| **Water Dawgs Lesson Plan**  **Topic: Stream Bioassessments, Part A**  **Learning Module #16** | | | |
| --- | --- | --- | --- |
| **Lesson Objectives(s):** | | * SWBAT define bioassessment. * SWBAT describe the use of bioassessments to assess stream ecosystem health. * SWBAT conduct macroinvertebrate bioassessment for hypothetical stream. * SWBAT calculate results of bacterial monitoring using Adopt-A-Stream methods. | |
| **Associated NGSS Standard(s):** | | * HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. | |
| **Associated A.P. Environmental Science Standard(s):** | | N/A | |
| **Materials:** | | * PowerPoint * Printed materials:   + Lesson worksheets (WS) – 1 copy per student   + Georgia Adopt-A-Stream Macroinvertebrate Bioassessment Form – p. 2 of Handout 1 (H1) – 4 copies per student   + Macroinvertebrate Images (~20; Handout 2 [H2]) – Multiple copies (see note in Instructor to do)   + Adopt-A-Stream Bacterial Monitoring Form – p. 34 of Handout 3 (H3)– 1 copy to project, or fill out form as a class electronically over projector   + Georgia Adopt-A-Stream Macroinvertebrate Guide –pp. 30-54 of Handout 4 (H4) – 2 total copies for use in “All about Macroinvertebrates” activity * A Guide to Common Freshwater Invertebrates of North America (~2 copies) * Computers for All About Macroinvertebrates Activity * Sample paper macroinvertebrate collections (see Instructor to do below) * Ziploc bags (see below) * Macroinvertebrate data from Simulations 3, 4, and 5 of the “Biodiversity” Learning Module (Learning Module #15)   *🡪* ***NOTE:*** *If your class did not complete Learning Module #15 (Biodiversity), you can disregard this part of the lesson. Instead, we suggest that you have students “practice” macroinvertebrate bioassessments on >1 sample paper macroinvertebrate collection.* | |
| **Instructor to do before lesson:** | | * Print:   + Lesson worksheets (WS) – 1 copy per student   + Georgia Adopt-A-Stream Macroinvertebrate Bioassessment Form – p. 2 of Handout 1 (H1) – 4 copies per student   + Macroinvertebrate Images (Handout 2 [H2]) – Multiple copies (~20; see note in Instructor to do)   + Adopt-A-Stream Bacterial Monitoring Form – p. 34 of Handout 3 (H3)– 1 copy to project, or fill out form as a class electronically over projector   + Georgia Adopt-A-Stream Macroinvertebrate Guide –pp. 30-54 of Handout 4 (H4) – 2 total copies for use in All about Macroinvertebrates activity * Review PPT/Lesson plan * Secure computers for EXPLORE Activity. * Assemble sample macroinvertebrate collections   + Create “sample” macroinvertebrate collections by printing off multiple copies (~20) of the Macroinvertebrate Images PDF (Handout 2 [H2]), cutting them up, and creating different assemblages using different number and types of macroinvertebrates in each “collection.”   + I would suggest using a Ziploc bag to keep the different “collections” together.   + Make enough “collections” so that each pair of students has one collection (i.e., if you have 6 students, make three collections). | |
|  | | | |
| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 1:00 | 15 min | Opening Activity  \*\*Pass out lesson worksheets (WS).  \*Students will answer the following questions as a think, pair, share:  **Question 1**: What do you think the term “bioassessment” means? (Hint- think about the two separate parts of the term.)  **Question 2:** How do you think we use a “bioassessment” in a stream ecosystem?  ^^Allow students 5 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.  \*\*If students seem confused by question 1, help them break up bioassessment into two words: “bio” (meaning life) and “assessment” (meaning test). |
| **EXPLORE** | 1:15 | 1 hour,  10 min | All about Macroinvertebrates  \*\*Tell students: Over the next two days, we are going to be learning how to perform stream bioassessments using macroinvertebrates. But, before we learn more about bioassessments, we need to learn more about macroinvertebrates themselves.  \*\*Ask students – what do you know about macroinvertebrates?  ^^Allow students 2-3 min to answer  \*\*Show macroinvertebrate slide from the food webs lesson. Review Key facts about macroinvertebrates:  Macroinvertebrates – organisms without skeletons that we can see with our eyes   * Have no skeleton * Some kinds only live part of their lives in the water (e.g., dragonfly, mayfly) * Some kinds live their whole lives in the water (e.g., snails, crayfish) * Important part of stream food web (food for fish!)   \*\*Tell students: Today, we will be learning more about individual macroinvertebrates. To do this, you will each be creating PowerPoint slides about different types of macroinvertebrates. Then, you will present your slide(s) to the class!  \*\*Next, let students choose which macroinvertebrate(s) they would like to research/present.  If there are a small number of students in the class, students can present on multiple macroinvertebrates. (For example, if there are 7 students in the class, each student can present three macroinvertebrates).  *🡪 NOTE: If students are working on ~3 slides, I would suggest telling students to try to complete 2 full slides, and then work on the third if they have time.*  Aquatic snipe flies  Aquatic sow bugs  Aquatic worms  Black fly larvae  Caddisflies  Clams  Craneflies  Crayfish  Damselfly nymphs  Dobsonfly nymphs  Dragonfly nymphs  Gilled snails  Leeches  Lunged snails  Mayfly nymphs  Midge fly larvae  Net-spinning caddisflies  Riffle beetle larvae  Scud  Stonefly nymphs  Water penny larvae  \*\*Review the instructions:  For each of your macroinvertebrates, you will create one PowerPoint slide. Each macroinvertebrate slide should contain:   1. Common name of macroinvertebrate (e.g., “Mayflies”) 2. Two images (make sure to provide image credit) 3. Two facts 4. Pollution tolerance:   \*\*Use this wording:  -Sensitive (low tolerance)  -Somewhat sensitive (medium tolerance)  -Tolerant (high tolerance)  When you are finished, email your slides to your instructor!  \*\*Go over website resources  Resources**:**   * Macroinvertebrates.org * Georgia Adopt-A-Stream Macroinvertebrate Guide (printed at front; H4) * Book: A Guide to Freshwater Invertebrates of North America (with instructor) * Google * Wikipedia   ^^Allow 10 min for introduction/instructions. Allow 40 min for PowerPoint creation and emailing of slides.  \*\*Review directions/expectations for presentations:  While presenting:   * You will have one minute (tops!) to present each of your slides/macroinvertebrates.   While watching the presentations:   * For each macroinvertebrate slide, use the chart on your lesson worksheet to write down the pollution tolerance each macroinvertebrate. * You can also write down any other notes that you wish.   ^^Allow 20 min for presentations |
| BREAK | 2:25 | 10 min | BREAK |
| **EXPLAIN** | 2:35 | 20 min | Stream Bioassessments  \*\*Go through the following slides on stream bioassessments.  There are no guided notes today -- students may take their own notes if they wish.  Encourage students to interact/ask questions.  **Slide 1** (building slide)  What are bioassessments?  **Slide 2**  What are bioassessments?   * The use of organisms to evaluate environmental quality   **Slide 3/4**  **Why do we use stream bioassessments?**  *Take five minutes to brainstorm ideas with a partner or group. Write your ideas down on your lesson worksheet.*  \*\*Note that you might need to clarify the question…  In other words – If we want to know how healthy or unhealthy a stream is, why don’t we just measure the dissolved oxygen, pH, or nutrients instead of looking at organisms?  ^^Allow students 5 min to brainstorm ideas with their partner or a group. They should write down their ideas on their lesson worksheet.  \*\*Go over student responses/ideas. Then, go into slide 5….  **Slide 5**  Why do we use stream bioassessments?   * Measuring physical/chemical parameters of stream (pH, O2 , temperature, nutrients, toxins, etc.) only give us an idea of the stream health at one point in time.   🡪 Bioassessments give us an idea of stream health over an integrated period of time.   * Can be less expensive and/or time consuming to use bioassessments than to evaluation for physical/chemical parameters.   **Slide 6**  What organisms do we typically use for stream bioassessments?   * Algae (primarily diatoms) * Macroinvertebrates * Fishes   **Slide 7/8**  **What about macroinvertebrates makes them useful for stream bioassessments?**  *Take five minutes to brainstorm ideas with a partner or group. Write your ideas down on your lesson worksheet.*  ^^Allow students 5 min to brainstorm ideas with their partner or a group. They should write down their ideas on their lesson worksheet.  \*\*Go over student responses/ideas. Then, list additional reasons in slide 9…  **Slide 9**  What makes macroinvertebrates useful for stream bioassessments?   * They are affected by the physical, chemical, and biological conditions of the stream * Not very mobile * Present in almost all streams * Relatively easy to catch * Can view and identify with your eyes (no microscope required)   **Slide 10**  What are the pollution sensitivities of macroinvertebrates?  **Slide 11**  What are the pollution sensitivities of macroinvertebrates?  Sensitive   * + Found in good quality water   Somewhat sensitive/Somewhat tolerant   * + Found in good or fair quality water   Tolerant   * + Found in any quality water   ^^Allow 20 min for PPT and discussion |
| **ELABORATE** | 2:55 | 40 min | Practice Macroinvertebrate Bioassessment  \*\*Pass out four copies of the Adopt-A-Stream Macroinvertebrate Bioassessment Form (p. 2 of H1) to each student.  \*\*Go over form with students, especially the directions part.  *🡪****NOTE****: One tip is to place a check in the box if that taxa is present, and then code the abundance (rare, common, dominant) to the right of the taxa.*  \*\*Tell students: We are going to practice using the Adopt-A-Stream Macroinvertebrate Bioassessment forms with   1. A sample paper macroinvertebrate collection – *work with a partner* 2. Macroinvertebrate data from Simulations 3, 4, and 5 of the “Biodiversity” lesson – *work on your own*   In total, you should fill out 4 forms! (One for the sample collection, 3 for the simulations)  *🡪 NOTES: A few notes on this activity*   * *You might split up the activity into two parts. Have students work in pairs on the sample macroinvertebrate collections, and then go over all responses as a class. Then, have students work independently on their simulations. Or, you can have all students work at their own paces.* * *For the sample macroinvertebrate collection, pair of partners should grab one sample macroinvertebrate collection from the instructor.*   \*\*Make sure to tell students: Everyone will have different answers for the simulations, because everyone’s simulations were slightly different.  ^^Allow 5 min for instructions, and 30 min for the activity.  *🡪* ***NOTE:*** *If you are running short on time, you might only have the students perform a bioassessment on only one of the simulations.*  \*\*As students are working, make sure you are observing students to help and answer any questions they may have. You could even check their work ask they work through each form.  \*\*When students are complete, have a de-brief about the activity.   * Did you have any questions or difficulties with the macroinvertebrate bioassessment form? * Did you have any observations or learn anything new as you were working through the forms?   ^^Allow 5 min for debrief. |
| --BREAK | 3:35 | 10 min | BREAK |
| **EVALUATE** | 3:45 | 15 min | Closing Activity  \*\*Have students answer the following question independently on their lesson worksheet:  Scenario: Imagine that you are conducting a macroinvertebrate bioassessment at a stream near a local trail. Two people hiking on the trail stop to talk to you. They ask you what you are doing.  Question 1: How would you answer the hikers?  (Make sure to explain what macroinvertebrate bioassessments are, and why they can be useful.)  ^^Allow students 10 min to write responses on their lesson worksheets. Collect responses and review after class. |
| **EXTENSION** | 4:00 | 30 min | Bacteria Follow-up  \*\*Tell students: Two days ago, we plated our bacteria samples on petrifilm. Our samples have incubated for 48 hours, so now it is time to quantify the *E. coli* colonies!  \*\*First, let’s go through the directions for how to count colonies.   1. Counting the colonies   When reading Petrifulm plates, ***E. coli*** colonies appear blue to red-blue and are closely associated with entrapped gas. **General coliform** colonies appear bright red and closely associated (approximately one colony diameter) with entrapped gas. Remember that we are only concerned with counting the *E. coli* colonies in the medium, and we do not count colonies that appear on the foam barrier of the plate. Gas bubble patterns associated with gas producing colonies are shown on the right. **Only count blue to red-blue colonies that have a gas bubble!**  Blank/Control: There should not be any colonies on the blank. If any colonies appear on blank, sample is null and void! And new sample must be taken from site location.  Example 1  ^^Allow students time to count *E. coli* colonies and share answers.  Answer: 4  Example 2  ^^Allow students time to count *E. coli* colonies and share answers.  Answer: 3  Example 3  ^^Allow students time to count *E. coli* colonies and share answers.  Answer: 1  2. Calculating the results  Bacteria growths on plates are enumerated using a standard unit. The standard reporting unit is the number of **c**olony **f**orming **u**nits per 100 milliliters of water sample (cfu/100ml).  Each Petrifilm plate holds 1mL of sample.  \*\*Go through steps of how to calculate the results from the sample plates  \*\*Now, let’s count the colonies and calculate the results for our own samples! You will count your own sample, and then we will calculate the results as a class.  \*\*Go with students to retrieve Petrifilm plates from the incubator.  \*\*Monitor students as they count colonies. Calculate the results as a class using the Bacterial Monitoring Form projected onto a screen (p. 34 of H3) (you could fill out the form electronically).  ^^Allow 30 min for activity |