| **Water Dawgs Lesson Plan**  **Topic: Biodiversity**  **Learning Module #15** | | | |
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| **Lesson Objectives(s):** | | * SWBAT define species richness and abundance. * SWBAT calculate species richness and abundance. * SWBAT describe the importance of biodiversity in freshwater ecosystems. * SWBAT explain threats to biodiversity in freshwater ecosystems. | |
| **Associated NGSS Standard(s):** | | * HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. | |
| **Associated A.P. Environmental Science Standard(s):** | | * ERT-2-A Explain levels of biodiversity and their importance to ecosystems. * EIN-4-C-Explain how human activities affect biodiversity and strategies to combat the problem. | |
| **Materials:** | | * PowerPoint * Printed materials:   + Lesson worksheets (WS) – 1 copy per student   + Bean Diversity Handout – p. 1-4 of Handout 1 (H1) – 1 copy per student   + Graph paper (Handout 2 [H2]) – 4 copies per student * Calculators (or students can use their phone for calculators)   ***🡪 NOTE: Students can use their calculators throughout all of the activities today.***   * Materials for Bean Biodiversity   + Coffee can or similar container (Total of 4)   + A large assortment of dried beans (8 to 10 varieties)     - E.g., Dark kidney beans, light kidney beans, navy beans, dried yellow peas, dried green peas, etc)   + One plastic cup for each group   + Graph paper (4 copies per student)   + Colored pencils * Access to computers for Estimating Stream Diversity Activity | |
| **Instructor to do before lesson:** | | * Print:   + Lesson worksheets (WS) – 1 copy per student   + Bean Diversity Handout – p. 1-4 of Handout 1 (H1) – 1 copy per student   + Graph paper (Handout 2 [H2]) – 4 copies per student * Look over PPT/Lesson plan * Set up Bean Biodiversity activity (see Teacher Guide [p.5-6] on Bean Biodiversity Handout [H1] for instructions; 1 hour) * Secure computers for Estimating Stream Biodiversity. * Test Estimating Stream Biodiversity on student computers to make sure the model loads– the model might not load if Java is not enabled. If this is the case, try a different browser. * Familiarize yourself with the Estimating Stream Biodiversity Model so you can explain it to the students/answer questions. It would be beneficial to run through the activity yourself before the lesson.   ***NOTE->*** *Additional information/directions for the estimating stream diversity online activity can be found in the (Extra1) PDF. The may be useful for you as an instructor.* | |
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| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 9:00 | 20 min | Opening Activity  \*\*Pass out lesson worksheet (WS).  \*\*Tell students that this morning, we are going to be learning all about biodiversity  \*Students will answer the following questions as a think, pair, share:  **Question 1**: What do you know about the word “biodiversity”? Explain what you think it means and/or give an example.  **Question 2**: Which of the two images below do you think has higher biodiversity? Explain your reasoning.  ^^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. |
| **EXPLORE** | 9:20 | 1 hour, 15 min | Bean Biodiversity  \*\*Tell students that we are going to be learning more about biodiversity with an activity that uses different kinds of beans as sample communities.  \*\*Pass out Bean Biodiversity Handout (p. 1-4 of H1). Ask students to read the opening paragraphs silently. While they are reading, ask students to:  -Underline the definitions of richness and abundance  -Circle any words you are unfamiliar with  ^^Allow students 5-10 min to read the opening paragraphs.  \*\*Discuss unfamiliar words, and the definitions of biodiversity, richness, and abundance.  **🡪 NOTE/OPTIONAL ACTIVITY**:  If needed, you can practice calculating biodiversity metrics with the students before they begin the bean activity. The next slide contains count data for an example community. You can work through the following questions as a class or as a think, pair, share.  1) What is the total # of insects in the community?  2) What is the richness of the community?  3) What is the relative abundance of ladybugs?  4) What is the relative abundance of bees?  ^^Allow 5-10 min for discussion and practice  \*\*Pass out 4 copies of graph paper (H2) to each student.  \*\*Go over materials and procedure of the activity as a class.  **\*Students can work in pairs to complete the activity, but each student should create their own graphs.**  **NOTES:**   * You might choose to assign the first two communities to each pair (i.e., half of student pairs get communities A & C, while other half get B & D), or you might let the students choose. * Students can use their calculators (or phone calculators) at any time throughout this entire day/lesson.   ^^Allow ~45 min for activity  \*\*Discuss activity questions from p. 4 as a class.  ^^Allow 10 min for discussion |
| *BREAK* | *10:35* | *10 min* | *BREAK* |
| **EXPLAIN** | 10:45 | 25 min | Stream Biodiversity  \*\*Use PowerPoint to go through different aspects of stream biodiversity. During this presentation, encourage students to interact and ask questions!  **Slide 1-3 (build)**  **What is biodiversity?** The variety of life that occurs within an ecosystem  Today, we are talking mostly about species biodiversity –  but ecosystem biodiversity and genetic biodiversity are other important components of biodiversity!  **Slide 4**  The southeastern United States is a hotspot for stream biodiversity!  The southeastern U.S. has   * 33% of the world’s crayfish species * 40% of the world’s freshwater mussel species   Of the 831 freshwater fishes in U.S. and Canada, 550 (79%) are found in the Southeast.  The Southeast also has very diverse assemblages of salamanders, turtles, mayflies, and caddisflies!!  **Slide 5-6 (build)**  **How do ecologists measure species diversity?**  There are multiple ways to measure species diversity:   1. Species richness (# of species) 2. Species abundance or evenness (how evenly distributed are the relative abundances of each species) 3. A combination of richness and evenness (Shannon Index; Simpson’s Index)   **Slide 7-8 (build)**  **Why is aquatic/stream biodiversity important?**  *Take five minutes to brainstorm ideas with a partner or group. Write your ideas down on your lesson worksheet.*  ^^Allow students ~5 minutes to brainstorm ideas with their group.  \*\*Then, have students share out answers (this might spark some discussion!). Once students share out their own responses, share additional reasons from…  **Slide 9**  **Why is aquatic/stream biodiversity important?**   * Species biodiversity = functional diversity = healthy stream ecosystem – and we depend on healthy aquatic ecosystems for survival * Maintain food web balance * Aquatic wildlife are important sources of food, energy, jobs, atmospheric oxygen, buffers against new diseases. * Biodiversity is a part of culture/identity/happiness * It’s our responsibility (?)   **Slide 10-11 (build)**  **What are threats to aquatic/stream biodiversity?**  *Take five minutes to brainstorm ideas with a partner or group. Write your ideas down on your lesson worksheet.*  ^^Allow students ~5 minutes to brainstorm ideas with their group.  \*\*Then, have students share out answers (this might spark some discussion!). Once students share out their own responses, share additional reasons from…  **Slide 12/13**  **What are threats to aquatic/stream biodiversity?**   * Habitat loss and destruction * Alterations to ecosystem composition (i.e., loss or decline or a species) * Introduction of non-native species * Over-fishing or over-collecting * Pollution or contamination * Climate change   🡪NOTE: You may want to go over definitions of native, non-native, and invasive species. Note that invasive species can be native or non-native.  **Native species**: a species that originated and developed in its surrounding habitat and has adapted to living in that particular environment.  **Non-native species**: a species that originated somewhere other than its current location and has been introduced to the area where it now lives.  **Invasive species** : a species of plant or animal that outcompetes other species, which may cause damage to an ecosystem – can be native or non-native!  ^^Allow 25 min for PPT slides and discussion. |
| BREAK | 11:10 | 10 min | BREAK |
| **ELABORATE** | 11:20 | 55 min | Estimating Stream Diversity  \*\*Tell students that we are going to run through a computer simulation activity to better understand how pollution affects stream macroinvertebrate biodiversity.  \*\*Use PPT to instruct students how to access the model:   1. Go to the following website: virtualbiologylab.org 2. Under ”Ecology Models”, click “Biodiversity Ecology” 3. Scroll down 4. Under “Model 2 – Estimating Stream Diversity”, click “Launch Model”   Show students the basics of how to use the model (i.e., basic controls). During the activity, students will mostly be adjusting the “pollution” and “sampling time” controls (in green).  ^^Allow ~5 min for model introduction  \*\*Allow students to work through the activity on their lesson worksheets. **Students should work independently, but can they talk to a neighbor if they have questions.**  ^^Allow 40 min for activity  \*\*Once students are complete with the activity, go over the questions on the activity pages as a class.  ^^Allow 10 min for classroom discussion. |
| **EVALUATE** | 12:15 | 15 min | Closing Activity  \*Students will answer the questions independently on their lesson worksheets:  Here are sample data for a fish assemblage in a stream in North Carolina:   | Fish species | Count | | --- | --- | | Mottled sculpin | 22 | | Brook trout | 10 | | Tennessee shiner | 8 | | Spotfin chub | 4 | | Rock bass | 4 | | Central stoneroller | 1 | | Mirror shiner | 1 |   Total count = 50  **Question 1**: What is the species richness of the assemblage?  **Question 2**: What is the relative abundance of Spotfin chub? (Note: can use calculator!)  **Question 3**: How might pollution coming into the stream for a local factory affect the species richness of this fish assemblage?  **Question 4**: What is one reason we should care about maintaining the biodiversity of this fish assemblage?  ^^Allow students ~10 min to answer.  \*\*Collect responses. Review responses after the lesson. |