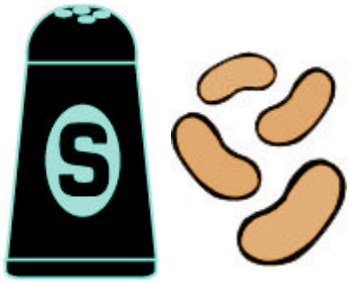
Lesson Plan: Can Salt Kill Beans (grades 4-6)

Objective: For students to understand that most plants cannot grow in salt water

Learning Outcomes



- Students can compare the salt concentration of selected foods.
- Students can form and test a scientific hypothesis.
- Students can interpret the results of an experiment and explain whether their hypothesis was supported or not.
- Students can discuss why beans cannot grow in a saltwater wetland.

Materials

Salt, large bag (or two) of lima beans, measuring teaspoon, 12 sealable plastic bags, water, rulers, roll of paper towels, two-liter plastic bottle, permanent markers

Vocabulary

brackish	observation
dilution	salinity
fresh water	sodium
hypothesis	testing

Preparation

Make a bottle of salt water by adding approximately 10 teaspoons of salt to a two-liter bottle; then fill the bottle with warm water and shake the mixture. This is considered “ocean strength” water.

Procedure

1. Start off by asking the students for their ideas about how salty the ocean is. Ask them to guess what percent of ocean water is salt. The answer is three-and-a-half percent. Explain that brackish water is water that falls somewhere

between fresh water (like that from the faucet) and ocean water. Ocean water is too salty for people to drink at all.

2. Your students may have heard about salt, or sodium, levels in foods, and that eating too much sodium can be unhealthy. Explain that sodium is a chemical "ingredient" in salt (sodium chloride). Then ask the students if they think some foods they eat might be a salty as the sea.

Either as a class or in groups, have your students calculate the percent salt in selected foods. Follow the steps below and use the figures in the box. The answers are provided in italics in the box.

a. convert the milligrams of sodium to grams by dividing by 1,000 (1g = 1,000 mg)

b. divide the grams of sodium by the grams of the food

c. *multiply the answer by 100 (to find the percent)*

Soup: 269 grams of soup has 820 milligrams of sodium: *0.3% salt*

Potato Chips: 28 grams of chips has 110 milligrams of sodium: *0.4% salt*

Tuna Fish: 56 grams of fish has 310 milligrams of sodium: *0.6% salt*

Pretzels: 28 grams of pretzels has 370 milligrams of sodium: *1.3% salt*

After the class completes the calculations, compare the results to the salinity of the sea (3.5%). As you can see, none of the foods we eat are as salty as the sea. Instead, they would be considered brackish.

3. Your students will conduct an experiment to see if seeds can develop under conditions that simulate two wetland conditions: salt water and fresh water. Inform your class that they will try growing lima beans in salt and fresh water and observe the results.

Explain that scientists use the **scientific method** to make advances in knowledge. At its simplest, the scientific method has four steps: **observation, hypothesis, testing, and drawing conclusions**. A scientist observes something, such as a falling apple in the famous story of Isaac Newton. The next step is to formulate a hypothesis to explain what was seen. Newton's hypothesis was that "objects fall to earth because of the force of gravity." Finally, a scientist tests the hypothesis, usually by conducting an experiment. Newton used advanced mathematics and physical experiments to show that his principles applied to all falling objects, not just apples. His mathematics could predict the behavior of falling objects and this was an effective test of his hypothesis. These

experiments led Newton to the conclusion that there is a strong force, gravity, that impels objects to fall to earth.

It should be stressed to the students that real scientists do not set out to prove a hypothesis, but to test it. If a scientist sets out to prove a hypothesis, he or she may unconsciously influence the results of the test. If the hypothesis does not work, that provides more information for a new hypothesis. In this case, the students are being asked to formulate a hypothesis to predict the outcome of an experiment, based on their own knowledge. An important part of the experiment is to have a class discussion about the results after its conclusion.

EXPERIMENT

Object of Experiment
To compare the development of lima beans in salt and fresh water.

Step One: Formulating a Hypothesis
Divide the students into six groups. Ask each group of students to formulate a hypothesis. A hypothesis is a prediction or assumption that can be tested through observation. For example, the following statement is one example of a hypothesis:

German shepherds bark louder than sheep dogs

So, based on what they know and what they have learned so far, students should predict which lima beans they think will show healthy development: the ones in fresh water, the ones in salt water, or both.

Students can work together to circle the appropriate answer below and create a hypothesis:

The lima beans in

FRESH WATER/SALT WATER
(circle one or both)

will grow into healthy plants.

Ask each group to explain why it chose its hypothesis and write down both the hypothesis and the possible explanation. In Step Two of this experiment, students will test their hypotheses by recording and measuring the growth of the lima beans in each bag. Be sure to emphasize that record keeping is an essential part of the experiment.

Step Two: Testing, Observing and Measuring

Give each group of students two sealable plastic bags, six paper towels, and two dozen lima beans. Have the groups label their bags with labels or permanent markers. One bag should read FRESH, the other SALT. On both bags, the students should also write their names.

Have the students soak three paper towels in tap water and place them in the FRESH bag. Then have them place a dozen beans on the towels in the bag.

Next, have the students soak three paper towels in the salt water you prepared and place them in the bag marked SALT. Then have them place the rest of their beans in that bag. Make sure that the beans are in close contact with the wet paper towels. (**Note**: keep the remainder of the salt water for future use).

Instruct students to seal their bags and place them in a location where they will not be disturbed. They will need to create a log so they can record the daily progress of their seedlings over the next week. Students should make observations in their notebooks using chart as shown. Alternately, you can give each group a blank chart for record keeping. The observations will take only a few minutes once the recording procedure becomes routine. Students will also need to keep the paper towels moist by checking the bags on a regular basis and adding tap or salt water, as required. (Keep the supply of salt water available.)

Observation Log: Experiment 1 – Salt versus Fresh

Date	How many have sprouted?	How do the seed coats look?	What is the length of the longest seedling?	General Notes Describe conditions in each bag
	Salt Fresh	Salt Fresh	Salt Fresh	Salt Fresh

Teachers' Note: *While the students are waiting for the beans to grow and recording their data, you may wish to move on to other lessons.*

Step Three: Figuring Out if the Results Support the Hypothesis

After approximately a week has passed, you should see a significant difference between the two bags. The time has come for the students to interpret the results (data) that they collected. Write the Thought Questions below on the chalkboard and ask the students to answer them. Discuss the results with the class.

Thought Questions

1. Summarize the results for the beans in the freshwater bag. When did the beans sprout? How many days did it take? How much did they grow per day?
Specific answers will vary; the beans in the freshwater bag should sprout.

2. Summarize the results for the beans in the saltwater bag. Did they sprout? If they did sprout, how many days did it take? How much did they grow per day?
Specific answers will vary; the beans in the saltwater bag should not sprout.

3. What was the length of the sprouts in the freshwater bag by the seventh day? What was the length of the sprouts in the saltwater bag by the seventh day?
Specific answers will vary; the freshwater sprouts should be longer than the saltwater sprouts.

Have each group respond to its hypothesis. Is it true or false?

Step Four: Drawing a Conclusion

Ask the students to write a paragraph and explain the results of the experiment. Was their hypothesis supported? Why or why not?

Teachers' Note: *The bean seeds that have been watered with salt water should not germinate. The freshwater beans should be healthy and sprouting. (Some mold might also develop, especially in the saltwater bag.) Have students write up a description of any differences between the seedlings. Discuss the reasons for these differences. Lima bean plants are not adapted to living in a saltwater environment. The salt draws the moisture out of the cells of the seed. Even most full-grown land plants would die if put in salt water because the salt upsets the normal working of the plant. There are some plants, however, like Spartina, or cordgrass, that have adapted to living in a salt marsh. Spartina has special pores on its leaves that get rid of the extra salt taken in by the roots.*

Options

- As a math extension, you may wish to have students graph the growth of the bean seedlings in each bag.
- As an art extension, you may wish to have students design an imaginary plant with wetland adaptations.