|  |  |  |  |
| --- | --- | --- | --- |
| **Water Dawgs Lesson Plan**  **Topic: Point Source and Nonpoint Source Pollution**  **Learning Module #7** | | | |
| **Lesson Objectives(s):** | | * SWBAT define: nutrients, point source pollution, and nonpoint source pollution. * SWBAT describe how excess nutrients enter stream ecosystems. * SWBAT differentiate between point and nonpoint sources of pollution. | |
| **Associated NGSS Standard(s):** | | NA | |
| **Associated A.P. Environmental Science Standard(s):** | | * STB-3-A-Identify differences between point and nonpoint sources of pollution | |
| **Materials:** | | * PowerPoint * Printed Materials:   + Lesson worksheets (WS) – 1 copy per student   + Handout for Stream Table Investigation Activity – pp. 7-8 of Handout 1 (H1) – 1 copy per student   + Graph paper (Handout 2 [H2]) – 3 copies per student (2 for each student for Stream Table Investigation; 1 copy per group for Pucker Effect).   + Handout for Pucker Effect Activity, pp. 341-343 of Handout 3 (H3) – 1 copy per student   + Card Sort Activity (Handout 4 [H4]) – 1 copy per group of 2 students * For Stream Table Investigation Activity (EXPLORE activity)   + Aluminum pans (1 per group)   + Sand   + Watering can/bottle with sprinkler (1 per group)   + Ruler   + Sharpie   + pH test papers   + tap water in container   + Pollutants – sprinkles (brown, green, pink), dried oregano, vegetable oil with soy sauce, cinnamon   + Colored pencils for sketches * For Pucker Effect Activity (ELABORATE activity – some other materials required are already within EXPLORE activity)   For intro:   * + Plastic cup with holes in bottom   + Unsweetened grape drink mix   + 1-2 clear baking pans   For each group   * + Aluminum pan (to be reused from Stream Table Investigation)   + More sand   + Bottle mister (1 per group)   + Lemonade packet (1 per group)   + Small object to raise end of tray (e.g., books)   + Straw (1 per group)   + Beaker or cup of water (1 per group)   + pH test papers (10 per group) * This lesson plans includes an activity from Project WET (“The Pucker Effect”). You need to purchase this activity form Project WET:   https://www.projectwet.org/   * The card sort activity was acquired from Teachers-Pay-Teachers website for $1.50. I have acquired it for our use (UGA Water Dawgs) but other users of this lesson will need to acquire their own license using this website.   https://www.teacherspayteachers.com/Product/Point-Source-and-Nonpoint-Source-Pollution-card-sort-3530747?st=195536c6a7a7ba371a3d6ce52ec3220c | |
| **Instructor to do before lesson:** | | * Print:   + Lesson worksheets (WS) – 1 copy per student   + Handout for Stream Table Investigation Activity – pp. 7-8 of Handout 1 (H1) – 1 copy per student   + Graph paper (Handout 2 [H2]) – 2 copies per student   + Handout for Pucker Effect Activity, pp. 341-343 of Handout 3 (H3) – 1 copy per student   + Card Sort Activity (Handout 4 [H4]) – 1 copy per group of 2 students * Look over PPT/Lesson plan * Set up Stream Table Investigation Activity   + We suggest students working on this activity in groups of two or three. For each group, use one aluminum plan.   + For each group/aluminum pan:     - Use a ruler to mark the sides to mark 1 cm plots on all four sides of pan. The points will be used to visualize a set of gridlines across the water table.     - Place sand in the pan. Form sand in such a way that there is a “river bed,” some “hills” within the landscape (made of sand), and a “lake” (on one side of the pan). * For Card Sort Activity – print and cut cards. Use paper clip to secure. * **Optional**: You may want to run through the Stream Table Investigation Activity and Pucker Effect Activity on your own before you do it with the students so that you can work out any kinks! * **Optional**: You may want to set up the “warm up” activity within the Pucker Effect Activity before the class begins. See note under “Warm up” within the Pucker Effect Activity for more directions. | |
|  | | | |
| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 9:00 | 25 min | Opening Activity  \*\*Pass out lesson worksheets (WS)  \*\*Complete the following activity as a think, pair, share:   1. What do you think about when you think about water pollution? Describe in words or draw a picture. 2. What are some specific things that might pollute water? Example: trash. Make a list 3. How does this “pollution” get to streams and rivers? Describe in words   ^^Allow ~ 8 minutes for students to write their answers on their own piece of paper  ^^Allow ~5 minutes to discuss with partner or small group  ^^Allow 10 min to discuss as a class. Instructor or student can make a list of pollutants as students list them.  \*\*When discussing last question, you may be able to guide students towards idea that there are two primary way by which pollutants can enter a stream – directly (point source) or indirectly (nonpoint source). |
| **EXPLORE** | 9:25 | 50 min | Stream Table Investigation (Nonpoint Source Pollution)  \*\*For detailed instructions for this activity, refer to page 7 and 8 of the Stream Table Investigation handout (H1). A brief description of the activity and its steps are detailed below.  **\*\*You may choose to have groups go through activity on their own, or to do the steps together as a class! Directions have been written out step-by-step on PowerPoint in case you want to do the activity as a class.**  \*\*Pass out the handout for the Stream Table Investigation (p. 7-8 of H1) and 2 copies of graph paper (H2) to each student.  \*\*Split student up into groups of 2 or 3 (or let them choose).  \*Students will use a prepared water table (aluminum 9x13 pan with sand), various “pollutants” (sprinkles, vegetable oil, etc.), and a “storm event” (watering can) to demonstrate how pollutants can travel overland during a storm event to create nonpoint source pollution.  Activity Directions:   1. Use meter stick/ruler to mark 1 cm plots on all four sides of pan. The points will be used to visualize a set of gridlines across the water table***. –* This will already be done for you!!** 2. Add pollutants to the landscape.    1. Animal waste – chocolate sprinkles    2. Pesticides – pink sprinkles    3. Nitrogen rich fertilizer – green sprinkles    4. Grass clipping, leaves – dried oregano    5. Oil and grease – vegetable oil mixed with soy sauce    6. Cinnamon – erosion 3. Using colored pencils, draw a sketch of stream table prior to storm event on the first piece of graph paper. Make sure to include landforms, river bed, empty pan, and location of pollutants. – ***Use graph paper for this!*** 4. Observe and test the water that will be used for the storm evet for pH (test the pH using strips), turbidity (describe in words), particulate matter (describe in words), and color/appearance (describe in words). ***– Use worksheet for this*** 5. Conduct the “storm event” 6. Re-sketch the stream table after the storm event on the second piece of graph paper. Make sure to include shifts in land forms, river beds and if location of pollutants have changed – ***Use second piece of graph paper for this!*** 7. Re-observe the water following the storm event for pH, turbidity, particulate matter, and color/appearance ***– Use the handout for this*** 8. Analyze the data: did the pH of the water change after the storm event? If so, what evidence can you find to explain the change? ***– Use the handout for this*** 9. Write: compare and contrast the before and after storm observations. Write a short description of how the storm water affected the pollutants. ***– Use the handout for this***   \*Note: students can ignore part on worksheet about mystery toxic (we did not do this part).  \*\*Discuss the activity. Potential discussion topics:   * Review observations before and after storm event. * Was there anything that was visible that was not visible during storm event? * The condition of the storm water as it moves through the watershed (water picks up anything in its path) * The condition of the lake after it rains; discuss the habitat (would fish be able to live in a dirty lake? Aesthetics? * Water supply and costs associated with clean-up and use * Recreation at the lakes and the effects of pollution on recreation * Ways to avoid nonpoint source pollution (erosion control, soil testing, re-vegetation, good housekeeping, auto care, litter clean-up   ^^Allow 35 min for activity and 10 min for discussion. |
| BREAK | 10:15 | 15 min | BREAK  \*\*Have students dump contents of pan during break. |
| **EXPLAIN** | 10:30 | 20 min | YouTube Videos: Point and Nonpoint Source Pollution  \*\*Go over instructions with the students:  Instructions:   * We are going to watch two short videos on pollution. * As we watch each video, write down examples of point source pollution and nonpoint source pollution.   \*\*Make sure to add that if students have a hard time watching and writing at the same time, students should just concentrate on watching. After each video, we will pause for a few minutes to give students time to write.  **Video 1:**  “Sources of Water Pollution”  1:18  https://www.youtube.com/watch?v=ekACmEJLK2Q  **Video 2:**  “What is nonpoint source pollution?”  2:49  <https://www.youtube.com/watch?v=phmN-IpR3xw>  \*As students are watching, students will write down examples of point source and nonpoint source pollution pollutant.  ^^Allow 10 min for instructions and video watching  \*\*After videos are completed, go over examples of point source and nonpoint source pollution. You can write these directly into the PowerPoint.  \*\*Then, work together as a class to come up with definitions of point source pollution, nonpoint source pollution, and nutrients. You can write these directly into the PowerPoint.  ^^Allow 10 minutes for definitions. |
| **ELABORATE** | 10:50 | 1 hour | The Pucker Effect Activity (Point Source Pollution)  Students will use the setup from the EXPLORE activity for the Pucker Effect Activity.  \*\*For detailed instructions for this activity, refer to The Pucker Activity Handout (H3). A brief description of the activity and its steps are detailed below:  \*\**Warm up*: Refer to “Warm Up” section of the handout to conduct the introduction. You may want to have two pans – one to show how to “hide” the substance, and one where you have already hidden the substance and misted for 5-10 min. This will save you time during the warm up.  \*\*Pass out pp. 341-343 of The Pucker Effect Activity (H3) to each student, and one piece of graph paper (H2) to each group.  \*\*Students should work in same groups as the Pucker Effect Activity (groups of 2 or 3).  \*\*The *Activity (go through step by step with students):*   * 1. Each group is a well-drilling company (team) that tests groundwater quality. * 2. Fill each pan with 6cm of sand. * 3. Mark one long end of the tray with an ”X”. * 4. Bury a small pile of lemonade-flavored powder drink mix somewhere in the container (see How to Hide and Seek Your Contaminant). * 5. Sketch a map showing where you have hidden the contaminant on graph paper. **BE SNEAKY AND KEEP THIS A SECRET!!!** * 6. Switch pans with the other team. * 7. We will read through the directions together!   \*\**Procedures*:   * Read through procedures with students, and then let students conduct the activity!   \*\**Wrap up*:   * Go over results and discussion slide with students: * Discussion:   + How did you use the results of your pH test to locate the contaminant?   + Did you have enough pH test papers to pinpoint source of contaminants?   + If you were given an unlimited supply of pH papers, would you have been able to?   + In a real situation, would testers have unlimited time and resources?   + In reality, underground storage tanks contain fuel oil or radioactive materials. What problems could arise if these materials leaked into water supplies?   ^^Allow 10 min for intro and 50 min for activity. |
| BREAK | 11:50 | 15 min | BREAK |
| **EVALUATE** | 12:05 | 25 min | Card Sort Activity  \*Students should work in pairs for this activity.    \*\*Pass out “cards” from the card sort activity (H4).  \*Students work together in pair or small groups to complete the “card sort” activity.  In the activity, there are a number of “cards” that describe or are examples of point source and nonpoint source pollution. Students will read cards and work together to sort each card into either “point source” or nonpoint source pollution”  ^^Allow 15 min for sorting  ^^Allow 10 min to go over/discuss responses as a full class. |