

1. CONTRIBUTOR'S NAME: Johnny MacLean

2. NAME OF INQUIRY: FLOAT OR SINK???

3. GOALS AND OBJECTIVES:

a. Inquiry Questions:

1. Will cold water float or sink in warm water?

2. Which is densest and least dense between plain water, salt water, and rubbing alcohol (mystery liquid)?

3. How does water density affect ecosystems locally and worldwide?

b. Ecological Theme(s): Water density's effect on lake and ocean ecosystems, as well as on global and regional climate.

c. General Goal: Students discover properties of water, such as density and salinity, and their effect on local and regional ecosystems.

d. Specific Objectives: Students observe density differences. They experiment to deduce relative differences in density. They relate properties of matter to ecological concepts.

e. Grade Level: 3

f. Duration/Time Required:

→ Prep time: 30 minutes

→ Implementing Exercise During Class: 2.5 hours

→ Assessment: 20 minutes

4. ECOLOGICAL AND SCIENCE CONTEXT:

Background: High temperature causes matter, including water, to expand and become less dense because the atoms become more energized and farther apart. High salinity (salt content) causes water to become denser. In a lake, especially in the summer, sunlight heats the surface of the lake, causing the water to become stratified, with the cold, dense water sinking to the bottom. Certain fish such as trout typically stay in the cold water at the bottom of the lake during the summer months. In the Atlantic Ocean, water circulates from the Arctic to the tropics and back again for a variety of reasons. During this circulation, the cold, Arctic water sinks to the bottom of the ocean, travels south to the tropics, and is heated by solar energy. The warm water rises and travels north close to Western Europe. This is one reason Western Europe enjoys its mild climate even though it is at a similar latitude as Canada. As the water travels north, some evaporates, making the remaining water more saline. Since salinity increases density, this water sinks and is cooled by the time it reaches the Arctic. The cycle repeats. This cycle is being interrupted by the cold fresh water that is melting off of the polar ice cap due to global warming. The interruption could cause drastic climate changes for Western Europe, and possibly the world. Climate obviously affects ecosystems.

5. MOTIVATION AND INCENTIVE FOR LEARNING:

Water is fun to 'play with.' The activity involves hands-on and investigative work. Western Montana students can easily relate to fish in lakes.

6. VOCABULARY:

Density—measure of mass per unit volume.

7. SAFETY INFORMATION:

Be careful not to spill water. Be aware of the hot plate used for heating the water. Do not let students drink any of the liquids

#### 8. MATERIALS LIST (including any handouts or transparency masters):

- 1 shoebox-size container per group.
- 1 hot plate
- ice cold water
- hot water
- blue and red food coloring
- 3 jars per group
- water
- salt
- rubbing alcohol
- ice
- 1 hard-boiled egg per group
- world map

#### 9. METHODS/PROCEDURE FOR STUDENTS:

- a. Pre-investigation work: Review properties of matter, temperature, density, etc.
- b. Investigation work:

##### Day 1:

Review knowledge regarding properties of matter, including density and temperature. Explain activity and its relation to properties of matter and to local ecology (such as Montana lakes and their fishes).

Give each lab group a shoebox-size, see-through container full of warm water that is dyed red or pink. The teacher pours cold water, dyed blue, into the side of each container, and students observe that the cold blue water sinks to the bottom and spreads out on the bottom as a blue cloud, before finally mixing with the red water.

Students should then draw what they saw before the two waters mixed, and draw what they saw after the two waters mixed. They should then draw and cut out a few small fish.

After students have completed much of their artwork, review again where the cold water would be in a pond or lake. Have the students glue the fish on their picture where they would be if the fish were trout or other cold-water species.

##### Day 2:

Review the previous day's activity. Give each group three jars. One jar should have plain water, one should have salt water, and one should have rubbing alcohol (mystery liquid). Make sure students don't drink any of the liquids. Also give each group some ice and a hard-boiled egg. The students are to deduce which jar has the densest liquid, and which has the least dense liquid.

Have a couple of groups present what they found and how they found it. Ask them what liquids they think are in each jar. Explain to them that the densest liquid had salt in it. This should lead into a discussion of ocean circulation, and its effects on climate.

1) What evidence (data, samples) do students collect? Students make observations of water density.

2) How do students present the evidence (data)? Students draw a picture of a pond's water stratigraphy. Students present their findings regarding which jar has the densest and least dense water. They also present how they figured it out.

3) What conclusions are drawn from the evidence students collect? Cold water is denser than warm water. Saline water is denser than fresh water.

10. ASSESSMENT:

The teacher should make sure students' drawings of pond water stratigraphy are accurate. The teacher should make sure that each group understood which jar had the densest and least dense water.

11. EXTENSION IDEAS: Students could research on the internet what types of animals lived in different depths of the ocean or in different depths of lakes. They could also research water temperature distributions on the Earth Observatory website (<http://earthobservatory.nasa.gov/>).

12. SCALABILITY: Higher grade levels could actually measure the density of the liquids in the three jars.

13. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT:

This exercise went well. The students seemed to understand why cold water is denser, and how it related to lakes and oceans.