| **Water Dawgs Lesson Plan**  **Topic: Nutrient Monitoring**  **Learning Module #8** | | | |
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| **Lesson Objectives(s):** | | * SWBAT define: eutrophication, nitrate, orthophosphate. * SWBAT explain effects of eutrophication on aquatic ecosystems. * SWBAT explain how nutrients enter ecosystems. * SWBAT conduct nutrient monitoring in a campus stream using Adopt-A-Stream protocols. | |
| **Associated NGSS Standard(s):** | | N/A | |
| **Associated A.P. Environmental Science Standard(s):** | | * STB-3-F-Explain the environmental effects of excessive use of fertilizers and detergents on aquatic ecosystems | |
| **Materials:** | | * PowerPoint * Printed materials:   + Lesson worksheets (WS) – 1 copy per student   + USGS Article Reading (H1) – 1 copy per student   + Protocols for Hach Pocket Colorimeter (Nitrate) – p. 1-3 of Handout 2 (H2) – 2 copies per student (one for notebook and one for field)   + Protocols for Hach Pocket Colorimeter (Orthophosphate) – – p. 1-3 of Handout 3 (H3) – 2 copies per student (one for notebook and one for field) * Water quality testing supplies:   + Hach DR300 Pocket Colorimeter, Nitrate   + Hach DR300 Pocket Colorimeter, Orthophosphate   + Nitrate reagent pillow pouches   + Orthophoshate reagent pillow pouches   + Gloves   + Safety glasses   + Sample water for EXPORE activity (stream water or other)   + Deionized water (for cleaning)   + Waste container   + Rite in Rain   + Pencils   + Waterboots   + Backpack | |
| **Instructor to do before lesson** | | * Print:   + Lesson worksheets (WS) – 1 copy per student   + USGS Article Reading (H1) – 1 copy per student   + Protocols for Hach Pocket Colorimeter (Nitrate) – p. 1-3 of Handout 2 (H2) – 2 copies per student (one for notebook and one for field)   + Protocols for Hach Pocket Colorimeter (Orthophosphate) – – p. 1-3 of Handout 3 (H3) – 2 copies per student (one for notebook and one for field) * Look over PPT/Lesson plan * Set up water quality testing supplies:   + Collect water from stream or turtle pond to use for practice during EXPLORE activity.   + We would suggest running through all of the protocols at least once before doing this activity with students. | |
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| **Part of Lesson** | **Time** | **Duration** | **Lesson** |
| **ENGAGE** | 1:00 | 40 min | USGS Article Reading  \*\*Pass out lesson worksheets (WS) and USGS Article Reading (H1) to each student.  \*Students will read USGS article about nutrients and the potential negative effects of eutrophication on aquatic ecosystems and answer associated questions on their lesson worksheets.  Article Questions   * 1. What does eutrophication mean? * 2. List at least two examples of nutrients? * 3. How do excess nutrients typically enter aquatic ecosystems? * 4. What are some problems that eutrophication can cause in aquatic systems? * 5. Would you classify nutrients as point source or nonpoint source pollution? Explain your answer.   ^^Allow 10 min for reading.  ^^Allow 10-20 min for answering questions (**Optional**: you could allow to students to work with partner to answer questions  \*\*Instructor will lead the class in discussion about article and questions. Instructor should be sure to include in discussion why scientists might want to measure nutrients in the field.  ^^Allow 10 min for discussion |
| **EXPLORE** | 1:40 | 55 min | Protocols for Nutrient Monitoring (Hach Colorimeter)  \*\*Explain that today we will be learning how to analyze stream water for nutrients (nitrogen and phosphorus). To do this, we will use a Hach colorimeter.  \*\*Show students the following video, which explains how colorimeters work:  <https://www.youtube.com/watch?v=noUSORH5JWo>  \*\*Pass out Hach Colorimeter protocols for Nitrogen (H2) and phosphorus (H3). Note that you should pass out two copies for each student – one for their notebook, and one for the field (clipboard).  \*\*Go through/pass out/ set up needed materials:   1. Hach Colorimeter for Nitrate and associated supplies (sample cells, powder pillows, cleaning cloth) 2. Protocols for Nitrate 3. Hach Colorimeter for Orthophosphate and associated supplies (sample cells, powder pillow, cleaning cloth) 4. Protocols for Orthophosphate 5. Pencil/Rite-in-Rain 6. Gloves 7. Safety Glasses 8. Sample water 9. Waste Jug 10. Deionized water (for rinsing/cleaning)   \*\*Lead students through nitrate protocols. You can do this by either reading through the protocol together as a group, OR by reading through the protocol together as a group while you demonstrate the steps with a sample.  (See PDF and PPT for exact protocols)  \*As the group works through the protocols, they will also answer a series of questions “why” questions.  -Why do you think the sample cell needs to be pre-rinsed with sample?  -Why do you think a 5 min wait period is required after the contents of the powder pillow are entered into the sample?  -What do you think the purpose of the blank is?  \*\*Split students into two groups. Students will work together to analyze stream water sample for nitrate.  *🡪 NOTE: You can run a blank with the class (or have a student do it) and then have each group run one sample. This will yield a total of two samples.*  \*Have students read through orthophosphate procedures, which are similar to the nitrate procedures. Can they spot the difference?  \*\*Students will now work together to analyze stream water sample for orthophosphate .  *🡪 NOTE: You can run a blank with the class (or have a student do it) and then have each group run one sample. This will yield a total of two samples.*  ^^Allow 55 min for activity |
| **EXPLAIN** | 2:35 | 10 min | Creating a Data Sheet  \*\*Explain that Adopt-A-Stream groups do not typically test for nitrate and phosphorus; thus, there is no data sheet created for measurement of nutrients. (However, you could use some of the empty blanks on the Chemical Data Sheet.)  \*\*Lead students in short discussion why Adopt-A-Stream might not regularly test for nutrients (example: expensive, prone to user error).  \*\*Then, explain to students that sometimes you need to create your own data sheet. Rite in Rains are useful because they are waterproof.  \*\*Lead students through creating their own data sheet for nutrient sampling. Let students help you come up with helpful information to include in the data sheet, such as:  -Stream Name  -Date  -Time  -Samplers name  -Any other notes  -Create spaces for data  \*\*Make sure to mention that creating blank spaces for data helps you to not forget anything!!  ^^Allow 10 min for activity |
| --BREAK | 2:45 | 15 min | BREAK  Instructor should encourage students to use the restroom, get water, etc. before field trip |
| **ELABORATE** | 3:00 | 20 min | Nutrient Monitoring of Campus Stream  \*\* Gather supplies for field trip:   1. Hach Colorimeter for Nitrate and associated supplies (sample cells, powder pillows, cleaning cloth) 2. Protocols for Nitrate 3. Hach Colorimeter for Orthophosphate and associated supplies (sample cells, powder pillow, cleaning cloth) 4. Protocols for Orthophosphate 5. Pencil/Rite-in-Rain 6. Gloves 7. Safety Glasses 8. Waste Jug 9. Deionized water (for rinsing/cleaning) 10. Water boots 11. Backpack   Walk to campus stream from classroom |
| 3:20 | 35 min | \*\*Instructor will go over instructions and safety considerations.  ^^Allow 5 minutes  \*Students will work in small groups to test for nitrate and orthophosphate using the Hach Colorimeter and pocket pillows. This will work best if done as a class (similar to practice in classroom). The instructor or one student can run a blank, and then each group can run one sample, to yield a total of two samples.  \*Both groups should record measurements in data sheet created in Rite-in-Rain.  ^^Allow 30 min for sampling |
| 3:55 | 20 min | BREAK  \*\*Walk back to classroom from campus stream  \*\*Give students time to use the restroom, get water, etc. |
| **EVALUATE** | 4:15 | 15 min | Exit slip  \*\*Have students answer questions on their lesson worksheets (WS).  Question 1: How can excess nutrients enter stream ecosystems?  Question 2: Why can too many nutrients in aquatic ecosystems be a problem?  ^^Allow 10 min. Collect responses and review after the lesson. |