

How Do I Get Started?

Module Overview

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- Air flows from areas of high pressure to areas of low pressure to equalize the pressure.
- When the volume of a given mass of gas increases, its pressure decreases, provided that the temperature remains constant (Boyle's Law).

In Activity 5, students build on ideas introduced earlier and discuss ways to reduce the boiling temperature of water. Students find that water can boil well below its typical boiling temperature by reducing the pressure above the surface of the liquid. They learn about phase change diagrams and use one to better understand their previous work with pressure and changes of state.

Key Concepts in Activity 5

- Water boils when its vapor pressure equals atmospheric pressure. As a result, water's boiling temperature is pressure, rather than temperature, dependent.

In Activity 6, students analyze temperature and pressure graphs from the first 30 days of the Pathfinder mission and realize that liquid water could not have existed under these conditions. Next, students look at a number of images of Mars. By interpreting the landforms and comparing a river cut valley on Mars with Earth's Grand Canyon, they identify water as the agent that shaped the surface. This hypothesis about how water could have flowed across the Martian surface, even though current conditions make it virtually impossible for liquid water to exist.




Key Concepts in Activity 6


- Current climatic conditions make the existence of liquid water virtually impossible.
- Features on the Martian surface provide strong evidence for past flows of large amounts of water.

In Activity 7, students generate questions based on their module experiences, and they propose specific information they would like to obtain. They then read about the objectives and instrument payloads of the upcoming missions and see how those missions may provide data that can help them answer their questions. Finally, students create a calendar for the missions and consider how they will access the information returned by the missions.

Key Concepts in Activity 7

- Each Mars mission has specific objectives and the instruments it needs to achieve them.
- Space missions also raise questions people have about Mars, and students can generate questions worthy of future study.
- Every mission has a specific timetable, and students can follow the progress of each mission in a number of ways.

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Activity 1—At a Glance

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How Hot Can You Make Water?

Purpose

To have students graph the temperature of water as it reaches a boil and discover the existence of the transition plateau.

Overview

Students become aware of their preconceptions by considering how hot they could heat water. They then test their preconceived ideas by heating water and measuring its temperature. At some point near 100 degrees Celsius, students find that the water temperature no longer rises. They graph the data and try to make sense of the temperature plateau.

Key Concepts

- Water can only be heated to its boiling temperature.
- The slope of a graph line in this activity shows the rate of temperature change.

Content for This Activity

Mars has such low atmospheric pressure that any water at the surface would boil away. In this activity, students investigate the process of boiling and what is involved when water changes from a liquid to a gas under everyday conditions. In Activities 3 and 5, they will take a closer look at pressure's role in maintaining liquid water.

Skills

- Predicting the outcome of an experiment
- Writing a procedure to test a prediction
- Controlling variables
- Conducting an experiment
- Collecting, recording, and graphing data
- Drawing conclusions
- Communicating explanations to others

Common Misconceptions

- Water can be heated indefinitely to very high temperatures.
- The heat source controls boiling.
- Boiling temperature plateaus means that something is malfunctioning.


Materials

Heat source, beaker or flask, water supply, thermometer, ring stand or tripod, ring clamps, thermometer clamp, stirring rod, wire gauze (flames only), graph paper, graphing, appropriate safety equipment (see pages 5 and 13).

Preparation

- Plan how to present the initial problem and the best way to develop a procedure.
- Set out the necessary equipment for each group. Attach thermometers to ring stands.
- Discuss safety procedures related to heat sources, thermometers, glassware, and hot water.

Time: 2 class periods

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Finding Out What Is In a Module

To understand how the activities in the module examine a question or topic, read the overview of the science concepts starting on page vi. Each activity and its key concepts are succinctly described.

Finding Out What Is In an Activity

To understand each activity in greater detail (including material and time requirements), read the shaded “At a Glance” page at the beginning of each activity.

Materials

The “At a Glance” pages list the materials used in an activity. The activities use readily available materials.

