Be a Fisheries Biologist

How do biologists detect changes in an environment when there are too many things to count?

MATERIALS:

- Laminated copies of fish photo sets for Sites 1 – 5 (enough for each student to receive one of the five sites)
- Prepared water samples for Sites 1 – 5 (enough for each student to receive one of the five sites):
  - Sample vials
  - Water sample labels (see Printable Resources)
  - Sodium carbonate (soda ash)
  - 1L bottle
  - Warm water
  - Tablespoon measure
  - Dropper
- Universal indicator paper test strips (one strip per student)
- Student lab notebooks
- Pencils
- Skill sticker sheets
- Fisheries Biologist career card
- Research Lab sign (see Printable Resources)
- Whiteboard or chart paper and marker
- (Optional) "Be a Fisheries Biologist" introductory video

Prepare

Prepare the following **before the start of the session**, so that students do not see which substances are added to which container:

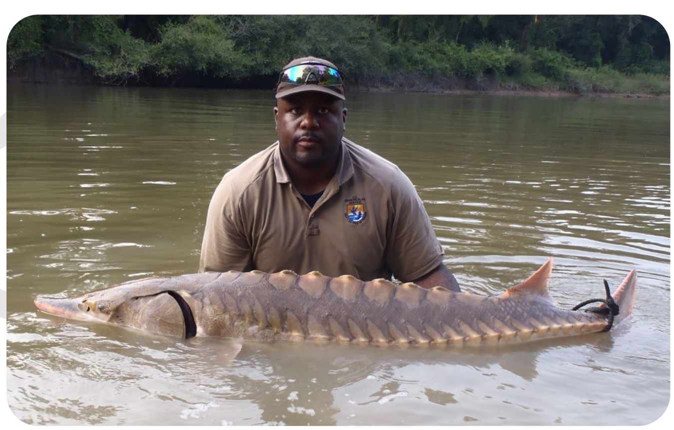
1. Laminate copies of the five sample site photo sets. Once prepared these can be used for multiple sessions.
2. Make a stock solution of sodium carbonate by adding one tablespoon of sodium carbonate to the 1L bottle and filling the bottle with warm water. Swirl or stir until the sodium carbonate is fully dissolved. Label the bottle "sodium carbonate solution" and use it to prepare and refill the water sample vials as needed.
3. Make the water samples for each site:
   - Label the vials with the water sample labels.
   - For all **Site 1** vials, fill with plain tap water.
   - For all **Site 2 and 4** vials, fill with the sodium carbonate solution.
   - For all **Site 3 and 5** vials, fill mostly full with tap water. Use the dropper to add 5–7 drops of the sodium carbonate solution to each vial and stir or shake gently to mix.
   - Water samples can be reused for multiple sessions unless they are spilled or contaminated.
4. Hang the Research Lab sign in a visible location.

Safety note: Sodium carbonate can be irritating to eyes or skin. Use caution when preparing the stock solution and rinse any affected areas thoroughly with water. The finished samples used by the students are diluted enough that they are unlikely to cause irritation, but for safety students should wash their hands if they have touched the water in the samples.

Engage

Note: You could also use the "Be a Fisheries Biologist" video to introduce the activity.

1. Introduce the fisheries biologist career by showing the group the career card and asking questions to encourage students to think about what a fisheries biologist might do:
   - *What do you notice about this picture? What do you think this person is doing?*
   - *Have you heard words like "fisheries" or "biologist" before? What do you think a fisheries biologist might do or study?*
2. Explain that a fishery is a place in a river, lake, or ocean where people raise fish, usually for food. A fisheries biologist makes sure that the fish have everything they need to be safe and healthy as they are growing.
3. Introduce the storyline of the activity like this:
   - We are a team of biologists working for a fishery on a river.
   - There's been a fire at an old, empty factory near the river, and some of the chemicals stored in the factory have leaked into the river.
   - Our job is to find out what effect these chemicals might have on our fish and the other fish in the river.
4. Ask the group for ideas about how they could find out if the chemical in the water is harming the fish.
   - *How could we tell if the fish are harmed? What evidence would we look for?*
   - *How could we tell if the chemicals are causing the problem?*
5. Point out that there are a lot of fish in the river—too many to check or count them all. Ask the group to brainstorm ideas for how to solve this problem:
   - *How could we check for effects on the fish without counting every fish?*
6. Introduce the idea of **sampling**—testing small parts of a large group to learn about the whole group. Explain that your fishery has five testing stations that can be put in different places in the river. These stations give you two kinds of information:
   - Photos of all the fish that swim past it
   - Samples of the water at that spot
7. Explain that your team can test the water samples to see how much of the chemicals are in the water, count the fish that are in the photos, and see if there is a connection between them.
8. Ask the group to brainstorm where in the river they might want to sample from. You may want to use the whiteboard or chart paper to draw an approximate map of the riverbank and factory site (based on the map in the lab notebook) to help them picture the location.



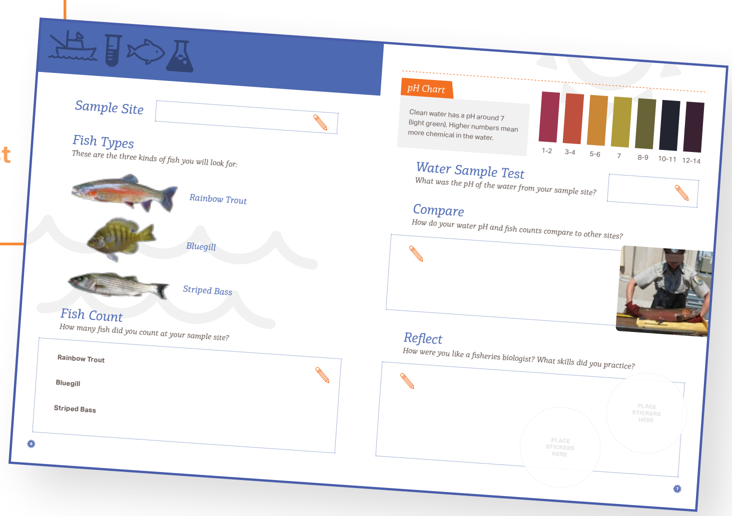
Explore

1. Ask students to look at the map on p. 5 of their lab notebooks and notice where the five testing stations are located. How do the locations compare to students' suggestions? **Encourage scientific thinking** by inviting them to make predictions:
   - *Do you think all the sites will have the same amount of chemicals in the water? If not, which ones do you think will have the most?*
   - *What differences do you think we will see in how many fish are at each site?*
2. Ask students to look at the Fish Identification Chart on p. 6 of their notebooks. Explain that these are the three types of fish your group is interested in studying. **Encourage scientific thinking** by inviting them to observe and share features that will help them tell the kinds of fish apart.
3. Distribute a fish photo set to each student or pair of students. (Some students will have Site 1, some will have Site 2, and so on.) Encourage students to use the photos to count how many of each of the three types of fish were found at their sample site. Point out that if a photo has more than one fish in it, they should count all the fish they see. Remind them to record their results in their lab notebook.

For younger students, you can simplify the activity by focusing on the rainbow trout, rather than all three fish types.

4. Explain that you will be testing the water samples using paper test strips that change color to show how much of the chemical is in the water. Demonstrate how to use the test strips:
   - Hold one end of the test strip and dip the other end in the sample water
   - Remove the strip quickly from the water and wait a few seconds until it stops changing color
   - Compare the color on the test strip to the chart on p. 7 of their notebooks
   - Normal, healthy water has a pH number around 7 (light green). The higher the pH number of a sample, the more of the spilled chemicals are in the water.
5. Invite students to test their water samples and record their results in their lab notebook.
6. Gather students in groups based on the test site they researched (all students who had Site 1 together, and so on). **Cultivate rich dialogue** by asking them to share and discuss their results with each other.
   - *Did you all have similar results? If not, what might explain the differences?*
   - *What do you think your results tell you about the chemicals and the fish at your site?*

Instead of working individually, students could work in pairs or small groups to analyze their site's data. Groups could also analyze and compare multiple sites, rather than just one.



Reflect

1. Gather the group for a "research team meeting." Invite students from each test site to share the pH number (or color) of their water sample and the numbers of each kind of fish. Write each group's results on a whiteboard or chart paper.
2. **Ask questions** to help the group look for patterns in the results:
   - *Which site(s) had the highest amount of chemicals? Which had the lowest? How does that compare to what you predicted at the beginning?*
   - *Which sites had the most or least of each kind of fish?*
   - *Do you see any connections between the amount of chemicals in the water and the number of fish?*
   - *Were there any sites that had similar results? Which ones? What do you think that tells us?*
3. Invite the group to decide what conclusions to report to your fishery about the effect of the chemical on these fish:
   - *What effect do we think the chemical is having on the fish?*
   - *Is it affecting all of them, or just some? How can we tell?*
   - *What do you predict we would find at a sampling site further upstream? Further downstream?*
   - *Is there other information we'd like, or other tests we should do to find out more?*

For older students, encourage the group to think critically about the connection between the chemical level and the fish populations:

- **Do we know for sure that the chemical is harming the fish? What other factors could change the number of fish at each site?**
- **What other tests could we do to find out if the chemical is affecting the fish?**

4. Encourage the group to reflect on how they were like biologists during the activity. You may want to show the fisheries biologist career card again, or refer to the science skills stickers in their notebooks:
   - *What are some of the things we did today as fisheries biologists?*
   - *How did we think like scientists? What science skills did we use?*
   - *What did you do today that made you feel like a scientist?*
5. Allow time for students to draw or write their reflections in their lab notebooks. Invite them to choose two science skills stickers that reflect skills they used and add them to their notebooks.

Extend

- Encourage students to create graphs or other visual representation of your research team's results. Look up examples of different types of graphs (bar graph, line graph, etc.) and discuss how best to picture the connections you found.

Background

- Biologists use **sampling** to study systems or groups of living things that are too large or complicated to study as a whole. This usually involves counting or testing multiple smaller samples and using the results to make estimates about the whole group.
- The field of fisheries deals with managing how people catch fish (and other aquatic animals) and how humans interact with the environments that contain fish. This includes wild populations found in rivers, lakes, and oceans, or places like commercial fisheries and fish farms.
- Environmental agencies monitor the water quality in waterways and limit what kinds of waste can be released into them to make sure it doesn't hurt the environment or people's health. A spill or illegal dump can affect rivers and oceans miles away from the source.
- The pH level of water is a measure of how acidic it is. Plain water has a pH around 7; when chemicals are added to water, either from natural processes or human activity, they can make water more acidic (pH 1– 6) or more alkaline (pH 8 –14).
- The pH of water can affect the animals and plants that live in it. Most freshwater (lake or river) fish can survive in water with a range of pH between 6 and 9, but some fish are more sensitive to pH and are damaged when the pH is above 8.
- In this activity, the pH levels of the samples are exaggerated to make them easier for students to tell apart. In real life, water with a pH as high as 10 or 11 would kill most of the animals living in it.
- Not all harmful chemicals change the pH of water; many are pH neutral. Chemists and biologists develop many kinds of tests to identify specific chemicals in the water.

Fisheries Biologist Quick Guide

ACTIVITY SECTION	DO	ASK
Engage	Use poster to discuss career	*What do you think this person is doing?* *Have you heard words like "fisheries" or "biologist" before?*
	Introduce story: • Working for a fishery • Find out if a factory's chemical spill is harming fish	*How could we find out if the chemical is harming the fish?* *How can we estimate how many fish there are in different parts of the river?*
Explore	Make predictions based on test site map	*Which site(s) do you think will have the highest chemical level? How will it affect the numbers of fish?*
	Identify & count fish in photos from test sites	*What differences did you see at your site between the three types of fish?*
	Test pH of water samples from test sites	*How are your results the same or different from each other?*
	Small groups discuss results for each site	*What do your tests tell you about the chemicals and the fish at your site?*
Reflect	Share group results & look for patterns	*Which sites had the most or least chemical in the water? Which sites had the most or least fish?* *How could we get an even more accurate estimate?*
	Report conclusions to fishery	*What effect do we think the chemical is having on the fish? What other information do we want or need?*
	Reflect on career connections	*How were we like fisheries biologists today?*
	Use stickers & notebook to draw/write reflections	*What science skills did you use?*

Water Sample Labels

Water Sample Site #1	Water Sample Site #1	Water Sample Site #1	Water Sample Site #1
Water Sample Site #2	Water Sample Site #2	Water Sample Site #2	Water Sample Site #2
Water Sample Site #3	Water Sample Site #3	Water Sample Site #3	Water Sample Site #3
Water Sample Site #4	Water Sample Site #4	Water Sample Site #4	Water Sample Site #4
Water Sample Site #5	Water Sample Site #5	Water Sample Site #5	Water Sample Site #5