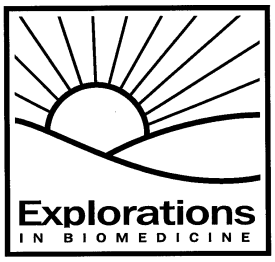

Fresh vs. Salty

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Grade-Level:

Middle-High School

Fresh vs. Salty

Purpose:
To introduce the difference between saltwater and freshwater organisms.
Recommended for grades 8-10.

Objectives (content):
Students will be able to:

- understand that freshwater organisms usually can't live in salt water and vice versa.
- recognize that some organisms are adapted to both environments.
- learn about the physiology that allows freshwater organisms to survive in freshwater and saltwater organisms to survive in salt water.
- learn how some organisms survive in both.
- realize the importance of niches in an ecosystem.

Objectives (process):

- engage students in planning an experiment and problem solving.
- allows students to clearly present their results to their peers.
- allows students to work cooperatively.

Materials (per group of 3-4 students):

- 5 petri dishes
- 500 mL pond water with microorganisms
- 100 mL of each salt solution – 3.5%, 2% .9%, .2%, 0% (pure pond water)
- 1 microscope
- 5 microscope slides (with microorganisms, see prep.)
- 1 student worksheet
- 2 sheets graph paper
- 1 clock with a second hand

Preparation:
All the slides should be placed horizontally on the bottom of a large dish. The slides should have pond water poured over them and be allowed to sit for a couple hours. This gives the microorganisms time to settle onto the slides, allowing for a more interesting lab.

Students need to know how to use slides and microscopes. The petri dishes are used to soak the slides in the salt solutions, for a limited time. Students need to be able to figure percentages of solutions. They need to have experience creating labs using their previous knowledge and supplies given to them. They need to know how to create line graphs and be able to present their information verbally.

Background Information:
Despite the continual deposit of fresh water, oceans maintain a fairly constant concentration of salts. The water that evaporates is approximately the same amount that is deposited. The water cycle demonstrates this concept.

The concentration of salt in the ocean generally varies from 32 $^{o}/_{oo}$ (32/1000) to 38 $^{o}/_{oo}$ (38/1000 or 3.8%). In this experiment you may want to consider ocean water to be 35 $^{o}/_{oo}$ or 3.5% sodium chloride (i.e. 3.5 gm of NaCl/100 mL of solution). Note: Marine biologists use the 32 $^{o}/_{oo}$ versus the 3.2%. Use whichever you feel more comfortable with.

The intermediate salinities you might want to call estuaries or brackish water.
They are more dilute. The concentration of brackish water generally varies from .51 $^{o}/_{oo}$ (.051%) to 17 $^{o}/_{oo}$ (1.7%) (i.e. 1.5% NaCl = 1.5 gm of NaCl/100 mL of solution). The concentration of fresh water is .5 $^{o}/_{oo}$ (.05%) salt or less. An example of mixing a salt solution would be 1.5% NaCl = 1.5 gm of NaCl/100 mL of solution.

Most marine organisms have internal body fluids similar to their environment (usually 33 $^{o}/_{oo}$ [3.3%] - 35 $^{o}/_{oo}$ [3.5%]). Freshwater and bony (teleost) fish usually have internal fluids with salinity in the 20 $^{o}/_{oo}$ [2.0%] range. If these organisms are placed in external fluids that are hypotonic (have a lower salinity than internal fluids) or hypertonic (have a higher salinity than internal fluids) the result is often fatal.

Some organisms have adaptations to survive a change in their environment.
They may have organs such as contractile vacuoles, nephridia, kidneys, and gills, which tend to counter water absorption. Or they may have outward structures, such as shells, that reduce the amount of exposed permeable area.

If an aquatic organism with an internal fluid concentration of 35 $^{o}/_{oo}$ (3.5%)is in a body of water whose salinity is 20 $^{o}/_{oo}$ (2.0%), water is going to move into the organism, trying to equalize the internal and external fluids. Unless the organs move as much water out as is coming in its internal salinity level will drop, causing swelling and probably death. Because extra water must be removed and salts retained, the organisms urine will be dilute and (excreted) in large quantities.

If an aquatic organism with an internal fluid concentration of 20 $^{o}/_{oo}$ (2.0%) is in an ocean whose salinity is 35 $^{o}/_{oo}$ (3.5%), salt water is going to move into the organism. The organs must keep enouigh NaCl and water moving out so that the internal salinity won't change, thereby keeping the organism alive. Because water must be preserved and salts excreted, the organisms' urine will be fairly concentrated and discharged in small quantities.

Procedure:
This is an inquiry-based activity. Once the teacher has handed out the worksheet and provided the materials it is up to the students to come up with a plan, get it approved by the teacher, who is head of the FASK (Further Advancement of Scientific Knowledge) board, and test it. The teacher needs to facilitate their learning by asking questions that will guide them in the right direction.

Questions to Ask:

1. How can you test whether freshwater organisms are capable of surviving in ocean water, given the equipment and supplies here?
2. What are you testing?
3. What are the petri dishes for?
4. How are you going to effectively count the microorganisms?
5. What do the different solutions represent?
6. How are you going to know the organisms are not dying due to elapsed time?

Suggestions for Assessment:

Have the students give group poster presentations explaining their hypothesis, experimental procedure, data, graph, and conclusion.

Where to Go From Here:

Any of the following could be studied next:
1. niches, ecosystems, and environments
2. animal behavior
3. aquatic organisms
4. oceans and their diversities
5. osmosis and diffusion

References and Resources:

1. McConnaughey, B.H. & Zottoli, R. (1983). *Introduction to Marine Biology (4th ed).* St. Louis, MO: C.V. Mosby Company.
2. Pennak, R.W. Ph.D. (1953). *Freshwater Invertebrates of the United States.* New York: The Ronald Press.