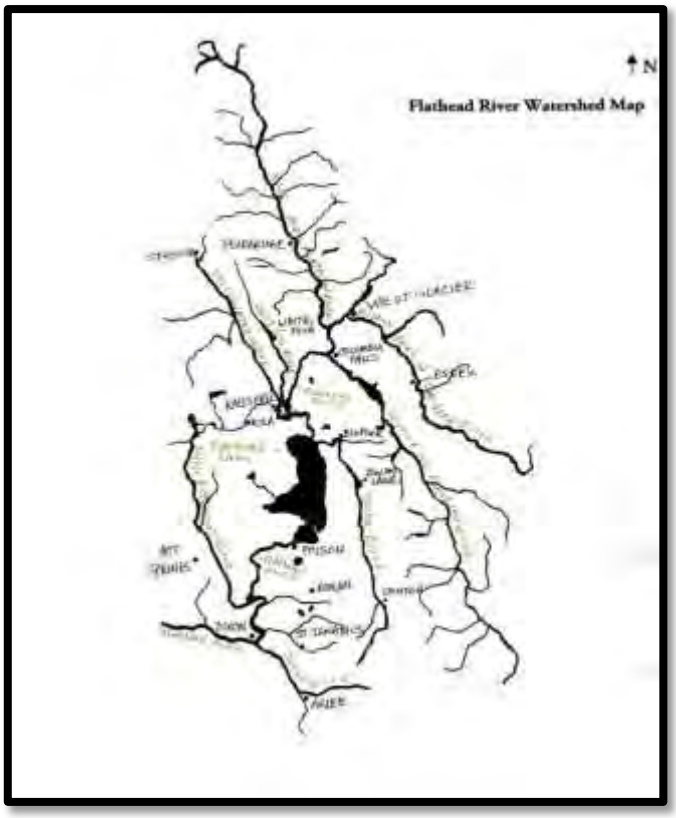
Labeling the Watershed:

Either with the watershed boundary map that the students have just created, or with a new outline map, have students label the rivers and locate the major towns and cities on their maps. Students can conduct research to find out the names and locations of all the rivers, towns and cities using both on-line resources and printed map resources.

Have students identify and mark where they live and where their school is located in the Flathead Watershed.

RESOURCES

http://earthexplorer.usgs.gov/



Example-Flathead Watershed Map – labeled: R. Vallor

Ch. 1-1 Boundaries of the Flathead Watershed

Flathead Watershed Map

Ch. 1-1 Boundaries of the Flathead Watershed

Flathead River Watershed Map

Ch. 1-2 'My Place in the Flathead Watershed' Journal

How does journaling awaken a 'sense of place' in the watershed where you live?

SUMMARY

Students create an on-going journal to record their observations, thoughts and feelings about their 'place' in the Flathead Watershed. The results from different activities, such as site maps, observations of local artists, and 'sense of place' poems, will be recorded in the journals.

OBJECTIVES:

Students will

- Record observations from various activities.
- Use writing and drawing to express observations, thoughts and feelings.
- Keep ongoing records.
- Communicate with others about their observations, thoughts and feelings.

MATERIALS

- Blank pieces of 8x11 paper, stapler
- Alternative: composition notebooks or spiral-bound notebooks
- Pencils & erasers
- Optional but useful: colored pencils

naturallyplayfuladventures.blogspot.com

BACKGROUND

Journals are a time-honored method of recording observations and thoughts. Scientists use field journals to keep a record of their research findings and observations.

Journals are also recognized throughout history and in many cultures as a place to record thoughts and feelings about specific subjects and life in general. Journaling can serve as a way to make sense of the world. It can clarify thoughts or feelings and can be a record to capture reactions to current happenings.

Using journals to develop a 'sense of place' in the natural world combines the work of a scientist closely observing and recording the natural world with the deep thinking that occurs as a person thoughtfully writes down or illustrates their thoughts and feelings.

Journaling to develop a 'sense of place'; clarifies and deepens a person's connection to the natural world that surrounds us.

A Sense of Place in the Flathead Watershed Sourcebook:
http://www.flatheadwatershed.org/watershed/sense_of_place.shtml

Ch. 1-2 'My Place in the Flathead Watershed' Journal

PROCEDURE

Warm-up

Students begin by creating a format to use each time they use their journal. The repeatedly used format prepares students to begin thinking of how they are going to record in their journal because it stimulates thinking and is a dependable way to keep track of entries. As students look back through the pages the format creates a timeline of activities and thoughts.

The format structure can be simple and basic: name, date, location. Further additions could be: weather observations, name of activity, teacher's name, partner's name.

What information is recorded and how it's recorded can be decided by the needs of the teacher and the class activities.

copyright Mike Dunn 2004

Start the first page by recording information in the format that is decided on, usually date, time, and location. If there is a title page, that page can include student's name, teacher's name, grade level and school name.

The Activity

The activities written about in the journal will vary, depending on what is being done in class.

Some examples include:

- 'Sense of place' poetry
- Site maps
- Observations and reflections on local artists' work, such as the artists in the Flathead Watershed Sourcebook: http://www.flatheadwatershed.org/docs/w_pPDF/Popout_Ogle.pdf http://www.flatheadwatershed.org/docs/w_pPDF/Popout_Marceau.pdf

Wrap-up

There are numbers of ways students can express themselves in a journal. Writing is the classic mode of expression, but drawing and sketching are equally vital ways of expressing connections to the watershed students live in. Collages of photos of Flathead would be a powerful source of images to work with, as would photos of art inspired by the Flathead Watershed.

Reflection is an important aspect of journaling. The act of thinking back on activities, observations and thoughts creates an opportunity to develop deeper connections and deeper engagement in the activities. Reflections can be an individual act or can be a group endeavor.

Journals are also an excellent place to express ideas for further exploration and investigation. Writing down the questions and ideas that come to mind during investigations can lead to interesting, engaging investigations.

http://www.laughingcrowcurriculum.com

Ch. 1-2 'My Place in the Flathead Watershed' Journal

ASSESSMENT

Journals are a form of assessment, similar to portfolios, which record a body of student work over time. Journals can be checked periodically, after specific assignments or at the end of grading periods or terms, to check on student progress and as summative assessments.

Rubrics that indicate content and format are helpful for both students and teachers. Keeping track of the class journals is something to think about. If the journals are kept in the classroom, there won't be a question of availability when it's time to use them for activities. Keeping journals in the classroom allow the journals to be checked for assessment purposes as well.

Allowing students to take their journals home, or asking students to carry journals with them, means that students can use them whenever they are inspired to do so and the journals can take on personal meaning, but it is risky to assume that students will always remember them when they are needed.

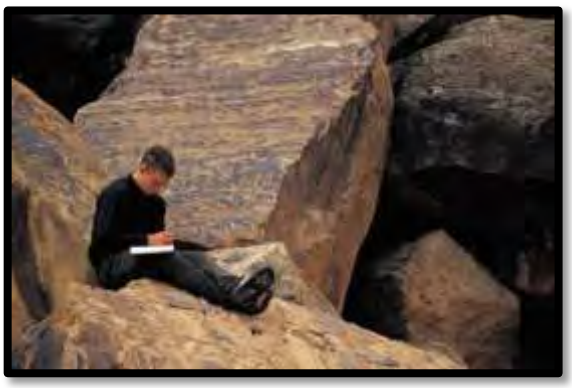
EXTENSIONS

Art Journals:

Journals with blank pages in place of lined pages and a supply of colored pencils can encourage freehand drawing and sketching.

Scientific Journals:

Specific formatting for recording observations and data, such as tables for recording size and other measurements, weather, time, partners, is an extremely good way to scaffold the types of journal entries that lead to excellent observation and recording skills.



readersunbound.com

RESOURCES

http://readersunbound.com/2013/03/18/eat-your-consonants-why-journaling-is-good-for-you-part-one/

http://naturallyplayfuladventures.blogspot.com/2013/04/nature-journaling-connecting-with.html

https://www.pinterest.com/brees7/nature-journals/

http://www.laughingcrowcurriculum.com/services/journaling-workshops

http://www.flatheadwatershed.org/watershed/sense_of_place.shtml

Ch. 1-3 Modeling Watersheds in Paper

How do you define a 'watershed'?

SUMMARY

In this lesson students will define the term 'watershed' both visually with a model and through language. Students will create a 3-D model of a landscape with a crumbled piece of paper and markers. On the model students will outline boundaries of watersheds and draw in water courses within the model landscape. Students will then draw a picture of their model on paper and label it. As an extension, students can add human interactions with the landscape and analyze how those interactions may impact water resources in a watershed.

In the Sourcebook see The Flathead Watershed: http://www.flatheadwatershed.org/watershed/flathead_watershed.shtml and The Watershed Community at: http://www.flatheadwatershed.org/watershed/watershed_community.shtml.

OBJECTIVES

Students will

- Define the term 'watershed.'
- Determine where the boundaries of a watershed are in a landscape.
- Analyze direction of flowing water within a landscape.
- Label their landscape by divide and watershed basin.
- Draw and label their 3-D model in a journal or on paper.
- Hypothesize the impacts of human and natural effects on the landscape.

MATERIALS

- Paper (recycled white 8.5x11 or other paper; paper can be cut into ½ sheets or ¼ sheets); this forms the watershed model
- Heavier paper, cardstock or cardboard, cut to match the white paper
- Newspaper - for clean-up (place under the model)
- Permanent Markers
  - black - for outlining watershed boundaries
  - Green – for marking vegetation along waterways (optional)
- Water-Soluble Markers
  - blue- for drawing water flow
- Spray Bottle filled with water with a mist setting - For creating precipitation
- Tape, used to tape white crumpled paper to cardstock

Example of watershed drawing, Sourcebook, p. 2

BACKGROUND

A watershed is an area of land that captures, stores, and releases water. The water that flows from the land eventually drains to a stream, river, or other body of water from which most watersheds get their names. Watersheds provide hydrologic functions such as collecting water from rainfall, storing it, and releasing it as runoff.

Ch. 1-3 Modeling Watersheds in Paper

They also perform ecological functions such as supplying diverse sites for natural chemical reactions to take place, and providing habitat for plants and animals. As we watch snow and rainwater flow from mountaintops to rivers, streams, wetlands, marshes, and lakes, we are watching our watershed at work. Watersheds are also referred to as drainage basins or catchments. Hydrologists use the term watershed to describe an area of land or drainage basin that discharges its surface waters through a single outlet. (Flathead Watershed Sourcebook, pg. 2)

PROCEDURE

Warm-up

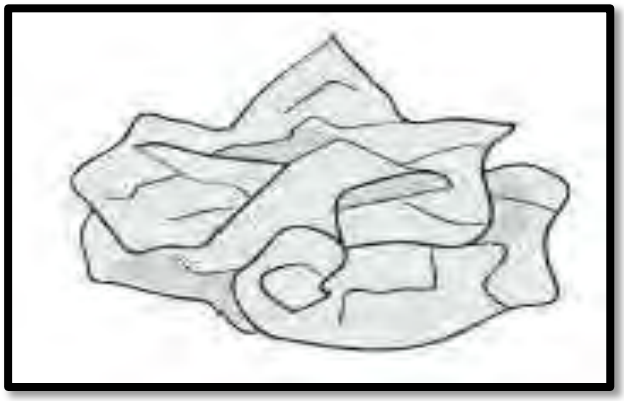
Ask the class if they know what a watershed is, and if they can give some characteristics of a watershed. Divide the class into 4 groups and give each group one of the four definitions from the Watershed Definitions listed. Have each group share their definition with the class, discussing the similarities and differences of each.

Watershed Definitions

1. A watershed is a drainage basin: an area of land that sheds its water into a common body of water.
2. A watershed is a water-shed (noun): stores water {groundwater}, and, a watershed is a water-shed (verb): sheds water {surface water}.
3. A watershed is the gathering ground for a body of water.
4. A watershed is an area of land where all the water flowing across or through the land exits at a single location.

The Activity

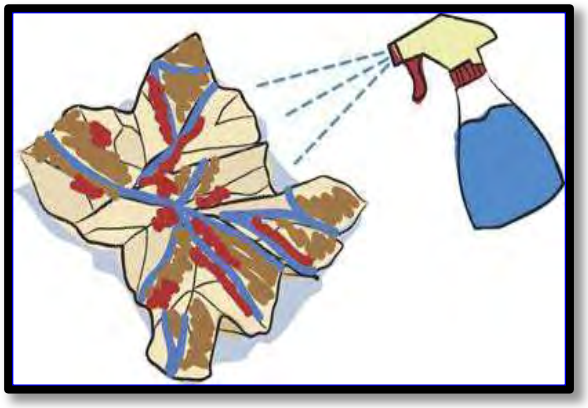
Explain that the students will create their own model of a landscape and outline the watersheds within their model. Hand each student a sheet of white paper and a piece of heavier paper.



Crumpled paper for watershed activity: www.howtosmile.org

Instruct each student to:

- Gently crumple their sheet of white paper
- Partially un-crumple the sheet of paper, leaving the folds and ridges mostly intact. Tape the corners of the crumpled paper to the heavier paper.
- With a *brown or black permanent marker* trace all of the upward pointing folds/crumple lines. These are the peaks, ridges, and hill tops that act as watershed divides in the landscape model.
- With the *blue water-based marker*, trace the downward pointing folds. These represent the paths and depressions where water flows and is held.
- If desired, use the *green permanent marker* to color in the vegetative areas typically found along waterways, especially in the flatter areas of the watershed.
- Use a spray bottle to gently mist the paper. Notice which way the color moves down each of the watersheds. The color movement may take a few minutes, but it should be possible to identify the flow patterns and direction as the colors move.



Spraying the crumpled paper: gopixdatabase.com

- Have students note how the high points, or divides, traced in black or brown, surround and outline the drainage areas, creating small watersheds within the paper landscapes. Also note how the misted water, colored blue with marker ink, flows to the lowest point in each small watershed. That point would be considered the outlet for the drainage basin.

Wrap-up

Lay out the individual landscapes for everyone to see. Point out the similarities and differences between the various sizes and shapes of watersheds represented in the paper landscapes. Ask students if any of the model landscapes resemble real-life landscapes they are familiar with.

Take the class outside with their models. Have students examine the landscapes they can see from where they are standing. Ask students to discuss together what elements in the landscapes around them look similar to elements in their models.

ASSESSMENTS

Have students analyze their own models to determine how many individual watershed basins are present in their model. Ask them to write the number of watershed basins they've identified in their model in the corner of their model along with their names. They can name their landscape, if desired.

Give students a blank piece of white paper or have them turn to a blank page in their notebook or journal. Have students draw an illustration of their landscape model on the paper with colored pencils or markers. Have them start with the black outline of the main ridges that are watershed divides, and then add the blue watercourses in each separate watershed basin. They can add sub-watersheds and sub-divides if desired. Have them identify how many watershed basins are present in their model drawing.

EXTENSIONS

Impacts in the Watershed:

Share this definition with the whole class.

"A watershed is more than an area of land defined by its ridges with one outlet for water to flow. A watershed supports a variety of resources, uses, and activities in such a way that eventually all things are affected by everything else in the watershed. A watershed contains the history of all that went before and the spirit of those who touched it remains."
George Wingate

Ask the class if they know what watershed they live in (the Flathead). Students may answer that they live on a smaller stream or river (Stillwater River, Whitefish River, Swan River, or any number of streams) within the Flathead Watershed. Point out that these are sub-watersheds that are all within the Flathead Watershed.

In thinking of the definition above, ask the class if they can give examples of some of the uses of the watershed they live in.

Explain that students will now make another landscape model, coloring it as they did with the first model.

After all upward pointing folds are outlined with permanent marker and the downward pointing folds with the blue water-based marker; they will add impacts to the

landscape in appropriate places. These can be human caused or naturally occurring impacts

Types of impacts:

- *Red water-based marker*- point-source impacts such as cattle feed lots, water treatment plants, logging operations at specific sites, mines, wildfire burn areas, and others that they can think of.

- *Brown water-based marker*– non-point source pollution such as dirt roads, sediments from overgrazed areas, pesticide run-off from fields and lawns, nutrients from stock pastures, and others.

- *Other colors - water-based markers*: can be used to differentiate between types of impacts

With all appropriate impacts identified and marked, mist the landscape. Note what patterns emerge as the impact colors move with the water flowing downslope. Notice where and how the impact colors interact with the blue-colored water representing precipitation.

Lead a discussion about what types of pollutants the different impact colors represent. Have the class determine what materials might be washing off roads, residences and buildings, and from disturbed areas.

RESOURCES

YouTube Videos describing the activity:

- **Watershed Lab** **https://www.youtube.com/watch?v=5_Hd_60sHcSA**
- **Into the Watershed** **https://www.youtube.com/watch?v=yyvO_Gq4iA-s**

Ch. 1-4 Site Mapping in the Watershed

How can I visually represent an area within the Flathead Watershed?

SUMMARY

"Maps are a way of organizing wonder."
Peter Steinhart (Sourcebook p. 3)

When studying nature there is always a need to map or locate our observations. One of the simplest methods of mapping a field site is creating a simple eye map.

Maps of the Flathead Watershed help record locations and document changes taking place. Before the development of new mapping technologies (see Mapping the Flathead) people made maps by hand. This lesson describes a procedure for creating a simple "eye" map of a study site.

OBJECTIVES

The students will

- Measure distance and direction using a compass and estimated stride length.
- Make an eye map of an area in the immediate vicinity of a school or field study site.
- Appreciate why maps are an important part of understanding our "sense of place."

MATERIALS

- compass
- measuring tape
- field notebook

A field notebook with a hard cover or a thin, light but sturdy board provides a flat surface on which to sketch and write.

Decide if the class will work in meters or feet/yards. A tape measure that extends to 20 to 50 meters or 50 to 100 feet is best.

A compass in a transparent housing works well for orienting the map to north. If possible, the compass can be attached to the corner of the notebook and serve for orientation of the sketch and map in relation to north and south (see illustrations in the lesson).

wildernessdave.com

BACKGROUND

As a pre-lesson activity, it is best to practice measuring distance and direction before beginning the actual eye mapping activity. This can be done in- or out-of-doors.

Make sure that all students are comfortable with survey techniques and can work independently with accurate results before starting the mapping activity.

The number of students who work together depends on the size and complexity of the site to be mapped. When surveying a large site, for example, a river floodplain, teams of 3-4 students work well. In a schoolyard setting two students per team is probably enough.

If possible, assign each team a specific area for surveying within the study site so that the sketches and maps can be combined into one general map of the area.

PROCEDURE

Warm-up

Measuring Distance

Using the tape measure mark off a specific length such as 50 or 100 feet.
Ask students walk off the distance and count their steps. Divide the number of steps into the distance to estimate average length of

stride. Have the students estimate the width and length of a small area such as the classroom.

www.ecosystema.ru

Using a Compass

Have the students sketch a small, reasonable area such as the classroom or another indoor site.
Begin by asking the students to place a compass on a sheet of paper and orient the compass to North and South.
Instruct students to draw the cardinal directions: north, east, south and west on the paper.
Indicate on the direction diagram the main degrees of orientation, 0, 45, 90.

Making a Field Sketch

Looking out onto the area to map or the field study site, draw a freehand sketch of the area. This can be practiced in the classroom.
Be sure to orient the paper and the sketch north to south and include a diagram of the north south directions.

The Activity

Making the Eye Map (this part be practiced in the classroom before going out of doors)

- First, mark point 1 which corresponds with a point where you are standing.
- Sight compass directions, or angles, from the initial point 1 to all the outstanding landmarks (posts, trees, buildings, cross-roads, hills, etc.) that are plotted on the previous sketch.
- Note: All the directions should be clearly drawn in a thin line in pencil from point 1 to the objects.

Write down the angles to each of the identified landmarks directly on the map or in a table of the field notebook.

- Walk to the next determined point (point 2) by counting your steps and drawing any interesting features of the area under study; road forks, landmarks, etc. You will use the average length of steps you've already calculated before measuring these distances.
- When you get to point 2, mark the path and the distance you travelled, then orient the map to north and south and measure the angle to point 3. Count steps to measure distance to point 3.
- Repeat to point 4.
- Draw any significant objects on the map such as trees, large rocks or man-made structures and create a key on the map for those objects. As an example see map below

Wrap-up

Post the eye survey maps in the classroom and compare the distances and positions of various features in the study area.

ASSESSMENT

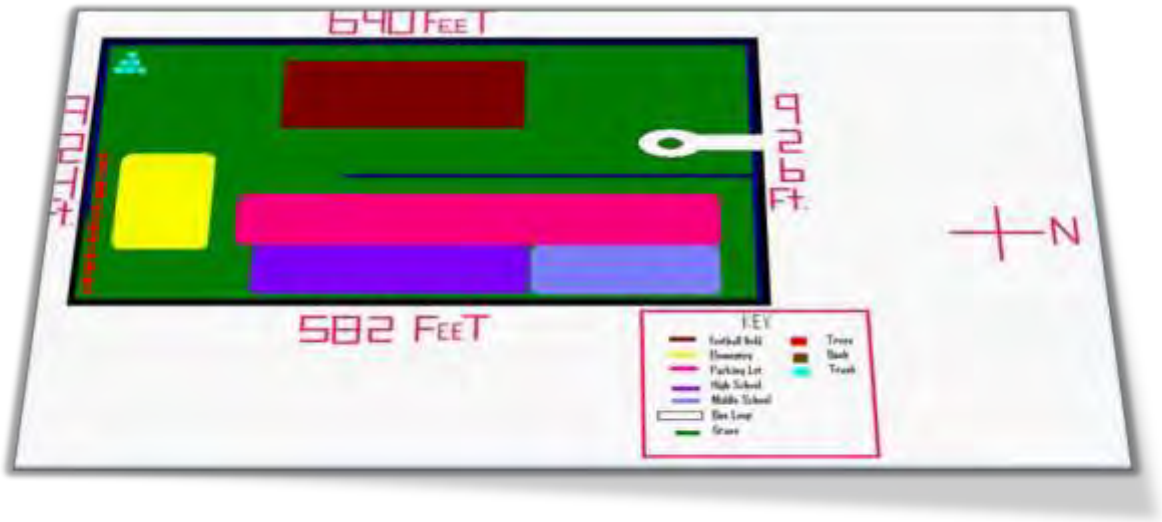
Have the students complete an eye map of the school property and then do an individual eye map of their home property.

EXTENSIONS

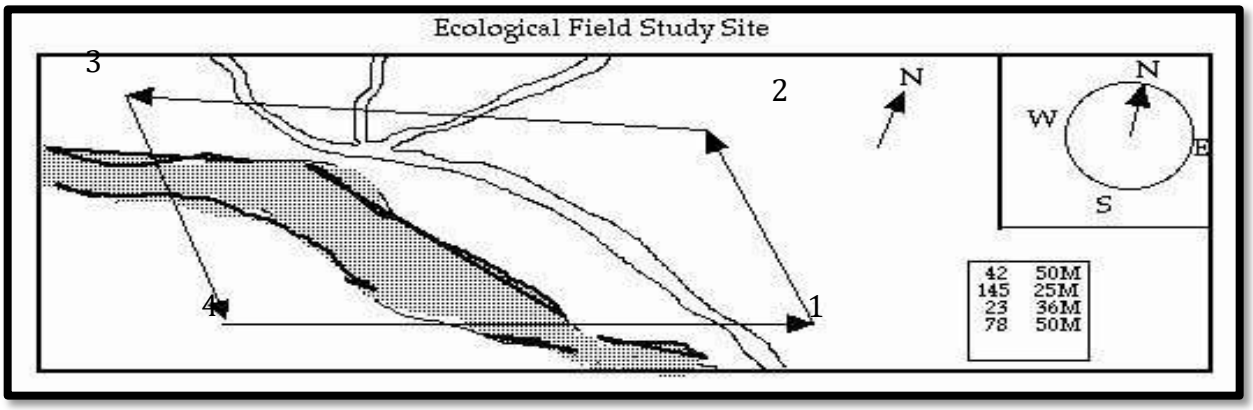
Divide the class into groups and assign smaller, adjacent areas within a large area such as a park, forest or wetland. Have the students complete their map of a part of the larger area and then connect all the maps together for a map of the larger area.

RESOURCES

http://www.flatheadwatershed.org/docs / wpPDF/Popout_Petri.pdf).



Above is eye map of school grounds done with the aid of computer software. All angles are 90 degrees in the four prime directions; N, E. S & W.



Example of an eye survey map: www.ecosystema.r

Ch. 1-5 Stream and River Flow

What is the pattern of water flow in the Flathead Watershed?

SUMMARY

In this lesson students access the stream flow data from the United States Geological Survey (USGS). Students can look at how stream flow changes over time from days to weeks to months to years to centuries. Students can also compare stream flow in different places in the Flathead Watershed during the same periods of time.

OBJECTIVES

The students will

- access stream flow data from the USGS.
- graph stream flow over time.
- interpret and compare stream flow within the Flathead Watershed.

MATERIALS

- stream flow data chart at end of lesson
- internet access linking to **USGS National Water Information System for Montana**

(http://waterdata.usgs.gov/mt/nwis/current?index_pmcode_STATION_NM=1&index_pmcode_DATETIME=2&group_key=NONE&sitefile_output_format=xml&column_name=agency_cd&column_name=site_no&column_name=station_nm&format=html_table&sort_key_2=station_nm&html_table_group_key=county_cd&rdb_compression=file&list_of_search_criteria=realtime_parameter_selection)

- graph and poster paper

BACKGROUND

Surface water generally consists of water that we can see in the forms of snow, ice, rivers, streams, lakes, wetlands, and soil moisture.

The Flathead Watershed is home to spectacular surface water features that are rich in social, cultural, and resource values. Flathead Lake, the three forks of the Flathead River, and the numerous glaciers, snowfields, and lakes are notable surface water features. The thousands of lakes, ponds, and wetlands in the Flathead Watershed are the direct result of recent glaciation that scoured the landscape and left behind deposits that now impound surface water (Flathead Watershed Source Book p11).

There are a variety of ways to measure the discharge of a stream or canal. A stream gage provides continuous flow data over time at one location for water resource and environmental management or other purposes. In the United States, stream flow gages are funded primarily from state and local government funds. In Fiscal Year 2008 the United States Geological Survey (USGS) provided 35 percent of the funding for everyday operation and maintenance of gages.

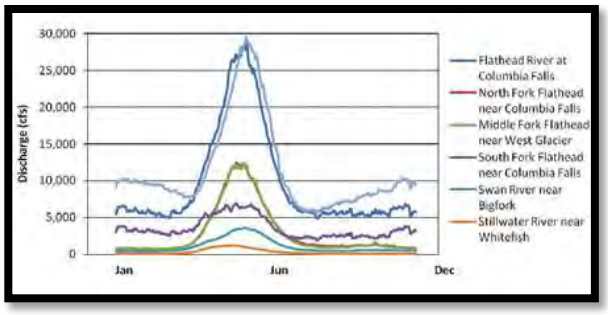
See Kendall, C. Hydrology of the Watershed, Flathead Watershed Sourcebook p.11 (http://www.flatheadwatershed.org/watershed/hydrology.shtml)

PROCEDURE

Warm-up

Ask students how they think stream and river flows change during the year, from year to year. What kinds of experiences have the students had related to the flow of streams, such as swimming or fishing? Using the graph below, taken from the Flathead Watershed Sourcebook p11, explain the x and y axes of the graph and the color code for the various rivers which are represented in the graph.

Have the students describe the patterns of average daily discharge. Handout a copy of the graph or project it in the classroom for discussion.



Discharge graph of Flathead Waterways: www.flatheadwatershed.org

The Activity

Using either the data set for the Flathead River at Columbia Falls at the end of this lesson or by accessing the USGS National Water Information System Mapper (http://maps.waterdata.usgs.gov/mapper/index.html) with a desk/laptop computer or a personal mobile device, students will investigate the pattern of stream flow in the Flathead Watershed.

Part 1 (internet or data table provided)

Have students work in pairs and graph monthly discharges over 5-10 years, assigning different periods of time to each team, and using different colors for each year. Have the students describe how monthly discharges change over the course of a year. Ask students to explain how discharges change from year to year.

Have students compare graphs of different time periods.

Part 2 (internet required)

From the table of stream gage sites below, assign students a unique stream gage site.

Click on the site number and look at the current conditions for their site.

Ask students to describe the current conditions at their site.

This would include:

- gage height
- discharge
- temperature

Have the students summarize their observations.

Part 3 (internet required)

Have the students click on summary of all available data for this site - here students can look at:

- current/historical observations
- daily data
- daily statistics
- monthly statistics
- annual statistics
- peak stream flow (related to flooding lesson)
- field measurements
- water quality
- water-year summaries

The stream monitoring stations in the Flathead Watershed are:

North Fork Flathead
12355500 N F Flathead River near Columbia Falls MT

Middle Fork Flathead

12358500 M F Flathead River near West Glacier MT

Flathead Lake

12371550 Flathead Lake at Polson MT

12363000 Flathead River at Columbia Falls MT
12366500 Flathead River at Foys Bend near Kalispell MT
12369000 Flathead River near Bigfork MT

South Fork Flathead

12362000 Hungry Horse Reservoir near Hungry Horse MT
12359800 S F Flathead R at Twin C near Hungry Horse MT

12362500 S F Flathead River near Columbia Falls MT

Stillwater

12365700 Stillwater River at Lawrence Park, at Kalispell
12366080 Whitefish River near mouth at Kalispell, MT

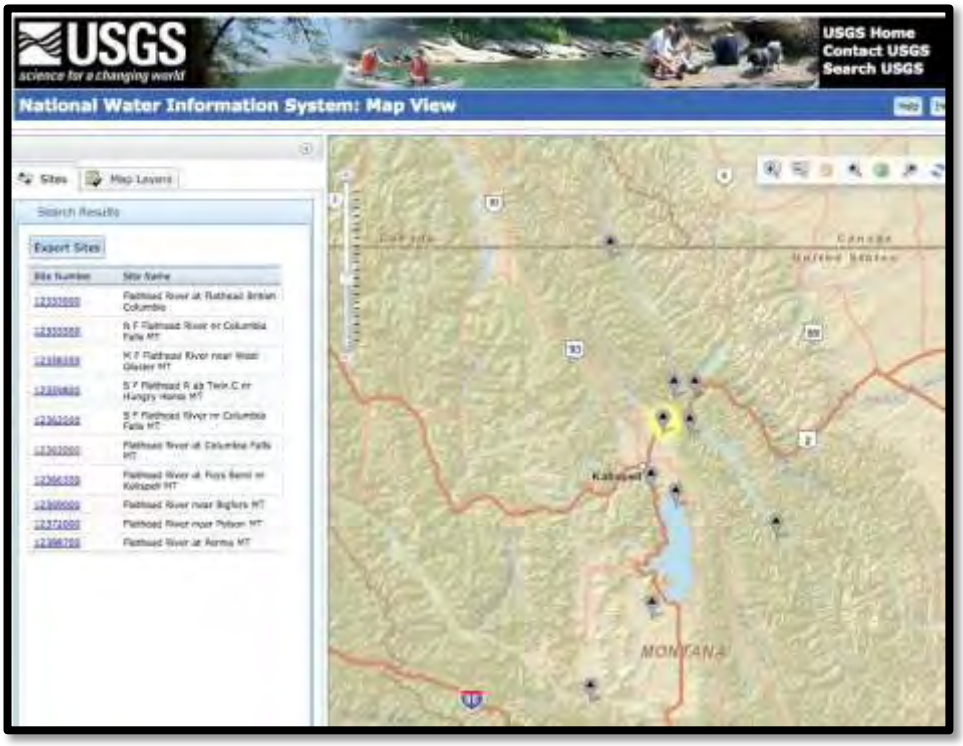
Swan

12370000 Swan River near Bigfork, MT

Lower Flathead

12388700 Flathead River at Perma MT
12372000 Flathead River near Polson MT
12374250 Mill Crab Bassoo Cr near Niarada MT
12377150 Mission Creek at reservoir near St. Ignatius MT
12375900 South Crow Creek near Ronan MT
12381400 South Fork Jocko River near Arlee MT

You can access the current data for each gage site by clicking on the number of the monitoring site (above). At the site you can also click on **Summary of all available data** for the site. Summary data for each site includes the data types below. The data set below is for the **Flathead River near West Glacier**. If you do not have internet access, you can use the data for average monthly discharge for the Flathead River at Columbia Falls at the end of this lesson for graphing monthly discharges over time in the lesson.



The image above is from the USGA National Water Information System website and it shows the gage sites on the Flathead River.

You can view similar images on the USGS website by clicking on http://maps.waterdata.usgs.gov/mapper/index.html. In the selection for **Place Name type in Flathead Lake** and the map will show the gage stations located near Flathead Lake. On the website you can click on each of the site numbers for all the available stream flow data for each site. When you click on the site you will get a popup window. At the bottom of the popup window click on access data, this will lead you to the sites complete information menu.

Sample Data Table from USGS website:

Data Type	Begin Date	End Date	Count
Current / Historical Observations	2007-10-01	2014-12-23	
Daily Data			
Discharge, cubic feet per second	1939-10-01	2014-12-22	27475
Daily Statistics			
Discharge, cubic feet per second	1939-10-01	2014-09-30	27394
Monthly Statistics			
Discharge, cubic feet per second	1939-10	2014-09	
Annual Statistics			
Discharge, cubic feet per second	1940	2014	
Peak streamflow	1916	2014-05-24	76

Field measurements	1943-06-18	2014-12-15	312
Field/Lab water-quality samples	1949-11-03	2013-09-09	244
Water-Year Summary	2006	2013	8
Additional Data Sources	**Begin Date**	**End Date**	**Count**
Instantaneous-Data Archive **offsite**	1995-10-01	2007-09-30	267640

Wrap-up

Post the stream flow graph on the walls of the classroom and connect each stream flow data collecting station to the Flathead Watershed map.

ASSESSMENT

Assessments can be informal and formative during student activity. Summative assessments are the stream flow graphs.

EXTENSION

– In the classroom

Divide up the USGS water monitoring sites in the Flathead Watershed, Flathead County or other geographical boundary and have students write a report on the river flow at that site over time. Select a variety of variables such as peak stream flow, field measurements or field/lab water quality to focus the report.

-Outside the classroom

If you have the opportunity have students visit a local stream or river; using a tape measure, measure off a length of stream or river, such as 10 meters. Then using an object that will float record the time it takes the object to travel the distance (an orange works well, floats but also partially submerged). Collect your floating objects! Calculate the rate of flow by putting the distance over time, such as, 10 M / 30 seconds or converting to minutes 20 M/ minute.

Map from USGS Water Information system with gauge sites marked around Flathead Lake

RESOURCES

Go to USGS National Water Information Systems at: http://waterdata.usgs.gov/nwis If you are using a mobile device go to Mobile-friendly water data site from your mobile device at: http://m.waterdata.usgs.gov/

For general information and updates on Water Information go to Full News at: http://help.waterdata.usgs.gov/new

USGS 12363000 Flathead River at Columbia Falls MT:

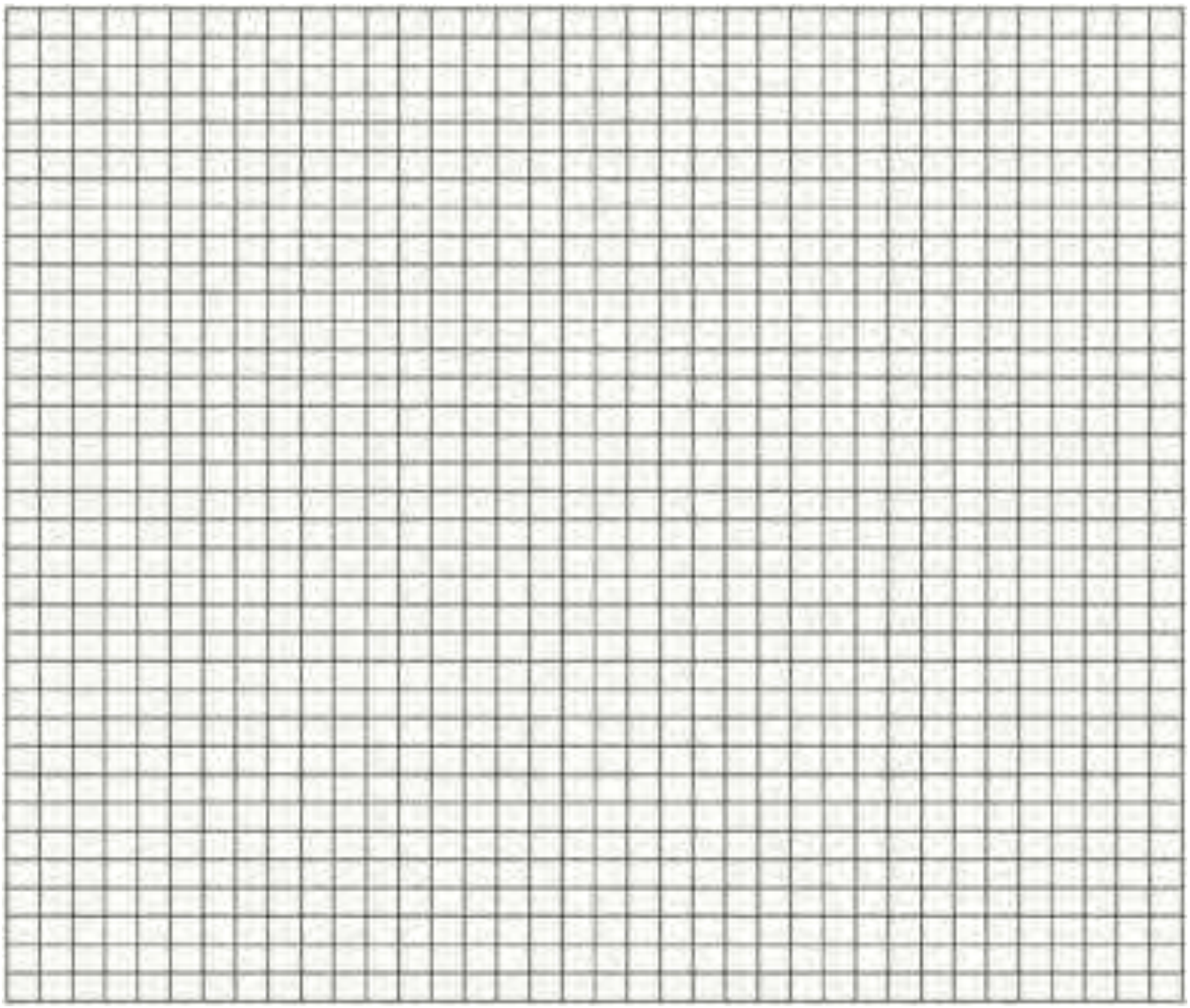
Flathead County, Montana Hydrologic Unit Code 17010208 Latitude 48°21'41.88", Longitude 114°11'03.93" NAD83 Drainage area 4,473 square miles Gage datum 2,977.67 feet above NGVD29	**Output formats** HTML table of all data Tab-separated data Reselect output format

00060, Discharge, cubic feet per second,												
YEAR	Monthly mean in ft3/s (Calculation Period: 1951-10-01 -> 2014-09-30)											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	Dec
1951										7,564	5,994	3,712
1952	2,432	2,012	1,906	17,260	29,900	16,490	8,917	3,729	2,351	1,561	2,855	5,205
1953	3,776	2,565	1,949	5,817	19,550	29,010	12,010	4,103	2,276	2,503	5,177	3,685
1954	4,273	7,667	3,658	12,050	33,670	29,970	24,530	6,900	4,535	4,903	4,419	8,797
1955	9,122	5,920	7,344	4,832	14,670	29,060	17,430	4,797	2,519	6,191	6,000	5,498
1956	8,247	9,892	11,020	16,130	29,580	30,900	11,890	4,486	3,591	5,864	7,037	10,560
1957	11,210	5,181	2,175	4,561	31,940	18,560	7,116	3,151	6,916	6,043	10,260	6,622
1958	1,987	1,299	1,841	5,258	30,580	14,410	5,928	2,774	2,633	4,244	6,764	7,260
1959	9,791	9,371	8,572	21,130	22,080	40,400	18,540	5,406	6,672	11,210	8,304	6,400
1960	4,700	8,281	6,939	21,300	17,900	29,050	12,500	4,355	2,625	2,240	2,743	2,276
1961	1,917	8,170	10,640	18,610	27,830	31,660	8,207	3,098	3,973	4,987	2,204	7,828
1962	10,270	8,306	1,597	15,700	24,180	22,370	9,724	4,011	2,403	3,732	4,369	9,060
1963	9,053	4,887	2,375	14,080	19,790	19,570	12,190	3,630	2,550	2,827	1,557	8,501
1964	10,700	4,132	4,739	6,489	23,530	45,510	15,740	4,693	4,346	4,955	4,338	7,265
1965	9,947	11,130	16,020	14,040	24,420	28,830	13,070	5,891	5,648	5,509	4,247	10,000
1966	9,885	3,844	3,613	8,272	22,630	25,160	11,160	4,369	6,886	10,440	9,588	6,951

1967	5,935	4,449	5,519	8,866	23,340	33,440	12,290	4,515	6,435	6,335	6,040	8,714
1968	9,173	2,216	3,423	3,825	19,670	25,810	9,015	4,545	7,827	7,529	5,874	7,914
1969	7,497	9,478	7,321	21,780	22,980	17,580	9,444	8,560	9,029	6,388	5,115	7,129
1970	1,550	1,604	2,561	7,552	23,760	27,930	7,105	6,593	8,123	7,246	2,826	7,916
1971	7,947	6,042	5,336	17,420	30,770	30,270	14,150	5,995	5,912	5,234	8,822	9,006
1972	7,983	4,851	12,040	14,290	29,000	34,470	11,840	4,952	5,229	7,519	5,512	6,376
1973	7,076	7,290	2,653	5,599	17,280	16,590	9,028	6,762	2,197	5,520	5,975	3,538
1974	9,516	9,394	10,010	20,410	23,150	42,690	21,050	7,035	6,637	7,438	9,423	6,735
1975	4,546	3,013	3,736	4,653	18,740	36,850	18,080	6,348	5,940	6,452	9,290	8,229
1976	6,583	6,236	7,551	16,200	27,730	21,640	14,930	7,405	3,326	7,581	3,522	7,571
1977	5,074	3,371	3,855	7,449	11,920	11,170	7,148	7,389	4,585	7,168	6,372	2,297
1978	5,041	4,416	4,497	7,407	18,690	23,930	12,550	5,705	4,953	4,546	9,595	9,155
1979	5,714	1,433	3,923	5,349	27,310	20,750	9,947	8,205	3,962	6,779	8,414	4,110
1980	1,639	1,328	1,263	9,204	23,310	18,790	7,352	4,754	7,023	4,506	6,485	9,693
1981	5,995	5,028	6,299	11,860	25,330	29,710	13,030	4,425	5,360	8,114	4,688	4,355
1982	5,340	4,750	6,420	11,320	22,660	30,060	17,540	5,285	2,898	3,244	3,969	4,418
1983	5,500	6,553	6,149	12,420	20,730	17,810	14,110	5,608	8,138	6,924	4,104	6,941
1984	6,335	7,874	5,629	7,561	15,080	20,060	8,052	6,388	7,077	5,586	4,091	6,321
1985	7,752	7,270	5,411	8,506	23,350	19,580	9,820	9,972	10,690	8,830	6,773	7,822
1986	6,727	4,119	6,546	11,110	19,470	20,660	6,725	5,263	8,519			
1987										7,487	3,776	3,510
1988	3,866	9,643	11,390	9,508	15,370	11,950	5,737	3,491	3,625	3,910	3,727	3,818
1989	3,890	6,041	5,537	9,970	20,150	20,430	10,630	10,610	12,300	5,133	11,180	5,995
1990	4,032	6,101	8,415	18,740	20,440	31,910	14,310	5,482	8,407	9,450	9,180	5,887
1991	10,390	10,660	10,150	14,530	29,610	29,860	17,970	6,987	10,030	8,254	4,999	7,363
1992	3,889	3,500	3,471	9,959	15,850	12,870	6,644	7,868	9,020	5,935	4,527	4,203

1993	7,127	6,070	5,035	5,728	21,900	13,380	11,110	4,801	7,073	5,666	6,203	7,866
1994	8,690	8,082	3,862	10,390	17,650	11,840	4,937	3,566	4,115	4,048	4,423	3,625
1995	3,727	4,364	4,148	5,120	15,140	25,730	11,400	5,401	4,006	5,200	10,110	15,010
1996	10,650	10,830	17,000	18,290	21,640	31,280	11,450	12,090	5,554	5,117	3,900	7,983
1997	10,140	7,969	8,612	13,010	30,910	35,130	11,760	10,310	6,919	5,375	4,565	5,499
1998	3,793	3,673	3,873	6,922	20,230	18,350	12,410	8,313	3,748	3,589	3,552	3,667
1999	4,957	4,956	9,259	9,338	17,670	24,680	13,960	7,943	6,045	4,591	6,986	6,379
2000	6,038	6,811	6,192	13,900	20,090	18,230	11,430	6,883	3,846	3,807	3,705	3,851
2001	3,647	4,604	3,502	4,186	14,120	10,970	4,625	3,500	3,463	3,493	3,512	3,478
2002	3,773	3,819	3,876	8,967	23,540	39,050	17,440	8,928	5,508	3,767	3,820	3,825
2003	3,826	3,578	3,770	9,393	18,730	19,570	9,525	6,161	3,462	3,550	3,484	3,609
2004	3,538	3,569	4,072	11,130	18,000	17,210	12,130	8,953	7,597	4,456	4,986	5,294
2005	5,865	4,323	3,505	10,680	19,750	24,550	11,150	7,427	3,465	6,229	4,239	3,533
2006	4,408	7,623	4,662	18,920	28,840	27,160	9,798	4,857	3,744	3,689	8,415	4,042
2007	3,958	3,856	9,285	12,300	25,980	19,810	9,458	6,118	3,945	3,763	3,737	3,846
2008	3,767	3,760	3,745	6,209	29,350	32,480	17,480	9,100	5,737	3,883	3,882	3,647
2009	3,698	3,775	3,723	7,348	20,930	19,030	8,336	5,362	4,001	3,774	3,915	3,975
2010	3,762	3,638	3,629	6,358	15,420	25,670	13,070	6,916	6,856	3,875	4,367	3,664
2011	5,725	9,120	9,151	14,890	28,800	40,300	26,850	8,875	5,189	4,037	3,927	3,914
2012	3,904	3,890	4,805	21,550	27,360	38,560	18,110	6,137	3,973	3,596	7,139	6,077
2013	6,061	3,932	4,424	16,000	31,320	24,720	9,916	5,145	3,967	4,056	3,630	3,677
2014	3,715	3,850	7,031	18,850	31,830	31,030	16,260	6,322	4,702			
Mean of monthly Discharge	5,980	5,570	5,820	11,500	22,900	25,300	12,100	6,110	5,390	5,440	5,530	6,050

Ch. 1-5 Stream and River Flow



Ch. 1-6 Flooding in the Upper Flathead Watershed

What factors can lead to flooding?

SUMMARY

Students will determine the environmental factors that led to the 1964 Flood of the Flathead River through a close reading activity of portions of the USGS investigative report of the event. Students will interpret hydrographs of stream flow data recorded at various gage stations during the 1964 flood event. Students will discuss flood effects on Flathead Lake.

OBJECTIVES

Students will

- analyze and explain the causes of the 1964 Flood and flooding in general.
- interpret hydrograph stream flow data.
- discuss the impacts and effects of flooding.

MATERIALS

- Excerpts from the report: Floods of June 1964 in Northwestern Montana; Geological Survey Water-Supply Paper 1840-B
- 5-day Hydrographs, June 8-13th, for 5 locations, of the Flood of 1964

BACKGROUND

Floods are natural events for rivers and streams as excess snowmelt and rainwater accumulates and overflows onto riverbanks and bordering floodplains. Floods occur annually in low-lying areas, though the severity of flooding is determined by the quantity of snowpack in winter and the subsequent rain in the spring. In the Flathead in spring Chinook winds – warm dry winds with gusts up to 100 mph (161 kmph) – can occur, rapidly melting snow in the mountains and consequently flooding valleys. (Flathead Sourcebook, pg. 7) The largest flood *on record* occurred in early June of 1964, when the Flathead River crested at 26.5 feet (8.07 m), over 12 feet (3.7 m) above flood stage. (Flathead Watershed Sourcebook, pg. 7)

There are a number of factors that can contribute to flooding. Floods are more common in areas that already have highly saturated soil. Combinations of other factors that must also be present for flooding to occur include: above average fall precipitation, above average snowpack, late spring snowmelt, high spring temperatures (which melt winter snowpacks) above average spring precipitation, above average summer precipitation, and below average summer temperatures, (from Discover a Missouri Watershed, Project WET, pg. 101).

PROCEDURE

Warm-up

Lead a discussion with students about flooding. Ask them for their ideas of what is a flood. Ask if anyone has seen a flood, or had any direct experience with flooding.

Share photos of the 1964 Flood (Flathead Watershed Sourcebook, pg. 8) and ask students to describe what they are seeing in the photos. As a class, develop a definition to describe a flood.

1964 Evergreen Floods. *Source: Flathead Planning & Zoning*

1964 Evergreen Floods. *Source: Flathead Planning & Zoning*

The Activity

Part I – Close Reading of 1964 Flood Report excerpts

Ask the class to discuss causes of flooding. List on the board ideas that are brought up – these may include: sudden heavy rains, rapid snowmelt due to high temperatures, deep snowpack leading to consistently high run-off, heavy rain on rapidly melting snowpack, saturated soils, and high water levels in streams and rivers that are suddenly filled with rain or melting snow, and other combinations of factors.

When all ideas have been brought up, list on the board environmental factors that can contribute to the possibility of flooding.

Environmental factors are:

- highly saturated soil
- above average fall precipitation
- above average snowpack
- late spring snowmelt
- high spring temperatures (which melt winter snowpacks quickly)
- above average spring precipitation
- above average summer precipitation
- below average summer temperatures
- Steep slopes above waterways
- Narrow waterways
- Bare surfaces such as deforested slopes or paved areas
- Large storms with heavy rain
- High river and stream levels
- Frozen ground

Divide the class into groups of twos or threes. Hand each group a copy of the 1964 Flood Report excerpt. Have each group closely read the excerpt and then list on a piece of paper as many factors that contributed to the 1964 flood as they can find in the reading.

When all the groups have completed their reading and have created their lists, have the whole class contribute to create a master list of all the environmental factors they have discovered in the excerpt. Compare the master list to the environmental factors list, determining together how many of the factors were present during the June 7-8, 1964 flood event.

Part II – Flood Hydrograph Interpretation

Ask the class how the flood data is collected, how people know how much water flowed through different areas in the watershed. Students may know of the stream gages that are located at certain points in the watershed. Hand out or show a map of the locations of the USGS stream gages in the Flathead Watershed.

Stream gages continually measure and record water volume flowing at that spot. Water is measured in cubic feet/second, or cfs. A cubic foot of water is like a box of water, 1 foot on each side, moving a box width per second.

Hand out or project the 5-day hydrograph for the 1964 floods, with flow (in cfs) measured at 5 different points in the Flathead River system. Have the class examine the hydrographs closely, noting on the map where the stations are located in the river system.

Have students analyze the graphs to answer these questions:

- -What is the direction of flow for the flood waters?
- What is the order of the gaging stations from furthest upstream to furthest downstream?
- How do the flood amounts vary from station to station? What is the pattern?
- What effect does Flathead Lake have on the flooding?
- Is there a difference in timing of flooding from station to station, and, if so, what is it?
- What is the story of the flooding that the graphs tell?

Wrap-up

Discuss with the class the flooding pattern discovered in the flood hydrographs. (Hydrograph Discussion: High water first occurs in the So. Fork of the Flathead late on June 8th. The graph for the Flathead River near Columbia Falls is located at West Glacier on the Middle Fork. It shows a much smaller flood crest at the same time as the main Flathead River. The flood crest is measured on the Flathead River at Columbia Falls early on June 9th at over 17,000 cfs. This is the accumulated water from the 3 forks of the Flathead. High water is measured at the N. end of Flathead Lake early on June 10th. At the other end of the lake, at Polson, moderate higher water builds over time and crests much later, on June 12-13).

Have students write down, in journals or on pieces of paper, the story of the 1964 flooding as it is seen in the flood data hydrographs. Students can draw illustrations of the flooding, either from an aerial view or an on the ground view.

ASSESSMENT

Several pieces of student work can act as assessments in this activity. Those are: the written list of the flooding factors determined in the close reading of the 1964 Flood Report, class participation in discussions about the flood factors and about the hydrographs, and the written story of the analysis of the flood hydrographs.

EXTENSIONS

Read Flooding Effects on Flathead Lake and other areas in the Flathead. (Flathead Sourcebook, pg. 8)

Ask the class to think of effects of flooding on land and water. List possible effects on the board (see Flathead Sourcebook, pg. 7). In the Flathead Watershed, much of the water drains into Flathead Lake. Ask the class to think of ways that flood water would impact the lake. (water quality, water quantity) and the lands surrounding the lake (property impacts, shoreline impacts).

Read the Flathead Beacon article: "When All Hell Came Down the Mountains": eyewitness accounts of experiences during the 1964 Flood.

RESOURCES

Newspaper accounts:
http://flatheadbeacon.com/2014/03/28/when-all-hell-came-down-the-mountains/
http://www.nytimes.com/2000/11/23/us/mel-ruder-85-publisher-and-prize-winner.html
http://michellerafter.com/2015/04/20/the-pulitzer-and-the-hungry-horse-news/
http://www.pulitzer.org/awards/1965
Flood Reports:

http://pubs.usgs.gov/wsp/1840b/report.pdf
http://wy-mt.water.usgs.gov/floodwatch/images/floods1964jun/floods1964jun_fig2.png

Floods of June 1964 in Northwestern Montana; Geological Survey Water-Supply Paper 1840-B, F C Boner and Frank Stermitz; http://pubs.usgs.gov/wsp/1840b/report.pdf

Close Reading: Excerpt from Floods of June 1964 in Northwestern Montana

CONDITIONS FOR THE JUNE 7-8, 1964 FLOODING IN THE FLATHEAD

PRECIPITATION
Precipitation during January to April 1964 was nearly equal to the 4-month normal for the standard period 1931-60, but for May was nearly double the normal.

The general snowfall of May 2-3 was the heaviest on record for May at Kalispell and Missoula and near record at Helena (US Weather Bureau, 1964). Precipitation in that storm ranged from about 2 to 4 inches. There was little precipitation thereafter until May 27-29 when significant amounts of rain fell along the summit and east of the Continental Divide. The higher mountains may have received some snow in the storm of May 27-29. There was little or no rain in June until the storm of June 7-8.

TEMPERATURE
Below-normal temperatures of March to May delayed the usual mountain snowmelt pattern. As a result, many streams were at a high level and there was significant amount of high-altitude snow when the intense rains began June 7. Although temperatures of early March were high enough to melt much of the snow in the plains and the exposed foothill area, the March mean temperatures were lower than the 2 prior months. The below-normal temperatures of late March delayed mountain snowmelt and may have contributed to the above-normal soil moisture that existed when the heavy rains began

SNOW COVER and STREAM FLOW
Snow water equivalent near the first of April was 110 percent of average in the Flathead basin, and 89 percent of average in the Marias, Teton, and Sun River headwaters. Many snow measuring courses at high elevation, particularly in the Flathead River drainage, showed increases of 10 to 14 inches of water during March. During April 1964 there was very little melt even at lower elevations and almost all snow measuring courses showed an increase in water equivalent during April. Many low elevation snow measuring courses had the highest May 1 water equivalent since recordkeeping began. The great response of Middle Fork Flathead River and Swiftcurrent Creek to the warmer weather that began about May 30 may indicate relatively greater area snow cover in those basins at that time.

SOIL MOISTURE
The soil mantle in most of the mountain area is relatively thin, and soil moisture was probably near capacity just prior to the flood. The widespread snow and rain of the first

few days of May, the general prevalence of snow cover until about May 20, and substantial rains along and east of the Continental Divide on May 27-29 support the assumption.

THE STORM

All the ingredients necessary for the intense 36-hour storm were present: the large supply of relatively warm moist air from the gulf was unusually direct, broad, and undisturbed until its arrival in the rain area. The timing of the entry of the cold front from the north into the rain area was critical as its "wedging" and upslope flow effects probably caused a few hours more of heavy rain than otherwise would have occurred. Precipitation rates were from 16 inches at the highest elevations to 2 inches in the lowest elevations in the affected areas. The intense rain fell on the remains of the mountain snowpack, adding to the amount of water flowing into stream and river channels.

From: Floods of June 1964 in Northwestern Montana; Geological Survey Water-Supply Paper 1840-B, F C Boner and Frank Stermitz; http://pubs.usgs.gov/wsp/1840b/report.pdf

1964 Flood Report Hydrograph

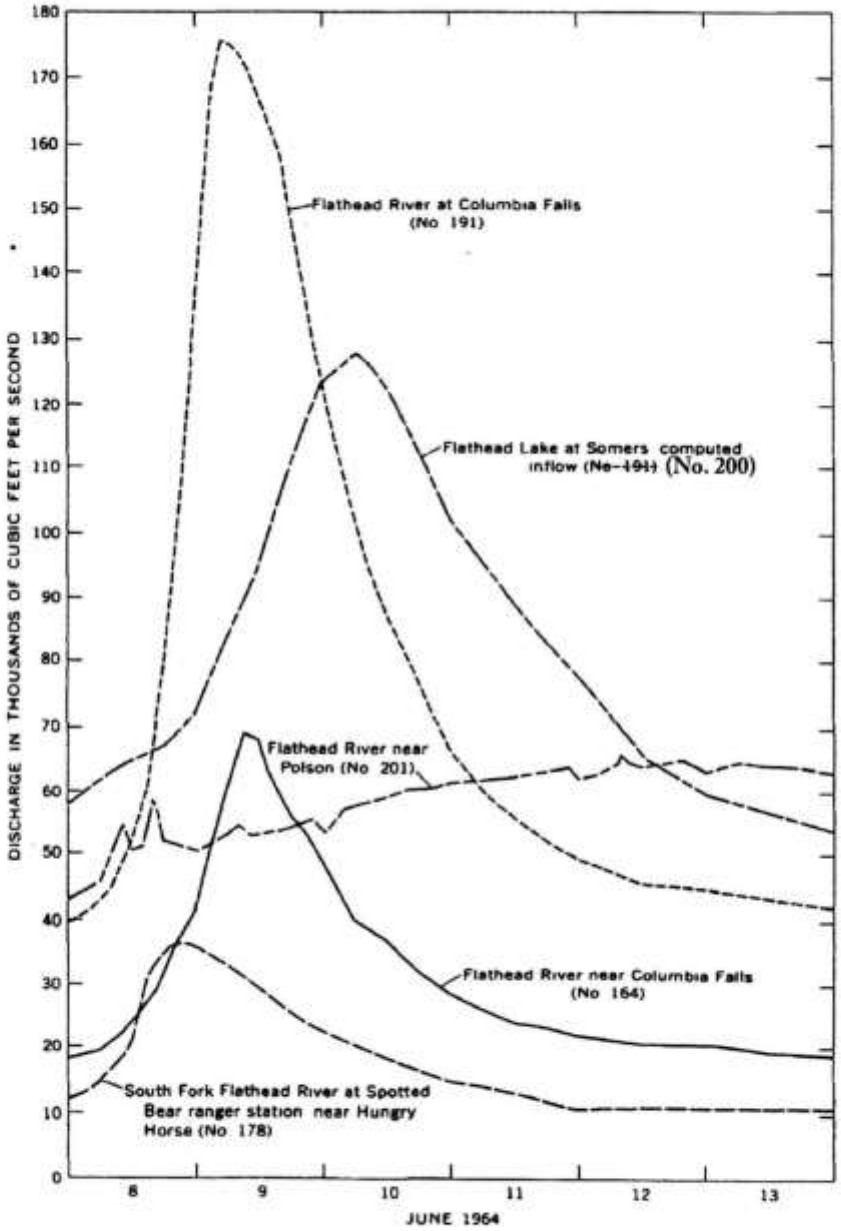
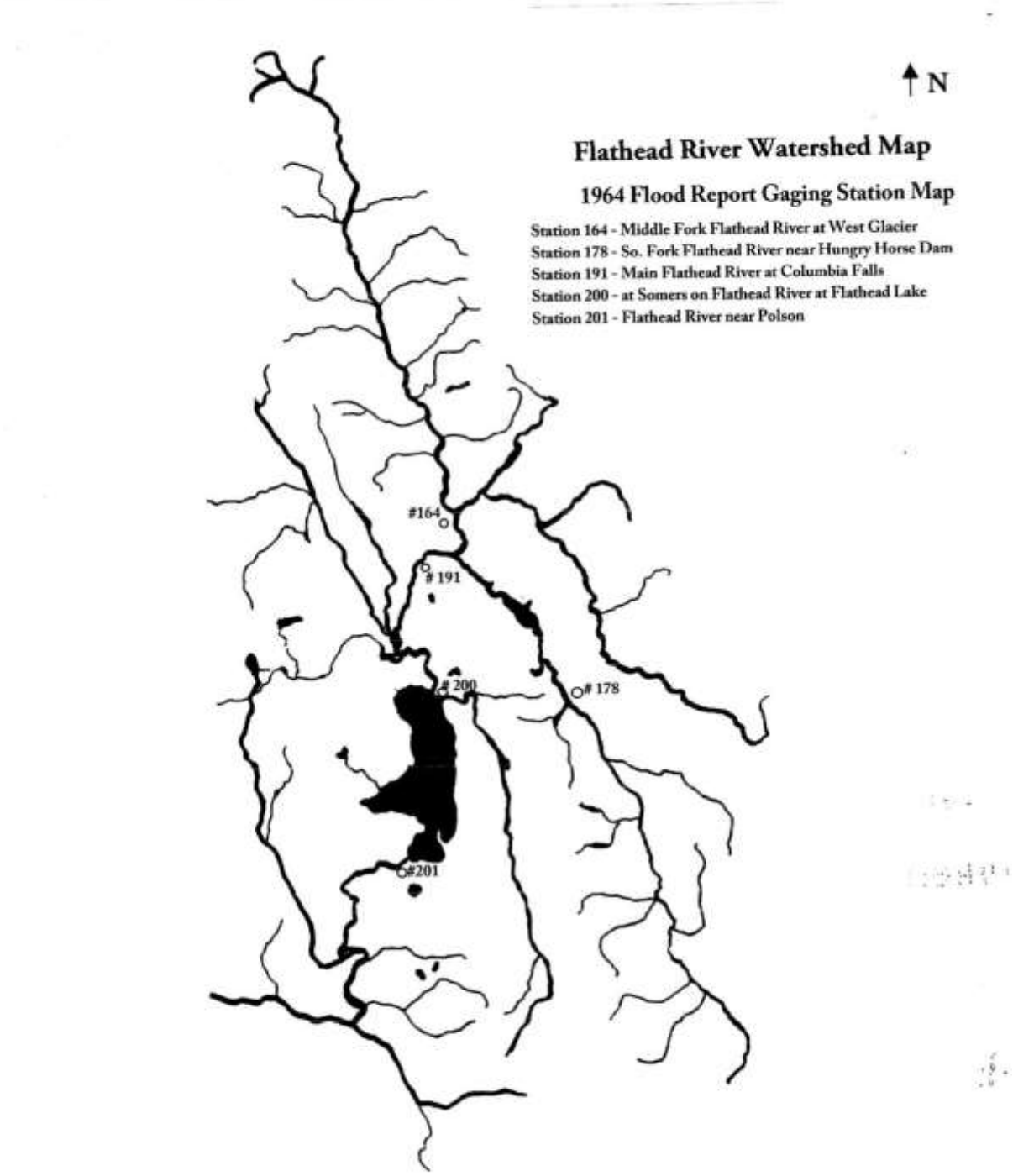


FIGURE 38.—Discharge at selected gaging stations in Flathead River basin, June 8-13, 1964. Numbers in parentheses conform with those in table 19 and on figure 2

249-795 O—67——6

1964 Flood Report Hydrograph Station Map



Ch. 1-6 Flooding in the Upper Flathead Watershed

Ch. 1-7 Quotes from Watershed Perspectives

What are people's thoughts about watersheds?

SUMMARY

In this lesson students will be given quotes that relate to watersheds in general and the Flathead Watershed in particular. The students will "close read" their quote and then create a small poster that describes the quote, its main ideas and how it relates to their experience of living in the Flathead Watershed.

OBJECTIVES

The students will:

- analyze a watershed quote for full comprehension
- investigate the different meaning of a watershed quote
- explain the meaning of the watershed quote
- compare different watershed quotes, and
- relate the quotes to their personal experience

MATERIALS

- Large pieces of paper for groups to work on and then present the results
- Watershed quotes at the end of this lesson
- Journals

BACKGROUND

Close reading means reading to uncover layers of meaning that lead to deeper comprehension. Close, analytic reading stresses engaging with a text directly and examining the author's meaning thoroughly and methodically. Students read and reread to increase familiarity with the text and to reveal patterns within the writing.

Directing student attention to specific passages and wording in the text, analyzing it in fine detail as well as from a bigger picture viewpoint enables students to understand the central ideas and supporting details. It also enables students to reflect on the meanings of individual words and sentences, the order in which sentences unfold, and the development of ideas. This leads students to arrive at a deeper understanding of the text as a whole.

Flathead Watershed: www.flatheadlakers.org

In this lesson students focus on the watershed and it's meaning to diverse people. See: Flathead Watershed Sourcebook, Ch. 1, What is a Watershed? pgs. 1-16.

PROCEDURE

Warm-up

Have the whole class suggest words that they think relate to the Flathead Watershed. List these words where they can be seen by whole class.

Look for similarities between ideas such as streams, rivers and lakes and suggest larger concepts which link the words such as ecosystems or river drainages. This helps organize student thinking.

Have students record the words and concepts in their journals.

The Activity

Part 1

Have the students work in groups of 2 or 3 students. Give each group a copy of the watershed quotes from this lesson or from another source (books, internet or other media). Ask students to write the quote in their journals. Have students paste the quote in the middle of the large piece of paper. Quotes from the Flathead Watershed Sourcebook are provided with this lesson.

As the students read the quote have them make notes in their journals under these headings:

- In one sentence, what is this text about?
- What are the main arguments?
- How does this quote relate to experiences I've had in the Flathead Watershed?

Headwaters of the Flathead Watershed: Glacier Park: www.nps.org

Part 2

Have the students illustrate their quote on the big piece of paper and restate the main ideas in their own words. Write in big text on the paper class words recorded earlier that relate to their quote and to Flathead Watershed.

Wrap-up

Compare the posters and the words students found in the text to the initial ideas suggested in the warm-up section of the activity. Are there similar words and meanings? Are there unique words and meanings?

ASSESSMENT

Have the students present their quote and their poster to the class.

EXTENSIONS

- **In the classroom**

Have the students do some background investigations about the speakers of the quotes. Have the students search for other quotes about watersheds.

- **Outside the classroom**

Have the students ask a family member, acquaintance or friend what they think about the watershed and collect a new set of watershed quotes.

RESOURCES

Common Core Standards and close reading: https://www.learninga-z.com/commoncore/close-reading.html
Environmental Quotes from the Grinning Planet:
http://www.grinningplanet.com/6001/envir onmental-quotes.htm

Water Quotes
http://www.texasthestateofwater.org/scree ning/html/water_quotes.htm

Watershed Quotes

"You can't know who you are until you know where you are." Wendell Berry (Flathead Watershed Sourcebook p.16)

"Find your place on the planet. Dig in, and take responsibility from there." Gary Snyder (Flathead Watershed Sourcebook p.13)

"If there is magic on this planet, it is contained in water." Loran Eiseley (Flathead Watershed Sourcebook p.11)

"Water is the best of all things." Pindar (Flathead Watershed Sourcebook p.5)

"that area of land, a bounded hydrologic system, within which all things are inextricably linked by their common watercourse and where, as humans settled, simple logic demanded that they become part of a community." John Wesley Powell (Flathead Watershed Sourcebook p. 3)

"Whether we know it or not, we all live in a watershed. The raindrops that fall in our lawns, fields, woods and pastures ultimately either replenish an aquifer or flow into a creek or stream. As a result, the actions we take and the decisions we make with how we use, manage, conserve and value water impact the needs of those downstream, including our fish and wildlife. Our aquifers, springs, creeks, rivers, bays, estuaries and gulf waters need you more than ever." Carter Smith, executive director Texas Parks and Wildlife Department.

"A river is the report card for its watershed." Alan Levere, Connecticut Department for Environmental Protection

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"This is the prospect from the watershed, and when the traveler reaches it, it is a good thing to take an hour's leisure and lookout on the visible portions of the journey, since never in one's life can one see the same view twice." Dame Freya Madeleine Stark: 1948, Perseus in the Wind.

"Here is an abandoned field in which the ragweed is sparse and short. Does this tell us anything about why the mortgage was foreclosed? About how long ago? Would this field

be a good place to look for quail? Does short ragweed have any connection with the human story behind yonder graveyard? If all the ragweed in this watershed were short, would that tell us anything about the future of floods in the steam? About the future prospects for bass or trout?" Aldo Leopold: "Natural History: The Forgotten Science" [1938]; Published in Round River, Luna B. Leopold (ed.), Oxford University Press, 1966,
p. 62

"Wilderness and the life dependent on it are fragile entities. They can be destroyed in a matter of years, if not days. Legislative protection is the surest way to maintain a wilderness reserve on our hungry and crowded planet. When wilderness is protected, watershed is protected. Biological diversity is protected. Game is protected. The proper functioning of a natural system is protected. Our quality of life is protected." Rep.
Wayne Owens (D-UT)

"Much of Delhi's regional importance came from the location in the watershed between the Ganga and the Indus river systems...In the sixth century BC, Delhi formed part of the Kuru kingdom, one of the Mahajanapadas or 'great states.' In the Buddhist documents of that period, Indapatta is mentioned as the capital of the Kuru state." A.G. Krishna Menon, "Delhi: A Heritage City: 20 Walks through History"

"Wild rivers are earth's renegades, defying gravity, dancing to their own tunes, resisting the authority of humans, always chipping away, and eventually always winning."
Richard Bangs, River Gods

"Rivers are inherently interesting. They mold landscapes, create fertile deltas, provide trade routes, a source for food and water; a place to wash and play; civilizations emerged next to rivers in China, India, Europe, Africa and the Middle East. They sustain life and bring death and destruction. They are ferocious at times; gentle at times. They are placid and mean. They trigger conflict and delineate boundaries. Rivers are the stuff of metaphor and fable, painting and poetry. Rivers unite and divide -- a thread that runs from source to exhausted release." Edward Gargan, The River's Tale

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"The river moves from land to water to land, in and out of organisms, reminding us what native peoples have never forgotten: that you cannot separate the land from the water, or the people from the land." Lynn Noel, Voyages: Canada's Heritage Rivers

Ch. 1-8 Watershed Poetry of Place

How can you express your 'sense of place' through poetry?

SUMMARY

Students use poetry as a means to discover their 'sense of place' in the Flathead Watershed. Themes for the poems are students' feelings and thoughts about the natural world of the Flathead Watershed and their interactions with it. The type of poem explored in this activity, a syntu, is typically used to express feelings and thoughts about the natural world. Students record their poems in journals. Song lyrics, haikus and concrete poems are also discussed.

OBJECTIVES

Students will

- Explore the natural world through the written form of poems.
- Express thoughts and feelings about nature in poems.
- Develop their 'sense of place' in the Flathead Watershed.

MATERIALS

- Students' journals
- Examples of the poetical forms of syntu, haiku, diamanete, and other concrete poetry forms
- Materials to write and draw with – such as colored pencils

BACKGROUND

There are many definitions for the word "place." Physical environment. Physical surroundings. A locality used for a special purpose. A proper or designated niche or setting.

There are numerous other simple definitions for this small, yet powerful word. Every location offers us a unique set of circumstances and conditions that define how we live in it.

Place is where and how we live, work, and play, it informs our viewpoints, and it is where we develop a sense of belonging.

In 1977, Peter Berg and Raymond Dasmann suggested that living-in-place meant "following the necessities and pleasures of life as they are uniquely presented by a particular site, and evolving ways to ensure long-term occupancy of that site. A society which practices living-in-place keeps a balance with its region of support through links between human lives, other living things, and the processes of the planet – seasons, weather, water cycles – as revealed by the place itself." (McGinnis, 1999)

The Flathead Watershed is a place with exceptional natural beauty, productive soils, abundant recreational venues, ancient and newfound spiritual connections, and diverse economic opportunities. Those of us who are fortunate enough to live in the Flathead Watershed are part of a truly extraordinary place.
(pg. 16, Flathead Watershed Sourcebook)

PROCEDURE

Warm-up

Ask students what sorts of experiences they have had with poetry. Have anyone written a poem? Ask them to think about how they feel after they have written or read a meaningful poem. Do they feel a deeper connection to the topic of the poem? Ask students to think about writing about something in the natural world. What happens to their thinking about that natural object or place as they consider writing about it?

The Activity

If possible, take students outside for this activity.

Ask students to think about (or observe, if outside) the natural world that surrounds them wherever they live in the Flathead Watershed. Have them turn to a neighbor and list some of the natural features they think of, or see, when they are outdoors where they live. The natural features can be prominent landmarks, unknown but personally important spots in nature, or anything in between. Ideally, the natural feature is something to which they have a personal connection.

Hand out a piece of paper to the small groups or pairs. Ask the group to pass around the paper amongst them so each person writes down at least one natural feature. Give the class between 5 and 10 minutes to make their lists, checking to see that everyone has participated.

Lead a class discussion about the natural features the students have listed. Ask students to share words that describe the natural features they've written down. These can be written down in front of the class if desired. Ideally, there will be a wealth of adjectives used to describe the natural features that have been listed.

Ask the students to think how their listed places make them feel. Have students share some of the words that come to their minds as they think of their feelings. These words can also be written on the board in front of the class.

Introduce the syntu. Explain that it is a very specifically written poem about a feature of the natural world. Explain the syntu format and give examples.

About Syntu:

A syntu is a poem composed of five lines that originated in Japan, written about a natural feature of the Earth. The poem emphasizes observations with the five senses, and is a way of describing your feelings about something in nature.

Line 1 - a natural feature: it has one word.
Line 2 - an observation about the natural feature in Line 1, using one of the five senses: sight, touch, hearing, taste, or smell. There is no limit on the number of words.
Line 3 - a thought, feeling, or evaluation about the natural feature in Line 1. There is no limit to the number of words.
Line 4 - another observation about the natural feature in Line 1, using a different sense than the one in Line 2. There is no limit to the number of words.
Line 5 - a synonym for the natural feature in Line 1; it has one word

Syntu Examples:

Rainstorm
Hear the rumbling thunder
Run outside!
Feel the cool raindrops
Downpour

Mountain
Jagged, towering
Majestic
Echoes through the valleys
Peaks

Stream
Rippling, flowing water
Life-giving
Cool and refreshing
River

*From:www.cormp.org/documents/**Poetry**.do*

Tell the students they are going to write a syntu in their journal. Ask students to choose one of the features they wrote down, and compose a syntu about that feature. When they have finished writing at least one syntu, have students illustrate their syntus

Wrap-up

When everyone is finished with their poem and their illustrations, if they have done those, ask if anyone would like to share their work. If no one volunteers, consider choosing a few people that you feel may be comfortable sharing with the class.

Ask students how it felt to write about something in nature, or a natural feature. Did they develop a closer feeling to that place? Did they find themselves observing that place or feature more closely? Did writing about their feelings about that place or feature create stronger feelings? Did it remind them of other natural features or places they felt strongly toward?

Let the students know that writing about a natural place or feature creates and strengthens their own 'sense of place', that feeling a connection to a natural place or feature creates a relationship with that place or feature and it becomes part of their life and the world in which they live.

Have students write a reflection in their journals about the process they just went through in writing the syntu poem.

Optional: Repeat the syntu writing exercise with another feature that students listed on their group paper, if desired, and if they have listed more than one natural feature or place.

The poems can be shared on a class blog, or displayed on classroom walls. The website: http://www.poetry.com/ , is a site where students can share their poems with the internet community for reviews.

ASSESSMENT

The poems recorded in the journals are a form of summative assessment. The written reflection about writing a syntu also serves as an assessment. Student responses to questions during class discussions are formative assessments, and can be used to check for understanding of both the written assignment and the concepts being discussed.

EXTENSIONS

Different types of poems based on the natural world can also be written, such as haikus and concrete poems.

Haiku-

A haiku is made up of 17 syllables which are arranged in 3 lines of 5-7-5. Haikus do not use similes and metaphors. A Haiku can be written to describe anything, though haikus usually depict an image from nature.

Haiku Examples:

Over the wintry
forest, winds howl in rage with
no leaves to blow.

By Natsume Soseki

Water reflects sky
Summer of my soul open
Under the spell still

By Robert A. Foss

Concrete poems:

Concrete poetry is a type of poetry that uses some sort of visual presentation to enhance the effect of the poem on the reader. The visual layout of the poem need not necessarily form a picture, although many concrete poems do. (from: yourdictionary.com)

Diamante

A diamante is a type of concrete poem that is written in the shape of a diamond. A diamante poem is an unrhymed 7-lined poem. "Diamante" is the Italian word for diamond. It is known as a "diamond poem" because it is shaped like a diamond. Diamante poems are 7 lines long. The pattern is:

Noun
Adjective, adjective
Verb, verb, verb
Noun, noun, noun, noun
Verb, verb, verb
Adjective, adjective
Noun

Example:

http://break2012.weebly.com/diamante-poem.html

RESOURCES

http://www.poetry.com/
http://www.poets.org/poetsorg/text/brief-guide-concrete-poetry
http://www.shadowpoetry.com/resources/wip/shape.html
http://www.poetry4kids.com/blog/news/how-to-write-a-concrete-poem/

Teaching Science Through Trade Bookshttps://books.google.com/books?isbn=193 6959135
Read more at http://examples.yourdictionary.com/examples-of-concrete-poems.html#kgdI8163pt3QlqXC.99
From:http://pubs.usgs.gov/of/1998/of98-805/lessons/chpt11/urban-sw.htm

Ch. 1-9 Field Notes

How do people observe and record features of the Flathead Watershed?

SUMMARY

In this activity students will develop a system for making records of the natural and social features of the Flathead Watershed. This system will comprise a method for taking "field notes" that can be applied throughout the study of the Flathead Watershed.

OBJECTIVES

The students will

- Understand various approaches to creating field notes and select a style for their own use
- Develop skills of observation, recording and interpretation
- Appreciate the field note taking as a unique way to record aspects of the natural and social world

MATERIALS

Depending on the students' styles and resources there are a variety of materials from basic spiral notebook and colored pencils to a computer tablet or smart phone that can be used to take field notes. In this lesson students will use a basic spiral notebook and colored pencils for the class.

BACKGROUND

Field note taking has been an activity of people from the beginning of time. It can be said that the earliest rock art such as petroglyphs or pictographs were field notes of primitive people. Relevant examples for classroom use are the notes of the greatest North American expedition, the Corps of Discovery led by Meriwether Lewis and William Clark.

Closer to home and the present day, the Hockaday Museum of Art in Kalispell has the Artist-Wilderness Connection program that enables artists to explore wilderness and record their impressions in words and paintings (see http://www.hockadaymuseum.org/index.cfm?inc=page&page=393).

http://www.hockadaymuseum.org/

In the Flathead Watershed Sourcebook there are a number of profiles of artists and journalists featured in Watershed Perspectives pieces; be sure to note A Journalist's Muse on page xiv.

Field note taking involves documenting observations or research with video, photographs, audio, and writing down observations on a type of device or the traditional pencil and paper.

Tablets and smartphones have features built into them for recording observations and making notes: there are apps that can access these features and keep all your notes in one place. An advantage of tablets and smartphones is that they are portable and fairly easy to use.

PROCEDURE

Warm-up

Assign selected Watershed Perspectives readings found throughout the Flathead Watershed Sourcebook to small groups for close reading and summary reports. You can also select readings from the featured artist at the Hockaday Museum of Art website.

Ask students to find evidence in the perspectives and readings that the authors are writing about their observations of the natural world around them. Have students pick out specific words, phrases and sentences that paint a picture in the reader's mind of a place or item in the Flathead Watershed that the author has seen and written about.

In class, arrange to listen to MTPR, Montana Public Radio's program called Field Notes: brief natural history talks about fascinating living creatures in Montana. See the resource section at the end of the lesson for the website information.

The Activity

In the classroom help students learn how to take field notes by having them make observations, draw sketches and record observations in their field notebooks.

Using props such preserved or live plants and animals, rocks, shells, interesting pieces of wood, or another natural item, have students take note of the elements of the item such as shape, colors, size, patterns, textures, amounts, relationships of parts, and so on..

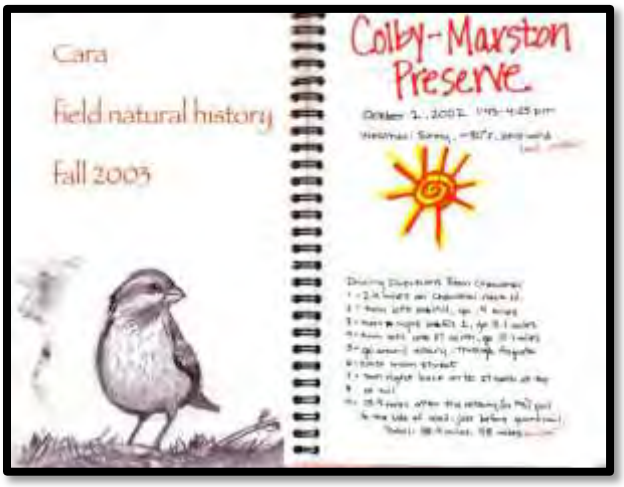
Encourage students to make qualitative (color, shape) and quantitative (size, width, height) observations. Have rulers and magnifying glasses handy.

On the top half of a journal page, have students draw a sketch of the item, doing their best to be accurate in terms of shape and relative sizes of different parts or elements of the item. Have colored pencils or fine-line markers available.

On the bottom half of the same page, ask students to write down descriptions of what they observed and drew in a list format, using adjectives to convey their observations. Complete sentences are not necessary. Have students' record place and time.

Be sure to emphasize that everyone's work will be different and interesting

Take a break from observations and have students share their field notes in small groups and comment to the other members about their observations. Have students share what they consider unique about their observations with their group.



Cara's field notes: M. Brody

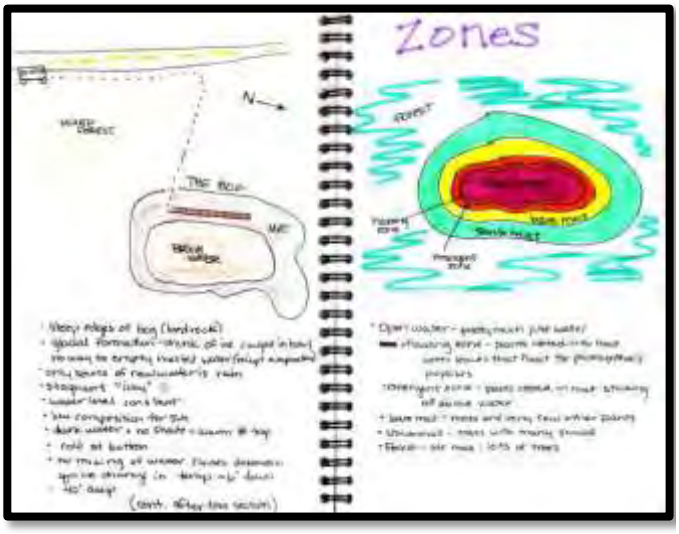
Next it is time to go outside and record field notes. Pick a pleasant day and an interesting field study site. This could be the school area, a nearby park or any close place that is safe for the group.

Have the students go through the same process as the classroom: observe an item, making note of its attributes such as shape, size, color and so on. Ask students to draw a sketch on part of their page, or on an adjoining page, and write a description on the other part of the page. Have colored pencils and sharpeners, measuring tools and observational aids (magnifying glasses and/or binoculars) available.

For homework have the students make field notes at or near their homes or some place they might have visited within the Flathead Watershed.

Wrap-up

Have the students present their field notes from home or some other place in the Flathead Watershed and locate those places on a map of the area. As they present their field notes, ask the rest of the class if they can see the place clearly in their minds as the student reads their notes and shows their sketches. Have the class share their thoughts about the presenter's field notes when they are finished.



Cara's field notes: M. Brody

ASSESSMENT

The field notes are the assessment. They should include accuracy of place and time, identification of subjects if possible, neatness, pictures, words, sentences and paragraphs.

EXTENSION

Digital variants of this activity using iPads, tablets or smart phones can be used with an emphasis on taking pictures of subjects for study. Field note taking sites can be recorded in popular mapping applications.

Students can continue with their field notebooks throughout the school year. Seasonal changes over time of a specific site can be a powerful field note theme.

Students can make observations and field notes of the actions and interactions of populations of animals or people, such as the activities of a flock of birds on the playground at school or the interactions of children playing at recess. These types of observations require a different type of field notes based on recording action on a timed basis such as once every 5 mins, or once every half hour, depending on what the action is.

RESOURCES

Examples of Journals:

Lewis, Meriwether; **Clark**, William; **Floyd**, Charles; **Whitehouse**, Joseph (1905). *Original Journals of the Lewis and Clark Expedition, 1804-1806, V.6*. Dodd, Mead & Company, New York.

Coues, Elliott; **Lewis**, Meriwether; **Clark**, William; **Jefferson**, Thomas (1893). *History of the expedition under the command of Lewis and Clark: Volume 1*. Francis P. Harper, New York.

Coues, Elliott; **Lewis**, Meriwether; **Clark**, William; **Jefferson**, Thomas (1893). *History of the expedition under the command of Lewis and Clark: Volume 2*. Francis P. Harper, New York.

MTPR: Field Notes radio program
http://mtpr.org/programs/field-notes

Teaching Resources about journaling
Field journaling for elementary education: http://www.edutopia.org/naturemapping-lesson-field-journal

Ch. 1-10 Field Trip Safety

What things can be done to make a successful and safe field trip?

SUMMARY

There are an infinite number of interesting and educational places to take field trips in the Flathead Watershed and the Flathead Watershed Resource Guide has many of the places and people identified. However, the teacher has specific tasks ahead of them to ensure that everyone is safe and the time is spent in meaningful educative ways.

OBJECTIVES

The teacher and students will

- Understand the guidelines for behavior on a field trip.
- Demonstrate appropriate behavior.
- Appreciate the opportunities to learn outside the classroom.

MATERIALS

- Field notebooks

BACKGROUND

Field trips are memorable experiences in almost everyone's school careers, especially when the field trip is to an exciting new outdoor location. Being prepared beforehand goes a very long way towards creating the engaged learning experience that marks a great field trip.

PROCEDURE

Warm-up

Ask students how they think people should behave on the field trip, list topics on board/paper. Use the board or poster paper to list the basic rules and appropriate behaviors of the field trip. Add appropriate behaviors as necessary.

The Activity

- Explicitly discuss field trip behavior rules with your students beforehand. - Teach, model, and review appropriate field trip behavior with your students for at least a week before the big event. Sound serious and back it up with consequences as needed.
- Give your students a learning task ahead of time. - Your students should show up for the field trip with a base of knowledge on the subject at hand, as well as questions to answer before returning to the classroom. Review a list of questions they will be looking to answer during the field trip. This will keep them informed, engaged, and focused on learning all day long.
- Choose parent chaperones wisely. Field trips require as many adult eyes and ears as you can get, but unfortunately you can't be everywhere at once. From the first day of school, observe the parents of your students closely, looking for signs of responsibility, firmness, and maturity.
- Make sure students know how to dress properly. You want everyone to be comfortable when they are learning so be prepared for changes in temperature and precipitation. Good shoes are necessary!
- Arrive at school early on field trip day. - The students will be excited and antsy, ready to go. You'll want to greet the chaperones and give them instructions for the day.

- Give your chaperones the tools they need to succeed. - Make nametags for all chaperones and students. Create a "cheat sheet" of the day's itinerary, special rules, your cell phone number, and the names of all kids in each chaperone's group; distribute these sheets to each adult on the field trip.
- Be proactive in regards to challenging students. - If you have a student who causes trouble regularly in the classroom, it's safe to assume he or she will cause at least five times more trouble in public. If possible, ask his or her parent to be a chaperone. That will usually limit any potential problems.
- Watch out for poison ivy, poison oak, poison sumac, stinging nettles, or any other poisonous or thorny plants. Be aware of what they look like and where they grow. Use a field guide and familiarize yourself and the participants with any of these plants.
- Keep plants and wildlife habitats intact by staying on trails.
- Before collecting any materials from a site, obtain permission from the person or organization who owns the land. Materials from state or national parks must stay where they are found.

Leave rare or endangered plant species alone. Consider contacting the Department of Natural Resources of the state in question, or a local office of the US Forest Service, for a description of local rare or endangered plants.

Wrap-up

Write thank you notes after the field trip. Lead a class language arts lesson the day after the field trip, formally thanking the people who hosted the group. This serves as an etiquette lesson for students, and helps form the school's good reputation at the field trip destination.

ASSESSMENT

Do a "debriefing" upon return to the classroom - If there are few extra minutes after the field trip and before dismissal from school, create a quiet atmosphere and have the students draw about what they saw and learned that day. It gives them a chance to decompress and review what they experienced.

The next day, it's a good idea to do a more active and in-depth review of the field trip material, extending the learning further and connecting it to what you're working on in the classroom.

EXTENSIONS

RESOURCES

Teacher Tips: Taking field trips at:
http://www.scholastic.com/teachers/article/teacher-tips-taking-field-trips
Field trip curriculum at:
FieldTripPlanningGuide.pdf
Planning a successful and educational field trip at:
http://www.learnnc.org/lp/pages/1824
National Science Teachers Association at
https://www.nsta.org/elementaryschool/connections/201304WashedAwaySafetyTips.pdf
Field trip safeguard at:
https://www.youtube.com/watch?v=-wr6bChJXcQ

Chapter 2: Natural History

Background

"The finest workers in stone are not copper or steel tools, but the gentle touches of air and water at their leisure with a liberal allowance of time." - Henry David Thoreau

Introduction

Chapter two is devoted to the study of the physical and biological components of the Flathead Watershed. Like the Flathead Watershed Sourcebook, chapter two starts with several lessons that focus on the geology of the Flathead Watershed. The physical characteristics of the watershed over geologic time are studied in lesson 2-1, in which students make a geologic mural of the watershed. In lessons 2-2 and 2-3 students study the characteristics of soils and the structure of the geologic features.

Climate and weather are important factors in the Flathead Watershed. Given the rapidly changing climate and its effect on such quintessential characteristics of the Flathead Watershed such as glaciers and annual snow levels, lessons around these factors are important for students and their future in the watershed. Lessons 2-4, 2-5 and 2-6 address climate and weather.

In order to address some of the biological factors related to the watershed, lesson involving aquatic plants and nutrient cycles (lessons 2-7 and 2-8), fish (lesson 2-11), food webs and trophic levels (lessons 2-10 and 2-12) and ecosystems (lesson 2-9) are included. The unit concludes with two lessons (2-13 and 2-14) that build on the mandated need to incorporate language arts (reading and writing) in animal stories and natural history quotes.

Essential Questions

- What are the physical and biological characteristics of the Flathead Watershed?
- How do weather and climate affect life in the watershed?
- What is the role of aquatic plants and animals in the watershed?
- How are plants and animals related to each other in the ecosystems of the watershed?
- What are people's ideas and feelings towards the watershed?

Content

The content for this series of lessons is drawn from the Flathead Watershed Sourcebook Chapter 2, Natural History. This is one of the most comprehensive and complex of the Sourcebook chapters. It contains background information on physical, biological, ecological science as well as human-nature interactions. Background information on the Flathead Watershed in geologic time is found on pages 18 – 23 and includes an interesting description of Glacial Lake Missoula. The various time periods of geologic history are summarized in a chart on page 20. Science content on soils is found on pages 24 and 25 and provides valuable background information for lessons 2-2 and 2-3. In lesson 2-4 students will investigate how temperature and precipitation change over time using the US Climate Data website. Information on the biological

cycles and ecological systems of the Flathead Watershed, used in lessons 2-7, 2-8, 2-9, 2-10 and 2-12, are found on pages 34 - 41. Descriptions of the native, iconic plants and animals of the watershed that are integral to lessons 2-9 and 2-13, are located on pages 42-73 of the Flathead Watershed Sourcebook.

Learning goals

In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
  - The geologic history of the Flathead Watershed
  - The role of climate and weather in the Flathead Watershed
  - Soil components and processes
  - Biological processes integral to the Flathead Watershed
  - Ecosystems and their components found in the Flathead Watershed
- Skills
  - Measuring and collecting water quality and aquatic biology data
  - Determining how to sample below the surface of the Earth
  - Writing stories and informative brochures about nature
  - Interpreting quotes about watersheds
- Dispositions
  - Appreciation for the physical and biological components of the watershed system
  - Positive attitudes and values related to the Flathead Watershed

Key Concepts

Animals
Climate
Fish growth
Fisheries management
Food webs
Glaciers
Geologic time
Photosynthesis
Plants
Respiration
Sense of place
Snow
Soil components
Soil structure
Trophic levels
Weather

Graphic Organizer

Chapter 2 Lessons 69

Ch. 2-1. Classroom Mural of Geologic Time in the Flathead Watershed

What has the Flathead Watershed looked like from the beginning of geologic time until today?

According to Henry David Thoreau, ***"The finest workers in stone are not copper and steel tools, but the gentle touches of air and water at their leisure with a liberal allowance of time."*** (Sourcebook p. 18)

SUMMARY

In this lesson students will create a small timeline showing the appearance of life and humans in geologic time and a wall mural of the Flathead Watershed over geologic time.

Timelines help students understand the chronology of events and they help students situate present day events and features in relation to those from the past.

They provide a visual aid for identifying cause and effect relationships between events and a visual prompt to activate student prior knowledge. They allow students to recognize how geologic events, eras and topics overlap.

OBJECTIVES

The student will

- Understand how forces of nature shape the Flathead Watershed landscape.
- Develop skills in visualizing landscape change over time.
- Appreciate the natural forces and extensive time that have led to the present landscape.

MATERIALS

- a long roll of "butcher" paper
- pencils, markers or crayons, watercolor paints
- 8.5 X 11 paper
- rulers, meter sticks

BACKGROUND

Studying the physical and biological processes that created the Flathead Watershed gives one a sense of place and of deep time...geologic time.

The Flathead Watershed landscape was formed through the deposition of layers of materials such as mud, sand and limestone that over time became rock, followed by uplifting and displacement of rock layers to form mountains, always combined with constant weathering and erosion—the slow, steady wear caused by wind, water, and ice.

This geologic legacy forms the foundation for the fascinating combination of climate, water, soils, flora, and fauna in the Flathead Watershed that collectively create unique ecological connections.

The mountains and valleys within the watershed are evidence that these forces—at work for over one billion years—remain active today shaping and changing the landscape (Read the Flathead Watershed Sourcebook pages 18 – 23.)

PROCEDURE

Warm-up

Ask students to describe the Flathead Watershed landscape as it is today.

Have students list at least three forces in nature that have helped shape the landscape around them.

Have students discuss in small groups the question: How have the natural forces listed above worked to shape the Flathead Watershed into how looks today?

Ch. 2-1. Classroom Mural of Geologic Time in the Flathead Watershed

The Activity

Part 1: Humans on the Geologic Timeline

- Divide the class into seven small groups. Have each group make a timeline on 8.5 X 11 paper, using the long side. On the left side mark 5000 million years ago (mya) (approximate age of Earth = 4,600 mya, or 6 bya) (5000 mya = 5 bya) to the present on the right side.
- Mark the timeline into 10 equal units. Divide 5000 mya by 10 (= 500 mya) and label each unit with 500 mya increments starting with the beginning of geologic time on the left side, to the most recent unit on the right side.
- Divide the most recent 500 mya unit in to 10 units each (50 mya each).
- Divide the last unit in 10 units (5 mya each).
- Label the approximate time life has been on Earth (3.49 bya) and mark the point when humans appeared on Earth at 164,000 ya, (have students determine where on the timeline 164,000 is located).
- Discuss with the class the comparison between the presence of all life and human presence on Earth.

Part 2:

Flathead Watershed Geologic Timeline

- Create a large timeline on "butcher" paper from 4600 mya to today. Label the timeline with the Era, Period, and Epoch as indicated in Figure 2.5 on pg. 20 in the Flathead Watershed Sourcebook. Time divisions will not be to scale.
- Assign each of the original seven small groups a period and epoch. Have the students read the description of their time period.
- Have the students illustrate their geological period on the timeline, basing their illustrations on the descriptions in the Sourcebook.
- The periods should blend into each other at the borders.
- Post the timeline on the wall of the classroom or in the hallway of the school.

Wrap-up

Discuss with the students the overall general geologic history of the Earth.

Point out the small amount of time that human life has been present.

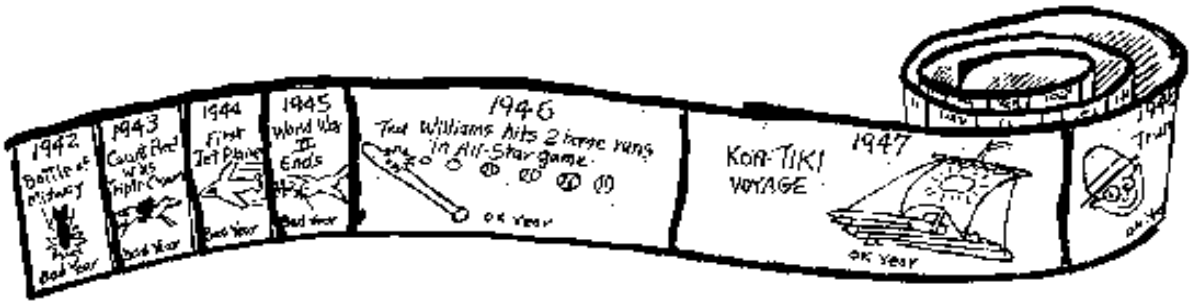
Discuss specifically how the Flathead Watershed has changed over time.

ASSESSMENT

The timelines created by the groups and the class timeline and illustrations are the overall assessment.

EXTENSIONS

Have students write a short story of the Flathead Watershed landscape in their watershed journals. The journal entry can also be illustrated to show change over time.



Egsc.usgs.gov

RESOURCES

For more information on the geologic time scale, see:

The USGS: overview of geologic time. (http://pubs.usgs.gov/gip/geotime/contents.html).

The Geological Society of America (http://www.geosociety.org/science/timescale/timescl.htm).

http://phys.org/news/2013-01-earliest-evidence-life-billion-years.html

http://www.sciencedaily.com/releases/2007/10/071017145252.htm

Ch. 2-2 Soil Pit Profile Survey

What is the soil like below my feet?

SUMMARY

In this lesson students dig a soil pit and investigate the layers and composition of soil in the Flathead Watershed.

OBJECTIVES

The students will

- Understand that the soil in the Flathead Watershed is not uniform and is the result of various geologic and biological processes.
- Learn how to construct a soil pit and sample various layers of soil.
- Appreciate the important role soil plays in our lives.

MATERIALS

- meter stick, ruler
- magnifying lens
- paper
- colored pencils, crayons
- shovels
- tarp (on which to place dirt when digging)

BACKGROUND

Humans and all other terrestrial animals depend on soil for life. Soil is the unconsolidated mineral and organic material on the earth's surface that serves as the medium for the growth of terrestrial plants. Its formation is the product of climate and organisms, conditioned by topography, acting on parent material over a period of time.

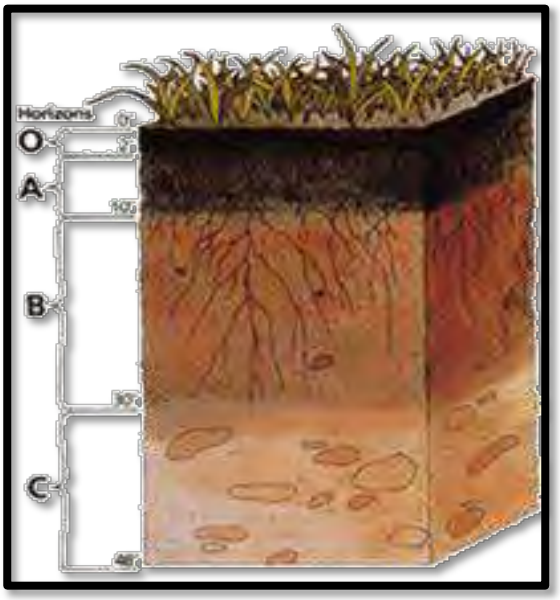
Soils are characterized by horizons, or layers, that are distinguishable from parent material as a result of changes over time.

Often overlooked, soil is a beautifully intricate and sometimes fragile substance that all terrestrial organisms depend on for their existence. (Flathead Watershed Sourcebook pp. 24-25)

PROCEDURE

Warm-up

Discuss with the students whatever experiences they have with digging holes in the ground or observations of other types of excavations such as construction or garden sites. Ask: Is the Earth uniform beneath the surface? Why or why not?



www.nrcs.usda.gov

The Activity

Digging a soil pit:

- Select a site for digging the soil pit, this should be an area that will not be disturbed or is a danger for walking or biking. Be sure to have permission before digging the pit.
- Carefully remove any vegetative layer such as sod from the surface and set aside on the edge of the tarp. Begin digging, placing the dirt on the tarp so

it can be easily replaced in the pit when finished.
- The pit should have three flat walls, the fourth stepped or sloping, one wall should face the sun.

Pit alternative: find a road cut or soil bank near the school and using a shovel, cut down evenly on the vertical surface to reveal a clean face.

Diagram the Soil Profile
- Identify the vertical sequence of soil layers. Identity of these layers is based on the ability to distinguish them from one another.
- These layers are called soil horizons: Labeled A (or O), B & C

Soil Horizon descriptions:
A (or O) horizon- top layer with organic matter and humus. Often roots, twigs and peat with a rich brown to black color. Most biological activity occurs here. This layer is often only inches to about 1' deep.

B – Subsoils – below the A horizon, combination of some organic minerals (no humus) often with clay a weathering product from the bedrock Minerals leach out. Altered/brown/yellows/white streaks. This layer is from inches to many feet deep.

C – Weathered bedrock, or saprolite; this soil is the raw weathered rock, no longer intact as rock but still resembling the parent rock below.

Collect and label a sample of each horizon and return to class.
All soils are not always present in all locations, and layers are not always horizontal, they may exist in some areas and pinch out in others.

Soil horizons in soil pit: depts.washington.edu

Wrap-up
In the classroom in small groups, complete the Soil Profile Chart provided below.
- Examine each of the soils provided to your table.
- Explore the contents using the techniques discussed in class.
- Can you identify what is in each type of soil?
- After viewing the soils in class and examining each layer sample, fill in the following table below.

ASSESSMENT
The soil profile table is the activity assessment.

EXTENSIONS
Go on a walking field trip around the school to look for different soil types present at the surface. Stop at each different type and examine the soil. In field journals note down the location, the color and texture of the soil, and any other characteristics.

RESOURCES
Natural Resources Conservation Services (NRCS)
Soil-Net.com

Soil Profile Description Form

Date:
Names:
Location of soil pit:

_____

Describe position of soil pit in the local area:

_____

Soil Layer	Horizon type, its depth and thickness (cm)	Horizon description: color; moisture; composition; structure; texture; new formations; inclusions; character of transitions; borders.

Ch. 2-3 Cupcake Soil Profiles

How can we see Earth's layers from Earth's surface?

SUMMARY

Students will model examining soil layers in a soil pit by taking core samples from a specially prepared cupcake. Students will examine the core samples for different layers and hypothesize about the possible origins of the layers.

OBJECTIVES

The students will

- Learn that the earth and soil are made up of various substances in different arrangement.
- Learn how to hypothesize an outcome of an investigation, plan a sampling strategy, and test their hypothesis.
- Understand the value of systematic sampling.

MATERIALS

- White cake mix or recipe, chocolate frosting
- Food colorings
- Straws
- Science journals

Prepare a cake mix recipe and divide into several batches. Add various food colorings to each batch of cake mix. Add small amounts of each colored batch in layers and blobs to each little cupcake baking dish. Each cupcake will be different. Bake. Top cupcake with frosting.

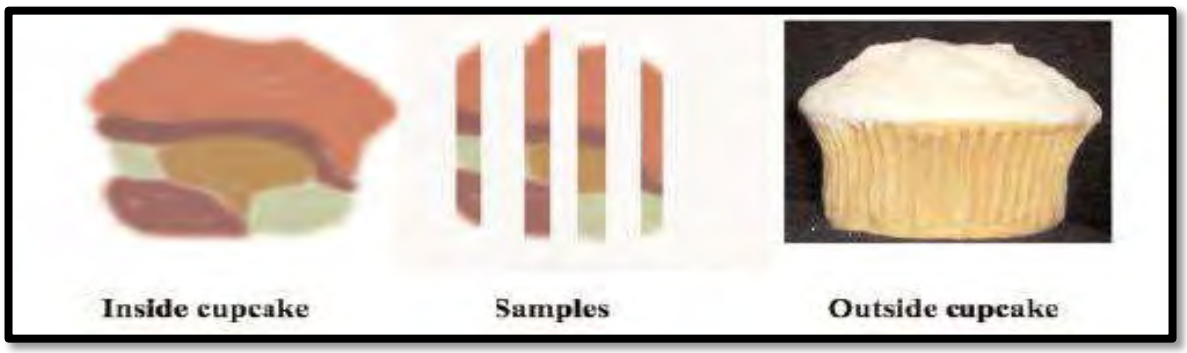
BACKGROUND

Soil is dynamic from the moment it begins to develop. It is crucial for agriculture, water purification, development, and maintaining overall biodiversity.

A number of natural factors, including time, climate, and biological processes, continually alter and renew the composition and character of soil. Some human activities such as over-fertilizing, spilling contaminants, deforestation, overgrazing, and erosion caused by development can degrade soil and reduce its functionality.

It is important to understand our soils and protect them from overuse and damage so there will be healthy, productive soils in the watershed long into the future, (Flathead Watershed Sourcebook, pg. 25).

Students' understanding of their environment must include some knowledge of the Earth on which they live. Knowing about the Earth's structure and understanding the processes of scientific investigations are essential for knowledgeable citizens. Among these processes are hypothesis development, observations, sampling and pattern recognition.



Ch. 2-3 Cupcake Soil Profiles

PROCEDURE

Warm-up

Ask students to think of reasons why it would be important to know what kind of layers of soil and rock are beneath their feet. Some ideas may include: digging wells for water, building on solid ground, good soil to grow crops and others.

Ask if anyone knows how people determine what type of soil or rock is underground without digging a pit.

Explain that people take core samples, using a hollow pipe with a hollow drill bit on the end that spins into the earth and removes a tube of soil or rock that can be examined.

The Activity

Explain to the students that geologists often predict what the earth is like below the surface before they drill and take a core sample, and they are going to do that in miniature with a cupcake.

Pass out napkins, straws, and a cupcake to each student. Ask the students to predict what the inside of their cupcake looks like and to draw a picture of their prediction in their science journals

Demonstrate how to sample the cupcake with a straw and explain that this is similar to a core sample of Earth. Insert the straw into the cupcake, remove, and gently squeeze out the sample.

Have the students take one core sample of their cupcake.

Have the students make a hypothesis and draw a picture of what they think the inside of the cupcake looks like based on their one core sample.

Direct the students to take four more core samples in any pattern they choose, recording the pattern as they take the samples.

Have the students draw another picture of what they think the inside of the cupcake looks like based on their five samples.

Discuss how their predictions changed based on their samples.

Have the students cut their cupcake in half and record the actual cross section of their cupcake.

Wrap-up

Have students compare their investigation results with each other. Discuss with the class how well their predictions matched the interior of the cupcakes. Ask students to think of other situations that show the importance of sampling in understanding unknown situations

ASSESSMENT

Collect the students' diagrams of the investigation and have them explain how sampling is essential to scientific investigations.

EXTENSIONS

Take students to an already identified soil pit or road cut where there are exposed soil layers. In their science journals have student draw a picture of the soil profile, identifying each layer with descriptive terms for the color and texture of each layer.

RESOURCES

Information about core sampling:
Plant and Soil Sciences eLibrary
https://passel.unl.edu/pages/

Ch. 2-4 Flathead Climate and Weather

What is the pattern of rainfall and precipitation in the Flathead Watershed?

"Summer is delicious, rain is refreshing, wind braces up, snow is exhilarating; there is no such thing as bad weather, only different kinds of good weather."
- John Ruskin, 1819 -1900
(Flathead Watershed Sourcebook, pg. 28)

SUMMARY

In this activity students will compare precipitation and temperature data at different sites in the Flathead Watershed. Students will hypothesize why the patterns are different and similar. Earth's surface is a patchwork of climates, but the pattern is not random. There is an order to climate zones: students just need a key to unlock this climate puzzle.

OBJECTIVES

The students will:

- Access temperature and precipitation data on the US Climate Data website.
- Students will select daily, monthly or historical yearly data for Flathead Watershed cities such as Kalispell, Polson and West Glacier.
- Students will interpret graphs and data sets.
- Appreciate the differences in weather and climate within the watershed.

MATERIALS

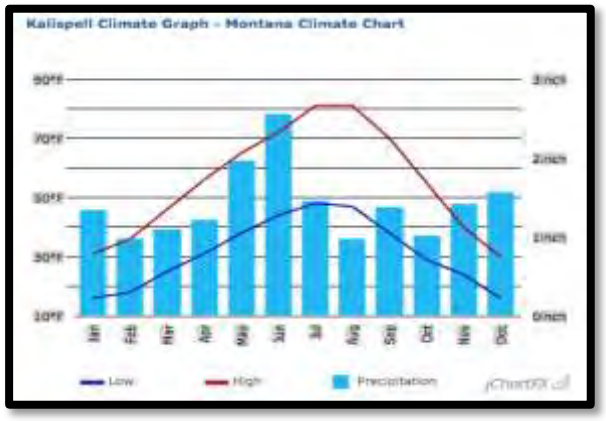
- Computer with internet access
- Graph paper

BACKGROUND

Climate is not the same as weather. Weather is the day to day, even hour to hour condition of Earth's lower atmosphere, but climate is the long-term average of atmospheric conditions at a particular place on Earth's surface.

Certain factors interact to determine the climate of a particular place: latitude, elevation, prevailing winds, ocean currents, landforms, and location relative to water.

The most common measures of climate are temperature and precipitation.



Average temperatures vary greatly with topography throughout the Flathead Watershed, however winter temperatures range from -20°F (-28°C) up to 32°F (0°C). Spring and early summer are partly cloudy and offer rain interspersed with occasional dry, warm days.

Summer temperatures range from the 70°Fs (21°C's) to the high 90F's (30°Cs) with generally clear skies punctuated by afternoon thunderstorms. Occasional periods of even hotter temperatures occur in summer.

In the later part of summer, it is not uncommon to see a 45°F (7°C) transition from a 75°F (24°C) day to a 30°F (-1°C) night. This explains the constant reminders to "dress in layers." Fall brings moderate temperatures and a mixture of both clear and cloudy skies.

Ch. 2-4 Flathead Climate and Weather

Climatic changes often follow elevation changes in the watershed, though not always exactly as expected. Higher elevations are typically colder and valleys are typically warmer. (Flathead Watershed Sourcebook, pgs. 26-29)

A climate graph displays two or more climate variables such as mean temperature and mean precipitation for a given place. The data are generally displayed by month. In this format, a climate graph allows for a quick, generalized assessment of the average climate for a given place.

Climate graphs are an effective tool for displaying the average temperature and average precipitation of a location. By combining a line graph showing temperature fluctuations over the course of a year and 12 bars representing the monthly rainfall, a quick understanding of climate at this location is revealed.

"Climate is what we expect, weather is what we get." - Mark Twain, 1835-1910 (Flathead Watershed Sourcebook, pg. 26)

PROCEDURE

Warm-up

Ask students to describe their own impressions of the pattern of weather and climate in the Flathead Watershed. Ask students to consider if there is a difference in weather or climate between different areas in the watershed.

The Activity

Go to: http://www.usclimatedata.com/climate/mo ntana/united-states/919

In the list of city names shown, click on the name of a city in Montana in the Flathead Watershed; for example Kalispell, Polson and West Glacier.

Copy the climate graph for each city chosen. Describe what the graph indicates about the two variables being shown. Compare data for the chosen cities with a table partner or in small groups.

Wrap-up

On the Flathead Watershed map note the location of each chosen city. Discuss in small groups or as a class:

- What climate characteristics does each city have compared to its location in the watershed?
- How does the cities' weather compare to each other?
- What trends or patterns can be seen in the graph data compared to city locations?
- How might factors such as latitude, elevation, prevailing winds, ocean currents, landforms, and location relative to water help explain these similarities or differences?

ASSESSMENT

Have the students write a short summary of the climate graph for the city closest their home.

EXTENSIONS

Repeat the activity using cities from major world regions. Use a search engine to find images that are representative of each climate type.

Ch. 2-4 Flathead Climate and Weather

Create a Weather and Climate Report, such as would be heard on television or radio, for selected cities in the Flathead Watershed. The report could be written or created using computer graphics, recorded and broadcast using Skype, Facetime, or uploaded as a YouTube video or a Facebook article.

RESOURCES

GeoSpace: Climate Graph:
http://www.geogspace.edu.au/verve/_resources/2.3.2.2_2_climate_graphs.pd

https://eo.ucar.edu/kids/green/what1.htm

Ch. 2-4 Flathead Climate and Weather

Flathead Watershed Map

Ch. 2-5 The Changing Glaciers of the Flathead Watershed

How might glaciers change over time?

SUMMARY

Students will examine photos of glaciers in the Flathead Watershed and Glacier National Park for evidence of change over time. Students will create a flipbook of a glacier they have drawn and show how it might change over time.

OBJECTIVES

Students will

- Recognize that natural features such as glaciers change over time.
- Chronicle potential effects of climate change on imaginary glaciers.
- Observe evidence of changing glaciers through photo documentation.
- Appreciate the legacy of glaciers of Glacier National Park and the Flathead Watershed.

MATERIALS

- 3x5 index cards, white, 8 or so per student, or a small amount of Post-it notes per student, or white paper or construction paper cut into quarters
- Pencils, (optional: colored pencils)

Sites.google.com: N. Siciliano

- Stapler, (binder clips, bulldog clips or rubber bands if using many more cards than 8 per student)
- Photos of glaciers of Glacier National Park, from Flathead Watershed Sourcebook, pg. 33, or from USGS Repeat Photography website http://www.nrmsc.usgs.gov/repeatphoto/repeatphoto_map.htm

From the Repeat Project: Grinnell Glacier, 1940: www.nps.gov

BACKGROUND

The earth's cooler temperatures of the Little Ice Age that ended 12,000 years ago brought massive amounts of snow that warmed and melted during summers, refreezing in winters to create glaciers.

Today, the earth's warmer temperatures are melting those glaciers faster than they are rebuilt by new snow.

From the Repeat Project: Grinnell Glacier, 2006: www.nps.gov

Ch. 2-5 The Changing Glaciers of the Flathead Watershed

In 1850 there were an estimated 150 glaciers on the land that eventually became Glacier National Park. At the time the park was created in 1910, there likely remained over 100 glaciers. Numerous smaller ice fields remained unnamed.

Mountain snowpacks have declined, rain often falls when snow previously occurred, and the spring runoff begins earlier. Early runoffs can contribute to an increased potential for flooding, while decreased snowpack leads to less water available in the dryer months.

As mountain ecosystems are altered by changes in weather patterns and water availability, a decline or loss of vegetation will occur. Changes in vegetation will in turn alter or reduce food sources and cover for a variety of wildlife. (pgs. 32-33, Flathead Watershed Sourcebook)

PROCEDURE

Warm-up

Ask students in the class if they've visited glaciers, in Glacier National Park or elsewhere. If anyone has, ask them to give their impressions about the glaciers they have visited.

Discuss the origins of glaciers and what conditions are needed for glaciers to exist (consistent snowfall, snowmelt equal to or less than snowfall amounts).

Show the class photos of glaciers from Glacier Park over time. Discuss observed changes. Tell students they are going to make a flipbook to show a glacier changing over time.

(A flip book is a collection of combined pictures intended to be flipped quickly to give the illusion of movement. (http://www.flipbook.info/history.php)

The Activity

Have students cut out the pages of their flipbook, but do not combine them together at this time. Students may want to number the pages. Have students decide how their glacier is going to change over time (grow, shrink, change shape, etc.). Have students consider what climatic conditions would be present to create that specific change in their glacier.

On the first page students draw the beginning size and shape of their glacier. On each subsequent page, students draw slight changes to their glacier to illustrate the change over time. On the last page, students draw their final, changed glacier.

Staple, clip or rubber-band the pages together in order. Bend the clipped pages into a c-shape, and run a thumb over the edges of the pages, causing them to flip open rapidly.

Wrap-up

Have students show each other their flipbooks, explaining what is happening to their glacier over time.

www.personal.umich.edu

ASSESSMENT

Have students explain what climate change has occurred to cause their glacier to change as they have drawn it. Did the climate become warmer, cooler, wetter, drier or some other change?

Give the students a climate change scenario and have them predict what would happen to their glacier given that specific climate change.

EXTENSIONS

Using the USGS website: Repeat Photography http://www.nrmsc.usgs.gov/repeatphoto/repeatphoto_map.htm, have students pick a real glacier to illustrate. In their flipbooks, on the first page have students draw the beginning photo of their real glacier, and on the last page draw the later photo. Students then fill in the inside pages by drawing the changes that led to the final drawing.

Ch. 2-5 The Changing Glaciers of the Flathead Watershed

RESOURCES

Glacier Park photos and info
http://glaciers.research.pdx.edu/glaciers-montana#comparison

Video of vanishing glaciers:
https://www.youtube.com/watch?v=6mveHWbGrf0&feature=youtu.be

Painting Vanishing Glaciers article:
http://www.flatheadnewsgroup.com/hungryhorsenews/chasing-ice/article_8a899c94-0a01-11e5-94ea-13d175e1fd28.html

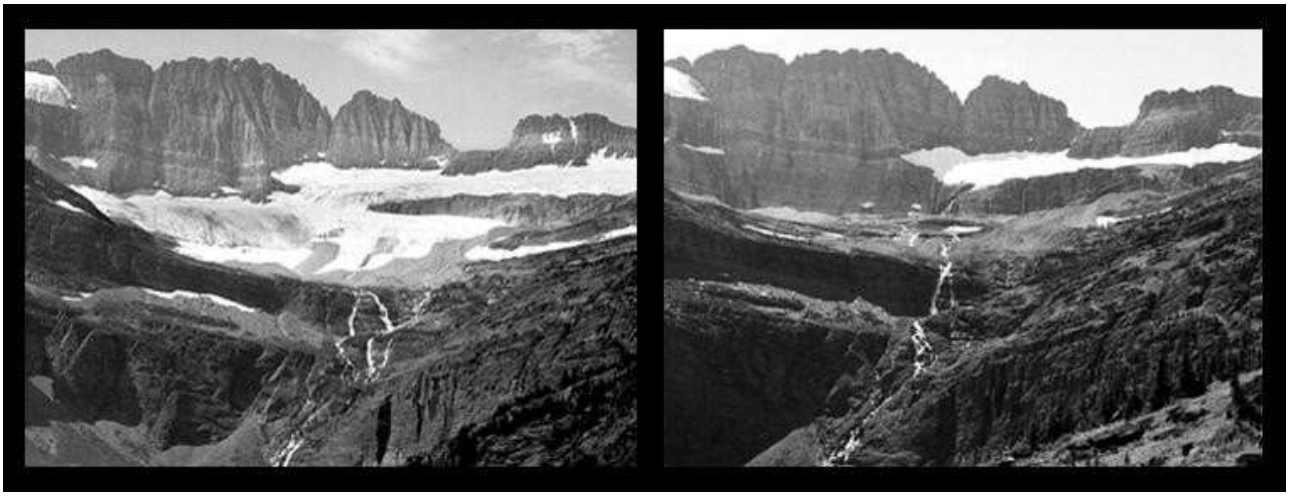
Huffington Post article:
http://www.huffingtonpost.com/zachary-podmore/glacier-national-park-without-glaciers-climate-change-and-wildlife_b_5157223.html

USGS Northern Rocky Mtn. Science Center:
http://www.nrmsc.usgs.gov/research/glacier_research.htm

Repeat Photography Project Website: Glacier National Park
http://www.nrmsc.usgs.gov/repeatphoto/repeatphoto_map.htm

How to make flipbooks:
https://www.youtube.com/watch?v=iExiCGV7jzI

http://www.wikihow.com/Make-a-Flipbook



From the Repeat Project: www.nps.gov

Ch. 2-6 Investigation of Snow Layer Profiles

What is the nature of snow and its structure?

SUMMARY

This is a winter time activity to get students outside and investigating the structure of snow. Students will dig a snow pit and analyze the characteristics of the snow layers.

OBJECTIVES

The students will

- Understand that snow pack is made up of layers with varying consistencies and depth.
- Learn how to construct a snow pit and describe snow layers.
- Appreciate the value of conducting snow profile investigations.

MATERIALS

- meter stick, ruler
- shovel
- plastic card
- hand lens
- thermometer
- field journal or other means to record measurements

BACKGROUND

One of the most important elements of the winter landscape is snow and its properties. In this study we are interested in the thickness and density of snow layers. As snow accumulates in winter it forms layers of different thickness and consistency. The thickness, consistency and depth of the snow are important characteristics for the survival of both plants and animals. It is also important for students to understand that the characteristics of the snow profile are different in varying conditions.

Digging a snow pit is an easy way to examine and measure the layers of snow that make up the snow pack.

SAFETY—it is very easy to get cold and wet during this activity. Dress in warm layers with a water-resistant outer layer. Extra gloves are recommended as each pair gets wet quickly during this activity.

Snowshoes and warm boots will help you and your students negotiate through the snow. Be alert for and keep your distance from wildlife. If snow is very deep, build a wider pit so you can step down into it. When leaning into the pit, have three points of support on the top of the snow.

PROCEDURE

Warm-up

Discuss with the students what they know about snow and its characteristics. Ask the students about the snow outside the classroom, near their home or other places they have been recently (ski hill?).

The Activity

- Find an area of fairly deep snow in a habitat in which you are interested. Look for somewhere that is flat and undisturbed.

Completed snow pit: www.hcn.org

- Carefully dig a pit at least a meter wide down to ground level, being careful not to disturb the snow layers as they lay. Pile the removed snow somewhere to the side where it will not impede your being able to reach down in and to see the various layers. Keep track of supplies throughout the procedure—it's easy for materials to get wet or lost in snow.
- Insert the pointed end of a thermometer into the ground. Wait at least one minute until liquid stops moving. Record ground temperature.
- Insert thermometer sideways into three other layers of snow profile. Measure distance from ground of each insertion point. Record distances and temperatures. Also measure air temperature while standing above the pit.
- On the shaded side of pit, use a shovel to carefully remove a little bit of disturbed snow vertically, leaving a fairly smooth wall to examine.
- Using visual clues and fingers to feel for different textures to identify boundaries between different layers of snow. Mark layers by inserting a popsicle stick between layers at each boundary.
- Measure the width of each layer. Determine the graininess, density, and dryness of the snow in each layer. Record measurements and texture descriptions.
- Record observations about the location of the snow pit and its surroundings.
- Gather up all materials. Check that nothing was lost under the snow. Brush snow off of papers before it melts.
- Fill the pit in before you leave.
- Back indoors, use data and observations to create a diagram of snow profile.

Measuring snow pit layers: realearthsystemscience.blogspot.com

Wrap-up

Have the students post their final snow profiles in the classroom. Ask the students to describe the environmental factors which would lead to different snow profiles.

ASSESSMENT

The assessment for this activity is the snow profile diagram.

EXTENSIONS

Have students create a snow profile for the snow near their house.

RESOURCES

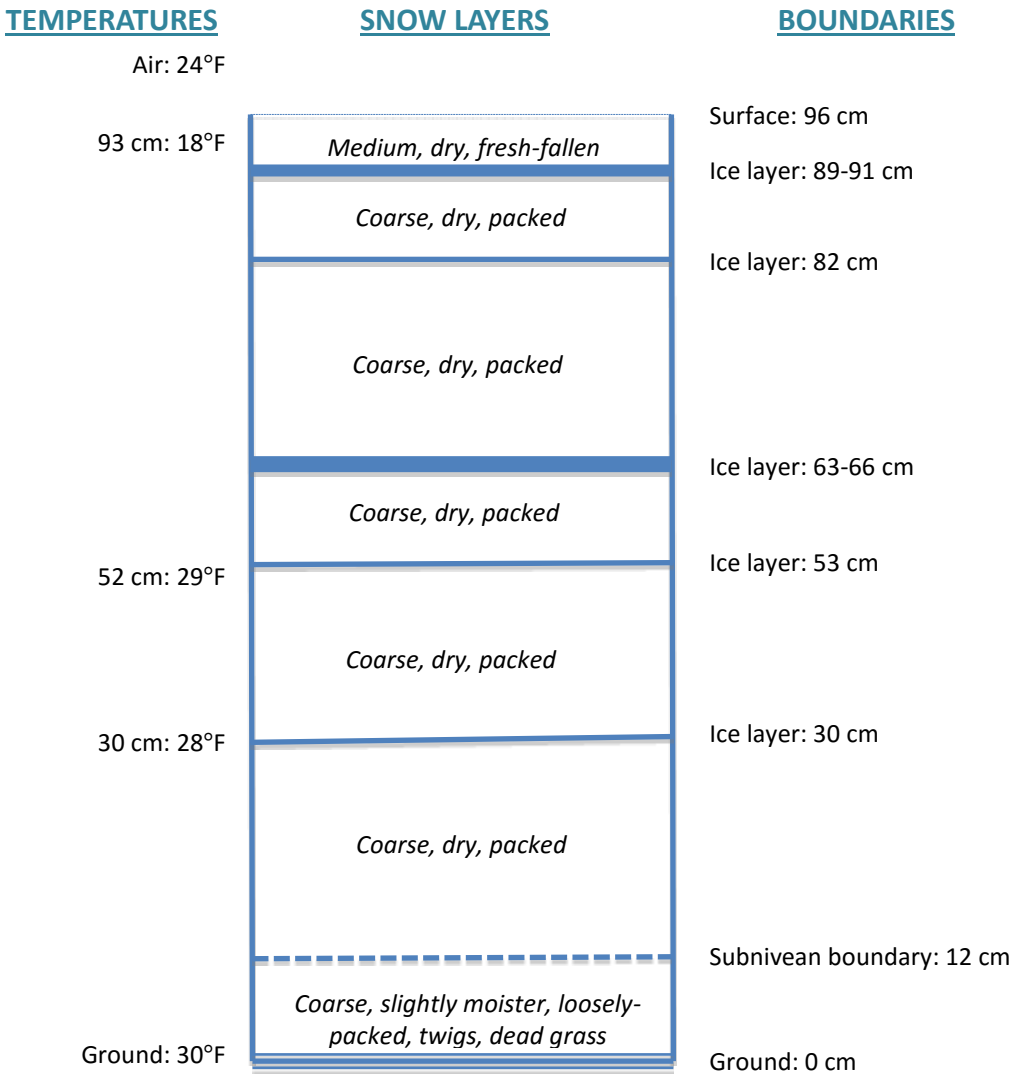
SnowPilot (http://snowpilot.org/)is a FREE software program that allows you to collect snow pit and avalanche occurrence data onto your computer (PC or Mac).

Snow Pit procedures from NASA: https://www.google.com/search?q=snow+pi ts&ie=utf-8&oe=utf-8

How to dig a snow pit – basics: https://www.youtube.com/watch?v=vcXogV HecF

Ch. 2-6 Investigation of Snow Layer Profiles

Example of a Snow Pit Profile:



Ch. 2-7 Water Breathing Classroom Investigations

How do photosynthesis and respiration work together in the natural water ecosystem?

SUMMARY

In this classroom activity students will investigate oxygen production by plants in water in the classroom. Students will observe aquatic plants, look at periphyton (algae) on rocks and in slides and use light/dark bags to observe and measure the effects of photosynthesis and respiration on dissolved oxygen concentrations.

This lesson may be combined with Ch. 2 – 8 to add a field component to this investigation.

OBJECTIVES

Students will

- Describe and draw the relationship between light and oxygen production in aquatic plants.
- Explain the processes of photosynthesis and respiration in aquatic plants.
- Measure levels of dissolved oxygen (DO) in water using scientific equipment.
- Predict changes in DO based on light availability.

MATERIALS

- Computers or tablets capable of accessing Google Drive spreadsheet during the investigations
- Paper or on-line Spreadsheet set up to record observations and data during class investigations (example provided)
- Science notebooks

Air Plants

- Containers for plants and water that can be sealed and can stand alone- such as test tubes with flat lids
- Source of light: sunlight or lamp
- Rulers
- Baking soda dissolved in the container of water (1 tsp. per qt.)
- Aquatic Plants (Elodea) obtained from an aquarium store

Light/Dark Bags

- One or more sets of Light/ Dark Bags made out of Ziploc bags (heavy duty slider type work best). (Set=two bags; one clear bag, one bag covered with duct tape, either silver or black)
- River or Stream rocks collected locally
- Dissolved Oxygen meters or DO measuring kits (see Resources at end of lesson for options)

Rock Scraping and Periphyton Slides

- Microscopes, both stereoptic and optical, if available, along with microscope slides and covers lens and eye droppers
- Magnifying glasses and/or hand lens if no microscopes are available

4th Grade Class: R. Vallor

BACKGROUND (repeated in Lesson Ch.2-8)

Nutrient cycles are systems by which substances (chemical elements or molecules) move through the biotic (living) component of the earth—or the biosphere— as well as the three abiotic (non-living) compartments of the earth: the lithosphere (crust and upper mantle of the earth), the atmosphere (the gasses surrounding the earth), and hydrosphere (the water of the earth).

Through this biogeochemical cycling, nutrients such as oxygen, carbon, nitrogen, phosphorous, and sulfur are used and recycled. Each of these cycles is complex. These brief descriptions and diagrams will provide a general overview of how these systems work and why they are important. (Flathead Watershed Sourcebook, pg. 34)

Aquatic plants can range in structure from simple unicellular algae to complex higher plants composed of many different types of cells adapted to perform different functions.

The two most vital processes that occur in all green plants, whether simple or complex in form, are photosynthesis and respiration.

***Photosynthesis*:**

During photosynthesis, carbon dioxide is absorbed and oxygen released. These gases enter and exit the plant through tiny pores called stomata. Inside the plant cells, principally in the leaves, carbon dioxide and water are combined in the presence of light and the green pigment chlorophyll to produce simple sugars, such as glucose. The process can be simply expressed in the following equation:

$6CO2 + 6H2O$ ----> $C6H12O6 + 6O2$

The formation of simple sugars is quickly followed by other reactions that convert sugar into starch. Oxygen is produced as a by-product.

Photosynthesis is most active in the blue and red portions of the light spectrum. Itis the chlorophyll that absorbs these wavelengths to energize photosynthesis, although only about 3% of the light falling on a leaf is absorbed and used in this way. The intensity of light, the supply of carbon dioxide and the temperature of the surroundings all affect the rate of photosynthesis.

Respiration

Respiration is the reverse of photosynthesis. It is the process by which food substances are broken down in the presence of oxygen to release energy, principally as heat. Carbon dioxide is produced as a by-product.

Respiration takes place in all plant cells and continues irrespective of light. Thus, during darkness - when photosynthesis ceases - respiration accounts for the net absorption of oxygen and the release of carbon dioxide from the plant.

PROCEDURE

<u>Warm-up</u>

Review photosynthesis. Introduce the fact that plants respire, just like animals do, if students are not aware of that aspect of plant metabolism. Point out that plants respire during the times they are not photosynthesizing, when there is no light available. Focus the discussion on the oxygen/carbon dioxide implications of photosynthesis and respiration.

Optional: show this slide show clearly describing photosynthesis and respiration:
Or this YouTube video: cartoon about dissolved oxygen:
https://www.youtube.com/watch?t=114&v=oVW5LAzd7Ec

Ch. 2-7 Water Breathing Classroom Investigations

The Activities

Collected by teacher before doing classroom activities:

Find an area where algae-covered river or stream rocks can be collected, in a local area if possible. These will be used for two investigations. At the collecting site, place algae rocks in the light and dark bags, attempting to have similar amounts of algae-covered rocks in each bag. Submerge the bags in the water and force out as much air as possible, and then seal the bags. Buckets to carry the rock-filled bags are very helpful.

In another container, collect some small algae rocks to bring into the classroom. These will be used to show what's in the light/dark bags, to scrape algae to put in petri dishes to examine under magnification, and to examine the rocks themselves under microscopes.

Measure and record water temperature and DO in the stream or river before leaving the site.

In the classroom:

Bring the light/dark bags into the classroom, along with the container of small algae rocks and all other materials: elodea, test tubes, etc.

Set up three stations: elodea, rock scraping, and microscopes with algae slides if available.

Light/Dark Bags:

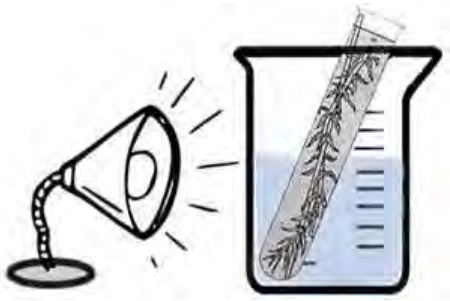
Show everyone the sealed light/dark bags. Discuss the conditions necessary for plants to produce oxygen. As a class, make predictions of how DO measurements will/may be different in the two conditions found in the light/dark bags.

When everyone is clear about what's may happen in the light/dark bags, move the bags to a spot where there is a lot of light, either outside in sunlight or under bright lights indoors.

Station Activities:

Divide the students into three groups. Groups will rotate through the three stations until near the end of the period, at which point the light/dark bags are opened and measured for DO.

Each group will take a computer or paper spreadsheet with them to record observations. Groups can designate a student to be the Recorder for each station.



www.biologycorner.com

Station 1: Elodea in water

- Using jars or test tubes that can be sealed, place measured lengths of strands of Elodea in each container.
- Pour the water with dissolved baking soda into a basin large enough to submerge the Elodea containers.
- Submerge the Elodea-filled containers underwater, fill with water, make sure all the air bubbles escape, and securely seal the containers.
- Stand the containers upright, clear end up, under the light. Attempt to have the light evenly illuminate all the containers.

  If using 4 containers, Elodea strands could be cut to measure 2", 4", 6" and 8".
- Note the time that the plants were put under the light

In the spreadsheet, create a chart to record amount of air generated over time for the Elodea containers.

Each group that comes to the station records the length of time the plants have been under the light and the number and size of the air bubbles that have formed for each of the containers.

Station 2: Rock Scraping – Stereoptic Microscopes, magnifying glasses or hand lens

Scrape very small sections of algae into petri dishes to analyze under a microscope or with a hand lens. Place small algae rocks under microscopes or observe with hand lens. Have the Recorder with each group enter the group's observations into the spreadsheet. Ask students to draw their observations in their science notebooks.

Station 3: Slides of Green Algae – if Optical Microscopes are available

Create slides of the periphyton (algae) from the stream rocks by scraping a tiny amount of algae onto a glass microscope slide and placing a cover lens over it. Show students where to adjust the focus, and how to look into the microscopes. Instruct them not to touch any other settings. Place the slides under each microscope lens. Create new slides as needed. Have students tell the Recorder characteristics of what they are seeing through the lens.

Wrap-up

Bring the light/dark bags to the middle of the classroom and have students gather around. Bring out the DO meter or the DO measuring kit and explain a bit what its function is and how it works.

Light/dark bags: R. Vallor

With a student or teacher Recorder ready to enter data into the spreadsheet, open the bags one at a time, insert the DO probe or take samples to use with DO kits. Record water temperature and DO readings. Enter data into pre-made chart on the spreadsheet. Enter the DO readings and temperature from the stream (obtained when the rocks were collected) if not already entered.

Compare and contrast stream readings and classroom readings for DO. Analyze data, write up and present results.

Discuss observations from the stations. Show data from the Elodea experiment.

Discuss what kinds of living creatures depend on the oxygen levels in the water:

- Fish communities
- Aquatic macroinvertebrate communities
- Plant growth
- Organisms as indicators of ecosystem conditions

Discuss what happens to organisms when DO levels change – either go up or down.

ASSESSMENT

Students can be assessed on their end results such as spreadsheets and graphs. Assessment can also be measured on participation in stations and in discussions. A summative assessment of understanding of the dissolved oxygen nutrient cycle could be a concept map of the students' understanding of the movement of an oxygen molecule through a stream ecosystem.

EXTENSIONS

Students can research what types of organisms they have observed on the rocks and in the microscope slides.

Students can create presentations representing the oxygen cycle in a freshwater stream.

Students can create an ecosystem web of the energy transfer from the sun through the plants and animals of the stream.

RESOURCES

DO monitoring options:

- DO meters – contact conservation groups (such as volunteer water monitoring groups) and natural resource agencies (such as conservation districts) for either the use of a meter or someone to assist with the lesson to run the meter.
- Pet stores often carry DO measuring kits using simple chemical reactions, usually under $25, able to run many tests with one kit.
- DO monitoring kits (Hach, LaMotte) using chemicals, can be borrowed, often available from monitoring agencies such as MT. Watercourse, DEQ or conservation districts.

Other water lessons

http://www.caryinstitute.org/educators/teaching-materials/changing-hudson-project/ecosystems-action-cycling-matter-energy/oxyge-1

http://www.funsci.com/fun3_en/exper1/exper1.htm

Water's the Matter: Measuring Dissolved Oxygen and its effects on water quality. Partnership for environmental education and Rural health, 2000. Web

http://peer.tamu.edu/curriculum_modules/Water_Quality/module_3/activity.htm

Holtzclaw, T. "Dissolved Oxygen and Aquatic Primary Production" Pearson, The Biology Place, Labbench, web, http://www.phschool.com/science/biology_place/labbench/lab12/concepts.html

http://www.aquariumlife.net/articles/aquatic-plants/photosynthesis-respiration-aquatic-plants/152.asp

Using indigo carmine colorimetric test for DO: https://www.youtube.com/watch?v=9Jk0AmmuLSY

http://www.slideshare.net/MMoiraWhitehouse/photosynthesis-teach?next_slideshow=1

Ch. 2-7 Water Breathing Classroom Investigations

Water Breathing Data Worksheet **Dissolved Oxygen (DO) in**

Light and Dark Bags

	Initial Dissolved Oxygen Reading %	Initial mg/l (ppm)	Temp	Final Dissolved Oxygen Reading %	Final mg/l (ppm)	Temp	
Light Bag #1							What do you predict about the amount of dissolved oxygen in the light versus the dark bags? why?
Light Bag # 2							
Dark Bag # 1							
Dark Bag # 2							

After the initial measurement did DO increase or decrease in the light bag?

After the initial measurement did DO increase or decrease in the Dark bag?

What are the algae doing in the light bag that it is not doing in the dark bag?

Elodea in Water Experiment		at 10 minutes		at 20 minutes		at 30 minutes	
	Volume of air in test tube (ml)	Observations	Volume of air in test tube (ml)	Observations	Volume of air in test tube (ml)	Observations	Volume of air in test tube (ml)
Test Tube 1 least elodea 2 inches							
Test Tube 2 4 inches elodea							

Ch. 2-7 Water Breathing Classroom Investigations

Test Tube 3 6 inches of elodea
Test Tube 4 8 inches of elodea

Rock Scrubbing Observations			
	What did you observe? *Periphyton*		What did you observe? *Insects*
Rock			
petri dish			

Observing Slides of Periphyton		
What did you observe?		

Ch. 2. 8 Field Investigations for Water Breathing

How does light affect photosynthesis in water?

SUMMARY

Students will investigate oxygen production in water based on light availability for aquatic organisms. Students will measure terrestrial canopy cover using a transparent grid. Students will place algae-covered rocks in water in light/dark bags and compare dissolved oxygen from photosynthesis in the light backs and respiration in the dark bags.

This lesson may be combined with Lesson Ch. 2-7 to add a classroom component to this investigation.

OBJECTIVES

Students will

- Describe and draw the relationship between light and oxygen production in aquatic plants.
- Measure levels of dissolved oxygen (DO) in water using scientific equipment.
- Predict changes in DO based on light availability.

MATERIALS

- Light and Dark Boxes made out of Ziplocs (Dark bags = heavy Ziploc bags with sliding closures covered completely in grey or black duct tape; Light bags = Ziplocs with no duct tape)
- Dissolved Oxygen (DO) meter, or other method of measuring DO – see Resources at end of lesson for DO monitoring options.
- Canopy Cover grids, 2 per team (10 x 10 cm. grids printed on transparencies, framed with tape or with cardboard if possible.
- Field report worksheet (copy at end of lesson)
- Flagging or small wire flags
- Water-based markers
- Cloth or paper towels to wipe transparencies clean
- Calculators, enough for one per group
- Pencils for field reporting

BACKGROUND (repeated in Lesson Ch.2-7)

Nutrient cycles are systems by which substances (chemical elements or molecules) move through the biotic (living) component of the earth—or the biosphere— as well as the three abiotic (non-living) compartments of the earth: the lithosphere (crust and upper mantle of the earth), the atmosphere (the gasses surrounding the earth), and hydrosphere (the water of the earth).

Through this biogeochemical cycling, nutrients such as oxygen, carbon, nitrogen, phosphorous, and sulfur are used and recycled. Each of these cycles is complex. These brief descriptions and diagrams will provide a general overview of how these systems work and why they are important. (pg. 34, Flathead Watershed Sourcebook)

Aquatic plants can range in structure from simple unicellular algae to complex higher plants composed of many different types of cells adapted to perform different functions.

The two most vital processes that occur in all green plants, whether simple or complex in form, are photosynthesis and respiration.

Photosynthesis:

During photosynthesis, carbon dioxide is absorbed and oxygen released. These gases enter and exit the plant through tiny pores called stomata. Inside the plant cells, principally in the leaves, carbon dioxide and water are combined in the presence of light and the green pigment chlorophyll to produce simple sugars, such as glucose. The process can be simply expressed in the following equation:

$6CO2 + 6H2O$ ----> $C6H12O6 + 6O2$

The formation of simple sugars is quickly followed by other reactions that convert sugar into starch. Oxygen is produced as a by-product.

Photosynthesis is most active in the blue and red portions of the light spectrum. It is the chlorophyll that absorbs these wavelengths to energize photosynthesis, although only about 3% of the light falling on a leaf is absorbed and used in this way. The intensity of light, the supply of carbon dioxide and the temperature of the surroundings all affect the rate of photosynthesis.

Respiration

Respiration is the reverse of photosynthesis. It is the process by which food substances are broken down in the presence of oxygen to release energy, principally as heat. Carbon dioxide is produced as a by-product.

Respiration takes place in all plant cells and continues irrespective of light. Thus, during darkness - when photosynthesis ceases - respiration accounts for the net absorption of oxygen and the release of carbon dioxide from the plant.

PROCEDURE

Warm-up

Review photosynthesis. Introduce the fact that plants respire, just like animals do, if students are not aware of that aspect of plant metabolism. Point out that plants respire during the times they are not photosynthesizing, when there is no light available. Focus the discussion on the oxygen/carbon dioxide implications of photosynthesis and respiration.

Practice measuring the grid sections along a transect arc before starting investigations. See Investigation #2 for directions for using the grids.

Pre-teach concepts of canopy cover and transects.

Review the Field Report worksheet before starting investigations.

The Activities

How does sunlight and shade affect the production of oxygen by the plants present in a particular stream?

How much sunlight is available for the plants to use for photosynthesis?

To answer these questions, students will conduct 3 investigations along a stream reach.

Investigation 1: Light/Dark Bags:
Measurements are made in pairs of light/dark bags placed in different reaches of the creek.

- Have several sets of light/dark bags ready – three would offer the opportunity for diverse data.
- Identify spots along the stream reach near the bank to place the light/dark bags. One set should be in full sunlight and one set in full shade, if possible. A third set can be in partial shade/sunlight. These will be the same sites canopy cover will be measured, if possible.
- Place numbered flags or flagging on the bank at each spot where the bags will be in the water.
- Find a spot in the stream near the bank with algae-covered rocks that will fit in the bags.

Dark bag: R. Vallor

- Fill the bags with rocks, keeping the algae-covered sides facing up.
- Submerge the filled bags in the stream and work all the air out of the bags, sealing them underwater.
- Place the bags in the previously identified spots along the reach. Leave the bags in their spots for as long as possible, at the end of the investigations allow a minimum 30 minutes to measure DO levels in the sets of bags.
- Near the end of the investigation time, measure the DO levels by taking one set of bags out of the stream at a time. Measure the DO with one of the methods mentioned. Record DO levels on the Field Report worksheet.

Investigation 2: Canopy Cover:
Conduct measurements at several points along the identified stream reach. If possible, pick points that are the same places where the light/dark bags are placed.

- Pick stream reaches with a variety of amounts of terrestrial canopy cover. If possible, choose the same points where the light/dark bags are placed if those sites offer a variety of canopy cover.
- Within chosen stream reaches, pick transects across the stream that have differing amounts of tree and shrub limbs and leaves extending into sky near and over the stream.
- Mark the point for the transect from the far bank to the near bank by placing a flag or flagging on both banks across from each other.
- Divide students into teams of 3-4. Each team receives a measuring grid, a Field Report worksheet, a clipboard, a water-based marker, a wiping cloth, a calculator and a pencil.
- Within the teams, decide who will do which job – data collector, recorder, calculator, team manager.
- Have each team measure the canopy cover at their transect point. *See the Team member duties for directions on how to measure the canopy cover.*
- Ask each team to measure at least two transects in their reach, switching roles between transects.

Measuring canopy R. Vallor

Canopy Cover Measure: Duties and Tools for Team Members:

- **Data Collector**: *measuring grid, water- based marker*

Holds the grid up at arm's length to measure sections of the transect from bank to bank. Each section = the width of a grid, or 10 cm. Outlines with marker on the transparent grid wherever there are trees or shrubs blocking the sky. Note where the edge of the grid is along the transect arc, brings the grid down and counts the outlined squares in the grid, tells the recorder the number of squares for that grid section, repeats for the next section of the transect.

- **Recorder:** *clipboard with Field Report worksheet, pencil*

The recorder writes down the number of intersection points that have been covered by canopy for that section of the transect, keeping track of which section of the transect the data belongs to.

Canopy cover measuring grid R. Vallor

- **Calculator:** ***calculator*** (works closely with recorder):

The calculator adds together the canopy cover numbers and the transect section totals, and when the measurement is completed, divides the canopy cover measure by the transect total (divides the small number by the big number) to calculate the percentage of canopy cover for that transect.

- **Team manager:** manages the transect line.

The team manager pays attention to the other members of the team- helps them stay on the transect line, helps keep track of the transect sections, helps decide what grid intersections are covered by canopy, helps count grid intersections if necessary, and is another set of eyes on the data sheet to help catch any errors.

Investigation 3: Stream DO

Measurements: Students will take DO measurements with one of the DO measuring method over a period of time, a couple of hours if possible. Pick a site in the reach of water where the light/dark bags are sitting and where canopy cover is being measured.

Measure DO at the start of investigations and again at the end. Record measurements on the Field Report worksheet.

Wrap-up

Individual Investigations:

Calculations can be done in the field or back in the classroom.

Light/Dark Bags: Create a graph showing the light/dark DO measurements at the different sites.

Canopy Cover: Do the calculations on the Field Report worksheet for the canopy cover. Each team calculates percent canopy cover for each transect, and total canopy cover for their reach.

When all the calculations are complete, draw a diagram of the stream reach being measured and map out the canopy cover along the reach.

Stream DO Measurement:

Record the DO measurements on the Field Worksheet. Comparing DO readings over time gives an indication of the productivity of the stream upstream of the investigation site.

Total Field Investigation:

Discuss the implications of the data that has been collected. Are there trends that can be seen in the data? Are there correlations between the canopy cover measurements and the DO readings in the light/dark bags?

Discuss the implications for the productivity and ecosystem populations of the stream reach under investigation.

Ch. 2. 8 Field Investigations for Water Breathing

ASSESSMENT

Students can be assessed on their field worksheets and graphs. Participation in field work and in discussions can be assessed.

A summative assessment of students' understanding of the dissolved oxygen nutrient cycle could be a concept map of movement of an oxygen molecule through a stream ecosystem.
either the use of a meter or someone to assist with the lesson to run the meter.

Teaching about water breathing R. Vallor

EXTENSIONS

Investigations could be repeated at different streams.

Presentations of investigations could be made with Prezis or iMovies.

RESOURCES

Materials

Pet stores often carry DO measuring kits using simple chemical reactions, usually under $25, able to run many tests with one kit. DO monitoring kits (Hach, LaMotte) using chemicals, can be borrowed and may be available from monitoring agencies such as MT. Watercourse, DEQ or DNRC.

DO monitoring options:
DO meters – contact conservation groups (such as volunteer water monitoring groups) and natural resource agencies to borrow meters.

Lessons and Information

YouTube video: cartoon about dissolved oxygen:
https://www.youtube.com/watch?t=114&v=oVW5LAzd7Ec

Other water lesson resources: Changing Hudson Project:
http://www.caryinstitute.org/educators/teaching-materials/changing-hudson-project/ecosystems-action-cycling-matter-energy/oxyge-1

Holtzclaw, T. "Dissolved Oxygen and Aquatic Primary Production" Pearson, The Biology Place, Labbench, web,
http://www.phschool.com/science/biology_place/labbench/lab12/concepts.html

United States Geological Survey (USGS)
http://water.usgs.gov/edu/dissolvedoxygen.html

Field Report worksheet for Water Breathing Investigation Field Day ____

Location Description: circle one: sunny partly sunny mostly shady very shady

Light/Dark Bag Investigation

Station #_____	Initial DO Reading	Temp.	Final DO Reading	Temp.	Change in DO
Light Bag:					
Dark Bag:					

Canopy Cover Transect #1

Data Collector:		Recorder:
Number Cruncher:		Manager:
# of Grids	# of squares counted	Percent % (# squares/100)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
		Total:
Average:	# of grids Total % =	

Canopy Cover Transect #2 (change roles)

Data Collector:		Recorder:
Number Cruncher:		Manager:
Grid #	# of squares counted	Percent % (# squares/100)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
		Total:
Average:	# of grids Total % =	

Stream DO measurements	Initial:	Final:	Diff:

Ch. 2-9 Travel Brochures to Flathead Watershed's Ecosystems

What are the unique characteristics of various ecosystems in the Flathead Watershed?

SUMMARY

Students will research and write about the characteristics of the different ecosystems found in the Flathead Watershed. The students will present their information in a 'travel brochure' that encourages visitors by presenting the unique characteristics of their chosen ecosystem. Students will visit various ecosystems to explore their unique characteristics in the field.

OBJECTIVES

Students will

- Be able to explain the characteristics
  - of an ecosystem.
- Describe the unique characteristics of
  - specific ecosystems.
- Create a brochure presenting ecosystem information.
- Present their ecosystem to their class.
- Recognize different ecosystems in the field.

MATERIALS

- Journal or notebook to record information
- Ecosystem research information from Flathead Watershed Sourcebook
  - (pgs. 42-47), and other resources (internet, library)
- Computer access with word processing software to create tri-fold brochure, or paper and writing/colored pencils to hand-draw tri-fold brochure

BACKGROUND

What is an ecosystem?

British botanist Roy Clapham (1904 - 1990) created the term ecosystem in 1930 to mean the combined physical and biological components of an environment. In 1935 British scientist Arthur Tansley (1871- 1955)—who initially urged Clapham to coin the term—further refined it to mean "The whole system,…including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment."

russell.kyschools.us

Today we define an ecosystem as a community of living and non-living things that work together as a unit. It includes the cycle of energy flowing from the sun to plants, to animals that eat plants, to predators that eat animals, and returning to the earth through excretion, decay and death. It includes the geology of an area, the type of rocks, components of the soil, and chemistry of the water and atmosphere. And it incorporates the climate, the amount of solar radiation, precipitation, and types of weather patterns.

Central to the ecosystem concept is that living organisms interact with the other elements of their environment. Ecosystems range in size from microscopic to global to cosmic, and each can be part of larger ecosystems, (Flathead Watershed Sourcebook, pg. 37).

PROCEDURE

Warm-up

Discuss with the class the definition of ecosystem given in the background information. Ask students to list as many elements of an ecosystem as they can come up with (animals, plants, weather, climate, rocks, water, slope aspects, elevation, soil types, food chains and webs) along with detailed information about these elements. Ask students to think of specific ecosystems in the Flathead Watershed where they live (grasslands, cottonwood forests, old growth and newer conifer forests, mountain lakes, rivers and streams, riparian areas along waterways, wetlands, alpine areas, and more). Define the characteristics of the different types of ecosystems for students if necessary.

www.flatheadwatershed.org, Lori S. Curtis

Students can think of places they know, possibly from camping, hunting or hiking.

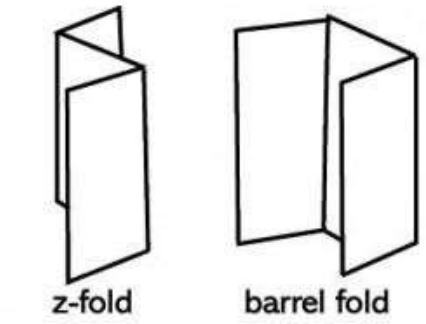
List the various ecosystems for everyone to see. If possible, have students name specific sites or areas that are examples of those types of ecosystems.

Have students form small groups and discuss among themselves the differences among the different ecosystems.

Forest ecosystem, *Source: Todd Berget, Flathead Watershed Sourcebook*

The Activity

Tell students that they are now going to create a tri-fold brochure as an advertisement for their favorite ecosystem. Their goal is to promote the natural beauty and wonder of their ecosystem so that people will learn about it, know why it's so fabulous, and want to visit there.



hubpages.com

Have students select the ecosystem of their choice, encouraging the class to have at least one brochure for each ecosystem.

In order to successfully promote their ecosystem, they first need to know facts about it- such as what plants grow there, what types of weather and climate, what it's like in different seasons, what animals might be seen and heard, elevation and steepness of slope, underlying geology in certain areas, and so on.

Ch. 2-9 Travel Brochures to Flathead Watershed's Ecosystems

Students will need to research their ecosystem to make sure of their information. (for ecosystems discussed in the Flathead Watershed Sourcebook, see list at end of lesson plan and on pgs. 42-47 in the Sourcebook)

Show an example of a tri-fold brochure to the class. Point out that a successful brochure has descriptive writing and compelling photos and graphics, perhaps even a map to the area being promoted. If there is a specific geographic area or site that students have in mind, they can create a brochure specifically about that area. Encourage students to collect photos (with credits) of their ecosystem as they do their research.

Allow students time to research and record their information and photos. Once they have collected enough information, give students time to create their brochures.

Wrap-up

When the brochures are complete, have students promote their ecosystem by presenting their brochure to the class. The class could have an anonymous vote on which ecosystems they would most like to visit.

ASSESSMENT

The brochure can act as a summative assessment of the understandings students have gained about ecosystems in general and certain ecosystems in specific.

EXTENSIONS

A field trip or field trips to visit a range of nearby ecosystems would allow opportunities to experience specific ecosystems to take field notes and photos to create the brochure or to experience the ecosystems after creating the brochures.

RESOURCES

- Ecosystems listed by plant communities in the Flathead Watershed Sourcebook: Grasslands
- Forests:
  - Old growth
  - Low to mid-level montane
  - Sub-alpine
- Wetlands
  - Willow/sedge
- Riparian

- Other ecosystems to consider:
  - Aquatic Systems
    - Lakes
    - Rivers and streams
  - Agricultural lands
  - Prairies

Ch. 2-10 Flathead Lake Living Web Through Time

How are the living and non-living elements in Flathead Lake connected?

SUMMARY

Students will create and present or act out for the class three food chains or webs of the Flathead Lake from early times to today that model the changing Flathead Lake ecosystem web. Students will closely read text and describe the ways the Flathead Lake eco-web has changed over time. Students will discuss the reasoning behind specific actions that have affected the lake ecosystem.

OBJECTIVES

Students will

- Be able to describe the relationship between a food chain and a food web
- Will explore the concept of an ecosystem in general and the Flathead Lake ecosystem in specific.
- Analyze relationships of various species to each other within the Flathead Lake Ecosystem
- Explain how ecosystems can change over time
- Be able to discuss what might happen when new species are introduced in an ecosystem

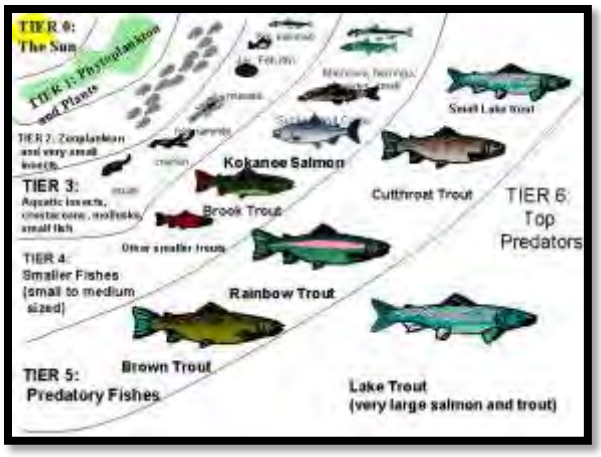
MATERIALS

- Worksheets provided with this lesson
- Text resources: pgs. 39-40, pg. 110, pg. 124, Flathead Watershed Sourcebook; additional text provided in Resources in this lesson
- Paper and colored pencils or markers
- Journals or other method to record information
- Research options – internet, library, Flathead Watershed Sourcebook
- Optional: ball of yarn to cut into pieces

BACKGROUND

A food web can be thought of as a community portrait of an ecosystem. It is a description of what species are present, who eats whom, and the resulting tangle of relationships.

In a lake ecosystem, such as Flathead Lake, feeding relations can be highly complex. Even if a food web has only 10 fish species, the interactions among those fish and all the other organisms that the fish eat (for example, aquatic insects, zooplankton, snails, algae, etc.) can result in a veritable spider web of connectivity. (Pgs. 39-40, pg. 110, pg. 124, Flathead Watershed Sourcebook). (Specific Flathead Lake Food Webs background information found at the end of the lesson in Resources.)



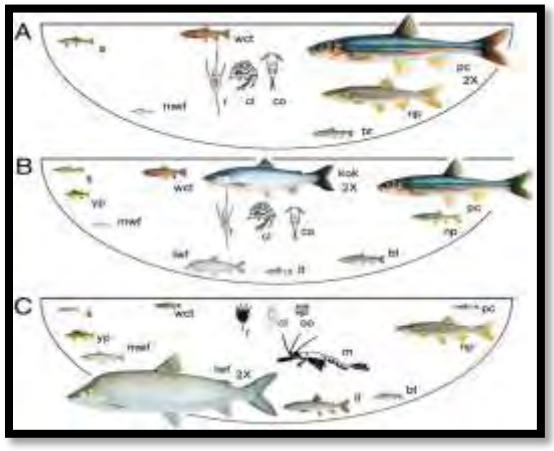
Lake food chain example: www.combat-fishing.com

PROCEDURE

Warm-up

Ask the class to define the difference between a food chain and a food web. (a food chain shows who eats who, going in one direction, while a food web shows the interactions between different species in a multi-directional model). As formative assessments: ask students to think of a food chain that is found in a lake environment; ask students to now think of a food web that is found in a lake environment.

Depending on students' knowledge, introduce the common types of species found in lake environments, such as phytoplankton, zooplankton, fish species that live at different levels, predator and prey fish species and their food sources



The food web of Flathead Lake over time: mtprof.msun.edu

The Activity

Hand out the worksheets of the three historic Flathead Lake ecosystem model illustrations. Have students label the species illustrated by writing out the name of the organism on the line by the abbreviation.

Ecosystem Research:

Divide the class into three groups and assign an historic era to each group. Have students in each group choose one of the organisms to research. (Not all the organisms may be chosen. Key species to include are bull trout, western cutthroat, mysis, kokanee, lake white fish, lake trout, peamouth chub, copepods and cladocerans)

Ask students to answer these questions:

- What does this organism eat?
- Who eats this organism?
- Where does this organism live in the lake?
- How did this organism come to be in the lake?
- During the time your ecosystem model represents, is there a big or small population of your organism in the lake?

Have students draw a full page color drawing of their organism. Have students write their research findings in their journal or on a piece of paper.

Ask each group to create a graphic organizer for their ecosystem model that shows the interrelationships among the species represented in their model.

As a group research project, ask each group to research and record what occurred that caused changes to the ecosystem they represent. Provide information from the Flathead Watershed Sourcebook, and other resources.

When each group has completed their graphic organizer for their time period, and the group has recorded the impacts to their ecosystem, have each person create a name tag for themselves as the organism they have chosen to be.

Presentations:

Ecosystem groups present in chronological order, starting with the ecosystem model from the earliest period.

Wearing their name tag and with their color drawing of their organism, have each group stand in front of the rest of the class and arrange themselves in the pattern of the food web they've created. Optional – students can use yarn to show connections between organisms.

Students take turns to tell their story as the organism in the ecosystem from that time period, explaining their connections to other organisms and stating where they live in the lake.

Ch. 2. 10 Flathead Lake Living Web Through Time

When each group member has taken their turn, have the group explain what changes occurred to their ecosystem and why.

The next-in-age ecosystem group presents their ecosystem information and explains what events occurred to cause change, and then the final group does the same.

Wrap-up

As a class, recap the changes that have taken place in the lake. Point out to the class that the information the last ecosystem group presented represents the conditions of Flathead Lake today.

As a class, look at each species individually and determine each species' change in status from the earliest ecosystem to the current ecosystem.

Ask students if they feel the lake is better off now than it was in earlier ecosystems, and why they think that way.

ASSESSMENT

Ask students to explain what the major mechanisms of change have been for Flathead Lake (introduction of species, human development, agricultural pollution, dam construction, change in flow regimes, etc.).

Ask students to explain why certain actions were taken in the Flathead Lake ecosystem, such as the introduction of kokanee salmon and opossum shrimp or the dam building on the tributaries and main stem rivers.

Ask students to correlate specific actions with the changes observed in ecosystem dynamics.

EXTENSIONS

Have students research the lives and work of prominent fisheries biologists such as Bonnie Ellis who have uncovered and mapped the changes in the Flathead Lake ecosystem over time. See Ellis article for a list of contributing scientists.

RESOURCES

Ellis, B. et. al.; Long-term effects of a trophic cascade in a large lake ecosystem, 1070–1075 | PNAS | January 18, 2011 | vol. 108 | no. 3 http://www.pnas.org/content/108/3/1070.full.pdf?with-ds=yes

Spencer, et. al.; Shrimp Stocking, Salmon Collapse, and Eagle Displacement, http://bioscience.oxfordjournals.org/content/41/1/14.extract

http://fieldguide.mt.gov/displayFamily.aspx?class=Actinopterygii mysis - Mack Days *www.mackdays.com/essentials/Misc/MysisShrimp/index.html*

http://www.flatheadlakers.org/index.php?page=flathead-lake-in-the-news

The **Fishy** Food Web of the Flathead Science Model Lesson. Grade 10. Created by Christine Briske. The **Fishy** Food Web of the Flathead. Approximate Duration: 200 minutes. opi.mt.gov/PDF/.../G10%20**Fishy**%20Food%20Web%20Flathd.pdf

Text Supplement for Flathead Lake Living Web Lesson:

See below:

Ch. 2. 10 Flathead Lake Living Web Through Time

Flathead Lake Food Webs

(Adapted from Ellis, et. al. 2005)

Native Period (Pre-1920). Only 10 fish species are known to have been native to the lake, and most are adfluvial, meaning that they rear in the lake but spawn in tributaries As far as can be determined from the early records (1890–1920), the pristine food web was diatom-based, with the most common crustacean zooplankton being large-bodied copepods such as Epischura, cladocerans of the Daphnia species and the smaller Diacyclops.

The most abundant piscivores were the northern pikeminnow and the bull trout, whereas abundant peamouth and westslope cutthroat trout occupied intermediate trophic levels. Cutthroat trout was predominant in angler catches during this period.

Although 14 species of nonnative fishes were introduced from 1890 to 1920, gill net surveys revealed a native fishery with only the incidental collection of a single nonnative species, largemouth bass.

Kokanee Period (1920–1984). In the 1920s, anglers began to report nonnative fishes, and in 1926–1928 lake whitefish and kokanee were caught in netting.

By 1940 kokanee replaced cutthroat trout as the dominant catch of anglers. Kokanee are landlocked sockeye salmon (the Flathead Lake stock came from the Bonneville, OR hatchery), and they began spawning very successfully in two groundwater upwelling zones on the lake shoreline. In later years as the population grew, Flathead kokanee established other spawning sites, notably the outlet of McDonald Lake in Glacier National Park, and colonized most of the accessible valley bottom lakes upstream of Flathead Lake. Similar to the marine-anadromous life history, juvenile kokanee emerges from the gravel spawning sites and migrate immediately to the lake, where they mature as pelagic planktivores.

Fish species compositions in comparable gill netting data (sunken, shoreline sets) contrasting 1915–1916 with 1951–1956 were similar, although there was a reduction in native peamouth chub and expansion of nonnative lake whitefish and yellow perch over this interval. Pygmy whitefish and kokanee catches near shore do not accurately index population size, owing to the pelagic distribution of kokanee and the deep water distribution of pygmy whitefish; kokanee were abundant in the fall net sets of the 1950s because those sets were made in near shore spawning areas.

Creel surveys from 1962 and 1981 showed that kokanee were the dominant angler catch (77% and 92%). During 1979–1983, the kokanee population (three to four age classes) was estimated at 1.6–2.3 million.

During 1980–1985, high kokanee spawner abundance drew congregations of bald eagles (peak density exceeding 600) that gathered to feed on the spawning run at the McDonald Creek spawning site.

Standardized gill netting was initiated in 1981, and species composition of fishes other than kokanee was then similar to the 1950s catch data, indicating a relatively stable state in the fish assemblage throughout the kokanee period.

Native cutthroat trout remained at low but measurable densities, nonnative lake whitefish continued to expand, and nonnative lake trout remained at low densities.

All crustacean zooplankton species reported in the native period, except one, remained present and abundant in the kokanee period. Phytoplankton again were reported as mainly diatoms, but 1978 autoradiographic analyses showed that the majority of the annual primary productivity (PP) was by nanoplankton of <10 μm (27).

At the conclusion of the kokanee period, the fish assemblage was predominantly pelagic: with kokanee as zooplankton consumers and bull trout as the top predator, with the other fishes mostly littoral, but with expansion in the profundal zone of nonnative lake whitefish and to a lesser degree predatory lake trout.

Ch. 2. 10 Flathead Lake Living Web Through Time

Mysid Explosion Period (1985–1988). The kokanee period ended abruptly in the mid-1980s with the establishment and rapid expansion of the glacial-relict opossum shrimp, Mysis diluviana. Mysis was transferred by fisheries managers from Waterton Lake, Alberta, where M. diluviana is native along with lake trout and other fauna of Canadian Shield lakes, to five lakes upstream of Flathead Lake from 1968 to 1976.

The intention was to promote kokanee populations by increasing forage, an action based on erroneous interpretations of the results of such introductions elsewhere. Mysids reside on the lake bottom during the day and migrate at night to the upper water column, where they feed on large cladoceran zooplankton; whereas kokanee, being visual feeders, consumed cladocerans during daytime.

The kokanee sport fishery collapsed the year after peak mysid abundance, along with the eagle–kokanee spawner relationship at McDonald Creek, and the large-bodied zooplankton (cladoceran and copepod) forage base in Flathead Lake markedly declined. Zooplankton abundance and biomass declined by half during the Mysis expansion period.

Within 2 y of its peak abundance, the Mysis population retreated to less than half of the peak level.

Mysid–Lake Trout Period (1989–Present), **the Mysis Reorganization of the Food Web.** After retreat from the initial explosion, Mysis levels fluctuated about what looks to be a new equilibrium, averaging perhaps one third the initial peak level. Kokanee never recovered, bull trout declined, and lake trout came to be the dominant top predator. Bald eagles dispersed after the collapse of their primary prey, kokanee. After listing as an endangered species in Montana, the number of nesting pairs increased steadily by an average of 14.5% per year from 1980 to 1990, and the wintering population seemed stable or slightly increasing by 1991.

The standardized gill netting before and after mysid expansion clearly showed a remarkable transformation of the Flathead Lake fish.

In surface catches the proportion of natives changed: cutthroat and bull trout were greatly reduced after Mysis, whereas peamouth and northern pikeminnow increased.

In deep water catches, the non-natives expanded dramatically: lake trout increased 19-fold and lake whitefish fivefold, largely at the expense of bull trout.

Pelagic kokanee were not effectively surveyed by shoreline gill netting, but kokanee clearly were very abundant before Mysis and completely disappeared subsequently. Kokanee represented 92% of the angler catch in 1981, but none of the catch by 1992.

The most dramatic change in the littoral fish community after Mysis was the large decline in the abundance of the native peamouth chub in sinking net sets; however, the increase observed in floating net sets suggests that some may have simply shifted to the upper water column.

Cladocerans and adult copepods and copepodites represent a smaller share of the zooplankton community after Mysis.

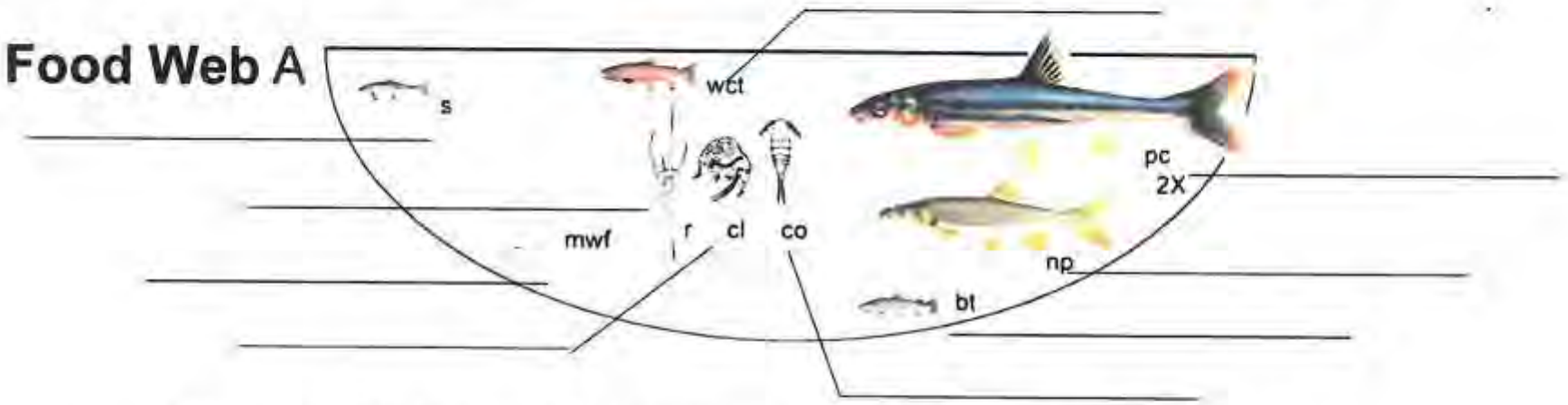
Mysid prey choice trials showed clear selectivity for the large, slow-moving cladocerans over other smaller, faster zooplankton.

In the lake, cladocerans were reduced by 78% overall, and Bosmina longirostris, which dominated cladoceran abundance before Mysis, declined by 92%.

Conversely, Daphnia thorata now dominates cladoceran numbers, increasing in the epilimnion every summer, apparently adapted to warmer temperatures that allow it to avoid predation by the cold-adapted mysids. Daphnia rosea and Scapholeberis kingi disappeared. Copepod adults and copepodites also declined by 65%. The largest copepod, Epischura nevadensis, declined by 95%.

Flathead Lake Living Web

Food Web A: Dominant fish and zooplankton species are shown in the native community: **before 1915–1916**



Directions: write the name of the organism on the line pointing to that organism

wct = westslope cutthroat trout
bt = bull trout
mwf = mountain whitefish
np = northern pikeminnow
pc = peamouth chub
s = longnose and largescale suckers
lt = lake trout

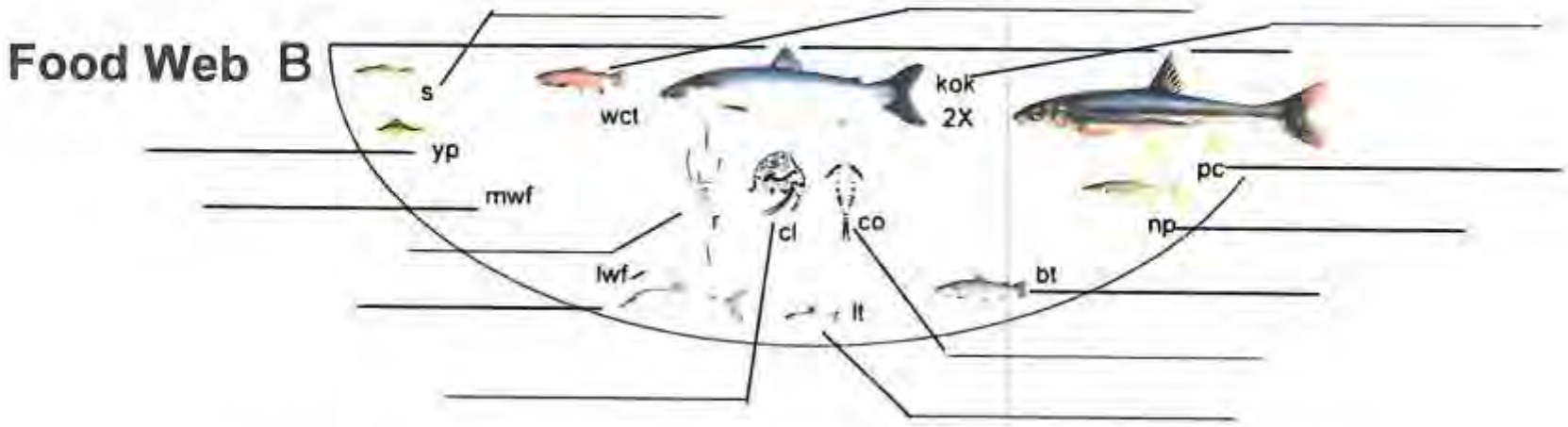
lwf = lake whitefish
kok = kokanee
yp = yellow perch
m = Mysis (opposum shrimp)
r = rotifers
cl = cladocerans
co = copepods

Organisms are not drawn to scale, although size of fish roughly represents abundance during each period, with "2×" denoting species approximately twice as abundant as shown.

Adapted from: Long-term effects of a trophic cascade in a large lake ecosystem, Ellis, B. et. all: Fish illustrations by Joe Tomelleri and zooplankton illustrations by Diane Whited.

Flathead Lake Living Web

Food Web B: Dominant fish and zooplankton species are shown in the native community: 1981-1983



Directions: write the name of the organism on the line pointing to that organism

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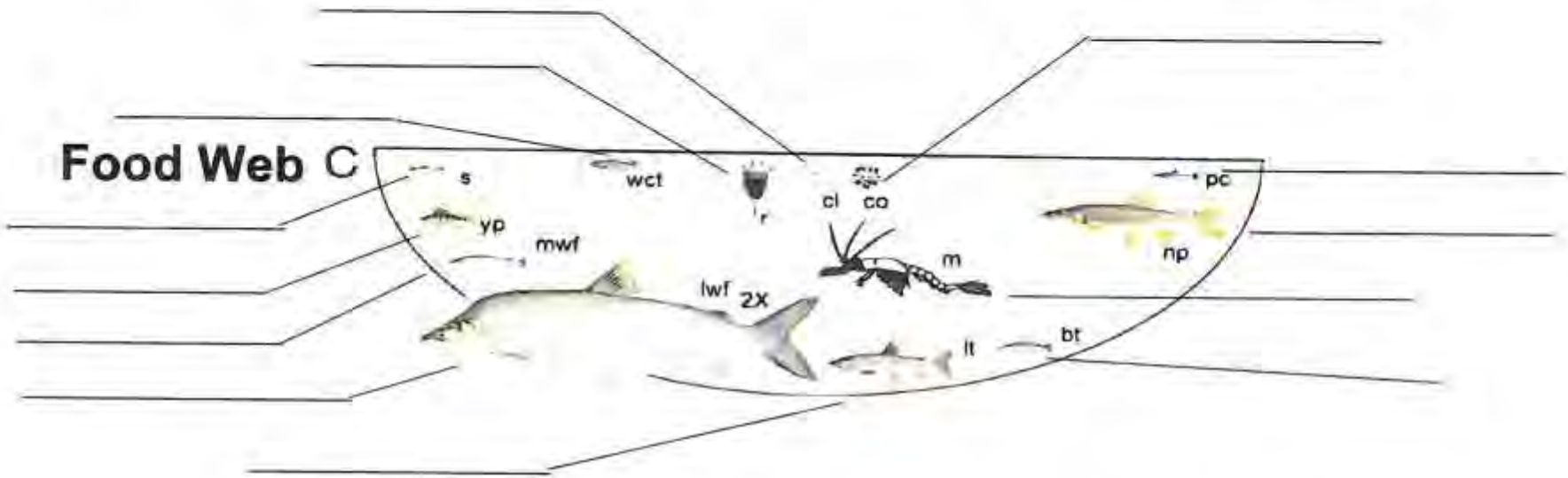
co = copepods

Organisms are not drawn to scale, although size of fish roughly represents abundance during this period, with "2×" denoting species approximately twice as abundant as shown.

Adapted from: Long-term effects of a trophic cascade in a large lake ecosystem, Ellis, B. et. all: Fish illustrations by Joe Tomelleri and zooplankton illustrations by Diane Whited.

Flathead Lake Living Web

Food Web C: Dominant fish and zooplankton species are shown in the native community: **1996-Present Day**



Directions: write the name of the organism on the line pointing to that organism

wct = westslope cutthroat trout
bt = bull trout
mwf = mountain whitefish
np = northern pikeminnow
pc = peamouth chub
lwf = lake whitefish
kok = kokanee
yp = yellow perch
s = longnose and largescale suckers
lt = lake trout
m = Mysis (opposum shrimp)
r = rotifers
cl = cladocerans
co = copepods

Organisms are not drawn to scale, although size of fish roughly represents abundance during this period, with "2×" denoting species approximately twice as abundant as shown.

Adapted from: Long-term effects of a trophic cascade in a large lake ecosystem, Ellis, B. et. all: Fish illustrations by Joe Tomelleri and zooplankton illustrations by Diane Whited.

Ch. 2 11 Fisheries, Fishing and Fish

What are common fish found in the Flathead Watershed and how are they managed?

SUMMARY

In this activity students will investigate a local fish, how to age a fish and how fish in the Flathead Watershed are managed. Students will investigate fish scales as an indicator of age and growth

OBJECTIVES

Students will

- Learn about fish identification, age, and growth.
- Gain some understanding of fisheries management.

MATERIALS

- Fish (can be caught or donated by fishermen and MT Fish and Wildlife)
- Fish scales
- Clear metric ruler
- Microscopes
- Slides and coverslips
- Graph paper

BACKGROUND

Fisheries biology is a scientific discipline that focuses on the study of fisheries. Fisheries are fish populations that are used for commercial value. A fishery is a delicate system. Fisheries biologists study fish habitats and fish populations, learning about the natural conditions that fish live in and then extending their knowledge to determine how a fishery can be used sustainably.

Fisheries management is an attempt to control fish populations for the maximum benefit of people and the species being managed. Benefit can be related to ecological, social or economic well-being. Fishery management can be a contentious and complex subject that has influenced the Flathead Watershed in many ways.

In the Flathead Watershed Sourcebook read the Watershed Perspectives related to fisheries on pgs. 110 and 124. This section contains important information about fisheries management in the Flathead Lake.

According to Clint C. Muhlfeld, Ph.D., "Biologists are working diligently to address the challenges facing the native fish species within the Flathead River and Lake System to maintain and restore critical populations and habitats for future generations to appreciate and enjoy."

Fisheries biologists in the Flathead Watershed are working hard to manage the endangered bull trout populations. You can read more about how they manage fish populations at http://www.flatheadwatershed.org/natural_history/fish.shtml.

In order to manage fish populations, managers must be able to determine the age and growth patterns of fish, as well as the number of fish in a population.

Creston National Fish Hatchery, Kalispell, MT

PROCEDURE

Warm-up

Ask students to tell about their experiences with fish in the Flathead Watershed. Discuss with the class the idea of fisheries management. What does it mean to

'manage' fisheries? This is a good time to visit the Creston National Fish Hatchery in Kalispell (see http://www.fws.gov/mountain-prairie/fisheries/creston.php)(Flathead Watershed Sourcebook, pgs. 128).

The Activity

- Measure the fish's total length and weight and remove multiple scales for analysis.
- Determine fish age by placing a slide of one of the scales under the microscope and counting the annuli. Annuli are growth rings in the scales of fish. Compare several scales from the same fish to gain confidence in the age of the fish.
- Use a clear ruler to measure distances from the scale focus to each of the scale annuli and the scale edge.
- Ask two additional "evaluators", other students in class, to determine the age of your fish and make scale measurements to gain reliability in the age and measurement between annuli.
- Use the fish total length and the scale measurements to back calculate the size of your fish at the formation of each annulus.
- Use the fish weight and the scale measurements to back calculate the weight of your fish at the formation of each annulus.

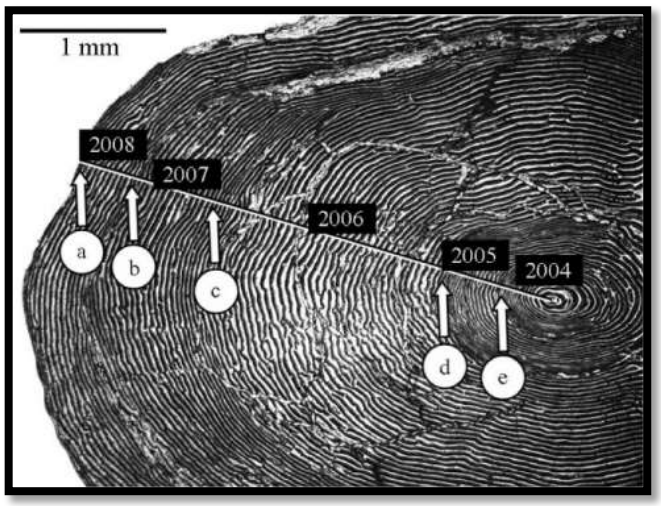
Taking scales for measurements: www.aliexpress.com

Wrap-up

Using data from ALL the fish scales examined by the class create a summary graph (dots connected by lines) for fish length at each age (or annulus). This graph (or figure) should present fish age (or annulus) on the X axis and fish length on the Y axis, with dots representing means and vertical bars indicating standard errors.
Include a descriptive heading identifying the contents of the figure, the species of fish (including scientific name), the total numbers of fish examined (sample size), and location and date of fish collection.

ASSESSMENT

The final graph of age on the y axis and weight and length on the x axis should indicate the growth pattern of the fish.



Magnified fish scale: www.myoutdoorbuddy.com

EXTENSIONS

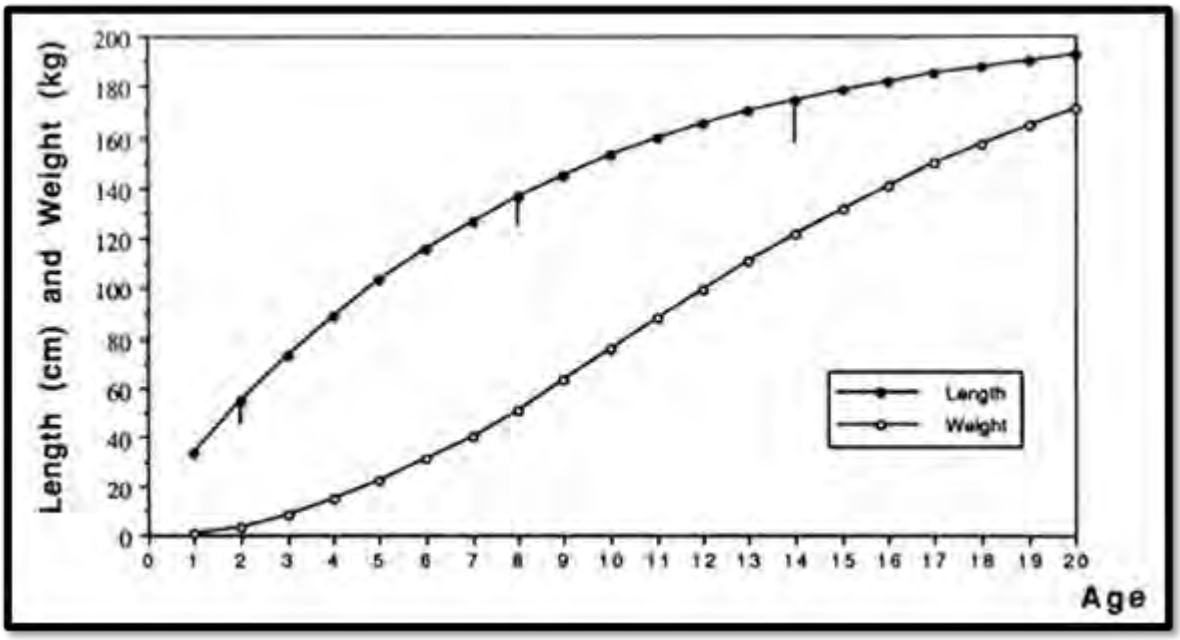
The present day fisheries in the Flathead Lake are being managed by a joint committee composed of members of the Confederated Salish and Kootenai Tribes and Montana Fish, Wildlife and Parks. Read the Flathead Watershed Sourcebook (pgs. 58–59, 60-61, 110, 122) on the conflicting scientific and social factors affecting the Flathead Lake.

RESOURCES

Fish biology and behavior inside FishBio at http://fishbio.com/field-notes/inside-fishbio/reading-scales

Wagner, Eric, The great flathead fish fiasco, High Country News, September 3, 2014. At https://www.hcn.org/issues/46.2/the-great-flathead-fish-fiasco,

Laughlin, Breeana, The edge of extinction, Montana Native News Project 2011 http://nativenews.jour.umt.edu/2011/flathead.html



Example of a growth chart for fish: Example Graph: Growth in length* and weight of southern bluefin tuna, from http://www.fao.org/docrep/005/t1817e/t1817e15.ht

Ch. 2-12 Passing the Trophic Level Energy Torch

How much energy is passed from level to level in an ecosystem?

SUMMARY

Through a learning activity played in a large area indoors or outdoors, students will act out passing energy through different trophic levels to illustrate energy transfer from the sun through organisms in an ecosystem. Students will graph the relationships of the trophic levels involving organisms of the Flathead Watershed and draw conclusions about population numbers and dynamics.

OBJECTIVES

Students will

- Investigate energy transfer between trophic levels.
- Model the survival rates and energy transfer for the different tropic levels in the energy transfer activity.
- Think critically and present conclusions about population numbers and population dynamics.

MATERIALS

- Large (3"x3") post-it notes for name tags, in several different colors if available
- Small craft sticks or straws, enough for 20 sticks per student for half the class. A class of 30 students = 300 sticks, (a large box of craft sticks holds 1000 sticks). *Use a red marker to color the ends of **10%** of the sticks about 1 inch up*. (300 sticks = 30 red sticks)
- List of plants and animals of the Flathead Watershed
- Paper
- Colored pencils (optional)

Ask the students to think of the relationships among the various

BACKGROUND

The processes of living (like hunting, feeding, and mating) are all fueled by energy originally captured by plants in photosynthesis. When respiration takes place, carbon bonds are broken and carbon combines with oxygen to form carbon dioxide. This process releases energy that is either used by an organism or lost as heat.

Energy is then passed from organism to organism up the food chain. Ecological efficiency is the percentage of energy transferred from one trophic level (the position each organism fills in their respective food web) to the next.

On average, 90% of an organism's energy is used for its life processes and only 10% is passed on to its predator in the next trophic level. There are rarely more than 4 or 5 trophic levels in a food web. (Flathead Watershed Sourcebook, pg. 38 – 41)

PROCEDURE

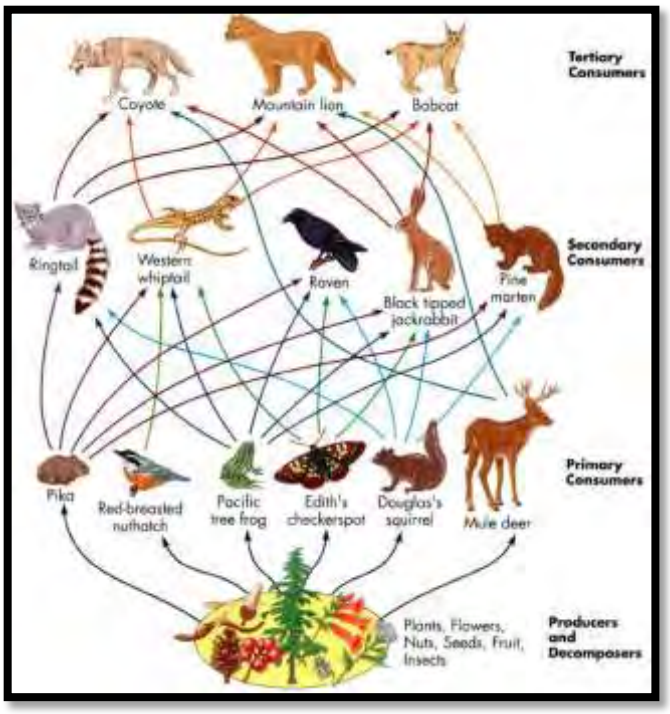
Warm-up

Review the terms herbivore, carnivore, omnivore and decomposers. Review the concept of predator – prey relationships, and/ or introduce the terms producer and consumer. Create a list of species that live in the Flathead Watershed, both plants and animals, indicating which are producers and which are consumers, including what type of consumer the organism is (herbivore, carnivore, etc.).

When there are at least 8 – 10 kinds of species listed in each category, and as many species listed as there are students in class, assign a species to each student or have students chose a species. Write the species name on a post-it note and having the student to wear it for this activity.

species. Have

Ch. 2-12 Passing the Trophic Level Energy Torch



Ecosystem web: education.com

Amount of energy transfer between levels measured by kcal from Schoolworkhelper.net

The Activity

Introduce the concept of energy transfer between organisms. Ask where the energy originates (the sun), and what type of organism uses the sun's energy to create food (producers = plants – through photosynthesis).

Ask how the energy is transferred from plants to other types of organisms (consumers either eat plants or eat animals who eat plants, and decomposers receive energy through breaking down other organisms).

Introduce the trophic level model. The first level is the producers – plants- who make obtain their energy from the sun. The second level is the primary consumers, herbivores or omnivores who obtain their energy from the producers – plants. The third level is the secondary consumers, carnivores that prey on the primary consumers and sometimes on other secondary consumers. A fourth level is tertiary consumers, large-scale predators.

Now the students will play a game that shows how much energy is transferred from one type of organism to another at the producer/primary consumer/secondary consumer levels.

To play:

- Pick a large indoor or outdoor area, relatively free of obstacles. As the teacher, you will act as the sun. The teacher can act as the recorder, or assign a student to the role. The craft sticks are energy packets, worth 10 points each.
- Choose the first half of the class to be plants, or producers. Label the students with a specific color post-it note, or a post-it note with a specific plant species name (willow, dogwood, strawberry, etc.).
- Announce that you are the sun, you are shining on the plants and they are producing energy. Hand each producer student 20 craft sticks, evenly distributing the 30 red-colored sticks among the producers. Let everyone know that each stick is worth 10 points. Producer students should hold the sticks upright in their fists, covering the red ends. Have producer students spread out in the area, but once they find a spot they cannot move (they're plants!).

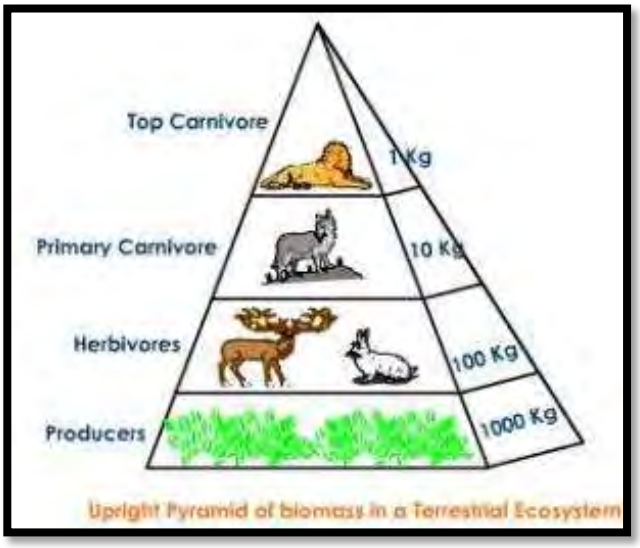
- With the second half of the students, choose two/thirds to be primary consumers - herbivores or omnivores. Label them with the animal of their choice, or your choice, with a post-it note with the animal name or a specific color.

Example of a circle game: www.sixsistersstuff.com

- On the count of 3, the herbivores walk to a producer and take a stick from their fist. They may take only one stick per producer, and must keep the stick they choose. They need to collect 3 sticks in total.
- When all the primary consumers have 3 sticks each, have everyone stand still where they are. Ask the producers to show everyone how many sticks they have left in their fists (there should be quite a lot of sticks left).
- Have the primary consumers hold up their sticks for everyone to see. Tell the class that only these many sticks – this much energy – has transferred from the producers to the primary consumers.
- Now have the primary consumers look to see if they collected red-colored sticks. Only those primary consumers with red sticks have survived this round. This represents the fact that these consumers have acquired enough energy to survive and reproduce. The consumers without red sticks did not survive due to various factors such a hunger, predation, exposure to weather, disease, etc.
- The remaining students (one/third of the second half), are secondary consumers – carnivores. Label them with the animal of their choice, or your choice, with a post-it note with animal name, or use a specific color for them.
- At the count of 3, they will chase down a surviving primary consumer to tag them and collect a stick. They need to collect one stick within 10 seconds. Secondary consumers first tag a surviving primary consumer, causing them to freeze, and then choose a stick from their fist. Primary consumers must allow secondary consumers to choose a stick when tagged. Both primary and surviving secondary consumers can only walk, not run.
- Producers and non-surviving primary consumers continue to stand in their places, neither helping nor getting in the way of the consumers.
- When 10 seconds are up, stop the action. Have the primary consumers hold up their remaining sticks. Let everyone know that this is the energy that did not transfer to the next level (surviving primary consumers should still be holding most of their sticks).
- Have the secondary consumers hold up their sticks. This is the energy that transferred. Note who is holding red sticks. These are the secondary consumers that survived (this may only be one or two students).
  While all the students are still holding on to their sticks, count and record on a piece of paper the distribution of sticks among the producers, the primary consumers and the secondary consumers. Also count how many red sticks were passed on at each level and how many survived at each level.

- Discuss the concept of trophic levels,

that energy passes through an ecosystem in proportion to the roles of the different organisms that are present in that ecosystem.



Trophic energy pyramid: classtalkers.com

- Remembering that each stick is worth 10 points of energy, calculate the amounts of energy that stayed at each level and was passed on to the next level.
- Repeat the activity several more times, if desired. Repeating the activity enables students to take on different roles and creates more sets of data to compare. Data can then be averaged between the two sets.

Wrap-up

Discuss with the class what happened to population numbers in the activity. Discuss the proportion of producers to primary consumers to secondary consumers. List the factors that may have caused the mortality of the animals that did not survive the game.

Ask students to think of what factors in animals' lives help lead to larger populations of producers than primary consumers and smaller populations of

ASSESSMENT

In the classroom or on paper, have students create a model of the outcome of the activity, either on paper or some other medium (word document, on-line graphic software, blocks or boxes).

EXTENSIONS

Students can graph the amount of energy that is transferred from level to level in the lesson activity.

RESOURCES

http://www.flatheadwatershed.org/natural_history/flow.shtml

http://www.juliantrubin.com/encyclopedia/ecology/food_chain.html

http://eschooltoday.com/ecosystems/ecosystem-trophic-levels.html

http://questgarden.com/81/69/4/090428165619/process.htm

http://ftwkennyapes.weebly.com/apes-food-for-thought-trophic-level-activity.html

*teachers.greenville.k12.sc.us/.../Building%20an%20Energy%20**Pyramid**.*
*departments.jordandistrict.org/curriculum/.../Starburstenergy**pyramid**.do...*

Ch. 2-13 Animal Stories of the Flathead

What can you learn about an animal when you tell their "story"?

SUMMARY

Students will do research, write stories, and perform "the story," a form of autobiography, of different iconic animals of the Flathead Watershed. The animals chosen will be unique and important to the watershed ecosystem, such as grizzly bears, wolves, bull trout, and loons. Stories will include information about the animals' historic and current importance to humans and other species in the watershed.

Missoulian.com

OBJECTIVES

Students will

- Research information about their animals' historic and current importance.
- Write an autobiography, "the story" of their animal using the 'first person' perspective.
- Perform their "story" for the class audience.
- Understand the importance of their animal to the Flathead Watershed.

MATERIALS

- List of animals native to the Flathead Watershed, from the Flathead Watershed Sourcebook (see list at end of activity)
- Research information from the Flathead Watershed Sourcebook (pgs. 51 - 73) and other sources
- Journal or other method to record information and write down stories
- Materials to create props and costume elements (optional)

BACKGROUND

The Flathead Watershed is rich in terrestrial and aquatic wildlife habitat. Our forests, meadows, lakes, rivers, streams, wetlands, and riparian corridors are home to a diverse community of large carnivores, ungulates (hoofed animals), small mammals, amphibians, reptiles, birds, fish, and aquatic and land insects.

Citizens and visitors marvel at the endless prairie panoramas, towering mountains, extensive waterways, and the wildlife that inhabit them. Grizzly and black bears thrive in dense forests filled with huckleberries. Deer and elk forage on plentiful grasses and shrubs. Birds of prey dive into the rich undergrowth for small mammals. Fish spawn in clear, cold rivers and streams that meander through miles of mountains, meadows, and fields of over 1,000 wildflower species.

The Flathead Watershed is one of the largest, most biologically intact ecosystems in North America with over 400 terrestrial wildlife species, including 11 amphibians, 11 reptiles, 319 birds, and 71 mammals. Forty-six species of fish (including 23 natives) also make the Flathead Watershed their home, (Flathead Watershed Sourcebook, pg. 42 and pgs. 51-73).

www.montanaoutdoors.com

PROCEDURE

Warm-up

Ask students to imagine telling their autobiography, their personal "story" to someone else. Ask them to imagine themselves describing their role in their own lives, what words they would use to describe themselves, how they would tell about what they do with their time. Ask students to imagine what they might wear or what prop they would use that would indicate something about themselves to others. Have them turn to their neighbor and briefly tell a bit of their "story" about themselves.

Now ask students to imagine themselves as an animal that is important to the Flathead Watershed where they live.

Tell students that they will be 'telling their story' as if they are that animal.

The Activity

Tell students that they are now going to 'tell their story' as though they are one of the animals that live in the Flathead Watershed.

A great activity to encourage students to think about themselves as an animal and to consider different aspects of their life as an animal is to play the game 'Who Am I?'

To play 'Who Am I?' the teacher posts the name of one of the Flathead Watershed animals on the back of a student so that the rest of the class can see the animal but not the student wearing the name. The student wearing the animal can only ask *yes or no questions* until they can guess who they are. Play until a certain amount of time (3-4 minutes) or number of questions (5-8 questions) has gone by. Repeat with other students until all have had a turn or time runs out. This activity could be done quietly in small groups.

To start the writing activity, give students the option of choosing an animal from the list provided or of being the animal from the 'Who Am I?' game.

Ask the students to think of what information they need to find and record so they can tell others about themselves as that animal. The information might include where they live, what they eat, how long they live, how often they have babies and how many babies they have, what they like to do with their time, what kind of family life they live, and more. Anecdotes and interesting facts are great to include.

Students should also include in their stories their role in their relationships to other animals and their interactions with human beings. Students should speak about their importance to other animals in their ecosystem and their importance to humans through time, along with what impacts human beings have on their lives as animals.

Provide time for students to research their animal and write their story. Stories can be a couple of paragraphs to a page in length. Have students think about what types of props or costumes they might want to have or wear when they tell their story to the rest of the class.

Wrap-up

When all students are finished with their story and any props or costumes have been found or created, have each student stand and tell their story to the rest of the class. Students can act out elements of their story, and can include other students if desired.

Alternatively, students can present their information as a 'guessing game', where the class attempts to guess what animal the student has become as the student tells their story.

ASSESSMENT

The animal story is an excellent summative performance assessment. Formative assessments would be class participation in discussions and in the 'Who Am I?' activity.

EXTENSIONS

When students have completed their animal stories, have the class create a food web in their animal personas.

To create the web, arrange the students in a circle. With a large ball of yarn, hand the yarn to any one of the students in the circle. Have that student hold on to the end of the yarn, and toss the ball of yarn to one of the students/animals that have a connection to them- as predator, prey, or helping out in the environment (creates habitat or other connection).

That next student then repeats the action by tossing the ball to another student and describing the connection. The action continues until all the students are connected in the yarn web and all the connections have been described.

www.indianz.com

RESOURCES

Flathead Watershed Native Animals:

- **Mammals:** Grizzly bears, black bears, grey wolves
- **Ungulates:** bison, moose, elk, woodland caribou, white-tailed deer, mule deer, mountain goat, bighorn sheep
- **Fish:** bull trout, westslope cutthroat trout **Birds**: Canada geese, dippers, harlequin ducks, tundra swans, loons
- **Amphibians and Reptiles:** western toad, rocky mountain tailed frog (Flathead Watershed Sourcebook, pgs. 51 - 69)

Other important native animals, from Species of Concern list in the Flathead Watershed Sourcebook (pgs. 70-73):

Canadian lynx, wolverine, northern bog lemming, Townsend's big-eared bat, fisher, northern alligator lizard, northern leopard frog, white-tailed ptarmigan, pinyon jay, pileated woodpecker, veery, and Columbia River redband trout

Ch. 2-14 Quotes from Natural History Perspectives

What do people say the natural world of a watershed?

SUMMARY

In this lesson students will be given quotes that relate to the natural history of watersheds in general and the Flathead Watershed in particular. The students will "close read" their quote and then create a small poster that describes the quote, its main idea, and how it relates to their experience of living in the Flathead Watershed.

OBJECTIVES

The students will

- Analyze a natural history watershed quote for full comprehension.
- Investigate the different meaning of a watershed quote.
- Explain the meaning of the watershed quote.
- Compare different watershed quotes
- Relate the quotes to their personal experience.

MATERIALS

- Large pieces of paper for groups to work on and then present the results
- Watershed quotes at the end of this lesson
- Science or class journals

BACKGROUND

Close reading means reading to uncover layers of meaning that lead to deeper comprehension. Close, analytic reading stresses engaging with a text of directly and examining the author's meaning thoroughly and methodically. Students read and reread to increase familiarity with the text and to reveal patterns within the writing.

Directing student attention to specific passages and wording in the text, analyzing it in fine detail as well as from a bigger picture viewpoint enables students to understand the central ideas and supporting details. It also enables students to reflect on the meanings of individual words and sentences, the order in which sentences unfold, and the development of ideas. This leads students to arrive at a deeper understanding of the text as a whole.

Flathead River: www.flatheadlakers.org

In this lesson students focus on the natural history of the Flathead Watershed and its meaning to diverse people. See: Flathead Watershed Sourcebook, Ch. 2, Natural History, pgs. 17-73.

PROCEDURE

Warm-up

Have the whole class suggest words that they think relate to the physical and biological aspects of the Flathead Watershed. List these words where they can be seen by whole class. Together look for similarities between ideas such as snow, rain and fish, and suggest larger concepts which link the words such as precipitation or climate. This

helps organize student thinking. Have students record the words and concepts in their journals.

The Activity

Part 1

Have the students work in groups of 2 or 3 students. Give each group a copy of the watershed quotes from this lesson or from another source (books, internet or other media). Ask students to write the quote in their journals. Have students paste the quote in the middle of the large piece of paper. Quotes from the Flathead Watershed Sourcebook are provided with this lesson.

As the students read the quote have them make notes in their journals under these headings:

- In one sentence, what is this text about?
- What are the main arguments?
- How does this quote relate to other things I've experienced in the Flathead Watershed?

Flathead Lake: www.flatheadlakers.org

Part 2

Have the students illustrate their quote on the big piece of paper and restate the main ideas in their own words. Write in big text on the paper class words recorded earlier that relate to the quote and to Flathead Watershed.

Wrap-up

Compare the posters and the words students found in the text to the initial ideas suggested in the warm-up section of the activity. Are there similar words and meanings? Are there unique words and meanings?

ASSESSMENT

Have the students present their quote and their poster to the class.

EXTENSIONS

- **In the classroom**

Have the students do some background investigations about the speakers of the quotes. Have the students search for other quotes about watersheds.

- **Outside the classroom**

Have the students ask a family member, acquaintance or friend what they think about the watershed and collect a new set of watershed quotes.

RESOURCES:

Common Core Standards and close reading: https://www.learninga-z.com/commoncore/close-reading.html

Environmental Quotes from the Grinning Planet: http://www.grinningplanet.com/6001/environmental-quotes.htm

Water Quotes http://www.texasthestateofwater.org/screening/html/water_quotes.htm

Natural History Quotes

"The finest workers in stone are not copper or steel tools, but the gentle touches of air and water at their leisure with a liberal allowance of time." - Henry David Thoreau

"Rocks are records of events that took place at the time they formed. They are books. They have a different vocabulary, a different alphabet, but you learn how to read them." - John McPhee

"Each soil has had its own history. Like a river, a mountain, a forest, or any natural thing, its present condition is due to the influences of many things and events of the past." Charles Kellogg, The Soils That Support Us, 1956

"Climate is what we expect, weather is what we get." - Mark Twain, 1835-1910

"Summer is delicious, rain is refreshing, wind braces up, snow is exhilarating; there is no such thing as bad weather, only different kinds of good weather." - John Ruskin, 1819 -1900

"Live in the sunshine, swim the sea, drink the wild air…" - Ralph Waldo Emerson, 1803-1882

It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change." - Charles Darwin

"I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer. And perhaps with better cause, for while a buck pulled down by wolves can be replaced in two or three years, a range pulled down by too many deer may fail of replacement in as many decades." - Aldo Leopold

"No human being, however great, or powerful, was ever so free as a fish" - John Ruskin, 1819 -1900

Ch. 2-14 Quotes from Natural History Perspectives

"Those little nimble musicians of the air, that warble forth their curious ditties, with which nature hath furnished them to the shame of art."
- Isaak Walton, 1593-1683

"The plow is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly plowed, and still continues to be thus plowed by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures." - Charles Darwin, The Formation of Vegetable Mould Through the Action of Worms, 1837

"The ant finds kingdoms in a foot of ground."
- Stephen Vincent Benét, John Brown's Body, 1928

"Civilization exists by geological consent, subject to change without notice." - Will Durant

Chapter 3: Cultural History

Background

"Our stories teach us that we must always work for a time when there will be no evil, no racial prejudice, no pollution, when once again everything will be clean and beautiful for the eye to behold—a time when spiritual, physical, mental, and social values are inter-connected to form a complete circle." – Salish and Pend d'Oreille Culture Committee

Introduction

This chapter in the *Sourcebook* includes a brief history of the people in the Flathead Watershed including Ktunaxa/Kootenai, Pend d'Oreille and Salish people, and concludes with European Exploration and growth. Current descriptions of the Flathead and Lake Counties are also found in chapter 2 of the Sourcebook.

Chapter 2 lessons in the Guide have a social and cultural perspective including a lesson on place names in the Flathead Watershed. Historical events are organized using native tree rings in lesson 3-2. Current activities oriented towards stewardship are the focus of lesson 3-3. In this section of the Guide there is a conscious effort to respect all the people who live in the Flathead Watershed. Lessons are directed towards how people have interacted with the watershed over time.

Essential Questions

- What are the various place names of features within the Flathead Watershed?
- What activities have occurred in the watershed over time?
- What are people doing in the watershed to promote stewardship of the watershed resources?
- What attitudes and values have people communicated about the watershed?

Content

This an important chapter in both the sourcebook and the Guide. The Flathead watershed has a long history of human habitation and subsequent human-ecological interactions. There a number of good resources in the Sourcebook that can be used to supplement the lessons. For example, there is a great map of the Flathead Watershed with Native American place names, and a map of the Lewis and Clark expedition. The lesson on place names in the Flathead Watershed (3-1) is an effective way to learn the history and culture of the watershed. Lesson 3-2, tree ring histories is a fun way of integrating the ecological conditions related to tree growth with cultural events.

There are numerous ways to incorporate stories of current stewardship efforts in the Flathead Watershed. Finally, historical quotes emphasize people's attitudes, values and beliefs related to the watershed

Learning Goals

In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
  - Native language related to the Flathead Watershed
  - Historical events in the watershed
  - Stewardship activities

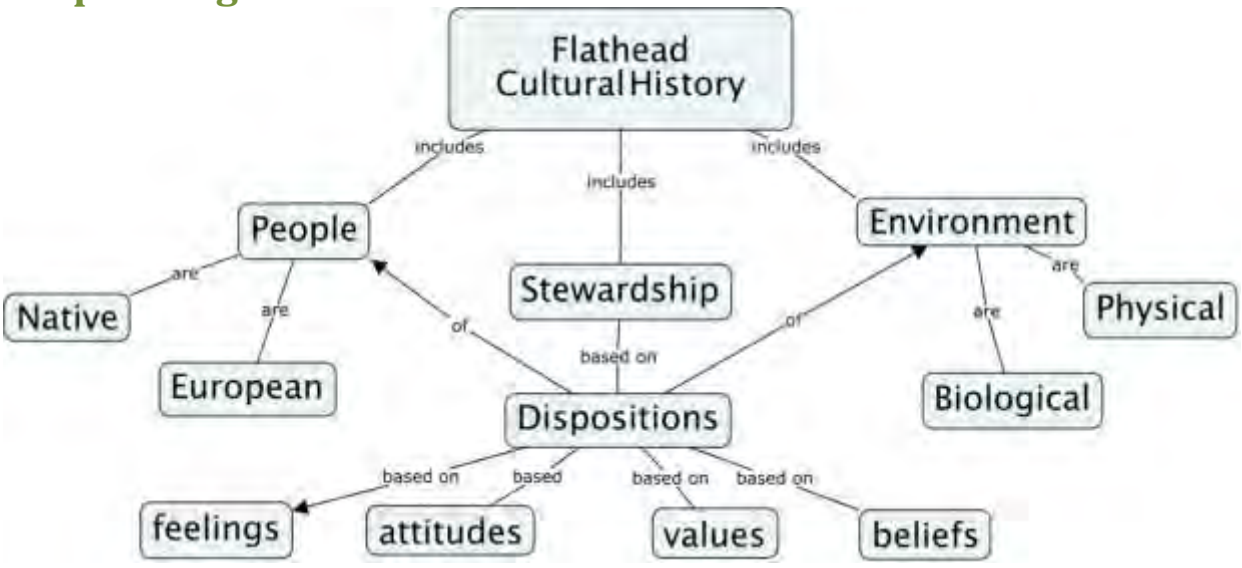
- Skills
  - Mapping landmarks, towns and natural features
  - Graph tree growth dynamics
  - Analyze watershed quotes

- Dispositions
  - Explain feelings, attitudes, values and beliefs associated with the watershed
  - Appreciate the changes in human habitation over time

Key Concepts

Community-based
Dispositions
European settlement
Growth dynamics
Indigenous
Language family
Native
Place names
Salish/Kootenai
Sense of place
Stewardship
Tree rings

Graphic Organizer



Chapter Three Lessons 137

Ch. 3-1 Native Place Names in the Flathead Watershed

What are the different cultural names of shared places?

SUMMARY

Students will map out and label landmarks, towns, and natural features using names given to those sites historically and in current usage by native cultures.

OBJECTIVES

Students will

- Map landmarks, towns and natural features on a Flathead Watershed map.
- Recognize names for features as used by various people, including Salish and Kootenai cultures.
- Appreciate how the same places can take on different names.
- Recognize that place names can have personal and cultural meanings.

MATERIALS

- Flathead Watershed Outline Map
- Pencils
- Salish and Kootenai Place Names information (Flathead Watershed Sourcebook, pgs. 76, 80, Google Earth Salish Place Name overlay)
- Internet access

BACKGROUND

Place names of sites within the Flathead Watershed are derived from many sources. Learning the origins of the place names in a watershed is a powerful way to learn the history and culture of the watershed. Native place names are important resources to learn about events and people of cultural significance to the tribes of the Flathead Watershed.

PROCEDURE

Warm-up

Ask students to think of different ways a site acquires a place name. List on the board the answers that come up (important events, commemorating famous or important people, personal significance to names, geographic features, other). Ask students to think of some examples in the area where they live, and to identify why or for whom that site was named.

Explain that knowing the reasons behind place names can tell the story of the history of that site. Explain that now students will learn about the history of the native tribes of the Flathead Watershed, the Salish, Pend Oreille, and Kootenai, from their place names and place name stories.

Ktunaxa traditional territory map.
Source: Ktunaxa Nation

Ch. 3-1 Native Place Names in the Flathead Watershed

The Activity

Hand out copies of the Flathead Watershed Outline Map. Students can work in groups of two or three for this activity, if desired.

Project on the wall the maps of the Salish Aboriginal Territory, pg. 80, and the Kootenai Territory, pg. 76, from the Flathead Watershed Sourcebook.

Have students pull up Google Earth with the Salish Place Names overlay, available on the Internet.

Have students find the sites from the three map sources on the Flathead Watershed Outline Map.

Have students label the Outline Map with the place names indicated in the map sources, using English and Native languages if possible.

Ask students to listen to the Elders' stories on the Google Earth resource.

Have students write up their story of their place name and share it with the class.

Wrap-up

Now give students an opportunity to label a place on the map that has importance for them. They can choose the name and location, and a symbol to represent the reason for the name, if desired.

ASSESSMENT

The finished map is a summative assessment, along with the short story of each student's personal place name.

EXTENSIONS

Read the brief description of the Buffalo Cow Trail on pg. 78 of the Flathead Watershed Sourcebook. Have students draw in the trail on their Outline Maps.

RESOURCES

Google Earth Salish Place Names mapping project with interactive Salish Commentary

Salish Language Curriculum https://sites.google.com/site/salishlanguage/

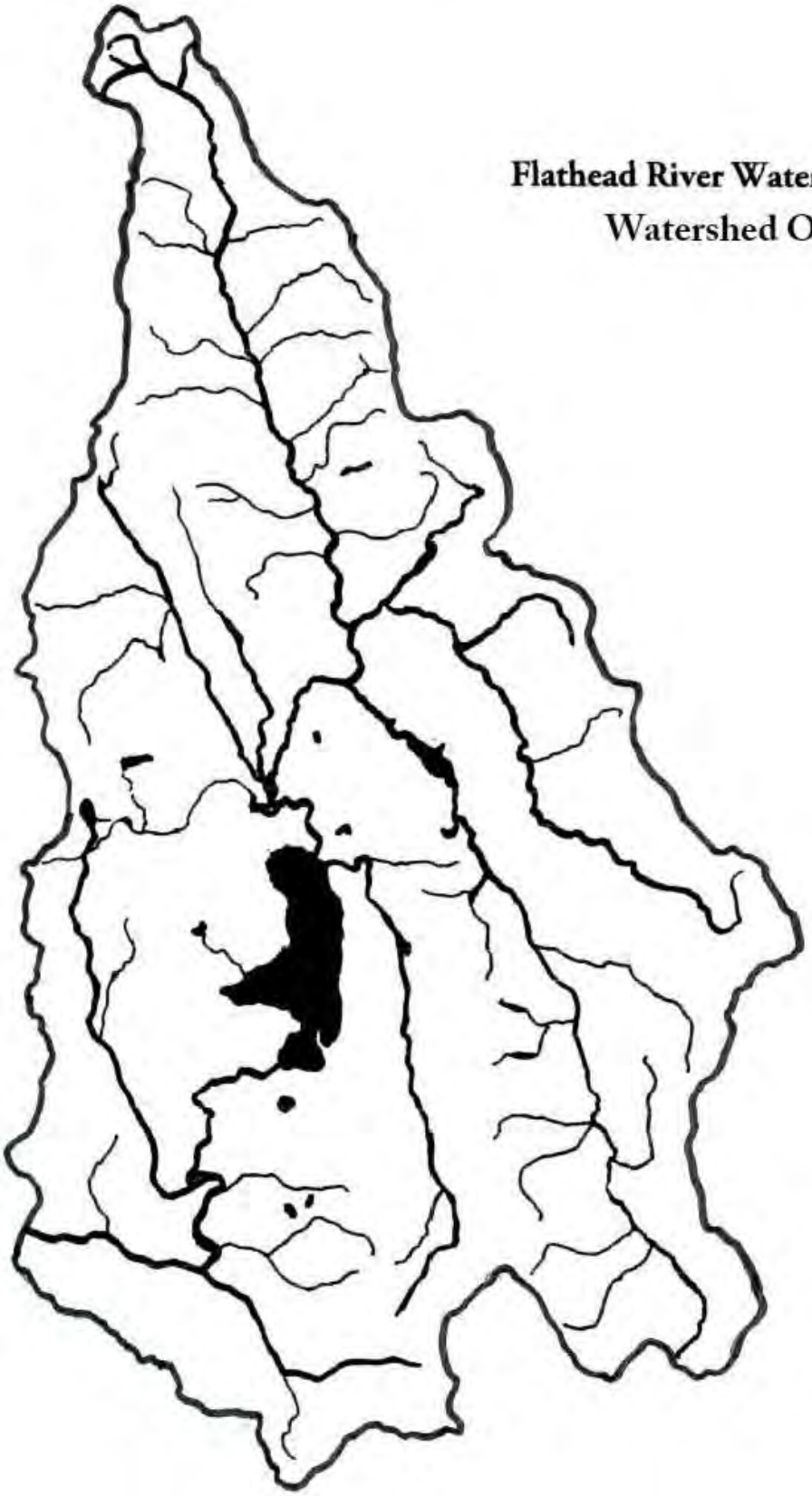
Salish/Kootenai Place Names Curriculum, Teachers Guide, Grade 6 http://www.spatialsci.com/PlaceNames/files/curriculum/PlaceNamesCurriculumJanuary_09_Final.pdf

Salish Speakers http://ourmothertongues.org/language/Salish/10

Spoken Kootenai website http://www.native-languages.org/kootenai.htm

Brief history and philosophy of Salish and Kootenai tribes – Montana Tribes Digital Archives, OPI IEFA resource http://montanatribes.org/links_&_resources/tribes/Flathead_Reservation.pdf

Source: Base Map – Confederated Salish and Kootenai Tribes Natural Resources GIS Division. Place name and content: - Salish-Pend d'Oreille Culture Committee



Flathead River Watershed Map
Watershed Outline

Ch. 3-2 Flathead Watershed History in Tree Rings

How can tree rings show you historical events?

SUMMARY

Students will closely read both European settler and Native Tribal history in the Flathead Watershed Sourcebook and then create timelines of events in Flathead Watershed history using tree ring slices obtained from locally grown trees. A field trip to examine tree stumps of very old trees is a powerful option.

OBJECTIVES

Students will

- Understand that tree rings can represent a timeline of human history.
- Recognize that different important events in history may have happened simultaneously.
- Be aware that the natural world coexists with the human world.

MATERIALS

- Actual tree ring slices obtained from a wood-cutting operation or from a Forestry Agency, Photos of tree rings in place of actual tree rings are an option.
- Historical information from Flathead Watershed Sourcebook, pgs. 76-89

www.sott.net/article

- Small post-it notes or pieces of paper in two colors
- Long straight pins (round head pins are easy to use)
- Tape

BACKGROUND

The Flathead Watershed has a rich history for both the native people and the incoming settlers. One of the common threads for both groups of people is the use of the abundant natural resources the area is renowned for.

Using tree rings as a way to show the timeline of the Flathead Watershed appropriately recognizes the tremendous benefits of the native forests to the livelihoods of the people of the Flathead Watershed.

PROCEDURE

Warm-up

Ask students about their prior knowledge of the history of both the settlers to the Flathead region and the native tribes of the Flathead. List on the board any major events that students know about.

With the help of students, place Flathead events in a bigger picture by listing major events and their dates in Montana, U.S and world culture (examples: WWI and WWII, invention of computers, automobiles, electricity, Berkeley pit in Butte, atomic bombs, Custer's battle against the Sioux, etc.).

The Activity

Hand out or hand around the tree ring slices. Students can be divided into small groups around one tree ring slice.

Have students count the tree rings. Pick a date the tree was cut down for the

outside ring. (Does not have to be accurate as to when the tree was actually cut down if that information isn't available, or if a different range of years is wanted.)

Have students read the historical information from pgs. 76-89 in the Sourcebook. Ask students to write important historical events from both Native Tribal history and European settler history, with the date, on a post-it notes or pieces of paper, and tape or stick it to a straight pin.

beptonranger.com

Starting with the outside edge of the tree cookie and the most recent event to be recorded in the timeline, have students push the pin for that event into the wood at the appropriate tree ring corresponding to the date of the event.

Continue marking historical events with pins until reaching the center of the tree ring slice.

Option 1: Hand each group of students another tree ring slice to continue marking earlier events. Students can imagine that the tree was older and cut down many years ago.

Option 2: Photos or drawings of tree ring slices can be used if actual tree slices are unavailable.

Wrap-up

After the tree ring slices are marked, have students look closely at the patterns of rings (wider and thinner bands) and the pattern of historical events. Have students evaluate the tree's history- how the shapes and widths of the rings reflect the experiences of the tree.

Have students look at the pattern of the pins with papers, noting any correlations to natural events that are reflected in the tree's growth rings.

Lead a gallery walk among the groups' marked tree ring slices. Have students share their insights into patterns they have noticed as a group with the class as a whole.

ASSESSMENT

Ask students to draw a traditional timeline, noting the correlations in events they have noticed in the placement of pins in the tree ring slice.

www.clipartpanda.com

EXTENSION

This activity can be done outdoors at actual tree stumps where rings are visible. Sometimes really old tree stumps (up to and over 100 yrs. old) remain in parks or on public lands, making them accessible to read and mark with pins. After the pins are placed a photo can be taken of the stump to include in presentations or to print and display. This can be a whole class activity.

Ch. 3-2 Flathead Watershed History in Tree Rings

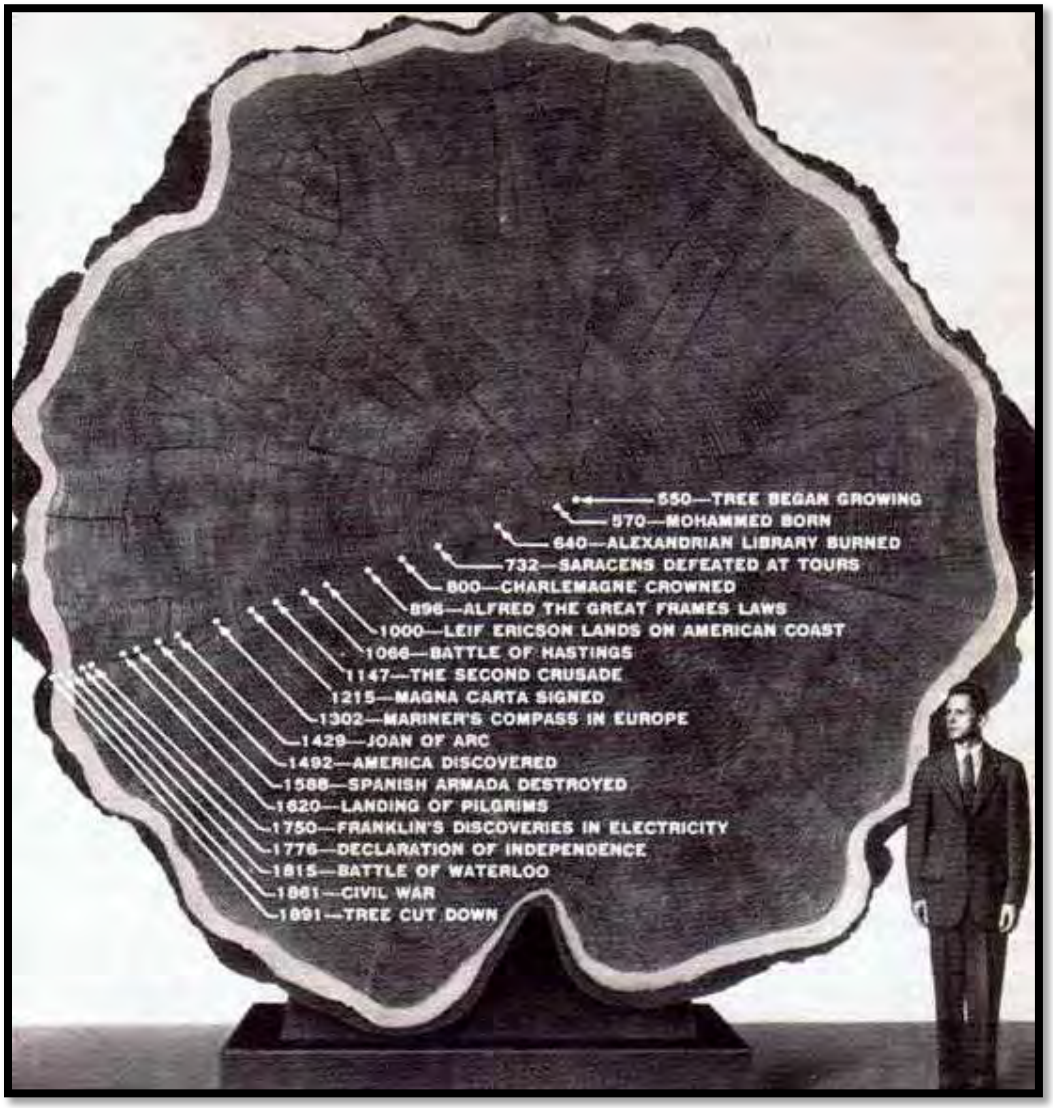
RESOURCES

Clear photo of tree rings
http://www.sott.net/article/230164-Tree-Rings-Record-Changing-Snowpack-Research-Finds

Clear illustration of tree ring
https://www.pinterest.com/pin/516647388 475078308/

FireWorks Trunk:
http://www.firelab.org/project/fireworks-educational-program

Tree Ring timeline pictures from:
http://picsant.com/61721585-tree-ring- timeline.html



www.modernroots.com

Ch. 3-3 Stories of Stewardship in the Flathead Watershed

How does a person's sense of place shape their actions?

People who resolve to live in a place indefinitely with deep commitment, no matter what their politics or philosophical views may be, are the key to that place's future."

- Robert L. Thayer, Author, Emeritus Professor of Landscape Architecture and the founder of the Landscape Architecture Program at the University of California, Davis
(pg. 221, Flathead Watershed Sourcebook)

SUMMARY

Students will practice interviewing each other and then create teams to interview community members featured in the Flathead Watershed Sourcebook to learn about individuals' sense of place and stewardship roles in the Flathead Watershed.

Students will report results of interviews in either a newspaper or video format. Coaching from local journalists is an option.

OBJECTIVES

Students will

- Conceive and ask interview questions and record answers.
- Listen closely to responses of
- interviewees.
- Create a newspaper, emagazine articles, YouTube videos or an iMovie to report interview results.
- Understand that stewardship actions can stem from personal beliefs.

MATERIALS

- Paper and pencils to write down questions
- Something to record information on – journal or other paper; recording device is an option
- Paper to create newspapers
- Optional: Recording devices such as video cameras, ipads or smart phones.
- Optional: Computers with movie- making software, or cloud-based movie-making or video option

BACKGROUND

Stewardship can be defined as: the responsible overseeing and protection of something considered worth caring for and preserving, (From: dictionary.reference.com).

Stewardship can be an individual act, as the Flathead Watershed Sourcebook Perspectives illustrate, and it can be collective action from people joined together in local, community-based organizations like the Flathead Lakers. People working in national and international organizations take action as stewards on far-reaching issues. Stewardship evolves from a person's responsibility to their 'place'.

Living in place is not about one's place of origin, politics, or point of view. Rather it is a commitment made by many diverse individuals to the place they live. It is a relationship that transcends the shortcomings, idiosyncrasies, and unpredictability of a place. It is a participatory relationship that inhabitants have with a natural region and the stewardship that grows from that bond.

The Flathead Watershed overflows with examples of people with differing views and politics joining together to preserve a stretch of land, repair a bridge, build a trail, or protect a waterway. (Flathead Watershed Sourcebook, pg. 221)

PROCEDURE

Warm-up

Ask students to describe what 'sense of place' is. Write ideas on the board. When the class has come up with a definition everyone agrees with, ask students to define stewardship. When a definition has been agreed on, ask students to examine the connection between a 'sense of place' and stewardship. Record all ideas for everyone to see.

The Activity

Practice Interviews in class

Divide the class into groups of 3 or 4 students. Give each group the task of developing questions that will reveal a person's feelings and thoughts about 'sense of place' and stewardship. Have each group write down their questions.

Sample questions could include:

- What do you enjoy the most about living in the Flathead Watershed?
- What do you feel is important for people who don't live in the Flathead Watershed to know about it?
- What concerns do you have about changes that are happening in the watershed?
- What ways do you spend time and energy taking care of the area where you live?

Assign roles within each group of recorder, interviewer and interviewee. (With 4 people, the fourth person can be the manager). Have each group conduct and record an interview.

Review the questions for any changes that may be needed, and then switch roles to repeat the interview process until everyone has been interviewed and each groups' questions are well-defined.

Community Interviews

Have the class look over the Perspectives writings on pgs. 85, 86, 87-88, 90, 93, 94, 96-97, 99-100, and 103: Chap. 3 of the Flathead Watershed Sourcebook.

Offer the class groups the option of who they would like to interview. After everyone has decided, have each group closely read their chosen Perspective piece.

Have them reread their interview questions to determine appropriateness and to check to add any additional questions appropriate for the people to be interviewed.

Contact Perspective individuals (either students or teacher can do this) to ask them if they would be willing to be interviewed by class members. If so, set up a time and place to conduct the interview. Interviews can be by phone, Skype or Facetime, personal visits by the Perspective individuals to the class or student visits to the Perspective individuals' home or business.

Try to have all the interviews scheduled within a small window of time so everyone can move on to the next task close to the same time.

With the interview arranged, determine within the group who will take which role – interviewer, recorder and photographer, if needed. Students can share roles to some extent, for instance – there can be two interviewers and one recorder.

Have students conduct the interviews, keeping careful record of the results. If interviews are being recorded as a video, have students save videos to several locations such as flash drives and on the cloud.

Wrap-up

When all the interviews are completed, compile the results into the format decided upon, such as a newspaper, emagazine articles, videos such as YouTube, or iMovie-type formats.

Arrange a presentation of the completed work, making sure to invite Perspective individuals to a showing, sending the Perspective individuals links to on-line presentations, or sending them copies of the newspaper.

When all the interviews have been compiled and viewed, ask the class to evaluate and analyze the body of work for any similarities and differences between individual interviewees' perspectives and actions. Ask if there are any generalities that can be detected or if there are any common threads that run through all the interviews.

Ask students if they can point to any specific experiences or circumstances that may lead individuals to becoming stewards in their watersheds.

ASSESSMENT

The completed project is a summative assessment piece; each student's participation can also be assessed.

EXTENSIONS

This could be an excellent opportunity to collaborate with local journalists and newspapers to coach students throughout the process of developing questions, interviewing and compiling results.

RESOURCES

Website exploring the definitions of world views around the environment: definitions and flashcards: https://quizlet.com/21481369/apes-chapter-26-flash-cards/

http://www.environmentalstewardship.org/

http://www.epa.gov/stewardship/

Ch. 3-4 Quotes from Cultural History Perspectives

What do people say about human history and culture in a watershed?

SUMMARY

In this lesson students will be given quotes that relate to the cultural history of watersheds in general and the Flathead Watershed in particular. The students will "close read" their quote and then create a small poster that describes the quote, its main idea, and how it relates to their experience of living in the Flathead Watershed.

OBJECTIVES

Students will

- Analyze a watershed quote for full comprehension.
- Investigate the meaning of a watershed quote.
- Explain the meaning of the watershed quote.
- Compare different watershed quotes.
- Relate the quotes to their personal experience.

MATERIALS

- Large pieces of paper for groups to work on and then present the results
- Cultural History Watershed quotes at the end of this lesson

BACKGROUND

Close reading means reading to uncover layers of meaning that lead to deeper comprehension. Close, analytic reading stresses engaging with a text of directly and examining the author's meaning thoroughly and methodically. Students read and reread to increase familiarity with the text and to reveal patterns within the writing.

Directing student attention to specific passages and wording in the text, analyzing it in fine detail as well as from a bigger picture viewpoint enables students to understand the central ideas and supporting details. It also enables students to reflect on the meanings of individual words and sentences, the order in which sentences unfold, and the development of ideas. This leads students to arrive at a deeper understanding of the text as a whole.

Polson, MT: playle.com

In this lesson students focus on the cultural history of the Flathead Watershed and its meaning to diverse people. See: Chapter 3, pgs. 75-104, Flathead Watershed Sourcebook

PROCEDURE

Warm-up

Have the whole class suggest words that they think relate to the cultural aspects of the Flathead Watershed. List these words where they can be seen by whole class. Look for similarities between ideas such as history and culture and suggest larger concepts which link the words such as Native American/Kootenai/Salish culture and European influence. This helps organize student thinking.

Ch. 3-4 Quotes from Cultural History Perspectives

The Activity

Part 1

Have the students work in groups of 2 or 3 students. Give each group a copy of the watershed quotes from this lesson or from another source (books, internet or other media). Ask students to write the quote in their journals. Have students paste the quote in the middle of the large piece of paper. Quotes from the Flathead Watershed Sourcebook are provided with this lesson.

As the students read the quote have them make notes in their journals under these headings:

- In one sentence, what is this text about?
- What are the main arguments?
- How does this quote relate to other things I've experienced in the Flathead Watershed?

www.travelguidebook.com

Part 2

Have the students illustrate their quote on the big piece of paper and restate the main ideas in their own words. Write in big text on the paper class words recorded earlier that relate to the quote and to Flathead Watershed.

Wrap-up

Compare the posters and the words students found in the text to the initial ideas suggested in the warm-up section of the activity. Are there similar words and meanings? Are there unique words and meanings?

ASSESSMENT

Have the students present their quote and their poster to the class.

EXTENSIONS

- **In the classroom**

Have the students do some background investigations about the speakers of the quotes. Have the students search for other quotes about cultural history in watersheds.

- **Outside the classroom**

Have the students ask a family member, acquaintance or friend what they think about cultural history in the watershed and collect a new set of cultural history watershed quotes.

RESOURCES:

Common Core Standards and close reading: https://www.learninga-z.com/commoncore/close-reading.html

Environmental Quotes from the Grinning Planet: http://www.grinningplanet.com/6001/environmental-quotes.htm

Water quotes from Cape Fear River Assembly http://cfra-nc.org/water-quotes/

Cultural History Quotes

"Our stories teach us that we must always work for a time when there will be no evil, no racial prejudice, no pollution, when once again everything will be clean and beautiful for the eye to behold—a time when spiritual, physical, mental, and social values are inter-connected to form a complete circle."
– Salish and Pend d'Oreille Culture Committee

"..... everything on the earth has a purpose, every disease an herb to cure it, and every person a mission.
This is the Indian theory of existence."
- Mourning Dove Salish, 1888 -1936

"After two hours travelling on level ground along Red-stone creek (Red-Rock) we emerged on the Saskatchewan plains, just six geographical miles north of the 49th parallel and camped at the lakes...
The scenery here is grand and picturesque... game is abundant, including, Grizzly bears...and we obtained both fresh meat and fish."
- Thomas Blakiston, Sept. 6, 1858

"The Crown of the Continent is one of the most intact natural ecosystems in the temperate zones of the world. It is a place of plunging valleys, sweet water, ancient cedar forests, native prairie and diverse wildlife. It's also a place with a rich cultural heritage: Sovereign First Nations still occupy the same territory after thousands of years, alongside loggers, ranchers, miners and more recently an influx of new residents
who have brought far-flung business ventures and incomes.
-Jonathan Tourtellot, National Geographic's senior editor for the Crown of the Continent MapGuide

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"By studying the stories told by the life of trees, and by nature itself, we can learn how to treat the forest and the land. We can learn how to imitate what nature does, and what trees to take and when to take them." "Our challenge is to enter this perpetual life cycle without interrupting it - Ben Thompson

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Ch. 3-4 Quotes from Cultural History Perspectives

"Each product that leaves our company is processed out of respect for the environment, for the people that produce it, and for the customers that receive it. – Roy Thompson

"You have to have a realistic notion of what you have and what you are doing with it."
Considering the land, Elaine added, "We're just borrowing it for a while."
- Elaine Roosa

The history of the people and places of the Flathead Watershed lives on, not only in stories and photographs, but in who we are today. The men and women who walked and worked this land before us—the Native Americans and then the early homesteaders—had dreams and hardships that gave way to the future we inherited. We have the ability to learn from their accomplishments as well as their mistakes, and to apply this knowledge to our current challenges. We have the opportunity now to shape the future for those who will follow in our footsteps in this amazing place we call home. – Lori S. Curtis

Chapter 4: Water

Background

"A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature." Henry David Thoreau

Introduction

Water is the key characteristic of any watershed, and the streams and rivers leading into and away from Flathead Lake are the defining features of the Flathead Watershed. Chapter 4 in the Sourcebook is extensive and includes many important concepts related to water features, use, politics and stewardship. This chapter in the Guide contains science lessons in which students map water uses in schools, investigate stream flow, and observe plankton from a lake. Several lessons deal with decisions around stream use and wetland restoration. Because recreation in the Flathead Watershed is often associated with water, we have included a lesson on being prepared for outdoor activities. Finally, language arts are addressed in a water quotes lesson

Essential Questions

- What are the water features in the Flathead Watershed?
- How does stream flow change over time?
- What is the foundation of the Flathead Lake biological ecosystem?
- How do people manage water resources?
- How do we prepare for outdoor studies?
- How do people communicate their relationship to water?

Content

Flathead Lake is the largest natural freshwater lake west of the Mississippi River. It is one of the cleanest lakes of its size and type anywhere in populated areas of the world. The lake is so clear because it is relatively low in nutrients that promote the growth of algae. Water quality in Flathead Lake is a barometer of the ecological health of the entire Flathead Watershed. As sediments and nutrients in its tributaries increase, algal growth in the lake increases. The quality of Flathead Lake reflects how well we are living in balance with our environment.

Clean water and healthy ecosystems profoundly influence quality of life and economic vitality in the Flathead Watershed. Water quality in Flathead Lake and its watershed is threatened by increasing sediments and nutrients from urban development, old and poorly maintained septic systems, poor agricultural and timber harvest practices, destruction of riparian vegetation, and air pollution. The Montana Department of Environmental Quality (DEQ) listed Flathead Lake as an impaired waterbody since 1996 due to nutrient and sediment pollution, PCBs, and mercury contamination. Flathead waters also face threats from possible introductions of harmful aquatic invasive species and climate change. (Flathead Lake Watershed Restoration Plan, 2014)

Learning Goals

In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
  - Streams and rivers running into and away from Flathead Lake
  - Plankton, the basis of the food chain in aquatic systems
  - Stream and river flows
  - Stream restoration principles

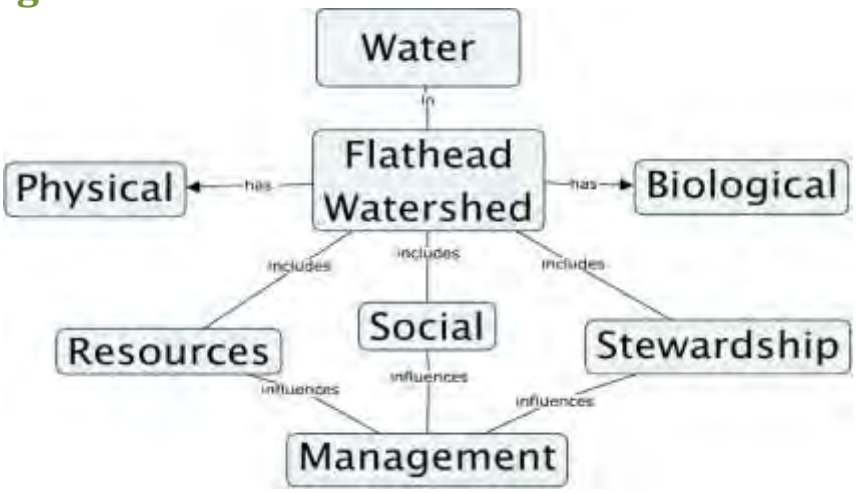
- Skills
  - Measuring stream flows
  - Applying stream restoration and management knowledge
  - Deciding about and cooperating on water management issues
  - Interpreting quotes about water
  - Mapping water resources

- Dispositions
  - Feeling, attitudes and values associated with water and its use
  - Stewardship of water resources

Key Concepts

Food Webs
Lakes
Outdoor Preparedness
Plankton
Resource Management
Resource Use
Rivers
Stream Restoration
Streams
Water flow

Graphic Organizer



Chapter Four Lessons 159

Ch. 4-1 Mapping Water Pathways in Our Schools

Where does our water come from when we turn on the faucet?

SUMMARY

Students will become investigative reporters to research and map the pathways that bring water into and out of their schools. Students will compare and contrast the different sources of water such as wells, surface water, and reservoirs, and they will study the different ways used water is treated, including septic systems and treatment plants.

OBJECTIVES

Students will

- Interview individuals to learn about water infrastructure in their schools.
- Map out and model water systems in their school.
- Describe the different sources of available water.
- Research investigative questions and write and present results.
- Appreciate that water is a vital resource that requires careful management.

MATERIALS

- Information about their schools' water systems, obtained from various sources such as interviews with principals, building managers, and building blueprints
- Paper and pencils for drawing water system designs and writing down research results

BACKGROUND

Drinking water in the Flathead Watershed is supplied by municipalities through an intricate network of water engineering. Some residents still pull surface water from Flathead Lake. But, most of the residential and agricultural developments in the watershed rely on municipal and on-site groundwater wells that are fed by shallow aquifers (Flathead Sourcebook, pg. 111).

http://www.drinktap.org

In addition to drinking water, other household uses—such as showering or bathing, washing clothes, flushing toilets, and maintaining landscapes—have a significant impact on our water resources. The average household uses approximately 40 percent of its water for flushing waste through toilets. There are a number of devices such as water-efficient appliances, showerheads, and toilets that can help conserve water in and around our homes (Flathead Watershed Sourcebook, pg. 114).

Today's septic system technology is very good. However, these systems must be properly installed and maintained to be effective. Property owners are individually responsible for the proper installation and maintenance of their private septic systems. Septic systems are designed to collect household waste in a tank and then filter pollutants and wastewater through leach fields. Septic systems break down and neutralize contaminants before they enter ground or surface water systems.

Properly designed, installed and maintained septic systems play an important part in maintaining water quality in the Flathead Watershed. Septic systems include four components: a pipe from the house, a tank which holds and begins to treat solid wastes, a distribution system which moves liquid wastes, and a drain or leach field (Flathead Watershed Sourcebook, pg. 156).

Community sewer facilities add an enormous density of waste to the water system. Wastewater treatment plants in the Flathead Watershed have been upgraded over the years to meet or surpass state mandated phosphorus limits and have reduced "point source" pollution considerably.

Point sources are identifiable outlets such as municipal and public sewage, stormwater outfall, and industrial discharges. New public systems in Lakeside and Somers and the expansion of areas served by public systems such as Evergreen, Whitefish Mountain, Whitefish Lake, and Bigfork have contributed to protecting our water quality. The amount of nutrients reaching Flathead Lake has been reduced through these upgrades efforts and the banning phosphorous-containing household cleaners.

All citizens and businesses have a critical role, a stake, and a responsibility in maintaining healthy water systems and in reducing water pollution (Flathead Watershed Sourcebook, pg. 157).

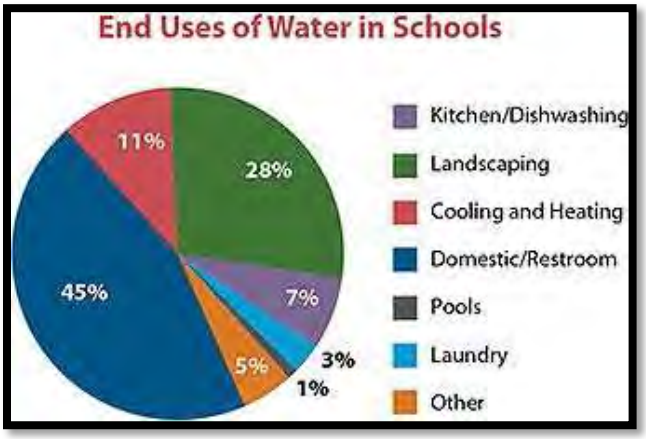
PROCEDURE

Warm-up

Take a poll of the class to find out how many know where the water comes from when they get a drink of water in the hall or class faucet. Answers may vary, but could include: wells, groundwater, water treatment plant, lake, or river.

Ask the same question about water in their homes. Answers may vary with this question as well.

Now ask if students know where the water goes after it runs down the sink, either at school or at home. Answers may vary but could include: into a stream or lake; to a treatment plant; into the ground.



http://www.epa.gov

The Activity

Tell students that they are going to become investigative reporters and that the whole class is going to work as a team to investigate a water-related issue in their school.

***The School Water Issue*:** One morning several students at different water fountains throughout the school noticed that the water had a reddish color when they turned on the fountain. The water did not smell different than usual and seemed as cold as usual, too. The red color lasted for several minutes and then went away.

For the next two days there was no sign of the red color, but, on the third day, the red color returned throughout the school, again lasting for several minutes. Another two days went by without any red color, and then the red color showed up for two days in a row, again only lasting for several minutes each day. Water quality tests indicated that the water was not harmful to drink, and that the red color was caused by the presence of iron in the water. The source of the iron was not indicated by the tests.

The class assignment is to track down the source of the red color in the water in the school faucets. They also need to find out where the red water goes after it leaves the school so they can determine any ecosystem effects.

Ch. 4-1 Mapping Water Pathways in Our Schools

http://www.epa.gov/schools

Brainstorm with the class for possible causes of the color red in the water supply. Some ideas: type of metal (possibly rusty) in the pipes, red (perhaps soil or rock) in the source of water, some kind of filter (rusty metal?) that the water passes through, water getting into the system from a red-colored source (stormwater passing through red soil or rock), a chemical leaking into the system, or other ideas. Also list where they think the red water goes and what or who it might effect on the way.

Ask the class what information they will need to solve the mystery of the red water. Possibilities are:

- Where does the school's drinking water originate?
- What landscapes do the intake pipes run through?
- What activities, such as earthmoving and construction, have taken place in the areas the pipes run through?

From these possibilities, decide which ones the class will research. For each information objective, list several ideas where the information could be found.

Possible sources of information: interviews with the principal or other person familiar with the school infrastructure, municipal websites with water systems information, weather data for recent storm events, news items about recent ground disturbances such as road or house construction near a water source or a class walk around the school to examine the infrastructure.

Point out to the class that the first important objective is to map out the water system of the school from the water source to its final destination.

Divide the class into small groups, either by their choice or your decision. Have groups choose or assign information objectives to each group. Ask each group to come up with a plan to find out the information they need and to check their plan with the teacher before they start (this gives you an opportunity to adjust the plan if needed). Include in each group's investigative objectives a section of the school's water system to research and outline.

Give the class enough time to conduct their research and write up their results. Each group will also draw a model of the section of the school water system they are responsible for researching.

http://www.drinktap.org

Wrap-up

Bring the class together to combine their research results. Have each group place their model drawings of the school water system together to create a schematic of the water system from water source to final destination. Post the schematic on the wall. A digital photo of the schematic could be posted on a class website.

Have each group present their research findings about possible sources and effects of the red color in their water supply.

As a class, discuss each group's findings. Decide together what the most likely source of the red color and what the most likely potential effects of the red color might be to the water supply after it leaves the school. Come up with recommendations to prevent potential water supply contaminations in the future.

Ch. 4-1 Mapping Water Pathways in Our Schools

ASSESSMENT

Participation in the class project can be assessed for individual students. Each group's school water system model and research results can be assessed separately. Each group's results presentation can be assessed as a performance piece.

Students can put their research findings into a story that describes the school's water system.

EXTENSIONS

Compare the types of water systems that are used in different types of dwellings such as houses, schools, farms, and factories.

Discuss the different sources of water and the different methods of treating water after use.

Discuss the importance of water security. Ask students to think of potential threats to water systems and ways to keep water supplies safe.

Arrange a field trip to local municipal water treatment plants, both for drinking water and wastewater.

RESOURCES

Information sources:
http://www.drinktap.org/kids.aspx
http://www.globe.gov/

http://www.h2oforlifeschools.org/
http://www.h2oforlifeschools.org/images/
Personal_Water_Use_Survey_.pdf

http://www.epa.gov/watersense/our_water/learn_more.html#tabs-6

http://www2.epa.gov/students

Article in the N.Y. Times listing all 111 community water systems in Flathead County, MT: http://projects.nytimes.com/toxic-waters/contaminants/mt/flathead

Background Information on the Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) defines a public water system (PWS) as one that serves piped water to at least 25 persons or 15 service connections for at least 60 days each year. There are approximately 161,000 public water systems in the United States. Such systems may be publicly or privately owned.

Community water systems (CWSs) are public water systems that serve people year-round in their homes. Most people in the U.S. (268 million) get their water from a community water system. EPA also regulates other kinds of public water systems, such as those at schools, campgrounds, factories, and restaurants. Private water supplies, such as household wells that serve one or a few homes, are not regulated by EPA. For information on household wells, see "How Safe Is the Drinking Water in My Household Well?" on page 18 of this booklet.

From:
http://water.epa.gov/drink/guide/upload/book_waterontap_full.pdf

Ch. 4-2 Plankton in the Flathead Watershed

What aquatic microscopic organisms exist in the Flathead Watershed?

SUMMARY

In this activity, students will make a plankton net and sample various streams, rivers and lakes to determine what microscopic organisms exist in the watershed.

OBJECTIVES

The students will

- Understand that microscopic plants and animals live in the Flathead Watershed.
- Build a plankton net and identify phytoplankton and zooplankton.
- Appreciate how microscopic life affects the watershed.

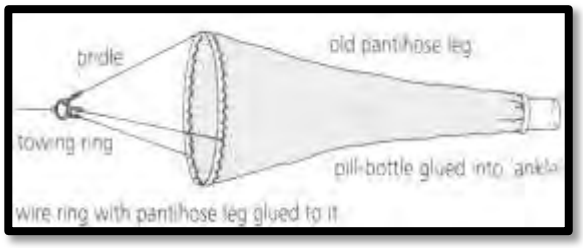
MATERIALS

- strong rope and twine
- wire
- pantyhose
- small bottle
- heavy thread and needle
- duct tape
- string
- key ring
- field notebook
- colored pencils
- container with ice to transport plankton bottle or
- Optional: if preserving plankton: club soda and ethanol (See extension)

BACKGROUND

Plankton are the floating or drifting plants and animals that live in the ocean as well as in freshwater. Most can only be seen under a microscope, yet they are remarkably abundant in the world's ocean.

It is estimated that phytoplankton, the plant forms of plankton, photosynthesize more than all other land and marine plants combined; some scientists place the figure at 90% of all photosynthesis on Earth. This means they also produce most of the oxygen breathed by humans and other animals.



Easily made plankton net: wesharepics.info

Phytoplankton are also the basis of the ocean food chain. They are grazed upon by small zooplankton (animals) that are in turn eaten by small fish and other zooplankton. Since most plankton are barely visible to the unaided eye, scientists must use a special net to gather these small creatures.

Read Flathead Watershed Sourcebook pgs. 110 and 124 to understand why plankton are so important in the Flathead Watershed system.

Zooplankton and phytoplankton: thinkprogress.org

PROCEDURE

<u>Warm-up</u>

A simple net can be constructed to capture microscopic plankton. The net is towed using a key ring and three strands of string that are tied onto a wire hoop. The hoop itself holds open a cylinder of fine mesh netting. The bottom of the plankton net is bound to a plastic bottle with a string.

After the net is pulled through water or set in a flowing stream, the particles that do not pass through the net will be concentrated and trapped within the bottle.

To make the plankton net:

- Bend the wire into a circle and use the electrical tape or duct tape to fasten the loose ends together.
- Roll the mouth of the stocking several times around the wire ring. Sew the stocking to the wire using the heavy thread and needle. Alternatively, use duct tape to secure the stocking all the way around the wire.
- Cut off the foot of the stocking, and then place the end of the stocking around the outside of the mouth of a small bottle. Use a piece of heavy string to tie the stocking securely to the top of the bottle. Use duct tape to reinforce the connection between the bottle and string.
- Cut three pieces of string, each about 50 cm long, to make the bridle to tow your net. Tie them at equal intervals around your ring. Tie the three loose ends of string to a key ring. This is the bridle ring.

The Activity

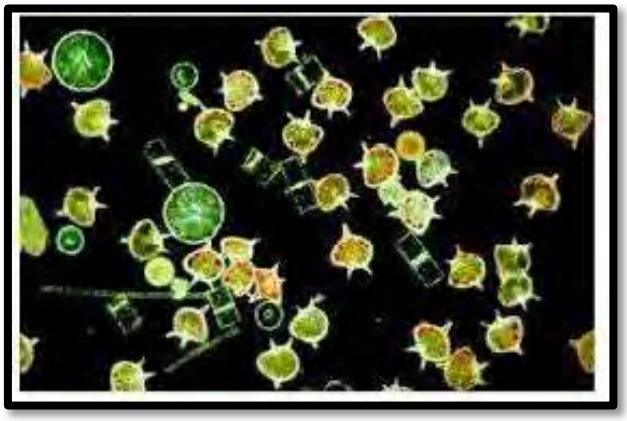
Take the students to a flowing stream or a dock on a lake. To tow for plankton, tie a length of string to your bridle ring and pull your net through the water.

If you are on a stream you can set the net in the flowing water. The plankton will collect in the bottle. Remove the bottle by untying the string.

Place the bottle on ice and transport to classroom. Have microscopes, slides and cover slips ready in the classroom.

To view your plankton through a microscope:

- Place a few drops of your plankton sample in half of a Petri dish or on a clean microscope slide.
- Watch the plankton under a microscope.
- Draw the plankton you see, large and with detail.
- List a few observable characteristics of your organisms.



Plankton: www.biologyreference.com

Wrap-up

Have the students record their observations in their field notebooks. Students should have neat diagrams of both phytoplankton and zooplankton.

Have students share their drawings with each other and display them in the classroom.

ASSESSMENT

Students' observations, records and drawings can be assessments. Students can do research into the physical structures of plankton and match their research to the drawings they've made of their stream and lake plankton.

EXTENSIONS

To preserve plankton for future use:

From Flathead Biological Station researchers: "When we need to archive or preserve to count later, in weeks or months or even years, we take the cup from the net (some water would have to be removed from the cup through additional pantyhose), and pour club soda over the zoops (zooplankton), then we rinse the zoops into a glass jar or bottle, and then add ethanol to where it is close to a 70% ethanol solution in the jar."

Ch. 4-2 Plankton in the Flathead Watershed

Visit YouTube websites by searching for plankton videos. Explain why plankton are so important and how they have contributed to life as we know it today.

RESOURCES

The story of plankton at: https://www.youtube.com/watch?v=jUvJ5ANH86I

The secret life of plankton at https://www.youtube.com/watch?v=xFQ_fO2D7f0

Plankton Chronicles at http://www.planktonchronicles.org/en/episode/protists-cells-in-the-sea

Long-term effects of a trophic cascade in a large lake ecosystem at http://www.pnas.org/content/108/3/1070.full.pdf

Ch. 4-3 Measuring Streams in the Flathead Watershed

What are the flow characteristics of streams and small rivers in the Flathead Watershed?

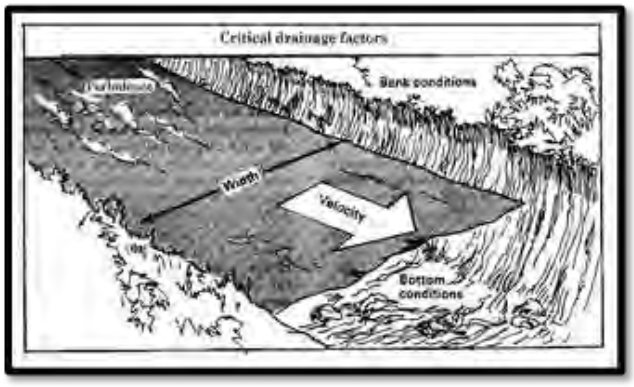
SUMMARY
In this activity, students will investigate a nearby stream. Students will investigate stream discharge and the variables that influence it.

OBJECTIVES
Students will

- Understand stream characteristics such as water velocity and discharge.
- Measure the velocity and stream characteristics in order to calculate discharge.
- Appreciate the differences in stream characteristics over time.

MATERIALS

- a measuring tape from 5 to 50 meters long or 50-100 feet long
- flagging or wire flags, enough to mark designated distances for each team
- an apple, orange or tennis ball, one each per team
- watch with a second hand, stop watch, or phone with a stopwatch function, one each per team
- pencils, sharpeners, erasers
- field notebooks, one each per team
- waders or tall rubber boots, enough for two sets per team, or for a warm day and a shallow stream: water shoes-at least two people wearing them per team
- large piece of paper like a poster board or butcher paper



www.globalsecurity.org

BACKGROUND

The ability of a stream or river to erode and transport sediment is affected by many factors. These factors, which are interconnected, include the velocity of the water, the stream's gradient, its discharge, and the shape of its channel.

The velocity of water in a stream or river is the speed that water travels in a given distance. The velocity of the water in a river is related to the amount of energy that the water carries.

Many factors affect a river's velocity, including the steepness of the slope, the amount of water traveling downstream, and the shape of the path through which the water travels.
The discharge of a stream or river is the amount, or volume, of water that passes a certain point in a given amount of time.

Discharge is not constant over the length of a river. In many rivers, discharge increases downstream because tributaries continually add more water. Discharge is not constant year-round either. During times of increased precipitation or at times when snow is melting, more water runs into rivers. (Flathead

Watershed Sourcebook, pgs. 106-107)

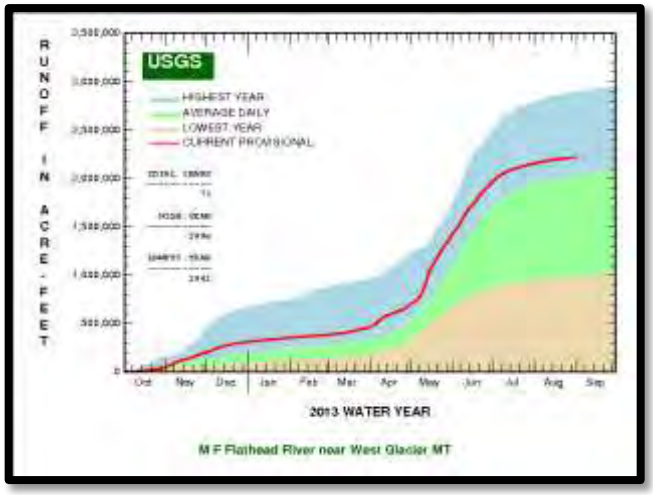
PROCEDURE

Warm-up

Have students look at stream flow information in the Flathead Region at the USGS National Water Information System.

Ask students to explore in what forms data about stream flow is presented on the website and look at patterns and trends in the data. Have students note what the axes of various graphs represent.

This can be found at: http://waterdata.usgs.gov/mt/nwis/current?type=flow



www.waterdata.usgs.gov

The Activity

Take the students to a nearby stream that is no deeper than their knees and work in small groups of four. Each group will have a stopwatch, a floating object and a field notebook.

In order to measure velocity, you must have a designated distance along the stream let's say 10-30 meters or 30-50 feet, depending on length of available stream.

Measure a designated distance for each team and mark each end with flagging. Assign groups along the course of the stream.

In the four-person team, two people will be in the stream – one at the start of the designated distance to drop the floating object (apple, orange or tennis ball) and one at the end of the distance to pick it out of the water. One person will operate the stopwatch. The fourth person will record data.

To start: release the floating object at the upstream end of the distance and record the time it takes to travel the distance. Record the time in the field notebook.

Repeat the timed trial at least three times. The velocity is then calculated by dividing distance by time; ex. 10 meters per 5 seconds = 5 meters per second, or 20 feet per 5 seconds = 5 feet per second.

Calculate velocity for all timed trials and then average the velocities. To average the velocity add the velocities together and divide by the total number of velocities measured.

Final velocity will be in either meters per second or feet per second.

Water monitoring: cleanstreams.anshome.org

Wrap-up

Have each group report the velocity at their point on the stream. On a sketch of the stream put the values. Compare findings and interpret why the velocity might be similar or different in different sections of the stream.

ASSESSMENT

Each student should have a sketch of the stream and the velocity values at each of their stream sites in their field notebook.

EXTENSIONS

Compare the students' data for the different sites along the stream.

On the large piece of paper, have each team draw a sketch of their section of the stream, combining them all into one long section of stream. Have each team enter their data at their measurement points represented in the sketch.

After the sketch is complete, have the class analyze the stream. Are the velocities the same throughout all the stream sections? If there is a difference in velocities, do they correspond to any changes in the shape of the stream?

Have the class do research into stream characteristics that would lead to differences in stream velocities.

RESOURCES

Learn more about:
Characteristics of small streams at:
http://staff.concord.org/~btinker/GL/web/water/ecosystem_river_stream.html

Biomes of the World, Streams and rivers at
http://www.thewildclassroom.com/biomes/stream.html

Water Encyclopedia, Stream Hydrology at
http://www.waterencyclopedia.com/St-Ts/Stream-Hydrology.html

Ch. 4-4 The Stream Restoration Game Plan

What are the benefits of restoring stream habitats?

SUMMARY

Students will close-read two perspectives in the Flathead Watershed Sourcebook about Jocko River and Hallowat Creek restoration projects in the Flathead Watershed. They will play a game matching waterway impairments with stream restorations that shows the connections between habitat improvement and ecological response and then create a restoration plan for a waterway near their school.

OBJECTIVES

Students will

- Recognize the need for restoration work in a local waterway.
- Correlate restoration efforts to habitat improvement for specific organisms.
- Determine ecological impacts of habitat improvement in the restored waterway.
- Develop a restoration plan outlining appropriate steps in the process.
- Recognize the many and various job opportunities in the stream restoration field.

MATERIALS

- Restoration of the Jocko River near Arlee perspective, Flathead Watershed Sourcebook, pg. 127
- Hallowat Creek Fish Habitat Restoration perspective, Flathead Watershed Sourcebook, pg. 153
- 4 or 5 sets of game cards for the Restoration Game, (provided at end of lesson)
- Paper and pencils or computers

BACKGROUND

The concept of stream restoration refers to returning degraded ecosystems to a stable, healthy condition. Those who take on this task must consider the factors that impact the rivers and streams and recognize that completing restoration projects involves a number of sequential steps.

Understanding the sequential steps of planning, designing, funding, constructing, and monitoring restoration projects is critical to venturing into the process and achieving restoration success.

River restoration requires expertise in a number of disciplines and specialized skills. The leader, or project manager, is responsible for organizing and bringing together various project partners, agency technical staff, non-governmental, and other parties interested in or concerned with a potential project. Such partnerships can create effective avenues for addressing multi-faceted river restoration projects with a variety of issues.

A reconstructed reach of the Jocko River illustrating channel shaping, large wood habitat structures, and vegetated soil lifts.

River and stream restoration involves the modification of a disturbed condition to re-establish physical channel and bank features of riparian plant communities bordering a particular river or stream reach. Numerous in-water and bank restoration techniques may be used.

Jocko River channel before and after restoration, www.riverdesigngroup.com

PROCEDURE

Warm-up

Discuss the idea of stream restoration with the class. Ask students to think of any places where they have seen or heard of a stream or river restoration project. If any students come up with a site, ask them to describe some of the changes they noticed.

Ask students to read the two perspectives and answer these questions:

1) What were the impairments of the Jocko River and Hallowat Creek?
2) How did the impairments affect stream function in the two waterways?
3) What restoration actions were taken on the two waterways and why?
4) What specific effects did the restoration have on stream function?
5) How did the improved stream function create improved habitats?
6) What species were impacted by the impairments and how did they respond to the restoration actions?

Write the answers on the board and discuss as a class, emphasizing the causes of the stream impairments, the impacts on stream function, and the effects of the restoration actions taken on the two waterways.

Have students record their findings in their science journals, in a computer or on paper. Students can work in pairs or small groups to read and analyze the perspectives.

The Activity

The Watershed Restoration Sequence Card Game

In this game small groups of students will create stream restoration plans based on the stream problem cards, the restoration fix cards, the stream improvement cards and the habitat benefit cards that are dealt to each player in the group.

Students will begin play by one person in the group laying down a stream problem card. The next card played is the restoration fix for that stream problem. Play continues by playing the appropriate resulting stream improvement card, and then the round ends with the appropriate habitat benefit card that matches the stream improvement is played.

All cards except the beginning stream problem card are discussed by the group before being played to determine if the card is the appropriate result of the actions of the card previously played.

When a round is complete, the group records the sequence of cards for one of their restoration plans.

Play continues until all the cards are used or there are no more appropriate cards to play.

To start: Divide the class into groups of 5-6 students per group. Hand out a set of Restoration Cards to each group. One student in the group is the Recorder.

Game Rules:

First player lays down a card from #1- Stream Problem. Everyone in the group checks the cards in their hands for the appropriate #2- Restoration Fix, and then plays it on the first card.

All players check to see if the card played makes sense as a fix for the initial problem; if it doesn't that person takes back their card and someone plays another # 2- Restoration Fix card. Everyone checks again, and the action repeats until the Fix works out.

Another player chooses a card from #3- Stream Improvement. Everyone must agree that the Stream Improvement is appropriate, if not, that person retrieves their card and someone else plays.

When everyone agrees with the Stream Improvement, a player chooses a card from #4-Habitat Benefit. Again, everyone must agree that it works in the sequence or a new card is played.

When the sequence is completed to everyone's satisfaction, the recorder writes down the Restoration Sequence, and then play starts again to create another Restoration Sequence, which the Recorder again writes down.

Each group continues until all the cards are played or until the groups can't create a restoration sequence that makes sense. Each group should now have a list of Restoration Sequences that lead from Stream Problems, or Impairments, to Restoration Fixes to Stream Improvements to Habitat Benefits. Have each student copy the Restoration Sequences into their own science journals or on a piece of paper (alternatively, each student can record them in a computer for their own use).

Creating a Restoration Plan

Go on a field trip around the school campus or to a nearby area where a waterway shows signs of needing restoration, or show photos of a local waterway needing restoration. As a class, identify and record what problems, or impairments, are present in the waterway.

Using the Restoration Sequences that were created in the groups, identify what Restoration Fixes could be for used to address the impairments. Use the identified Restoration Fixes to develop the restoration actions.

O'Dell Creek prior to restoration
www.riverdesigngroup.com

Students can work independently or in small groups to write about the waterway impairments they've identified and the restoration fixes they've decided would be most appropriate. Their plan should include what stream improvements they expect to achieve and the habitat benefits they hope to see after restoration.

Drawings are an important part of restoration plans. Students should include before, during and after restoration drawings of the waterway they are writing their restoration plans.

Wrap-up

Students can post their restoration plans around the room and give presentations of what they have created.

ASSESSMENT

The Restoration Sequences created when playing the card game are a formative assessment that indicates the level of student understanding of watershed restoration based on the two readings. The Watershed Plans are the summative assessment.

Grave Creek, before and after restoration:
www.kootenairivernetwork.org

EXTENSIONS

Begin a monitoring program on a local waterway to determine water quality and to establish baseline data to determine impacts of possible future restoration efforts.

Research companies and individuals who do stream restoration work in the local area. Create a list of the job opportunities within the stream restoration field and what types of activities each job entails.

Ask a local stream restoration specialist to come speak to the class about restoration efforts on local waterways.

Plan a field trip to a restored waterway, ideally with a restoration specialist on hand to discuss and explain the work that was done.

(See pg. 168, perspective on River Design Group, Flathead Watershed Sourcebook)

RESOURCES

Further information on stream restoration:
http://www.kootenairivernetwork.org/grave-creek-restoration.html

http://www.riverdesigngroup.com/projects/surveying/jocko-river-restoration/

http://geumconsulting.com/portfolio-items/jocko-river-master-plan-and-restoration/

https://media.dojmt.gov/wp-content/uploads/John-Muhlfeld-NRDP-2015-Presentation_rev3-2.pdf

http://www.skercorp.com/projects.php

Watershed Restoration Card Game
8 pieces in each of the 4 categories = 32 cards

#1 Stream Problem:

- Eroding stream banks
- Outdated dams with filled up ponds
- Straightened stream and river channels
- Stream gravels are covered in silt and mud
- Shallow, wide streams, no deep areas
- Water too warm in streams and lakes
- Too much sediment in the water (high turbidity)
- Banks too high for the stream or river to meander

#2 Restoration Fix

- Cutting back steep stream banks
- Planting bare, eroded areas
- Creating curves in the stream channel
- Putting log structures in the water at points
- Planting willows along the stream banks
- Deepening certain spots in the stream with equipment
- Removing or breaching dams
- Adding big rocks at points in the stream

#3 Stream Improvements

- Water slows down and gets deeper
- Water gets deeper and stays cooler in summer, doesn't freeze in winter
- Water speeds up and clears away the muddy bottom
- Water gets cooler- has more oxygen
- Shady areas provide cooler water, more cover
- Water is clearer, has less sediment, (less turbidity)
- Stream channel develops natural curves
- Stream is not blocked completely

#4 Habitat Benefit

- More spawning gravels for fish
- More rocks and gravels for macroinvertebrates to live
- Increased dissolved oxygen = more fish survival
- Fish habitat increases with combined shallow and deep water areas
- Reduced algae growth from less sunlight in deep water
- Different types of stream bottom surfaces increases habitat options
- More macroinvertebrates means more food for fish and other animals
- Increased bank cover from riparian plants increases safe areas for animals

SEE BELOW FOR RESTORATION ELEMENTS IN CARD FORMAT:

Watershed Restoration Cards

1.Stream Problem Eroding stream banks	**1.Stream Problem** Outdated dams with filled up reservoir ponds	**1.Stream Problem** Straightened stream and river channels	**1.Stream Problem** Stream gravels are covered in silt and mud
1.Stream Problem Shallow, wide streams, no deep areas	**1.Stream Problem** Water too warm in streams and lakes	**1.Stream Problem** Too much sediment in the water (high turbidity)	**1.Stream Problem** Banks too high for the stream or river to meander

2. Restoration Fix Cutting back steep stream banks	**2. Restoration Fix** Planting bare, eroded areas	**2. Restoration Fix** Creating curves in the stream channel	**2. Restoration Fix** Putting log structures in the water at points
2. Restoration Fix Planting willows along the stream banks	**2. Restoration Fix** Deepening certain spots in the stream with equipment	**2. Restoration Fix** Removing or breaching dams	**2. Restoration Fix** Adding big rocks at points in the stream

3. Stream Improvement Water slows down and gets deeper	**3. Stream Improvement** Water gets deeper, stays cooler in summer, doesn't freeze in winter	**3. Stream Improvement** Water speeds up and clears away the muddy bottom	**3. Stream Improvement** Water gets cooler- has more oxygen
3. Stream Improvement Shady areas provide cooler water, more cover	**3. Stream Improvement** Water is clearer, has less sediment, (less turbidity)	**3. Stream Improvement** Stream channel develops natural curves	**3. Stream Improvement** Stream is not blocked completely

4. Habitat Benefit More spawning gravels for fish	**4. Habitat Benefit** More rocks and gravels for macro-invertebrates to live in	**4. Habitat Benefit** Increased dissolved oxygen = more fish survival	**4. Habitat Benefit** Fish habitat increases with combined shallow and deep water areas
4. Habitat Benefit Reduced algae growth from less sunlight in deep water	**4. Habitat Benefit** Different types of stream bottom surfaces increases habitat options	**4. Habitat Benefit** More macro - invertebrates means more food for fish and other animals	**4. Habitat Benefit** Increased bank cover from riparian plants increases safe areas for animals

Ch. 4-5 Stream Use Town Council

What is the best use of a free-flowing stream?

SUMMARY

Students will participate in a town council meeting to decide who will get to use the water in a free-flowing stream on a piece of land up for sale. Groups of students will represent different potential users who apply for use permits. A separate group will represent town commissioners who listen to the presentations and make the decision.

OBJECTIVES

Students will

- Develop arguments and give persuasive speeches.
- Evaluate permit information to obtain appropriate information.
- Research and present accurate information about stream impacts related to different land uses.
- Appreciate the effort involved in making decisions that affect others.

MATERIALS

- Information from Flathead Watershed Sourcebook about water use permitting (pgs 115-119)
- Descriptions of user groups (found at end of lesson)
- Land use proposals and property description (found at end of lesson)
- Props for costumes for different user groups and commissioners
- Research into impacts related to various land uses

BACKGROUND

Montana's streams range from large year-round flowing rivers to small intermittent streams that flow only when recharged by precipitation or groundwater to ephemeral streams that flow only during large runoff events. Lakes range from large persistent natural freshwater systems to saline basins that evaporate completely each year. These surface waters contribute to uses including public water supplies, domestic household water, irrigation, livestock, industry, mining, and tourism. Our wellbeing, much of our economy, and a number of our recreational activities depend on the abundance and quality of water (Flathead Watershed Sourcebook, pg.111).

Krause Creek, Kalispell, www.vrbo.com

The State of Montana owns all surface, underground, flood, and atmospheric waters within the boundaries of the State for the use of the people. Because the water is state-owned, water rights holders own a right to use water within the State guidelines, but they do not own the water itself. Water rights are guided by the Doctrine of Prior Appropriation known as "first in time is first in right." This doctrine gives the priority right to divert water from a water source for "beneficial" uses to the person ("appropriator") who first put the water to use, known as the "senior right." In Montana,

"beneficial" refers to use of water that benefits the appropriator, other persons, and the public, and includes agricultural, domestic, fish and wildlife, industrial, irrigation, mining, municipal power, and recreational uses. The priority system is used to settle disputes that often arise in low-flow years, when more than one appropriator wishes to use the same limited supply of water (Flathead Watershed Sourcebook, pg.114).

Northwestern Montana Stream
http://www.livewaterproperties.com

PROCEDURE

Warm-up

Tell students that they are going to use their imagination to think of all the things they could do on a 10-acre plot of land with a good-sized stream running through it (10 acres is equal to approx. 9 football fields put together, or 1/8 square mile).

Tell them the activities could be for fun, recreation, make money, preserve or restore the environment, or anything else. Students can talk together in small groups to discuss ideas. Generate a list of all the activities the students come up with. Ask students to think of the impacts of the various activities on the stream banks and the water quality and quantity. List impacts next to the activities.

Ask students what they know about the actions they would need to take to accomplish the activities they've come up with. Some of those answers might be – buy the land, get permits, get permission, find someone to do the work, or other ideas.

Tell them they are going to act out a scenario where they will compete as groups for the right to use the land and water in specific ways.

The Activity

Divide the class into 6 groups. Tell the groups that they will be either one of five user groups who wants to use a 10-acre property for a specific activity, or they will be a group of commissioners who will decide which group is given permission for the property use.

Let the groups know they will be presenting their property proposal to the commissioners; different groups will be competing with each other for permission to use the property.

Draw straws or otherwise decide which group of students will become which user group or the commissioners.

Give each group a copy of the 10-acre property description.

Give each group their description of their proposed use of the property. Give the county commissioners the description of their duties.

Hand out any props and costume items to each user group.

Have the student complete these requirements as they prepare for their presentations:

User Groups:

- Must clearly indicate to the commission how you will use all water on the property, both underground and surface water.
- Must indicate what your intentions are for the wetlands area.

- Must indicate what permits you will need to obtain to do the activities you have planned for the property (pgs. 115-120 Flathead Watershed Sourcebook).
- Must clearly indicate the work of each member of your group in preparing the proposal. Each group member must take part in the presentation
- Must prepare at least 3 answers to questions the commissioners might ask. One of your answers should be about impacts of your proposed activities to the quality and quantity of water on the property and beyond. (When writing these down, indicate both the question and the answer).

Commissioners:

- Write out three questions to ask each of the user groups (15 questions total).
- One question for each group should be about the impacts of their proposed activities to the quality and quantity of water on the property and beyond.
- Each commissioner is responsible for writing 3 to 5 questions, depending on the number of commissioners. Authors' names must be indicated.

Send each group to separate areas to prepare their presentation in secret. Send the commissioners to an area where they can't hear or see the user groups as they prepare. Give students 15 minutes or so to develop their presentation and write their questions and answers.

While groups are working, prepare a table or spot where the commissioners can sit to listen to presentations, the other groups can listen quietly, and the presenting user group can deliver their presentation.

Give a time limit for presentations so that each group has equal time to present in the amount of remaining time and the commissioners have time to discuss and present their decision.

mtpr.org

Bring the groups back together. Arrange the commissioners at their table. Ask for volunteers to begin the presentations.

Presentation Format: User group gives presentation within time limit. Commissioners ask 3 questions. Audience may ask questions if there is time, but they must wait until all commissioner questions have been asked and answered first.

After all the presentations are complete, the commission retires for discussion, and then returns to give their decision. Commissioners must explain why they chose the property proposal they did. If there is time, the commission can accept questions.

Wrap-up

After the commissioners have given their decision, hold a whole class discussion about each of the proposals to discuss their advantages, disadvantages, impacts and feasibility. Ask the class for a general consensus of their opinion of the best proposal for the land and why.

Read and discuss with the whole class:
From the Flathead County Growth Policy:

One of the single largest impacts of growth in any community is change to land uses. Many land uses are converted as access, infrastructure, visibility and other factors make certain uses more or less desirable. Changes in land use are an inevitable result of growth and can fuel multiple segments of an economy. However, without careful planning, some land uses can have unintended deleterious impacts to the surrounding area. This is especially true in communities with increasing populations and decreasing space or "buffers" between uses.

The Flathead County Growth Policy seeks to allow the market to benefit naturally from the desirable impacts of growth and land use changes while protecting the community from the accompanying undesirable impacts to public health, safety, morals, convenience, order, or general welfare (76-1-106, M.C.A.). https://flathead.mt.gov/planning_zoning/documents/10-Chapter2LandUses_000.pdf

Ask the class to think of what criteria in their opinion is most important to use to make land use decisions. If they were in the commissioners' shoes, what would they do? Do they think the commissioners should be free to choose whatever they want, or do they need to follow certain rules in making their decisions? Have each student write down what they would have decided as a commissioner and why, indicating what criteria they are using for making their decision.

ASSESSMENT

The written work of each of the groups serves as a measure of each students' individual contribution. Each student is assessed on their participation in giving the presentation. Discussion participation is an important assessment of understanding.

EXTENSIONS

Have students research an actual property with a similar scenario: conflicting user proposals that have been or will be decided by a county or city planning board.

Ask agency personnel to come speak about land use policies and the decision-making process. Conservation district supervisors or city or county commissioners would be appropriate people to consider.

Give each student the 10 acre parcel of land and have them create their own land use proposal, indicating what permits are needed, what water uses are, what impacts their proposal would have on the land, water and adjacent properties.

RESOURCES

Further information on government planning in Montana and in Flathead Watershed counties:

http://mtwatercourse.org/media/downloads/MTWC%20Guidebook%20revision_lo%20res.pdf

http://fwp.mt.gov/fishing/regulations/ponds.html

http://mtwatercourse.org/media/downloads/Suggested%20Wetlands%20Curriculum_2010-11.pdf

http://www.uwex.edu/erc/eypaw/

http://www.uwex.edu/

https://flathead.mt.gov/planning_zoning/documents/10-Chapter2LandUses_000.pdf

http://www.lakemt.gov/plannin

Ch. 4-5 Stream Use Town Council

User Groups Proposals:

1) A group of partners want to start a Community Supported Agriculture (CSA) business. They would put 3 acres in produce, 4 acres in fruit trees and berries, 1 acre of pumpkins, have a greenhouse, plus chickens. There would be a small building on the property with a septic system and well. The business would use the stream for irrigation. They would open it to schools for field trips. (see pgs. 193-195, Flathead Watershed Sourcebook, about CSAs)

2) A group of fisheries biologists want to go into aquaculture by creating at least two ponds for raising rainbow trout for sale to markets throughout the Northwest. Ponds would be mostly groundwater fed, but there is a strong connection between the groundwater and the stream, and the stream could be a source of water for low water times of the year and a potential place for pond run-off. They would offer the ponds for fishing for a fee. They would build a small building with a recycling toilet and a well. (See Pgs. 11-12, Flathead Watershed Sourcebook, for groundwater/surface water interaction information)

3) A citizens' group wants to acquire the land for 2 handicapped fishing access sites, a picnic area and park lands. They would preserve and restore natural riparian habitat along the creek to encourage wildlife population stability, including native fish. One of the public agencies (county or state) would manage it. There would be a handicap-access pit toilet and a well for drinking water. (see pg. 7, pgs. 144-147, for riparian zone information; and pgs. 126-127, pg.153, for stream restoration information, Flathead Watershed Sourcebook)

4) A developer company wants to sub-divide the land for housing. They propose building 10 moderate income houses on 8 acres with a small park on 1 acre. The park would be maintained by the county with fees from the homeowners association. The houses would have septic systems and have their own wells. (see pgs. 156-157, 111-115, Flathead Watershed Sourcebook, for septic systems and well information)

5) An adjacent landowner who runs cattle on their 90 acres but has no stream access wants to purchase the property for watering cattle. They will put the land into fields for grazing rotation with their other acres and maintain a narrow riparian area just within the high water mark. (see pg. 7, pgs. 144-147, for riparian zone information, Flathead Watershed Sourcebook)

County Commissioners Actions:

County Commissioners' roles are to listen to arguments from each of the groups and to decide on who receives the land use permit. (Need 3 or 5 students, majority rules in the decision).

This group of individuals is responsible for allowing activities on land and water that are compatible with all laws and regulations and that maintain the values that the community considers important, such as open land, clean air and water, stable wildlife populations, limited or no pollution from noise, dust, smells and other sources, and fair housing and working opportunities. They must also recognize that landowners have a certain amount of freedom to do as they like with their property and to make a living.

The Property Description: the land consists of 10 acres approximately 8 miles from the closest city center. The property is outside city limits and not within reach of city water and sewer services. The piece of land is a rectangle, approximately 2 acres wide and 5 acres long, with the stream flowing roughly the length of the 5 acres along one side of the property. About 1 acre of the 10 acres is stream channel or stream bank/riparian area.

The property is one of the lots created from the sale of a 160 acre homestead to a developer who subdivided it into 10 acre plots. On two sides of the rectangle the adjacent land is divided into 10-acre lots with a high-income level house on each lot. On one of the short ends of the 10 acres is an adjacent cattle rancher. There is road access along one of the short ends of the property. The property is in the 100-year flood plain of the stream and is an old hay meadow with shrubs growing in. There is a small wetlands area by the stream near the corner of the property next to the cattle rancher.

Across the stream from the property is Forest Service land consisting of rocky hills leading up to forested slopes. There are nesting pairs of ospreys in the cottonwoods along the stream, and bald eagles have been seen. There is a small beaver dam. Cutthroat trout are found in the stream. Though the riparian areas along the stream are fairly intact, there are broken down banks and eroded areas where dirt bikes have crossed the stream to ride on the Forest Service land on the far side of the stream.

Ch. 4-6 The Outdoor Preparedness Challenge

Do you know what it takes to be prepared for the outdoors?

"Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop off like autumn leaves." - John Muir

SUMMARY

Students will create a checklist of items, skills, and knowledge necessary to stay safe, healthy, and comfortable in the outdoors. Students will present their checklists for a vote on the most appropriate and complete checklist using criteria students have developed themselves. Students will share any outdoor skills they may possess with other students.

Over the river. Source: Lori Curtis

OBJECTIVES

Students will

- Identify basic human needs.
- Recognize the needs of people when outdoors for extended periods of time.
- Develop an awareness of important skills needed when spending time outdoors.
- Work with others to determine criteria and create the lesson artifact.
- Appreciate the challenges inherent in spending time outdoors.

MATERIALS

- Flathead Watershed Sourcebook, pgs. 130-131
- Online and other resources to research outdoor preparedness
- Optional: Computers to create PowerPoint or other types of presentations of student checklists

BACKGROUND

Spending time in the outdoors can be an exhilarating, inspiring experience. Thinking ahead so you are prepared to meet your needs can prevent the experience from being uncomfortable (at best) and hazardous (at worst). Knowing what's required ensures that you will have what you need when you venture outdoors.

Basic human needs include staying warm and dry, having enough water and food, having shelter from the elements, and staying free of danger.

Carrying a selection of specific items in a day pack or overnight backpack can help provide for those requirements when venturing outdoors. The top items often considered essential to a comfortable and safe outdoor adventure are listed below:

- Navigation (map and compass)
- Sun protection (sunglasses and sunscreen)
- Insulation (extra clothing)
- Illumination (headlamp/flashlight)
- First-aid supplies
- Fire (waterproof matches/lighter/candle)

- Repair kit and tools – duct tape, sewing kit
- Multi-tool with knife
- Nutrition (extra food)
- Hydration (extra water)
- Emergency shelter

(From: http://www.rei.com/learn/expert-advice/ten-essentials.html)

PROCEDURE

Warm-up

Ask the class to list basic human needs. Ask students to list how those needs are met in their everyday living situations. Next, give students the scenario that they are taking an extended day trip into a lake in the mountains. Ask students to think of how those needs are going to be met while they are on their trip and if they end up staying the night at the lake unexpectedly.

The Activity

Tell the class that they are going to work in small groups to develop a checklist of the items, skills, and knowledge that everyone should have to stay safe, healthy and comfortable for a long day hike in the outdoors. The items need to fit into a pack that could be comfortably carried. The class will vote on each groups' checklist as the one most thorough and complete.

To start, students will write down the criteria for a thorough and complete checklist.

The criteria for the checklist should look something like this:

- include the means to have water and food
- provide for shelter, warmth and protection from being wet
- will help the person stay safe.

Write criteria items on the board for all to see, and as a class have everyone agree when it is complete. Optional: develop a rubric to use for evaluating each group's checklist.

Groups can create a PowerPoint, Prezi or other type of electronic presentation, if desired.

Divide the class into small groups of 3 or 4 students. Assign the groups the task of coming up with a checklist of the items, skills and knowledge they feel is most important to be prepared for being outdoors. As part of the checklist students should indicate how each provides for a specific basic human need.

Wrap-up

Have each group present their checklist to the rest of the class. Have the class evaluate each checklist by the criteria that was developed. When all the checklists have been presented, have the class decide which checklist best matches the criteria.

Lead a discussion about the types of activities students could do that would put them into emergency situations. That could include hiking, hunting, skiing, boating, mushroom hunting, berry picking, etc.

Discuss items that would be needed based on the seasons. Talk about survival challenges for winter, summer, spring and fall, that each season requires forethought when selecting emergency items.

ASSESSMENT

Students can be assessed for their participation in the group activity, including the presentation of their checklist. The checklists are a form of assessment that indicates students' understanding of basic human needs, the challenges of spending time outdoors, and their creativity in meeting needs in the outdoors. If groups create an electronic presentation it can be assessed as final project.

EXTENSIONS

Ask students what outdoor skills they know and are willing to share. If several respond, set up a station format in which the

rest of the students move from station to station to learn the various skills students may know. Possible skills could be: fire building, navigation, water purification, knot tying, shelter building and others.

If there are no skills that students want to share, but the class is interested in learning several, community members such as outdoor store personnel, agency personnel such as wildland firefighters, or outdoor hiking and hunting guides may be able to provide demos and hands-on training.

RESOURCES

Further information about survival essentials:

http://www.wildernesscollege.com/wilderness-survival-tips-2.html

http://sectionhiker.com/day-hikers-ten-essentials-guide/

http://www.nemoequipment.com/5-essentials-that-should-be-in-your-day-pack-no-matter-what/

http://boyslife.org/outdoors/outdoorarticles/6976/scout-outdoor-essentials-checklist/

http://www.outdoors.org/recreation/hiking/hiking-essentials.cfm

http://www.rei.com/learn/expert-advice/ten-essentials.html

http://www.rei.com/learn/expert-advice/day-hiking-checklist.html

Ch. 4-7 Quotes about Life and Water

What do people say about the importance of water in a watershed?

SUMMARY

In this lesson students will be given quotes that relate to people living in a watershed in general and the Flathead Watershed in particular. The students will "close read" their quote and then create a small poster that describes the quote, its main ideas and how it relates to their experience of living in the Flathead Watershed.

OBJECTIVES

Students will

- Analyze a watershed quote for full comprehension.
- Investigate the different meaning of a watershed quote.
- Explain the meaning of the watershed quote.
- Compare different watershed quotes.
- Relate the quotes to their personal experience.

Materials

- Large pieces of paper for groups to work on and then present the results
- Water quotes at the end of this lesson
- Journals

Background

Close reading means reading to uncover layers of meaning that lead to deeper comprehension. Close, analytic reading stresses engaging with a text of directly and examining the author's meaning thoroughly and methodically. Students read and reread to increase familiarity with the text and to reveal patterns within the writing.

Directing student attention to specific passages and wording in the text, analyzing it in fine detail as well as from a bigger picture viewpoint enables students to understand the central ideas and supporting details. It also enables students to reflect on the meanings of individual words and sentences, the order in which sentences unfold, and the development of ideas. This leads students to arrive at a deeper understanding of the text as a whole.

www.kidsdiscover.com

In this lesson students focus on the importance of water in the Flathead Watershed and its significance to diverse people. See: Flathead Watershed Sourcebook, Ch. 4, pgs. 103-141,

PROCEDURE

Warm-up

Have the whole class suggest words that they think relate to water in the Flathead Watershed. List these words where they can be seen by whole class.

Look for similarities in all the various ways water is important to the watershed and to living organisms in the watershed, including people. This helps organize student thinking.

Ch. 4-7 Quotes about Life and Water

The Activity

Part 1

Have the students work in groups of 2 or 3. Give each group a copy of the watershed quotes from this lesson or from another source (books, internet or other media). Ask students to write the quote in their journals. Have students paste the quote in the middle of the large piece of paper. Quotes from the Flathead Watershed Sourcebook are provided with this lesson.

As the students read the quote have them make notes under these headings:

- Describe what this text is about in one sentence.
- What are the main arguments?
- How does this quote relate to things I've experienced in the Flathead Watershed?

Flathead Lake: flatheadlakelodge.com

Part 2

Have the students illustrate their quote and restate the main ideas in their own words. Record in big text on the paper all the students' words related to the text.

Wrap-up

Compare the posters and the words students found in the text to the initial ideas suggested in the warm-up section of the activity. Are there similar words and meanings? Are there unique words and meanings?

ASSESSMENT

Have the students present their quote and their poster to the class.

EXTENSIONS

- **In the classroom**

Have the students do some background investigations about the speakers of the quotes. Have the students search for other quotes about the importance and significance of water in watersheds.

- **Outside the classroom**

Have the students ask a family member, acquaintance or friend what they think about the importance and significance of water in the Flathead Watershed and collect a new set of water-related watershed quotes.

RESOURCES:

Information on common core

Common Core Standards and close reading: https://www.learninga-z.com/commoncore/close-reading.html

More quote sources:

Environmental Quotes from the Grinning Planet: http://www.grinningplanet.com/6001/environmental-quotes.htm

Water Quotes http://www.texasthestateofwater.org/screening/html/water_quotes.htm

Water Quotes

"In rivers, the water that you touch is the last of what has passed and the first of that which comes, so with time present." - Leonardo da Vinci, from his notebooks, translated by Edward McCurdy

"A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature."
- Henry David Thoreau

"And an ingenious Spaniard says, that rivers and the inhabitants of the watery element were made for wise men to contemplate, and fools pass by without consideration."
- Izaak Walton (1593-1683)

Night
The forest sleeps and dreams;
the river does not sleep, it sings.
In between the green shadows
the rapid water flows,
leaving on the dark edges
bundles of white foam.
With eyes filled with stars,
in the bottom of the boat
I go with great emotion
by the music of the water.
And I take the river in my lips.
And I take the forest in my soul.

Conrado Nale` Roxlo (1898 - 1971), writer, journalist, and humorist
(Submitted by Jim Vashro)

"All the romance of trout fishing exists in the mind of the angler and is in no way shared by the fish."
- Harold F. Blaisdell, The Philosophical Fisherman, 1969

"Land was created to provide a place for boats to visit."
- Brooks Atkinson, N.Y. Times Theater Critic 1894-1984

Ch. 4-7 Quotes about Life and Water

"The man who is swimming against the stream knows the strength of it." - Woodrow T. Wilson

"Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop off like autumn leaves." - John Muir

"What is life? It is the flash of a firefly in the night. It is the breath of the buffalo in the wintertime. It is the little shadow which runs across the grass and looses itself in the sunset." - Crow Foot (1821-1890)

"Look deep into nature, and then you will understand everything better." - Albert Einstein

"The sportsman lives his life vicariously. For he secretly yearns to have lived before, in a simpler time. A time when his love for the land, water, fish and wildlife would be more than just part of his life. It would be his state of mind." - Jim Slinsky

"Water is life's mater and matrix, mother and medium.
There is no life without water."
- Albert Szent-Gyorgyi, 1893 – 1986

Chapter 5: Influences

Background

"A thing is right only when it tends to preserve the integrity, stability and beauty of the community; and the community includes the soil, water, fauna and flora, as well as the people." Aldo Leopold, A Sand County Almanac, 1949

Introduction

The attraction to—and subsequent growth of—the Flathead Watershed is largely driven by our remarkable natural land and water resources, in particular our clean water. But continued growth puts pressure on the very resources that attract people to the watershed and make life here so special. In the Flathead Watershed, citizens and the environment are dependent upon and affect one another. They continually change and adapt alongside one another.

Our decisions today about where and how we build our homes, where we extract and develop our resources, and what activities we pursue on our land and in our waterways will determine the legacy we will leave our children. (see: Flathead Watershed Sourcebook, p.144) In this chapter lessons address water resource use, its management, stewardship, invasive species and the meaning of conservation.

Essential Questions

- What influences stream erosion and runoff?
- What happens to water quality as impacts accumulate?
- How can we influence pollution and water quality?
- How can we preserve and protect the watershed?
- What are Flathead Lake invasive species?
- What does conservation and stewardship mean to me?

Content

This chapter is primarily about water resources and how people influence the quality of those resources. There are many things that can affect water quality in a watershed. For example, stream channelization can affect erosion and runoff. Human impacts in the watershed include the introduction of invasive species. As we make changes to the environment there is an accumulation of impacts which affect water quality.

However, there are things we can do to improve water resource quality. One important component is conserving the flora or plants in the system. We can educate the public about the effects of storm water runoff and we can build water treatment plants to remove pollutants. All living things affect water quality. In general, values and ethics related to conservation and stewardship can help improve the quality of resources and life in the watershed

Learning Goals

In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
  - Stream channelization, runoff and pollution
  - Accumulation of human impacts
  - Effects of humans on water resources
  - Invasive species

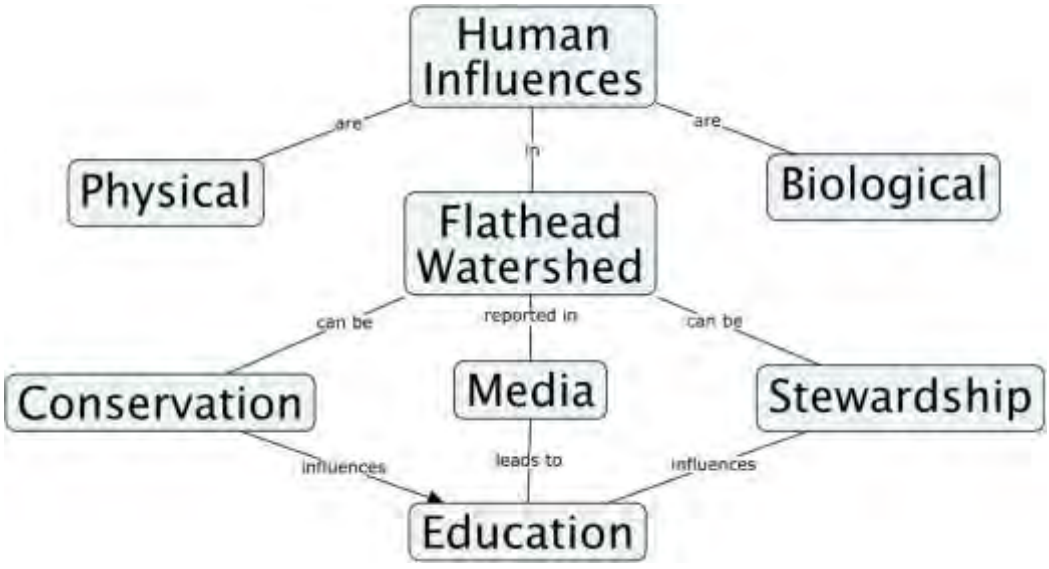
- Skills
  - Education and advertising about water stewardship

- Dispositions
  - Feelings, attitudes, values and beliefs about conservation and stewardship of water resources

Key Concepts

Advertising
Channelization
Conservation
Education
Human impacts
Impacts
Invasive species
Native species
Pollution
Runoff
Stewardship
Streams

Graphic Organizer



Chapter Five Lessons 197

Ch. 5-1 Paint Tray Stream Investigations

How does the stream channel pattern relate to erosion and run-off?

SUMMARY

In an outdoor area or well-protected indoor area students create a landscape with two different types of stream channels in a paint tray with soil and sod. Trays are then sprinkled with water. Students observe and record the characteristics of the water moving through the different stream channel patterns and evaluate their observations to determine how stream patterns affect erosion and run-off.

OBJECTIVES

Students will

- Recognize and re-create different stream channel types found in nature.
- Analyze stream channels for run-off and erosion potential.
- Record observations in field journals.
- Correlate observations made in their investigations with effects seen in the natural world.
- Report on their observations and correlations.

MATERIALS

- Paint trays, (roller type), enough for one per group of 2 to 3 students. Tray liners are flimsy but inexpensive and work well if they won't be moved
- Soil– can be any quality. Several buckets of soil from a garden or lot should be sufficient.
- Sod – a partial roll or several large scraps, possibly donated from a sod or landscape company.
- Twigs, leaves and small rocks for landscaping (students can collect if outdoors).
- Tools to create stream channels – sticks, large craft sticks, spoons
- Watering can with water, or garden hose with spray attachment
- Outdoor area where students can freely work with the paint trays, soil, sod and water, or well-protected indoor area (if indoors, a larger tray to put paint trays in to collect water when sprinkling)
- A place to recycle the dirt and sod when finished
- Clean-up materials – rags or towels
- Information about types of stream channel patterns
- Field Journals or other means to record observations
- Digital camera for still shots and videos (optional)

BACKGROUND

The pattern stream channels make on the land is a function of the slope of the land and the amount of sediment the water is carrying. A stream's natural channel pattern is formed in response to the underlying geology and the land the stream is flowing through. A stream generally erodes either downward in steeper areas with sediment carried downstream or laterally in flatter areas, with sediment deposited in point bars or pools.

In situations where stream channels have been straightened for reasons like flood control, the stream responds with faster moving water capable of greater erosion and greater sediment transport. The end results are:

- Streams with high banks so that the stream can no longer access its flood plains,

- loss of shallow and deeper areas necessary for wildlife habitat as are found in meandering streams,
- water quality degradation from dirt entering water as a result of undercutting of the high banks,
- loss of stable stream-side vegetation due to bank erosion.

Stream and river restoration often involves recreating meanders by recontouring high banks and allowing the waterway to reconnect with its flood plain.

Previously straightened and now restored Jocko River channel. www.riverdesigngroup.com

PROCEDURE

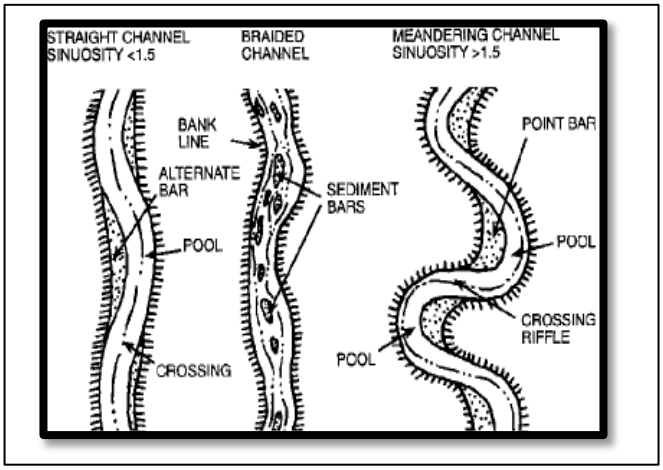
Warm-up

Ask students if they can remember a time when they played in a stream. Ask them if they noticed that some areas of the stream were deeper and others were shallow. Ask if they can see in their mind's eye if the stream curved, and perhaps went out of sight under willows along the banks.

Now ask if any students have seen a stream with high, steep sides, making it difficult to get to the water. If they've seen streams like that, tell them they are looking at a waterway that is cutting down into its stream bed. They may have noticed that the banks were crumbling into the water and the water was rushing past at about the same depth. Such streams are eroding and transporting sediment to another area and may not provide suitable habitat for fish and other wildlife.

The Activity

- Tell the class they are now going to create their own mini-stream channels in trays.
- Show the class examples of stream channel types. Tell them they will be creating two stream channels in their paint trays, a meandering channel and a straight channel.



https://riverrestoration.wikispaces.com/Fluvial+geomorphology

- Divide the class into teams of 2 or 3 people. Challenge the teams to see which one can create a meandering stream that keeps flowing water the cleanest.
- Hand out a paint tray and a couple of tools to each team. Have each team fill their paint tray halfway full of dirt in the deep end of the tray.
- Each team takes sod, enough to partially or mostly cover the dirt in their trays. Sod can be torn into whatever shapes and sizes are needed.
- Teams can collect twigs, leaves and small rocks for landscaping and use the sod chunks to cover dirt and define the stream channels.
- If the landscapes are flat inside the tray, prop up the deep end of the tray so there is enough slope that the water will run out the shallow end of the trays.

- Have teams make a field drawing of their tray before the 'rain' happens.
- When every team is finished, lead a tour around to each tray to survey the landscapes and stream channels. Take photos of each tray with their creators if possible.
- Ask for volunteers to be the first ones to see how water will flow in their mini- stream channels.
- Assemble the class to watch, and have the teams ready with field notebooks or paper to record observations. Have the video recorder ready.
- Sprinkle water on the landscape until the stream channels begin to flow.
- Have the team that created the tray record all observations – the comparative water speed in each channel, any signs of erosion, where erosion is taking place in their stream channels, clarity of the water as it exits the tray, along with an 'after the rain' field drawing.
- Take note of how clear the meandering channel water is to decide who wins the challenge in the end.
- Go to each teams' tray and sprinkle water on each landscape tray, recording observations and making note of water clarity.
- When all the trays have been observed, hold a class vote on which meandering stream channel was best at keeping the flowing water clean.

Wrap-up

Discuss the observations the class has made about the trays. Are there any observations that are true for all the trays? Can the class make some general statements about the two different stream channels?

What can they say about the role of the sod in stream channel stability? Did they notice any correlation between the slope of the tray and flow characteristics of the streams?

Ask students to think of any stream channels in the Flathead Watershed that are similar to the ones in their trays, both the straight and meandering channels.

In the Flathead Watershed, Flathead Lake is often, the place where eroded sediments ultimately are deposited. Can they think of any other areas in the Flathead Watershed where sediments are deposited by stream channels?

At the end of the discussion have students empty their trays back into the buckets and clean up their area.

ASSESSMENT

Building the stream channel tray landscapes is a form of performance assessment. Individual and group observations in their field notebooks can be assessed for participation and understanding.

A final assessment covering the two types of stream channels, their characteristics and effects on the landscape would show student understanding.

EXTENSIONS

Bring in a Rolling Rivers trailer to create different stream channels on a larger scale.

Students can identify impaired stream channels in their area and begin a citizen-science project to monitor water quality.

Students can take a field trip to view different stream channels and possibly a restoration area in progress in the area.

RESOURCES

Information on river restoration techniques:
https://riverrestoration.wikispaces.com/Fluvial+geomorphology

http://itc.gsw.edu/faculty/bcarter/physgeol/river/types.htm

Classroom resource:
Rolling Rivers Trailer –Flathead County Conservation District 406/752-4220

Ch. 5-2 Adding up Impacts in Flathead Waterways

What can happen to water quality as impacts accumulate?

SUMMARY

Students examine the impacts of land use on water quality in waterways and lakes in the Flathead Watershed. Students create a land use plan on a given amount of acreage, and then estimate the impacts on a nearby waterway. Impacts are passed downstream to adjacent properties, stopping at the final downstream property. Intact riparian areas on some land use plans offset impacts.

OBJECTIVES

Students will

- Develop an awareness of land use impacts on adjacent waterways.
- Think about types of impacts according to land use type.
- Show that impacts accumulate as water flows downstream.
- Explain the role riparian areas have in maintaining water quality.

MATERIALS

- Paper, pencils and colored pencils or markers
- Small tokens such as poker chips, pennies, or small random items, up to 5 per student or more

Prepped beforehand:

- 8 1/2" x11" paper, one per student, laid out lengthwise with short edges touching, to create a continuous band of paper. Draw a continuous stream channel with blue ink through the middle or along the edge of all the papers, leaving the majority of each paper blank. Number the sheets of paper consecutively starting from the left in the lower left-hand corner of the paper. The increasing numbers indicate the direction of downstream flow in the stream channel. Put a capital letter R in the upper right corner of a random sampling of about half the papers. Scramble the papers so they are no longer in order.

BACKGROUND

"*A thing is right only when it tends to preserve the integrity, stability and beauty of the community; and the community includes the soil, water, fauna and flora, as well as the people*."

- Aldo Leopold, *A Sand County Almanac*, 1949

Source: Amy Chadwick, Watershed Consulting
www.flatheadwatershed.org

The backbone of the Flathead Watershed is clean water. Our many rivers and streams recharge groundwater and create floodplain areas, riparian corridors, and wetlands that sustain water quality throughout the watershed. These natural systems filter nutrients, trap sediments, reduce flooding, and stabilize soils. Together, these functions sustain our rapidly growing population, our wildlife and fisheries, and our timber, agriculture, and tourism industries. (Flathead Watershed Sourcebook, pg. 139)

Deciduous Riparian Area, Source: Amy Chadwick, Watershed Consulting www.flatheadwatershed.org

Riparian areas and wetlands—where land and water meet—are vitally important to the health of our waterways. They are places where physical, chemical, and biological components work together to create some of the most biologically diverse areas in the watershed. Maintaining the integrity of these areas is critical to the long term health of the ecosystem. (Flathead Watershed Sourcebook, pg. 144)

There are two main sources of pollutants that influence water quality, point and non-point sources. Both are the products of human influence on the landscape. The greatest percentage of stream and lake pollution in Montana comes from non-point sources.

Point sources are discharges from an identifiable outlet such as municipal and public sewage discharge, stormwater outfalls, and industrial discharge.

Non-point sources (NPS) are dispersed sources, including excess erosion from roads, agriculture and forestry activities, and construction, as well as unregulated storm water discharges, individual septic systems, and municipal sewer leakage.

Natural sources of NPS pollution include sediment and nutrients from forest fires and naturally high concentrations of metals and chemicals from rock and soil that leach into surface and groundwater. (Flathead Watershed Sourcebook, pg. 140)

Non-Point Source pollution is perhaps the greatest threat to water quality in the Flathead Watershed. NPS occurs when rainfall or snowmelt move over and through the ground, picking up natural and human-caused pollutants and depositing them into streams, rivers, lakes, and groundwater. NPS pollution originates from multiple sources and is difficult to directly measure. It is also responsible for the largest number of impaired miles of streams throughout the state of Montana (impaired streams do not meet Montana water quality standards).
(Flathead Watershed Sourcebook, pg. 147)

PROCEDURE

Warm-up

Ask the class to think of a stream they've visited lately or have seen in a picture. Ask students to describe the banks of the stream – what kinds of plants are growing, can they see or hear birds and other wildlife, is there bare soil or are the banks vegetated, is the water clean or muddy, and any other observations they can remember.

Tell the students that the belt of green leafy plants growing along the banks of a stream are called 'riparian areas' and that while they are important habitat for wildlife, they serve an important function in keeping land use impacts from degrading water quality.

The Activity

- Tell the class that each one of them has received a large piece of land with a stream running through it, along with a large sum of money. The land is not developed in any way and they can use the land for anything they desire. They can decide if the land is forested or not.

- Pass out the papers with the stream channel drawn in. Have the students look over their papers to see if they have a capital R.
- If they do, they have to draw in the riparian area. They cannot develop the riparian area, cut down the vegetation, or change the banks. They can put a trail down to the water and along the bank. Give the class time to draw in any changes they would like to see if they choose to develop their land.
- When all the students have completed their drawings, have them look at the number in the lower left-hand corner of their paper.
- Ask everyone to arrange themselves in order by their numbers so that the stream channel is laid out completely. (The papers can take up a long stretch of the room. Moving desks, or laying out the papers in the hall, or taking everyone outside are options)
- Starting with the student with the first number, have that student explain to the rest of the class what they've decided to do with their property. For each impact they've had on the stream, give them one token. Students can accumulate any number of tokens. If they had an R on their paper they should have an intact riparian area, in which case they still accumulate tokens from their own land uses but give back their accumulated tokens at the end of their turn. If they do not have an R on their paper, they keep the tokens they are given. The student then passes their tokens, if any, to the next person downstream.
- The process repeats with each person in order downstream. Those people with intact riparian areas on their property still receive tokens, but then pass them back to the teacher at the end of their turn. However, they keep the tokens passed down to them from upstream users and pass those on to downstream property owners.
- The last person downstream has all the accumulated tokens plus any tokens they have gained from their own land use impacts.

Have the class look at the pile of tokens that have accumulated and discuss the water impairments the tokens represent.

Note that even if the last person has an intact riparian area along their stream, the water flowing through their property is still impaired because of the land use practices of other people.

Let students know that this type of pollution is called 'non-point source' pollution because it comes from many small sources, not one 'point source' that is easily identified. Non-point source pollution is a major contributor to impaired water quality yet it is the most difficult to identify and control.

Wrap-up

Lead a discussion about the impact of the riparian areas in the stream channel that has just been created. Discuss with students why riparian areas can maintain and improve water quality (riparian areas prevent stream bank erosion, act as a filtration unit for surface run-off, create habitat for wildlife and fish, moderate water temperatures, filter water flowing through streamside vegetation, loosen packed soil with roots to allow water filtration through the soil).

Discuss the different sources for stream impacts. Ask the class to identify stream impacts from as many different land uses as they can think of. Let students know that stream impacts can occur from road- building, mining waste run-off, fertilizer and pesticide run-off, soil erosion from bare land, groundwater contamination, oil, gas and rubber from vehicles both on land in water, septic tank malfunctions and drain field leaching, and more.

Coal bed mining. Source: Erin Sexton
www.flatheadwatershed.org

Paths cutting through riparian areas caused by cattle
deq.mt.gov

Ask students about their opinions of land use planning. Should property owners have the right to do whatever they choose on their own property, even if it affects downstream users?

Discuss Best Management Practices (BMPs), actions that landowners and others can take to minimize or end water quality impacts from property development. (See pg. 147, Flathead Watershed Sourcebook)

Let students know that in Montana, the water in streams is owned by the state. There are regulations prohibiting water pollution and property owners need to apply for permits for any actions that affect water quality and quantity in streams, rivers and lakes.

ASSESSMENT

A short-answer assessment asking students to reiterate the definition of point and non-point source pollution and to list the impact of riparian areas on maintaining and improving water quality can serve as an exit ticket after the Adding Up Impacts activity is finished.

EXTENSIONS

A field trip to examine a stream channel with intact riparian areas and impacted areas would clearly illustrate the differences between the different types of land use.

A service-learning project that identified and restored an impacted stream channel with minimum riparian areas would make an excellent class project.

Complete an Adding up Impacts assessment on an actual stream or river. Obtain aerial photos or use Google Maps to study land use along a waterway of interest.

RESOURCES

Further information on wetlands and riparian areas:
http://water.epa.gov/polwaste/nps/wetlands.cfm

http://water.epa.gov/learn/resources/index.cfm

http://water.epa.gov/learn/training/wacademy/index.cfm

http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/cp/ncps/?cid=nrcs143_026849

Wetland and Riparian Studies Trunk - (Grades 4-8) – Contact the NW MT Educational Cooperative 406/752-3302

Ch. 5-3 School Stormwater Stencil Projects

How can we clean up pollution in stormwater leaving school grounds?

SUMMARY

Students will examine their school grounds for evidence of the stormwater system around their school. Students will map their school grounds, analyze maps for stormwater run-off and hypothesize about what might be in the run-off from the school grounds to the stormwater system. Students will stencil or paint No Dumping signs at stormwater drains.

OBJECTIVES

Students will

- Map out their school grounds with the stormwater drains indicated.
- Understand that stormwater may carry pollutants into local streams, rivers and lakes.
- Hypothesize about the types of pollutants entering the stormwater system at their school.
- Appreciate that citizens can be responsible for clean water in their communities.

MATERIALS

- Field journal or notebook, or paper on a clipboard
- Pencils and colored pencils or markers

For stenciling project:

- Stencil that says: No Dumping, etc., or other wording; (alternative: freehand wording and images)
- White and/or other color latex paint
- Protective gear: gloves, smocks
- Paint trays and rollers
- One or more brooms
- Washing up gear: soap, towels, water
- Digital camera or video equipment
- Media contacts to publicize event

www.bluewaterbaltimore.org

BACKGROUND

In undisturbed landscapes, rainwater runoff is part of the natural hydrologic cycle. Vegetation, soils, and a wide range of organisms filter, absorb, and use rainfall in their living processes. Evaporation and transpiration takes place. Excess precipitation infiltrates into groundwater and flows into surface waters, recharging aquifers and supporting aquatic life.

The entire system is affected when the landscape is changed: impervious surfaces (paved streets, parking lots, rooftops, etc.) prevent runoff from percolating into the ground and cause it to pick up debris, sediments, chemicals, and other pollutants as it moves over the ground.

An example of NPS pollutants entering a watershed: http://www.stormwaterpa.org/best- practices-overview.html

As water flows across these hard surfaces, it picks up sediments, winter deicers, vehicle oil and grease, and other

polluting substances and transports them into storm drains which lead directly to our waterways. Unlike porous terrain which allows water to filter into the ground, impervious areas cause runoff to accumulate above the surface and move in large quantities into surface waters.
(Flathead Watershed Sourcebook, pg. 154)

PROCEDURE

Warm-up

Ask students if they know where the water goes when it rains on the school grounds. Some students may know about the stormwater system and the difference between absorbent and impervious surfaces. If so, have them share with the class what they know.

Otherwise, ask students to think of the different surfaces that cover the land that makes up the school ground area. What do they think happens to the water falling on the different types of surfaces?

Absorbent surfaces like grass, gravel and wood chips allow water to soak in, while hard surfaces like pavement and roof tops cause water to flow off, taking whatever is on the surface with it.

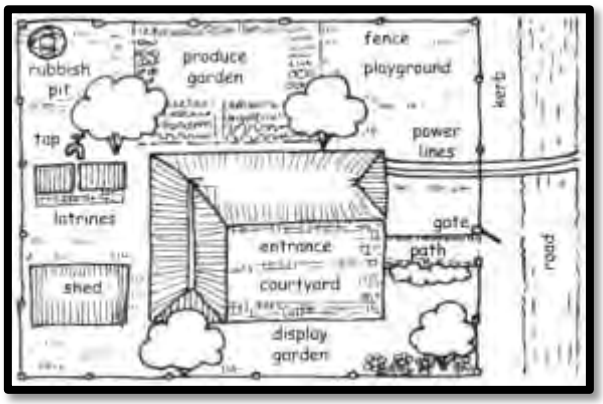
Tell students that under many city streets there is a system of pipes that carry stormwater away from the streets, usually carrying it away to drain into nearby surface water such as a stream, river or lake. Whatever is swept along with the draining rain water will also go into that nearby surface water.

The Activity

Head outside with the class, asking them to bring their journals or clipboards with them.

Walk around the school grounds as a group to determine where the absorbent and impervious surfaces are located. Include the school building/roof as an impervious surface. As the class tours the grounds, have them look for signs of water draining off the grounds, stormwater drains on school grounds, stormwater drains along street curbs, and roof gutter downpipes.

Tell students they are now going to draw an aerial map, or a birds-eye view of the school grounds, roughly to scale (the building, playgrounds, sidewalks, etc. are in rough proportional size). On their maps have them draw in the locations of all the storm drains, including roof drains.



www.fao.org

After students have drawn storm drains on their maps, have them think of where rainwater will flow off the school grounds and into the drains. Students may need to walk the grounds again to see what areas will drain in which directions. Have students draw arrows to indicate flow directions on their maps. Students can use colored pencils to illustrate different areas and different flow directions.

Gather students together and hold a discussion about what types of pollution could flow into the storm drains from the school grounds. Answers could include food scraps and wrappers, small articles of clothing, dirt and gravel, de-icing salt and sand, oil and gas leaks from cars and mowers, fertilizers and pesticides from lawn care, paint chips from building walls and ceilings, sidewalk chalk and paint, and more.

Let students know that this type of pollution is called 'non-point source' (NPS) pollution since it comes from many points, not just one big source. It's the most common source of water pollution, and one of the hardest to deal with.

Ask students for suggestions on how to reduce or eliminate NPS pollution from the school grounds, now that they know where the water flows from, and what types of pollution the water could be carrying.

As students come up with ideas, ask someone to record the ideas on paper. The ideas could become a service-learning project at a later date.

Wrap-up

Before beginning the stormwater drain stenciling project, check with school and city officials to let them know about the project and ask if they have any objections. Many cities contribute materials and manpower to help out with stenciling projects.

www.clark.wa.gov

Stenciling Project

Carry the stencil materials to the storm drains that will be marked that are on or near school property. Assign tasks to various students: sweepers to remove dirt and gravel, stencil holders, paint sprayers, and traffic watchers. Rotate tasks for each storm drain.

Take photos and/or video the stenciling process. Check with parents or guardians for permission to take photos for students. If media professionals have been notified, make sure they have student and teacher names spelled correctly and find out when and where the news will be broadcast. Let them know about the school grounds maps and possible service projects to reduce and eliminate NPS pollution from school grounds.

ASSESSMENT

The school grounds maps serve as a project-based assessment. A brief short-answer quiz or short paper on the nature of non-point source pollution would determine students' understanding of the concepts.

EXTENSION

Students can develop one or more of the ideas the class discussed about ways to reduce or eliminate NPS pollution from school grounds.

Students could create an information campaign to educate their families and other students about stormwater run-off, NPS pollution and the stormwater drain systems in their communities.

Students can map stormwater drainage at their own homes and stencil storm drains in their neighborhoods.

Students can do research into other water quality improvement measures they can take at their school or in their neighborhoods.

RESOURCES

School grounds mapping project: an example of a hand-drawn aerial view map of a school grounds.
http://www.fao.org/docrep/009/a0218e/a0218e05.htm

Ch. 5-3 School Stormwater Stencil Projects

Amazing examples of street art!
http://www.stormwaterpa.org/the-street-art-of-stormwater-stencils

Girl Scouts doing stenciling projects_
http://www.watersheds.org/outdoors/girlscouts1.htm

Newsletter article about stormwater stenciling in Polson watershed summer camp, 2011:_
http://www.flatheadlakers.org/uploads/pdfs/Flathead%20Lakers%20Newsletter%206-11%20WEBSITE.pdf

http://www.clark.wa.gov/environment/stormwater/stenciling.html

http://www.bluewaterbaltimore.org/protect/stencil-a-storm-drain/

www.bluewaterbaltimore.org

Ch. 5-4 Visiting Water Treatment Plants

What happens to our water after we use it?

SUMMARY

Students will visit a wastewater treatment plant in their community. They will ask questions to fill out a questionnaire about water treatment and use. Students will discuss drinking water and wastewater treatment options.

OBJECTIVES

Students will

- Understand the steps of the water treatment process that must occur before water can be safely used by community residents.
- Compare and contrast the water treatment guidelines used in different water treatment plants.
- Appreciate the practices of their own community water treatment plant with regards to safe water treatment.

MATERIALS

- Contact information to set up a date and time to tour water treatment facilities
- Field trip arrangements
- Field notebooks
- Question sheet (included at end of lesson
- Clipboards for students, if available

BACKGROUND

Sewage consists of household wastes, industrial wastes and street runoff. Much of the household sewage consists of food products

Street runoff often contains oils and grit. Industrial wastes vary but are not supposed to contain hazardous wastes. In recent years an attempt has been made to keep street runoff separate from the sewage waste waters. It may then be processed differently.

Kalispell Wastewater Treatment Plant: m-m.net

The treatment of urban sewage consists of three phases: primary, secondary and tertiary treatment.

Primary Treatment generally involves first mechanically filtering out large materials such as sticks, tires, rags etc. It may also include the sedimentation of grit and other heavy solids and the skimming of floating oil and grease from the surface.

Secondary Treatment involves biological digestion of biodegradable organic wastes. This is usually an aerobic process requiring large amounts of oxygen. This process should reduce the biological oxygen demand (BOD) by about 90%. (That is the amount of oxygen needed to decompose these compounds, e.g., the amount that would be taken from a lake if the sewage were dumped into a lake.) This process is carried out by bacteria which are settled from the water before the water is released into natural bodies of water.

Tertiary Treatment involves removing mineral nutrients and other compounds remaining after secondary treatment. This may be done by chemical means or by biological means such as running the sewage through a marsh to remove most of the nutrients, heavy metals etc.

The sewage plant effluent may be treated with chlorine or ultraviolet light to kill any bacteria and other microorganisms which remain after the treatment process. The treatment of sludge from the primary settling tanks and the sludge from the secondary bacterial settling tanks (activated sludge) may differ from plant to plant. For more information, read Flathead Watershed Sourcebook, pgs. 156-157.

PROCEDURE

Warm-up

Pre-tour discussion:

Open the discussion by asking students where their water comes from before use and where it goes after use. They might not understand that their water doesn't come straight from the ground or from a surface water supply. Students may not be aware that water is treated in a water treatment plant prior to being sent into the homes and buildings in the community. Most students will know that water is treated after leaving homes and buildings in a wastewater treatment plant.

Students should also discuss the activities in their local watershed that may be possible sources of contamination to their own community's water system. They can also discuss how actions by their community may affect other communities' water systems.

The Activity

Take a tour of the water treatment plant. Students should be able to answer the questions in their question sheet throughout the tour. (They may need prompting and reminding… encourage them to fill in the answers during the tour rather than waiting until the end when they might already be forgetting important information). Gather whatever brochures and pamphlets that are offered to you while you are there.

Wrap-up

Recap the tour with the students by discussing their Water Treatment Plant question sheet answers.

Encourage students to come up with new questions of their own. This could provide an opportunity for students to undertake a major research project.

If student interest in the subject is apparent, encourage them to investigate these issues and share their findings with the school and community. This is a great way to bridge classroom learning outcomes with relevant community issues.

Students may also have their own ideas of showing what they have learned. Encourage them to share their plans and work with them to develop a rubric that will outline the goals they plan to meet.

ASSESSMENT

Students hand in their answers to the field trip questions. You can also mark the students' participation and behavior while on the tour.

EXTENSIONS

Students can research water treatment issues and practices in their communities. Research topics include:

- Comparing/contrasting a community's water treatment practices with the other neighboring communities.
- Comparing/contrasting examples of urban, rural and First Nation water treatment processes.
- Comparing/contrasting water quality

Ch. 5-4 Visiting Water Treatment Plants

RESOURCES

Further information on human uses of water resources:
http://www.caryinstitute.org/educators/teaching-materials/teaching-local-water-cycle/teaching-local-water-cycle/where-does-our

Waste water treatment in the Flathead:
https://flathead.mt.gov/wastewater_management/documents/FlatheadCotreatingwastewaterintheflathead_000.pdf

City of Kalispell Advanced Wastewater Treatment & Biological Nutrient Removal Facility at:
http://www.kalispell.com/wastewater_treatment/

Flathead Lake MATTERS: How the Bigfork Water and Sewer District protects water quality:
http://www.flatheadnewsgroup.com/bigforkeagle/flathead-lake-matters-how-the-bigfork-water-and-sewer-district/article_f2a0a2ca-e5a3-11e2-9b4d-001a4bcf887a.html

See Water Treatment Question Sheet below:

Ch. 5-4 Visiting Water Treatment Plants

Wastewater Treatment Plant Questions: Before, During and After the Field Trip

1) Track your water usage for 1 day:
- What activities required water?
- Which activity(s) required the most water at the end of the day?
- Estimate how many gallons of water you used:
- What did you add to this water that made it 'dirty'?

2) Think about the water cycle. Is there a new water making factory making new water for everyone to use?

3) All of the water you used was drinking water. Where did it come from?

4) Where will this water go when it leaves your house?

5) If this dirty water went directly to Flathead Lake what might happen? Consider people, plants, animals and the environment.

6) What is the difference between water that runs off a road, house or yard and into the storm drain (stormwater) vs. water that leaves a drain or toilet in your house (wastewater)?

7) Pick one of the following cycles to draw or describe in writing. Make sure and include yourself and the wastewater treatment plant in the cycle.
- Water cycle
- Nutrient cycle
- Pollutant cycle
- Energy cycle

8) What happens if too much water enters the sewer system?

9) Think about all of the pipes and pump stations that help move dirty water away from your home or school. How old are they? How big are they? What are they made of? What happens as these pipes get old?

Ch. 5-5 Advertising BPM's for a Cause: Best Management Practices for the Flathead Watershed

What actions can we take to conserve and protect our watershed?

SUMMARY

Students will closely read the best management practices (BMPs) listed in the Flathead Watershed Sourcebook and develop an advertising campaign to inform the community of BMPs: actions they can take to protect water quality in the Flathead Watershed.

OBJECTIVES

Students will

- Read and interpret BMP information from the Flathead Watershed Sourcebook.
- Create informational materials about BMPs.
- Determine ways to inform their community about BMPs.
- Recognize that personal choices about actions can make a difference in their community.
- Understand that their voices can influence others and be a factor for conservation in their watershed.

MATERIALS

- Flathead Watershed Sourcebook, pgs. 147, 154, 156, 159, 161, 162-164, 165, 170, 172-177
- Selected means to create advertising: paper, markers, digital recording items, software such as Prezi, Power Point, YouTube video, voice recorders, blogs
- Access to public media: newspapers, radio, websites, television

BACKGROUND

Definition of Best Management Practices:

Methods or techniques found to be the most effective and practical means in achieving an objective (such as preventing or minimizing pollution) while making the optimum use of resources.
(adapted from: www.businessdictionary.com)

BMPs are widely recognized as standards of practice in fields where environmental quality is at stake. Forestry, mining, land development and use, agriculture, outdoor recreation and other areas have acknowledged BMPs that agencies and industries are often mandated to follow.

www.flatheadwatershed.org

Other BMPs are common sense actions that citizens can take to mitigate their own impacts on their environment.

Learning about and practicing BMPs and informing other community members can help ensure that citizens continue to be stewards of the environment in their watershed.

Ch. 5-5 Advertising for a Cause: Best Management Practices

www.chesapeake.org

PROCEDURE

Warm-up

Ask students to name some of the actions they and their families take every day to help take care of the environment in their watershed. Students could respond with: recycling trash, conserving water by not letting it run, watching their energy use by keeping their houses a little cooler in winter and warmer in summer, not driving more than needed, staying on trails when hiking, and many more.

Let students know that the actions that people take to care for the environment are called best management practices, or BMPs, and often specific industries have written lists of BMPs that businesses and agencies are tasked to follow.

The Activity

Tell students that they are going to become advertisers in their community about BMPs that ordinary citizens can follow as watershed stewards.

Brainstorm with the class all the ways they can get the word out about best practices. It could include YouTube videos, public service announcements (PSAs) on radio and television, brochures and flyers, posters, newspaper and magazine articles, websites and blogs, and possibly others.

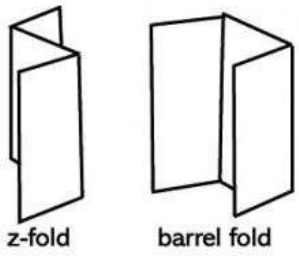
List on the board the areas of BMPs, based on Flathead Watershed Sourcebook information that students can create advertisements about:

- Wetlands and Riparian Areas,
- Non-Point Source Pollution,
- Water Treatment,
- Low Impact Development,
- Landscaping,
- Agriculture – Livestock and Farming,
- Aquatic Invasives,
- Outdoor Recreation

www.flatheadbasincommission.org

To decide on what BMPs to advertise, have students read over the Flathead Watershed Sourcebook pages listed in the Materials section of this lesson.

Option A: As a class, decide on which way they will spread the word about BMPs. Each team of students will create a similar advertisement. The class may decide to take on one set of BMPs to advertise, such as Outdoor Recreation, or teams of students may choose different BMPs to work on.
Depending on the media chosen, advertisements could be formatted in similar ways for all the groups, (i.e. type of tri-fold brochure, formats for YouTube videos, and formats for radio announcement).



hubpages.com

Option B: The whole class decides on one BMP, and then each team of students chooses a different advertising format, i.e. brochure, video, radio, newspaper, etc. The whole class then generates a set of advertising tools for different media. The classes' advertisements, taken together, create an advertising campaign for their chosen BMP.

To start, have each group create a plan about what they want to say and how they will say it. Have the teams work together, comparing plans to ensure they are creating a cohesive campaign message.

Wrap-up

When the advertising campaign is complete, hold a viewing for the whole class. Invite the principal to participate along with local resource conservation professionals from conservation districts, Forest Service, and others. If the class chooses, share the advertisements with the whole school and community.

ASSESSMENT

The final assessment for this activity are the completed advertisements created in the small groups along with the advertising campaign consisting of all the advertisements put together. Formative assessments during the project could be checking for understanding during reading and individual participation in the group project.

EXTENSIONS

The term 'advertising campaign' implies a plan for getting the advertisements out to public. Have the class create a plan for how to go about an actual 'campaign' and then put it into action.

Bring in media professionals to discuss the process of creating effective advertising.

Look at an overview of the careers involved in advertising and in watershed stewardship. Have students talk to professionals in those fields in a class visit.

Take a field trip to look at BMPs in action on the ground. Visit a stream restoration site, a logging operation, or land development area to observe best practices and talk to on-the-ground professionals.

RESOURCES

There are BMPs for many industries and actions that involve the environment. An internet search for specific types of BMPs would be an efficient way to find that information.

Many agencies such as the Flathead Conservation District, City of Kalispell or Polson, the Forest Service, Park Service, Dept. of Natural Resources, and others are an excellent source of BMPs and the regulations regarding their use.

Specific industry professionals such as loggers, construction companies and resource conservation professionals would be an important source of information on implementation of BMPs in their work in the field.

Ch. 5-6 Investigating Flathead Flora

How does planting willows in riparian areas promote sustainability?

SUMMARY

In this activity students will collect and preserve common plants in a class herbarium. The class will collect and root willow cuttings with a plan to plant them in compromised riparian areas.

OBJECTIVES

The students will

- Understand the types of plants and where they live within the Flathead Watershed.
- Construct an herbarium.
- Root willow saplings and plant them in a riparian area.
- Appreciate the diversity of flora and the need to restoration of riparian areas.

MATERIALS

- Cardboard
- Newspaper
- Plywood
- Straps/rope
- Willow cuttings

BACKGROUND

Riparian vegetation growing along the edges of streams, creeks, and rivers is critical for controlling erosion and providing wildlife habitat. This vegetation includes grasses, forbs, and woody plants such as willows and aspen.

Many riparian areas would benefit from more willows. Improving management practices such as grazing often results in more willows but on some riparian areas willows must be planted. Planting willows can be an effective technique to quickly reestablish new populations. Be sure to read the Flathead Watershed Sourcebook, pgs. 45-47, related to plant life (see online: http://www.flatheadwatershed.org/natural_history/plant.shtml)

Willows are among the most common woody plants found in riparian areas. They are an important source of food and cover for wildlife. Their roots hold the stream banks in place and provide a place for fish to hide. They also provide shade to help reduce stream temperatures.

Classroom willow cuttings

A herbarium is a collection of preserved plant specimens. Herbarium specimens form an important record of what plants grew where over time. They may have been created for an environmental survey or botanical research, and serve as a permanent record allowing anyone to go back and check the identification, re-sample or repeat research.

Plant presses are used to flatten and preserve specimens for herbarium collections. The production of herbarium specimens is an important, but often forgotten aspect of botanical studies.

There are 3 steps to making a good herbarium: collecting, pressing and labeling. See directions at the end of this lesson on creating your own plant press out of readily available materials.

PROCEDURE

Warm-up

Take a walk around the school and point out types of plants found there. Have the students make records in their field notebooks. Discuss experiences with plants and add impressions to field notes. Draw the plants in field notebook.

The Activity

Plant Identification and Collection

Prepare or borrow a few plant presses for the entire class. Bring some plant samples to class and demonstrate how the press works and how to collect plants. To make a plant press see the instructions at the end of this lesson.

Have students collect several examples of plants in the Flathead Watershed. Have students work on their own, in small groups or as a class. In class have the students identify the plants.

Be sure students take field notes about the location and time that they collect plants for the herbarium. Use internet resources or field guide to identify plants.

Riparian Restoration

Before starting a willow restoration project, check with local agencies and land owners for appropriate areas to cut and plant willows. Obtain any permission needed. Willow planting areas may need preparation before planting.

Arrange for follow-up care for the willow plantings before getting started.

Collecting and rooting cuttings

Collect willow cuttings. In order to sprout and then grow, willow cuttings must be collected when they are dormant. Normally once the leaves have fallen from the plant and the nighttime temperatures are consistently below freezing, i.e. late fall, winter, early spring, they are dormant enough to be collected for cuttings.

Willow cuttings should be taken from plants growing in riparian areas similar to where they will be planted. Often cuttings can be obtained on nearby streams or on different portions of the same stream where they will be planted. If that is not possible, select willow species that grow in riparian areas. Those cuttings with root tissue develop earlier than those taken from the top of the stems.

To avoid planting the cuttings upside down, cut the bottoms at a steep angle and the tops flat. All the cuttings should be stripped of long branches to avoid excess drying before transplants have developed enough roots. The cuttings can be stored in bundles placed in plastic bags in a cool place.

Alternative to rooting willows in water: growing willow cuttings in a classroom

Willow cuttings should be soaked in water before planting. About seven to ten days before planting, place the cuttings in buckets and fill them with water. The water should be deep enough to cover the bottom half of the cuttings. It needs to be changed every two days as roots need oxygen to develop. Roots grow best if the water is about 60 degrees Fahrenheit.

Do not soak the cuttings too long as the roots will overdevelop and break off when the cuttings are planted. After soaking, keep cuttings moist and out of direct sunlight till planting.

Planting the cuttings

Take a field trip and plant the rooted willows in an appropriate riparian area.

Cuttings should be buried to at least one-half their length or deeper when possible. In loose or gravelly soil, a steel rod can help poke the hole.

Planting in groups is better than spacing individual cuttings several feet apart. Tamping with a foot ensures good soil contact. It is not unusual to lose up to one-half of the cuttings planted.

Group plantings increase the chance of a willow colony getting started. Established willows increase rapidly by sprouting and widely spaced colonies can spread over large areas.

Wrap-up

Caring for willow cuttings after planting is very important to ensure survival. Arrange for watering during the first weeks and months after planting if cuttings are planted in areas with low groundwater.

Weeding around the cuttings in the first weeks and months after planting is also very important for survival. Plan to have volunteers or the class return to the willow plantings to do follow-up maintenance.

Visit that same area and repeat plantings until vegetation has taken hold. Record observations in field notebooks.

ASSESSMENT

Each student will have contributed one permanent specimen to the flora collection.

Notes in field notebook will include types of plants and where they live. Students will have continuous notes regarding the willow rooting investigation.

EXTENSIONS

Have a representative from Montana Native Plant Society, Flathead chapter, another citizen group or an agency such as the local conservation district or Forest Service come to discuss types and location of plants and current restoration activities.

RESOURCES

Information on willow planting and riparian are conservation:
http://www.motherearthnews.com/nature-and-environment/trees-for-soil-erosion-zmaz86mazgoe.aspx

https://www.youtube.com/watch?v=Jp0WTe1bpw8

https://www.youtube.com/watch?v=oBkk5tm1rY

Montana Native Plant Society at:
http://www.mtnativeplants.org/Flathead

http://www.flatheadlandtrust.org/places-we-protect/river-to-lake-initiative/

How to make a plant press:

There are a variety of ways to make a plant press. An easy and economical method can be constructed with materials from recycling materials. This is what you will need:

- Several old newspapers
- Corrugated cardboard
- Two pieces of wood
- Two straps with buckles that can be secured—belts, canvas straps, light bungee cords or rope

Fold individual sheets of newspaper along the normal folding creases. These folded sheets act as blotters.

Cut the cardboard to fit the folded newspaper blotters. Be sure the zigzag corrugation to run through the width of your cardboard, not the length, to allow for maximum airflow.

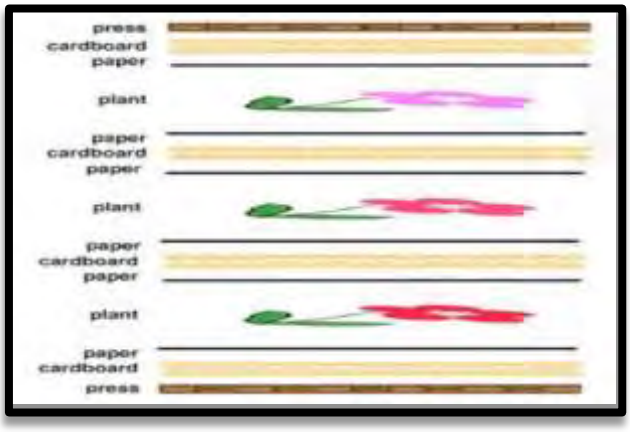
Assemble your press by placing three single sheets of folded newspaper on top of one piece of cardboard, and then continue by layering another piece of cardboard, three more individual sheets of folded newspaper, and another piece of cardboard.

Next, sandwich your stack between two pieces of wood that measure about the same as the cardboard.

Secure two straps around the width of the boards to hold it all together. Old belts work well; keep in mind that the press doesn't need too much pressure to work.

There are many YouTube videos on making plant presses. A few of them are:

- https://youtu.be/LyuK6qwlqBg
- https://youtu.be/5IbeK62ix-E
- https://youtu.be/dyxA6wyvAR0
- https://youtu.be/rhspYfnQM9M



Order of layers in a plant press

Finished plant press: compleatnaturalist.com

Ch. 5-7 Flathead Watershed Aquatic Invasive Species

What are Flathead Watershed invasive species and how do these affect people?

SUMMARY

Students learn about aquatic invasive species (AIS) and about specific invasives in the Flathead Watershed. Students design the ultimate invasive species and explain its characteristics.

OBJECTIVES

Students will

- Understand the AIS found in the Flathead Watershed.
- Communicate to the public about AIS.
- Appreciate citizen efforts to address AIS.

MATERIALS

- Flip chart/poster paper
- Scrap paper for note taking
- Color markers or pencils
- Information about specific AIS (to be created)

BACKGROUND

Aquatic Invasive Species (AIS) are plants such as Eurasian Watermilfoil *(Myriophyllum spicatum)*, animals such as zebra mussels (*Dreissena polymorpha)*, and other organisms such as *Myxobolus ceresbralis,* the parasite that, along with the aquatic worm *(Tubifex tubifex),* causes whirling disease in trout.

Once introduced into new habitats, these organisms disturb native species through competition, predation, displacement, hybridization, spread of disease and parasites, and they can ultimately cause the extinction of many valued organisms. AIS also affect humans by adversely impacting commercial, agricultural, aquacultural, and recreational activities that depend on water resources.

There are a number of ways for aquatic invasive species to find their way into the Flathead Watershed. It is important that anglers, boaters, and personal watercraft users help stop the spread of aquatic invasive organisms. Our lakes are a prime habitat for invasive nonnative species to become established and destroy the native habitat while also negatively affecting our economy. AIS are a growing concern in the Flathead Watershed (Flathead Watershed Sourcebook, pgs. 169- 172, see online at: http://www.flatheadwatershed.org/influences/invasive.shtml).

prezi.com

PROCEDURE

Warm-up

Ask students if they know what it means to invade someplace. Ask students what is a species. Combine these ideas into invasive species in the Flathead Watershed.

Invasive species are organisms that are introduced from somewhere else and take over the environment. They cause problems for other plants, animals, and people. Compare characteristics of invasive species to non-native species that are not considered invasive.

Ch. 5-7 Flathead Watershed Aquatic Invasive Species

Invasive species often have physical traits that enable them to reproduce and spread rapidly, outcompeting native species for resources. Their physical traits make them difficult to control.

Introduce aquatic invasive species to the class. Provide some examples of different aquatic invasive species that are found in the Flathead Watershed, using some of the resources in the Flathead Watershed Sourcebook and in this lesson. Discuss with the class why these species are considered invasives, listing how each species outcompetes native species or dominates habitats.

Introduce the zebra mussel as the 'ultimate invasive species'. Discuss zebra mussel characteristics that give it extreme advantage over native species.

The Activity

Divide students into teams (three to five students per team) and ask them to design, draw, and describe the characteristics of their own ultimate invasive species. The species must be an aquatic species. Each description should include the invasive characteristics of their species. Encourage students to be creative. If students need help getting started, here are a few questions they might consider:

- What are the characteristics of this plant or animal?
- What is its native habitat?
- How did it get to the Flathead Watershed?
- How does it reproduce?
- What is it capable of doing?
- What does it look like? (Draw a sketch.)
- Where does it live?
- What does it eat?
- What eats it?
- Where did it come from?
- What is its name?
- What might you do to control, compete or co-exist with it?

Wrap-up

Have the students make a three-minute presentation on their aquatic invasive species with illustrations.

ASSESSMENT

Assess the student presentations using standard communication skills and points for creativity. Video record the presentations and share them with other classes.

EXTENSIONS

Focus on the ultimate invasive species: the zebra mussel. Have students research about the zebra mussel, and ask students to track the zebra mussel through time or across the country. Have students research current practices around the state/ country to prevent the spread.

Have the class take part in an Invasive Species Watch, where students can help find and report on locations of different invasive species in the Flathead Watershed. Go to the Montana fish, wildlife and Parks website on aquatic invasive species at http://fwp.mt.gov/fishAndWildlife/species/ais/.

RESOURCES

Information on invasive species and other teaching resources
Center for Invasive Species Management at http://www.weedcenter.org/education/k-12.html

Project Learning Tree
https://www.plt.org/prek-8-activity-12---invasive-species

Flathead Basin Commission Report at http://www.flatheadbasincommission.org/chd_bcdc10/files/FBansPlan2010.pdf

Flathead Basin Commission: AIS traveling trunk:http://www.flatheadbasincommission.org/chd_sec3pg7.asp

Ch. 5-8 What is the Meaning of Conservation?

What does conservation mean to you?

"Conservation is ethically sound. It is rooted in our love of the land, our respect for the rights of others, our devotion to the rule of law."
- Lyndon Baines Johnson, 1908 –1973, 36th U.S. President.

SUMMARY

Students will explore the concept of conservation through readings and in discussion with others. Students will develop their own sense of conservation through examining their 'personal 'sense of place' in connection with the Flathead Watershed.

OBJECTIVES

Students will

- Closely read and interpret perspectives from the Flathead Watershed Sourcebook.
- Contribute to discussions regarding conservation ideas.
- Understand and write down their sense of conservation.
- Reflect on their 'sense of place' in the Flathead Watershed.

MATERIALS

- Paper and pencil or journals
- Perspective readings in the Flathead Watershed Sourcebook

Each student reads all three readings:

1. *A Legacy of Clean Water, Habitat and Farm Land Along the Flathead River,* Jim Mann, pgs. 148-149
2. *Highway Reconstruction with Spirit of Place*, Whisper Camel, wildlife biologist, CSKT, pgs. 160-161
3. *Brokering a Solution,* Mike Koopal, Founder and Executive Director, Whitefish Lake Institute, pg. 158

Students choose one or both of these readings:

4. *River to Lake Initiative*, Constanza von der Pahlen, Critical Lands Project Director, Flathead Lakers, pg. 149
5. *Flathead Land Trust: Saving the Land and Water We Care About*, Marilyn A. Wood, Executive Director, Flathead Land Trust, pg. 164

BACKGROUND

The attraction to—and growth of—the Flathead Watershed is largely driven by our remarkable natural land and water resources, in particular our clean water. But continued growth puts pressure on the very resources that attract people to the watershed and make life here so special. In the Flathead Watershed, citizens and the environment are dependent upon and affect one another. They continually change and adapt alongside one another.

Our decisions today about where and how we build our homes, where we extract and develop our resources, and what activities we pursue on our land and in our waterways will determine the legacy we will leave our children. Almost every human land use puts some pressure on the watershed and has the potential to adversely impact our water quality. However, the Flathead Watershed has a long history of beneficial utilization and natural resource protection, (Flathead Watershed Sourcebook, pg. 144).

PROCEDURE

Warm-up

Ask students to think of a personal spot outdoors that they like to visit. Have them turn to their neighbor and tell that person why they like that particular spot, perhaps share a story about a time they've been at that spot.

When the class has finished sharing, ask them to imagine what they would feel and think if they found out the personal spot they've just talked about was going to be changed in some way, perhaps a house or a road will be built there, or the trees will be logged, or a stream will be altered for somebody's purposes. Have the students share their thoughts and feelings about the possibility with their neighbor.

Now, ask the students: If they could think of a way they could keep their personal spot the same, but still allow the change to go forward in some fashion, would they take action to keep their spot from changing? Give the class a few moments to consider their response. Ask students to share their answers with their neighbor.

Let them know that they are going to read stories of people who have taken action to work with changes being made to protect or improve their favorite spots.

The Activity

Conservation Readings

Assign readings 1, 2 and 3 from the materials list for everyone to read. Give students a choice of reading at least 1 of the other two readings listed and encourage them to read them all.

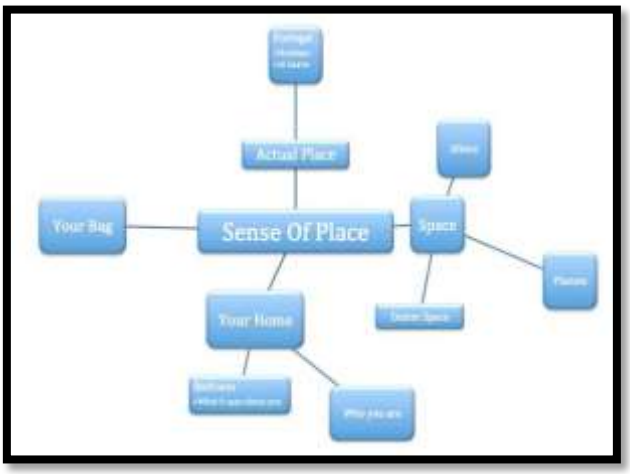
When everyone has finished with their reading, as a group come up with a definition of conservation based on what they've just read in the perspectives. Keep working through the definition until everyone feels it is complete and everyone feels some ownership of it.

Have students take out paper and pencils or journals. Ask students to write down their own personal definition of conservation, keeping in mind their personal outdoor spot and their thoughts and feelings if change might possibly happen to it.

Sense of Place Concept Map

On the same paper if there is room, or a different paper so that most of the paper is available to use, have students draw a concept map, starting with a circle in the middle representing them.

Nearest to their circle have students draw circles representing elements in their lives that have a close meaning for them. The circles can be people, places, animals and things. Label the circles and draw a line from their circle to those circles. Label the line with a word that describes what that circle means to them. Their personal spot might be one of these circles.



Example of sense of place concept map:ldnfoolishly.wordpress.com

Next, have students think of elements in their lives that have a less close meaning and draw a circle to represent each one of those, placing them a little farther away from the middle circle and labeling them as well. Again, draw lines to those circles and label the lines with that element's meaning to them. If there is room on the paper, continue with a further row of circles and lines.

When finished, have each person take a close look at what they have created on their paper. Let them know that this is a representation of their 'sense of place', the people, places, animals and things that have meaning for them in their lives. Their concept map represents their community, which includes living and non-living elements in their lives. They may share this with another person if they desire, but since it is meaningful only to them, they may keep it private.

Wrap-up

Share the Aldo Leopold quote below with the class:

"*A thing is right only when it tends to preserve the integrity, stability and beauty of the community; and the community includes the soil, water, fauna and flora, as well as the people*."

- Aldo Leopold, *A Sand County Almanac*, 1949

Ask students to respond to the quote based on their thoughts about their personal spot, the sense of place concept map they just created, and the ideas in the readings they just read.

Some of the questions you could ask are: Do you agree with the ideas in the quote? If not, what would you change in the quote? Do the ideas in the quote remind you of any other language you know of (civil rights, animal rights)?

ASSESSMENT

Assessment can be measured by reading completion of the assigned perspectives, class participation in defining conservation, writing their own conservation definitions, a completed concept map, and participation in the final Leopold quote discussion.

EXTENSIONS

Look for service – learning projects that involve taking action to conserve an outdoor area near the school or a place that has meaning for the students.

Research what actions need to be taken to put a conservation plan into action. Consult with professionals to discuss on-the-ground conservation efforts and the work that is involved, particularly in the form of job opportunities.

RESOURCES

Environmental ethics information
http://www.amnh.org/our-research/center-for-biodiversity-conservation/publications/lessons-in-conservation

https://www.nwf.org/What-We-Do/Kids-and-Nature/Educators/Lesson-Plans.aspx

http://www.fs.usda.gov/detailfull/conservationeducation/educator-toolbox/middle-school/?cid=STELPRDB5057674

http://science.jrank.org/pages/2526/Environmental-Ethics-Environmental-attitudes.html

Concept Mapping Resources
http://katierener.weebly.com/concept-mapping.html

http://lifehacker.com/how-to-use-mind-maps-to-unleash-your-brains-creativity-1348869811

http://www.open.edu/openlearnworks/mod/oucontent/view.php?id=52353&printable

https://ldnfoolishly.wordpress.com/2012/02/02/sense-of-place-spider-diagram/

Chapter 6: Our Land and Bounty

Background

"I think having land and not ruining it is the most beautiful art that anybody could ever want to own." - Andy Warhol, American painter, printmaker, & filmmaker 1928-1987

Introduction

This chapter is about managing land in the Flathead Watershed. It explores multiple perspectives about management including multiple use, resolving conflicts, wilderness, agriculture and products. Multiple perspectives and resolving conflict are important concepts for students to learn because the history of human settlements in the Flathead Watershed is complex and controversial. In the present state of the watershed interests in wilderness, agriculture and industrial production compete for their stake in the watershed. Chapter seven in the Sourcebook focuses on land ownership, agriculture and forestry products.

Essential Questions

- What is multiple use and how can this perspective be applied to land resources in the Flathead Watershed?
- How can conflicts over natural resources be resolved?
- How do people relate to wilderness experiences in the watershed?
- Where does our food come from?
- What products are produced in the Flathead Watershed?

Content

One of the ways to consider multiple use of natural resources is to investigate how different groups might want to use National Forest land in the watershed. Of course National Forest land is public land and is managed for a variety of uses, such as enjoyment of the experience of being there, forest management for lumber and other forest products, wildlife conservation and recreation. Some uses are consumptive and others conservative.

In the Flathead Watershed activities are governed by the Multiple-Use Sustained-Yield Act of 1960. One of the contentious conflicts in the Flathead Watershed is about social and economic impacts of wildlife and natural resource management. It is important to consider how people describe wilderness and their relation to it because their beliefs will influence their perspectives on management. In addition, the Flathead Watershed has a long tradition of agricultural land uses. Agriculture is an important industry in the watershed and students can learn more about it through maintaining a school garden.

Learning Goals

In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
  - Multiple use of natural resources
  - Wilderness in the watershed
  - Agriculture in the watershed
  - Products made in the Flathead Watershed

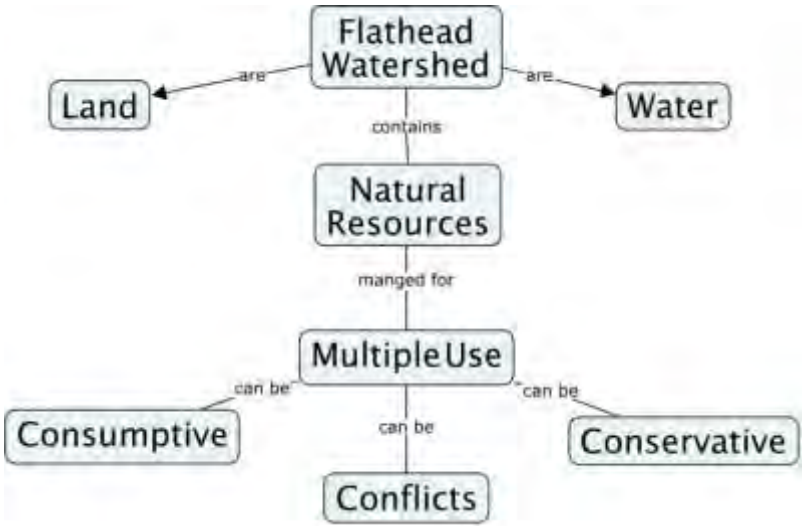
- Skills
  - Resolving conflicts
  - Interviewing local residents
  - Researching local food production
  - Maintaining school gardens

- Dispositions
  - Wilderness perspectives; feelings, attitudes, values and beliefs
  - Positive attitudes about different perspectives

Key Concepts

Agriculture
Conservative
Consumptive
Forestry
Multiple use
Natural resources
Preservation
Resolving conflicts
School garden
Wilderness

Graphic Organizer



Chapter 6 Lessons 231

Ch. 6-1 Managing Multiple Use in the Flathead Watershed

What are the ways different users' needs can be met?

SUMMARY

Students will evaluate how multiple types of use can be accommodated on a piece of National Forest land. Students will draw up their use proposals and present their options to the class.

OBJECTIVES

Students will

- Recognize multiple use values.
- Evaluate types of land uses and their impacts.
- Debate within their groups how to accommodate different uses.
- Illustrate their multiple use proposals.
- Present their land use option to the class.

MATERIALS

Perspectives:

- Multiple Use Management at the Headwaters; Flathead Watershed Sourcebook, pg. 183
- Haskill Basin Watershed; Flathead Watershed Sourcebook pgs. 188-189
- The Multiple Use and Sustained Yield Act (MUSY) of 1960 (a copy is given at the end of this lesson).
- Paper and drawing materials or computer

BACKGROUND

The National Forests and the Public Lands

The 193-million-acre National Forest System administered by the Forest Service, an agency of the Department of Agriculture, and the 265 million acres of Public Lands managed by the Bureau of Land Management (BLM), an agency of the Department of the Interior, are concentrated in the Western third of the lower 48 and Alaska.

While the statutory regimes differ -- the National Forests are administered under the National Forest Management Act, and the BLM lands under the Federal Land Policy and Management Act -- both statutes borrow from the Multiple Use Sustained Yield Act in their emphasis on striking a balance in land use planning among the competing values of recreation, grazing, timber, watershed protection, wildlife and fish, and wilderness. They thus, as famously observed, "are not parks."

www.terrainworks.com

For historical reasons, the statutorily sanctioned timber and grazing uses of these lands have resulted not only in the expectation by ranchers and the timber industry that these uses will continue unabated, but similar expectations in communities whose livelihood depends on the persistence of these uses. At the same time, the National Forests and the Public Lands represent significant, and in some cases, the only large scale refuges for certain wildlife, and have nationally recognized ecological significance.

Recreational uses may conflict with both of the above interests, and there may be conflict within the neighboring community between the economic value of consumptive and/or recreational uses and preservation values.

As can be expected, the use allocations made by the agencies often do not sit well with one or the other of these constituents. The result is litigation. Information about multiple use from: http://www.justice.gov/enrd/multiple-use-lands

www.flatheadwatershed.org

PROCEDURE

Warm-up

Have the class closely read the two perspectives from the Flathead Watershed Sourcebook. Discuss with the class the content of the two perspectives, particularly the Haskill Basin Watershed piece.

Ask the class to list the multiple uses within the Haskill Basin.

Create a chart, showing each use and have the class list the measures that have been or are being taken so that the other users can also take advantage of the basin.

Ask students to come up with a definition of multiple use. Ask if they can think of an example of an area or place that is being used in multiple ways. Have the class think of the different kinds of uses: are there restrictions to the kinds of uses? Are there ways of using the place or area that prohibit other types of use? How are the different kinds of use managed? (For instance, the school gym is often a multi-use room – P.E., lunch, band and orchestra, after-school activities, and more.)

The Activity

Have the class read the Multiple Use and Sustained Yield Act (MUSY) of 1960 (a copy is given at the end of this lesson). Compare the directives in the MUSY Act with the management of Haskill Basin.

Now give the class the description of the fictional Forest Service (FS) parcel given in this lesson. After reading it, have the class divide into groups of 5 students each. Have each student within a group represent one of the land uses recognized in the MUSY Act: outdoor recreation, range, timber, watershed, and fish and wildlife.

If there are less than 5 students per group, chose as many uses as there are students in the group. Make sure all the students know what each land use could entail (watershed represents clean water supplies for various purposes, for example).

Users decide what type of use they are going to propose for the FS parcel. An example could be the range user wants to run sheep on the land, while the timber user wants to cut lumber for the sawmill and the outdoor recreationist wants to cross-country ski and hike into several small lakes to fish for cutthroat trout. The wildlife user is concerned for the grizzly bear population. Have students include an estimate of the impacts on the land of their proposed use.

When each person in the group has written down their land use proposal, have each group develop and write down their plan to accommodate all the multiple uses on the fictional Forest Service parcel.

Have each group draw a map of the FS parcel and indicate clearly how and where each user group's activities are going to take place.

Wrap-up

Have each group give a presentation to the rest of the class about their land use proposal while showing their map of the FS parcel. When all the groups have presented, tell the class they will now decide how they will evaluate the proposals. Lead a discussion about the evaluation process.

One factor to consider in the evaluation process is to think of what land uses could complement each other and what uses are incompatible with each other. When evaluation criteria are established, have the class evaluate the different groups' proposals and decide as a whole class about the relative merits of each one and which one they would choose to enact.

ASSESSMENT

The land-use proposals and maps are a type of summative assessment that can be judged with a rubric. Class participation in discussions and group participation in presentations are readily assessed. Short answer questions could be asked after the close reading as formative assessments.

EXTENSIONS

Ask the class to think of real-life land use proposals. Do they know how land use proposals are decided upon? Do they know who is responsible to make those decisions? Have the class divide into teams and do research into how and by who conflicting land use proposals are decided.

Students can research the pros and cons of the Multiple Use Sustainable Yield Act, and its subsequent consequences and effects on forest health.

RESOURCES

Forest Service Perspective from Flathead Watershed Sourcebook: http://www.flatheadwatershed.org/docs/wp PDF/Popout_Wenum_Mulitple_Use.pdf

Historical Overview, Flathead Nat. Forest: http://www.foresthistory.org/ASPNET/Publi cations/region/1/flathead/intro.htm

Mapping coverage of multiple uses in the Flathead Watershed: http://www.headwatersmontana.org/

News article: recreational multiple use: http://www.flatheadnewsgroup.com/bigforkeagle/news/multiple-use-sentiments-dominate-forest-forum/article_32ebfe08-f404-5620-9195-498ce5d6612d.html

http://flatheadbeacon.com/2016/02/17/haskill-basin-conservation-easement-finalized/

http://www.fs.fed.us/about-agency/meet-forest-service

http://www.flatheadnewsgroup.com/hungryhorsenews/flathead-national-forest-releases-draft-forest-plan-environmental-impact-statement/article_62a54daa-243f-11e6-b567-0f1574a24cee.html

http://flatheadbeacon.com/2016/05/27/flathead-national-forest-proposes-updated-management-blueprint/

For use with the Activity:

Description of Fictional Forest Service Parcel:

The parcel is around 2000 acres with two stream basins forming one watershed basin that drains into a small river. At the headwaters of both streams are two small lakes with native cutthroat trout populations. The watershed basin faces south. Some of the ridges surrounding the basin and the ridges defining smaller streams flowing into the main stream run north/south and some run primarily east/west. The north and east facing slopes are heavily timbered in larch, spruce and Douglas fir, while the south and west facing slopes are grassy with stands of ponderosa pines. There are cottonwoods and aspens in the stream bottoms.

The watershed basin is part of the water supply for the small town nearby. There are a few small private acreages in the basin with summer cabins reached by limited road access. Some of the acreage in the stream bottoms is owned by the nearby town.

10. MULTIPLE-USE SUSTAINED-YIELD ACT OF 1960 1

(Public Law 86–517; Approved June 12, 1960)

AN ACT To authorize and direct that the national forests be managed under principles of multiple use and to produce a sustained yield of products and services, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That [16 U.S.C. 528] it is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. The purposes of this Act are declared to be supplemental to, but not in derogation of, the purposes for which the national forests were established as set forth in the Act of June 4, 1897 (16 U.S.C. 475). Nothing herein shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish on the national forests. Nothing herein shall be construed so as to affect the use of administration of the mineral resources of national forest lands or to affect the use or administration of Federal lands not within national forests.

SEC. 2. [16 U.S.C. 529] The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom. In the administration of the national forests due consideration shall be given to the relative values of the various resources in particular areas. The establishment and maintenance of areas of wilderness are consistent with the purposes and provisions of this Act.

SEC. 3. [16 U.S.C. 530] In the effectuation of this Act the Secretary of Agriculture is authorized to cooperate with interested State and local governmental agencies and others in the development and management of the national forests.

SEC. 4. [16 U.S.C. 531] As used in this Act, the following terms shall have the following meanings:

(a) ''Multiple use'' means: The management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

(b) ''Sustained yield of the several products and services'' means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.

SEC. 5. [16 U.S.C. 528 note] This Act may be cited as the ''Multiple-Use Sustained-Yield Act of 1960''.

From: http://www.fs.fed.us/emc/nfma/includes/musya60.pdf

Ch. 6-2 Resolving Wildlife and Natural Resource Conflicts

What is the social and economic impact of wildlife and natural resource management?

SUMMARY

Students will utilize information involving the controversial issues of wildlife and society.

Students should be familiar with how to do research and analyze primary research sources. Students should also be familiar with controversial issues and how to reach decisions based on interviews, data, and analysis.

OBJECTIVES

Students will

- Explore the impact that wildlife has on society.
- Learn about the impact that society has on wildlife.
- Research the relationship between wildlife and economics and society.

MATERIALS

- internet and library

http://www.pbslearningmedia.org/resource/midlit10.soc.splland/conflict-over-western-lands/

BACKGROUND

There have been many conflicts between people and the natural world throughout human history. A specific form of conflict involves society and wildlife and natural resources.

There are many controversial issues between wildlife and society. Some of the conflict has to do with land management and the question of how the land is to be used. By analyzing controversial issues and debates on wildlife and how it influences society, students will be able to reach decisions based on interviews, data, and analysis.

PROCEDURE

Warm-up

Have a class discussion on "conflict." Have students write down what they think conflict is and how it is resolved. An historical lesson that could be used to exemplify this would be wolf reintroduction to the Yellowstone ecosystem.

Have the students discuss what conflicts they are familiar with in the Flathead Watershed. This might focus on bear and human interactions. Discuss how attitudes and opinions lead to conflict. Note: This could be done as a cooperative learning exercise, depending on the dynamics of the class.

The Activity

Have the students research the conflicts between wildlife and society. Some of the methods to be used include the Internet, personal interviews, newspaper, magazines and books. The teacher may lead into this by explaining the conflict of reintroducing the wolves into Yellowstone National Park. The students should be aware of the impacts the wolf reintroduction has on wildlife and society including ranchers, conservationists, and hunters.

Have the students select topics on conflict between society and wildlife. Depending on the level of the students, the teacher can suggest topics for the students. Some topics include:

- Hunters versus animal rights activists
- Introduced fish species such as the lake trout in Flathead Lake
- Invasive species such as zebra mussels in Flathead Lake
- Oil spills and wildlife
- Urban development and wildlife conflicts
- Clearcutting forests and endangered species such as the spotted owl

You can read about some of these conflicts in the Flathead Watershed Sourcebook, pg. 164 and at http://www.flatheadlandtrust.org/places-we-protect/river-to-lake-initiative/

Wrap-up

Students will prepare a speech detailing the issue to the rest of the class. Small groups can be assigned to prepare a speech in a large class. When all speeches are concluded, the class should be divided into groups of four. The people in each group will re-analyze one the issues and discuss all perspectives, this will allow for more opinions and further analysis.

ASSESSMENT

Each group will write a solution to of issue. The groups are "charged" with presenting both sides of the argument and they must present a solution. It is okay to have a "split" decision based on different opinions. All members of the group and their perspectives should be included in the paper including quotes from each member of the group.

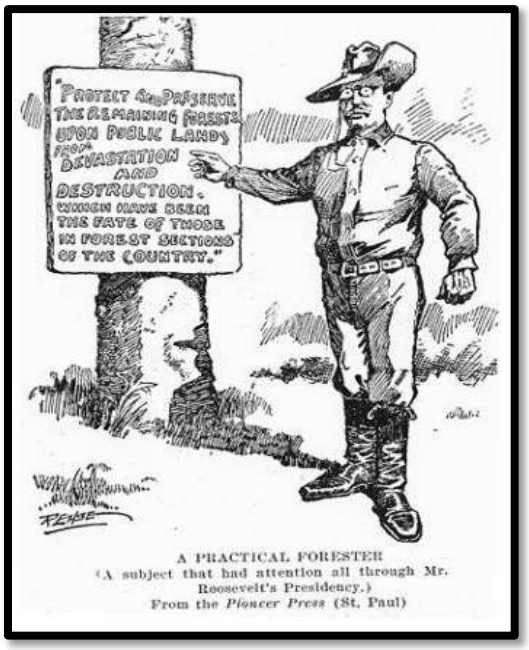
Train approaching grazing buffalo

http://www.legendsofamerica.com/photos-oldwest/ShootingBuffalo.jpg

EXTENSION

The solutions are read to the class. The rest of the class is encouraged to ask questions, debate, and discuss as necessary. This should be facilitated by the teacher.

Students should realize that there are a lot of opinions on society, wildlife and natural resource interactions. Not only does land use affect wildlife, but it also affects society. It is our world and we must work together to conserve it for people and wildlife.



A PRACTICAL FORESTER
(A subject that had attention all through Mr. Roosevelt's Presidency.)
From the *Pioneer Press* (St. Paul)

gvbooktalk.gpo.gov

RESOURCES

More information on conflicts between Humans and Wildlife:

What are human – wildlife conflicts?
http://www.neohiowildlifeconflicts.org/what-are-human-wildlife-conflicts.html

Human-wildlife conflicts: an interview with Dr. Michael Hutchins
http://voices.nationalgeographic.com/2013/03/09/human-wildlife-conflict-an-interview-with-dr-michael-hutchins/

Influences in the Flathead Watershed:
http://www.flatheadwatershed.org/influences/influences_riparian.shtml

Ch. 6-3 Wilderness Perspectives

How do people describe wilderness and their relationship to it?

SUMMARY

In this lesson students will read quotes and descriptions of what wilderness is and then describe their own impressions of wilderness.

OBJECTIVES

The students will

- Understand the concept of wilderness.
- Analyze famous quotes about wilderness and apply them to their own understanding.
- Appreciate and value the need to have wilderness areas.

MATERIALS

- Wilderness quotes
- Poster paper
- Field notebooks
- Flathead Watershed Sourcebook perspective, Wilderness in the Flathead, pg. 185

BACKGROUND

The quality of the Flathead Watershed's natural environment is one of the watershed's chief assets. Relatively pristine lands and clean air and water are tangible elements of this asset. Sections of several federally designated wilderness areas are found within the Flathead Watershed , which also encompasses portions of Glacier National Park. Glacier National Park is the southern gateway to Waterton Lakes National Park, which together forms Waterton-Glacier International Peace Park.

The Flathead Watershed is part of the Crown of the Continent ecosystem, one of the premier mountain regions of the world.

The Flathead National Forest manages the largest portion of this Wilderness Complex. This is the third largest wilderness complex in the lower 48 states. They are managed by four national forests - Flathead, Helena, Lewis and Clark, and Lolo, and five ranger districts - Spotted Bear, Hungry Horse, Lincoln, Rocky Mountain, and Seeley Lake.

The Crown of the Continent attracts individuals, educators, researchers, tribes, agencies, and organizations in a quest to comprehend, appreciate, enjoy, and preserve this culturally and ecologically important place.

The Confederated Salish and Kootenai Tribes (CSKT)Reservation comprises the southwest quarter of the Flathead Watershed. The CSKT reservation contains the Mission Mountain Tribal Wilderness, a unique component of the Flathead Watershed landscape.

Federally designated wildernesses with portions in the Flathead Watershed include the Great Bear Wilderness, the Bob Marshall Wilderness and the Scapegoat Wilderness . These areas, including the southern portion of Glacier National Park, together form the Bob Marshall Wilderness Complex, an area of more than 1.5 million acres.

See the Flathead Watershed Sourcebook, Wilderness in the Flathead perspective, pg. 185, and at http://www.flatheadwatershed.org/docs/wpPDF/Popout_Hadden.pdf

The beauty, wildlife, and recreational opportunities of the Flathead Watershed bring U.S., Canadian, and global visitors to the parks and the surrounding communities and attractions.

Ch. 6-3 Wilderness Perspectives

PROCEDURE

Warm-up

Ask the students to write 2-3 sentences about what they think wilderness is and have them draw a corresponding picture in their field notebooks. Ask students to share their ideas.

The Activity

Have the students read the Flathead Watershed Sourcebook perspective, pg. 185, Wilderness in the Flathead by Dave Hadden, Director, Headwaters Montana.

Hand out the wilderness quotes, giving one quote to each pair of students.
Have each student read the quote and write their interpretation (deep reading).
Students then share their interpretations.

Among all the students make a list of all the descriptive words and ideas to describe wilderness and list on poster paper.
Have students create a wordle of their wilderness words.
Discuss a universal definition of wilderness.

Wrap-up and ASSESSMENT

In their field notebooks have the students write their personal description of wilderness and illustrate their ideas.

EXTENSIONS

Listed along with the quotes are several books

Choose a single book or several books to read about wilderness.

Have a representative of the Flathead National Forest visit the class and discuss wilderness in the Flathead Watershed.

that reference wilderness

RESOURCES

Flathead National Forest at:
http://www.fs.usda.gov/flathead.

See also:
http://www.fs.usda.gov/attmain/flathead/specialplaces.

Great Bear wilderness at:
http://www.fs.usda.gov/recarea/flathead/recreation/ohv/recarea/?recid=77673&actid=51

Montana Wilderness Association at:
http://www.fs.usda.gov/recarea/flathead/recreation/ohv/recarea/?recid=77673&actid=51

Seeley Swan Pathfinder at:
http://www.fs.usda.gov/recarea/flathead/recreation/ohv/recarea/?recid=77673&actid=51

National Parks, Landscape Art & American Imagination
https://arthistory327.wordpress.com/2012/09/15/perception-of-wilderness

Websites about The Wilderness Act of 1964
http://www.wilderness.net/nwps/legisact and
http://www.foresthistory.org/ASPNET/policy/Wilderness/1964_Wilderness.aspx

Wilderness Quotes

Edward Abbey:

"But love of the wilderness is more than a hunger for what is always beyond reach; it is also an expression of loyalty to the earth which bore us and sustains us, the only home we shall ever know, the only paradise we ever need - if only we had eyes to see."

"I come more and more to the conclusion that wilderness, in America or anywhere else, is the only thing left that is worth saving."

"The idea of wilderness needs no defense. It only needs more defenders."

"Wilderness is not a luxury but a necessity of the human spirit."

Suggested readings: Desert Solitaire, The Monkey Wrench Gang, Down The River

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Rachel Carson:

"Those who contemplate the beauty of the earth find reserves of strength that will endure as long as life lasts. There is symbolic as well as actual beauty in the migration of the birds, the ebb and flow of the tides, the folded bud ready for the spring. There is something infinitely healing in the repeated refrains of nature - the assurance that dawn comes after night, and spring after the winter."

Suggested readings: Silent Spring, The Sea Around Us

Crowfoot (Blackfoot):

"What is life? It is the flash of a firefly in the night. It is the breath of a buffalo in the wintertime. It is the little shadow which runs across the grass and loses itself in the sunset."

Black Elk (Oglala Sioux):

"Is not the sky a father and the earth a mother, and are not all living things with feet or wings or roots their children?"

Ch. 6-3 Wilderness Perspectives

Ralph Waldo Emerson:

"The greatest wonder is that we can see these trees and not wonder more."

"The flowers, the animals, the mountains, reflected the wisdom of his best hour, as much as they had delighted the simplicity of his childhood."

Suggested reading: Nature

Aldo Leopold:

"Wilderness is the raw material out of which man has hammered the artifact called civilization."

"Wilderness is a resource which can shrink but not grow... the creation of new wilderness in the full sense of the word is impossible."

"For unnumbered centuries of human history the wilderness has given way. The priority of industry has become dogma. Are we as yet sufficiently enlightened to realize that we must now challenge that dogma, or do without our wilderness? Do we realize that industry, which has been our good servant, might make a poor master?"

"The outstanding scientific discovery of the twentieth century is not television, or radio, but rather the complexity of the land organism. Only those who know the most about it can appreciate how little we know about it. The last word in ignorance is the man who says of an animal or plant: "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."

Suggested readings: A Sand County Almanac, Round River

John Muir (Wilderness Quotes):

"Thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wildness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life."

"In God's wildness lies the hope of the world - the great fresh, unblighted, unredeemed wilderness."

"I only went out for a walk, and finally concluded to stay out till sundown, for going out, I found, was really going in."

Ch. 6-3 Wilderness Perspectives

"Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop off like autumn leaves."

"Wilderness is not only a haven for native plants and animals but it is also a refuge from society. Its a place to go to hear the wind and little else, see the stars and the galaxies, smell the pine trees, feel the cold water, touch the sky and the ground at the same time, listen to coyotes, eat the fresh snow, walk across the desert sands, and realize why its good to go outside of the city and the suburbs. Fortunately, there is wilderness just outside the limits of the cities and the suburbs in most of the United States, especially in the West."

Suggested reading: Our National Parks (John Muir), John of the Mountains (by Linnie Wolfe)

Margaret Murie :

"I hope the United States of America is not so rich that she can afford to let these wildernesses pass by, or so poor she cannot afford to keep them."

Suggested reading: Two in the Far North

President Theodore Roosevelt:

"…short-sighted men who in their greed and selfishness will, if permitted, rob our country of half its charm by their reckless extermination of all useful and beautiful wild things..."

Chief Seattle (Suquamish):

"Our dead never forget this beautiful world that gave them being. They still love its verdant valleys, its murmuring rivers, its magnificent mountains, sequestered vales and verdant lined lakes and bays, and ever yearn in tender fond affection over the lonely hearted living, and often return from the happy hunting ground to visit, guide, console, and comfort them."

Dr. Seuss (Theodor Seuss Geisel):

"…the word of the Lorax seems perfectly clear. UNLESS someone like you cares a whole awful lot, nothing is going to get better. It's not."

Suggested reading: The Lorax

Ch. 6-3 Wilderness Perspectives

Henry David Thoreau (Wilderness Quotes):

"I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived."

"The West of which I speak is but another name for the Wild, and what I have been preparing to say is, that in Wildness is the preservation of the World."

"This curious world we inhabit…is more wonderful than convenient; more beautiful than useful; it is more to be admired and enjoyed than used."

Suggested readings: Walden, Walking

Terry Tempest Williams:
"If you know wilderness in the way that you know love, you would be unwilling to let it go.... This is the story of our past and it will be the story of our future."

Ch. 6-4 Who's Your Flathead Farmer?

What local foods are parts of your meals?

SUMMARY

Students will research and visit local food growers to learn about how foods are grown and raised in their area. Students will conduct interviews and publish their findings to inform their school and community.

OBJECTIVES

Students will

- Conduct research on local food growers.
- Interview growers in person or via computer.
- Write about their findings.
- Publish their findings to inform the community.

MATERIALS

- Information about local food growers
- Interview questions for growers
- Methods to record interview information (paper, computer, voice recorders or something similar)
- Materials or methods to publish information
- Optional: poster board to display research results

BACKGROUND

The Flathead Watershed has a long tradition of agricultural land uses. Tribal people managed land for native plant harvest and later raised horses, cattle and other crops for subsistence and trade. As non-Indian settlers moved in, they began raising cattle and growing crops for a living. Today a substantial portion of land in the watershed remains in agricultural production.

Agriculture contributes to the economy, offers a remarkable bounty of foods and natural medicines, and plays a vital role in preserving the culture of the watershed, (See Flathead Watershed Sourcebook pgs. 190-197).

PROCEDURE

Warm-up

Ask students about their favorite foods to eat. Have them share with a neighbor about some of their favorite meals.

Ask students what they know about where their food is grown. Ask if anyone helps with a food garden or raises animals for 4H or other reasons. Some students may have families that raise and preserve food for their own needs and/or to sell for profit.

The Activity

Have students work in teams to research food growers and producers in their local area. The research can be organized by types of food – small groups in the class could choose to research meat, eggs, dairy, vegetables, fruits, wild produce (huckleberries, mushrooms), honey or products like pickles, jams, and sauces. Each team can choose a product or grower to research.

Help the class with their research by suggesting sources of information: chambers of commerce websites, producer and grower websites, local phone book yellow pages, phone calls to supermarkets, visits to farmers' markets, and other sources.

As part of the research, have students record where each grower is located, their seasons of production, and whether a class visit is possible. Have teams present their research information to the whole class.

When everyone has shared their research, as a class decide which grower or producer they will interview. If a field trip is possible, the interview could be conducted in person during the field trip. Another option would be to ask the grower or producer to visit the classroom. Interviews can also be conducted over the internet or by phone.

Develop interview questions for the growers. See 'Interviewing' lesson in Chap. 1 for suggestions. Decide on the format for the interview. Decide on the end product for the interview, i.e. class newspaper article, blog, video, etc.

Conduct the interview(s) and record the results.

Wrap-up

Edit the interview results for the format selected by the class. Publish the results for other classes and the community to learn about.

Each team could create posters of their research and post them in class or school hallways.

ASSESSMENT

There are a number of opportunities for assessment during this activity. Those include research results about local growers, interview questions, conducting the interview, and field trip behavior. The published interview result is a summative assessment.

EXTENSIONS

Students can research and enact ways to incorporate local growers' products into school breakfast and lunch programs.

As a class project, decide on a food production project that the class can take on – school gardens, sponsoring a livestock animal, raising small animals like chickens or rabbits.

Research local food growing traditions in other areas of the country or other parts of the world. Explore the staple diets of different countries.

Analyze the costs and needs to produce a food item, create a cost/benefit spreadsheet.

Contact NRCS, 4H and FFA groups in the Flathead Watershed to come speak in class and as a local grower resource.

Students will keep a 'school lunch diary' for a week and then research the source of the ingredients, looking specifically for locally grown items. Students will interview the food buyers for their school meals.

RESOURCES

Western Montana Growers Cooperative: http://wmgcoop.com/about

Farm Hands
http://nourishtheflathead.org/home/
Farm Hands Map
http://nourishtheflathead.org/map/

Article about local growers and pollinators:
http://www.xerces.org/2011/08/30/local-growers-in-flathead-share-native-pollinator-experiences/

Pick your produce in Montana
http://www.pickyourown.org/MT.htm

Flathead Lake Cherry Growers
http://www.montanacherries.com/faq.asp

Flathead Farms: highland cattle
http://flatheadfarms.com/

Western MT. Economic Development Strategy; appendix C, D: Food Economy
http://www.lakecountycdc.org/fileaccess/getfile/634.pdf

Ch. 6-5 School Gardens

How can my class create a school garden?

SUMMARY

School gardens are as distinctive as the teachers and students who create and enjoy them. Ideally, they're created to meet local program needs, and they use the physical site and available resources to their fullest.

In this lesson students build a school garden with the help of their community and school administrators.

OBJECTIVES

Students will

- Build support for a school garden.
- Plan the school garden.
- Create a school garden.

MATERIALS:

- Dependent on types of gardens to be built

BACKGROUND

The local food movement that has swept across the nation has been enthusiastically embraced by Flathead residents. The Flathead Valley Community College (FVCC) has adopted the Farm to School program initiated by the University of Montana in Missoula. (Be sure to read Community Gardens in the Flathead Watershed Sourcebook, pg. 195, and at http://www.flatheadwatershed.org/docs/wpPDF/Pat%20McGlynn.pdf)

School gardening engages students by providing a dynamic environment to observe, discover, experiment, nurture and learn. School gardens are living laboratories where interdisciplinary lessons are drawn from real life experiences, encouraging students to become active participants in the learning process.

Building The Case

As a teacher who wants to incorporate a school garden in their curriculum, or a parent who is interested in creating an outdoor learning space at their child's school, recruiting a team to help develop and manage the project will keep energy levels high and help share the work load. Your team could include other teachers and parents, students, school administrators, outside support from interested agencies and organizations like 4-H, FFA, Farm to School or local initiatives to build more gardens.

To rally support from administrators, volunteers, and funders, you need to build your case. Why do you need a garden? How will it benefit the youth in your community? Point to research-based evidence and anecdotes that illustrate how the hands-on nature of gardening can enrich the curriculum, will improve students' interest in learning, encourage them to eat well, and develop social skills. Introducing children to gardening instills a life-long passion for plants and respect for the environment.

School gardens:

- build an understanding of and respect for nature and our environment
- motivate kids to eat and love fruits and vegetables
- provide opportunities for hands-on learning, inquiry, observation and experimentation
- promote physical activity and quality outdoor experiences
- teach kids to nurture and care for other living things while developing patience

PROCEDURE

Warm up

Gathering Support

"Who will you involve in your garden program?" The answer is, "Everyone!"

Involve the students in every step along the way. Educators across the country report that when students are involved in all stages of the process, they are more invested in the project's success, and are inspired to care for and respect their gardens.

Obtain buy-in from administrators. Make sure you have solid investment from the top down. Supportive administrators can provide valuable help in finding the time and resources needed for a successful garden project.

Recruit parents, staff and community volunteers for a garden team. Many hands are needed to ensure a successful, sustainable garden program.

Creating a team or committee that is actively involved results in the best garden plan possible, and it broadens your reach into the community for resources, adds extra hands for installation, helps prevent volunteer burnout during maintenance, and ensures long-term sustainability.

The Activity

Planning the Program

"What" comes next. What will your garden accomplish? Although it is tempting to start drawing up landscape plans once a gardening committee is organized, it is important not to skip the step of determining how you will use the completed garden. Each program should have defined goals and objectives. It is hard to chart a path without knowing where you want to end up.

To have the most impact, school gardens should be integrated into the curriculum, and community gardens should be crafted to meet local needs. A purposeful garden will be a worthwhile and long-lasting garden.

School garden, Image by OAEC.org

Designing The Garden

Finally, it is time to design the garden. A very important tip: Plan big, but start small. A large project can exhaust the enthusiasm of your students and volunteers. Let them get excited about the success of a bountiful, enjoyable, small garden, then expand as your confidence and experience increases.

There are many different design options depending on the space and time you have. A traditional outdoor garden is planted in the ground. Unless the area has been cultivated before, you will need a tiller to break the compacted soil before you begin planting.

Another common option is to use raised beds. These are framed structures, typically 9 inches (on soil) to 2 feet (on paved surfaces), made of rot-resistant wood (like cedar), concrete blocks, or recycled plastic planking and filled with soil. Although they require more initial investment than a traditional in-ground garden, the benefits of raised beds pay off in the long run: they're easier to cultivate; you don't have to worry about toxins in the soil, such as lead; there are fewer weed and drainage problems; and the raised soil and plants are protected from crushing footsteps.

Plus, design is flexible -- you can build them to be handicap accessible, and to fit the space available, whatever the shape or size.

Another outdoor option is to plant in containers. Typically, garden containers are pots and troughs made of clay, plastic, or wood, but plants aren't fussy -- they'll grow in anything that holds soil and has drainage holes. Experiment with whatever is at hand, from discarded 5-gallon buckets to an old bathtub! Window boxes and hanging baskets are great if you have little or no ground space.

By adding handles or wheels, or placing containers on wheeled platforms, you can make your garden mobile, and can move plants around the space to where they'll grow best as the season advances or as conditions change (e.g., the angle of the sun shifts slightly each day). If threat of vandalism is extreme, you can move containers to sheltered or locked area.

No room outside? Try an indoor garden. This is a good option for schools/youth organizations in areas where winters are long and growing seasons are short. The simplest form of indoor gardening is to place plants in front of windows that receive a decent amount of light. Windows that face south and west are best because they usually receive enough light to grow leaf and root vegetables (beets, carrots, lettuce, onions, and radishes) and herbs. East- and north-facing windows do not receive as much light, and are a good place for houseplants. Spend a few days monitoring your window space to determine how much light is available for an indoor garden.

Grow lights designed to hang low over growing areas are a more effective way to produce indoor crops. With grow lights, you can control the amount of light your plants receive and can expand your crop options to fruit crops like tomatoes and strawberries.

Once you have selected what type of garden you want to plant, it's time to focus on designing your space.

Remember these key things:

- a school garden should be fun and functional
- incorporate sustainable practices
- keep it simple

Focusing on these concepts will help you create a useful and successful design.

Searching for Resources

Finding the resources you need to begin and maintain a school garden is always a challenge, but it doesn't need to be a roadblock. Think of your funding search as an opportunity to allow other community members to participate in an extraordinary youth program. You can find donations, apply for grants, host fundraisers, start a youth garden business -- get together with your committee and the kids and get creative! Think of it as a search for people and organizations that can share in your success.

Digging In

It's time to get your hands dirty and work up a sweat! Although the installation processes vary greatly with each design, typically this stage requires you to address:

- Weed and grass removal
- Soil preparation, including bringing in soil or amending existing soil
- Planting of seeds or plants
- How to facilitate basic maintenance including watering, weeding, mulching, and harvesting
- Composting options for garden scraps
- Rain barrels

It's important to have a dedicated group of parent and community volunteers to help you with garden installation and maintenance. A small adult-to-student ratio ensures a safe experience that provides kids with the most opportunities to contribute.

Here we need to emphasize the importance of good soil preparation. Ask any farmer or gardener -- they'll tell you that the most important step in the planting process is preparing the soil. Soil rich in organic matter that drains well produces healthy plants that are more resistant to pest and disease problems.

Wrap-up

Maintaining and Sustaining the Garden

Why think about maintenance and sustainability in the planning stages? School gardens are a significant investment of time, energy, and resources so you want them to last beyond one growing season! Make plans for maintenance before there is a garden to maintain. Consider long-term costs and volunteer recruitment before you put your first plant in the ground.

RESOURCES

Benefits of school gardens at:
http://web3.cas.usf.edu/tbsg/benefitsofschool gardening.aspx

My healthy school at:
http://myhealthyschool.com/school-garden- benefits/

Kids Gardening at:
http://grants.kidsgardening.org/

Benefits of garden-based learning at:
http://blogs.cornell.edu/garden/grow-your- program/benefits-of-garden-based-learning/

Ch. 6-6 Products from the Flathead Watershed

What products are produced and sold in the Flathead Watershed?

SUMMARY

In this lesson students will use the newspaper to investigate what products are produced and sold in the Flathead Watershed. In most cases these will be related to natural resources and their value to the community.

OBJECTIVES

The students will

- Understand what renewable and nonrenewable natural resource products come from the Flathead Watershed.
- Research various Flathead Watershed products.
- Appreciate and value the economic worth of Flathead natural resources.

MATERIALS

- local newspapers
- poster paper
- markers
- research options such as a library and internet access

BACKGROUND

Be sure to read the Flathead Watershed Sourcebook chapter, pgs. 189-196, on Our Bounty at: http://www.flatheadwatershed.org/land/land_ag.shtml.

It is important that students learn how much in their daily lives comes from the Earth and its environment. We use plants for food, clothing, and many other purposes. We use trees to make paper products, but we also harvest wood for building materials and to make furniture. We use animals like cattle for food and dairy products, but we also rely on them for leather. We use rocks and minerals to make a variety of materials, including glass, metal, and ceramics. We convert fossil fuels into energy to power and heat our homes and fuel modes of transportation, including planes, buses, boats, and cars. We also use petroleum, a fossil fuel, to make a variety of materials, including plastics. Our dependence on natural resources is creating many problems in the environment, including pollution and the loss of habitat for plants and animals.

http://www.flatheadwatershed.org

Collecting and burning fossil fuels for energy can damage the environment, polluting air, water, and land. Students should understand that finding and using renewable sources of energy will be one of the most important tasks of future generations. Natural resources take time to replace so it is important that we use them wisely.

The Flathead Watershed has a long tradition of agricultural land uses. Tribal people managed land for native plant harvest, and later raised horses, cattle and other crops for subsistence and trade. As non-Indian settlers moved in, they began raising cattle and growing crops for a living. Today a substantial portion of land in the watershed remains in agricultural production. Agriculture contributes to the

economy, offers a remarkable bounty of foods and natural medicines, and plays a vital role in preserving the culture of the watershed (Flathead Watershed Sourcebook, pg. 189)

The forest products industry contributes significantly to the economy of the Flathead Watershed. With 13 varieties of commercial tree species harvested from public and private lands in the watershed, local mills can produce a diverse array of products. Some products manufactured in the Flathead include logs for log homes, dimensional and specialty lumber, plywood, MDF (medium density fiberboard), and siding, trim, flooring, molding, and framing used in the building industry. A number of other products are made from the materials remaining from major wood products manufacturing, including paper, cardboard, and toothpaste (Flathead Watershed Sourcebook, pg. 196)

PROCEDURE

Warm-up

Select a few advertisements from the newspaper that focus on products that come from the Flathead Watershed. Ask students where they think they came from and how they are sold. Discuss if the products come from renewable or nonrenewable resources

The Activity

Provide small groups of students with a copy of local newspaper. Have students circle all the ads they can find in the paper with a red marker. Have the students categorize the products that are advertised.

Categories could be by source: industry, farm or manufacture or by renewable and non- renewable resources, or possibly other categories.

Have the groups compare their categories, numbers of ads in each category and the products in each category. Summarize the class results in a graph.

Wrap-up

Have students decide on a product they particularly like that is produced in the Flathead Watershed and research that product.

Ask students to find out:

- Where the product is created
- How the product is shipped to market
- How great the distribution area is
- What the product is made of
- If any components are locally produced
- If the company is locally owned
- Any other interesting facts about the product.

Have students create their own ad for their chosen product for the newspaper. Allow students to be creative and give them enough time to share their work with their classmates.

ASSESSMENT

Students can be assessed on the research paper they write about their product along with the ad they create for that product.

http://www.flatheadwatershed.org

EXTENSIONS

Compile all the research information along with the student-created ads to create a guide to locally produced items for the school and community.

RESOURCES

Resources

Flathead County Extension
http://flathead.mt.gov/extension
406.758.5553

Lake County Community Development Corporation
http://www.lakecountycdc.org/
406.676.5901

Lake County Extension
http://www.msuextension.org/lake
406.676.4271

Mission Mountain Food Enterprise Center
http://www.mmfec.com

Montana DNRC Agriculture and Grazing Management Division
http://dnrc.mt.gov/trust/agm/Default.asp

Montana Department of Agriculture
http://agr.mt.gov/
406.444.5409

Montana Department of Livestock
http://liv.mt.gov
406.444.9431

USDA Department of Agriculture
http://www.usda.gov/wps/portal/usda/usdahome
202.720.2791

Montana State University Flathead County 4-H
http://flathead.mt.gov/extension/msu/Flathead%204h.html
406.758.5553

Chapters 7 & 8: Economics & Partners

Background

"A creative economy is the fuel of magnificence." Ralph Waldo Emerson 1803-1882

Introduction

In the Flathead Watershed most people are associated in some way with economic factors. Living in the watershed requires financial resources. People moving to the watershed invest in property and land development. Most people must work to maintain their lifestyles. Some people work directly with natural resources investing and profiting from the land. However, the Flathead Watershed has value in and of itself without human intervention. Many people within the watershed work together to promote sustainability, conservation and stewardship.

Essential Questions

- What are conservation employment opportunities in the flathead watershed?
- What do people do who work with natural resources?
- What are the inherent values of the watershed?
- How do people promote conservation and stewardship in the watershed?

Content

Economic growth in the Flathead Watershed is characterized by transition and diversity. Historically the economy was a natural resource-based driven by logging and agricultural production such as livestock and crops. Growth followed in the manufacturing sector, particularly in wood products and the aluminum refinery.

In the last couple of decades there has been a decline in agricultural income, and growth has shifted toward the service sectors, including tourism, education, healthcare, construction, and retail. The decline in agriculture led to a rapid conversion of farmland for high-value real estate development and a change in employment rates, earnings, and sales.

The quality of the Flathead Watershed's natural environment is a valuable asset and drives the economy. Scenic lands and clean air and water are integral elements of this value. The watershed in one of the premier mountain regions of North America. (Flathead Watershed Sourcebook) Many people and organizations work together to promote sustainability, conservation and stewardship.

Learning Goals

In this chapter students will have the opportunity to develop a greater understanding of:

- Knowledge
    - Careers and jobs in the Flathead Watershed

- Work with natural resources
- Intrinsic values

- Skills
  - Apply values to their lives
  - Conduct interviews with natural resource workers
  - Working together

- Dispositions
  - Ecosystem values associated with the Flathead Watershed
  - Stewardship

Key Concepts

Careers and jobs
Extrinsic values
Intrinsic values
Stewardship
Working together

Graphic Organizer

Chapter Seven Lessons 259

Ch. 7-1 Flathead Careers and Jobs

How do people make a living in the Flathead Watershed?

SUMMARY

In this lesson students use the local newspapers to investigate jobs and careers in the Flathead Watershed. According to Newspapers in Education: (http://www.tdn.com/app/nie/index.html) students who use the newspaper in school read more and show significantly greater interest in government, community events, and current issues. It's possible this effect can extend to natural resource management and policies.

"A creative economy is the fuel of magnificence."
Ralph Waldo Emerson 1803-1882

OBJECTIVES

The students will

- Understand that newspapers are an influential, informative and important part of our society that give us insight into the professions and jobs in the Flathead Watershed.
- Develop research skills related to working in the Flathead Watershed.
- Appreciate the relation between learning in school and real world applications in their communities.

MATERIALS

- hard copy newspapers
- online newspapers

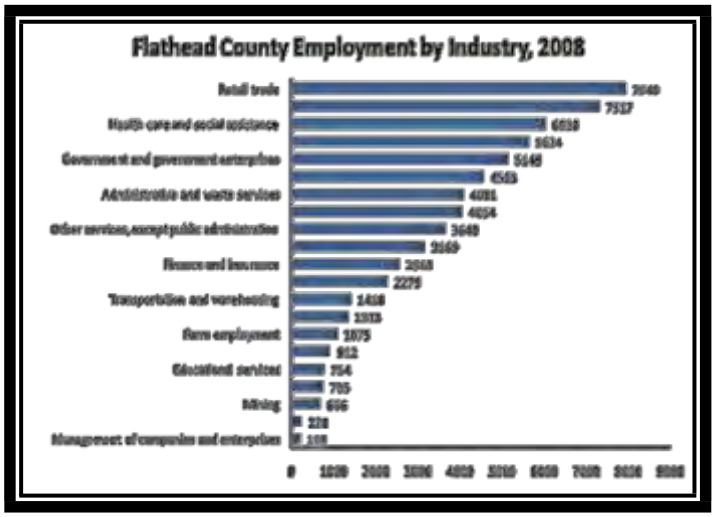
BACKGROUND

Be sure to read in the Flathead Watershed Sourcebook, Ch. 7: Economics, pgs. 201-206, and at: http://www.flatheadwatershed.org/economics/engines.shtml.

There are numerous "engines" of growth in the Flathead Watershed, an economy characterized by transition and diversity. Historically, this was a natural resource-based economy driven by logging and agricultural production such as livestock and crops. Growth followed in the manufacturing sector, particularly in wood products and the aluminum refinery.

Since the 1990's there has been a distinct decline in agricultural income, and growth has shifted toward the service sectors, including tourism, education, healthcare, construction, and retail.

The decline in agriculture led to a rapid conversion of farmland for high-value real estate development and a change in employment rates, earnings, and sales (Flathead Watershed Sourcebook, pg. 202).



www.flatheadwatershed.org

PROCEDURE

Warm-up

Discuss the meaning of the term *classified ad.* Show students examples of classified ads from the help-wanted section of the newspapers. Discuss the content of

different help-wanted ads. - See more at: http://www.educationworld.com/a_lesson/002/lp2175.shtml#sthash.Q4rK4Rpj.dpuf

The Activity

- Collect local newspapers for a few days, perhaps a week.
- In small groups have the students look at the classified ads for jobs in the Flathead Watershed and cut each out individually.
- Another source for classified ads for jobs could be the local Craigslist website if the newspaper has few jobs listings.
- Have the students organize the job announcements into categories similar to the county employment by industry in the 2008 graph page 202 of the Flathead Watershed Sourcebook.
- Count the numbers of jobs in each category and combine the results of the whole class. Use the combined data to create a graph similar to the 2008 graph.
- Analyze the graph of the current listings, looking for trends and patterns in the jobs being offered.
- Compare the class-made graph to the 2008 graph, again looking for trends and patterns. Ask the class to predict what a jobs graph might look like in another 10 years, given the trends and patterns they've determined by comparing the two graphs.
- Have the students consider if it is possible to make an accurate prediction, and if so, or if not, why? What factors might change to alter the trends and patterns?

Wrap-up

Have students create a classified ad. Use examples from the activity and discuss what kind of information needs to be included when placing an ad. Then have students write a brief classified ad for a job in their preferred profession.

ASSESSMENT

Have students write a short paragraph describing a job they would like to have and what the essential elements to qualify for that job.

EXTENSION

Visit the Montana Memory Project and use the early Polson newspapers to compare job classifieds. Early-day Polson, Montana, located on the beautiful shores of Flathead Lake, boasted of two weekly newspapers: The Flathead Courier and The Lake Shore Sentinel. Their small-town stories and articles, pictures, and ads for long-ago products and businesses give a clear glimpse into Polson/Lake County life during the early years of the twentieth century.

Both newspapers show the vibrant history of this prospering Montana location. In 1911, The Lake Shore Sentinel consolidated with The Flathead Courier. World news continued to mingle with local editorial comments, homestead news, school happenings, births and deaths, and farm and ranch news, along with details like stage coach and ferry schedules. See http://www.mtmemory.org/cdm/landingpage/collection/p16013coll16

RESOURCES

Local and National Newspaper Sources
NewsVoyager A gateway to your local newspaper.
United States Newspapers: both popular and obscure newspapers are featured here
Newspapers in Education at http://nieonline.com
Daily Interlake at http://www.dailyinterlake.com/
Flathead Beacon: http://flatheadbeacon.com

Ch. 7-2 A Day in the Life: Natural Resource Work in the Flathead Watershed

What types of natural resource work do people do in the Flathead Watershed?

SUMMARY

Students will visit with professionals in the natural resources fields to learn about the types of work that can be done to maintain and enhance the unique qualities of the Flathead Watershed. Students will write a story about 'A Day in the Life' of one of the jobs they learn about.

OBJECTIVES

Students will

- Compare natural resource jobs.
- Ask questions and record answers from interviews with class visitors.
- Write down their work information.

MATERIALS

- Flathead Watershed Sourcebook, pgs. 216-219
- Sourcebook Steering Committee members; pgs. xi – xiii
- Sourcebook reviewers; pgs. vii-ix
- Sourcebook Perspectives content contributors; pgs. 220-221
- Information about natural resources and conservation jobs – from newspapers, internet, community members
- Methods of recording information – computer, paper and pencil
- Field notebook – can be used to record resource work information

BACKGROUND

The lands of the Flathead Watershed are owned and managed by diverse stakeholders, all responsible for protecting the beauty, health, and traditional way of life that makes the Flathead Watershed a unique and desirable place. We depend on watershed resources for our cultural foundation, economic stability, bountiful goods, and recreational opportunities. It is important to know, understand, and care for the complex and interwoven systems that make up this extraordinary place (Flathead Watershed Sourcebook, pg. 200).

Jessie B., the Flathead Lake Biological Station's research boat www.umt.edu

Research interviews conducted with residents of the watershed strongly favor protection of our natural resources as they see these resources as beneficial to their own quality of life and the economic health of their businesses. Research also shows that people living in the Flathead—as throughout the state of Montana—tend to participate to a great extent in their natural environment. More Montana residents hunt than in any other state except Alaska, almost six times the national average. Nearly triple the amount of residents here fish than anywhere else in the U.S.
(Flathead Watershed Sourcebook, pg. 205)

PROCEDURE

Warm-up

Lead a discussion of what is a 'natural resource'. List some of the types of work that revolve around natural resources. Those can include agriculture, forestry, fishing, mining, tourism, agency conservation jobs in water resources, soils, forest health, fire and land-use planning, and non-profit jobs in conservation, outdoor education, and more.

Assistant Professor Bonnie Ellis at the Flathead Lake Biological Station archive.umt.edu

Ask for a show of hands of those students who know someone who works with natural resources in the Flathead Watershed. Ask students to share some information about the work that person does.

After all have shared, ask students to consider the types of work they would love to do in the future. Have them imagine their dream job, and write down a description in their field notebook or other place. When finished, ask for a show of hands of who imagined themselves in a natural resource job.

The Activity

As a class, identify professions in the natural resources that students would like to learn more about. A range of types of work would be ideal, with representation in a number of fields. The Flathead Watershed Sourcebook is an excellent reference for contacts in many professions; area Chambers of Commerce is another.

Have students work in common interest teams to research professions they are interested in. Ask each team to find a contact person in their chosen profession. Arrange to ask those individuals to come into class to speak about their professions. Let the visitors know they will be speaking about their profession from the viewpoint of 'A Day in the Life'- what their work entails on a day to day basis. Ask visitors to include a job overview as well.

Have students prepare a list of questions to ask their visitor. Students should be prepared to take notes as the visitor speaks to capture a record the visitor's answers and comments. Let students know they will be writing a story about the visitor's account and will need plenty of detail about their work.

Visitors can also video recorded with a camera, iPad, smartphone, or other device as they speak with the class. Be sure to ask permission before videoing visitors.

Rich Janssen, director of the CSKT Natural Resource Department was recently awarded the American Indian Distinguished Alumni Award: www.charkoosta.com

Wrap-up

After all the chosen resource professionals have visited the class, have students write their story about one of the resource professionals that were invited to class.

They may choose to write about the profession they were initially interested in or another profession they learned about from the visiting speakers.

Students will write their stories in a first-person narrative of that professionals' 'Day in the Life', using their notes and recordings.

Stories can be in written form, PowerPoints, iMovies or in other forms. If students videoed the speakers, the recordings can be edited and incorporated into their stories.

Thank you cards to the class speakers are an important part of interviews. Have the class create and send cards to all the visiting resource professionals.

Chip Weber, Flathead National Forest Supervisor, www.fs.usda.gov

ASSESSMENT

Students can collect their stories into a booklet entitled "A Day in the Life" and present their information and videos to other classes in the school.

EXTENSIONS

Field trips to see resource professionals 'in action' would be a valuable experience to further understanding of the types of skills and knowledge needed in various types of work.

Service-learning projects in natural resource fields give students an opportunity to experience work in that field and have a positive impact in their communities.

RESOURCES

See the Materials section of this lesson for page numbers of people and agencies that do work in natural resources.

See the 'Interviewing' lesson in the Flathead Watershed Educator's Guide, Introduction, for information on interviewing concerns and techniques

Ch. 7-3 Ecosystem Values of the Flathead Watershed

In what ways do we value the watershed we live in?

SUMMARY

Students will explore the different ways of valuing natural resources in the Flathead Watershed. Students will read comments and quotes from the Flathead Watershed Sourcebook and compare the meaning and intent within the readings, including Native American readings.

OBJECTIVES

Students will

- Gain an understanding of 'intrinsic' value.
- Compare intrinsic value with other values.
- Apply different values to their own lives.
- Develop their own concept of intrinsic value in the Flathead Watershed.

MATERIALS

- Quotes from the Flathead Watershed Sourcebook (provided at the end of the lesson), cut apart and placed in a bag or bowl
- Field notebook or other way to record thoughts and writings

BACKGROUND

There are a number of ways people define the concept of 'value' in their lives and in the world around them. Two of those definitions are intrinsic value and economic value.

Intrinsic value has traditionally been thought to lie at the heart of ethics. Philosophers use a number of terms to refer to such value. The intrinsic value of something is said to be the value that that thing has "in itself," or "for its own sake," or "as such," or "in its own right." (From: http://plato.stanford.edu/entries/value-intrinsic-extrinsic/)

Economic value is defined as the worth of a good or service as determined by people's preferences and the tradeoffs they choose to make given their scarce resources, or the *value* the market places on an item. (From: *www.investopedia.com/terms/e/**economic-value**.asp)*

It is easy to look around the Flathead Watershed and conclude that what we have is priceless. However, it is equally difficult to quantify the economic value associated with our natural environment. Yet, our resource managers struggle to incorporate that value into their decision-making and management processes.

Flathead Watershed: www.fs.usda.gov

From a scientific perspective, there are a growing set of disciplines to evaluate the best use of an area as well as the potential impact of certain human activities. But how much are those uses worth and at what cost are those activities? For example, how much

are our aquifers worth for providing the crystal clear, relatively pure water we enjoy? What would be the cost of losing that function? (Flathead Watershed Sourcebook, pg. 205)

Marilyn Wood from the Flathead Land Trust on Mojo. Source: Marilyn Wood www.flatheadwatershed.org

Economists have developed several ways to look at the value of ecosystems. There are *direct uses*: the value we get from using part of the environment, such as water, timber, fish, pasture, and medicinal and subsistence plants used by tribes; *indirect uses*: the value produced by ecosystems (often referred to as *ecosystem services*) such as water storage provided by aquifers, filtration and nutrient cycling provided by wetlands, and soil stabilization provided by plants; and *optional values* such as agriculture and recreation. Other values that encompass culture, heritage, and aesthetics fall into various categories depending on the cultural and economic viewpoint. The methodologies for determining these values remain somewhat complex (Flathead Watershed Sourcebook, pg. 205).

PROCEDURE

Warm-up

Go over the definition of intrinsic value with the class. Have students come up with values in their lives that are intrinsic to them.

Introduce the idea of economic value. Have students discuss what has economic value in their lives.

The Activity

Introduce the idea of ecosystem values. The ecosystem can be thought of as the watershed they live in. Have the class create a list of all the values they can think of that their watershed provides. Introduce different categories of the ecosystem values listed above: direct, indirect, optional, cultural, intrinsic, and others. Let students know that the categories are a way to understand and evaluate how people interact with and feel about their watershed.

Ask the students if one value is worth more than another value. Answers may vary greatly.

Ask if there are values that could conflict with each other, such as sustainable fisheries and timber, or available housing and critical habitat such as old growth forests and wetlands. Ask students to think about how they would accommodate conflicting values around their watershed.

The Flathead Range: www.flatheadwatershed.org

Have students find a partner or two to work with. Pass around the quotes that have been cut apart and placed in a bag or bowl. Have each student pull out a quote and read it, and then share their quote with their partner or partners, so each group has several quotes to read and compare.

Have students record their quotes in their field notebooks and draw an illustration of their quote.

Ask the students to evaluate their quotes and list the values they feel the writer is expressing. Ask students to think of economic values, intrinsic values and ecosystem values that might be expressed in their quotes, and if there are conflicts between the different types of values. Have students compare quotes to determine if different values are expressed in different quotes.

Ask them to apply the quote to their own sense of place in the watershed they live in. They should determine if they agree with the values in the quote and if they would change or add anything to it.

Wrap-up

Lead a class discussion about the values students found in the quotes. Ask if they've determined if there are values that conflict with each other, and if so, if they have thoughts on how they would resolve the conflicts.

Ask the class if they found any common values in the quotes, and, if so, what those values are.

ASSESSMENT

Have each student write their own 'quote' expressing their values about their watershed.

EXTENSIONS

Have students research the writers of the quotes to learn more about them, and how their values were or are expressed in their lives.

Ask students to find one other quote from a different source or person that has personal meaning for them.

RESOURCES

Further information on the meanings of intrinsic and extrinsic values
http://plato.stanford.edu/entries/value-intrinsic-extrinsic/

Explanation of ecosystem valuation
http://www.ecosystemvaluation.org/benefits.htm

The Flathead River: www.flatheadlakers.org

Flathead Watershed Sourcebook Quotes

1) American geologist, ethnologist, explorer, and government administrator John Wesley Powell described a watershed as "…that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community."

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2) "You can't know who you are until you know where you are." - Wendell Berry

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3) "Live in the sunshine, swim the sea, drink the wild air…" - Ralph Waldo Emerson, 1803-1882

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4) "Edible. Good to eat and wholesome to digest, as a worm to a toad, a toad to a snake, a snake to a pig, a pig to a man, and a man to a worm." - Ambrose Bierce

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5) "I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer. And perhaps with better cause, for while a buck pulled down by wolves can be replaced in two or three years, a range pulled down by too many deer may fail of replacement in as many decades."
   - Aldo Leopold

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6) "Our stories teach us that we must always work for a time when there will be no evil, no racial prejudice, no pollution, when once again everything will be clean and beautiful for the eye to behold—a time when spiritual, physical, mental, and social values are inter-connected to form a complete circle."
   - Salish and Pend d'Oreille Culture Committee

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7) "..... everything on the earth has a purpose, every disease an herb to cure it, and every person a mission. This is the Indian theory of existence."
   - Mourning Dove Salish, 1888 -1936

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8) "After two hours travelling on level ground along Red-stone creek (Red- Rock) we emerged on the Saskatchewan plains, just six geographical miles north of the 49th parallel and camped at the lakes... The scenery here is grand and picturesque... game is abundant, including, Grizzly bears...and we obtained both fresh meat and fish."
   - Thomas Blakiston, Sept. 6, 1858

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9) "A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature."

- Henry David Thoreau

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10) "And an ingenious Spaniard says, that rivers and the inhabitants of the watery element were made for wise men to contemplate, and fools pass by without consideration."

- Izaak Walton (1593-1683)

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11) "No human being, however great, or powerful, was ever so free as a fish"
- John Ruskin, 1819 -1900

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12) "Those little nimble musicians of the air, that warble forth their curious ditties, with which nature hath furnished them to the shame of art."
- Isaak Walton, 1593-1683

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13) "...certain rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." – From the Wild and Scenic Rivers Act, October 2, 1968

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14) "Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy, while cares will drop off like autumn leaves." - John Muir

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15) "What is life? It is the flash of a firefly in the night. It is the breath of the buffalo in the wintertime. It is the little shadow which runs across the grass and looses itself in the sunset." - Crow Foot (1821-1890)

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16) "Look deep into nature, and then you will understand everything better." - Albert Einstein

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17) "Skiing is a dance, and the mountain always leads."

- Author Unknown

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18) "No hour of life is wasted that is spent in the saddle."

- Winston Churchill

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19) "The sportsman lives his life vicariously. For he secretly yearns to have lived before, in a simpler time. A time when his love for the land, water, fish and wildlife would be more than just part of his life. It would be his state of mind." - Jim Slinsky

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20) "All the romance of trout fishing exists in the mind of the angler and is in no way shared by the fish."- Harold F. Blaisdell, The Philosophical Fisherman, 1969

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21) "Land was created to provide a place for boats to visit."
- Brooks Atkinson, N.Y. Times Theater Critic 1894-1984

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22) "A thing is right only when it tends to preserve the integrity, stability and beauty of the community; and the community includes the soil, water, fauna and flora, as well as the people."

- Aldo Leopold, A Sand County Almanac, 1949

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23) "More gold has been mined from the thoughts of men than has been taken from the earth."

- Napoleon Hill, Author 1883 - 1970

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24) "I only went out for a walk and finally concluded to stay out till sundown, for going out, I found, was really going in." -
John Muir, 1913, in L. M. Wolfe, ed., John Muir, John of the Mountains: The Unpublished Journals of John Muir, 1938

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25) "Conservation is ethically sound. It is rooted in our love of the land, our respect for the rights of others, our devotion to the rule of law."

- Lyndon Baines Johnson, 1908 –1973, 36th U.S. President.

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26) "I think having land and not ruining it is the most beautiful art that anybody could ever want to own."

- Andy Warhol, American painter, printmaker, & filmmaker 1928-1987

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27) "Conservation is a state of harmony between men and land." - Aldo Leopold

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28) "There are two spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery and the other that heat comes from the furnace."

- Aldo Leopold, 1887 -1948

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29) "When tillage begins, other arts follow. The farmers, therefore, are the founders of human civilization."

- Daniel Webster 1782-1852, Former U.S. Senator & Secretary of State

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30) "A creative economy is the fuel of magnificence." - Ralph Waldo Emerson 1803-1882

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31) "If you would like to know the value of money, go and try to borrow some."

- Benjamin Franklin, 1706 - 1790

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32) "People who resolve to live in a place indefinitely with deep commitment, no matter what their politics or philosophical views may be, are the key to that place's future."- Robert L. Thayer, Author, Emeritus Professor of Landscape Architecture and the founder of the Landscape Architecture Program at the University of California, Davis

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33) "The plow is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly plowed, and still continues to be thus plowed by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures." - Charles Darwin, The Formation of Vegetable Mould Through the Action of Worms, 1837

Chapter Eight Lessons 275

Ch. 8-1 Working Together in Dragon Boats

How can people work together to attain a shared goal?

SUMMARY

In this lesson students will learn about dragon boat racing as a metaphor for working in community with other people. Students will construct their own dragon boat and race against the other students

OBJECTIVES

Students will

- Understand the history and popularity of dragon boat racing.
- Build a small dragon boat and race it.
- Value working together for a common goal.

MATERIALS

- cardboard
- scissors
- soap
- trays with water
- pennies
- aluminum foil

BACKGROUND

Dragon boat racing on the Flathead Lake began in the summer of 2012. It is held at Volunteer Park in Lakeside. It is a colorful and exciting event drawing many people from outside the Flathead Watershed. You can see highlights of the 2015 Montana Dragon Boat Festival at https://youtu.be/eELQinRzl8Y.

Traditional Hong Kong style dragon boats are 46-feet long, with 10 seats and 20 people. A drum seat in front of the first two paddlers (seated beside each other) holds a drummer – you want the smallest, loudest, most rhythmic person you can find. A steerer guides the boat with the steering oar in back. These 22 people make up a dragon boat team. The stroke is similar to an outrigger canoe.

With origins dating back 2,300 years, dragon boat racing is a fun, unique cultural event featuring adrenaline-pumping action. Teams race in authentic 46-foot long Hong Kong style dragon boats. Participants like about the excitement, friendly competition community spirit surrounding the sport.

kalispellevents.sportngin.com

PROCEDURE

Warm-up

Read this history of dragon boats to the class: According to legend, Dragon Boat racing originated in China more than 2,300 years ago. Chinese history describes the fourth century B.C. as the Warring States period; a time of shifting alliances and treachery.

The patriot and poet Qu Yuan championed political reform and truth as essential to a healthy state. The King, who had fallen under the influence of corrupt ministers, banished his most loyal counselor, Qu Yuan, from the kingdom.

Left to wander the countryside, Qu Yuan composed some of China's greatest poetry which expressed his fervent love and loyalty for his country and his deep concern for its future. Upon learning of his kingdom's devastation at the hands of a rival kingdom in

277 B.C., Qu Yuan threw himself into the Mei Lo River.

The people loved Qu Yuan. They raced out in their fishing boats to the middle of the river in a vain attempt to save him. They beat on drums and splashed their oars in the water, trying to keep the fish from his body and ward off evil spirits. To honor his soul and ensure it didn't go hungry, they scattered rice into the water.

Today, dragon boat races are primarily a form of amusement and fun while also highlighting the history and culture of this colorful event. Every year, people come together to pay tribute to this fallen statesman by paddling to the beat of their own drum.

The traditional dotting of the Dragon's eye before dragon boat racing begins awakens the dragon and unleashes its fire, giving boats and their crews the strength of the dragon.

Example of an aluminum foil boat: No1pdfplans.de.ve

The Activity

Tell the students they are going to build their own dragon boat that will float the most mass without sinking.

- Have the students work in teams of three or four. Ask them to choose a team name.
- Provide each team with two .5m x .5m sheets of aluminum foil. For older students you may wish to have students measure and cut the foil sheets. Be certain to check the students' work for accuracy and to ensure fairness.
- Instruct the students that one sheet of foil is to test their design ideas and the other sheet is for their final "dragon boat".
- Provide the students with the design challenge to create a "dragon boat" that will hold the most pennies/washers. Instruct the students that they are not allowed to use anything to build the boat other than one .5m x .5m sheet of foil.
- Place a large number of pennies in a location that is easily accessible to the students.
- Partially fill a large tub or sink with water.
- Have the student teams brainstorm ideas for the design of their dragon boat. Monitor their communication for use in discussion at the conclusion of the investigation.
- Have the students use one sheet of foil to test their ideas. It is important to provide adequate time for the testing process so the students can fully develop their ideas and discover the principles of floatation. Monitor the testing for use in discussion at the conclusion of the investigation.
- Have the students create their final dragon boats. Once completed, they should report to the test location to begin the challenge.
- Have the teams draw numbers to assign the order in which the teams will complete the challenge.
- Have the first team place their boat in the water and add pennies to the boat until it begins to sink in the water, but remains floating and does not sink to the bottom.
- Count the pennies as they are being added to the boat or after the completion of each team's trial

(this is the most time-effective method).

- Write the results of the challenge on the board next to the name of each team.

Wrap-up

Ask the students why they believe one boat could hold more pennies than another could. Their responses will most likely be concerned with the following:

- The method in which the pennies were added to the boat such as being dropped or gently placed in the boat.
- The boats that performed best had the largest surface area.

Although the students most likely will not use the term surface area, their description of this concept provides an opportunity to introduce and discuss the term and its relationship to the distribution of force.

EXTENSIONS

Design your own dragon boat using modeling compound. Dragon boats are usually long and narrow. They often have a dragon's head at the front and a tail sweeping up the back.

www.crayola.com

Choose which color(s) to use for your dragon boat. To make your own shades, mix two or more colors. Knead until the color is evenly mixed.

To shape your boat, make a long, thick roll of clay. Hollow out the center of the boat by pressing into the roll with your fingers. Smooth the inside edges.

Shape more modeling material into a dragon's neck and head. Many dragons have long jaws. Their necks are often long and graceful. Press the bottom of the neck onto one end of the boat.

Use more clay to sculpt your dragon boat's tail. You might roll the modeling material into a snake that is thicker at one end than the other. Fold the roll back and forth on itself to make a wavy tail. Press the thick end of the tail onto the other

Add finishing features to your dragon boat head and tail with contrasting colors of Model Magic. You could add eyes, teeth, a nose, or decorations on the boat if you'd like. Shape small pieces of Model Magic for detail work.

RESOURCES

An explanation of Dragon Boats:
https://en.wikipedia.org/wiki/Dragon_boat
Montana Dragon Boat at:
http://kalispellevents.sportngin.com/
3D origami dragon boat at:
https://www.youtube.com/watch?v=cZNHAhTkWkI

Ch. 8-2 Stewardship in Action

What does stewardship mean to you?

SUMMARY

Students will examine the meaning of stewardship and look for acts of stewardship in their own lives. Students will discuss and develop service learning projects based around watershed conservation concepts.

OBJECTIVES

Students will

- Define stewardship.
- Apply stewardship ideas to their own lives.
- Determine what service learning is.
- Develop a plan for a service learning project.
- Record and present their plan to others.

MATERIALS

- Access to ways to research the definition of stewardship, i.e. internet, dictionary, encyclopedia, other
- Information about local waterways, riparian areas or other green areas for potential service-learning projects
- Field notebook
- Presentation options
- Video and/or photo equipment

BACKGROUND

Definitions of Stewardship

1. The conducting, supervising, or managing of something; especially*: the careful and responsible management of something entrusted to one's care (*stewardship *of natural resources)* From: (http://www.merriam-webster.com/dictionary/stewardship)

2. The responsible overseeing and protection of something considered worth caring for and preserving: Example: New regulatory changes will result in better stewardship of lands that are crucial for open space and wildlife habitat. (From: http://dictionary.reference.com/browse/stewardship)

The lands of the Flathead Watershed are owned and managed by diverse stakeholders, all responsible for protecting the beauty, health, and traditional way of life that make the watershed a unique and desirable place. We depend on watershed resources for our cultural foundation, economic stability, bountiful goods, and recreational opportunities.

It is important to know, understand, and care for the complex and interwoven systems that make up this extraordinary place. With sound information, thoughtful planning, responsible stewardship, and a shared commitment, we can maintain this quality of life for future generations in the Flathead Watershed (Flathead Watershed Sourcebook, pg. 200).

PROCEDURE

Warm-up

Ask students if they can define the term 'stewardship'. As they come up with ideas, put them on the board for all to see.

Depending on what they say, share the definitions listed in this lesson, particularly #2, *responsible overseeing and protection of something considered worth caring for and preserving*.

The Activity

Part A: Defining 'Stewardship':

Lead a discussion about the above definitions – or a similar definition that students have developed.

Using Definition #2, break down the definition – starting with 'something considered worth caring for and preserving'. Ask students what that means in their lives – could easily include family and pets, possessions, home, school, friends, etc.

If it doesn't come up, ask students to think about the natural world around them and if there is 'something worth caring for and preserving' in that area.

Answers could include clean water, good fishing, good skiing, glaciers in the park, grizzly bears or other wild animals, favorite places to hike, snowmobile, or ride.

Look at the first half of the definition, and ask what 'responsible overseeing and protection' means, and what those words look like when put into action. Ideas can range widely and can include caring for family, possessions, land and others. Steer the conversation to the watershed and the natural world, asking what types of action would show 'responsible overseeing and protection'. Answers could include: not littering, using less gas, not polluting water, use less water, and others.

Have students write in their field notebooks their thoughts and ideas about stewardship. Ask students to write in their own words their definition of stewardship.

Part B: Stewardship Service-Learning Project

Ask students to think of a natural area near their school or in their neighborhood that they feel could use an act of stewardship. The natural area could be in or near the school grounds, along a nearby waterway, in a local park, or some other site. Take a walking field trip to the sites to evaluate them for service projects. People in local agencies such as city and county governments, conservation districts, Forest Service and others could offer ideas for possible service project sites.

Have students discuss what stewardship actions could be taken, such as cleaning up a local park, planting willows along a stream, trail building and maintenance, creating guided hike signs or brochures or other ideas needed in the nearby natural areas.

When the class has determined that there is an area they could look into as a project, begin research into the ownership of the area, the scope of the issue and the types of actions that can reasonably be taken.

As a class, develop an action plan for the stewardship project. Include a timeline, materials and tools needed, and number of people and hours needed. Define an end result for the project, and possible further actions to keep up on the stewardship of the area.

Identify community groups such as conservation agencies, parent groups, community and civic groups that could lend aid such as people, materials, funds or expertise.

If the project is feasible, and all permissions have been obtained, do the project as planned.

crown-yellowstone.umt.edu

Be sure to let the community and school know about the project before, during and after the class is finished.

Take lots of photos and videos as a record of the project. Create a presentation of the project and show parents, school board members, other classes and the community what the class has accomplished.

If the project cannot be accomplished on the ground, have students create posters of potential service learning projects with before and after drawings of the proposed project. Include on the poster the benefits to the area and the ecosystem of the project.

wilderness.org

Wrap-up

When the project has been completed, debrief with the class how the whole project went. Discuss what worked well, what was okay, and what didn't succeed as planned.

Discuss unexpected aspects of the project that both helped and hindered success. Have students reminisce about the most fun and pleasantly surprising aspects of the project.

Ask students to think of a next project they would consider undertaking.

Ask students how they feel about stewardship, now that they have completed an effective stewardship project. Do they have a different sense about the importance of their actions in making a difference?

ASSESSMENT

The development of a rubric by the class at the beginning of the project can serve as both a formative and a summative assessment.

The stewardship definition can act as a formative assessment, indicating students' understanding of the concept. The class work on the service-learning project can be graded as a project-based learning assessment.

EXTENSIONS

Have students develop their own Stewardship Credo. They can write it in their field notebook.

Definition of credo: an idea or set of beliefs that guides the actions of a person or group (from: http://www.merriam-webster.com/dictionary/credo)

Have the class write up a synopsis of the stewardship project as though they were going to give advice to another class about to take on a stewardship service-learning project.

Have the class look for ways to increase the impact of the project they've just completed- such as making it a yearly project, doing the same project in another area, doing another aspect of the project they've just completed, or other ideas.

RESOURCES

County Extensions
https://flathead.mt.gov/extension/
http://www.lakemt.gov/extensionoffice/Ind ex.html

Community organizations:
Flathead Lakers: www.flatheadlakers.org/
Flathead C.O.R.E : flatheadcore.org

Flathead Conservation District:
flatheadcd.org/

NatureBridge: service learning

clearinghouse for community-based outdoor projects; https://www.naturebridge.org/training-tools/teachers/get-outside-service-learning

Website for The Center for Social and Environmental Stewardship: http://www.cfses.org/pages/20_service-learning_programs.html

Wilderness Society: service projects by state http://wilderness.org/fifty-50th

Just say Yes to Youth Environmental Stewardship: https://edis.ifas.ufl.edu/fr120

From ERIC: Kaye, Cathryn Berger, Environmental Stewardship through Service Learning, Principal Leadership, v12 n4 p26- 30 Dec 2011 http://eric.ed.gov/?id=EJ965269

Appendix A: NGSS and Common Core Correlation Table

Activity Number	Activity Name	Page #	NGSS correlation: Performance Expectations (PE) And Disciplinary Core Ideas (DCI)	Common Core Correlations: Literacy History/Social Studies, Science & Technology 6-12
Introduction Intro-1	Flathead Watershed People and Perspectives	1	PE: MS-LS2-5; M-ESS3-3, MS-ESS3-4; MS-PS1-3 DCI: LS2.A, LS4.D, ESS3.A, ESS3.C, PS1.B, ETS1.B	RST.6-8.8, RI.8.8, WHST.6-8.1, WHST.6.8-2, WHST. 6.8-8, WHST.6-8.9, MP.4, 6. RP.A.3
Intro-2	Interviewing People in the Flathead Watershed	4	MS-ETS1-1, MS-ETS1-2, MSETS1-3, MS-ETS1-4 DCI: ETS1.A, ETS1.B, ETS1.C	RST.6-8.9WHST.6-8.7, WHST.6-8.8, WHST.6-8.9
Chapter One		11		
1-1	Boundaries of the Watershed	12	PE: MS-ESS2-4, DCI: ESS2.C	RST.6-8.7
1-2	Watershed Journals	18		RST.6-8.7, WHST.6-8.2, WHST.6-8.4
1-3	Modeling Watersheds in Paper	21	PE: MS-LS2-3, MS-LS2-4, MS-ESS2-4 DCI: LS2.C, LS4.D, ESS2.C	RST.6-8.7, SL.8.1, SL.8.5
1-4	Site Mapping	25	PE: MS-PS-5 DCI: PS2.B	RST.6-8.3
1-5	Patterns of Stream and River Flow	28	PE: MS-ESS2-4, MS-ESS2-5 DCI: ESS2.C, ES2.D	RST.6-8.1, RST.6-8.7, SL.8.5
1-6	Flooding in the Flathead	37	PE: MS-ESS2.4, MS-ESS2-5, MS-ESS2-6 DCI: ESS2.C, ESS2.D	RST.6-8.1, RST.6-8.7, WHST. 6-8-1a, b, c, WHST.6-8.2, WHST.6-8.9, SL.8.5
1-7	Watershed Quotes	45		RH.6-8.2, RH.6-8.4, RH.6-8.6, WHST.6-8.7, WHST.6-8.8, WHST.6-8.9, WHST.6-8.10
1-8	Poetry of Place	49		RH.6-8.4, WHST.6-8.2a, b, c, d, e, WHST.6-8.4, WHST.6-8.10
1-9	Flathead Field Notes	53		RH.6-8.1, RH.6-8.2, RH.6-8.4, RH.6-8.6, RH.6-8.7, WHST.6-8.4, WHST.6-8.7,

				WHST.6-8.8, WHST.6-8.9, WHST.6-8.10
1-10	Field Trip Safety	56		
Chapter Two		61		
2-1	Geologic Mural of the Flathead Watershed	62	PE: MS-ESS1-4, MS-ESS2-1, MS-ESS2-2, MS-ESS2-3 DCI: ESS1.C, ESS2.B	RH.6-8.7, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.5, RST.6-8.7, WHST.6-8.2, WHST.6-8.8, WHST.6-8.9, MP.2
2-2	Soil Pit Survey	65	PE: MS-ESS2.1, MS-ESS2.2 DCI: ESS2.A	RST.6-8.3, RST.6-8.7, RST.6-8.9
2-3	Cupcake Soil Profiles	68	PE: MS-ESS2.1, MS-ESS2.2 DCI: ESS2.A	RST.6-8.3, RST.6-8.7, RST.6-8.9
2-4	Flathead Climate and Weather	70	PE: MS-ESS2.5, MS-ESS2-6 DCI: ESS2.D	RST.6-8.1, RST.6-8.4, RST.6-8.7 RST.6-8.9, WHST.6-8.2, WHST.6-8.8, WHST.6-8.9, SL.8.5
2-5	Changing Glaciers of the Flathead Watershed	74	PE: MS-ESS2-4, MS-ESS3.5 DCI: ESS2.A, ESS3.C, ESS3.D	RH.6-8.7, WHST.6-8.6, WHST.6-8.8, WHST.6-8.9, SL.8.1, SL.8.5
2-6	Snow Layer Profiles	77	PE: MS-ESS2.5 DCI: ESS2.C, ESS2.D	RST.6-8.3, RST.6-8.7
2-7	Classroom Investigation of Water Breathing	80	PE: MS-LS1-5, MS-LS1-6, MS-LS1-7, MS-LS2-1, MS-LS2-4, DCI: LS1.C, PS3.D, LS2.B	RST.6-8.3, RST.6-8.7, MP.4, 6.RP.A.3, 6.SP.B.5
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