

Saving for a Rainy Day: Instructor Guide

Title:

Saving for a Rainy Day

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Discipline:

Chemistry and Biochemistry

Target Audience

Introductory, nonmajors or majors

Keywords

Energy storage, enthalpy of fusion, heat transfer, phase transitions, phase-change materials, specific heat capacity

Length of Time/Staging

One 50 minute class

Abstract

A request for help comes in from a scientifically-illiterate relative trying to choose a system for passive solar energy storage. In providing this help, students must deal with concepts of heat and energy transfer, heat capacities, phase transitions and related enthalpy changes.



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Format of Delivery

This is the second problem in a thermochemistry unit; the first is a brainstorming session focused on a Discover magazine article on hot-headed moles (inspired by a problem written by Hal White at UD, see <http://www.udel.edu/pbl/hotheads.html>). The first problem raises some general learning issues and concepts related to energy and heat, but with no formal resolution. The Rainy Day problem is then distributed; students spend a 50-minute class working in group of four, and are asked to return to the next class with their solution on overhead transparencies, to share in a whole-group discussion of the problem.

Student Learning Objectives

After completing this problem, students should:

1. understand heat flow and its dependence on mass, specific heats, and temperature differential.
2. recognize the role of energy in phase transitions and be able to calculate enthalpy changes as well as heat flow in appropriate cases.
3. be able to make reasonable assumptions in constructing an energy storage system, and to recognize other complicating factors that will affect that choice.

Student Resources

A general chemistry textbook, web resources for additional information

Instructor Resources

From U.D. Dept of Energy:

Phase Change Materials for Solar Heat Storage

<http://www.eren.doe.gov/consumerinfo/refbriefs/b103.html>

TEAP energy

Commercial supplier of phase change materials

<http://www.teappcm.com/>

Phase Change Material homepage

<http://freespace.virgin.net/m.eckert/>

Author's Teaching Notes

The problem as presented here can readily be modified to make it more open-ended; e.g., by removing the "availability" of the six copper sheets, whose presence suggests the possibility of



constructing a cubic storage tank and a common starting point for the class. If more time is available, students may be left to come up with suggestions on their own. Similarly, the thermodynamic data provided may be expanded to provide more alternatives from which to choose, or deleted entirely and left for the students to find on their own.