# Alaska Water Quality

*Alaska FFA Association and USDA Northwest Climate Hub*

*Grade Levels 6-12*

## DESCRIPTION

Students will investigate and determine water quality in Alaska by using biological and chemical tests (pH, dissolved oxygen, turbidity, and water temperature). Students will learn about the effects of changing water quality in Alaska.

## OBJECTIVES

1. Use and build scientific observation skills to make predictions about the health of a local body of water.
2. Test a local body of water to determine temperature, pH, turbidity, and dissolved oxygen content.
3. Consider how climate change could affect water quality in Alaska.

## MATERIALS NEEDED

1. Computer for watching preparatory videos and PowerPoint (1 per classroom)
2. Water Quality Testing PowerPoint

3. Water Quality Testing handout
4. Stream Discovery Training Series on water quality testing (optional introduction for activity and/or a teacher's guide)
5. Gloves
6. Safety glasses (sunglasses suffice)
7. Water Monitoring Test Kit (classroom kit provides five individual kits)

## BACKGROUND—Start PowerPoint.

**Slide 1: Opening**

1. How many of you woke up this morning and took a shower or drank some water? How many of you saw a body of water on your way here (stream, river, inlet, pond, lake)? Have you ever considered where that water comes from?
    a. Allow time for students to respond. Consider sharing where your area's tap water comes from to share with students.
2. How many of you have been to a local body of water and really looked at it? Have you seen fish in a stream? What about insects or plants in a pond? Water has many different characteristics and many different creatures living in it.
    a. What have you seen that might indicate a healthy or unhealthy body of water? For example, lots of fish = healthy; lots of trash in the water = unhealthy.
3. Many different species benefit from healthy water, including humans and animals that drink the water.
    a. Name the many uses for streams and rivers. For example, transportation, recreation (boating, canoeing, swimming), fishing, drinking water supply, crop irrigation, stock/animal water supply, education, and scientific studies.

**Slide 2: What is water quality?**

- Allow students to answer in their own words before defining.
- Much about water quality can be determined by asking these few questions while you look at a waterway. Does it look like you could drink it? Could fish and other aquatic organisms live in it? Does it look and smell healthy? Does it look like it's doing harm to the environment?
- A healthy waterway is one that supports a rich and varied community of organisms and does not harm humans or animals. The water quality of a body of water influences the way communities use the water for activities such as drinking, transportation, recreation, and agricultural purposes.

**What are some indicators of water quality?**

- Water quality can be evaluated by how many and how varied the living organisms in a stream are, and by the nutrient value of a stream. While observing a body of water is important for determining its water quality, testing the water for its nutrient and chemical levels (things you cannot see) is one way to determine water quality.

**What can affect water quality?**

- Irrigation and diversions reduce river flow and can alter the quality of the water if too much water is diverted.
- Pollution from organic wastes (fertilizers, human wastewater, etc.), industrial waste, and military waste can have a negative impact on the water quality of a body of water.
- Use local examples.

**Slide 3: Climate Change and Water Quality in Alaska**

- Many climate change models predict more extreme weather events in Alaska. Some models predict that Alaska will receive more rainfall in the future, but this will likely mean fewer, larger rainfall events with longer periods without rainfall in between.
    - In Alaska, researchers predict increasing temperatures, more extreme precipitation events, loss of permafrost and sea ice, more wildfires, melting of glaciers, and coastal and riverine erosion. All these issues will degrade soil quality and cause erosion into waterways, which will affect water quality by releasing more nutrients and sediments into streams.
    - **Permafrost Thaw**—the slow release of nutrients from thawing permafrost affects water quality, as additional nutrients can increase algal growth on sediments, influence stream insects, and fish size. Also, as land sinks or caves , it could damage wastewater containment sites and cause leakage into bodies of water.
    - **Increased wildfire** could increase erosion and contaminate waterways.
    - **Coastal and Riverine Erosion**—with decreased sea ice coverage, some coastlines in Alaska erode as much as 59 feet per year. Rivers are experiencing flooding and erosion, causing damage to infrastructure and waterways.
    - **Increased Glacial Melting**—the melting of glaciers is expected to increase in coming decades. Streams could become more turbid, and water temperature could increase, affecting cold-water fish like salmon.

**Slide 4: Monitoring Water Quality: Why is it important?**

Monitoring water quality is one way we can determine how climate change might be affecting our waterways.

- Water quality monitoring provides information on whether our waterways are safe to drink from, travel in, use to irrigate our crops, and safe and healthy for fish and other aquatic species like zooplankton and insects.
- There are many ways to monitor water quality. Fixed stations, where water quality is regularly measured, are used to determine how a body of water changes over time. Temporary stations are used to determine the qualities of a body of water, or to seasonally monitor water quality.
- Today, we are going to establish a temporary station. Though there are many different elements of water that can be tested and monitored, we will be utilizing the most common water quality tests. These are the tests that scientists use every time they monitor water quality.

**Today, we will test how water temperature, turbidity, dissolved oxygen, and pH play into waterway health.**

## Testing Water Quality

**Slide 5: Water Temperature**

We will begin our outdoor activity by taking water temperature. **Why is water temperature important?**

- Give students a couple minutes to consider and share their thoughts.
- Water temperature affects growth rates, productivity, and life cycles of organisms. Temperature affects the amount of oxygen in the stream because the ability of oxygen to be dissolved in water decreases as temperatures increase.
- Water temperature determines what kind of organisms can live in waterways. Because there is usually more oxygen in cold water, many Alaskan aquatic organisms breathe and survive in cold water more efficiently. Salmon, a critical fish in Alaskan waterways, need cold, clean, and oxygenated water to survive.
- As air temperatures continue to rise in Alaska, the temperature of waterways could also rise.
- In Alaska, rising temperatures cause the melting of glaciers to quicken. **How might that affect streams that come from glaciers?**

**Slide 6: Dissolved Oxygen**

Our second test will be **Dissolved Oxygen (DO)**. Dissolved oxygen is the measure of how much oxygen is dissolved in water and available to aquatic organisms.

- Quick moving water usually has more dissolved oxygen. Think of a quick-moving stream:

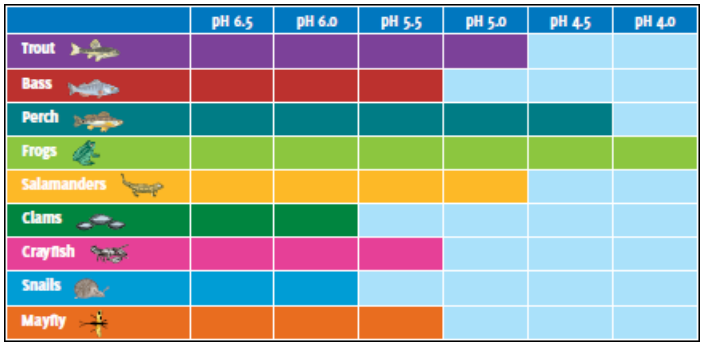
you can usually see the white bubbles of oxygen floating throughout it. (see lower picture for reference). Slow moving water usually has less dissolved oxygen and more plant matter (see upper picture for reference).

- Temperature is inversely related to dissolved oxygen. When temperatures are cold, there is more dissolved oxygen. When water temperatures are warm, there is less dissolved oxygen.
- **As a living organism, would you rather live in a cool, clean creek with lots of oxygen, or in a slow-moving warm pond with very little oxygen?**
- As the climate continues to warm in Alaska, and pollution increases from soil erosion, and agricultural and industrial pollutants, water could begin to contain less dissolved oxygen. It is important to monitor streams to ensure that dissolved oxygen levels stay at a livable level for Alaskan fish and aquatic species.

**Slide 7: pH**

**pH is our third test** and is the measure of how acidic or basic water is.

- The pH scale ranges from 0 to 14, with 7 being neutral, less than 7 being acidic, and greater than 7 being basic.
- If the pH of water is too high or low, the organisms living within it will die. Most organisms prefer a pH of 6.5-9, though some can live outside that range.
- Changing pH can be an indicator of pollution. Low pH (acid) can be caused by toxic drainage from mines. High pH (basic) can be caused by industrial waste and agricultural runoff.
- Note the pH organism tolerance chart. Guide students through organism pH preference. Explain that outside these pH boundaries, these organisms will die.




**Slide 8: Turbidity**

**Turbidity** is our fourth and final test. It is the measure of the clarity of water. High turbidity water is difficult to see through, like the top picture. Low turbidity water is clear, like the bottom picture.

- What makes water turbid? Water becomes turbid from several sources. In Alaska, high

turbidity water usually comes from glaciers (see photo in PPT), which scrape the ground and cause sediment from soil and rock to enter the water way. In many places in Alaska, water becomes turbid because it comes from glaciers and collects sediment as it moves. Water can also become turbid from sources like agricultural runoff, soil erosion, and industrial pollution. Increased nutrient runoff from thawing permafrost can also increase water turbidity.

- It is important to monitor turbidity because it can help to determine how a stream changes over time. Since many Alaskan species need clean, clear water to survive, monitoring turbidity helps to ensure that waterways maintain water quality and can support life.

## PREPARE for OUTDOOR ACTIVITY

*Steps to take before beginning activity*

1. Watch the Stream Discovery Training Series on water quality testing.
2. When out in the field, have students put on safety glasses and gloves prior to beginning activity.

## ACTIVITY

*Testing for water temperature, dissolved oxygen, pH, and turbidity.*

1. Begin the activity by breaking students into groups of three or four.
2. **Observe the water source** with your group.
    a. Have students observe the stream and answer the questions in the presentation: Could I drink this water? Could fish and other aquatic organisms live in this water? Does it look and smell healthy? Does it look like it's doing harm to the environment?
    b. Have students take note of turbidity, color, smell, and any plants or debris floating or growing in the water. This is important for developing skills of scientific observation.
    c. Have students make simple predictions about levels of temperature, dissolved oxygen, pH, and turbidity.
3. **Take water temperature**:
    a. Using the sample container (with lid on so it doesn't sink to the bottom if mishandled) to the water source, submerge the container at least 5 inches. Hold under water for one minute (gloves can help with cold temperatures).
    b. After one minute, remove the container and read the temperature strip on the side of the container. Record temperature.

    c. Alternatively, a plain alcohol thermometer can be used to take temperature, see this video for an example of taking water temperature with an alcohol thermometer.
4. **Collect a water sample**: taking the container (with lid off), collect a water sample from your water source. Be sure to aim the opening upstream. Hold underwater for 30 seconds to ensure you've received a good sample, and fill to the top of the container.
5. **Test for dissolved oxygen**: Complete the dissolved oxygen (DO) test next, as it takes the longest to return results.
    a. Fill the dissolved oxygen test tube provided in the kit all the way to the top with water from your sample.
    b. Add **two** dissolved oxygen test tabs to the tube (it's okay if a little water spills out). Cap and then toggle and invert until they dissolve. This process can take a while (at least four minutes), so it may be beneficial to assign one student per group to invert while the group moves to testing pH. Results will be read later.
    c. See this video for an example of dissolved oxygen testing.
6. **Test for pH:**
    a. Fill the long pH test tube to the 10-ml line with water from your sample.
    b. Add one pH test tab.
    c. Cap and invert until the test tab dissolves. Again, one student can continue to invert the test tube while others move on to turbidity screening. Results will be read later.
    d. See this video for an example of pH testing.
7. **Screen for Turbidity:** After filling your container, read the turbidity symbol at the bottom of your container and compare it to your indicator card to determine turbidity level of your water source.
    a. Have students write results on worksheet.
    b. See this video for an example of turbidity testing.
8. **Compare Results to Indicator card:** It won't be perfect, you're in the field, but check for the number that corresponds with each of your tests. Write it down on your worksheet.
9. **Answer Review Question—**in small groups, answer review questions on worksheets.
10. **Reflect Together.** How do your results compare?