High School Science
Lesson Plan

In this activity, you'll experimentally measure the melting point/freezing point for coconut oil. The true temperature at which this phase change is known to occur is 78 °F. By comparing your experimental results with the known value, you'll be able to determine what is called "experimental error." *The temperature at which a liquid changes into a solid is known as the freezing point. A liquid must first cool down to its freezing point before this phase change begins. The temperature at which a solid changes into a liquid is known as the melting point. A solid must first heat up to its melting point before this phase change begins. When the substance is exactly at its freezing/melting point, it will actually exist as a mixture of the liquid and solid phases. If its temperature increases, it will melt and fully convert to the liquid phase. If its temperature decreases, it will freeze and fully convert to the solid phase.* *Through careful measurements in this experiment, you should observe an experimental phase change temperature within 3 degrees of the true value. Your results should also indicate the following:* • *The freezing point is the same as the melting point* • *While a substance is undergoing a phase change, its temperature remains relatively constant*	***Procedure*** • *Work in pairs. Each student should take his/her own measurements. Record all measurements in the data table below.* • *Obtain a test tube filled with coconut oil, a thermometer, a beaker willed with cold tap water, and a beaker filled with hot tap water.* • *Hold the test tube in the hot water until the coconut oil melts. Then, place the thermometer in the liquid coconut oil.* • *Remove the test tube from the hot water and place it in the cold water. Immediately record the temperature, and then record additional temperature readings every 10 seconds (use the space below to record your measurements).* • *Note on your data sheet when you observe the first appearance of solid due to freezing, and when you believe all of the sample has converted to the solid phase.* • *Remove the test tube from the cold water and place it in the hot water. Immediately record the temperature, and then record additional temperature readings every 10 seconds. Record the measurements to the ones place (no digits past the decimal place).* • *Note on your data sheet when you observe the first appearance of liquid due to melting, and when you believe all of the sample has converted to the liquid phase.*

Temperatures During Cooling Experiment

Initial: ______________________
10 sec: ______________________
20 sec: ______________________
30 sec: ______________________
40 sec: ______________________
50 sec: ______________________
60 sec: ______________________
70 sec: ______________________
80 sec: ______________________
90 sec: ______________________
100 sec: ______________________
110 sec: ______________________
120 sec: ______________________
130 sec: ______________________
140 sec: ______________________
150 sec: ______________________
160 sec: ______________________
170 sec: ______________________
180 sec: ______________________

Temperatures During Heating Experiment

Initial: ______________________
10 sec: ______________________
20 sec: ______________________
30 sec: ______________________
40 sec: ______________________
50 sec: ______________________
60 sec: ______________________
70 sec: ______________________
80 sec: ______________________
90 sec: ______________________
100 sec: ______________________
110 sec: ______________________
120 sec: ______________________
130 sec: ______________________
140 sec: ______________________
150 sec: ______________________
160 sec: ______________________
170 sec: ______________________
180 sec: ______________________

Data Table

Trials	**Freezing Point (T at which formation of solid is first observed)**	**Melting Point (T at which formation of liquid is first observed)**
Student 1		
Student 2		

Questions

1. Calculate the average of the two students' freezing point and melting point:

   Average FP:

   Average MP:

2. Compare your average values with the true phase change temperature known to be 78°F. What is the experimental error in your results? (hint: subtract your averages from the known value)

3. Share your results with the entire class. Who in the class had the least amount of experimental error? How much experimental error did they have?

4. Explain if your results confirm that the freezing point is the same as the melting point.

5. Explain if your results confirm that while a substance is undergoing a phase change, its temperature remains relatively constant.

Middle School Science
Lesson Plan

In this activity, you'll measure the density of a small iron block that is shaped like a box. The true density of iron is known to be 7.9 g/cm^3. By comparing your experimental results with the known density for iron, you'll be able to determine what is called "experimental error."

The density of an object is a ratio of its mass to its volume. This ratio is calculated by taking the mass of the object and dividing it by the volume of the object.

$$\text{Density} = \frac{Mass}{Volume}$$

The mass of an object can be measured using a digital balance which reports the measurement in the unit grams (g). The volume of a solid object that has all straight edges can be determined by using a ruler to measure the length of each straight edge.

Volume = Length x Width x Height

If the edge measurements are all in the unit centimeter (cm), then the calculated volume will be in the unit cubic centimeter (cm^3).

Good results for this experiment should have a difference of less than 10% of the true density for iron.

Procedure

- *Work in groups of 3 students. Each student should take his/her own measurements. Record all measurements from each student in the data table below.*
- *Obtain an iron block and ruler from the teacher.*
- *Measure the mass of the block using the digital balance. Make sure the balance is reading zero before taking a measurement. Record the measurement (in g) with one digit past the decimal place.*
- *Measure the length, width, and height of the block using the ruler. Record each measurement (in cm) with one digit past the decimal place.*
- *Calculate the volume by multiplying the length x width x height measurement. Record the volume (in cm^3) with one digit past the decimal place.*
- *Use your experimental measurements to answer the questions below.*

Data Table

Trials	**Mass (in g)**	**Length (in cm)**	**Width (in cm)**	**Height (in cm)**	**Volume (in cm^3)**
Student 1					
Student 2					
Student 3					

Questions

1. Use the measurements from each student to calculate the density of the block. Take the mass and divide it by the volume to determine the density. Then, calculate the average of the three density values from your group. Record each value below with one digit past the decimal place.

Student 1 Density (g/cm^3)	Student 2 Density (g/cm^3)	Student 3 Density (g/cm^3)	Average Density (g/cm^3)

2. The true density of iron is known to be 7.9 g/cm^3. What is 10% of this true value? (hint: multiply this density by 0.1)

3. Calculate the difference between the average density value from your group's measurements and the known density of iron. (hint: subtract your average density value from the known density of iron) Is this less than 10% of the true density of iron?

4. Share your results with the entire class. Who in the class had the least amount of experimental error?

Elementary Science
Lesson Plan

In this activity, you'll experiment to determine what kinds of mixtures allow for bubbles to last longer. Bubbles are made up of air surrounded by a thin film of water. The film, or skin, wraps around moving air, trapping the air within. Some mixtures allow the "skin" of water to stretch by lessoning its surface tension. This allows bubbles to last longer before popping! *Previous investigations have found the following results:* • *Bubbles can form from plain water* • *Soapy bubbles are stronger than bubbles made from plain water* • *Glycerin mixed with water makes very long lasting bubbles* • *The tool used to blow a bubble has an effect on how long the bubble lasts* • *The surface on which a bubble attaches has an effect on how long the bubble lasts*	***Procedure*** • *Work in groups of 2-3 students.* • *Obtain four cups. Prepare a small amount of four separate liquids to test—1) water only, 2) water & soap, 3) water & glycerin, and 4) soap & glycerin. When preparing the mixtures, use equal amounts of each liquid.* • *Obtain four plates which have a smooth surface. Pour a small amount of liquid on each of the four plates, one liquid per plate. Use a straw to blow a bubble in each liquid. Measure how many seconds the bubbles last before popping. Record your test results in the table below.* • *Repeat this experiment using plates with a rough surface. Record your test results in the table below.* • *After you have completed all experiments, use the space provided to answer the questions.*

Data Table

Mixture	Time Until Bubble Pops	
	Using Straw and Flat Surface	Using Straw and Rough Surface
Water only		
Water and soap		
Water and glycerin		
Soap and glycerin		

Questions

1. Which mixture created the longest lasting bubbles? ______________________________
2. Did your bubbles last longer when they were attached to a flat or rough surface? ______________________________
3. Share your results with the entire class. Who in the class had the longest lasting bubbles, and how long did they last? ______________________________
4. Consider the results for the entire class. What experimental conditions allowed for the longest lasting bubbles? ______________________________