StreamWebs
student stewardship network

StreamWebs Field and Classroom Watershed Investigation Curriculum

Unit Overview

The unit is designed for 6th through 9th grade but may be adapted for older or younger grade levels.

The StreamWebs Field and Classroom Watershed Investigation curriculum is designed to help formal and nonformal educators use StreamWebs as a platform to conduct meaningful, field-based, student-driven investigations that continue in the classroom. The desired outcomes are to provide science inquiry-based opportunities for students to work collaboratively in the field in ways similar to scientists; to understand that science doesn't only happen in a lab or classroom; to design their own investigative question and research plan; to collect data; to learn how to look for patterns and changes in their data; to make logical conclusions based upon their data; to answer or refine their investigative question and/or research plan; and to understand what the data indicate for their stream over time.

In this unit, you will choose a local stream to study, and identify and work with partners who can support their students' project. The lessons may lead you and your class toward designing and implementing a stewardship project, but the main focus is on field research and engaging students in their environment through inquiry and student-driven projects. Students will research their watershed, design investigative questions, plan and conduct an investigation, and collect, analyze, interpret, and present data. These lessons focus on water quality and macroinvertebrate data, although StreamWebs offers options for collecting other data as well. These lessons will achieve cross-curricular connections in math, language arts, and science as students develop their data literacy.

Lessons are aligned with the Next Generation Science Standards (NGSS): Each lesson will describe the corresponding Middle School (MS) Performance Expectation and Science and Engineering Practice(s) that connect to those lessons. Special thanks to Amy Hoffman, who did the initial writing, and the many teachers who contributed to these lessons.

Lesson 1

Timeframe

One to two 50-minute class periods, depending on how much students know about watersheds

Materials

- Maps of the watershed (if you have them or are able to get them from a partner. Otherwise, Google Earth is a good alternative)
- Computers or tablets (one per group)
- Pictures of local bodies of water
- 3x5 index cards

Objectives

- Work together and collaborate in groups
- Learn about watersheds and identify your own local stream or river
- Identify where a particular stream's water originates, and where it flows to
- Research the local needs of your community and watershed

Discover Your Watershed

Teacher Background

This lesson is intended to help prepare students for an upcoming field experience by introducing them to the field site they will visit and helping them determine their research interests. Whether your students are doing a single field trip or multiple trips, we encourage you to use the opportunity to help them develop and answer an investigative question through the data they collect. A great resource to help them develop an investigative question is "Field Investigations: Using the Outdoor Environments to Foster Student Learning of Scientific Processes" (https://tpwd.texas.gov/publications/nonpwdpubs/media/field_investigation_guide.pdf).

There are most likely some organizations in your community that work to protect, monitor, and care for your watershed. This is a great time to invite them in to talk with your students about their local watershed before you go out. Staff might also be available to assist your students during their field trip or to provide other field resources such as equipment. Suggested organizations to reach out to include watershed councils, city parks, or other city/state departments tracking stream health such as transportation departments, state parks (if nearby), the Bureau of Land Management, Oregon Department of Forestry, the United States Forest Service, private agricultural or forestry businesses within the community (for example: Starker Forest in the Corvallis area), and nonprofits such as friends groups caring for a particular park or stream.

Description

In this lesson, students will be introduced to the concept of a watershed and learn about their own watershed. Students will use Google Earth to get to know their local watershed and to identify features of a watershed. Students will begin to understand what scientists study in a watershed, identify their own interests about the watershed.

Preparation

Teachers will need to spend time researching the watershed you and your students will work with and familiarize yourself with the headwaters (where a stream begins), mouth (where it meets and flows into another body of water, such as another stream or the ocean), and other important features (such as incoming streams or dams) along the stream you are studying. If you haven't already used Google Earth, you will want to spend some time becoming familiar with it and identifying the key features of your watershed that you would like to point out. You can download Google Earth at https://www.google.com/earth/

If you have not previously discussed watersheds with your class, you may want to do a lesson that provides a basic introduction before beginning this lesson. This would also be a great time to bring in someone from your local watershed council to conduct a watershed-based activity with your class (see extended learning).

Activity Introduction

Explain to students that they will be learning about their local watershed, understanding their role within a watershed, and discovering the needs of their watershed. Explain that they will eventually work in teams to design a field investigation they can conduct in their watershed.

Discuss the following as a class:

- We depend upon our natural resources for our health and needs such as clean air, food, and clean water.
- We monitor our resources, such as streams, to better understand the health of our resources.
- We will be planning an investigation in teams as a way to study and learn more about our local community, identify the needs of our local watershed, and discover what sort of work is done to maintain a healthy stream and watershed.

Next Generation Science Standards

DISCIPLINARY CORE IDEAS:
LS2.A: Interdependent Relationships in Ecosystems
ESS3.C: ESS3.A: Natural Resources

PERFORMANCE EXPECTATIONS:
MS-LS2-4. Construct an argument supported by empirical evidence showing that changes to physical or biological components of an ecosystem affect populations.

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

PRACTICES:
Practice 1: Asking Questions and Defining Problems

Part 1: What Does Your Watershed Need?

1. Using Google Earth, project your watershed at the front of the class, or assist students in navigating Google Earth to find their watershed. If you are using Google Maps, open and select the Terrain or Satellite view. Type into the Search box the locations you are interested in exploring (e.g., your school's address, a local creek, etc.) or click on the map to select each.
2. Save each location and, once you have the map locations, explore. Zoom in and out; use Street View and Photos to virtually visit each site. Point out landmarks such as schools, grocery stores, restaurants, and parks to give students a better sense of place.
3. As a class, identify the following characteristics and discuss:
   - What do you notice about our watershed? Where does our stream start?
   - Where does the water travel before entering the stream? *Over land, soil, rock, or pavement, and/or through the ground.*
   - Where does the water from that stream or river go? *To a bigger stream or river, to a lake, and/or to the ocean.*
   - What does it mean for a watershed to be healthy? *Elements include: correct temperature and chemical properties of the water, adequate tree and plant coverage for habitat and for filtering/slowing water, very little bank erosion, low levels of invasive species, etc. All of these attributes affect our drinking water.*
   - Who and what lives in a watershed? *People, fish, birds, our pets, deer, and other wildlife. Point out to students that other living and nonliving things, including buildings, rocks, soil, trees, and plants, all "live" in our watershed. Even your school and your house are part of your watershed.*
   - How do we impact our watershed? *Recreation such as hiking, fishing or camping can impact the watershed. We can have a negative impact by not properly disposing of pet waste or garbage, washing the car in the driveway or allowing other pollutants to run into the street and/or storm drains, allowing invasive species to grow in their yard, etc. There are also a number of ways that we can positively impact our watershed, such as removing invasive species and/or planting native plants.*

Guiding Questions

- What is a watershed? Which one do we live in?
- What local stream or river do we live close to?

Part 1: Continued

4. Start talking about potential places where students could collect data and/or conduct a field investigation. Work as a class to help students identify:
   - a nearby stream, river, lake, etc. where there is enough standing water for students to be able to collect data
   - other potential areas where they could collect their data for a field investigation.

5. Let students know they will be going out into the watershed to learn more about it! Ask them to think about what interests them most and give them a minute to jot down the top three things they want to investigate and learn while they are in the field. Note: You will want to consider which tools you have and the site you will be investigating, so you may want to provide students with some parameters.
6. Have students share their interests with a partner and then with the class. As students share, record topics and possible investigative questions on the board.
7. Hand out 3x5 cards and ask students to write down their top three interests or questions on the cards. Use these cards to arrange students into groups based on their interests or to develop a class research question.
8. If you are able to have students work in teams by interest, you will need time to arrange student research teams before moving on to Part 2. If you aren't able to have students work on separate projects, you can use their ideas to come up with research question the entire class can investigate.

Part 2: Developing an Investigative Question

1. Let students know that, before heading into the field, scientists know what they are looking to discover, based upon an investigative research question they are trying to answer or a problem they are trying to solve. Have students discuss (in groups or as a class) what they were interested in studying.

   - What interests do they all share?
   - What questions about the stream or watershed do they have in common?
   - What is one thing they could focus on together to study in the stream?
2. Now that students have an area of interest, walk them through the process of developing a good investigative question. Tell students they may refine their questions throughout the research process. Scientists are always learning and refining their questions and studies.
3. Have student discuss and follow these guidelines when creating a good investigative question:

   - Cannot be answered with a simple yes or no
   - Needs to be interesting to you
   - Must be able to measure/study within our timeframe and with our tools
   - Starts with words like:

     How does...

     What is....

     Would x affect y...
4. Share examples of investigative questions, and then have students work in teams to create an investigative question their team will study, or have them generate one question that the larger class will study. Example questions might include:
   - What is in our water, and how might it have gotten there?
   - What is our creek's amount of tolerant or intolerant macroinvertebrate species, compared to other creeks?
   - How much does the water temperature drop during winter?
   - Is this creek healthy for the fish that live here?

Part 2: Continued

5. Have each team share its investigative question(s) with the class. Will they be able to answer it/them with the tools and within the time allotted for your field investigation? Does it make sense for the watershed you are working in? If not, how can they change it?

6. After students have finalized questions, discuss how scientists often create an investigative plan to outline how they will conduct research to generate data. Students might document in a notebook logical steps written clearly so that someone else could follow the procedure. *What data will they collect? Which tools will they use? What part of the watershed will they study? How much data will they collect? Etc.*

Activity Wrap Up

Review with students what they will be studying when they head into the field. Assure them that, through the experience of getting out into the field and investigating their watershed, they will learn what to write down and become more comfortable recording field observations, such as specifics about what they see, hear, smell, do, and the data collected. Let students know that in the next lesson they will have the opportunity to learn more about the resources they will be using to collect data and study their watershed.

Extended Learning

Looking for lessons that will introduce students to watersheds?

Check out "Home, Home in a Stream," an activity compiled by Oregon State University's Science Math Investigative Learning Experiences (SMILE) Program; or "Crumple a Watershed," from Oregon Museum of Science and Industry (OMSI)!

Lesson 2

Timeframe

Three 50-minute class periods, depending on the class and how much students already know about water quality and macroinvertebrates

Materials

- Water quality sampling equipment —StreamWebs water quality and macroinvertebrate datasheets (http://streamwebs.org/resources/data-sheets)
- Containers and labels for water quality activity
- Lemon juice, vinegar, coffee, baking soda, antacid, etc. to demonstrate pH
- Mud or debris to demonstrate turbidity
- Macroinvertebrate pictures from "Macro Mayhem" (http://smile.oregonstate.edu/lesson/macro-mayhem)

Objectives

- Work together and collaborate in teams
- Learn how to properly collect and record data
- Be introduced to StreamWebs and equipment they will use in the field
- Learn how to create, log in to, and use the class StreamWebs account

Getting Ready for the Field

Teacher Background

For information on water quality and macroinvertebrates, refer to:
A Citizen's Guide to Understanding and Monitoring Lakes and Streams, http://water.usgs.gov/edu/waterproperties.html

"Water Quality and Macroinvertebrate Field Studies," found in "Resources" section for individual Kits: http://seagrant.oregonstate.edu/education/streamwebs-educator-kits/streamwebs-kit-descriptions

For information on setting up an account and getting started using the StreamWebs database, refer to the sheet "Getting to know StreamWebs."

Description

In this lesson, students will learn about the research tools available to them for collecting data, how scientists monitor water quality health, and the online resource www.streamwebs.org for storing data. After students have a better understanding of the resources available to them, they will work on creating an investigative research question.

Preparation

Create a StreamWebs account ahead of time to share with your class. It is recommended that you share one account as a class.

1. Go to www.streamwebs.org; "Create New Account." It is recommended that you make one account that your class can login to so be sure to choose a user name and password that you will be comfortable sharing with students.
2. If there is an existing project site that you plan to work at you can locate it by selecting "Search Projects" from the menu. Sites are found by using the search bar and on the map by colored "pegs."

Preparation cont.

3. If you need to create a project site, select "Add Project" from the menu and enter in the information about your project site.
4. Obtain sampling tools for students to use as part of their investigation. Equipment may be available to borrow through your local watershed council, STEM hub, etc.
5. Make macroinvertebrate card packets for students to practice identification, using the pictures found in the "Macro Mayhem" lesson developed by Minnesota DNR (http://smile.oregonstate.edu/lesson/macro-mayhem). You will divide students into four or five groups and will need one packet per group. You will also need to set up "stations" with sample water that will allow students to practice collecting data with their equipment. You should label stations as different parts of the watershed, such as urban, rural, estuary, or upstream, downstream, etc. You could also provide each group of students with their own "set" of samples rather than rotating. If you are unable to collect a variety of water samples to show variation, you will want to adjust your water accordingly. In order to get a good variety of pH readings, you can add lemon at one station, baking soda to another, coffee to another, etc. Add mud or debris to demonstrate turbidity; hot and cold water for measuring temperature and dissolved oxygen; etc.

Activity Introduction

Explain to students that they will practice using sampling tools that help determine whether a stream is healthy. Specifically, they will be learning about the different water quality parameters and macroinvertebrate species commonly used to measure stream health.

Part 1: Understanding Water Chemistry

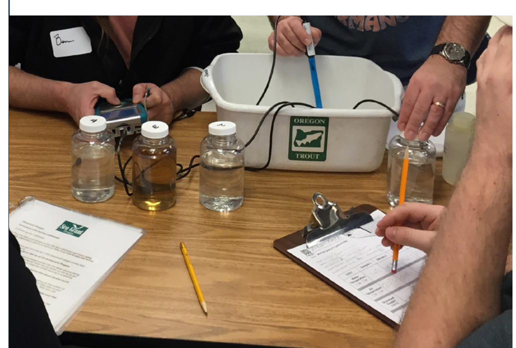
1. Ask students what we can learn by studying the water quality and macroinvertebrates in our watershed. *We can learn about the health of our watershed.*
2. What are some ways scientists determine whether a stream is healthy or unhealthy? *They do different tests to look at temp, oxygen in water, sediment in water, etc.*
3. Discuss stream temperature, dissolved oxygen, turbidity, and pH and what they measure and tell us about the water. Provide students with water quality parameters sheets (included in lesson).

Next Generation Science Standards

DISCIPLINARY CORE IDEAS:
LS2.A: Interdependent Relationships in Ecosystems
ESS3.C: Human impacts on Earth Systems

PERFORMANCE EXPECTATIONS:
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

PRACTICES:
Practice 1: Asking Questions and Defining Problems
Practice 3: Planning and Carrying out Investigations



Preparation cont.

4. Ask students to break into pairs or small groups. Tell them they are going to do an inquiry activity to get to know the tools they will work with in the field.
5. Pass out field equipment to students and have them discuss: What is it? What is it used for? How does it work? What might this tool tell you about a water sample? How do you know? What is your *evidence?*
6. Pass out StreamWebs water quality datasheets to student teams, and use the Guiding Questions to help students understand the importance of data collection.
7. Have students rotate through the water quality sample stations and use their equipment to collect water quality data. Remind them to record all the required information on the datasheet.
8. When students have finished collecting their data, have them report out their findings.

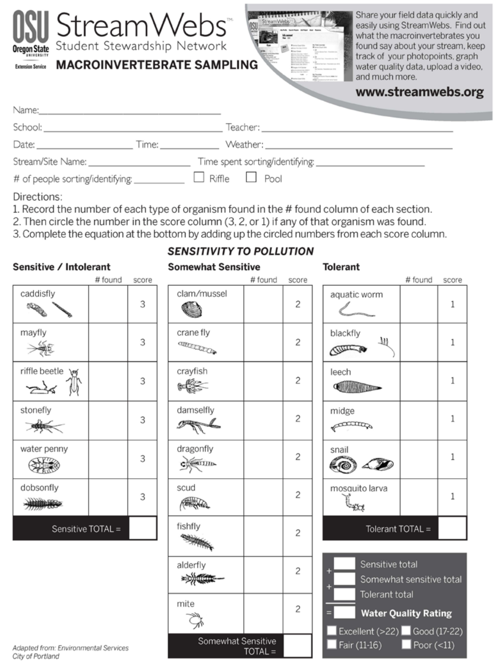
Part 2: Understanding Macroinvertebrates

1. Tell students that scientists also use macroinvertebrates that live in the water to determine how healthy it is.
2. Define to the class what the word *macroinvertebrate* means. Break it up into *macro* (large enough for us to see with our naked eye) and *invertebrate* (without a backbone).
3. Explain how macroinvertebrates living in a stream can be an indicator for water quality.
4. Hand out to each group a packet of macroinvertebrate cards. Ask students what they notice about their macroinvertebrates that might help us tell them apart.
5. Explain that macroinvertebrates are grouped by characteristics similar to the ideas students just discussed. Among these characteristics are size and shape of their body, legs, eyes and mouth if visible, and where they are found in the stream. Now have them sort their macroinvertebrates based on some of the things they notice about them.

Guiding Questions

- What are data? *Facts and information gathered from observation. Data can be numbers, words, sketches, and drawings—all of the things we just collected with our tools.*
- Why is it important to collect data? *Data are part of the scientific method (explain, if a new idea to students). Data help scientists gain understanding about the natural world, identify patterns and correlations, answer questions, and make conclusions.*
- Why is it important to record data accurately and neatly? *Once collected, data are often input into a database, such as StreamWebs, or a spreadsheet. It is important to be able to read what you have recorded so that it can be input later. Common errors such as bad handwriting, no recorded date, or blank spots on datasheets can make it difficult to use the data.*
- What will we do if we do not have information to record in a certain spot on our datasheets? *Instruct students to record the number 0, mark N/A, or note other reasons for no data collected.*

Macroinvertebrates cont.



OSU Oregon State University Extension Service

StreamWebs™ Student Stewardship Network

MACROINVERTEBRATE SAMPLING

Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

Name: ____________

School: ____________ Teacher: ____________

Date: ____________ Time: ____________ Weather: ____________

Stream/Site Name: ____________ Time spent sorting/identifying: ____________

# of people sorting/identifying: ____________ ☐ Riffle ☐ Pool

Directions:
1. Record the number of each type of organism found in the # found column of each section.
2. Then circle the number in the score column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION

Sensitive / Intolerant	# found	score	Somewhat Sensitive	# found	score	Tolerant	# found	score
caddisfly		3	clam/mussel		2	aquatic worm		1
mayfly		3	crane fly		2	blackfly		1
riffle beetle		3	crayfish		2	leech		1
stonefly		3	damselfly		2	midge		1
water penny		3	dragonfly		2	snail		1
dobsonfly		3	scud		2	mosquito larva		1
Sensitive TOTAL =			fishfly		2	Tolerant TOTAL =		
			alderfly		2			
			mite		2			
			Somewhat Sensitive TOTAL =					

☐ Sensitive total
+ ☐ Somewhat sensitive total
+ ☐ Tolerant total
= ☐ **Water Quality Rating**

☐ Excellent (>22) ☐ Good (17-22)
☐ Fair (11-16) ☐ Poor (<11)

Adapted from: Environmental Services City of Portland

Discuss what it means to be a tolerant versus an intolerant macroinvertebrate species. *Some macroinvertebrates are able to handle pollution better than others.*

7. Hand out macroinvertebrate datasheets. Ask students to sort their macroinvertebrate cards by tolerance level and record them on their datasheets. What does the water quality rating tell you about the health of the stream?

8. Discuss the importance of recording readable data. Have students review their sheets and see how they did.

Part 3: Getting Comfortable with the StreamWebs Website

1. Show students how to log in to StreamWebs, and share the username and password with students. *We recommend one class account that students share, as it is easier to manage.*

2. Have students visit the site page where they will be collecting data during your class field trip(s).

3. Show students how they will go about entering water quality and macroinvertebrate data into the website after their field trip. Have them make note of the importance of having complete datasheets. Are their datasheets missing any important information?

4. Give students time to explore the website and look at what other schools are doing and the data they have collected.

Activity Wrap Up

Review with students what tools they are going to use to investigate their watershed. Now that they have practiced using sampling equipment and datasheets and learned more about what data they will be collecting, they are ready for the field! Go over any need-to-know information for your upcoming field day, such as what to bring or not bring, appropriate clothing, boots, etc.

Lesson 3

Timeframe

As many trips as possible to your class's site

Materials

- Field equipment — available for checkout
- Water Quality and/or Macroinvertebrate lesson plans for the field
- Pencils
- Datasheets

Objectives

- Gather and record data
- Make observations into a field journal
- Understand the importance of water quality monitoring
- Learn the appropriate techniques to sample water quality
- Perform in-stream water quality tests measuring for pH, turbidity, temperature, and dissolved oxygen
- Understand the important role macroinvertebrates play in the aquatic ecosystem
- Collect, record numbers of, and study macroinvertebrates

Heading Into the Field

Teacher Background

For information on water quality and macroinvertebrates, refer to: A Citizen's Guide to Understanding and Monitoring Lakes and Streams, http://water.usgs.gov/edu/waterproperties.html; and Water Quality and Macroinvertebrate Field Studies, found in the "Resources" section for individual Kits: http://seagrant.oregonstate.edu/education/streamwebs-educator-kits/streamwebs-kit-descriptions

Description

In this lesson, students will be heading out into the field to do a watershed investigation that includes collecting water quality and macroinvertebrate data. You can find lessons for leading your students in the field around these focus areas at www.streamwebs.org. Students should collect data that will help them answer their investigative questions and save their data so they can follow up in the classroom at a later date.

Preparation

If you do not already have gear available to use, you may be able to borrow equipment through your local watershed council, STEM hub, etc. You will also need to make sure students have their datasheets, and remind them to be thinking about their investigative question while gathering data.

Visit the site ahead of time to determine safe spaces for students to work, and to determine boundaries. Each group will need to access appropriate spaces in the field to collect their necessary data. Create and share a site schedule and field-day plans with students ahead of time. Arrange for parent, partner, or community volunteers to help with the trip.

Activity Introduction

Have students gather in a predetermined spot, such as an open area in a field or by the bus in the parking lot, to orient them to the space and to reiterate the day's activities, procedures, and schedule. Once students are gathered, ask them to group with their field team.

- Instruct students to be aware and careful while conducting their activities.
- Choose access sites to the stream or water that will cause the least disturbance, especially considering erosion of stream banks.
- Remind students to be respectful of nature (do not remove plants, handle organisms carefully, return them as close to the location they were found as possible, etc.).
- Remind students to make good observations and to record them.
- Remind students to take pictures and/or video for final projects.

Please see the water quality and macroinvertebrate lesson-plan links under supplies for more information on field activities and data-gathering techniques.

Activity

1. Students will work within field teams to gather data using StreamWebs water quality and macroinvertebrate tools and datasheets. The goal for students should be to gather information that pertains to their investigative question in order to try answering it, and to have data for their final presentations in Lesson 7.
2. Remind student groups studying and collecting macroinvertebrate data to be sure to gather species from different habitats, such as pools and riffles, if possible.

Activity cont.

3. Remind teams to safely store their datasheets until their return to the classroom. Or collect datasheets at the end of the trip.
4. For each field event, students should enter their data into StreamWebs as soon as possible so that it will be available for interpretation, data analysis, and presentations.

Activity Wrap Up

When students are done collecting their field data, discuss what they found. Let them know they are going to follow up with the data back in the classroom to get a better idea of the health of the watershed. If you are planning to visit the site again, you can let them know this and discuss how more data will provide them with a better picture of what is going on in the watershed.

StreamWebs
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Lesson 4

Timeframe

One to three 50-minute class periods, depending on activities completed

Materials

- Completed StreamWebs datasheets or example student datasheets (included)
- Computer and projector; iPads or additional computers for students (optional)
- Extra water quality and macroinvertebrate field datasheets for each team
- Water quality parameter sheets (included)
- StreamWebs' login information (optional)

Objectives

- Learn how to organize and input raw data into the StreamWebs database
- Recognize and discuss any data or equipment issues
- Answer questions about their data
- Compare their own data to another site chosen on StreamWebs
- Consider variability within data typical of complex systems such as watersheds
- Examine and analyze trends and relationships in water quality and macroinvertebrate data

www.streamwebs.org

Following up with Field Data

Teacher Background

Scientists collect and use data for a variety of reasons. Often, watershed data are collected and analyzed to monitor water quality, certain species, and relationships over time to track the health of a watershed and how it might affect the communities' health, land usage and building projects' effects on the stream, future plans for the land, and the overall care of that watershed.

Discussions with students will include the idea that other project sites may have many similarities and many differences. For example, they may have more or less tree coverage to help keep the stream cool, add more or less debris in the stream, and/or to affect bank stability and erosion. The general watershed location, conditions, and how the land is used greatly affect the stream.

Description

In this lesson, students will work in the classroom with their field data specifically to learn how to read data, enter them into a spreadsheet or database such as StreamWebs, and begin to build data analysis and interpretation skills that allow them to explain and share their data with their community. Students will answer questions concerning their field experience, about their data, and begin to consider what these data might tell them about their stream or body of water. Students will also use StreamWebs to compare their data to other students' data and project findings.

Preparation

If you are planning to have students enter their own data, you will need to:

- share the StreamWebs username and password
- have iPads or computers for students to use
- have completed datasheets from field experience

If student data have already been entered into the database and you are going to be reviewing them with students, you can skip that section of Activity 1, but you should still have them review and discuss datasheets (example student sheets included if needed).

Students will compare their findings with those of another project site within the StreamWebs database. If you don't have another project site in mind, refer to "Getting to Know StreamWebs" at the beginning of the unit for suggestions.

Activity Introduction

Tell students they will begin to understand the stories their data tell them, while working to answer questions similar to those that professionals and other stakeholders may use to better understand watershed health. Discuss:

- Getting out into the field and introduced to how scientists collect, record, and store data was an important first step in understanding our watershed and becoming stewards of our natural resources.
- The second step is to make sure data are entered into StreamWebs or another database, for safekeeping and to share with others.
- The third step is to explore and analyze the data so we can understand what it tells us about our watershed. We can also compare our data to that of other sites or studies, to determine how our watershed health compares with other types of Oregon watersheds.

Next Generation Science Standards

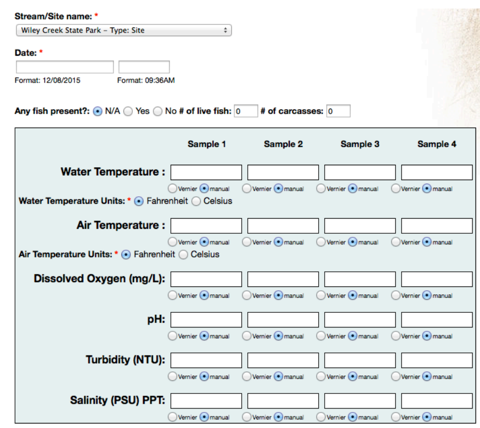
DISCIPLINARY CORE IDEAS:
LS2.A: Interdependent Relationships in Ecosystems

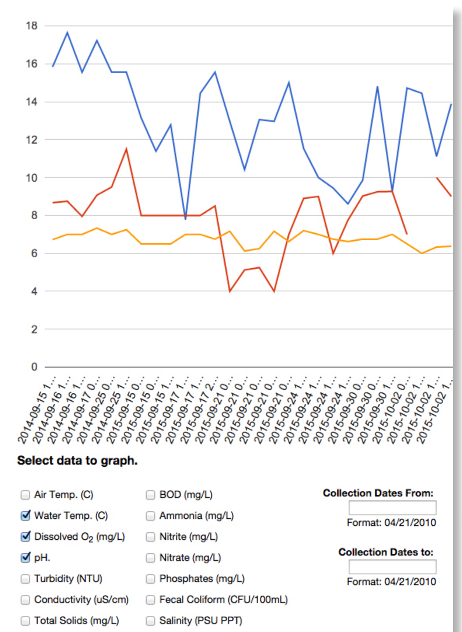
PERFORMANCE EXPECTATIONS:
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

PRACTICES:
Practice 4: Analyzing and interpreting data

Part 1: Reviewing/Entering Field Data

1. Group students into their previous research teams or groups of four to six.
2. Pose the following questions one at a time, giving students time to discuss with their group and then share out:
    - What problems did you encounter collecting the data in the field? *Problems with tools, group dynamics, recording proper information, recording information neatly.*
    - What went well while collecting data in the field? *Enjoyed using the tools, good teamwork, recording proper information, recording information neatly, discovered new information or questions in regard to their study.*
3. Provide students with datasheets from their field experience or example student datasheets provided. If students are going to enter their own data, remind them that though many of them may have recorded data, they will only enter data recorded by a single member (unless they were sampling at different times/places).
4. Have students log in to www.streamwebs.org with class username and password. Students can login as a team on tablets or computers, and take turns reading and entering their data (if students aren't entering data, skip to #6).
    - Direct students to the project site where you collected data.
    - Demonstrate for students how to enter their data into the class StreamWebs webpage.
    - Ask students to enter their team's data into the class StreamWebs project site.
5. Pose the following questions one at a time, giving students time to discuss with their group and then share out:
    - Did you have problems reading your datasheets?
    - Were your field datasheets organized well, filled out completely, and information recorded neatly?
    - Were you missing any data?
    - How did/would that affect entering the data into StreamWebs?





6. Introduce students to the StreamWebs graphing function (if students aren't working on iPads/computers, demonstrate on a projector). Have students practice (or demonstrate) making three to four different graphs with their data in StreamWebs. Look at each parameter and have students use their water quality parameter sheets to determine whether it was in a healthy range.
7. Ask students to consider any interesting data they see on their graphs. For example, are there any really high or low data points? What might have caused these points to be so different?
8. Have students look at two parameters together (e.g., temperature and dissolved oxygen) and discuss what sort of relationships they saw or what they learned from their graphs. *Dissolved oxygen levels went up with cooler water, weather may affect results such as turbidity levels, may be higher on a rainy day, etc.*

If time allows, have students draw the graphs they create using StreamWebs so they may compare them with other graphs later on.

Part 3: Comparing Your Data

1. Have students compare their data to other data in StreamWebs, such as a site different from yours (rural, urban, coastal, mountains, forest).
2. Assign one or two different StreamWebs study sites to each team (or choose one to look at as a class).
3. Have students make and record predictions about how our data might compare to the other site's. Have students consider:
   - which study site is more urban or rural?
   - how does being more urban or rural affect a stream?
4. Have students compare their data to that of another site, being sure to notice what time of year the comparison data were taken in regard to when their own data were taken.

Guiding Questions

Water Quality

- What was the lowest water temperature recorded? The highest? Are these data in line with what you would expect to see? What factors night have influenced these results? Repeat questions for each parameter.
- How might water temperature influence dissolved oxygen? Do dissolved oxygen levels increase or decrease in cooler water?
- What sort of human activities might affect pH and turbidity? Hint: think about ways that individuals, businesses, and other organizations use the land and water within a watershed, and how this might affect the stream.

Macroinvertebrates

- What percentage of tolerant, intolerant, and somewhat tolerant species did you find?
- Using the macroinvertebrate datasheet, what is the overall water quality rating?
- What might that tell you about this stream?
- What factors night have influenced the type of macroinvertebrates you found?
- How might the type of macroinvertebrates change throughout the year at this location?

Activity Wrap Up

- How do the water quality and macroinvertebrate data work together to inform us about the health of a stream? *Higher temperatures and turbidity may reduce dissolved oxygen, which means certain species of macroinvertebrates may be unable to live there; high or low pH levels may cause us to see more-tolerant species. Can you think of other examples?*
- Can our data help us answer our class/team's question (e.g., is X creek healthy)? *Would you need to collect more data to answer your question? If so, what kind of data would you collect? Do you need to revise your original question?*
- If we looked at our site over time, how might our data change? For example, if there was heavy rainfall in April, how might it affect/change our data? *The rainfall may bring more pollution from run-off in the streets or chemicals from agricultural land as it flows into the local stream; this may affect turbidity, pollution levels, temperature, and dissolved oxygen levels; there might also be higher levels of tolerant species recorded because intolerant species may die off, or move if they are able to swim, or even fly away (if they have hatched into their adult stage).*
- Do we have enough data to make some assumptions about how our body of water might affect the greater watershed?

Guiding Questions

Comparing Data

- How are this site's data similar to or different from your own?
- How much data did they collect? More or less than your team? How does this affect what you can learn from their data?
- How does this stream compare to your own stream? Is your stream urban or rural?
- What is the overall water quality rating compared to your own stream (this is based on the rating found on the macroinvertebrate datasheet(s)?
- How might being an urban or rural stream affect the overall water-quality rating?

Lesson 5

Timeframe

One to two 50-minute class periods. This lesson may take longer if students have not previously learned about graphing. To provide an overall introduction to graphs and graphing skills, use the "Intro to Graphing" lesson.

Materials

- Graph paper
- Colored pencils
- Computers (and Excel, if using)
- Data collected and recorded on StreamWebs datasheets
- "Graphing Overview" and "5 Key Components of Any Graph" handouts

Objectives

- Construct graphs illustrating relationships within their data
- Analyze data to determine the health of the stream
- Discuss how this data and the possible relationships may or may not help answer students' investigative questions
- Identify areas where they might need to follow up and gather more data to better answer their investigative question

Analyze, Interpret, and Graph Field Data

Teacher Background

Understanding the meaning of the word *data* and how to graph, interpret, and use data can be very overwhelming to students. Helping students understand that data are simply information, that they can be many things depending upon what we are studying, or how we are using data is an important first step. Data change per project and are based upon the objective of your own goals. Data are evidence of a certain thing, change, idea, preference, or quantity and are often measured over time, especially for accumulated data. By helping our students feel more comfortable using data and learning about graphs and how to make them, we are setting students up to be successful in the future by giving them transferable skills.

In this lesson, students will consider *independent* and *dependent* variables. Independent is the variable, or part of the data, that changes and can be controlled or manipulated by the scientist, or any other user of data. This variable should be placed on the horizontal or x-axis, or represent the outside circle, or slices of the pie chart. This variable stands alone and cannot be affected by the other variable being measured. For example, someone's age or the time will not be affected by the dependent variable, such as how much time one spends on Facebook, watching television, or playing guitar. However, someone's age may affect how much time they spend on Facebook, watching television, or playing guitar. We are often trying to see if there is a relationship between variables, and if the independent variable possibly changes or affects the dependent variable.

Dependent is the variable directly affected by the independent variable. It is the result of what happens because of the independent variable; in other words, it depends on the other variables or factors. This variable is placed on the vertical or y-axis, or represents how big the sizes of the pieces are (usually percentages) of a pie chart. The pieces should be drawn out using radial lines from the center to the outside of the circle (much like the spokes on a bicycle wheel). This variable can change based upon the independent variable. For example, a test score may depend upon other factors, such as how much you slept or studied beforehand, making it a dependent variable.

Description

In this lesson, students will work on their data interpretation and visualization skills, and make their own graphs of their data. They will attempt to use their data to answer their question and/or discuss what additional data they would need to answer their question. If students did not develop an investigative question, you can pose one to them such as, "Is x creek healthy for the organisms that live there?" Students will create materials for their final presentation products that explain their findings and begin thinking about an audience to share their findings with.

Preparation

If your class needs an introduction to graphing or a refresher, prepare to teach the lesson "Intro to Graphing." Students will need to access their data (off their datasheets or in the StreamWebs database) and have access to laptops or tablets and Excel if they will make graphs with it. Students will reassemble to work together in their field teams with all their data and findings.

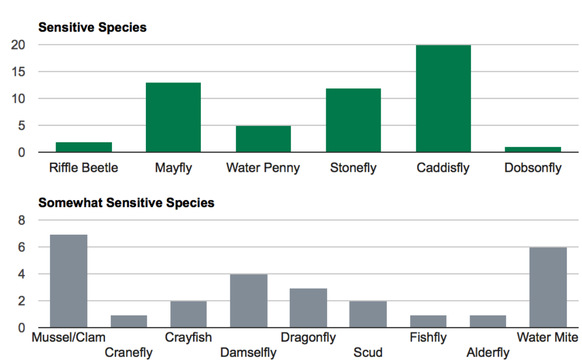
Next Generation Science Standards

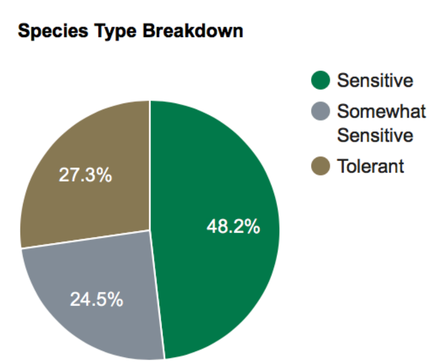
DISCIPLINARY CORE IDEAS:
LS2.A: Interdependent Relationships in Ecosystems

PERFORMANCE EXPECTATIONS:
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

PRACTICES:
Practice 4: Analyzing and interpreting data
Practice 5: Using mathematics and computational thinking

Macroinvertebrates Data Graphing



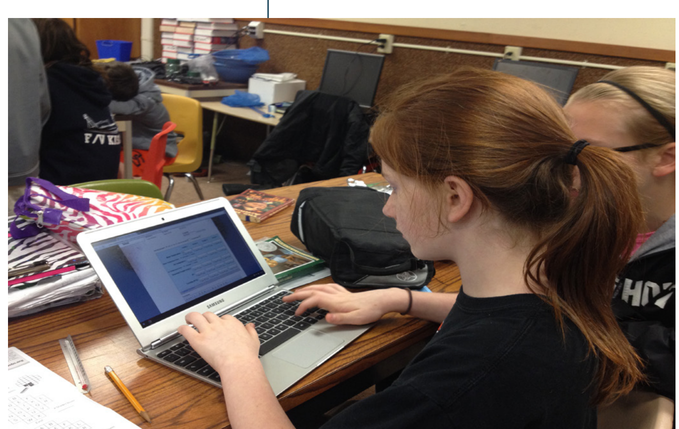


Activity Introduction

Let students know that they will be working in their field teams to construct graphs, tables, and written materials to interpret and share their data. Inform teams they are going to examine their data, decide how to best graph them, and then make two or three graphs to represent their data. Students will also create tables, paragraphs, maps, or even cartoons to best present their data. It is important that students understand it is okay if they do not have an answer to their investigative question, as long as they talk about what they did find, notice, and infer from their data.

Discuss the following guidelines for creating graphs with students:

- Choose correct colors for data visualization and representation. *E.g., colors that are easy to see and that align with what people may already perceive as related to certain colors, such as red for hot and blue for cold.*
- All graphs should be about a third to a half of a page, so that information and data points can be located on them clearly and accurately.
- The scales should be selected so the data points fill the graph space.
- The graph must have a title and the axes should be clearly labeled.
- The quantity and units must be shown for each axis.
- Consider independent and dependent variables. *E.g., an independent variable might be time, and a dependent variable might be water quality parameters such as temperature, dissolved oxygen, or types of macroinvertebrates.*
- Data points should be recorded with a clear dot or easy-to-see symbol; bars or pie wedges should be clearly drawn with separate colors.
- Appropriate and best graphs chosen for specific data: line graph, bar graph, pie chart (see Intro to Graphing lesson).

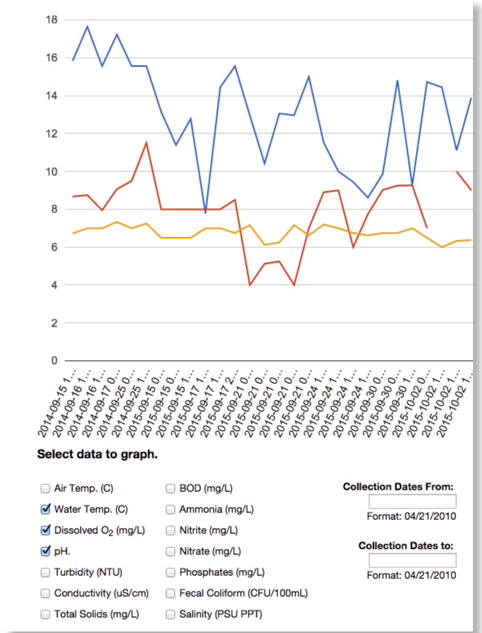


Guiding Questions

- What might data tell us about our site? *Watershed health; whether or not our stream can support macroinvertebrates, fish, and other aquatic organisms; provide clues to problems in our watershed such as pollution, too-small trees and plants for coverage; and problems with food sources, cooling, or other issues.*
- How can graphs act as a tool to demonstrate these relationships? *Consider our information, what we are trying to share or demonstrate with our graph, what the variables are, etc.*

Activity: Analyzing and Interpreting Data

1. Group students into their previous field teams. They will need access to their data in StreamWebs or their original datasheets.
2. Hand out or project the "Graphing Overview" and "5 Key Components of Any Graph" sheets for students to reference.
3. Instruct students to revisit their investigative question and discuss what they are trying to show or share in relation to their question. They will want to make some conclusions or correlations from their data to answer their investigative question(s). Have teams briefly discuss their data and brainstorm what type of graphs or tables they will use to demonstrate this information.
4. Ask each team to identify its independent and dependent variables for each data set they plan to graph to answer their investigative question, which axis each variable will go on, and their scale. Have each team share with the class or individually with the teacher to ensure students are using proper variables, and understand the relationship between them.
5. Hand out graph paper and colored pencils, and instruct students to make their graphs. When student teams are done, have them share their graphs.



Activity Wrap Up

- Do you have the data you need to answer your investigative question?
- If not, what data do you still need to collect, or would you collect in the future?
- Were you able to illustrate your answer(s) in the form of a graph?
- Did you discover any new relationships or information while you were graphing your answers to your investigative question(s)?
- How strong is your scientific evidence? How do you know?
  Stress to students that even if they don't have the data they need to answer their question, they can still present what they do have and explain their findings, what they still need, and any changes to their investigation plan.

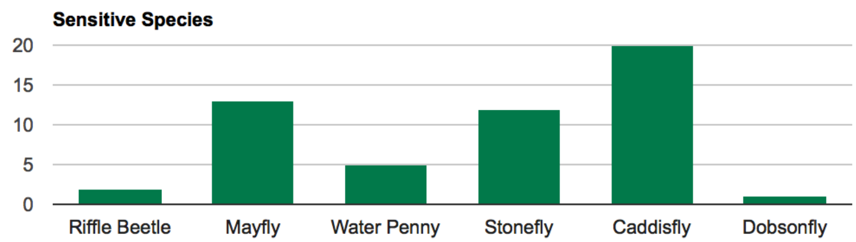
A Graphing Overview

Line Graphs:

- Are often used to show how something changes over time
- The x-axis (horizontal line) has the data for the time period (months, days, or time)
- The y-axis (vertical line) has the data for things being measured

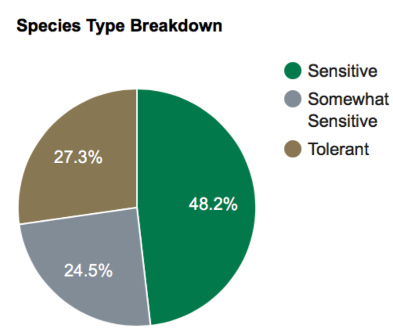
Bar Graphs:

- Are often used to represent categorical data
- The x-axis (horizontal line) represents the categories being measured
- The y-axis (vertical line) represents the amount of the information/ data being measured
- Sometimes they may display data that have nothing to do with time
- Macroinvertebrate data are easily shown in a bar graph, where each bar is a different macroinvertebrate and the height of the bar represents the number of each species that were found.



Pie Charts/Graphs:

- Useful for showing percentages, or portions of a whole
- Show data at a certain and set point in time, and are not used to show information over time



Advice on Creating Maps:

- All graphs should be big enough (for example, half of a piece of an 8.5x11 page) that information and data points can be located on them clearly and accurately.
- The quantity and units must be labeled for each axis, bar, or pie piece.
- Data points, bars, or pie pieces should be recorded, or drawn with a clear dot, bar, or easy-to-see symbol. Depending upon what the graph represents and who it is being prepared for, symbols may be used instead of simple plotting dots.

  For example, for our StreamWebs data we may use fish to represent our data, and draw them stacked upon each other to represent each bar.
- Choosing correct colors for data visualization and representation is another important step. Choose colors that are easy to see and are representative of categories in data (e.g., red symbolizing hot and blue symbolizing cold).

Five Key Components of any Graph

1. The Title
    - Explains concisely what the graph is about
    - Should give the reader an idea about what he/she will see or learn about in the graph
    - Placed above the graph
2. The Independent Variable
    - The data that change and can be controlled or manipulated by the scientist, or any other user of data
    - Represented along the horizontal or x-axis, or the outside circle, or slices of the pie chart
    - This variable stands alone and cannot be changed by the other variable being measured
    - Graphs are often used to observe whether the independent variable possibly changes or affects the dependent variable
3. The Dependent Variable
    - The variable directly affected by the independent variable
    - Represented along the vertical or y-axis, or by how big the pieces of a pie chart are (usually percentages)
    - This variable stands alone and cannot be changed by the other variable being measured
    - Graphs are often used to observe what defines how a dependent variable changes when we graph data
4. The Scales for Each Variable
    - Guides where we plot the points, or symbols, representing the data when we construct our graph
    - Designed to include all the data points and fill the graph space as much as possible
    - Each space or mark in the scale should have a consistent and standard increase in amount, or increment, on a particular axis
5. The Legend
    - Short description concerning the graph's data
    - Tells the reader what they are looking at, including symbology, color scheme, or lines on graph
    - Short, concise, and placed directly under or beside the graph

Lesson 6

Timeframe

Two to three 50-minute class periods

Materials

- Graph/colored paper
- Colored pencils
- Poster paper
- Craft/art supplies
- Media collected during your field trip(s)

Objectives

- Create a final product and present findings via graphs, tables, paragraphs, pictures, etc.
- Attempt to answer an investigative question based on findings and data, and identify areas to further investigate if unable to answer question
- Build an argument by using data as evidence
- Understand what a community stakeholder is and identify local stakeholders
- Construct recommendations for partner/stakeholders related to investigative question and the needs of the community

Sharing Your Field Project

Teacher Background

Student projects produce real results, and celebrating their contributions and demonstrating to others what they have learned is an important part of the learning experience. This lesson will help students prepare to tell your project story to the community. Not only does the community want to hear about the goals and outcomes of the project, but it is important to compile project information into a complete and final package that makes sense to your students.

Students should compile data and create the story of their project. It's important to consider the multiple ways of telling the project's story; synthesizing and analyzing the data is simply one piece of a compelling story. Remember to have students utilize all their project team skills and talents to include creative arts, natural history, technology, and community components in their watershed story. Their story should capture information about the investigative question they chose, hypothesis they tested, methodology they used, and conclusions they were able to draw.

Description

In this final activity, students will develop their communication and presentation skills. This is also the class's opportunity to share its findings with stakeholders, the school, and the community. You will want to help students tie this back to the community needs discovered and the work they did in Lesson 1, so that it is a meaningful presentation for your particular audience.

Preparation

Ideally you will plan or take part in an event in which students can share their projects with their community, the partner or stakeholder you worked with, and their school. This could be done at a family math and science night, science fair, or a partner organization's board meeting or community night, or you may want to create a special event for your class at the school. Be sure to invite families, partner organizations, stakeholders, other teachers and school staff, community members, etc., and if possible, include students in the planning process. Other ideas for sharing projects include working with a local watershed council or other partners to showcase them at a meeting or event, hanging up posters in their building to share with the public, or showcase students' posters at the school. Articles, videos, and pictures can (and should!) be uploaded to StreamWebs, school and partner websites, or to Wikispaces.

Activity Introduction

Let students know that an important part of doing science is sharing results with your community, the watershed council you may have worked with, and any other potential stakeholders, via products such as a report, poster, article, video, song, or a combination of these products that answers the project's overall investigative question(s) and showcases the results.

- Who are our stakeholders? *Individual people, a group, business, or an organization with an interest in your project, such as: your school, watershed council, state park, or any other partners with whom you will be sharing information.*
- What will we share with our stakeholders? *Our data collected; our results and findings from analyzing our data; information regarding our research; answers to our investigative questions; other questions that came out of our research; any recommendations that we have.*

Next Generation Science Standards

DISCIPLINARY CORE IDEAS:
LS2.A: Interdependent Relationships in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience

PERFORMANCE EXPECTATIONS:
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

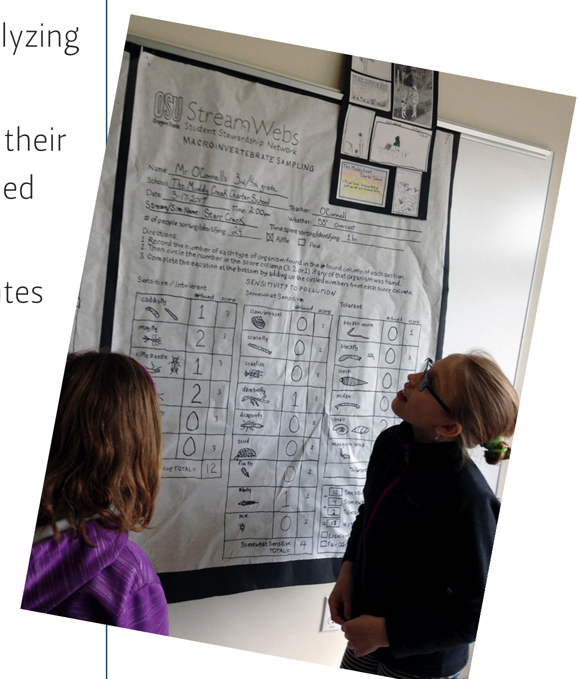
PRACTICES:
Practice 1: Asking Questions and Defining Problems
Practice 3: Planning and Carrying out Investigations
Practice 4: Analyzing and Interpreting Data
Practice 6: Constructing Explanations and Designing Solutions
Practice 7: Engaging in Argument from Evidence
Practice 8: Obtaining, Evaluating, and Communicating Information

Activity

1. Divide students back into their field investigation teams. Instruct students that they are going to continue to build upon their answer to their investigative question(s).
2. Give students a few minutes to get their investigative question(s), graphs, data, and other information gathered and ready to use.
3. Give students time to refine graphs, tables, or other forms of data interpretations they may need to answer their investigative question.
4. Explain to students that they are going to build an argument using their data as evidence to defend their answers to their investigative question(s). Students need to refer back to their investigation plan, tools used, the data found, and make a plan to provide the best evidence they have to support their conclusions and claims. Data are not evidence until used in the process of supporting a claim!
5. To help students get started, have them free-write two or three paragraphs sharing what they found during their field investigations. Tell them to start with their investigative question, and attempt to answer it by referring to and analyzing the data to explain and defend their answers.
6. Have each team share and then combine the best parts of their paragraphs to create a draft of a written piece to be included in their final presentation.
7. Have students attempt to fill in the sentences "____ indicates that ____" or "evidence from ____ indicates that ____."
8. Go over any guidelines or presentation elements that you would like students to include. Have students brainstorm what kind of presentation they would like to create and how they might share it. *We encourage you to upload your projects onto the project page in the StreamWebs database as one avenue of sharing!*
9. Give students plenty of time to create their team's presentation. Remind them that the idea is to share what they learned from their field project in a creative way with stakeholders or an interested audience, such as the watershed council or state

Guiding Questions

- HOW do I plan to share my project and make the sharing successful?
- WHO will I share my project with? *City council members, school board, watershed council, school paper, local businesses, family and friends, agency partners, other?*
- WHAT resources do I need to compile/create my presentation? *PowerPoint, maps, datasheets, Excel...*
- WHERE and WHEN will I share my project?

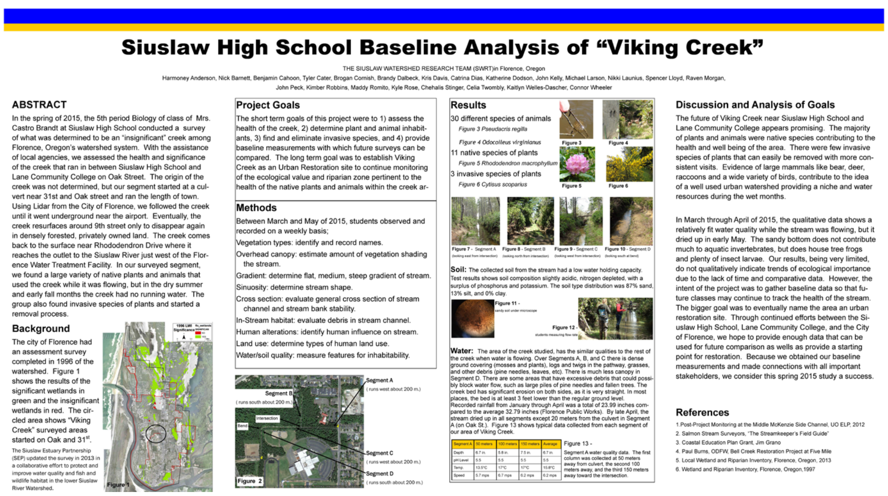


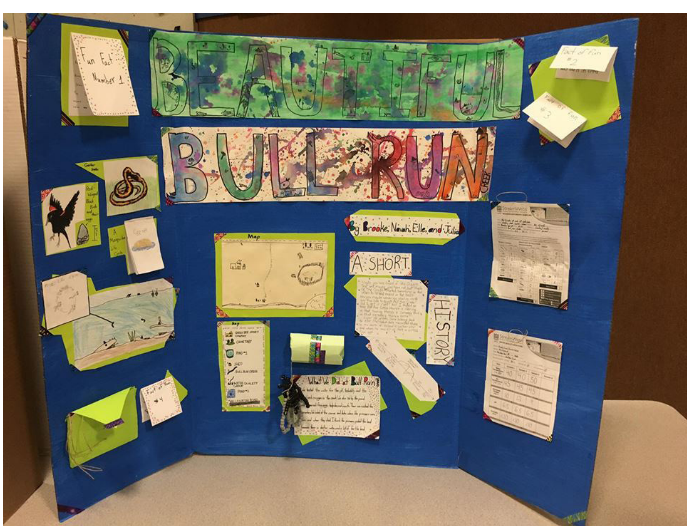
park you may have worked with on your project. Students may also be able to share their findings at a family math and science night, or through another school event.

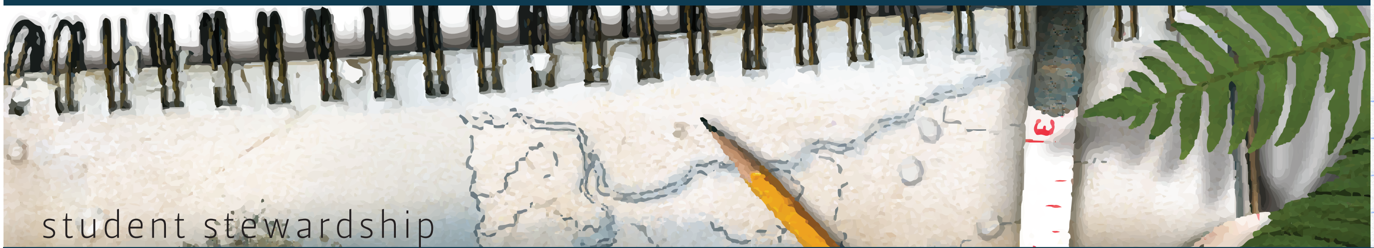
Activity Wrap Up

When students are done with their final presentation, have each group present to the class. This should be practice for sharing with the broader community!

If you plan to follow up your field investigation with a stewardship project, use the StreamWebs Stewardship 101 planning sheet as a guide to planning a stewardship project with students!







Stewardship 101

StreamWebs Stewardship projects can be as big or small as you want them to be! The goals of a StreamWebs Stewardship project are to engage students in a meaningful watershed experience that is hands-on and community-oriented, is integrated into classroom learning, increases awareness and knowledge of important environmental issues such as invasive species, and leads to actions that improve and/or restore the watershed.

Step 1: Needs Assessment

This step will help you launch your investigation into developing a project idea. First and foremost, spend a moment brainstorming about the things you find interesting. How would you like to approach the project? What inspires you about the natural world? What types of learning activities are you most drawn to? Writing? Art? Science? Outdoor exploration? Consider the way you best connect to the natural world as you assess the ecological and educational needs for your project.

Step 2: Identify Community Partners

This is your opportunity to reach out to the wider community to tell others about your project idea and get them excited and involved! This step will help move you into action.

1. Identify and contact professionals and specialists you may want to get involved with your project.
2. Establish the contributions and responsibilities agreed upon by both parties as you enlist community professionals to help you with your project.

Step 3: Organize and Plan Your Project

Brainstorm a project that most interests you and your students and allows students to explore their local environment through exciting, creative, inquiry-driven investigations. Project ideas include:

- Field Research. Conduct field research to determine the health of a stream or overall health of the watershed. This can include parameters such as chemical water quality testing, macroinvertebrate sampling, plant identification, and instream habitat assessments.
- Stream Restoration Projects. Remove invasive species and/or plant native plants to restore healthy functioning of the riparian zone.
- Photography. Photograph something that interests and inspires you in your local watershed, and share your photos with the community.
- Photo-Point Monitoring. Monitor the progress of a stream restoration site over time, by taking specific photographs at identified priority locations.

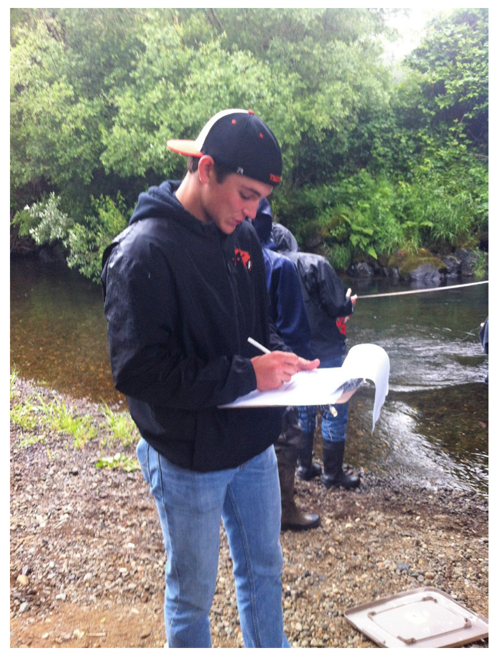
- Videography. Create a video that traces the path of the water from the headwaters to the confluence.
- Journalism. Report about a local restoration project or need within the watershed.
- Art. Develop a creative art project, such as a mural, to portray the life of a stream over time, depicting the watershed and each of the components within it or the lifecycle of salmon.
- Mapping. Create a map of the stream pre- and/or post-restoration work, or create a three-dimensional map of the watershed.
- Creative Writing. Share, through creative writing, something that interests and inspires you about your local watershed.

Step 4: Implement Project

This is where you put your project plan into action. Make sure to plan field days in advance and coordinate with project partners who can support students in the field. Streamwebs.org has a number of resources that can help support the implementation of projects, including curricula, datasheets, and field gear.

Step 5: Reflection and Evaluation

This valuable step will help you weave it all together. Each and every student will experience his/her project in unique and special ways. It is important to have students take some time to document their own project perspective and jot down their streamside thoughts and river reflections. Through reflection, they hit the pause button so they can make integrated connections throughout their project. Have students take a moment each day they are in the field to record a journal entry.



Step 6: Prepare to Share

Your project has produced real results, and celebrating student contributions and encouraging them to demonstrate to others what they have learned is important. This step will help them prepare to tell their Stewardship Project's story to the community. Not only does the community want to hear about the goals, objectives, and outcomes of their project, but it is important for them to compile their project information into a complete and final package that makes sense to them.

Have students compile their data and create the story of their project. It's important to consider multiple ways of telling the story of the Student Stewardship Project; synthesizing and analyzing the data is simply one piece of a compelling story. Have students remember to use all their creative arts, natural history, and technology and community components in their watershed story.

Step 7: Demonstrate and Celebrate

It is now time to turn it up, showcase the results of your students' hard work, and demonstrate to others what was learned. There are many ways to have students share their knowledge and experience with their peers and the community; here are a couple of ideas:

- Give a school or community presentation about the project
- Upload your project to streamwebs.org
- Find a student watershed summit within your community
- Take part in a city council meeting

WORK FOR CLEAN RIVERS - HELP RESTORE STREAMBANKS AND FISH HABITAT

Dissolved Oxygen (D.O.)

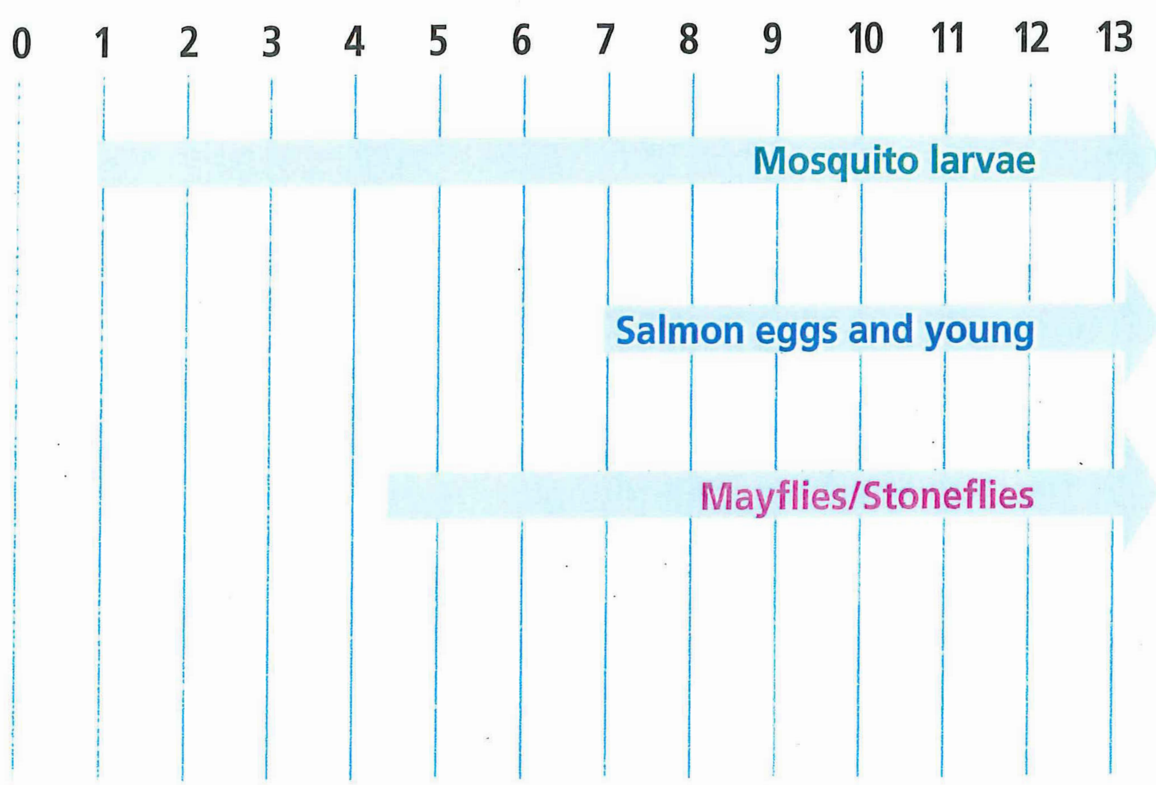
Definition: The amount of oxygen in the water.

Importance: Required by aquatic life to breathe.

How is it measured? In Parts Per Million (PPM).

(some scientists use mg/l or percent saturation)

Dissolved Oxygen (PPM)



CITY OF PORTLAND ENVIRONMENTAL SERVICES WORKS FOR CLEAN AND HEALTHY WATERSHEDS

WE ALL LIVE IN A WATERSHED - REDUCE - REUSE - RECYCLE - FOR A HEALTHY ENVIRONMENT

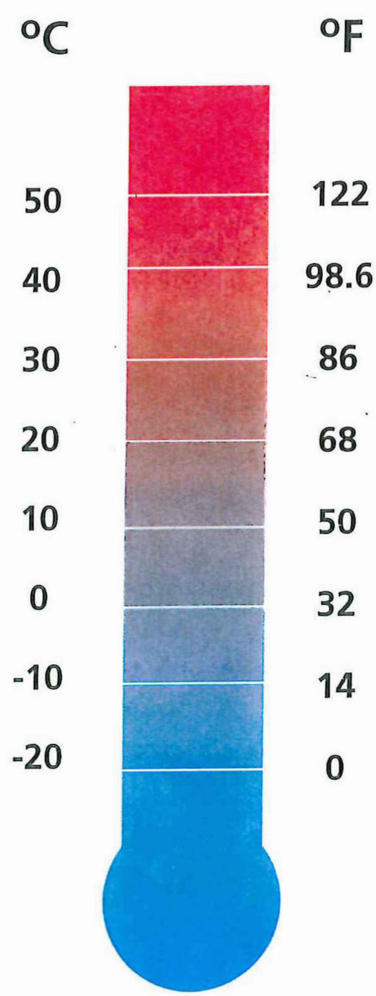
WORK FOR CLEAN RIVERS - HELP RESTORE STREAMBANKS AND FISH HABITAT

Temperature

Aquatic organisms breathe oxygen that is dissolved in the water.

- Warmer water may mean less dissolved oxygen is available for aquatic animals to breathe.
- Colder water can hold more dissolved oxygen.

Rapid changes in water temperature can kill aquatic organisms.

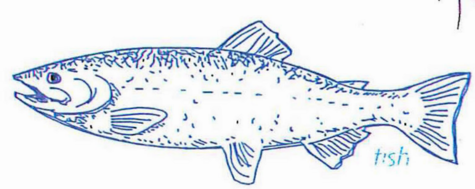


Preferred Temperature

Warm
Above 68° F (20° C)
dragonflies, bass, carp, catfish

Cool
55-68° F (13-20° C)
Chinook, coho, sturgeon, cutthroat trout, mayflies

Cold
Below 55° F (13° C)
Steelhead, caddisflies, stoneflies, salmon eggs and alevins



CITY OF PORTLAND ENVIRONMENTAL SERVICES WORKS FOR CLEAN AND HEALTHY WATERSHEDS

WE ALL LIVE IN A WATERSHED - REDUCE - REUSE - RECYCLE - FOR A HEALTHY ENVIRONMENT

HELP PREVENT POLLUTION - HELP KEEP OUR RIVERS AND STREAMS HEALTHY

WORK FOR CLEAN RIVERS - HELP RESTORE STREAMBANKS AND FISH HABITAT

CITY OF PORTLAND ENVIRONMENTAL SERVICES WORKS FOR CLEAN AND HEALTHY WATERSHEDS

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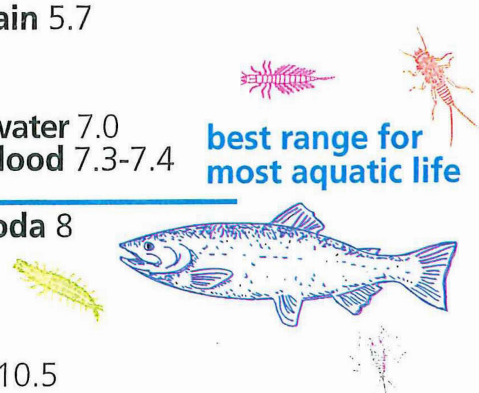
pH

Definition: Measure of how acidic or basic (alkaline) the water is.

Importance: Pollution can change the pH of water.
If water is too acidic or too basic aquatic life can die.

	pH scale	*Examples of pH levels*
ACIDS	0	**battery acid** 0.3-1.0
	1	**stomach acid** 1-3
	2	**lemon juice** 2.3
	3	**cola** 2.6
	4	**coffee** 4.9-5.2
	5	**NW acid rain** 5.2-5.4 **normal rain** 5.7
	6	**milk** 6
NEUTRAL	7	**distilled water** 7.0 **human blood** 7.3-7.4
	8	**baking soda** 8
BASES	9	
	10	**antacids** 10.5
	11	**ammonia** 11
	12	**bleach** 12.6
	13	
	14	**drain cleaner** 14

best range for most aquatic life (pH 7–8)



HELP PREVENT POLLUTION - HELP KEEP OUR RIVERS AND STREAMS HEALTHY

Turbidity Chart

Turbidity: A measure of the cloudiness of the water.

Why is it Important?

- Sediment can smother eggs.
- Sediment can clog the gills of fish and other stream animals making it hard for them to breathe.
- Increased turbidity can result in warmer water, leading to lower levels of dissolved oxygen.

If you obtained a JTU measurment of . . .	You would be able to see down this far with a Secchi Disk.
100	1 inch
90	2 inches
80	3 inches
70	4 inches
60	5 inches
50	6 inches
40	8 inches
30	10 inches
20	1 foot
10	3 feet
0	5 feet

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StreamWebs™
Student Stewardship Network

WATER QUALITY DATA FORM

Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

School: oAK hieght

Teacher: hnedihg

Date: Sept 29 Time: 9:30

Stream/Site Name: S. Santiam @ trout creek Lat________ Long________

Any fish present? ☐ Yes ☒ No # of live fish: ____ # of carcasses: ____

TEST	Sample 1	Sample 2	Sample 3	Sample 4
Water Temperature ☒ °C ☐ °F	10 10			
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Air Temperature ☐ °C ☐ °F	10?			
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Dissolved Oxygen (mg/L)	9			
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
pH	7.0, 7.5 7.5 7.0 5 6.6 [illegible]			
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Turbidity (NTU)	20cm 55cm 50cm 53 cm 60cm 60cm			
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐

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www.streamwebs.org

School: ______________________________

Teacher: ______________________________

Date: ________________ Time: __________

Stream/Site Name: ______________________ Lat______________ Long______________

Any fish present? ☐ Yes ☐ No # of live fish: ____ # of carcasses: ____

TEST	Sample 1	Sample 2	Sample 3	Sample 4
Water Temperature ☑ °C ☐ °F	10°C 56.f 47.f	11°C 52.f 15.C	12°C 50.f	10°C
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Air Temperature ☐ °C ☐ °F	61.F 19.C	16.C 61.F		
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Dissolved Oxygen (mg/L)	11			
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
pH	7.0 7.5	7.5	7.0	8.0
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Turbidity (NTU)	52 53 11 45	52 60	58 49 13 54	33 37
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐

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GP #4

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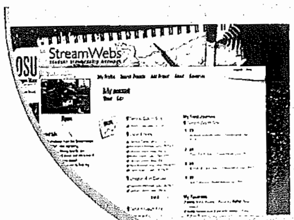
WATER QUALITY DATA FORM



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www.streamwebs.org

School: ____________________

Teacher: ____________________

Date: ____________ Time: ________

Stream/Site Name: ____________ Lat ____________ Long ____________

Any fish present? ☐ Yes ☐ No # of live fish: ____ # of carcasses: ____

TEST	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**
Water Temperature ☐°C ☐°F	11, 10, 10	11°C,	10°C	
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Air Temperature ☐°C ☐°F				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Dissolved Oxygen (mg/L)				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
pH	7.5, 7	7.5	7.0	
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Turbidity (NTU)	58.45 41,5	60	53	
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐

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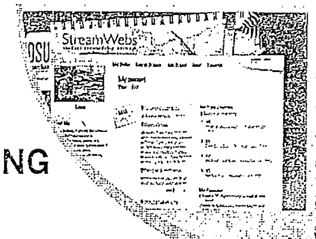
MACROINVERTEBRATE SAMPLING



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www.streamwebs.org

Name: Group 1

School: Oak Grove Elementary Teacher: Riley

Date: 9/17/13 Time: 10:50 Weather: Very Rainy

Stream/Site Name: Wiley Creek Time spent sorting/identifying: 45 min

# of people sorting/identifying: 9 ☒ Riffle ☒ Pool

Directions:
1. Record the number of each type of organism found in the # found column of each section.
2. Then circle the number in the score column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION

Sensitive / Intolerant

	# found	score
caddisfly	1	3
mayfly	1	3
riffle beetle		3
stonefly	4	3
water penny		3
dobsonfly		3
Sensitive TOTAL =		18

Somewhat Sensitive

	# found	score
clam/mussel		2
crane fly		2
crayfish		2
damselfly		2
dragonfly		2
scud		2
fishfly		2
alderfly		2
mite		2
Somewhat Sensitive TOTAL =		

Tolerant

	# found	score
aquatic worm		1
blackfly		1
leech		1
midge	8	1
snail		1
mosquito larva		1
Tolerant TOTAL =		8

18 Sensitive total
\+ Somewhat sensitive total
\+ 8 Tolerant total
= 26 **Water Quality Rating**

☒ Excellent (>22) ☐ Good (17-22)
☐ Fair (11-16) ☐ Poor (<11)

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MACROINVERTEBRATE SAMPLING

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www.streamwebs.org

Name: Arika

School: NAES Teacher: Mrs. Blaire

Date: 4-21-15 Time: 12:30 Weather: Sunny

Stream/Site Name: Wiley Creek Time spent sorting/identifying: 11 people

# of people sorting/identifying: ______ ☒ Riffle ☒ Pool

Directions:

1. Record the number of each type of organism found in the # found column of each section.
2. Then circle the number in the score column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION

Sensitive / Intolerant

	# found	score
caddisfly		3
mayfly		3
riffle beetle		3
stonefly	|||	3
water penny		3
dobsonfly		3
Sensitive TOTAL=		

Somewhat Sensitive

	# found	score
clam/mussel		2
crane fly		2
crayfish		2
damselfly		2
dragonfly		2
scud		2
fishfly		2
alderfly		2
mite		2
Somewhat Sensitive TOTAL=		

Tolerant

	# found	score
aquatic worm	||	1
blackfly		1
leech		1
midge		1
snail		1
mosquito larva		1
Tolerant TOTAL=		

☐ Sensitive total
\+ ☐ Somewhat sensitive total
\+ ☐ Tolerant total
= ☐ **Water Quality Rating**

☐ Excellent (>22) ☐ Good (17-22)
☐ Fair (11-16) ☐ Poor (<11)

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MACROINVERTEBRATE SAMPLING

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www.streamwebs.org

Name: Trout Creek Campground Group 2

School: Foster Elementry Teacher: Mrs. Hawkin

Date: 9-21-15 Time: Weather: Slightly cloudy w/ chance of rain

Stream/Site Name: Trout Creek Time spent sorting/identifying: 30 minutes

# of people sorting/identifying: 9 ☐ Riffle ☑ Pool

Directions:

1. Record the number of each type of organism found in the # found column of each section.
2. Then circle the number in the score column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION

Sensitive / Intolerant

	# found	score
caddisfly	2	3
mayfly	22	3
riffle beetle		3
stonefly	21	3
water penny		3
dobsonfly		3
Sensitive TOTAL =		9

Somewhat Sensitive

	# found	score
clam/mussel		2
crane fly	2	2
crayfish		2
damselfly		2
dragonfly		2
scud		2
fishfly		2
alderfly		2
mite	1	2
Somewhat Sensitive TOTAL =		4

Tolerant

	# found	score
aquatic worm	6	1
blackfly		1
leech		1
midge	1	1
snail		1
mosquito larva		1
Tolerant TOTAL =		2

9 Sensitive total
+ 4 Somewhat sensitive total
+ 2 Tolerant total
= 15 **Water Quality Rating**

☐ Excellent (>22) ☐ Good (17-22)
☑ Fair (11-16) ☐ Poor (<11)

Adapted from: Environmental Services City of Portland

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