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| **Water Dawgs Lesson Plan**  **Topic: Chemical Monitoring, Part A**  **Learning Module #5** | | | |
| **Lesson Objectives(s):** | | * SWBAT define: temperature, pH, dissolved oxygen, conductivity, water clarity. * SWBAT describe the effects of urbanization on stream temperature, pH, dissolved oxygen, conductivity, and clarity. * SWBAT describe relationship between temperature and dissolved oxygen. * SWBAT explain the importance of different types of chemical monitoring in maintaining stream ecosystem health. * SWBAT analyze chemical monitoring parameters in a campus stream over time. | |
| **Associated NGSS Standard(s):** | | N/A | |
| **Associated A.P. Environmental Science Standard(s):** | | * STB-3-G-Describe the effects of thermal pollution on aquatic ecosystems * EIN-2-M-Describe the effects of urbanization on the environment | |
| **Materials:** | | * PowerPoint * Printed Materials:   + Lesson Worksheets (WS) – 1 copy per student   + Graph paper (Handout 1 [H1]) – 5 copies per student   + Campus Stream Data (Handout 2 [H2]) – 1 copy per student * Pencils * Markers * Poster paper (1 for each group) | |
| **Instructor to do before lesson:** | | * Print:   + Lesson Worksheets (WS) – 1 copy per student   + Graph paper (Handout 1 [H1]) – 5 copies per student   + Campus Stream Data (Handout 2 [H2]) – 1 copy per student * Look over PPT/Lesson plan * Ensure video works with sound * **OPTIONAL CHANGE TO LESSON PLAN**: The EXPLORE Activity (How do chemical properties of water relate to stream health?) was originally created to be a pencil/paper activity. However, you have the option of making this a computer/excel activity, depending on your access to computers. To do this, you would need to:   + Reserve computers for students   + Modify the excel file (Graphs) so that it only contains data (i.e, remove answers) and send out to students.   + Teach/show students how to create a line graph in excel!!! * NOTE that the Extra1.xls file contains answers the EXPLORE activity. | |
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| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 9:00 | 30 min | The Last Dragons  \*\*Pass out Lesson Worksheets (WS)  \*\*Show video “The Last Dragons” – instructor should provide brief intro about salamanders/hellbenders and explain that Hellbenders are found in north Georgia! (very close to Athens)  <https://vimeo.com/108512185>  ^^Allow 10 min for video  \*\*Lead students in discussion about the video and why hellbenders are becoming endangered:  Why are the hellbenders becoming endangered?  A: Siltation/Turbidity; people moving rocks  -Why is siltation/turbidity a problem for hellbenders?  A: fills in spaces between rocks where they live  -What causes siltation/turbidity in a stream?  A: How we use the land/watershed – for example, increasing roads or impervious surface  -Where are hellbenders still found?  A: National forests (instructor could show map here on National Forests close to Athens, explain what National forests are)  -Do you think hellbenders may have ever lived in Athens? Why/why not?  -Any other thoughts?  ^^Allow ~20 minutes for discussion |
| **EXPLORE** | 9:30 | 1 hour | How do chemical properties of water relate to stream health?  \*\*Pass out 4 sheets of graphing paper (H1) to each student. The rest of the materials (data, questions) are found within the Lesson Worksheets (WS).  \*\*Split students into pairs (or let them choose). Note: each student should create his/her own graph, but they can work together to answer questions.  \*Students will work in partners to create four graphs of relationships between chemical water quality parameters and other variables. Students will answer 2 questions to go along with each graph.  \*\*Lead students through activity instructions:   1. For this activity, you will be working with a partner/small group to graph relationships between chemical water quality parameters and other variables. You/your team will also be answering question associated with each graph. 2. Please use a separate sheet of graphing paper for each graph. Answer the questions in the space provided. 3. One you graph the points, connect you points with a line. 4. Don’t forget to label the x and y-axes!   *🡪NOTE: You may want to show a model of how to create the first graph before students attempt the activity on their own (it will depend on skill level of students).*  **Graph 1:**  Water temperature and abundance of salamanders  Question 1: Describe the relationship between maximum temperature and number of salamanders.  Question 2: Based on the graph, what do you think will happen to salamanders as temperatures become warmer due to climate change?  **Graph 2:**  Water temperature and dissolved oxygen  Q3: Describe the relationship between water temperature and dissolved oxygen.  Q4: Why would dissolved oxygen be important to organisms living in a stream? What might happen if dissolved gets too low?  **Graph 3:**  pH and number of Rainbow Trout  Q5: Describe the relationship between pH and number of rainbow trout.  Q6: What range of pH can rainbow trout tolerate?  **Graph 4:**  Percent impervious surface and conductivity  Q7: What do you think “conductivity” in a stream means? Take your best guess!  Q8: Describe the relationship between conductivity and impervious surface.  ^^Allow 1 hour for entire activity (~45 min for graphing and ~15 min for discussion)  OR  Split the activity into four parts – 12 min for each graph and questions/3 min for discussion.  *🡪NOTE that the graphed data (i.e., answer to each graph) is within the PPT. This will be useful for going through “the answers.”* |
| --BREAK | 10:30 | 15 min | BREAK |
| **EXPLAIN** | 10:45 | 30 min | Guided Notes  \*\*Lead students through definitions of five chemical monitoring parameters and why parameters are important for stream ecosystem health. Students will take “notes” with guided notes in lesson worksheets (WS).  \*\*Go through directions for guided notes:   * Listen and ask questions! * Write down anything you see that is **bold, brown, and underlined**   *🡪 For each water quality parameter, instructor will go over definition, units, importance, and Georgia standards. For each, student will have to write down the units and importance.*  *🡪* ***Make sure to relate notes/definitions/importance to opening activity!*** *Each parameter starts out with blanks for units and importance, so try to solicit answers from the students before showing them the next slide with the answers filled in…* ***in other words, try to make the “guided notes” section as interactive as possible!***  **Slide 1/2**  Temperature   * Definition: how hot or cold the water is * Measured in: **°C** * Importance:   + **Affects feeding, respiration (breathing), and metabolism of aquatic**   + **Most aquatic life is adapted to a narrow range of temperatures**   + **Temperature/Dissolved Oxygen relationship**   Georgia Standards: Less than 32.2°C (90°F)  **Slide 3/4**  Dissolved oxygen   * Definition: how much oxygen is dissolved in water * Measured in: **mg/L or ppm (parts per million)** * Importance:   + **All aquatic organisms need it for respiration (breathing)** * Georgia standards: Average of 5 mg/L; minimum 4 mg/L   **Slide 5/6**  Temperature and Dissolved Oxygen (DO)   * **Inversely** related to temperature   + As temperatures go **up**, DO goes **down**   + As temperatures go **down**, DO goes **up** * DO may decrease due to:   + Rising temperatures   + An overload of decaying organic matter   + Slow moving, deep water   **Slide 7/8**  pH   * Definition: a measure of hydrogen ions (H+) * Measured in: **unitless; measured on scale from 0-14** * Importance:   + **Aquatic organisms are sensitive to fluctuations in pH** * Georgia standards: 6-8.5   **Slide 9/10**  Conductivity   * Definition: a measure of water’s ability to pass electrical current; Indicate presence of ions in water * Measured in: **µS/cm** * Importance:   + **Higher conductivity can be an indicator pollutants in the water (nutrients, sewage, urban runoff)** * Georgia standards: No regulated levels in Georgia; ranges from 50-1500 µS/cm   ^^Allow 30 min for Guided Notes. |
| BREAK | 11:15 | 15 min | BREAK |
| **ELABORATE** | 11:30 | 45 min | Monitoring the chemical properties of our campus stream  \*\*Pass out Lily Branch Water Quality Data form UOWN (H2)  \*Each student (or student pair) will be in charge one of five water quality parameters for the campus stream:   * Visual * Temperature * pH * DO * Conductivity   *🡪 You can assign the parameters or let the students choose!! If there are more than 5 students, form into students into pairs or groups.*  \*Each student (or group) will receive markers and a poster graph and an additional sheet of graph paper. Using these materials, each student or student pair will create a poster for their water quality parameter. Each poster should have:   * Title the poster with the water quality parameter * Define the parameter * Explain why it’s important to stream health * Graph trends over time of the parameter * Describe any trends over time in the stream   ^^Allow 30 min for creation of posters.  \*\*Students will present posters to class in 2-3 minutes  ^^Allow 15 min for presentation of posters  \*\*We recommend hanging the posters around class after presentations are complete. |
| **EVALUATE** | 12:15 | 15 min | Closing Activity  \*\*Have students answer questions on their lesson worksheets (WS).  Question 1: At high water temperatures, would you expect to measure high or low dissolved oxygen?  Question 2: Why is dissolved oxygen important to aquatic life?  Question 3: How would you expect conductivity to change with increasing urbanization?  ^^Allow 10 min. Collect responses and review after the lesson. |