Polymer Activity from the:

Saran Wrap Investigation

Grades: 6-8

Purpose: to discover the "memory" of Saran Wrap at various temperatures

Background: The potential energy stored in the extended molecules of Saran Wrap has "elastic memory". When the plastic is reheated near its orientation temperature of the manufacturing process, it shrinks, as the molecules tend to return to the original spatial arrangement in the sheet of plastic.

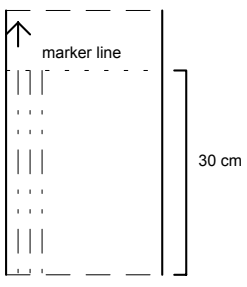
Science Standards: Content Standard A: Science as Inquiry; Content Standard B: Physical Science; Content Standard E: Science and Technology

Materials: (for a class of 30 working in pairs)

One roll of Saran Wrap made by S.C. Johnson a Ziploc® Brand
15 scissors
15 - 30 cm rulers or meter sticks
15 markers
hot water bath at an assigned temperature with a thermometer
stirring rod or spoon
tongs (optional)
one poster board with axes drawn and transparent tape

Procedure:

1. Tear off a piece of Saran Wrap approximately 40 cm long. Make sure the torn edge is straight. If it is not, use scissors to make it straight and perpendicular to the outer edge.
2. Use a marker to draw a small arrow at one end to indicate the direction in which the sheet came off the roll.
3. Holding the sheet along the width edge (not the 40 cm length edge), use a ruler and a marker to make a mark at the 30 cm position on the lengthwise direction.
4. Make two more marks in the same way, one in the middle and one at the other edge of the sheet.
5. Draw a line connecting the three marks.
6. Cut the sheet along this line.
7. Mark off strips in the direction of the arrow that are 3 cm wide. Cut three strips.



Saran Wrap

8. Get your assigned temperature or your temperature bath from your teacher. Heat a beaker half filled with water to the assigned temperature or make sure your temperature bath is at the assigned temperature before you proceed. Check the temperature with a thermometer.
9. Put one strip of Saran Wrap into the water.
10. Stir the strip with a stirring rod or spoon. Make sure the strip is under the surface of the water for part of the time.
11. After about one minute, pull the strip out with a pair of tongs or "catch" it with the spoon. Be careful some strips will be very hot.
12. Place the strip on the counter or tabletop to cool if needed. Try not to tear the strip as you straighten it. Measure its length in cm. Record in the data table below.
13. Repeat steps 9-12 for the other two strips.
14. Choose a strip, which is intermediate in length, and give it to your teacher. Make sure to tell your teacher the temperature bath for your strip.

The teacher will place each strip from each temperature bath on the poster.

Data Table: Original length of Saran Wrap strip = _____ cm

Temperature bath = _____° C	**Length of strip after being in water bath**
Strip #1	
Strip #2	
Strip #3	
Average length in cm	

Conclusions:

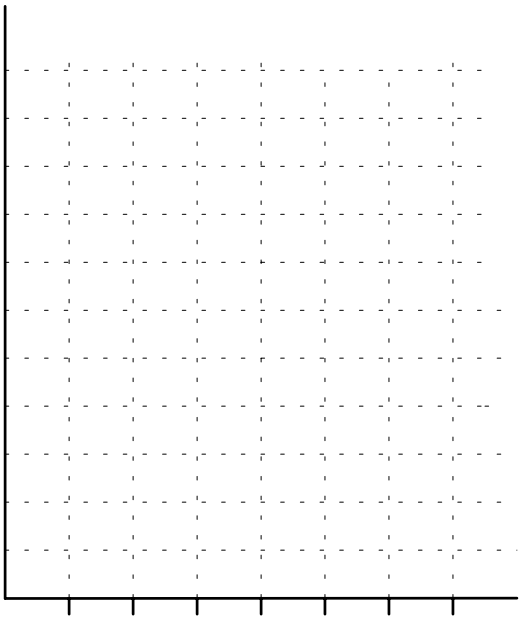
1. One strip from each temperature bath is now displayed on the poster graph for the class. Do you see any trend in the length of the strip compared with the temperature? Explain.

2. Calculate the average length of your three strips and place that number on the data table. Show your work here.

3. Find the average length of each strip for all the various temperature baths. See the chalk board of the class data or visit other groups to get the data. Record the results below: (remember each strip started out at 30 cm) Fill the other columns by doing the math requested.

Temperature bath in ° C	Average length in cm	Difference in length in cm	Percent difference = (Difference/30 cm) x 100
40			
50			
60			
70			
80			
90			
100			

4. Make a line graph of the class data for the percent difference in cm length. Place the independent variable on the X axis and the dependent variable on the Y axis. Label the axes and title your graph.



5. Which temperature had the greatest shrinkage in the food wrap? _____
6. Which temperature had the least shrinkage in the food wrap? _____
7. How does your line graph compare to the poster bar graph? Explain.

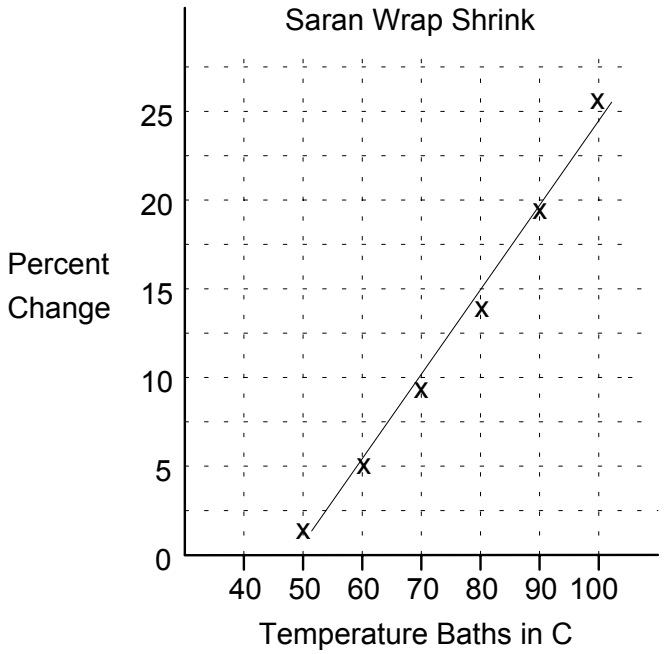
8. Does the shrink-ability of Saran Wrap make it an inferior food wrap?

Teacher Notes for Saran Wrap Investigation:

Saran was the first shrink film. It is a copolymer made out of poly(vinylidene chloride) with vinyl chloride. It has a symbol of PVdC. It shrinks below 100°C while most other films shrink at temperature exceeding 100°C. The potential energy stored in the extended molecules has "elastic memory". Making Saran Wrap involves blowing a bubble of hot Saran, and using air to cool the bubble into a film. During this process, orientation of the molecules is introduced which causes the wrap to "de-orient" when exposed to hot water. When the plastic is reheated to its orientation temperature of the manufacturing process, it shrinks, as the molecules tend to return to the original spatial arrangement. Other food wraps may not demonstrate this "memory".

The teacher needs to provide several hot plates with 250 mL or 400 mL beakers of water heated to various temperatures depending upon how many temperatures are being studied. The recommended temperatures are 40, 50, 60, 70, 80, 90, and 100° C.

1. The poster graph is a large poster board with the axes drawn. The x axis is the temperatures starting at 40°C and going up to 100°C. Allow for each strip to be 3 cm wide with a one cm space between each strip. This makes the axis at least 30 cm long. The y axis is the length of the strips in cm. The maximum height will be 30 cm. Use transparent tape to stick the strips to the graph. The 40°C bath will have a strip 30 cm long since no shrinkage is seen at this temperature.
2. The average length is calculated by adding the three strip lengths and dividing by three.
3. The percent difference will range from 0% at 40°C to about 25% at 100°C.
4. A typical line graph for this experiment looks like this:



5. The greatest shrinkage is at 90°C or 100°C.
6. The least shrinkage is at 40°C or below.

7. The two graphs represent the same data. One is the average length at each temperature and the other is the percent change.
8. Saran Wrap is an excellent food wrap and one does not usually heat the wrap so this shrink property is not a concern.

   Saran Wrap provides a barrier to oxygen, water, and odor that other plastic wraps do not provide. To demonstrate the barrier property, wrap one-half an onion in Saran Wrap and the other half in Glad Wrap or Handi-Wrap. Wait 10 minutes and smell both wrapped packages.

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