General StreamWatch Schools Lesson Plan

Overview:

The purpose of this document is to use as a guide for incorporating a stream assessment into a full lesson. This includes how to introduce the water quality parameters, introduce what can affect these parameters, and specific questions that might be helpful to ask students in order to guide the discussion. You do **NOT** have to use this to be part of StreamWatch Schools. It is just to use as a reference or to provide some ideas. Feel free to use as much or as little of this document as you'd like. *Italicized text* indicates a good question you might want to ask to get your students thinking.

NJSLS standards addressed:

K-ESS3-3 Earth and Human Activity

- Runoff activity - demonstrates how pollution can get into the water. We have to pick up litter or else it could all end up in the water!

3-LS4-3 Biological Evolution: Unity and Diversity

- Ties in perfectly to sensitive vs. tolerant macroinvertebrates. Look at your chemical data and see how it relates to the types of macros you observed

5-ESS3-1 Earth and Human Activity

- You can discuss how collecting water quality data can help inspire change by showing the impacts of human activity

MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics

- Monitor My Watershed is great for this one! Compare your data to other schools' data and see how the chemical components have affected the types of macroinvertebrates present.

Before the Stream Assessment:

Objectives:

- Identify the chemical parameters that help us draw conclusions on water quality
  - Analyze what this data means; identify what "good" water quality looks like
- Identify the reasons why these chemical parameters may change
  - Use your judgment, but it may be best for younger students to stick with oxygen, temperature, turbidity, and maybe salinity
- Discuss human impacts on water quality
  - What we can do differently
- Understand the relationship between the chemical parameters and the types of macroinvertebrates that may be found in a habitat
  - Sensitive vs. tolerant macros

Materials:

- pH scale handouts
- Clean and "dirty" water to demonstrate turbidity
- Waterproof paper
- Spray bottle

Start by asking the students some things that we might look at to decide if water quality is good or bad. One of the first answers you'll probably get is "pollution".

How does pollution get into the water? Do you think bodies of water tend to have more pollution than the land? Or less?

Model-Runoff Demonstration

Salts, nitrates, phosphates can all find their way into a stream due to runoff. Runoff can also increase turbidity. This activity is great to help them visualize how this happens (Even if you don't want to get into nitrates and phosphates, this is still GREAT for grades K-2 because it shows how litter can find its way to the water).

- Watershed activity
    - Give each student a piece of waterproof paper (wax paper, parchment paper, etc.)
    - Have the students crumple the paper into a ball
    - Have them open up the crumpled-up ball, but don't flatten it back out all the way
        - The idea here is we still want to see some "mountains" or "valleys" on the paper
    - Go around with a spray bottle and spray each student's paper. They will notice how a lot of the water will pool together on different parts of the paper.
    - *Did all the water stay in the same spot or did it move around and collect? Where did it collect?*
        - Explain that this happens out in nature too. After it rains, the water doesn't stay in the same place. Most of it will flow to one place, like a river or a lake.
            - The area of land where all the surface water flows to the same location is called a watershed
        - As the water moves over the land, it starts to carry things with it. This is one of the ways that pollution can end up in a stream.

Transition to nitrates and phosphates

Explain that not all pollution is easy to see and easy to clean up. Nitrates and phosphates can be considered chemical pollution.

- *Does anyone have any ideas on where these chemicals may come from?*
  - You may choose to give hints like "think of something that a lot of people put on their lawns." The students will land on fertilizers as an answer. This is the main source of nitrates and phosphates that we tend to talk about, but there are other sources, like wastewater, pet waste, etc.
- *As rainwater washes over the grass, it carries the fertilizers with it, and eventually it flows to a body of water.*

Transition to salinity

- *We're going to talk about one more thing that finds its way into the water because of runoff. But this thing does not wash off the grass usually. Instead, it comes from the roads and gets carried into the water. Does anyone have any ideas on what that may be?*
  - Let the students think for a bit, then give them the hint that it's something that we do when it's snowy/icy
- *When that salt gets into a freshwater habitat, do you think that could cause some issues?*

Turbidity

- *So far, we've decided that we want to make sure that our stream water doesn't have a lot of pollution, and we also want to look at how much salt is in the water. What is something else we might want to look at to decide if the water quality is good or bad?*

- Students will often bring up water clarity if the water looks brown and dirty. From there, you can explain that the scientific word for water clarity is turbidity
- Really cloudy, murky water is highly turbid, while clear water is not turbid.
- An increase in turbidity can also usually be attributed to runoff. Stormwater increases erosion, which will increase the amount of suspended particles in the stream

Visual Demonstration (Part 1)

Get three cups of water. One cup should be filled with just clear water. A second should be filled most of the way with water, and then a bit of black coffee. This second cup should still be see-through. The third cup should be filled most of the way with water, and then a bit of coffee with creamer in it. This third cup should be opaque. The idea here is to demonstrate turbidity versus color. The cup with just water and black coffee has a different color than the clear water, but because you can see through it, we would still consider it to have low turbidity. The third cup with water, coffee, and creamer, would be considered highly turbid because it has low clarity.

From there, ask the students which one they would want to drink from. Then ask them which one they think a fish would want to live in.

- *If you were a fish or something else living in the water, why would it be bad if the water is very murky?*
    - Can't see, can't see prey, can't see predators approaching, sediment can get in the gills, etc.
- *Do you think murky water is a bad thing for every animal?*
    - Not every animal. If the animal can put up with the murkiness, it can also help them hide from predators

This is a good time to explain that good water quality for aquatic life is not the same as good water quality for humans to drink. Although most animals *prefer* clear water, they can still survive if the water is a little murky.

Dissolved Oxygen

What else can we look at to decide if water quality is good or bad?

Often, students will only name things that we *don't* want in the water. Ask if anyone can name something that we *do* want in the water? What are some things that animals in the water need? Guide them toward answering with oxygen**.**

Air bubbles are not technically "dissolved," but it can be helpful to mention air bubbles, especially with younger students, since it's something they would be familiar with. It can convey the idea that oxygen and other gases mix with water.

- *How do you think the oxygen gets in the water?*
  - If they don't have an answer you can start with *Well, how does oxygen get in the air?*
  - Oxygen dissolves in the water directly from the atmosphere, or through aquatic plants
- *Do you think we want there to be a lot of oxygen in the water or just a little?*
  - We want lots of oxygen. It helps animals live and grow.
  - For older classes you may choose to mention that too much oxygen *can* be a bad thing, since it can cause gas bubble disease, which starts when gases become supersaturated in water. This is rare, however.
- Depending on grade level, you may choose to talk about eutrophication
- Eutrophication sequence:
  - Excess nutrients (like nitrates and phosphates) enter the water, often due to runoff
  - This promotes the growth of excess algae which can lead to a harmful algal bloom
  - The algae die and gets eaten by microorganisms
  - Microorganism populations increase drastically because the algae provides so much food
  - The microorganisms deplete the oxygen in the water through respiration, making it harder for life to thrive

Visual Demonstration (Part 2)

- Show the cups of water again.
- This time, let's pretend that the turbid cup of water has lots of oxygen in it, but the clear cup of water has very little oxygen.
- *Which one do you think animals would want to live in?*
    - This can be a tough question, especially for younger students, but it can help convey that water quality is more than what we can observe with just our eyes.
- Most animals would survive better in the murky water with lots of oxygen instead of the clear water with little oxygen

If your students are familiar with pH, you can transition right into pH.

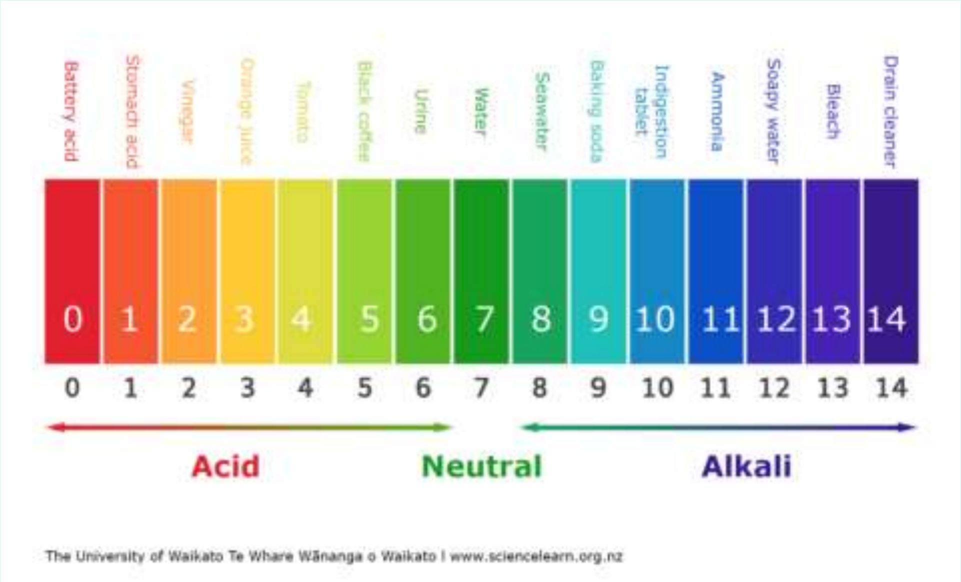
- *How about **pH**? Is that something we should test for, too? What is the pH of water supposed to be?*
    - Pure water has a pH of 7. However, surface water (streams, lakes, the ocean) is not pure water. The rocks and sediment in them usually make surface water slightly basic (between 7 and 8.5)

Groundwaters	5-7
Rivers	6.8-7.8
Fresh lakes	7.3-9.2
Ocean	7.8-8.3
Salt (soda) lakes	up to 10.5

- *If the pH of the water is 3, what might happen to the animals living there?*
    - Most life will die in those conditions

If your students are not familiar with pH, but you want to introduce them to the concept:

- *pH is a measure of how acidic something is (introduce a pH scale).*



- If the pH is really low, that means it's a really strong acid. *Tell me anything you know about acid.*
    - Someone will probably answer that acid can burn you
- *If the water is really acidic, do you think animals would be able to survive in that?*
- *So we don't want the water to be acidic. That means we don't want the pH to be close to 0. Do you think we want it to be all the way up to a 14?*
    - Some students will probably say yes, some may say no. Explain that when pH is really high, it's the opposite of a strong acid, it's something called a strong base. To give a real-world example, you can say that many household cleaning products are bases, such as bleach. We use them for cleaning, but they can really hurt us if we use them too much or if we get them in our eyes by accident.
- From there, you can explain that the pH of the water should be pretty close to the middle. This way the animals won't get hurt living in the water.
- You may choose to discuss acid rain
    - The fumes that we put in the air with our vehicles and factories cause rain to be more acidic than it normally would be

Macroinvertebrates:

Discussion on sensitive vs. tolerant macroinvertebrates can happen before or during the actual stream assessment. Just make sure to explain that sensitive macroinvertebrates can be a great indicator of good water quality.

Sometimes with younger students, it can help to tell a story. Here's one that I've used:

I love to keep my bedroom super clean. I don't want there to be any dust or any mess at all. In fact, I won't even sleep in my room if it's too messy. Last week I came home one night, and I saw that my brother had completely messed up my room. There was trash everywhere, there was food rotting, and I was disgusted. So I decided I didn't want to sleep in my room until my brother cleaned it back up. I slept in a different room that night. But the fly that was in our house came into my room and it smelled all that food on the floor and saw all the mess and decided that my room was a good place to stay for a while. The next day, my brother thankfully cleaned up all the mess and so I went back into my room. I was thinking that because all the mess was gone that the fly would stay away, but I was wrong. The fly didn't care if my room was messy or not. The fly was still happy to spend time in my room even when it was super clean. It was frustrating, but I was happy that at least my room was clean now.

- *In this story, can you tell me who was more sensitive, me or the fly?*
    - I was more sensitive, since the fly didn't care if my room was clean or not. Explain that if I'm more *sensitive*, then the fly was more *tolerant.*
- Macroinvertebrates are the same way. Some of them are like me and need the water to be super clean and high quality or else they'll choose to go somewhere else. So, when we find those macros, we know the water quality is probably pretty good. Other macroinvertebrates are like the fly and they don't really care either way. Those macros are considered tolerant.

After the Stream Assessment

Make sure the students have uploaded the data to Monitor My Watershed. You can do this independently, or you can fill it out with your students by having them read the data off their data sheets as you're filling it out on the website.

Potential discussion questions:

- *Does the water quality look good or bad and why?*
- *Would any of the data we've collected indicate poor water quality?*
    - *What would "good" data look like for those parameters? Why?*
- *What are some things we can do as a community to make the water quality better?*
    - Pick up litter, pick up after our pets, only salt our roads when we really need to (or find other alternatives), use less or different kinds of fertilizers
- *Does the quality of our stream affect the quality of other streams on the map? Why?*
    - Yes! All waterways are connected in one way or another. Pollution from upstream sources will find its way downstream.
- *Does the quality of other streams on the map affect the quality of our stream? Why?*
- *What are some ways that we can reduce stormwater runoff?*
    - Native plants are a great solution to this as they will reduce erosion and drink up a lot of the water. This means fewer pollutants will make their way to the stream. With older students, you can talk about pervious vs. impervious surfaces. Impervious surfaces like roads do not allow water to infiltrate into the ground, meaning more runoff that will carry pollutants.