

Homemade Hydrometer

Teacher Section

Overview With a name like hydrometer you might pause and say: “...a what?” You might have even gone a step further and added “why do I want one of those?” Simply put, hydrometers test the density of liquids. Specifically, they compare the density of liquids to the density of water (a comparison called the specific gravity of a substance). A substance's specific gravity is extremely useful. We use it to tell how creamy milk is, how salty the ocean is, and much more! In the following experiments we'll test the salinity of several solutions.

Suggested Time 30-45 minutes

Objectives : Students will understand that the density of a liquid determines how much force it exerts on objects floating in it.

Materials (per lab group)

- Drinking straw
- Modeling clay
- A drinking glass
- Salt
- Distilled water (or as filtered as you have on hand)
- Permanent marker
- Graph paper (optional)

Lab Preparation

1. Print out copies of the student worksheets.
2. Read over the Background Lesson Reading before teaching this class.
3. Watch the video for this experiment to prepare for teaching this class.

Background Lesson Reading

The hydrometer works via the *Archimedes Principle* which states that an object will be buoyed up by the force equal to the weight of the fluid displaced. Thus, the more dense the fluid, the more force it exerts on objects floating in it. This is why the hydrometer moves higher as more salt is added. Cool, huh?

Lesson

1. Ask a student to hold a heavy textbook in one hand, outstretched at waist level.
2. Ask another student to stand next to the first student, and help hold the same textbook with one hand outstretched.
3. Ask a third student, and see if they all can raise the textbook to shoulder or even head height.
4. Students should notice that the more hands there are, the more strength there is to hold the book, and it is easier to raise up higher.
5. Explain: Liquid has this same strength, and it can get stronger as it gains density. For instance salt water and honey are denser than fresh water.

6. Explain: Because these liquids are more dense (stronger), they push harder on the objects in them. Therefore the objects raise up higher in the liquid.
7. Explain: Today we are going to build a tool that helps us measure just how strong the liquid is by measuring how much of a straw it can lift. We will add salt to the water, instead of more students underneath the book!

Experiment

1. Review the instructions on their worksheets and then break the students into their lab groups.
2. Hand each group their materials and give them time to perform their experiment and write down their observations.
3. Plug one end of the straw with a small marble-size ball of clay. This is your hydrometer.
4. Fill your glass with water (find a glass that holds about 2 to 2.5 cups of water).
5. Place the hydrometer in the glass. Add or remove clay until the straw floats midway up your glass. Mark that level "0" with the permanent marker (because there is no salt).
6. Remove the hydrometer.
7. Add 1 teaspoon of salt to the water.
8. Place the hydrometer in the glass. Mark the new level and label it "10" for 10 ppt (parts per thousand).
9. Add another teaspoon of salt to the solution.
10. Repeat step 6 (except this time mark the level "20" for 20ppt).
11. Repeat until you have marks up to 50 (or higher!).
12. Have a partner prepare unknown solutions of salt and water. Test them with the hydrometer. Graph your findings.
13. Try solutions at different temperatures. (Water is most dense at 4°C, which is the temperature at the bottom of most deep lakes and seas).
14. Troubleshooting: Is your hydrometer not working correctly? First, check the plug. If the plug is letting water the hydrometer may be getting heavier as you add salt—the opposite result you expect!

Exercises

1. What do hydrometers test? (the density of liquids)
2. What is specific gravity? (the density of water)
3. What is the Archimedes Principle? (theory which states that an object is buoyed up by the force equal to the weight of the water displaced. The denser the liquid, the more pressure it exerts on an object and the more water is displaced.)
4. Would a boat float better in water or honey? Why? (It would float better in honey, because honey is a denser liquid, hence it exerts more force on the boat to buoy it up.)

Closure Before moving on, ask your students if they have any recommendations or unanswered questions that they can work out on their own. Brainstorming extension ideas is a great way to add more science studies to your class time.

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Student Worksheet

Name _____

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What to Learn Hydrometers compare the density of liquids to the density of water (a comparison called the specific gravity of a substance). A substance's specific gravity is extremely useful. We use it to tell how creamy milk is, how salty the ocean is, and much more! In the following experiments we'll test the salinity of several solutions.

Materials

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Experiment

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8. Repeat step 6 (except this time mark the level “20” for 20ppt).
9. Repeat until you have marks up to 50 (or higher!).
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11. Complete the data table below.

Homemade Hydrometer Data Table

Solution	Density

Reading

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Exercises

1. What do hydrometers test?
2. What is specific gravity?
3. What is the Archimedes Principle?
4. Would a boat float better in water or honey? Why?

Answers to Exercises: Homemade Hydrometer

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