

Heat and Water

Strand	Matter
Topic	Investigating the effects of heat on water
Primary SOL	6.5 The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include b) the properties of water in all three phases.
Related SOL	6.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which e) a method is devised to test the validity of predictions and inferences; f) one variable is manipulated over time, using many repeated trials; g) data are collected, recorded, analyzed, and reported using metric measurements and tools; h) data are analyzed and communicated through graphical representation. 6.5 The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include d) the ability of large bodies of water to store thermal energy and moderate climate.

Background Information

Scientific evidence indicates that Earth formed about 4.5 billion years ago from dust and debris orbiting the sun. Due to gravity, this debris became compacted and grew quite hot, creating hot gases, including water vapor and carbon dioxide. Over millions of years, Earth and its gases cooled, and it is believed that seas formed when Earth cooled enough for water vapor in the atmosphere to condense.

Materials

- Copies of the attached handouts
- Hot plates
- Beakers
- Celsius thermometers
- Ice cubes
- Water
- Goggles

Vocabulary

boiling point, condensation, evaporation, melting point

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Pass out copies of the Inquiry Graphic Organizer, and lead students through the questions on it.
2. Give students time to think and jot down their ideas on the organizer.

Procedure

1. Have students share their ideas with partners. Then, have partners share ideas with other students in lab teams of four or five students each.
2. Give each student a copy of the attached Heat and Water lab sheet, and have each team use the sheet to design an investigation of the effects of heat on the states of water. Approve all designs before allowing teams to perform their investigations. (Sample investigation: Students start with ice cubes in a beaker and record the temperature. They place the beaker on a hot plate and heat, recording the temperature every minute until all the ice becomes liquid. Students continue heating and recording the temperature every minute until the liquid becomes steam. Finally, students graph the gathered data on a chart.)

Observations and Conclusions

1. Discuss with students the discoveries they made during their investigations. Go over the Reflection Questions on the lab sheet. Among other things, students should have discovered that
 - the temperature did not change during the phase changes
 - the temperature range of water in the liquid state is 0–100°C
 - as water vapor cools, it forms droplets and condenses.
2. Remind students that Earth formed from dust and debris orbiting the sun when the dust and debris compacted due to gravity. As the debris grew hotter and hotter, gases, such as water vapor and carbon dioxide, formed. Ask, “How do you think the oceans formed?”
3. Have each team write a conclusion for their investigation, including all discoveries they made.

Assessment

- **Questions**
 - What are the properties of water in each of its three phases?
 - What created the change in the properties of water from one phase to another?
- **Journal/Writing Prompts**
 - Describe the properties of water in all three phases.
 - Explain the role of temperature in the formation of Earth’s oceans.
- **Other**
 - Have teams write a Readers Theater script in order to act out the changing properties of water in all three phases.

Extensions and Connections (for all students)

- Use this or a similar investigation to examine the effects of heat on water’s ability to dissolve materials.
- Relate the findings of the experimental investigations to climates near large bodies of water.

Strategies for Differentiation

- Have students make a flip book that demonstrates water changing from one phase to another.
- Have students use different colors on a graph to represent the different phases.
- Have students use plastic linking cubes together to model 3-D components of a graph.
- Have students physically model the action of molecules in each phase of water.
- Have students create a display graph, using bulletin board paper.
- Have students play a memory match game, using vocabulary words on cards.
- Have students use graphing software.
- Have students use thermometer probeware and relevant software.
- Have students collect information in an interactive notebook or journal.

Inquiry Graphic Organizer

Name: _____ Date: _____ Class: _____

OBSERVATIONS: (The effects of heat on the states of water)



RELEVANT FACTS OR RULES: (Heat's role in the water cycle)



POSSIBLE EXPLANATION: (Explanation of heat's role in the water cycle and in changing the states of water)



HYPOTHESIS:



ACTIVITY OR EXPERIMENT (list steps): (Design of an investigation to show the effects of heat on the states of water)



RESULTS:

Heat and Water

Name: _____ Date: _____ Class: _____

Purpose

To determine the effects of heat on the states of water

Hypothesis

Materials

Celsius thermometer, ice, beakers, stopwatch, hot plate, goggles

Procedure

Independent Variable:

Dependent Variable:

Constants:

Steps

1.

2.

3.

4.

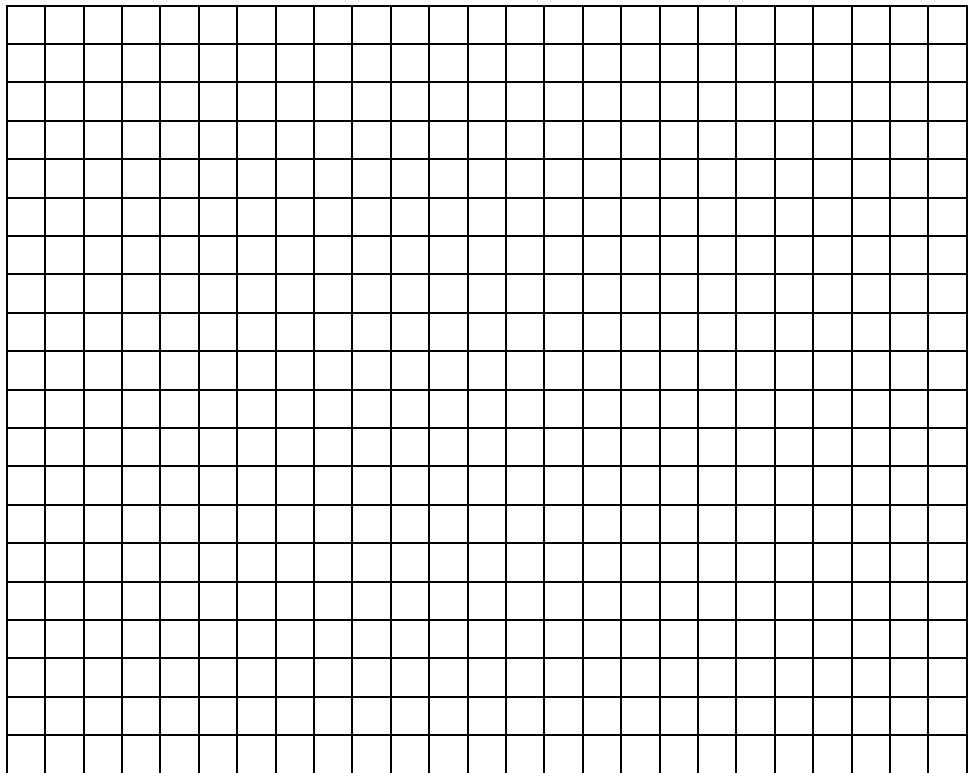
5.

Data Table

Construct a data table, and record your data in it as you do the experiment.

Graph

Create a line graph from your recorded data to show the change in temperature (*y*-axis) over time (*x*-axis).



Reflection Questions

1. What are the effects of heat on the states of water?
2. Put on your imaginary molecular glasses. What does heat do to water at the molecular level?

3. What happened to the temperature as ice was changing to liquid and as liquid was changing to gas?
4. What was the temperature range of water in the liquid state?
5. How could you explain the transfer of heat energy in the changing states of water?
6. What happens to water vapor as it cools?

Conclusions

1. What was your hypothesis?
2. Do the results of your experiment support your hypothesis? _____
3. Was your hypothesis correct or incorrect? _____
4. What happened in the investigation?
5. Use the average data and your answers to the Reflection Questions to summarize the results. Explain why the results happened the way they did, and include all discoveries you made. Make an inference based on what you now know.

Inquiry Graphic Organizer Answer Key

OBSERVATIONS: Heat makes ice melt into liquid water and makes liquid water become steam.

RELEVANT FACTS OR RULES: Heat causes water to evaporate. When cooled, water vapor condenses, and precipitation forms.

POSSIBLE EXPLANATION: The addition of heat causes an increase in water temperature. Heat causes molecules to move faster and spread apart.

HYPOTHESIS: When ice is heated, the temperature will increase and the ice will become liquid water. When liquid water is heated, the temperature will continue to increase and the water will become water vapor.

ACTIVITY OR EXPERIMENT: (list steps)

Possible steps:

1. Place ice in a beaker, measure temperature, and record temperature.
2. Place beaker on hot plate and turn on heat.
3. Record temperature every minute until ice is melted.
4. Continue heating the liquid water.
5. Record temperature every minute until liquid water becomes steam.