Name: ______________________________ Class: ______ Date: _________

Expanding Solids

Learner Outcomes;

- Investigate and describe the effects of heating and cooling on the volume of different materials, and identify applications of these effects.

Key Terms:

Expansion	Contraction	Particle theory

Background Information: When substances are heated and cooled, the particles move faster or slower, and thus either spread apart or come closer together. This means the length of different materials can change at different temperatures.

Question: What evidence can you observe of solid materials expanding as they are warmed, and contracting as they are cooled?

Hypothesis: Complete the following statements:

Particle theory suggest that when

a) a material is heated it will ______________________

b) a material is cooled it will ______________________

Materials:

Long copper or iron wire	Ball and ring apparatus	Candles
200 or 500 g mass	Methanol burner	Cold water
Meter stick	2 lab stands	Matches
	2 C clamps	

Procedure:

Part 1: The Sagging Wire

1. Clamp two supports firmly to the table and stretch the wire between them. Place a small mass in the middle of the wire and record the height to the lowest point of the wire.
2. Use lighted candles or an alcohol burner to warm the length of the wire for several minutes, recording the height of the wire every 30 seconds.
3. Stop warming the wire and observe and record what happens to the height of the mass during the next 2 or 3 minutes.

This investigation / activity has been adapted from:
Bullard J, Krupa G, Krupa M, et al. *Science Focus 7*. Toronto, ON: McGraw-Hill Ryerson.

Part 2: The Ball and Ring

1. Observe whether the brass ball fits through the brass ring when both are at room temperature.
2. Warm the ring in the methanol burner flame for 30seconds and observe whether the ball fits through the ring.
3. Warm both the ring and the ball and observe whether the ball fits through the ring. Cool the ball and the ring in a cold water bath and observe whether the ball fits through the ring.
4. Manipulate the heating and / or cooling of the ball and / or ring to make the ball fit through the ring.

Observations:

Part 1: The Sagging Wire

1. Prediction:

2. Initial Height: _______cm

3. Height after 30s of heating: _______ cm
   Height after 1 min: _______ cm
   Height after 1 min 30 sec _______ cm
   Height after 2 min _______ cm

Qualitative Observations:

4. Height after 30 sec of cooling: _______ cm
   Height after 1 min: _______ cm
   Height after 1 min 30 sec _______ cm
   Height after 2 min _______ cm

Qualitative Observations:

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Part 2: The Ball and Ring

Procedure:

1. Observation of ball and ring at room temperature:

2. Prediction:

3. Observation after 30 s of heating the ring:

4. Observation of both ring and ball heated:

Analysis:

1. If the wire sags, the mass moves down. Does this mean the wire is getting longer or shorter? Is the metal expanding or contracting?

2. What happens to the wire if the mass moves up?

3. Did your observation support your hypothesis? Explain.

4. What combination of heating and cooling allowed you to place the ball through the ring? Describe what happened to the particles in each of those objects.

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5. How well did your hypothesis help you predict the behavior of the ball and the ring? Was it useful/ how would you change it?

6. Use the particle model to explain why objects expand and contract when heated.

Conclusion:

Extension:

1. Electrical transmission lines are made of metals that expand and contract when the temperatures change. Why would it be a bad idea to stretch transmission lines tightly between towers so they sag less in the summer?

2. Many livestock owners use a type of electrified, braided rope to keep in their livestock. This product is made of nautical grade nylon strands and 6-8 strands of copper wire braided throughout. Some ranchers complain that this product seems to stretch and become looser in the winter. Explore and suggest a reason why this might be the case, or propose a scientific experiment to test whether this claim is actually true or not.

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