

Hot Stuff: An Energy Conservation Problem

Introduction

This laboratory exercise is a departure from the usual experiment. It is an attempt to simulate the kind of problem solving that takes place in a scientific laboratory. There are no instructions, procedures, or data sheets. There is simply a problem to solve that requires reasoning skills and the application of previous experience or knowledge.

A student team will typically consist of three or four members, one of whom should be designated as the recorder for the group. This person records ideas, data, experimental procedures, etc. Your group might also want to assign other tasks to members of the group, for example, a "go-fer," an experimentalist, a report writer, a team leader. (Your investigation will be more efficient if you take a few minutes at the beginning to be sure each person has a clear role to play.) Your team must devise a method for solving the problem and then obtain a numerical answer. When finished, your instructor will lead a class discussion in which teams will compare answers and methods.

The Problem:

As an energy conservation method, you decide to turn down your home water heater so that it only heats water to 55°C. (It previously heated the water to between 60°C and 70°C.) Unfortunately, when you decide to measure the temperature of the water in your water heater, the only thermometer available has a maximum temperature of 40°C. In the laboratory, there is a simulated water heater, consisting of a large coffee pot filled with hot water. Each team will have available a thermometer that has the graduations above 40°C covered so that you cannot see them. Using your 40°C thermometer and materials available to you in the lab, devise a way to measure the temperature of the water in the coffee pot. Your team should be prepared to defend your answer and the method you used to obtain it.

Your instructor will ask you to propose two or three *different* methods for solving this problem, then test each of them, decide which gives the most reliable answer, and explain why.

Materials and Equipment

A variety of materials and equipment will be available that you can use to solve this problem. At a minimum your "lab" should have graduated cylinders, burets, beakers, flasks, plastic ware, Styrofoam cups, stirrers, test tubes, plastic pipets, a balance, and, of course, a 40°C thermometer.

Reporting Your Results

When everyone is finished, your class will assemble to hear a report from each student team about the method used and the results. Therefore, it is important for your team to keep a complete record of everything you do and the numerical data you obtain. In addition to an oral report to the class, your group should prepare a brief (one-page) written report of your investigation. Your instructor will specify what should be included in the report.

This exercise was adapted from the following reference:

Stratton, W., Steehler, G., Pienta, N., & Middlecamp, C. (2003). Laboratory Manual for Chemistry in Context, 4th Edition. McGraw Hill Higher Education, Boston, MA. p. 65