AQUATIC/STREAM ENVIRONMENTS

Students will conduct field experiments to explore the aquatic ecosystem and look at the stream chemistry, physical habitat, and biodiversity within a stream. Students will obtain data and present their results to other group members.

LESSON LENGTH:

- 7.5 hours

GOALS:

- Provide an integrated view of stream chemistry (water quality), physical habitat, and biodiversity.
- Students should gain an understanding of which types of habitats control species diversity and why.

OBJECTIVES:

Students will be able to:

- Explain what an aquatic ecosystem is and how this system is different than other types of ecosystems
- Explain biodiversity and aquatic biodiversity
- Collect chemical, physical, and biological data from an aquatic system
- Explain ecosystem health and factors that can influence aquatic systems: sediment, chemical pollutants, stream temperature
- Interpret data collected from an aquatic system
- Draw conclusions from interpreted data
- Discuss both positive and negative human impacts on aquatic systems

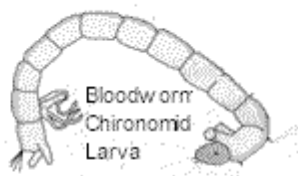
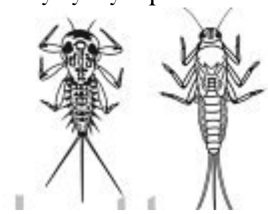
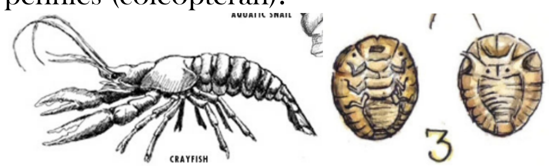
NATIONAL, STATE, LOCAL STANDARDS

North Carolina Standard Course of Study

- EEn.2.3: Explain the structure and processes within the hydrosphere
- EEn.2.4: Evaluate how humans use water.
- EEn.2.7: Explain how the lithosphere, hydrosphere, and atmosphere individually and collectively affect the biosphere
- Bio.2.1: Analyze the interdependence of living organisms within their environments
- Bio.2.2: Understand the impact of human activities on the environment (one generation affects the next).

STUDENT TAKEAWAYS FROM LESSON:

- Essential question/theme
    - The ecology of aquatic systems and biodiversity within an aquatic system
- Key concepts and vocabulary
    - **Abiotic:** non-living chemical and physical parts of the environment
    - **Biotic:** any living component of a stream ecosystem.
    - **Habitat diversity:** each habitat type supports different types of aquatic life
        - Typical stream contains **two major flow regimes**:
            - **Pools:** an area of slow moving water
            - **Riffles:** an area of fast moving, churning water
        - **And each stream may contain many different types of substrates, ranging from** sand → gravel →cobbles → boulders → bedrock.
        - **Turbidity:** the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air
    - The combination of flow regime and substrate type control the resource availability and the kind of diversity that may persist.

Habitat	Pools (slow)	Riffles (fast)
Fine sediment (silt, sand, gravel)	Low oxygen, few nooks for animals to hide or for organic matter (food) to collect. Low species diversity, few large insects). Look for small worms (but try to avoid leaches). 	High oxygen, but these bugs need to be fast to catch the food particles that are swept by. Look for small but highly motile bugs like mayfly nymphs and water beetles. 
Course substrates (cobbles, boulders, bedrock)	Low oxygen but high organic matter. Look for cranefly larva and other large grubs that require lots of food but are more sedentary, so require less oxygen. Sharp eyes a must, these guys camouflage in cocoons of debris! 	Lots of oxygen. Medium level of organic matter, some maybe washed downstream by rapid flow. Look for high diversity. Lots of habitat for larger inverts like crayfish to hide. And rock clingers like snails and water pennies (coleopteran). 

ASSESSMENTS:

- Formative
  - Check-in discussions after each rotation
  - Analyzing data obtained before moving onto the next rotation
- Summative
  - Students will synthesize all the data collected during the group investigation.
  - They will make posters to present to the rest of the groups and instructors.

DIVERSITY (REACHING STUDENTS OF ALL LEVELS/ABILITIES):

- Prompt teams to give each member a job and rotate the jobs after each measurement is conducted.
- Students are working on hands-on activities using instruments that scientists use in the field.
- Students are working in groups during the entire activity.

MATERIALS & EQUIPMENT:

- Student
- worksheets (1 per student)
- Thermometers
- Tape measure (XX m long, waterproof, 2 per group)
- Refractometer

- Petri dishes
- pH strips
- Multi-probe if available
- Calculators
- Nets
- Gravelometer
- Hand lenses
- Pan for macros
- Rulers
- Stopwatches
- Oranges (fruit)
- Water chemistry kit
- Secchi tube
- Macroinvert ID keys
- Safety goggles (1 pair per student)
- Waste container for chemical waste
- Bucket of clean water for hand-washing
- Soap (biodegradable if possible)
- Towels
- Plastic gloves
- Eye wash bottles

LOCATION:

- One natural stream off the trail; search for riffles and pools with a range of substrates
- One altered stream with impact from infrastructure (near a road, bridge, or dam)

RISK MANAGEMENT & SAFETY CONCERNS:

- Participants will be near water and in water. Participants may not enter the water past their waist. Participants must be near someone at all times while in the water.
- Drinking from the water is not allowed (unless it's purified with Aquamira)
- Potential contaminants in water (hazardous materials, litter)
    - Impacts such as rip-rap or concrete lining present enough of a physical habitat disturbance to affect biodiversity and will affect water chemistry (such as oxygen and nitrogen, which is the only type of pollution being measured) without being explicitly polluted with chemicals. This is an important safety distinction.
- Look out for dangerous plants and animals near and inside water; check for leeches periodically
- Rocks in water can be angular and sharp or very slippery; ensure students have proper footwear.
- Students must wear safety goggles while performing water quality tests that require shaking a chemical mixture. Students must wash hands after performing water quality tests and avoid placing hands in contact with eyes or mouth during testing. All reacted samples must be poured together into a waste container for later disposal. They can be disposed of back home by flushing them down the drain with excess water.

BAD WEATHER ALTERNATIVE:

- Chemical measurements and some physical measurements can be done at camp by collecting a bucket of water (though temperature and DO will change over time)
- If short on time, have each group do physical or chemical, then do biological as a group.

PRE-LESSON PREPARATION:

- Introduce the lab the night before.
- Introduce the concepts of accuracy and reproducibility with the following examples, have them identify what is wrong:

Measurements	
7	Depends: Is this frogs, temperature, or meters? If its meters, not enough units after the decimal place. If it is temperature, not enough repeated measurements. If its frogs, good work! You are good at spotting frogs.
3, 3, 4, 3, 4, 2, 3, 99, 3	99 is an outlier
7.2376492768364	Too many digits reported, instrument is not this accurate
3.1, 2.9	Good, but wouldn't a third rep be better?
23.0, 23.0, 23.0, 23.0, 23.0	If your thermometer is reading the exact same measurement 3 or more times, you don't need to take any more. You know the temperature is not exactly 23.0 but the variation is less than the accuracy of the instrument.

LESSON:

Activity	Time
Engage: Pre-Activity Questions (in three groups of 8 students)	10 minutes
Explore & Explain: Each group of 8 students will be assigned a section of stream that is either a POOL or a RIFFLE and has either FINE (silt/sand), MEDIUM (gravel) or COURSE substrate (cobble/boulder/bedrock). Within those groups of 8, students can work in two smaller groups of 4 students and rotate through measuring chemical, physical and biological measurements, and doing the calculations, **rotating the equipment** from group to group.	Approx. 1 hour for each: chemical, physical, biological
Break for lunch	1 hour
Explain: As a group, review all of the results from each group. Use big paper to draw big conclusions about habitat type and species diversity.	1 hour
Explore: Relocate the group to a stream with notable impacts from human development (roads, culverts, cement lining, erosion, dams). In groups, students make observations about how these impacts affect stream habitat and devise a testable hypothesis about those impacts.	30 minutes to explore, develop hypotheses, develop a plan
Students should run the plan by instructors for approval before beginning to collect data	
Explore: Groups investigate their own hypothesis and collect the data necessary to test their predictions.	1-2 hours
Explain: Groups analyze data and create visual aids to present their results.	1-2 hours
Break for dinner	
Extend/Elaborate: Groups present their findings and ask/answer questions.	12-15 minutes each
Debrief as a group about stream habitat and human impacts	30 minutes

ENGAGE

- Students are in three groups of 8.

- Pre-Activity Questions: Ask students the following questions:
  - What bodies of water do you know of, in your community or across the country/world? (lakes, ocean, swimming pools; some of these are considered aquatic ecosystems, e.g. coastal, wetland, stream, lake)
  - What different stream organisms have you seen so far or in your previous experience? (e.g. amphibians, invertebrates, birds, or other animals)
  - What are the different habitats you noticed within the stream that animals tend to prefer? Why is this the case? (ex. frogs near the stream bank catching insects)
  - What makes up aquatic ecosystems? Look for both abiotic and biotic factors (e.g. rocks, water, plants). What does abiotic and biotic mean?
  - How do the components of aquatic ecosystems interact? (e.g. food chain/food webs, symbiotic relationships)
  - What do you know about biodiversity in aquatic systems? What lives there?
  - What do you know about aquatic ecosystem health? (e.g. macroinvertebrate diversity can tell you about the level of pollution in the water, and too much sediment in the water leads to high levels of turbidity.)
  - Why is it important to study aquatic ecosystems? (e.g. humans rely on healthy aquatic ecosystems for recreation and drinking water.)

EXPLORE

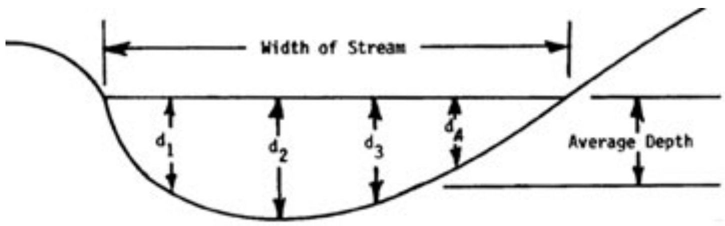
- The instructor should introduce the following concepts: **habitat diversity, pools, riffles, substrate types** (see key concepts and vocabulary)
- The instructor should then explain an important physical attribute: habitat diversity (a stream with a greater diversity of habitat types will generally support a greater diversity of organisms)
- The instructor should then split students into two groups of four students.
- Each group will conduct a full series of measurements at a cross-section of the stream. (If additional time, ask each group to run a repeated set of measurements at a different stream cross section.)
- Explain the the array of measurements that students will make (e.g. stream temperature, substrate class size, cross sectional area, flow velocity, bank height). Don't explain too much—allow discovery and mistakes!!!
  - One instructor should accompany each group and explain how to take each measurement (only explain when necessary).
- Instructor should prompt the students to seek out parts of the stream that look different from one another, and have them begin to describe the **qualitative** differences they see (if time allows).
- Instructor should identify cross sections that are easily wade-able and covering the entire gamut of stream characteristic combinations in the table below.
  - (** are the most distinguishable from one another and easiest to find. Make sure to include one of each of these for showing a range of diversity. Pick others as available; mixed/intermediate sites are fine too!)

Stream characteristics	Riffle	Pool
Mud, silt, sand		* *
Gravel		
Cobbles, boulders, bedrock	* *	

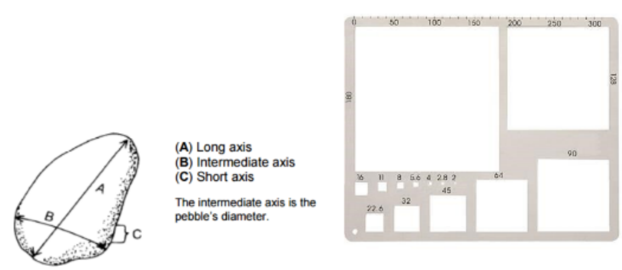
EXPLAIN

<u>Part 1. Physical Characteristics of Streams</u>

- Cross sectional area
  - Using the diagram as a guide, have students use one tape measure to lay a transect across the stream.



  - Instruct students to then use the other tape measure to measure stream depth at a regular interval points. (Be sure to record the interval width (W) and have at least 5 depth measurements.)
  - Provide the students with this formula to calculate the area:
  - (D1 + D2 + D3 + D4 + D5)/5 = average depth
  - Average depth * stream width = cross sectional area
- Stream Temperature
  - Distribute a thermometer to each group.
  - Ask students to read stream temperature with a thermometer held underwater until a stable reading can be taken.
  - The students should repeat 5x at different points along the transect and at different depths.
  - The students should then take an average of the temperatures at the different points.
- Substrate size class
  - Instruct students to walk "randomly" around in the stream near the transect picking up the stone that lies at the tip of their toe.
  - The students will use a gravelometer to measure the rocks/stones OR measure the longest axis of the stone and then replace it in the stream. (Note: it is not necessary to record every measurement exactly; they



could tally the stones based on size class). The gravelometer provides a more accurate measurement of pebble/rock being measured.
    - The students should continue until at least 50 measurements have been made.
    - Instruct the students to sketch a substrate histogram for their site.
- Flow velocity
    - Give students an orange and a stopwatch, and see if they can come up with a way to measure the velocity of the stream.
    - Hint: if they haven't measured the distance between starting point and stopping point, they are doing it wrong. Think about what groups can do to improve the accuracy of this measurement.
        - Are they choosing different parts of the stream to measure and making an average? Are they coordinating their timing and their orange deployment? Are they using an appropriate reach length (because smaller than a meter will not be accurate)? Velocity = distance/time

- Bank height
    - Ask students to examine the stream bank.
        - Students can measure the channel depth (from bank height to deepest point) and width (from bank to bank) and then calculate the depth to width ratio, called the **incision ratio**. A greater incision ratio indicates a more incised channel.
        - Instruct students to calculate the incision ratio to examine the stream bank.

Depth:width ratio = incision ratio

Incision ratio = 9/10 (more incised)   Incision ratio = 3/10 (less incised

        - A stream with a more incised channel will have more erosion, resulting in faster storm flow rates, greater turbidity, higher temperatures, and greater diurnal variation in temperature. These conditions are less favorable for most species because they result in lower oxygen saturation levels and more intense disturbance after rain events.
- The instructor should have a debrief discussion with the students by asking the following leading questions:
    - Why do we care?
    - What do these calculations mean?

- What does the stream incision ratio tell us about stream health?
- What do you notice about the slope? Is it undercut? How high is the top of the bank from the deepest point of the stream?

<u>Part 2. Chemical Characteristics of Streams</u>

- pH, DO, nitrate, phosphate.
  - Instruct students to follow the instructions on their worksheets for measurements of pH, dissolved oxygen (DO), nitrate, and phosphate using the water chemistry kit. Have them repeat each test three times and find the average.
  - ***Safety information:***
    - ***Students must wear safety goggles while performing water quality tests that require shaking a chemical mixture.***
    - ***Students must wash hands after performing water quality tests and avoid placing hands in contact with eyes or mouth during testing.***
    - ***All reacted samples must be poured together into a waste container for later disposal. They can be disposed of back home by flushing them down the drain with excess water.***
  - If time, students can also find pH using pH strips (dip a pH strip in water for two seconds. Read within 1 minute. Repeat 3 times and find the average)
  - If available, students can use the multi-probe to assess DO and other stream chemistry such as nitrogen and phosphorus levels. Have them make at least 3 measurements at different points along the transect. BE SURE TO EXPLAIN PROPER HANDLING OF THE PROBE - IT IS EXPENSIVE! Don't drop it. Don't touch the tips of the sensors to anything, especially not rocks. Tips should touch water only. Always use two hands to hold the sensor by the body. Some parts shouldn't be fully submerged. This should be obvious.
- Turbidity
  - Use a secchi tube, turbidity chart, or turbidity meter.
  - Instruct students to place the secchi tube/disk into the water to determine the turbidity of the stream.
- The instructor should have a debrief discussion with the students by asking the following leading questions:
  - Why do we care?
  - What do these calculations mean?
  - Introduce ecosystem services (the various benefits an ecosystem provides to humans such as water filtration, oxygen, timber, nature, etc.)
    - How do chemical changes in characteristics of streams influence the ecosystem services?
  - Chemistry of water, sediments, and the life in the water all interact with one another. There are huge implications for what's in the water and the terrestrial ecosystem.

- Relate temperature and DO levels. Ask students to draw a graph of this relationship (cooler temperatures= higher DO levels; warmer temperatures= lower DO levels), and ask them why the think this trend exists (it's because more gas can dissolve in cooler liquid).

Part 3. Biological Characteristics of Streams

- Macroinvertebrates
    - Instruct students to use the D-net to disturb the substrate along the transect in order to collect loose debris and substrate into a plate/pan for closer inspection. They may need to repeat several times to acquire enough insects.
    - The students should sort and tally the insects in broad groups (see worksheet) and then try to use the insect key to identify as many species as they can.
    - Once students have gathered their data, they should calculate at least one or two biotic metrics of stream health.
        - One metric: total number of taxa (total number of different kinds of organisms). If students found three different species of mayflies at their site, they should report these as three different kinds of taxa.
        - Second metric: total number of EPT taxa by counting the total number of different species of mayflies, stoneflies and caddisflies found. (EPT taxa belong to one of three major groups of macroinvertebrates that are intolerant of pollution and demanding of oxygen: **E**phemeroptera (mayflies), **P**lecoptera (stoneflies) and **T**richoptera (caddisflies).
        - Students should attempt to ID insects to the species level. However, acknowledge that not all insects will look like the pictures.
    - Other
        - Instruct students to make a note and draw sketches of any other animals or plans you observe in and near the stream (minnows, frogs, terrestrial insects, newts, birds, algae, etc.)
- The instructor should have a debrief discussion with the students by asking the following leading questions:
    - Why do we care?
    - What do these calculations mean?
        - Diversity from microbes to determine water quality and the services we can get from water (talk about ecosystem services)
        - Eutrophication- human caused- upsets the food web. You end up with algae, microbes, and toxins in the water. Diversity declines and we can't drink from it.

EXTEND

Group Investigation:

- In this section, the students will conduct a group investigation of their own choosing. Instruct the students that they are trying to find an example of impacted versus non-impact streams.
- Relocate the group to a stream with notable impacts from human development (roads, culverts, cement lining, erosion, dams).

- In groups, students make observations about how these impacts affect stream habitat and devise a testable hypothesis about those impacts.
    - Example: Hypothesis: Stream sun/shade cover affects temperature of water. Question: Can you detect a temperature difference in the water?
    - Example: Hypothesis: A riparian buffer affects the biological/chemical make-up of the river. Question: Does the existence (or not) of a riparian buffer make a difference in the biological or chemical make-up of the river?
    - Example: Hypothesis: The impacted stream is different from the stream from this morning in the following way…(This should be fairly specific with directed predictions (ie, not "the human-impacted stream will be worse"). Question: Is the temperature/pH/DO of the impacted stream different from the stream we measured this morning?
    - Ensure students check in with the instructor about their testable hypothesis before beginning investigation.
    - Instruct students to collect data, etc. in order to test their hypothesis

<u>More topics for continued discussion:</u>

- Introduce the concept of a stream food web. This might be a good follow-up activity to conduct during the evening or another day. Have each student draw their own food web. Feel free to incorporate both organisms that live in the stream and near the stream. Ask the students: "Can you link all the organisms we have encountered on the trip?"
- Introduce the concept of life-stages in stream invertebrates. They live most of their lives as aquatic animals, then a short portion of their lives flying and mating.
    - What are some advantages of living this way?
    - What are some of the disadvantages?
    - Relate to news such as Flint, pipelines, algal blooms, oil spills, saltwater intrusion, environmental justice, mining (natural gas & coal)

ELABORATE

- Why do we care?
    - Direct benefits: relationship between humans and water quality—we want to have access to clean water and to healthy foods we obtain from the water.
    - Our drinking water supply comes from groundwater and surface water such as rivers. But we must purify before we are able to drink it
    - Using what we learned about terrestrial ecosystems yesterday, what are relationships between the terrestrial and aquatic ecosystems? Does one affect the other? If so, how?
    - Why do aquatic ecosystems matter to humans?
    - Why do aquatic ecosystems matter to the environment?

EVALUATE

- Instructor should ask students these closing questions:
    - Why is it important to study aquatic ecosystems?

    - How do humans impact aquatic ecosystems? (e.g. pollution, land use changes, stream erosion, etc.)
    - How do aquatic ecosystems connect to other systems? (e.g. aquatic-terrestrial subsidies, energy and contaminant link to terrestrial systems)
- Ask the students to compile the data they collected while investigating their hypothesis, analyze the data, and create a 10-minute presentation assessing the stream health based on physical, chemical and biological components. Encourage them to create graphs, tables, or other visualizations.
- Students will present their findings to the entire group or to the smaller groups of 8.
- Additional closing activity:
    - Ask the students to draw a representation of human impact on aquatic ecosystems.

REFERENCE MATERIALS/RESOURCES

- http://www.learnnc.org/lp/editions/mudcreek/6395
- http://www.caryinstitute.org/sites/default/files/public/downloads/lesson-plans/water_life_riffle_and_pool_background.pdf
- http://www.learnnc.org/lp/editions/mudcreek/6395
- Options for invert keys:
    - http://www.stroudcenter.org/education/MacroKey_Complete.pdf
    - http://www.learnnc.org/lp/media/uploads/2010/06/macrokey.pdf
    - http://www.stroudcenter.org/research/projects/schuylkill/macroslideshow.shtm
- At minimum, instructor should familiarize themselves with slides 13-18 of this presentation: https://www.hws.edu/fli/pdf/stream_tier2_presentation.pd

Aquatic Ecology

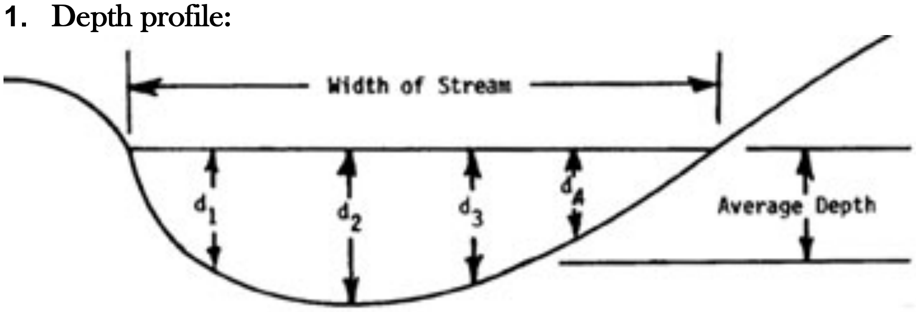
Your Name: **Your Partners' Names:**

Site:

General Observations:

Physical Characteristics

1. **Depth profile:**



Using the diagram as a guide, use one tape measure to lay a transect across the stream. Then use the other tape to measure stream depth at a regular interval point (be sure to record the interval width (W) and have at least 5 depth measurements). Calculate the area using the following equation.

$$D1(W) + D2(W) + D3(W) + D4(W) + D5(W) \ldots = \text{cross sectional area}$$

Interval width: ____________

D1	D2	D3	D4	D5	Area:

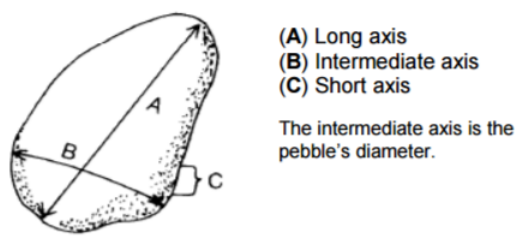
2. **Stream Temperature:**

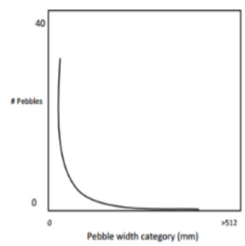
Read stream temperature with a thermometer held underwater until a stable reading can be taken. Repeat 5x at different points along the transect and at different depths. Take an average.

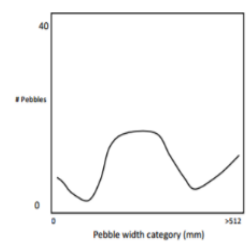
T1	T2	T3	T4	T5	Average:

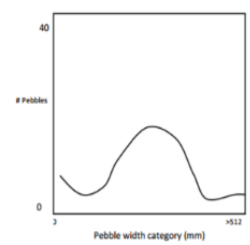
3. **Substrate size:**

Walk in a random zigzag around the stream within a foot of the transect. Pick up the stone that lies at the tip of your toe on each step. Measure the intermediate axis of the stone and then replace it in the stream. Continue until at least 50 measurements have been made. (Note, it is not necessary to record every measurement exactly, merely tally the stones based on size class). Sketch a substrate histogram for each site.



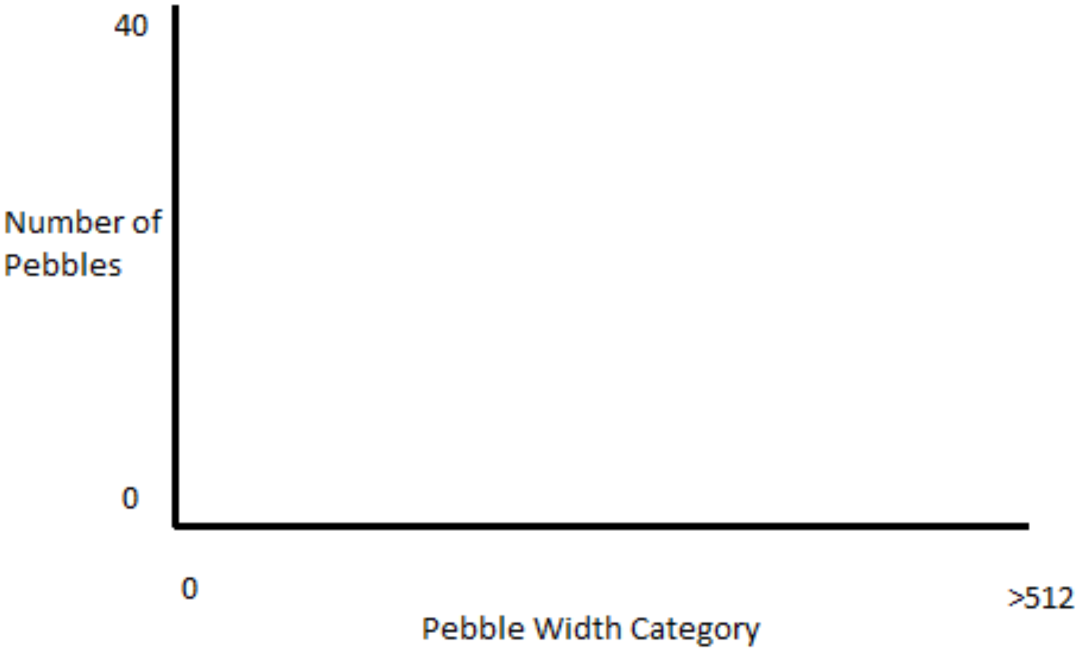






Pebble category	**Number of Pebbles**
Silt Clay (<0.1mm)	
Sand (0.1 - 2 mm)	
Gravel (2 - 16 mm)	
Coarse gravel (16 - 64 mm)	
Small cobble (64 - 128 mm)	
Large cobble (128 - 250 mm)	
Boulder (>250 mm)	
Bedrock (unbroken rock)	

Woody debris (leaves and sticks)	



4. Flow velocity:

Use an orange and a stop watch to measure flow velocity. Show your work below.

V1	V2	V3	Average:

5. Bank height:

Examine the stream bank. What do you notice about the slope? Is it undercut?

Measure the channel depth (from bank height to deepest point) and width (from bank to bank). Then calculate the depth to width ratio, called the incision ratio. A greater incision ratio indicates a more incised channel.

Depth ÷ Width = incision ratio

Depth	Width	Incision Ratio

What does the stream incision ratio tell you about stream health?

Chemical Characteristics

1. **pH, DO, Nitrate, Phosphate Levels**

Follow the instructions below for measurements of pH, dissolved oxygen (DO), nitrate, and phosphate. Repeat three times and find the average.

- ***Safety information:***
    - ***Students must wear safety goggles while performing water quality tests that require shaking a chemical mixture.***
    - ***Students must wash hands after performing water quality tests and avoid placing hands in contact with eyes or mouth during testing***
    - ***All reacted samples must be poured together into a waste container for later disposal. They can be disposed of back home by flushing them down the drain with excess water.***

pH	Dissolved oxygen	Nitrate	Phosphate
1. Fill the test tube (0106) to the 10 mL line with sample water 2. Add one pH Wide Ranges TesTab (6459) 3. Cap the tube and mix until the tablet has disintegrated 4. Compare the color of the sample to the pH Color Chart. Record as pH	1. Fill a small test tube (0125) to overflowing with sample water 2. Add two Dissolved Oxygen TesTabs (3976) to the test tube. 3. Cap the tube. Be sure no air bubbles are in the sample. 4. Mix until the tablets have disintegrated (about 4 minutes) 5. Wait 5 minutes 6. Compare the color of the sample to the Dissolved oxygen Color Chart. Record the result as ppm Dissolved Oxygen.	1. Fill the test tube (0106) to the 5 mL line with sample water 2. Add one Nitrate #1 TesTab (2799) 3. Cap the tube and mix until the tablet has disintegrated. 4. Add one Nitrate #2 CTA TesTab (NN-3703). Immediately slide the tube into the Protective Sleeve (0106-FP) 5. Cap the tube and mix for two minutes to disintegrate the tablet 6. Wait 5 minutes. Remove the Protective Sleeve 7. Compare the color of the sample to the Nitrate Color Chart (5891-CC). Record the results as ppm Nitrate	1. Fill the test tube (0106) to the 5 mL line with sample water. 2. Add one Phosphorus TesTab (5422) 3. Cap the tube and mix until the tablet has disintegrated 4. Wait 5 minutes 5. Compare the color of the sample to the Phosphate Color Chart (5862-CC). Record the result as ppm Phosphate

pH

			Average:

Dissolved Oxygen (DO)

			Average:

Nitrogen

			Average:

Phosphorous

			Average:

2. **Turbidity**

   Use a secchi tube, turbidity chart, or turbidity meter. Place the secchi tube/disk into the water to determine the turbidity of the stream. Repeat three times and find the average.

Turbidity

			Average:

Notes from Discussion:

Biological Characteristics

Macroinvertebrates:

Use the nets or your hands to collect the substrate along the transect. Collect all loose debris and scrape material off stones into nets or plates. Repeat collection until enough specimens have been collected. Identify as many species groups as you can and count the total number of individuals in each group.

Major Group	Species	Number of Individuals	Percent Composition
TOTAL:			

*Determine the number of ETP taxa and individuals (**E**phemeroptera (mayflies), **P**lecoptera (stoneflies) and **T**richoptera (caddisflies) and calculate the EPT ratio. EPT ratio is the ratio of ETP taxa to total taxa observed at a site.*

Other:

Make a note and draw sketches of any other animals or plants you observe in and near the stream (minnows, frogs, terrestrial insects, newts, birds, algae, etc.).