STEM Connections

myTemp miniSystem

Below are ideas for connecting the myTemp miniSystem to STEM concepts and principles. For more ideas and detailed STEM lessons, consult the *myTemp Teacher's Guide*.

ACTIVITY OVERVIEW

Students use the myTemp miniSystem with various Pitsco products, such as the Solar H_2O Heater. The Solar H_2O Heater uses electromagnetic energy (light) to heat small amounts of water by means of a black flat-plate panel with serpentine metal tubing.

SCIENCE

Electromagnetic Radiation – Systems and System Models

Have teams of two students construct the Pitsco Solar H_2O Heater as indicated in the user guide for the heater. Connect three thermistors to the myTemp miniSystem.

Students add 20 ml of tap water to a container – a plastic 50 ml or larger beaker would work well – and place one of the thermistors in the water.

The other two thermistors should be taped to the Solar H_2O Heater, one on each of the metal tubes coming out of the device. Place the free end of the tube without the accordion bottle in the water in the container. Place the heater in sunlight or under an incandescent lamp, as described in the user guide. Start the data collection for the myTemp.

Slowly compress and then release the accordion bottle so that it draws water into the collector and then pushes it out again. Repeat the compressing and releasing 10 times and then stop the data collection.

Student teams analyze and share their data in terms of electromagnetic radiation and the model heater system. Students can calculate the time that would be required to raise the water temperature to 50°C (typical temperature for a hot shower).

ENGINEERING

Developing and Using Models

Using energy from the Sun to heat water is not a new idea. However, the best or most efficient way to do this is still to be determined.

This can become an engineering design challenge: create a working model of a solar water heater that can be used to heat water and store that thermal energy overnight.

As with most engineering projects, a first step is research to determine how devices currently heat, collect, and store water heated by the Sun.

From the research, students should develop a viable solution to the challenge. This could include a description, sketches, and materials, among other things.

After an idea for a solution is refined, students can build a model that reflects that solution. The model can be tested and revised (through design iterations).

The Pitsco Solar H_2O Heater can be provided as an initial starting point for their designs, and students could engineer a more efficient container for the device – as well as a way to store the thermal energy overnight.

The myTemp miniSystem can be used to test the design and to determine where heat loss might be occurring within the system.

TECHNOLOGY

Sustainable Design

Have teams of students build model homes, all with the same interior length, width, and height, but with various materials and thicknesses of the outside walls and roof.

Materials could include wood, cloth, crumpled paper, accordion-folded paper, foam board, plastic, cardboard (both single layer and corrugated), and other materials. Combinations of materials in layers could also be used.

Using the myTemp, one thermistor is used to measure the ambient air temperature as the models are set in the sun (or under an incandescent lamp – please use caution) for a class period. A second thermistor is placed inside the model to collect data on the temperature rise within the model.

If appropriate, more thermistors can be used within the material or between layers to collect temperature data from those positions.

Using data collected from the model and from other students' models, students can make determinations as to characteristics of materials that provide effective insulation.

As an extension, students can design model homes with efficient insulation and add a solar water heating system by using the Pitsco Solar H_2O Heater on the roof, a circulating system, and a radiant heat exchanger for inside the model.

MATH

Use Ratio and Rate Reasoning to Solve Real-World and Mathematical Problems

Students collect data using the activity described in the **Science** portion of this document by utilizing the myTemp miniSystem and the Pitsco Solar H_2O Heater but add in another variable – rate.

Using a stopwatch or timer, students compress and release the accordion bottle within specific time frames, such as five seconds, 10 seconds, 20 seconds, and so on. Data for each rate is analyzed and compared.

Using ratio and rate reasoning, students determine the effect that rate has on the heating of water with the Pitsco Solar H_2O Heater. Students should be able to provide evidence that supports their reasoning.

Upon completion of this determination, students will use the data and their rate reasoning to determine how large of a collector (in terms of surface area and water volume) would be needed to supply an average amount of water for a warm shower at 40°C for a length of five minutes.

Students should write a report on the underlying ratio and rate reasoning they used and provide supporting graphs and calculations used to come to this conclusion.

PITSCO EDUCATION

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