

Salty Streams & Mighty Macroinvertebrates: Observing the Impacts of Salt Pollution on Freshwater Streams

Suitable for GRADES: 5, 6-8



BACKGROUND

Salt pollution in freshwater streams occurs when these streams have higher levels of salt than usual. This often happens because of things like fertilizers used in farming or the salt spread on roads used to melt ice after a winter storm. When the amount of salt in the water fluctuates, it can mess up the balance of the ecosystem, and some species that can't handle too much salt might start to disappear.

To find out how much salt is in different bodies of water, students will use a special tool called the GaiaXus device. They will also figure out which species of tiny water creatures called macroinvertebrates can handle different levels of salt. They can do this by using a field guide or a smartphone app like *iNaturalist*.

Through this lab, students will discover how too much salt in the water can harm the environment. They'll also brainstorm ideas on how to reduce the problems caused by salt pollution.

This lab has 5 stations. Ideally, each station should contain 4-5 students. Most of the stations will be student-led, while the GaiaXus app prompts students with directions and questions. 1 station will be led by the classroom teacher, and 1 station will be led by an

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expert. The expert should be knowledgeable of macroinvertebrates as indicator species in freshwater streams.

This lab was designed to be performed in the classroom setting, but it can also be done near a local stream. Be sure to follow safety guidelines when performing this lab near bodies of water.

LEARNING OUTCOMES

Students will be able to:

- Evaluate mathematical data regarding water quality data.
- Identify organisms based on physical traits using a field guide.
- Create and defend a claim based on evidence that organisms can only live in certain parameters.
- Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

LOCATION

This lab is designed for indoor learning but can also be performed outdoors with safe access to a creek or river.

MATERIALS

- 3 GaiaXus sensors
- 3 Tablets running the GaiaXus Mobile App
- SaltWatch Stations Lab on the GaiaXus Tablet
- 1 Sheet of graphing paper per student
- 1 Laboratory notebook per student
- Pencils
- Printed and laminated macroinvertebrate information cards
- Macroinvertebrates collected from a local stream
- 5 Sheets of printer paper (optional)
- 6 5-gallon buckets filled with enough water to submerge the GaiaXus sensor
 - Ocean (35 ppt)
 - River (0 ppt)
 - River (5 ppt)
 - River (5 ppt)
 - River (10 ppt)
 - River (15 ppt)

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SAFETY

- Always wash hands before and after handling live specimens.
- If you choose to perform this lab in the field, always be aware of your surroundings, never traverse alone, and wear the proper personal protective equipment.

Station Set-Up

Station 1	Station 2	Station 3	Station 4	Station 5
Salinity Station	Macroinvertebrate Station	Tolerance Station	Conservation Station	Interactions Station

PROCEDURE

- Connect each GaiaXus Sensor to its corresponding tablet and select "SaltWatch Stations Lab".
- The tablets should be separated and spread around the room in such a way as to allow for easy flow of student traffic as they transition between stations.
- The teacher should obtain the materials and place them at their proper location.

STATION 1: Salinity Station

Materials needed:

- o 1 GaiaXus Sensor
- o 1 Tablet
- o 2 buckets of water
 - Ocean (35 ppt)
 - River (0 ppt)

Procedure

1. This is a student-led station.
2. Students will collect salinity data from the ocean and river samples using the GaiaXus device.
3. The GaiaXus App will prompt students to compare their results to a typical salinity measurement from a stream near them during the same season. The teacher will provide this information.
 - a. The GaiaXus Tablet will ask students why different bodies of water have different salinities.
 - i. The average salinity of ocean water is 35ppt, and the average salinity of a river is between 0 and 0.5ppt. Think about the different organisms that live in the ocean versus rivers. Do you think a hammerhead shark could survive in a river? Why or why not?
 - ii. What are some environmental and human factors that might affect salinity levels? How do you think this would impact aquatic ecosystems?

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- b. If students finish this station early, they may opt to complete a 'Challenge'.
 - i. The GaiaXus App will prompt students to make a list of as many aquatic organisms as they can think of. They will then identify which organisms from their list would live in the saltwater and which would live in freshwater.

STATION 2: Macroinvertebrate Station

Materials needed:

- o 1 GaiaXus Sensor
- o 1 Tablet
- o 1 bucket of water
 - River (5 ppt)

Procedure:

1. This station should be led by an 'expert'. The expert should have a thorough understanding of macroinvertebrates (biologist, environmental scientist, etc.) and their interactions within ecosystems.
2. The expert will prompt students to observe macroinvertebrates found in a local stream.
3. The expert will help students use a field guide or an app like, *iNaturalist*, to identify the macroinvertebrates.
 - a. Students will note the range of salinity that each type of macroinvertebrate thrives in.
4. Students will collect salinity data from the river sample.
5. The expert will discuss with students how different organisms can only live in certain conditions. Possible discussion questions are:
 - a. You have just identified several macroinvertebrates and learned about the varying levels of salinity each of them can tolerate. Which macroinvertebrates would thrive in this water we just tested? Which would not do well?
 - b. If we did not have a sensor, how could we use macroinvertebrates to determine the relative salinity of a body of water?

STATION 3: Tolerance Station

Materials needed:

- o 1 GaiaXus Sensor
- o 1 Tablet
- o 3 buckets of water:
 - River (5 ppt)
 - River (10 ppt)
 - River (15 ppt)

Procedure:

1. The classroom teacher will lead this station.
2. Distribute the laminated macroinvertebrate cards randomly to each student. Each student should have 1.
3. Students will collect salinity data from each 'river' sample (5, 10, and 15 ppt).

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4. Students should record their results for each water sample in their lab notebook.
5. The teacher will instruct students to place their macroinvertebrates by the water sample that they would best thrive in.
 - a. If students place the macroinvertebrate in the wrong water sample, the teacher may use it as an opportunity to discuss how different organisms tolerate different environments.
 - b. The teacher may choose to discuss indicator species and how they help scientists determine the health of streams.
6. The GaiaXus App will prompt students to write down what they think might happen to intolerant macroinvertebrates if they are not placed in their optimum range.
7. The GaiaXus App will prompt the students to brainstorm what might happen to bodies of water if their salinity were to rise.
 - a. As students brainstorm, the teacher should gauge student understanding by asking questions such as:
 - i. What would happen to the ecosystem?
 - ii. Would this affect human health?

STATION 4: Conservation Station

Materials needed:

- o 1 Tablet
- o 1 Laboratory notebook per student
- o 1 Sheet of printer paper (optional)

Procedure:

1. This station will be student-led.
2. The GaiaXus App will instruct students to brainstorm ways in which salinity can affect ecosystems as well as human health. They will jot their ideas down in their laboratory notebook.
3. The GaiaXus App will then tell students to identify anthropogenic (man-made) sources that may affect the salinity of local bodies of water.
4. Once they have created their lists, students will be asked to develop a strategy that their local community can take to prevent sub-optimal salinity in their waterways.
5. If students finish this station early, they may opt to complete a 'Challenge'.
 - o The GaiaXus App will prompt students to make an informative flyer for their school about how to reduce water pollution.

STATION 5: Interaction Station

Materials needed:

- o 1 GaiaXus tablet
- o 1 Laboratory notebook per student

Procedure

1. This station is student-led.
2. The GaiaXus App will provide students with information regarding tipping points.

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3. Students will then predict with their groups what might happen to a stream ecosystem if the salinity permanently changes. They will record their predictions in their laboratory notebooks.
4. Students will create a 'timeline' in their laboratory notebooks that shows how macroinvertebrate populations would change over time if salinity increased, specifically macroinvertebrates.
 - b. Students may choose to use their field guides or iNaturalist to obtain information in this station if they do not have strong background knowledge in this area.
5. If students finish this station early, they may opt to complete a 'Challenge'
 - c. The GaiaXus App will prompt students to create a food web that consists of at least 3 trophic levels and includes at least one macroinvertebrate. They will then hypothesize what would happen to the community if the macroinvertebrate was removed.

Further Reading

To download this guide and others, visit our website at gaiaxus.com



About GaiaXus

GaiaXus Learning Systems is a Maryland-based company developing education tools for environmental STEM education. All presented projects and information are based on pre-released prototypes.

To contact the company, visit gaiaxus.com or email info@gaiaxus.com

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