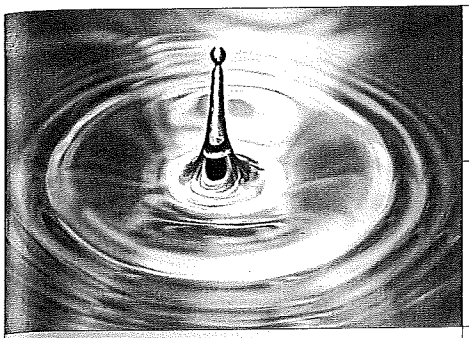


Is There Water on Zork?

You're stranded on the planet Zork and you're thirsty. The Zorkians present you with a clear liquid. Is it water? Will you drink it? How in the Zork would you know?

Grade Level
Middle School

Subject Areas
Physical Science

Duration
Preparation time: Part I: 50 minutes; Part II: 50 minutes
Activity time: Part I: 50 minutes; Part II: 50 minutes

Setting
Classroom or laboratory

Skills
Applying learned information (experimenting, designing, hypothesizing); Evaluating (testing, assessing); Presenting

Charting the Course
The activity "Life Box" establishes water as one of the essential factors for life to exist on Earth and could be used prior to "Is There Water on Zork?" "H2Olympics" enhances students' understanding of adhesion and cohesion, unique properties of water. "What's the Solution" provides additional information on the physical and chemical characteristics of water that make it unique.

Vocabulary
investigation, solubility, surface tension, chemical reactions, evaporation, condensation, specific heat, density, mass, volume, phase change, pH, acidity, agronomists, scientific method, hypothesis

Summary

Students describe the unique characteristics of water and design investigations to distinguish water from other clear liquids.

Objectives

Students will:

- describe qualities that distinguish water from other clear liquids.
- design an investigation to test characteristics of water.
- analyze the efficiency and effectiveness of the investigation.

Materials

Part I

- *Liquids to be tested.* (Place liquids in separate beakers, numbered 1-7; label the water with a different number for each group. Depending upon time and grade level, use seven or fewer liquids.)
- *Water*
- *White vinegar*
- *Hydrogen peroxide*
- *Corn syrup*
- *Alcohol*
- *Glycerin or mineral oil*
- *Clear soda*

Part II

Testing materials. (Possible tests are provided in parentheses for students needing more guidance. Items may be deleted or added to the list to fit the needs of the investigations.)

- *Salt* (solubility)
- *Pepper* (surface tension)
- *Sugar* (solubility)
- *Baking soda* (solubility, chemical reactions)
- *Corn starch* (solubility)
- *Wax paper* (surface tension)
- *Aluminum foil* (chemical reactions)
- *Hot and cold water baths* (evaporation, condensation, specific heat)
- *A scale* (mass)
- *Objects of different density: metal to wood* (density)
- *Paper clips* (surface tension)
- *Toothpicks* (density, surface tension)
- *Food coloring* (density)
- *Graduated cylinders* (volume)
- *Thermometers* (temperature, phase change)
- *pH strips* (acidity)
- *Liquid soap* (surface tension)

Testing equipment

- *Goggles*
- *Extra beakers or cups for conducting tests*
- *Eyedroppers*
- *Glass rods*
- *Copies of* ***Problem: Which of these liquids is water?*** (optional)

Making Connections

We use our senses to learn about the world. Students have seen and used a variety of clear liquids in their lives, such as white vinegar, corn syrup and water. Knowing the difference among these will make a big difference in following a salad dressing recipe. Focusing on students' curiosity, this activity encourages students to use scientific inquiry to investigate how water is unique and unlike other clear liquids.

Background

We all use scientific inquiry to answer questions about our lives and the world. Farmers study their fields, confer with agronomists and conduct tests to learn why a certain crop is producing low yields. Teachers, when selecting an approach to best convey a concept, gather resources, attend workshops and try out activities with their students. Students selecting among brands of shampoo read labels, talk with friends, listen to commercials and test samples. All these actions are guided by questions: Why are my crops failing? What's the best way to teach this? Which shampoo should I buy?

Scientists use questions to guide their research as well. How scientists answer questions depends on current understandings, available resources and the nature of the questions themselves. Despite the rigid flow chart depicted in many science textbooks, there is no single scientific method. Nonetheless, investigations are often guided by a series of focusing questions:

- What is the question we are trying to answer?
- What do we know that is related to this question? (This can involve forming a hypothesis.)
- What are the procedures to answer the question?
- What are the results of the investigation?
- What conclusions can we draw?
- What is the value of these conclusions? (Can these conclusions be used to answer the question?)

This process facilitates thorough, organized investigations. The questions need not be followed in sequential order. Sometimes researchers first recall what they know about the problem, or they might pose a hypothetical answer first and then test it.

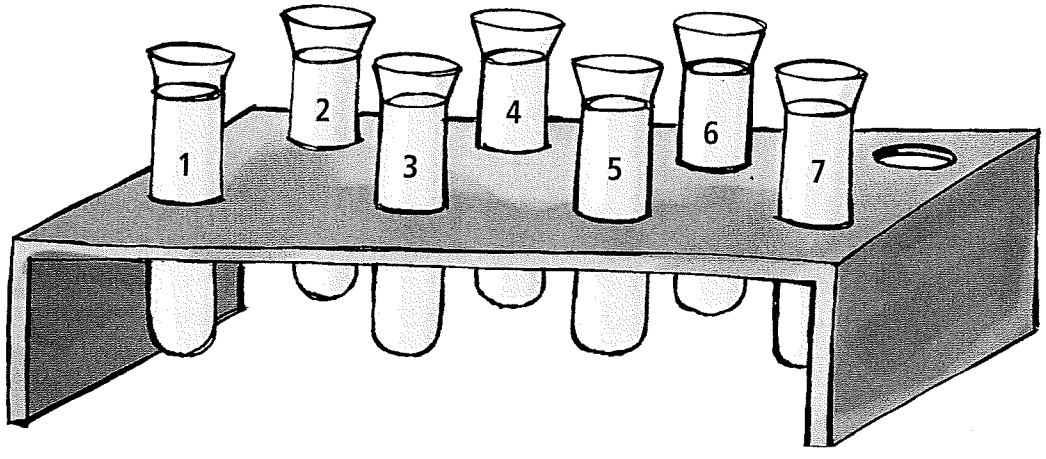
Even when these questions are used to guide an investigation, the problem may not be solved or more questions may arise. Results may be erroneous or causality impossible to establish. The farmer may not learn why crop yields are low. The teaching strategy may reveal gaps in student knowledge, requiring the teacher to develop supplementary lessons. The student may find that his or her choice of shampoo causes frizzy, unmanageable hair.

Investigations into problems are ongoing. As they learn, people continue to ask questions.

Procedure

Warm Up

- Present the following situation to the class. Some students are visiting planet Zork. They are running low on water. Through remote sensing techniques, they know that water exists on Zork, but they're not sure where it is. Fortunately, they encounter some friendly Zorkians who speak English; unfortunately, their words for water, clear and liquid are different from ours. The visiting students need to explain to the Zorkians that they are looking for water.
- Have several students play the visiting students and others play the Zorkians. The class can help the Zorkians think of questions they can ask about this commodity (e.g., What does it feel like? What is it used for? Why do you need it?). Mindful that the Zorkians do not understand the words clear and liquid, the visiting students must try to describe the characteristics of water.
- After a few minutes, have students summarize their responses. How much do students think they know about water? Did they think it was difficult to describe water?
- Ask students to list the words and phrases they use to describe water. Encourage them to use all five senses.

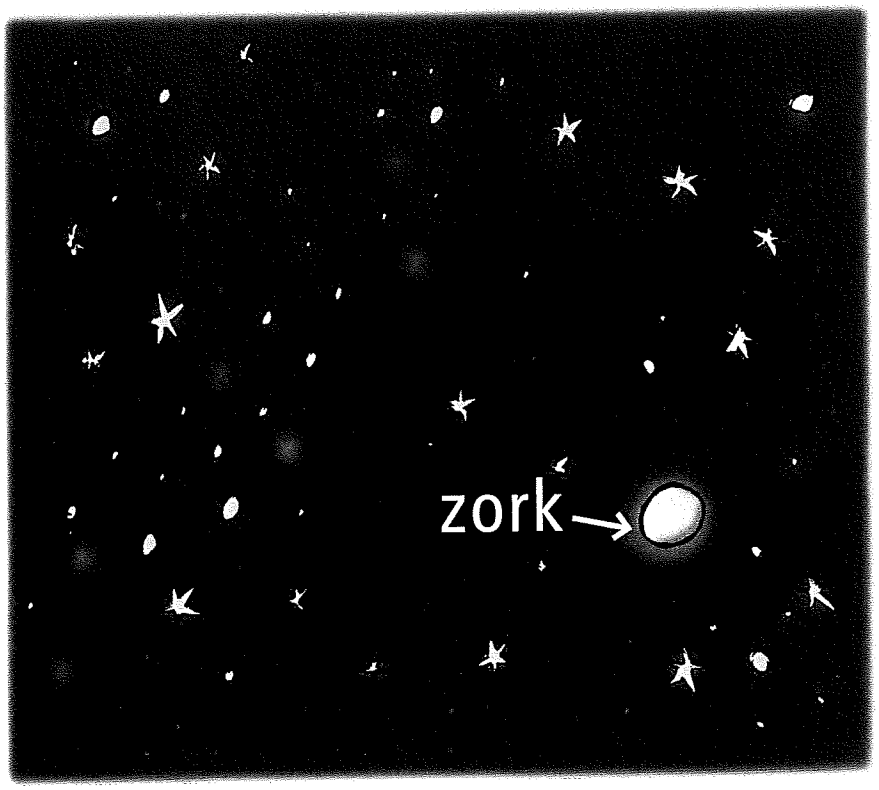


Make a master list and post it in the classroom. This list of words and descriptions provides students with a synopsis of what they know about water. It also provides information they can use to solve the problem presented in this activity.

▼ *The Activity*

Part I

1. **Tell students the Zorkians brought forth seven different clear liquids, based on the stranded travelers' descriptions.**
2. **Divide the class into small groups. Provide each group with samples of the clear liquids. Present students with the problem: Which of these liquids is water?**
3. **Based on what they know about water, have students write out several questions they have about the liquids.** Ask them to brainstorm different ways to answer the questions. Display the materials they can use in the front of the room.
4. **Have students develop a set of procedures to determine which liquid is water.** Check the designs for safety and feasibility. TASTE TESTS ARE NOT ALLOWED! IF STUDENTS HEAT THE LIQUIDS, THEY SHOULD USE A HOT WATER BATH, LIMIT THE HEATING TIME TO THREE MINUTES AND BE IN A WELL-VENTILATED AREA. ANY TIME A SUBSTANCE IS HEATED, GOGGLES MUST BE WORN.
5. **Have students write out their questions and procedures in a table or diagram.** A suggested format is provided in this activity, but students may design their own to match the needs of their investigation. (See *Problem: Which of these liquids is water?*)



Part II

1. **Students can now conduct the tests to answer the questions.** Make sure they record their results or answers. These can be included in the table, as well.
2. **At the end of their investigations, students should draw conclusions based on their findings.** If they were unable to determine which liquid was water, they should still summarize the results by indicating liquids they know are not water. Explain that the investigative process is more important than determining which liquid is water. If the investigation stimulated other questions, these should be listed in the conclusion, as well.

▼ *Wrap Up*

- Discuss the investigative process and results with students. What was the value of the conclusions? Did the investigation solve the problem? To confirm their results, students can run identical tests on a sample of tap water. If students were to repeat the activity, would they revise their procedure or alter their conclusions? If time allows, have students conduct the investigations a second time.
- What do they know about water that they didn't know before? Match these discoveries to the list of words and phrases used to describe water in the *Warm Up*. Ask students if they think the list is accurate or if descriptions should be changed or added.

Project WET Reading Corner

Ardley, Neil. 2006. *101 Great Science Experiments.* New York, NY: DK Children.

Step-by-step instructions help students design their own experiments at home or school.

Long, Tony. 2007. *The Universe: Liquid Universe.* Television program. US: History Channel: October 20, 2009.

One-hour presentation as part of the series discussing the properties of liquids found throughout the universe.

Mebane, Robert C., and Thomas Rybolt. 1997. *Water & Other Liquids.* New York, NY: Twenty-first Century Books.

This book includes experiments on water and liquids.

Stille, Darlene R. 2004. *Solids, Liquids, and Gases.* Mankato, MN: Child's World.

This book includes discovering states of matter; exploring solids, liquids, and gases; changing from solid to liquid to gas; and using solids, liquids and gases.

Wick, Walter. 1997. *A Drop of Water: A Book of Science and Wonder.* New York, NY: Scholastic, Inc.*

Using photography, this author captures the properties of water on film.

Yolen, Jane. 2004. *Water Music.* Honesdale, PA: Boyds Mill Press.^

This book combines photographs and text to detail water in various shapes and appearances.

*National Governors Association Center for Best Practices and Council of Chief State School Officers. "Texts Illustrating the Complexity, Quality, and Range of Student Reading K-5." And "Texts Illustrating the Complexity, Quality, and Range of Student Reading 6-12." *Common Core State Standards Initiative.* www.corestandards.org (June, 2009)

^Listed on one or more state reading lists.

Assessment

Have students:

- design an investigation that distinguishes water from other clear liquids (*Part I,* steps 3 and 4).
- draw conclusions to investigations based on their findings (***Part II,*** step 2).
- describe the properties of water that distinguish it from other clear liquids (***Wrap Up***).
- assess how effectively the investigation addressed the needs of the problem (***Wrap Up***).

Extensions

Have students collect water samples from sources throughout the community. To compare and contrast the samples, have them design tests for: smell, temperature, clarity, pH and precipitates.

Teacher Resources

Books

Eichinger, John. 2009. *Activities Linking Science with Math 5-8.* Arlington, VA: National Science Teachers Association.

The downloadable chapter "Observing the Effects of Acids and Bases" experiments with dissolving solids in several types of liquids.

Konicek-Moran, Richard. 2009. *More Everyday Science Mysteries: Stories for Inquiry-Based Science Teaching.* Arlington, VA: National Science Teachers Association.

The downloadable chapter "Iced Tea" describes ways to dissolve items in water.

SciGuides. 2005. *Properties and Changes of Properties in Matter.* Arlington, VA.: National Science Teachers Association.