freshwater vs saltwater ecosystems

Description

Students will learn about adaptations needed for freshwater vs saltwater ecosystems and re-create an osmosis experiment to better understand osmoregulation in fish.

Curriculum Fit

Grade 8, Unit E: Freshwater and Saltwater Systems

Specific Learner Expectations

3. Analyze factors affecting productivity and species distribution in marine and freshwater environments
    a. investigate life forms found in fresh water and saltwater, and identify and interpret examples of adaptations to these environments (e.g., describe and interpret examples of fish and invertebrate species found in a local freshwater environment)
    b. analyze factors that contribute to the development of adaptations in species found in saltwater and freshwater environments
    c. investigate and interpret examples of seasonal, short-term and long-term change in populations of living things found in aquatic environments (e.g., algal blooms, changes in local freshwater fish populations, cod and salmon stock depletion)
    d. analyze relationships between water quality and living things, and infer the quality of water based on the diversity of life supported by it

Key Terms

- *Freshwater Ecosystem*: a biological community, found in or by freshwater (not of the sea), of interacting organisms and their physical environment.
- *Saltwater Ecosystem*: a biological community, found in or by saltwater (living in the sea) of interacting organisms and their physical environment.
- *Adaptation:* a change or the process of change by which an organism or species becomes better suited to its environment.
- *Osmosis:* A process of diffusion, where water moves from an area of low solute concentration to an area of high solute concentration

Introduction

If you visit Alberta's lakes or rivers, you might see cattails by the edge of the water. Or, if you

fish in that lake or river, you might catch a pike. But you would be really surprised if you saw a whale in that lake, or saw kelp growing there. That is because whales and kelp are adapted to saltwater ecosystems, and the cattails and pike we see in Alberta are adapted to freshwater ecosystems. Today, you will learn about the differences between fresh and saltwater ecosystems, and the adaptations plants and animals need to thrive in those ecosystems.

Activity One: Freshwater vs Saltwater Adaptations

Goal: Discover some adaptations that help animals and plants survive in their ecosystems.

Instructions:

Listed below are adaptations for plants and animals that live near or in bodies of water.

1. Read the adaptation.
2. Decide if you think it is an adaption for a freshwater or saltwater ecosystem.
3. Circle your choice.
4. Come up with a reason why that adaptation would help the organism survive in the ecosystem you chose.

Which ecosystem do I live in?

1. I am a plant that has adapted to expel (release) salt onto my leaves.
    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the plant?

2. I am a small fish that has adapted to climb trees and move across land, and I will do this when the water I am living in dries up.
    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the fish?

3. I am a mammal that has adapted to collapse my lungs for diving.
    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the mammal?

4. I am a fish that has more salt in my body tissues than is in the water around me. My adaptation is excreting lots of water in my urine.
    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the fish?

5. I am a bird that has a salt gland in my eye socket that drains a salt solution out through my beak.

    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the bird?

6. I am a fish that is adapted to live on land and breathe air for up to 6 days.
    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the fish?

7. I am a plant that has adapted to have shallow roots and weak stems, instead devoting resources to my broad leaves that float on top of the water.
    a. Freshwater
    b. Saltwater
        i. Why would this adaptation help the plant?

Activity Two: Understanding Osmosis

Goal: Understand how the process of osmosis works through a hands-on experiment.

Materials:

- Three glasses
- Three eggs
- White vinegar
- Light corn syrup
- Slotted spoon
- Measuring cups (1 cup and ¼ cup)
- Stirring spoons
- *Optional*: Kitchen knives
- *Optional*: Scale

Instructions:

1. Put an egg in each glass.
2. Pour vinegar into the glasses covering each egg. You might need to place a knife over the glass to keep the egg submerged.
3. Let the eggs sit in the vinegar for 24 hours.
4. After 24 hours, drain the vinegar. Be gentle with the eggs as their shells will be dissolving.
5. Cover the eggs with vinegar again and let sit for 24 hours.
6. After the next 24 hours, drain the eggs, being very careful with them as the shell should be completely dissolved now.
7. *Optional*: Weigh each egg. Write down the weights.
8. In the first glass, pour in a cup of corn syrup. This is a hypertonic solution for the egg. (Think: saltwater). In the second glass, put in ¼ cup of corn syrup and ¾ cup water. This is your isotonic solution. Ensure it is well mixed. In the third glass, put a cup of

water. This is a hypotonic solution for the egg. (Think: freshwater)
9. Label all the glasses with the type of solution (hypertonic, isotonic, hypotonic) in them.
10. Gently put an egg in each glass. If you weighed the eggs, keep track of which weight went into which glass. Let them sit in the liquids for 24 hours.
11. After 24 hours remove the eggs from the liquids and observe them. What differences do you notice? What explains these differences?
12. *Optional*: If you weighed your egg at Step #7, weigh your eggs again and see if there is a difference in weight depending on the solution you put them in.

RESULTS: The egg in the hypertonic solution (all corn syrup) should have shrunk, the egg in the isotonic solution should be about the same size, and the egg in the hypotonic solution (all water) should have swelled. Why did this happen?

Discussion Questions

1. Why would the oceans warming be bad for the ocean inhabitants? (Hint: Warmer water holds less dissolved oxygen).
2. Based on your osmosis experiment, why would freshwater fish want to excrete lots of water? Why would saltwater fish want to swallow lots of water?

Assessment

1. What is an adaptation?
2. What is an adaptation to freshwater?
3. What is an adaptation to saltwater?

Background Information

Answers to Activity 1:

1) Saltwater. The mangrove tree has adapted to extrude salt onto its leaves, so that it can take up saltwater without being harmed by the salt present in the water.
2) Freshwater. The mangrove killfish can alter their gills to live on land, so that if their pond dries up, they can walk to a log and hide there until the next rainfall.
3) Saltwater. Seals and other mammals can collapse their lungs as they dive so that they can survive the immense pressure of the ocean.
4) Freshwater. Fish in freshwater ecosystems have a lot of water enter their body because of osmoregulation, and part of that process is the excretion of lots of water so that their body can stay regulated.
5) Saltwater. Seabirds can excrete salt out of their nasal cavity. This allows them to drink saltwater with no deleterious effects as they can use the water and get rid of the salt.
6) Freshwater. Climbing perch have adapted to survive on land for up to 6 days, this allows them to find other sources of freshwater if the water they are in has dried up or become uninhabitable.
7) Freshwater. Water lilies' big leaves help them capture a lot of sunlight on the surface of a pond. Their weak roots and stems allow them sway with the movements of the water without snapping.

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