



## Teacher Guide: Phase Changes



### Learning Objectives

Students will...

- Describe and compare the molecular properties of solids, liquids, and gases.
- Observe how heating affects molecular motion.
- Create and explain a graph of temperature change during phase changes.
- Explain why temperature does not change much during a phase change.
- Determine the boiling, freezing, and melting points of water.
- Find how altitude affects the boiling, freezing, and melting points. (Extension)



### Vocabulary

altitude, boil, boiling point, freeze, freezing point, gas, liquid, melt, melting point, phase, solid

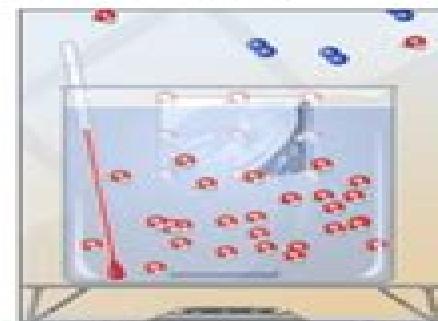


### Lesson Overview

The Phase Changes Gizmo illustrates how molecular motion is related to phase changes. As students add heat to the system, molecules move faster and phase changes occur—ice melts and water boils. When heat is taken away, condensation and freezing occur. Students can create a graph of temperature vs. time, and the altitude can be changed as well.

The Student Exploration sheet contains two activities and an extension:

- Activity A – Students determine the temperatures at which phase changes occur.
- Activity B – Students discover that adding heat energy causes molecules to move faster. The movement of molecules explains why ice melts and water boils.
- Activity C – Students discover how altitude affects phase changes.



### Suggested Lesson Sequence

#### 1. Pre-Gizmo activity: Phase change graph

Before class, create an ice-water bath by placing a bag of ice and a small amount of water into a tub. The temperature should be close to 0 °C. Divide the class into lab groups, and ask students to put on goggles and aprons for safety.

Have each group set up an apparatus to heat the ice water as shown. Stir the water constantly, and record the temperature every two minutes. Once the water is boiling, record 4 more temperature readings before turning off the burners. Graph the results, and discuss. Why does the temperature rise very slowly (or not at all) at first? Why does the temperature stop rising once the water starts to boil?

(45 – 60 minutes)



# Study Guide Phase Changes

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Stormzand**

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*Student Study Guide & Selected Solutions Manual* David D. Reid,2007

**Study Guide to Accompany University Physics, Hugh D. Young, Eighth Edition** James R. Gaines,Young,William F. Palmer,1992

**Student Study Guide and Selected Solutions Manual, Volume 2** Bo Lou,2006-05

**Physics, Study Guide** John D. Cutnell,Kenneth W. Johnson,1992-02-26 This Second Edition designed for a one year course in college physics includes the following new features Integration of Concepts explores the common ground between fundamental ideas in the current chapter and previous ones Problem Solving Insight provides reinforcement and emphasizes issues that students need to recognize as important and a reasoning step which appears before numerical solutions in each example Enhanced by hundreds of applications to biology medicine architecture and technology Worked out examples and homework problems have been substantially increased and full color reproductions added to facilitate students learning ability

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**Study Guide for Chemistry, Third Edition [by] Steven S. Zumdahl** Paul B. Kelter,1993

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