

Green Girls Curriculum

Lesson 4: Water Quality In My City

Duration: 2 hrs

Standards:

Next Generation Science Standards: MS-LS:1-5, 2-2, 2-4, 2-5;
MS-ESS: 3-3, 3-4, 3-5; MS-ETS 1-1; MS-PS 1-2

New York State Science Learning Standards: MS-LS:1-5, 2-2, 2-4, 2-5; MS-ESS: 3-3, 3-4, 3-5; MS-ETS 1-1; MS-PS 1-2

Keywords: Pollution, Nitrates, Phosphates, pH, Turbidity, Dissolved Oxygen, Salinity, Watershed, Point source pollution, nonpoint source pollution

Purpose:

- In urban ecosystem Knowledge, students will:
 - Identify the causes and types of water pollution
 - Understand the importance of healthy water quality for marine and human ecosystems
- In analytic skills, students will:
 - Students will be able to sample, test and assess water quality.
- In social emotional skills building, students will:
 - Increase confidence level through group challenges and activities
 - Develop social awareness and gain a deeper understanding of collective responsibility
- In advocacy skills building, students will:
 - Increase positive attitude towards conservation efforts

Essential Questions:

1. What are the different types of water pollution?
2. What are the different factors in our area that affect water quality?
3. Whose responsibility/job is it to care for our waterways and drinking water and other communal resources?
4. What are communication strategies we can use when solving challenging problems together?

Session Routine:

Activity	Time	Description
Opening Circle	15 min.	Agenda + Demonstration
SEL Activity	20 min	Concentric Circle
Activity 1	30 min.	Sum of All Parts Activity/Enviroscape Activity
Activity 2	40 min.	Water Quality Testing
Final Circle	10 min.	Debrief Questions and Discussion

Some things you should know before you start this lesson:

- [Water quality parameters](#)
- [Point source vs. nonpoint source pollution](#)
- [Types of water pollution](#)

Background

Understanding whether water is clean or polluted requires more than just what the naked eye can see and it gives educators an opportunity to dive into some chemistry with students. Water quality testing allows us to determine things like how much oxygen is available for fish, the ubiquity of pH (in our blood, beverages, soil, water and on and on!), whether the quality is within a healthy range for aquatic organisms to live and whether or not there is an issue with runoff near a local water body. In this lesson, we focus on dissolved oxygen (DO), nitrates and temperature. However, if you're aware of issues that may affect other parameters (temperature, turbidity, etc) in your local water body, below is a list that can help you get started:

Dissolved Oxygen is a key measurement of water health as it indicates the amount of oxygen present in the water. All aquatic creatures use oxygen to survive. Unlike humans who use their lungs to process oxygen, marine creatures use their gills to absorb the dissolved oxygen directly into their bloodstream. Optimal levels of DO in the water are between 80-120%. If DO levels are too low in the water that can put fish and marine creatures under stress and even cause death. A water body gains DO from the atmosphere and also through a balanced presence of algae as the algae produces oxygen during photosynthesis. A body of water loses DO for several reasons. Fertilizers and fecal matter encourage excessive algae growth. With too much algae present, algae is constantly decomposing and dying off. The process of

decomposition uses up the dissolved oxygen, not leaving enough for the marine ecosystem.

Nitrates are found in decomposing natural materials. When organic matter decomposes an element called ammonia is produced and the bacteria that decomposes the matter will turn the ammonia into nitrates. Pollutants such as sewage and manure contain high levels of nitrates. If there is too much nitrate in water then rapid growth of algae and other plants occur. Rapid growth like this can change the water significantly, making water murky and increasing the temperature and causing algae growth which ultimately depletes oxygen levels due to decomposition as described above. The natural level of ammonia or nitrate in surface water is typically low.

In each of these experiments, we are using chemistry to test water quality. We will use different solutes (the different testing tablets) and mix them in with a solvent (water) to create a solution. The chemical reaction that occurs in this solution will help us to determine certain chemical measurements of our water sample. For example, how much dissolved oxygen is present in our water sample.

For more information on other water quality parameters, [please use this longer guide.](#)

Assessment

Formative:

Active participation in discussions (can be logged at each session)

[Data sheets](#) (accuracy in process of collecting data)

Exit Ticket (i.e. What is the importance of dissolved oxygen in a water body?)

Summative:

[Data sheets](#) (accuracy in completion)

[Pre- and Post-Survey](#)

Materials: Natural materials for sum of all parts game OR paper, markers, water quality testing kits, test tablets for dissolved oxygen and nitrates, test tubes, water sample from local water body.

Opening Circle:

SHOW Students: 2 clear water bottles. 1 bottle with clear looking water (contains high salt content or white vinegar) and 1 bottle with leaves/pine needles and other

natural materials in it that give it the appearance of “dirty” (possibly tea leaves or hot cocoa mix).

ASK Students: Observe the water, which one would you rather drink? Why?

Teacher takes a sip of the “dirty” water and shows their reaction to students. Teacher also takes a sip of the vinegar or salt water and show’s their reaction. If you have a squirt bottle then you can allow students to taste if they would like (or small cups for samples).

Allow students to have their reactions.

Ask Students: What do you think happened? Was that what you expected? Where do you think these water samples came from? What do you think is in the water?

TELL students: Looks can be deceiving when it comes to water quality. Today we are going to explore different methods on how to find out if a water source is actually safe to human uses.

ASK students: What are some ways water can become polluted? What are the consequences of water pollution? Who is responsible to prevent water pollution?

Activity 1: Concentric Circles¹

Materials:n/a

Location: any safe location where students can sit in a circle

Implementation:

This fun “speed dating” type of activity is adapted from...

- Have the group arrange their chairs so that they are facing each other in two circles, one inside the other. You can have the group count off by 2s (1, 2, 1, 2...). Then have all the 1s form their chairs into an inner circle, facing the 2s who were to their left. Or you can simply say that every other person should move their chair to face the person to their left. If the group includes people from different subgroups (for example, teachers and students), tell one subgroup to form the inner circle, so they will be talking with people from the other subgroup rather than to each other.
- Once the circles have been created, tell the group that they will be having a series of short conversations with a series of partners. They should introduce

themselves to each new partner, and they should share the time so that each person has a chance to speak.

- Give the group a question that each pair is to discuss (prompts below).
- After one or two minutes, call time. Allow less time for younger people and more time for older people but keep the time short enough so that people still have more to say when they need to move on. Tell the inside circle to move one seat to the left so that everyone is facing someone new.
- Remind people to be sure and introduce themselves to their new partners. Then give another question for the new pairs to discuss.

Concentric Circle Questions:

- What is one example of a resource that you share with others? How do you decide who gets it and when?
- Who is responsible for taking care of you/us?
- Who is responsible for taking care of people in our town?
- Who is responsible for taking care of the garbage in our town?
- Who is responsible for taking care of our environment?

Activity 2: Sum of All The Parts² (Adapted from Project WET)

The goal of this game is to have students understand how different towns and cities along a river all affect each other. It is also a fun game to do at the beach or in the forest because you get to build towns out of stones/sticks/seaweed.

Materials: Natural materials from forest or beach OR multiple sheets of paper and markers.

Time: 20 – 30 minutes

Ideal location: Forested area/park with many trees/beach; Split students into groups of 2-3.

Teacher Preparation

Educator creates a “winding river” by drawing out a long squiggly line in the sand/dirt (on the beach or in the forest)/lays down a long rope, or draw one out with markers/chalk to symbolize a river that is flowing through a town on multiple sheets of paper.

Implementation

TELL students: Today, in groups, you are all going to build a few small towns along this river. Make sure to include important town infrastructure such as, gas stations, construction sites, power plants, supermarkets, commercial farms, parks. You can get creative with the town, give it a name, make it what you want!

1. *Give students anywhere from 5-15 minutes to build. Get them excited about the construction, they get very into this part. Come around and observe their work as they build.*
2. *Make sure to indicate that at the end of the town there is an organic farm - give yourself or another educator the job of building the organic farm.*
3. *Have students do a show and tell of their site.*
4. **BREAK THE HARD NEWS.**

TELL students: Thank you so much for sharing your beautiful towns with us. Unfortunately, I have some upsetting news to break. While the towns were very well thought out, there were some engineering issues that led to different types of pollution entering the river.

Go through each down and pick one particular part of the town that would have released a certain type of point source pollution. For example, in Town A, the gas station is releasing chemical pollution into the river; In Town B, farm is releasing organic pollution; Town C- the power plant is releasing thermal pollution, the park is releasing ecological pollution. Describe each of these types of pollution and [why they occur](#).

TELL Students: You now have 10 minutes to build solutions to the water pollution problems your town has caused!

Let students get creative----- they are the environmental engineers of the future!!! E.g. if they are releasing thermal pollution, maybe they can have a holding tank for the water to let it cool before it re-enters the waterway.

REFLECT

ASK students...

- What challenges is this town facing?

- Discuss with students the effects pollution could have on human and plant life. How can people use waterways respectfully?
- Going back to our concentric circles discussion, who is responsible for taking care of the water quality in this river?

Activity 3- Water Quality Testing

ASK students: Why do we test water quality?

This is to know....

- if the water is clean or dirty
- if there are toxic chemicals in the water
- if it is safe to drink the water
- if it is safe to swim at the beach
- if we are harming the ecosystem

TELL students: Today we will be testing for dissolved oxygen and nitrates.

ASK students:

About dissolved oxygen:

- What do you think dissolved oxygen is?
- Do fish need oxygen to survive?
- How do you think fish get the oxygen they need?
- About nitrates:
- Where do you think nitrates might come from?
- What is the problem with having too much nitrate in the water?

See background section and [Water Quality Testing Guide](#) for more information on DO and nitrates

Implementation

TELL students: Today we're going to use special dissolved oxygen/nitrate tablets. They dissolve in the water, making a solution. After shaking the tablet around in the water, it may start to change color. We'll be able to use our guidebook and color charts to figure out what the color change means about the amount of DO in the water.

Facilitation suggestion: Put students in groups of 3 and assign different roles for water quality testing. Assign a peer mentor or intern to each group or to rotate amongst the groups.

Testing roles:

1. Reads testing directions
2. Fills water/inserts tablet
3. Notetaker of color changes/observations
4. All students can shake the test tube.

***Please follow the directions of your particular water testing kit as they all vary in procedure.*

REFLECT

ASK students:

- Based on what we saw today in our results, does this water body have healthy levels of DO and nitrates?
- If you were a fish would you want to live in this water body? Why or why not?

Closing Circle:

Snowball Reflection

ASK students to write out on a piece of paper: What is one thing you learned today about water quality that you didn't know before?

TELL students to crumple up their answers, throw their answers into the middle and have the students pick up different peoples answers and read them aloud.

Community celebration: Shout outs!

Is there someone you would like to give a shoutout to...

- Someone who helped you learn today?
- Someone who you worked with today?
- Someone who made you laugh today?

References:

1. Concentric Circles Activity
<http://www.movingbeyondicebreakers.org/includes/activity.php?video=concentricCircles>
2. Sum of the Parts. http://watershedmatters.lcbp.org/PDFs/Sum_of_Parts.pdf