CSI: Cool Science Investigations of Water

Description:

Version A: Oyster Bay Stormwater Module
Students will be provided with a simulated stormwater runoff scenario and must investigate where pollution is coming from along Starfish Creek and into Oyster Bay. Pollutants and parameters of interest include Nutrients, Chlorine, and pH. Students will use a map of sampling sites along with multiple water quality testing tools and deductive reasoning in order to pinpoint the source of pollution and determine potential follow-up actions to solve the issue.

Version B: Sewer Sleuthing Module
Students will be provided with a treatment plant upset scenario and must determine the source of the unknown contaminant. Pollutants and parameters of interest include Nutrients, Chlorine, and pH. Students will use a map of sampling sites along with multiple water quality testing tools and deductive reasoning in order to pinpoint the source of pollution and determine potential follow-up actions to solve the issue.

Essential Questions:

Version A: Oyster Bay Stormwater Module
1. What is stormwater runoff, where does it come from, and why can it be harmful to waterways?
2. What are some ways you can reduce pollution from stormwater runoff?
3. Why is it important to monitor the health of our waterways?

Version B: Sewer Sleuthing Module
1. How can wastewater get "polluted"?
2. Why is it important to monitor water quality at wastewater treatment plants?
3. Who tracks down pollution in the sewer system?

General Supplies:

- Laminated Starfish maps - 3
- 1L sample bottles - 9
- Water – 6L
- "Spiked" water – 3L
    - Lemon juice
    - Bleach
    - Fertilizer
    - Dry leaves, dirt, and/or mulch
- Funnel
- Labels (A, B, C, D, E, F, G, H, & I) – 3 sets

- Field Team 1 (pH sampling) supplies
- Field Team 2 (chlorine sampling) supplies
- Field Team 3 (nutrient sampling) supplies
- Introductory Water Quality power point
- Gloves (2 boxes of XS, S, M, & L)
- Lab coats – 20 (optional)
- Safety goggles – 20 (optional)
- Paper towels – 2 rolls
- Trash Bags
- Specimen Cups – 2 sleeves
- Dry erase markers - 3

Procedure/Instructional Strategies:

1. Instructors will set up three testing stations throughout the classroom: one for Field Team 1, one for Field Team 2, and one for Field Team 3. After presenting and discussing the introductory Water Quality power point and answering the worksheet pre-questions, the class will be separated into three groups and each group will be placed at a different testing station. Each testing station will contain three 1L Starfish Creek/Avenue samples (A, B, and C). Sample B and C will contain plain water while sample A will contain "spiked water."
2. The instructor at each station will direct the students through the specific testing procedures on Starfish Creek/Avenue samples A, B, and C. Sample A will test positive for the analyte or parameter of interest. Students will compare their findings to the laminated Starfish Creek/Avenue map and cross-off the non-polluted sites with a dry erase marker.
3. Each group will move to a new testing station and instructor to complete the next component of their investigation. As the students are moving to their new stations, the instructor will re-label the Starfish Creek/Avenue samples to D, E, and F. Label D will be placed on the "spiked" sample while labels E and F will be placed on the deionized water samples. Students will then be guided through the specific testing procedures on samples D, E, and F; sample D will test positive for the analyte or parameter of interest. Students will compare their findings to the laminated Starfish Creek/Avenue Map and cross-off the non-polluted sites with a dry erase marker.
4. Each group will move to a new testing station and instructor to complete the next component of their investigation. As the students are moving to their new stations, the instructor will re-label the Starfish Creek/Avenue samples to G, H, and I. Label I will be placed on the "spiked" sample while labels G and H will be placed on the deionized water samples. Students will then be guided through the specific testing procedures on samples G, H, and I; sample I will test positive for the analyte or parameter of interest. Students will compare their findings to the laminated Starfish Creek/Avenue map, cross-off the non-polluted sites with a dry erase marker, and determine the pollution is coming from a developed section of stores and parking lots.

5. Instructors and students will discuss potential implications of their findings and what follow-up actions could be taken to solve the pollution problem.

Field Team 1 (pH Sampling)

Supply List:

- Waste container – 1
- Water – 2L
- "Spiked water" – 1L
- 1L sample bottles – 3
- Labels (A, B, C, D, E, F, G, H, & I)
- Specimen cups – 6
- pH strips – 2 boxes
- Plastic pipets – 6
- pH color comparator – 6
- pH meter – 1 (optional)
- YSI – 1 (optional)

Instructions:

Set up for the experiment: Lay down paper towels at the work station. Place specimen cups with pH strips and color comparators at 6 spots around the table. Place the ysi and pH meter in the center of the table to verify pH strips if available. Create "spiked water" by adding ¼ cup lemon juice, 1 drop bleach, 1 tsp of fertilizer, and a handful of dirt/leaves/mulch to an empty 1L bottle. Fill the bottle with water and shake vigorously. Create your "non-polluted" samples by adding dirt/leaves/mulch to the remaining two 1L containers of water.

1. Instruct students to put on their lab coats, safety glasses, and gloves. If applicable, talk about the different methods of measurement being used, their accuracy, and when it might be most appropriate to use each.
2. Place a specimen cup between each pair of students with a small amount of sample volume in each (either A, B, or C; D, E, or F; or G, H, or I depending on where you are in the module).
3. Instruct each student to pipet enough sample onto their pH strip to get an accurate color reading and then have them to compare their strips to their color comparator cards. Ask them which sample appears to be polluted.
4. Optional- Students will now verify their results with the ysis and pH meters. Have each pair take turns using the instruments and recording their results. Discuss why the results from the instruments may be slightly different from those of the pH strips and what that may mean/ be caused by.
5. Once students determine which sample site is polluted have them circle the offending area on the map and mark out the areas that have been "cleared."

Field Team 2 (Chlorine Sampling)

Supply List:

- Waste container – 1
- Water – 2L
- "Spiked water" – 1L
- 1L sample bottles – 3
- Labels (A, B, C, D, E, F, G, H, & I)
- Specimen cups – 6
- Chlorine test strips – 2 boxes
- Colorimeter – 1 (optional)
- Chlorine chemetric – 1 (optional)
- Plastic pipets – 6

Instructions:

Set up for the experiment: Lay down paper towels at the work station. Place specimen cups with chlorine test strips and color comparators at 6 spots around the table. Place the colorimeter and chlorine chemetric in the center of the table to verify chlorine strips if available. Create "spiked water" by adding ¼ cup lemon juice, 1 drop bleach, 1 tsp of fertilizer, and a handful of dirt/leaves/mulch to an empty 1L bottle. Fill the bottle with water and shake vigorously. Create your "non-polluted" samples by adding dirt/leaves/mulch to the remaining two 1L containers of water.

1. Instruct students to put on their lab coats, safety glasses, and gloves. If applicable, talk about the different methods of measurement being used, their accuracy, and when it might be most appropriate to use each.
2. Place a specimen cup between each pair of students with a small amount of sample volume in each (either A, B, or C; D, E, or F; or G, H, or I depending on where you are in the module).
3. Instruct each student to pipet enough sample onto their chlorine test strip to get an accurate color reading and then have them to compare their strips to their color comparator cards. Ask them which sample appears to be polluted.
4. Optional- Students will now verify their results with the colorimeter and chlorine chemetric. Have each pair take turns using the instruments and recording their results. Discuss why the results from the instruments may be slightly different from those of the chlorine test strips and what that may mean/ be caused by.
5. Once students determine which sample site is polluted have them circle the offending area on the map and mark out the areas that have been "cleared."

Field Team 3 (Nutrients Sampling)

Supply List:

- Waste container – 1
- Water – 2L
- "Spiked water" – 1L
- 1L sample bottles – 3
- Labels (A, B, C, D, E, F, G, H, & I)
- Specimen cups – 6
- Ammonia test strips – 2 boxes
- Plastic pipets – 6
- Ammonia chemetric kit (optional)

Instructions:

Set up for the experiment: Lay down paper towels at the work station. Place specimen cups with ammonia test strips and color comparators at 6 spots around the table. Place the ammonia chemetric kit in the center of the table to verify ammonia test strips if available. Create "spiked water" by adding ¼ cup lemon juice, 1 drop bleach, 1 tsp of fertilizer, and a handful of dirt/leaves/mulch to an empty 1L bottle. Fill the bottle with water and shake vigorously. Create your "non-polluted" samples by adding dirt/leaves/mulch to the remaining two 1L containers of water.

6. Instruct students to put on their lab coats, safety glasses, and gloves. If applicable, talk about the different methods of measurement being used, their accuracy, and when it might be most appropriate to use each.
7. Place a specimen cup between each pair of students with a small amount of sample volume in each (either A, B, or C; D, E, or F; or G, H, or I depending on where you are in the module).
8. Instruct each student to pipet enough sample onto their pH strip to get an accurate color reading and then have them to compare their strips to their color comparator cards. Ask them which sample appears to be polluted.
9. Optional- Students will now verify their results with the ammonia chemetric kit. Have each pair take turns using the kit and recording their results. Discuss why the results from the ammonia chemetric kit may be slightly different from those of the test strips and what that may mean/ be caused by.
10. Once students determine which sample site is polluted have them circle the offending area on the map and mark out the areas that have been "cleared."