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| **Water Dawgs Lesson Plan**  **Topic: Stream Bioassessments, Part C**  **Learning Module #18** | | | |
| **Lesson Objectives(s):** | | * SWBAT conduct macroinvertebrate bioassessment of a non-urban stream using Adopt-a-Stream protocols. * SWBAT compare and contrast bioassessments in urban vs. non-urban streams. * SWBAT identify a stream macroinvertebrate to the family level. | |
| **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 students   + Macroinvertebrate Bioassessment Form – p. 2 ONLY of Handout 1 (H1) – 1 copy per student   + Macroinvertebrate Morphology Guide – Handout 2 (H2) – 1 copy per student * Materials for healthy stream bioassessment:   + Preserved Macroinvertebrate Collection (see below)   + Forceps (1 per student)   + Collecting trays (1 per student)   + Pencils (1 per student)   + Rite in Rains (1 per student)   + Clear plastic cups or similar   + Macro ID Binders (see instructions in Lesson 9 Morning)   + Ethanol (for re-filling vials) * Materials for family-level identification:   + Dissecting microscopes or magnifying glasses   + Additional forceps or dissecting kits   + Access to laptops/Chromebooks or similar devices to access Macroinvertebrates.org * Additional macroinvertebrate identification materials:   + A Guide to Common Freshwater Invertebrates of North America (~2 copies)   + Introduction to Common Insects of North America (1-2 copies)   + Aquatic Entomology: The Fisherman’s and Ecologist’s Illustrated Guide to Insects and Their Relatives (multiple copies)     - *🡪* ***NOTE:*** *The family level keys in the McAfferty Book are a great resource for the Family-Level IDs.* | |
| **Instructor to do before lesson:** | | * Print:   + Lesson worksheets (WS) – 1 copy per students   + Macroinvertebrate Bioassessment Form – p. 2 ONLY of Handout 1 (H1) – 1 copy per student   + Macroinvertebrate Morphology Guide – Handout 2 (H2) – 1 copy per student * Check to make sure audio/visual works on video * Review PPT/Lesson plan * Collect macroinvertebrates from pristine/healthy stream and preserve in ethanol for class collection.   *🡪****NOTE:*** *The goal of this activity is to have students observe/ID a large range of macroinvertebrates – and perhaps macroinvertebrates that would not be present in an urban stream. We suggest you travel to a healthy/non-urban stream and collect a wide variety of macroinvertebrates. These can be stored in ethanol and used year after year and can be replenished as needed (as some may be damaged beyond use during observations).*   * **OPTIONAL**: Add in PowerPoint slide to EXPLORE activity showing the location/stream from which you collected the non-urban stream macroinvertebrates. * Secure dissecting microscope(s) for macroinvertebrate family-level ID activity   *🡪****NOTE:*** *Dissecting microscopes are optional for this activity, but recommended. We advise you to secure at least one dissecting microscope, so students can take turns looking at their macroinvertebrates in the microscope.*   * Secure Chromebooks or similar devices so students can access Macroinvertebrates.org during family-level ID activity. * Familiarize yourself with macroinvertebrates.org * **OPTIONAL**: Enlists 1-2 other graduate students or scientists familiar with family-level macroinvertebrate ID to help with family-level ID activity. | |
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| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 1:00 | 15 min | Opening Activity  \*\*Tell students:  For the opening activity, we are going to watch a short video that gives us an in depth look at caddisflies and how they survive in streams!  \*\*Watch:  Video: Sticky. Stretchy. Waterproof. The Amazing Underwater Tape of the Caddisfly  https://www.youtube.com/watch?v=Z3BHrzDHoYo&t=14s  ^^Allow ~5 min for video  \*\*After the video plays, discuss the following questions with the students:   1. Did we collect any caddisflies that looked like the ones we saw in the video? Why do you think this is? 2. Was there anything that surprised you in this video? 3. What other observations or questions do you have after watching this video?   ^^Allow ~8 min for discussion |
| **EXPLORE** | 1:15 | 1 hour, 30 min | Non-Urban Stream Bioassessment    \*\*Tell students:   * So far, we have performed a stream bioassessment on our campus stream. * This afternoon, we are going to perform a stream bioassessment on a non-urban stream. This will allow you to compare and contrast macroinvertebrates that you might observe in urban vs. non-urban streams and give you another chance to practice your macroinvertebrate identification and bioassessment skills!   *🡪****NOTE****: You might choose to add in a slide to the PowerPoint showing the location/stream from which you collected the non-urban stream macroinvertebrates.*  \*\*Pass out Macroinvertebrate Bioassessment Form (Page 2 only; H1)  \*\*Review the materials required, and how to set up the macroinvertebrate data sheet.  You will need:   * Preserved Macroinvertebrate Collection * Forceps * Collecting tray * Pencils * Rite in Rains/Data sheet * Clear plastic cups or similar (for sorting) * Macro ID Binders * Ethanol * Macroinvertebrate Bioassessment Form (Page 2 only)   \*\*Go over directions for activity:   1. Work with your partner/group to identify your macroinvertebrates. Use any ID guides that are helpful to you! (You will have about 1 hour for identifications). **Record your group’s data in your Rite-in-Rain data sheet!** 2. When your group is finished identifying their macroinvertebrates, your group should bring their data sheet to the instructor so that the instructor can compile macroinvertebrate collection data from all groups. 3. Once data has been compiled, use the Non-Urban Macroinvertebrate Collection Data to fill out the Macroinvertebrate Bioassessment Form (Page 2 ONLY).   \*\*Show students how to set up data sheet within their Rite-in-Rain.  ^^Allow students about 1 hour for the identifications. Allow ~20 min for aggregation of data and time to fill out the Macroinvertebrate Bioassessment Form.  \*\*Go over correct answer/score for Macroinvertebrate Bioassessment From.  ^^Allow ~5 min for review of correct answer/score. |
| *--BREAK* | *2:45* | *10 min* | *BREAK* |
| **EXPLAIN** | 2:55 | 20 min | Compare and Contrast Bioassessments  \*\*Pass out lesson worksheet (WS).  \*\*Go over directions for activity with the students:   * Working with a partner, take 10 minutes to create a Venn Diagram comparing and contrasting our Campus Stream Bioassessment with the Non-Urban Stream Bioassessment on your lesson worksheet. * Things you might include in your Venn Diagram:   + Macroinvertebrates that were only in one or the other, and ones they both contained.   + Quantity (number) of macroinvertebrates   + Bioassessment scores   + Anything else you noticed!   ^^Allow students 10 minutes to work with partners to fill out the Venn diagrams.  \*\*Tell students: Let’s share out what you found.   * ***NOTE:*** *As students share out answers, you may choose to create a large Venn diagram that combines all student answers on a whiteboard, poster sticky paper, or PowerPoint.*   ^^Allow 5-10 minutes for sharing out responses. |
| **ELABORATE** | 3:15 | 1 hour | Macroinvertebrate Family Level IDs  \*\*Go over intro slides with students:  **Slide 1**  So far, we have used a macroinvertebrate bioassessment that use macroinvertebrate identifications at the classification level of **order**.  However, other types of bioassessments use macroinvertebrate identifications at the classification level of **family**.  **Slide 2**  \*\*Show example of mayflies/Hepageniidae  **Slide 3**  Within each “order” of macroinvertebrates, there are many “families”  **Slide 4**  \*\*Briefly describe the Family Biotic Index and how it works/is calculated (see notes for more info).  **Slide 5**  Pros of using family-level IDs and bioassessments:   * Macroinvertebrate families within each order vary in their tolerances to poor water quality. Thus, family-level IDs and bioassessments can provide a more accurate bioassessment than those that only ID to order.   Cons of using family-level IDS and bioassessments:   * Requires more materials (microscopes) * Requires more expertise and training   **Slide 6**  Today, you are going to practice identifying a macroinvertebrate of your choice to the family level!  Some macroinvertebrate morphology terms you may need to know (your instructor will also pass this out)  \*\*Pass out Morphology Handout (H2)  **Slide 7**  \*\*Go over directions for family-level ID activity:  Directions:   1. Pick a macroinvertebrate of your choice from the collection. 2. Use a dissecting microscope or magnifying glass and forceps, make observations about your macroinvertebrate. What are its distinguishing characteristics? 3. Then, use ID resources to identify your macroinvertebrate to the family level (we will help!) 4. When you think you have correctly identified your macroinvertebrate to family, raise your hand to have the instructor check your work. 5. Learn more about your macroinvertebrate family using the tools in macroinvertebrates.org. 6. If you have leftover time, try to ID your macroinvertebrate to genus OR pick a new macroinvertebrate to ID to family.   \*\*Go over ID resources for family-level ID activity:  ***🡪 NOTE: Make sure to show students how to use macroinvertebrates.org for family-level ID, and briefly go over resources available in other ID books.***  ID resources:   1. **Macroinvertebrates.org** 2. A Guide to Common Freshwater Invertebrates of North America 3. An Introduction to Common Insects of North America 4. Aquatic Entomology: The Fisherman’s and Ecologist’s Illustrated Guide to Insects and Their Relatives   ^^Allow 15 min for introductory slides and directions.  *🡪****NOTE:*** *If you are using dissecting microscopes, you will need to give a brief overview of proper use of dissecting microscopes.*  \*Students will then work independently on family-level IDs of their choice macroinvertebrate(s). Make sure to help students as much as possible with morphology/ID questions.  *🡪****NOTE****: If possible, it may be helpful to have an additional graduate student or scientist familiar with family-level macroinvertebrate IDs to help answer questions/guide students through this activity.*  ^^Allow ~45 min for IDs. |
| **EVALUATE** | 4:15 | 15 min | Closing Activity  \*\*Depending on the number of students in the class, have a few volunteers OR all students present their family-level ID to the class. Use the following format for presentations:  Use macroinvertbrates.org to show the class:   1. The order of your macroinvertebrate 2. The family of your macroinvertebrate 3. What characteristics of your macroinvertebrate you used to help you distinguish its family-level identification 4. Any other cool facts about your macroinvertebrate (i.e., from family overview, pollution tolerance, feeding habits, or moving habits)   *🡪****NOTE:*** *You might want to show an example of this “presentation” before students present.*  ^^Allow 15 min for student presentations. |