Density Currents

Motivating Question: What happens when salt and freshwater mix?

Take Home Message: Fresh and saltwater have different densities, which results in a density current as the more dense saltwater moves below the less dense freshwater. This happens in estuaries, which affects where certain organisms can live in an estuary.

Grade: K-6 as a demonstration; 3-8 as a hands-on exercise

Estimated Time: 15 minutes for a single run, but encourage the students to perform the experiment several different times, varying the conditions and observing the results.

New Jersey Core Curriculum Content Standards - Science

Grade	Content Statement	CPI#
2	Living and nonliving things are made of parts and can be described in terms of the materials of which they are made and their physical properties.	5.2.2.A.1
4	Building and refining models and explanations requires generation and evaluation of evidence.	5.1.4.B.1
4	Evidence is used to construct and defend arguments.	5.1.4.B.3
4	Some objects are composed of a single substance; others are composed of more than one substance.	5.2.4.A.1
4	Objects and substances have properties, such as weight and volume, that can be measured using appropriate tools. Unknown substances can sometimes be identified by their properties.	5.2.4.A.3
6	Pure substances have characteristic intrinsic properties, such as density, solubility, boiling point, and melting point, all of which are independent of the amount of the sample.	5.2.6.A.3
8	Evidence is generated and evaluated as part of building and refining models and explanations.	5.1.8.B.1
8	Carefully collected evidence is used to construct and defend arguments.	5.1.8.B.3
8	Substances are classified according to their physical and chemical properties.	5.2.8.A.6

Background:

Density is a property of matter. It is the amount of material that fits in a given space. Denser objects are heavier than less dense ones of the same size in the same gravitational field. Thus, a quart of cotton is light but a quart of lead is very heavy; lead is denser than cotton. Liquids have density too. Water is denser than oil, and honey is denser than water. If two liquids of different densities come into contact, then the denser liquid sinks down below the less dense liquid and flows along the bottom. This is a density current.

A density current flows because of the pull of gravity and the density difference, and it stops moving when the two fluids mix, or when the current uses up its energy. This is like what happens when you let a marble roll into a bowl. The marble rolls quickly to the bottom of the bowl, and then it rolls back and forth, gradually slowing, until it stops. The marble uses up its energy of position by moving from the lip to the bottom of the bowl. It uses up its energy of motion by rubbing against the air and against the bowl, turning its energy of movement into heat by friction.

Adapted from lesson by David C. Kopaska-Merkel, Geological Survey of Alabama, PO Box O, Tuscaloosa AL 35486-9780 (www.beloit.edu/sepm/Water_Works/density_currents.html)

Water is the most important liquid on earth; density currents are common where waters of two different densities meet. How does water change its density? If solid material is mixed into the water, then the density increases. Sea water (which is salty) is denser than fresh water because the salt adds material without making the water take up more space. However, if the fresh water has a lot of mud mixed into it, then it may be denser than the seawater. Cold water is denser than hot water; because when water gets hot it expands. The same amount of material takes up more space, so it is less dense.

In the following experiment the students will make a density current.

Materials:

- Density tank (or large elongate clear-walled container (e.g., 10-gallon fish tank))
- Kosher Salt
- Cups
- Food coloring
- A place to work where, if you spill water, no one will get angry

Procedures:

1. Provide each student pair with a density tank. Ask the students to decide which partner is going to have blue freshwater and who is going to have red saltwater.
2. Have the students come up to the front to retrieve their appropriate water samples.
3. When back at their density tanks, instruct the students to pour their water samples into each side of the tank. Then on the count of three have the students remove the divider.
4. Have the students observe the density current and make observations about how the blue and red water move in relation to each other.
5. They may wish to repeat the experiment with different levels of freshwater and saltwater or visit another partner group to observe their results.
6. Once the students start to slow down in their experiments, have them clean everything up.

Results and Discussion:

1. Once the students have finished cleaning up their stations, have the students talk with another partner group over what they observed in their density tanks.
2. After a few minutes, ask them to complete their student worksheets individually.
3. After the students have written down their responses, ask for student volunteers to share with the class their results. Make sure the students are using evidence to support their statements about what they observed.
4. Ask the students what these results mean for the ocean or an estuary. Be accepting of all answers as the students brainstorm where density currents might occur in the ocean or estuaries.
5. Once the discussion slows down, point to the motivating question and ask:
   Q. What happens when salt and freshwater mix?
   Ask students to share their ideas about the question with a partner. After a minute, ask volunteers to share the ideas they discussed with the entire class. Be accepting of all responses from the students. This is your opportunity to make sure the students understand the "take home message" that you identified.
6. Ask if the students have any questions about the activity.

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DENSITY CURRENTS - Student Worksheet

NAME _____ DATE _____

1. Describe what the density current did when you allowed the blue freshwater to mix with the red saltwater in the tank. Where did the saltwater go? Why? Where did the freshwater go? Why?

2. Did the density current stop? If so, why?

3. Draw a picture of your density current in the box provided. If you think it takes more than one picture to show what happened, draw as many as you need to.

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