Shared Waters: Making a positive impact on our local watershed

Authors: Nanette Marcum-Dietrich, Ph.D.[1], William McConnell, Ph.D.[2]

Contributors: Abdul Ibrahim, Ed.D.[1], Bradley Showalter[3], Elizabeth Fulton[1], Katherine Harnish[3]

[1]Millersville University of Pennsylvania, 40 Dilworth Road, Millersville, PA 17551
[2]Virginia Wesleyan University, 5817 Wesleyan Drive, Virginia Beach, VA 23455
[3]Penn Manor School District

Preferred Citation:
Shared Waters. (2023). Shared Waters: Making a Positive Impact on Our Local Watershed. Millersville, PA: Marcum-Dietrich, N., McConnell, W., Ibrahim, A., Showalter, B., Fulton, E., & Harnish, K.

Author's Note:
Nanette Marcum-Dietrich: https://orcid.org/0000-0001-7535-3984
William McConnell: https://orcid.org/0000-0002-7050-2167
Abdulsalami Ibrahim: https://orcid.org/0000-0001-7778-3582
Elizabeth Fulton: https://orcid.org/0000-0002-1474-708X

This work was funded by the National Oceanic and Atmospheric Administration B-WET Grant NA21NMF4570498. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration.

Correspondence concerning this curriculum should be addressed to:
Nanette Marcum-Dietrich, Ph.D., Millersville University, 51 Lyte Road, Millersville, PA 17551, USA. Email: nanette.marcum-dietrich@millersville.edu

Google Drive

Lesson 7: Chemical Analysis of a Natural Body of Water
(1+ days)

Overview:

A common misconception among elementary-aged students is that clear water is always healthy, while murky or cloudy water must be polluted. To address this misconception, conducting water quality tests with your students on a local body of water can be a powerful teaching tool. In this lesson, students will perform a series of chemical tests on water from a local source. You have the option to either take students to a nearby body of water or collect a bucket of water from a local river, stream, or lake and bring it to the classroom for analysis.

Completing this lesson outdoors at a local stream offers students a direct link between their investigation and the natural environment, providing a more comprehensive understanding of the scientific process of chemical analysis. However, if time, distance, or weather conditions make an outdoor field trip impractical, you can visit the stream yourself to collect water samples. (video on how to collect the water) When collecting water for the students, remember to record the temperature of the stream water to share with them. You can use a bucket or a jug to collect the water for all tests except the dissolved oxygen test. For the dissolved oxygen test, you'll need to collect water in a capped bottle, such as an empty Gatorade bottle. Make sure to fill the bottle to overflowing before screwing on the cap to ensure there is no air at the top, as this could adversely affect the data.

The fact sheets provided in this lesson offer a basic understanding of the parameters for each water quality indicator measured in this lesson: Dissolved Oxygen, Phosphates and Nitrates, pH, Turbidity, Water Temperature

Google Drive

Safety: If you can bring students to sample streamside, here are some safety considerations. Visit the location before bringing students to identify spots to safely walk into the water, such as areas that aren't too steep or muddy and can accommodate one adult and one to three students. Also, look for other hazards such as litter, poison ivy, or stinging nettle. Never enter a body of water deeper than below the students' knees, especially in moving water like a stream or river. Do not sample during inclement weather or high water events. Plan to bring extra adults along on the day of the trip to help you monitor students. Students can easily fall into the water, so be sure to sample on warm sunny days or bring changes of clothing.

Chemicals: As with any chemical, some safety measures should be taken to ensure student safety. Safety data sheets for the chemicals used in the lesson can be found in the lesson 7 resource folder.

Dissolved Oxygen, pH, Phosphate, Nitrate

Materials:

Materials provided in the lesson 7 kit:

- **Activity 1:** 2 clear bottles
- **Activity 1:** pH Strips
- **Activity 2:** Student Data Sheet
- **Activity 2:** 6 black, fine tip whiteboard markers
- **Activity 2**: Water Chemistry kits for each test: Dissolved Oxygen, Nitrate, Phosphate, pH, Temperature, Turbidity

Materials you will need to gather:

- Lesson 7 slide show
- **Activity 1**: White vinegar
- **Activity 1:** YouTube Video, "Monitoring the Health of Our Waters"
- **Activity 2**: timer, large class data chart, waste bottles
- **Activity 2**: Safety: If you have access to safety goggles, have students wear them

Learning Objectives:

At the completion of the lesson, students will be able to:

- Accurately measure several chemical indicators of water quality.
- Analyze data gathered from water quality tests.
- Make conclusions based on evidence as to the health of a water body.

Google Drive

Activity 1 (15 min): Scientific Processes Related to Water Quality Testing

To prepare for the activity, fill two similar bottles. Bottles should be clear and have caps or lids. Fill one with white vinegar and the other with drinking water. Display the bottles on a table for students to see. Ask the class *if the water in each bottle would be considered healthy for the environment*. Allow students to discuss their thoughts with a partner. Additional prompts can include, 'What does it mean for water to be healthy,' 'What would healthy water look like?' or 'What words would you use to describe unhealthy water.' Once students have had sufficient time to discuss, ask the class, "What data would you need to answer the question, '*Is the water within the bottles healthy for the environment*?'" Allow students to answer.

Next, have a volunteer come up and uncap and examine each bottle. The student should notice a big difference in smell! Have the volunteer share with the class their observations. Use the pH strips to test the pH of each bottle quickly.

Let students know, "In order to measure the quality or health of the water properly, it is important that we understand the scientific practices related to testing water quality." Ask the class to predict some things that might be important when testing the health of the water. Discuss. Then, play the beginning of the water chemistry video, "Monitoring the health of our waters," for students.

Possible Differentiation Adaptations:

Create a Nearpod for the video and include checks for understanding. Nearpod can provide individual performance statistics, which can help you identify students who had difficulty understanding the video's content.

Activity 2 (40 min): Water Testing

Note: This activity can be done in the classroom or at the stream. If you are doing this activity in the classroom, stream samples should be collected in the morning and stored in capped bottle(s) that were filled to overflowing. Be sure to record the temperature of the water when taking the sample; this data is needed to calculate dissolved oxygen.

Divide students into 5 groups. Provide each group with a laminated data sheet and a whiteboard marker. Set up the room with stations for each test.

- Dissolved Oxygen
- Nitrates
- pH
- Phosphate

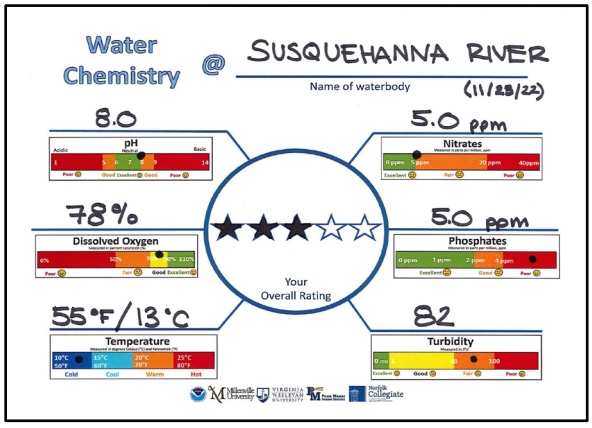
The teacher should practice performing each chemical test

Google Drive

- Turbidity
- *Temperature - must be performed at the stream

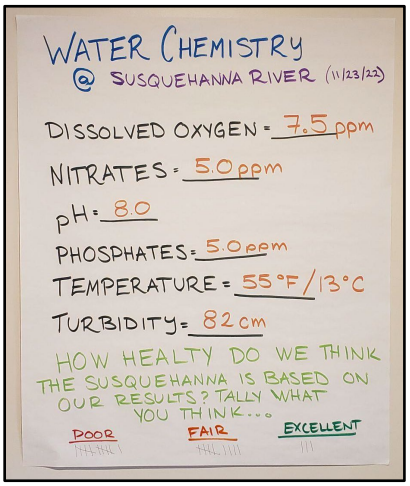
**Include a “waste bottle” with a cap at each station where students dispose of their chemicals when they finish each test. An old Gatorade bottle works well. If sampling streamside, be sure to bring the waste bottle with you. Do not dispose of wastewater outdoors or in the stream; bring it back to school and follow disposal instructions. See page 8 in the instruction manual for disposal instructions.

Have groups rotate through the testing tables to complete as many tests as possible.Students should fill in their data sheets and discuss their findings with their small groups. Time estimates for each test are included below. If students finish early, they should clean up the table and predict what they will find in the next station.



- **Dissolved Oxygen**: 13 minutes
- **Nitrates**: 11 minutes
- **pH**: 5 minutes
- **Phosphate**: 9 minutes
- **Temperature**: 5 minutes
- **Turbidity**: 5 minutes

Bring the class back together and have them record their data on a large data sheet at the front of the class. Groups should use the class data to fill in any data they are missing. Have each group rate the stream's overall health using 5 stars. As a class, discuss what the data reveals about the stream's health.



Possible Extension #1:

Consider doing this activity streamside with your students! If you take the class to the stream, you can also include a physical stream assessment. A physical survey is a great tool that generates a third way to look at stream health.

Possible Extension #2:

Compare water at different points along the stream, such as an upstream or downstream location. Other ideas include getting a jug of water from a stream that flows into the waterbody you’re studying,

Google Drive

the river your stream flows into, the outflow of a lake or reservoir, downstream of a golf course or other major landuse, or downstream from a major city like Harrisburg.

Possible Differentiation Adaptations:

The teacher may feel more comfortable walking through each water quality investigation using a demonstration. For example, the teacher models a step in the investigation, and then the students complete the step, and so on.

See the complete LaMotte instruction booklet for instructions and information in Spanish.

Assessment:

Use the datasheet to evaluate the overall health of the sampled water body. How would you rate your stream's condition? Excellent 👍😊 Good 😊 Fair 😐 Poor ☹

Explain your answer.