Saltwater vs. Freshwater

Overview:

Students will learn about density through comparing salt and freshwater in various experiments. This lesson supports scientific thinking, observation, with an emphasis that freshwater can have many differences even between other freshwater sources.

Grade Level: K-5, 6-8, 9-12

Subject(s): Science

Topic(s): Biology, Ecology, Animals, Water

Time: 1 Hour

Great Lakes Literacy Principles:

1. The Great Lakes, bodies of fresh water with many features, are connected to each other and to the world ocean.
5. The Great Lakes support a broad diversity of life and ecosystems.
8. The Great Lakes are socially, economically, and environmentally significant to the region, the nation and the planet.

Standard(s):

SCI.ESS2.C.2 Water is found in many types of places and in different forms on Earth.

SCI.ESS2.C.m Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.

SCI.ESS2.C.h The planet's dynamics are greatly influenced by water's unique chemical and physical properties.

SCI.ETS1.B.K-2 Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

SCI.ETS3.A.3-5 Science and engineering knowledge have been created by many cultures. People use the tools and practices of science and engineering in many different situations (e.g. land managers, technicians, nurses, and welders). Science and engineering affect everyday life.

What do I already know about the learners themselves, what they have done before, what they will do after, and where they are located?

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Materials:

The following materials list is what you will need to set up each of the three stations only once.

Station A:

- 1 large clear container filled 2/3rd with freshwater (this could be a fish tank or a clear large pitcher that can hold two cans of soda)
- 1 X can of soda
- 1 X can of the same soda but diet.

Station B:

- 2x 1 -1.5-liter Beakers (One filled with freshwater & one filled with the saltwater solution)
- 2 eggs (Fresh not hard boiled)

Station C:

- 1x 1.5-liter beakers
- 2 x 500 mL beaker (one filled with freshwater & one filled with the saltwater solution)

Preparations Ahead of Teaching:

Station Rotation:

This lesson has three stations that students cycle through. You will need to set up stations for students to cycle through so that they are able to do these experiments in table groups of 3-4 students. If you have a class of 24 students, then you will set up each of the three stations twice. If you have 36 students, then you will set up each of the three stations, three times.

Saltwater solutions:

Each of the saltwater solutions for this experiment are based off the ratios of ocean water. The ocean's salinity is 35 ppm which you can create in your classroom by using 35 grams of salt for every liter of water.

Smaller ratios include:

- 500 mL of water for 17.5 grams of salt (1/2 a liter)
- 250 mL of water for 8.75 grams of salt (1/4 a liter)
- 125 mL of water for 4.375 grams of salt (1/8 a liter)

You can prepare a large quantity of the 35ppm solution of salt water before this lesson for student to fill their beakers with. The volume you need is dependent on how many stations you will have. If you are running each of the stations twice (6 total stations) you will need about 4 liters (one gallon) of saltwater solution.

Or depending on grade level and desired objectives you may have your students make their own saltwater solutions at each of the stations to practice concentrations, measurements, and following experimental procedures/methods.

Lesson Plan:

Water we know about H_2O?: Invitation (10 Minutes)

Whole class discussion (5 Minutes)

1. Ask the whole class to share some different bodies of water that they know! As student share with the class write their answers on the whiteboard.
2. Where are some of these bodies of water found? Student may share ponds and lakes that are nearby where they live or by their school. They may also know the names and locations of others larger lakes in the regions. Your students may often have many stories or memories of their time on or near different bodies of water. You can make a hand single, like moving your arms like waves so that as students share, they can let others know that they know that water or if they have been to that water before!
3. Once you have generated a list on the board, ask students to share if these bodies of water on the board are salt water or fresh water.
    a. You can underline them in different colors to mark the different types of water.
    b. As students share which bodies of water and salty and which are fresh ask students to share how they know that water is salty or fresh!

Four Corners (5 Minutes)

1. Tell students in a moment they will participate in an activity moving their bodies to share their answers. This is like 4 corners but there will only be yes, and no. Pick a wall to represent “yes” and one to represent “no”
2. Read one of the following questions and tell your students to answer by moving their bodies to the side of the room they agree with. Remind them once they make their choice, they need to find a partner to discuss with. Some questions you might want to ask include:
    i. Are all types of freshwaters the same? Why/Why not?
    ii. Are all types of saltwater the same? Why/Why not?
    iii. Could a creature that live in freshwater survive if it was moved to a saltwater ecosystem? Why/Why not?
    iv. Is there more freshwater on earth than saltwater? Why/why not?
    v. Could a human survive drinking only saltwater? Why/why not?

Saltwater & Freshwater Experiments: Exploration & Concept Invention (35 Minutes)

Whole class demonstration (5 Minutes)

1. Tell your students that they are going to use their amazing skills of observation to collect evidence from three different experiments to gather information on the similarities and differences of salt and freshwater.

2. Explain to students that they will have a certain amount of time at each station and will move to the next station when it is time.
3. Label the stations A, B, C so that your students know where to go once it is time to move to another station.
4. It can be helpful to have timing cue for your students to signal ½ through their station time and 2 minutes before transition so they are prepared, have signal to clean up, and can have autonomy to complete watch experiment while also knowing when to transition.
5. Pass out the worksheet they will use to complete their experiments and collect data and ask them to read the instructions for each station.
6. Beguin with the whole class experiment.
7. Tell students to writ their prediction on their paper.
    a. Make a prediction about what could happen if you left a pot of freshwater on a burner to boil?
    b. What would happen if you did that with a pot of salt water?
8. Tell your students that you did this experiment the night before and boiled a pot of salt and freshwater until most of the water changed from liquid into a gas and show them the containers. Then ask them to draw what they see in each of the pots.
    a. You can do this ahead of time and take pictures or you can bring the pot into your classroom. Otherwise, you can briefly share a video of this experiment with your class. https://www.youtube.com/watch?v=riEbNXcmLrQ
    b. While students are answering the class demo questions on their paper you can begin to set up each of the three stations.

Station Rotation (30 Minutes)

1. Give students 10 minutes for each station with a 2 minute, clean up, reset, and transition time. It is helpful for all students to have a visual countdown of their time. You can use a YouTube timer online to project on your screen to help students know when they are expected to finish and transition to a different station.
   10-minute timer → https://www.youtube.com/watch?v=4ASKMcdCc3g
2. As students complete their stations with their groups you can support them by asking questions or guiding their observations making sure that their drawings are reflecting the phenomenon they are experiencing. Some questions can include:
    i. What have you noticed in this experiment so far?
    ii. What is happening with each (water types or soda types)?
    iii. What about that (water type or soda type) is different than the other?
    iv. Why might this difference be causing what we are seeing?
    v. What do we know about the molecules in one water v.s the other?
    vi. What might the molecules be doing that could cause us to see this observation?
3. When everyone has completed each station ask students to clean up all their stations so they can participate in a class discussion about what they experienced.

Describing Density: Concept Invention (10 Minutes)

Class Gallery Walk (5-7 minutes)

1. Display three large sheets of paper teach labels with the three station experiments, you can also do this on the white board if you can partition it into three sections.
2. For each of the three stations ask the class to share the explanation that they wrote down in the last boxes on their evidence sheet.
3. Ask each table group to summarize their different explanations into a 2 -3 bullet points for each of the three stations.
4. When they finish their summary discussion, have two people from the group them add their bullet points to the large poster/white board section for that specific statin.
5. Once each group has added their 2-3 bulleted list to the statin poster, ask students to walk around to the three station posters and read the summarized bulleted lists of other groups explanations.
6. As they gallery walk, encourage students to add any explanation they might have had that is missing from the other groups.

Whole Class Discussion (10 minutes)

1. Discuss with the class that all the experiments they conducted today demonstrate the physical characteristics of density. If your students have prior knowledge of molecules, you can encourage them to review their explanations and add or change them to discuss what they thought in terms of molecules and density.
2. This can also be your way to introduce the concept of density by drawing a picture of what the molecules in the higher density saltwater solution look like compared to less dense freshwater.

Reflection (5 Minutes)

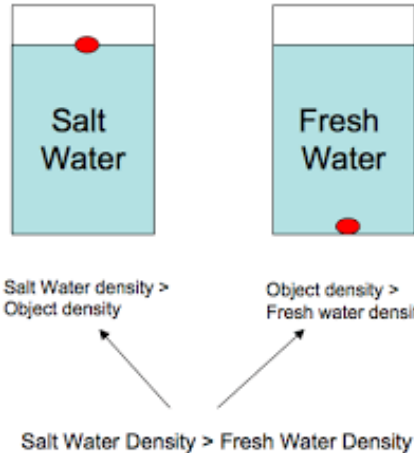
1. Once the class has reviewed the phenomena they observed in terms of molecules and density, ask students to reflect on how their thinking changed from their first explanation to now. Students can discuss in partner pairs or with their table groups, you can also ask them to write their reflection on a sheet of paper.
    i. Looking back at your original explanation from your data sheet, how has your thinking changed from when you first did the experiment to know? If your thinking did change, what are you better able to explain now?
    ii. What helped your thinking change? If your thinking didn't change, what helped you better understand what you observed?
    iii. Pick one of the three experiments that you observed today and explain to your partner, what was happening with the molecules.

Scientific Phenomenon Explained:

Use this section to add context and background information about the scientific principles at play in these different experiments.

Station A: Salty and Fresh Eggs

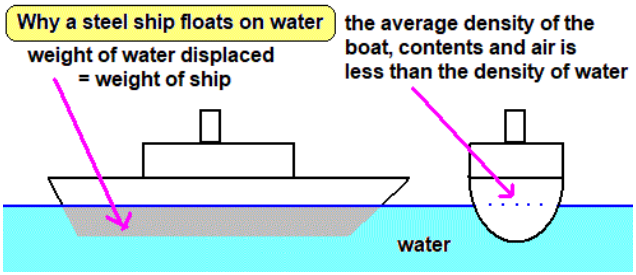
Fresh eggs are more dense than fresh water and therefore will sink. However, as the water's salt content increases, it becomes denser. The eggs float in the two beakers with the added salt. The solution with the 35 grams of salt represents the salinity of the oceans. The egg in the beaker with the salt should float higher than the egg in the less salty solution.



The increased density of salty water increases the weight of water. An egg will be buoyant (float) if the weight of the egg is *less* than the weight of the water it displaces. The egg sinks if it weighs *more* than the weight of the water that is displaced.

Station B: Two Types of Pop

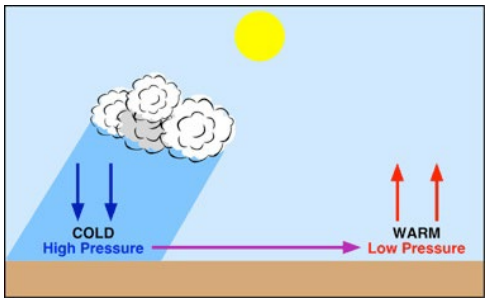
While both cans displace the same volume, the diet soda will float and rise to the top. Look at the ingredients on each can. The regular soda has approximately 40 grams of sugar that the diet soda does not contain. The *added sugar increases the density of the fluid* in the can to the point where it now weighs *more* than the weight of the water that is displaced by the volume of the can.



Ships float for the same reason. The physical weight of the ship is less than the weight of the water that is displaced. Since the weight of the water displaced is greater, ships float.

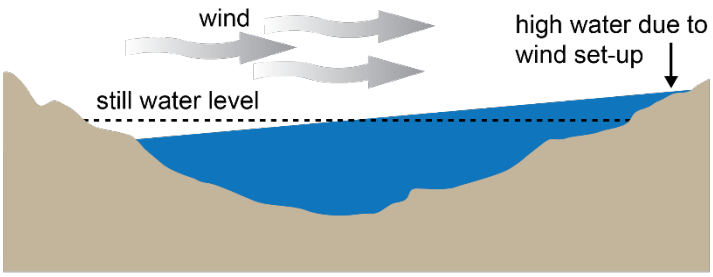
Station C: Colorful Differences

When salt dissolves in water, the salt adds mass to the water but does not increase the volume of the water very much. Thus, saltwater is denser than freshwater and freshwater will float on the surface of saltwater. Understanding density is important for understanding weather and currents. Warm air is less dense than cold air, it also has a lower pressure.



Air temperature can increase due to heat energy from the sun or heat energy from air sitting over warmer bodies of water. As air molecules warm the less dense the air becomes. Less dense air rises easier. The movement of air molecules due to density creates the winds that blow across large bodies of water like Lake Superior or the Oceans.

Wind currents are produced because of different atmospheric air pressures. The higher the air density the greater air pressure differences may be created. The change in air molecules density from one side of Lake Superior to the other causes molecules to spread out and creates winds that cause the seiche in Lake Superior.



Wind setup is a local rise in water level caused by wind.

Resources:

ADD CITATIONS TO EXPLINATIONS

Teacher Comments:

Station Procedures

Station A: Salty and Fresh Eggs

Procedure

1. Fill one beaker with one liter of tap water.
2. Fill the other beaker with one liter of salt water (OR one liter of tap water and 35 grams of salt)
3. Make a prediction on your paper. What do you think will happen when you place an egg into each of the two jars.
4. Place an egg in each solution and observe what happens.
5. Draw a picture on your data observation sheet for each beaker and describe what the picture.

Station B: Two Types of Pop

Procedure

1. Fill the jug/tank 3/4th of the way with tap water.
2. Make a prediction on your paper about what you think will happen when you place both sodas cans in the jug of water.
3. At the same time place the regular soda at the bottom of the jug/tank of water and place the diet soda at the bottom of the jug/tank. It can be helpful to have one person do this.
4. Release your hands and observe what happens to both cans. N
5. Record your observations on your sheet for each can. Draw a picture and describe what you see happens.
6. After you observe what happens take both cans out of the water to make sure that they haven't been tampered with.
7. Remove both cans and have a student come up to verify that the cans have not been tampered in anyway.
8. Place both cans back into the water.
9. On your observation sheet try to explain what you think is happening.

Station C: Colorful Differences

Procedure

1. W Fill one beaker with 200 mL of tap water.
2. Add 4 drops of blue food coloring to the first beaker with tap water.
3. Fill the second beaker with 200 mL of salt water OR 250 mL of tap water and 17.9 grams of salt.
4. Add 4 drops of red food coloring to the beaker with salt water.
5. Make a prediction on your sheet. What do you think will happen when you pour the blue freshwater into the container with the blue freshwater?
6. When you finished writing your prediction on your sheet very slowly follow the next direction.
7. Take the spoon and carefully hold it against the surface of the red saltwater.
8. Very carefully and slowly begin to pour the blue freshwater onto the spoon and into the red saltwater beaker.
9. Continue to slowly pour the water until all the freshwater has been poured into the saltwater beaker.
10. Record your observations on your sheet, drawing what you notice and describing your drawing with words.

Name: _____

Saltwater V.S Freshwater Experiments

Class Demonstration: What could happen if you left a pot of saltwater in a pot to boil?	
Prediction:	**Observations:**

Station A: Salty and Fresh Eggs	
Prediction:	
Observations: Be sure to draw what you see and describe it in the boxes below	
Saltwater Observations	**Freshwater Observations**
Explain what you think is happening:	

Saltwater V.S Freshwater Experiments

Station B: Two Types of Pop in Freshwater
Prediction:
Observations: Be sure to draw what you see and describe it in the box below
Explain what you think is happening:

Station C: Two Types of Pop in Freshwater
Prediction:
Observations: Be sure to draw what you see and describe it in the box below
Explain what you think is happening:

Saltwater V.S Freshwater Experiments