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| **Water Dawgs Lesson Plan**  **Topic: Basal Resources**  **Learning Module #14** | | | |
| **Lesson Objectives(s):** | | * SWBAT define stream basal resources. * SWBAT describe protocols for quantifying basal resources in streams. * SWBAT explain importance of basal resources to stream ecosystem processing. | |
| **Associated NGSS Standard(s):** | | N/A | |
| **Associated A.P. Environmental Science Standard(s):** | | N/A | |
| **Materials:** | | * PowerPoint * Printed materials:   + Lesson worksheets (WS) – 1 copy per student   + Science Daily Article Reading (Handout 1 [H1]) – 1 copy per student * Materials for field trip to campus stream:   + Wading boots   + For leaf collection demonstration:     - Quadrat - 1     - Measuring tape - 1     - Collection bag for leaves – 1-3   + For algae collection:     - Whirl-pak bags -- 1 for each student   collection, you will need to   * + - Sharpie * Materials for observing live algae samples:   + 1 compound microscope projector for screen   OR  ~1 compound microscope for each pair of students   * + Plastic tray for scraping algae substrates – 1 for each student   + Toothbrush or brush – 1 for each student   + DI water   + Gloves   + Plastic disposable pipette – 1 for each student   + Microscope slides – 1-2 for each student   + Coverslips (#1) – 1-2 for each student   + Sharps container   + Colored pencils   + Optional: microscope projector to screen | |
| **Instructor to do before lesson:** | | * Print:   + Lesson worksheets (WS) – 1 copy per student   + Science Daily Article Reading (Handout 1 [H1]) – 1 copy per student * Review PPT/Lesson plan * Test videos (ELABORATE activity) to ensure both are still available and that visual/audio works. * Secure microscope(s) for EXPLORE part of lab.   **NOTE: This lesson is written up as having only one microscope, and the ability to project the microscope lens onto a projector. However, if you are able to obtain more than 1 compound microscope, I would suggest modifying the EXPLORE part of the lesson so that each student or student group has their own microscope, and then they “switch stations” to view other samples. Keep in mind, if the lesson is modified this way, it would also need to involve a brief introduction or reminder on how to properly use a microscope, and lesson instructions will need to be modified accordingly.**   * Set up lab/classroom for algal observations. | |
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| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 1:00 | 20 min | Opening Activity  \*\*Pass out lesson worksheets (WS).  \*\*Tell students that this afternoon, we are going to be diving deeper into stream basal resources.  \*\*Students will answer the following questions as a think, pair, share:  **Question 1**: What do you know about the term “stream basal resources”?  **Question 2:** Imagine that you are a scientist that studies basal resources in streams. What are some basic questions you might ask basal resources in a stream ecosystem to better understand the health of a stream?  ^^Allow students 5-10 minutes to write their response on their lesson worksheets, 3 minutes to share their responses with a partner, and ~7 minutes to discuss the question with the class.  \*\*For Question 1, review that basal resources are at the base of the food web in streams. There are two main types of basal resources in streams: algae and leaves (i.e., detritus).  \*\*For Question 2, review that scientists might ask questions like:  -What kind of algae/leaves are in the stream?  -How much algae/leaves are in the stream?  -How nutritious are the algae/leaves for their consumers? |
| **EXPLORE** | 1:20 | 15 min | Basal Resources in our Campus Stream  \*\*Tell students that we are going to take a field trip to our campus stream to see how researchers might sample stream basal resources (algae and leaves). We will also collect some algae samples to look at under the microscope when we get back to class.  \*\*Go over materials needed for the field trip to the stream:   * Wading boots/backpacks * For leaf collection demonstration:   + Quadrat   + Measuring tape   + Collection bag for leaves * For algae collection:   + Whirl-pak bags   + Sharpie   \*\*Walk to campus stream from classroom |
| 1:35 | 20 min | Leaf collection demonstration:  \*\*At the stream, as students how they might go about measuring how much (biomass) of leaves in the stream.  ^^Wait for student responses.  \*\*Demonstrate how to use meter tape, quadrat, and collection bags to sample leaves/estimate leaf littler standing stock.  \*If desired, a student group can practice measuring bank full width and collecting leaves.  *🡪 NOTE: we are NOT quantifying leaf litter standing stocks, but we want to give students the idea of how it is done.*  Algal collection:  \*\*Now, ask students how they might go about measuring how much (biomass) of algae in the stream  ^^Wait for student responses.  \*\*Explain that algae can grow on many different surfaces (substrates). Examples include rocks, leaves, other plants (moss, Podostemum)… algae can even live freely in the water.  \*\*Have students each pick a substrate they think algae might be growing on. Try to have students pick a variety of substrates… rocks, leaves, sticks, bryophytes, etc… have students put the substrate a whirl-pak bag. Make sure to put a little stream water (~10mL) in with the substrate, and label the bags with relevant information (stream name, date, time, substrate type). |
| 1:55 | 15 min | \*\*Walk back to classroom from campus stream  \*\*Give students time to use the restroom, get water, etc. |
|  | 2:10 | 40 min | Observing live algae samples  **Step 1: Preparation of wet mount slide**  Materials needed:   * Gloves * Sample from stream * Plastic tray for scraping algae substrates * Toothbrush * DI water * Plastic disposable pipette * Microscope slides * Coverslips (#1) * Sharps container   \*\*Walk through the preparation of wet mount slides with students, step-by-step.  Directions:   1. Put on gloves 2. Take out sample (substrate) from whirl-pak bag and place into plastic tray. Pour water from the bag into the tray. 3. Use to toothbrush to gently scrape your substrate. Try to scrape the surface at least 3x. 4. Use DI water to rinse your substrate AND your toothbrush. NOTE: use as little water as possible! Using too much water will dilute your sample, making it difficult to observe algae. 5. Collect 1 microscope slide and 1 coverslip from your instructor. 6. Pipette the sample water. 7. Place 1-2 drops of sample water onto microscope slide 8. Gently place coverslip on top of microscope slide.   **Step 2: Algae observations**  \*\*Have each student bring their wet mount to the instructor’s microscope. The instructor will show the sample, scanning it to let the students view different types of algae.  \*\*For each sample, students will use their lesson worksheets to indicate:   1. sample information (i.e., collector’s name) 2. the substrate type 3. atleast one drawing of an algal cell 4. observations   Cycle through as many samples as you have time for! Help students make the observations. If you are knowledgeable about algae, you can point out different types.  ^^Allow 40 minutes for algal observations. |
| *BREAK* | *2:50* | *10 min* | *BREAK* |
| **EXPLAIN** | 3:00 | 15 min | Basal Resources in Stream Ecosystems  \*\*Go through the following slides on the importance of the quantity/type of basal resources in streams.  There are no guided notes today -- students may take their own notes if they wish.  \*\*Encourage students to interact/ask questions.  **Slide 1** (background)  Basal resources are important to stream food webs because they are the producers of the stream/at the bottom of the food web.  There are two major types of basal resources in streams:   1. Leaves 2. Algae   **Slide 2/3/4** (building slide)  When ecologists study basal resources in streams, they are often interested in two aspects of basal resources:  1. Quantity  --How much of the basal resource is there in the stream?  2. Type  --What kinds of algae or leaves are in the stream?  --Are algae or leaves the more important food source in the stream?  Changes in the quantity or type of basal resources can have major effects on stream ecosystem health!  **Slide 5**  Leaves/Detritus  Quantity – how many leaves are in the stream? (What is the biomass of leaves in the stream?)  Type – what types of leaves are in the stream?  **Slide 6**  The quantity of leaves in streams is important because many organisms rely on leaves as a food source!  Too little biomass of leaves can be a problem.  **Slide 7**  The type of leaves in streams is important  because leaves vary in their nutrition!  Too much of leaves with little nutrition can be a problem.  **Slide 8**  Algae  Quantity – how much algae is in the stream?  Type – what types of algae are in the stream?  **Slide 9**  The quantity of algae in streams is important because many organisms rely on algae as a food source!  Too much or too little algae can be a problem.  **Slide 10**  The type of algae in streams is important because different types of algae vary in their nutrition.  Some types of algae are toxic and can become a big problem if present in large quantities.  ^^Allow 15 min for PPT/notes. |
| **ELABORATE** | 3:15 | 45 min | Basal Resources and Water Health  \*\*Tell students: In this next activity, we will be learning about three real-life scenarios where changes in basal resources are affecting the health of aquatic ecosystems and/or those using the ecosystems.  After each video or reading, the students will answer the three associated questions on your lesson worksheets (WS). We will then discuss the video or reading and associated questions as a class before moving onto the next scenario.  **Scenario 1:** Dog death in Georgia (video)  \*\*Play the following video:  <https://www.11alive.com/article/news/a-marietta-couple-take-their-dog-to-lake-allatoona-less-than-an-hour-later-a-vet-tells-them-the-dog-might-have-died-from-algae-toxins/85-b8c44ca2-a390-4c4e-82a2-0e67ab29dd94>  ^^Following the video, allow students ~3-4 minutes to answer the associated questions on their lesson worksheets, and 3-4 minutes for a class discussion. Encourage students to ask questions.  **Scenario 2**: Nutrient pollution damages streams (article reading)  \*\*Pass out Science Daily Article Reading (H1).  ^^Allow students ~15 minutes to read the article and answer the associated questions. Allow ~5 minutes for class discussion.  **Scenario 3**: Fish kill in Australia (video)  \*\*Play the following video:  <https://www.youtube.com/watch?v=TkpRsY81FIg>  ^^Following the video, allow students ~3-4 minutes to answer the associated questions, and 3-4 minutes for a class discussion. Encourage students to ask questions. |
| *BREAK* | *4:00* | *10 min* | *BREAK* |
| **EVALUATE** | 4:10 | 20 min | Closing Activity  \*\*Have students answer questions independently on their lesson worksheets (WS).  **Scenario**: Imagine that you are tutoring a middle school student in science. You are looking at a picture of a river food web, points to a picture of algae, and asks, “What’s that? Why is it important?”    Question 1: How would you answer the student in ~3 sentences?  ^^Allow students 10 min to write responses on their lesson worksheets. If time remains, student can share their answers. Collect responses and review after the lesson. |