

## **Design and Construction of a Precision Heating Unit**

**Problem:** A child must take a medicine 4 times a day. This medicine must be administered at a temperature exactly 10 °C above room temperature. A portable device is required to warm the medicine when no external heating services are available. The unit must meet the heating specifications. Ease of use, safety and cost are also considerations. You have been assigned to design, construct and test a prototype that uses salt dissolution to heat the medicine.

**Prototype Objective:** The system must increase the temperature of 100.0 mL of water by 10.0 °C in 10.0 minutes, using heat generated by the dissolution a salt from the attached list. The salt can be dissolved in a separate solution. However the salt solution cannot come into contact and contaminate the 100.0 mL of medicine (modeled as water).

**Collaboration Policy:** Unless explicitly stated, there is to be no collaboration or cooperation between groups. It is important to work in your group. Take this policy seriously.

The elements for the project:

### **Team Organization**

Overall Definition of the problem

Summary of approaches considered

Concept Map: Break down the overall project into related elements

(Example: Some sections of the final report can be begun early)

**Chemical Concepts** described at the molecular level (Minimum: HS Chemistry level)

**Basic Principles** (macro properties)

Chemical Reactions equations

Properties of salts and water

Heats of reactions

**Rationale for salt selection**

Evaluation and Selection Criteria

**Heat calculations for dissolution/water heating**

**Selection of Container Materials**

Criteria

**Diagram/Complete list of equipment**

**Procedure**

**Physical Trial 1**

## Analysis of Results

### Revisions for Final trial, with rationale and revised calculations

### Final Trial

### Final Report/Exam

The report must have a section for each phase of the project. The report rubric is included in the book.

### Additional Information

Available Salts: (Rev 2)

Sodium acetate 3H <sub>2</sub> O
Sodium acetate
Lithium Chloride
Sodium Hydroxide
Calcium Chloride 2H <sub>2</sub> O
Calcium Chloride
Magnesium Sulfate 7H <sub>2</sub> O
Magnesium Sulfate
Lithium Bromide
Potassium Hydroxide
Potassium Bromide
Ammonium Chloride
Potassium Sulfate