**LESSON**

## Exploring: Salt in Our Lives

Introduce how salt affects living and non-living things.

### What We Are Hoping For: Learning Goals

- Abiotic and Biotic Factors
- Water
- Human Impact
  - A, B

### Learning Goals:

- Different ecosystems have different salt levels, changing salt levels in ecosystems causes problems for the organisms that live there.
- Dose makes the difference when it comes to salt and other abiotic factors.
- Changing the amount of salt in an ecosystem causes problems for the organisms that live there.

**CHECKLIST**

## Exploring: Salt in Our Lives

In this lesson, students will:

- Be introduced to how salt affects living and non-living things
- Predict the appearance of tomato plants grown in saltwater. **(5 min)**
- See and discuss the eggplant/salt osmosis demonstration. **(10 min)**
- Use the salt and ecosystem case studies to complete the graphic organizer in the Investigation Booklet. **(15 min)**
- Watch the salt level demonstration, which demonstrates that what appears to be very little salt can cause big environmental changes like changing freshwater to saltwater. **(5 min)**
- Discuss the salt and ecosystem case studies and salt level demonstration. **(5 min).**
    - Dose makes the difference.
    - Some organisms are more sensitive to changes in salt than others.
    - Salt does not necessarily cause problems in ecosystems. It is changing salt levels that cause problems.
- Complete *Exploring: Salt in our Lives* section of the Investigation Booklet. **(5 min)**

(Times indicated are approximate.)

## 1. Introduce how salt affects living and non-living things. (1 minute)

### Introduction

"Yesterday, we watched the Science Bulletin based on Dr. Kaushal's work. We also discussed why road salt is used to melt snow and ice. Today we are going to look more closely at how added salt affects living things."

## 2. Students predict the effect of salt on tomato plants. (5 minutes)

### The Effect of Salt on Tomato Plants

Predict the effect of salt on tomato plants.

**Slide show and Discussion**

Before showing the slide, ask students to think about what plants need for life, and to predict how a tomato plant exposed to salt will fare.

**Question:** What do plants need to grow?
**Answer:** Water, sunlight, soil

**Question:** What happens to a plant when these things are unavailable or not in the right quantities?
**Answer:** The plant will die.

**Question:** What do you predict what will happen to a tomato plant that has been watered with a salt solution?
**Answer:** The plant will die; the plant will wilt, nothing, etc.

Show students the tomato plant comparison slide, and ask them to evaluate their predictions.

**Question:** Did you accurately predict what would happen?
**Answer:** Answers vary.

**Question:** Why does the plant not grow as well?
**Answer:** The salt water disrupts the plant by pulling water out of its cells. Without a proper balance of water (homeostasis), the plant will grow poorly or die.

**Background: Salt as a commodity:**

Salt is an essential part of the human diet. Today, it is used for seasoning food, preserving meat without refrigeration, and manufacturing soap and glass. These characteristics and a limited supply made it so important in the past that wars were fought over it and it was even used as a form of salary!

## Background: Why does our body need salt?

We use salt to keep a balance of water in each of the cells in our body. When you have too much salt in your blood, the cells shrivel because water rushes out of the cells due to osmosis. When you have too little salt in your blood, the cells burst from too much water again due to osmosis. Salt is needed in order to help muscles and nerves to function and to regulate blood pressure. When we lack salt, our brains cannot function. It is an essential nutrient that we need to stay alive. Without enough salt, organisms would not be able to survive.

## 3. Demonstrate salting the eggplant. (10 minutes)

### The Effect of Salt on Plant Cells

Salting an eggplant to demonstrate the effect of salt on plant cells.

Distribute the worksheets or investigation booklets for students to use to draw their predictions of what will happen when the eggplant is salted. (Students will also use the investigation booklet for the salt and ecosystem case studies that follow.)

**Materials**

- A large eggplant
- Salt

**Demonstration: Salting the eggplant**

**Key Idea: Salt pulls water out of cells killing them.**

In their Investigation Booklet or worksheet, ask students to draw their predictions of what will happen when you place salt on the eggplant.

1. Slice a large eggplant in half longitudinally
2. Cover the eggplant with generous amounts of table salt.
3. Watch how the salt draws the water out of the cells (osmosis). The eggplant will get very wet.

**NOTE:** It can take 15 minutes for the water to leave the eggplant. You may want to set up this demonstration at the beginning of the period and return to it after completing the next steps in the lesson.

**Discussion**

**Question:** Where did all the water come from?
**Answer:** The water is pulled out of the cells by the process of osmosis (See Teacher Tip for another suggested demonstration about osmosis).

**Question:** What happens to the eggplant without all of that water?
**Answer:** If the eggplant was still growing, its cells would not have the necessary water to perform important life functions and would die.

**Question:** How do you feel when you eat potato chips? Are you thirsty? What do you think is happening to your cells?
**Answer:** The water is diffusing via osmosis out of the cells, decreasing the quantity of water in their cells and causing them to be dehydrated. That is why after eating a bag of potato chips, you feel thirsty.

**Question:** Using what happened to the salted eggplant, develop an explanation for what happens to a person's cells when a person drinks seawater?
**Answer:** A person's cells would also lose water that they need for normal life functions, which would disrupt homeostasis (a stable internal environment) causing that person's cells and eventually that person to die!

## Alternative Demonstration

Another simple way to show the effect of salt water on plants is to place a piece of celery in a glass half full with water and one tablespoon of salt for 24 hours. The celery will wilt and lose its rigidity because the salt water is hypertonic and causes the water from inside of the celery cells to go into the solution.

## Background: Were did the water come from? – OSMOSIS!

Osmosis is when water moves across a semi-permeable membrane (i.e. the outside layer of the cell) from an area with low levels of dissolved material (solute) to an area with a high levels of dissolved material (solute) In this case, the salt sprinkled on top of the eggplant dehydrated the plant by drawing the water across the eggplant cell membranes and out of the eggplant!

## Teacher Tip:

Osmosis and Diffusion can be defined and introduced at this part of the lesson.

Osmosis: the diffusion of water (across a membrane). Water will move in the direction where there is a high concentration of solute and hence a lower concentration of water.

Diffusion: the process by which molecules spread from areas of high concentration to areas of low concentration.

4. Ask the students to review ecosystem fact sheets and complete in pairs the graphic organizer. (15 minutes)

Have students review the Ecosystem Fact Sheets and, working in pairs, complete the graphic organizer. The fact sheets are available as a slide show to download or display from this page, and are also included in the Worksheets downloadable on this page, and the Investigation Booklet available on the **lesson home page**.

## 5. Complete the Salt Level demonstration as a "front of the class" demonstration or as a short laboratory exercise. (5 minutes)

### Salt Level Demonstration

What appears to be very little salt can cause big environmental changes like changing freshwater to saltwater.

If you have completed the Salt and Ecosystems activity, ask students what surprised them from the case studies. Students should point out that the amount of salt or dose makes the difference in ecosystems

**Materials**

- Water
- Salt
- Graduated cylinder
- Digital scale, if available; or measuring cup and spoons

**Demonstration**

**Key Idea: What appears to be very little salt can cause big environmental changes like changing freshwater to saltwater.**

Use a 1000 ml graduated cylinder and a digital gram scale if available to measure out:

A. 1 mg table salt and 1000 ml of water = Salt levels of 1mg/L (freshwater)
B. 250 mg table salt and 1000 ml of water = Salt levels of 250 mg/L (EPA drinking water guidelines; freshwater)
C. 1 gram table salt and 1000 ml of water = Salt levels of 1000 mg/L (considered slightly salty; brackish water)
D. 3 grams table salt and 1000 ml of water = Salt levels of 3000 mg/L (NY/NJ Harbor Estuary water, considered moderately salty; estuary water that changes with the tides)
E. 10 grams table salt and 1000 ml of water = Salt levels of 10,000 mg/L (NY/NJ Harbor Estuary water considered very salty)
F. 35 grams table salt and 1000 ml of water = Salt Levels of 35,000 mg/L (Very salty; open ocean water)

**Teacher Tip**

Use teaspoons and a measuring cup to measure out the same quantities, so that students can taste the differences in salt:

A. 1mg/L ~ 0 tsp. of salt in 4 ¼ cups of water
B. 250 mg/L ~ 1/19 tsp. salt in 4 ¼ measuring cups of water
C. 1000 mg/L ~ 1/4 tsp. salt in 4 ¼measuring cups of water
D. 3000 mg/L ~ 5/8 tsp. salt in 4 ¼ measuring cups of water
E. 10,000 mg/L ~ 2 and 1/8 tsp. salt in 4 ¼ measuring cups of water
F. 35,0000 mg/L ~ 7 and 1/3 tsp. salt in 4 ¼ measuring cups of water

## 6. Ask students to reflect on what they have learned from the salt and ecosystem case studies. (5 minutes)

### Dose Makes the Difference

Some organisms are more sensitive to changes in salt than others.

**Discussion**

**Key Idea: Dose makes the difference. Some organisms are more sensitive to changes in salt than others.**

**Question:** At what level does salt start to affect non-saltwater organisms in the forest? In a freshwater pond? Is it a small or large amount and which organism is most affected?
**Answers:** Pine trees are affected by 67.5 mg/L of salt, which is a very small amount of salt. The Mountain Holly and Tamarack plants cannot grow in salt levels higher than 170 mg/L and small freshwater plants and animals that are the basis of the food web will begin to die at salt levels of 226 mg/L.

**Question:** Pine trees are hurt by salt levels as low as 67.5 mg/L, but people are allowed to drink water with more salt than that level. Why is that?
**Answers:** People are able to flush out the extra salt in urine, sweat, and tears, while pine trees cannot.

**Question:** Why is it okay for people to drink water with some salt, but bad for people if they drink water that is too salty?
**Answers:** The water will taste bad and the water may not be healthy because if a person drinks too much saltwater they will die from dehydration. Human blood has a very narrow salt range. Drinking sea water will cause the blood to take water from the cells to keep the correct blood salt levels. This loss of water will cause the cells to die and eventually the organs and the body will fail.

**Question:** Some of the organisms that are most affected by salt are the small plants and animals that are lowest on the food chain. How will their death affect other biotic factors in a freshwater ecosystem?
**Answers:** If plants and animals that are the basis of the food web disappear, the animals that eat them will also suffer because they have less to eat.

**Question:** How does the dose or amount of the salt affect freshwater ecosystems?
**Answers:** The larger the dose of salt, the saltier the water and the larger the negative effects.

**Question:** How is it possible for a freshwater swamp to turn into a salt marsh without trees? What happened to the trees? How can this occur?
**Answers:** The Hackensack River was dammed, cutting off the flow of freshwater to the swamp. The water became saltier, killing trees and only allowing the salt tolerant reedy marsh grasses to grow.

**Key Idea: Salt does not necessarily cause problems in ecosystems. It is *changing* salt levels that cause problems.**

**Question:** But do high amounts of salt always negatively affect ecosystems? Why is salt in stream water so bad, when a great white shark lives in saltwater with no problems?
**Answers:** Organisms are adapted to live in a specific habitat, so great white sharks are adapted to living in salt water, but would not be able to survive for long in a freshwater ecosystem. The same is true of a freshwater fish that is moved to a saltwater ecosystem.

**Question:** What would happen to a great white shark if it was put in a freshwater tank?
**Answers:** It would not survive.

**Question:** Please summarize the role of salt in all ecosystems and explain why if high salt is good for an ecosystem, why it is also sometimes bad for systems.
**Answers:** Different systems depend on different levels of salt. Salt isn't per say bad, but *changing* salt levels can harm ecosystems.

**7. Complete the *Exploring Salt in Our Lives* section of the Investigation Booklet. (5 minutes)**

**Extensions:**

**Inquiry Lab:** Have students create a procedure for an inquiry laboratory exercise based on the question "What level of salt will start affecting the growth of plants or algae?" Provide students with supplies for the lab, which for the most part can be purchased in a grocery store (algae can be purchased from scientific supply stores). Make sure that students include a control group in their experimental design (i.e. a plant or algae that receives regular tap water or rain water with no extra added salt).

**Regents Lab:** The osmosis red-onion lab required for the NYS Living Environment Regents Examination is a possible extension to this lesson and/or unit.