Bridgeport Public Schools
Science Department

Embedded Performance Task

Synthetic Polymers

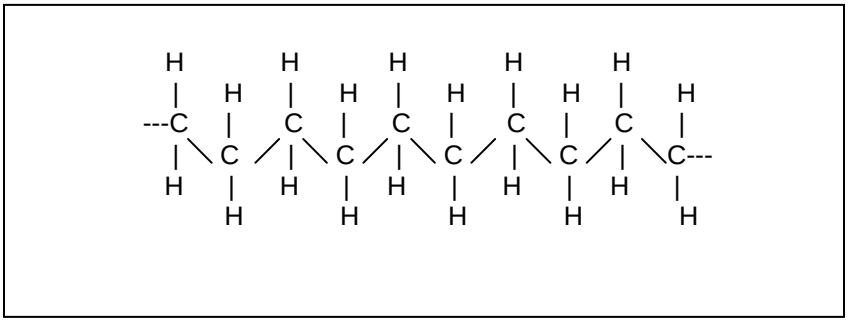
Laboratory Investigation
Student Materials

Synthetic Polymers

Student Materials

Polymers are large molecules consisting of chains of small molecules called monomers joined together in a repeating pattern. In the early 1900s, scientists began to understand the chemical makeup of natural polymers and how to make synthetic polymers with properties that complement those of natural materials. One simple synthetic polymer chemists developed is polyethylene. They developed it by repeating units of the monomer ethylene ($H_2C=CH_2$). Polyethylene is a very large, zigzag-shaped molecule. One small part of a polyethylene chain is shown below.

$$-(CH_2- CH_2)-_n$$



Chemists and engineers have learned to process and modify molecules of polyethylene in different ways to manufacture common household products with a variety of characteristics. Polyethylene is used to make plastic trash bags, dry cleaning bags, milk jugs and soda bottles. In industry, materials made from polyethylene are tested for what are called "stress-strain behaviors." Stress-strain behaviors include:

tensile strength - the amount of pulling force placed upon a material before it breaks
abrasion resistance - toughness of material against scraping, scuffing or scarring
puncture resistance - ability of a material to keep moving objects from perforating the surface

Your Task

You and your lab partner will design an experiment that investigates a stress-strain behavior among various plastic products made of the synthetic polymer polyethylene.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided.

Suggested materials:

plastic dry cleaning bag
plastic kitchen wrap
plastic sandwich bag
plastic grocery bag
ball bearings (different masses)
scissors
markers
sandpaper (coarse and fine)
coffee can
rubber bands
ring stands/ or clamps
ruler
safety goggles

Designing and Conducting Your Experiment

1. In your words, state the problem you are going to investigate. Write a hypothesis using an "If … then … because …" statement that describes what you expect to find and why. Include a clear identification of the independent and dependent variables that will be studied.

2. Design an experiment to solve the problem. Your experimental design should match the statement of the problem and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate and state which variables need to be held constant.

3. Review your design with your teacher before you begin your experiment.

4. Conduct your experiment. While conducting your experiment, take notes and organize your data into tables.

Safety note: Students must wear approved safety goggles and follow all safety instructions.

When you have finished, your teacher will give you instructions for cleanup procedures, including proper disposal of all materials.

Communicating Your Findings

Working on your own, summarize your investigation in a laboratory report that includes the following:

- **A statement of the problem you investigated. A hypothesis ("If ... then … because …" statement) that described what you expected to find and why.** Include a clear identification of the independent and dependent variables.

- **A description of the experiment you carried out.** Your description should be clear and complete enough so that someone could easily replicate your experiment.

- **Data from your experiment.** Your data should be organized into tables, charts and/or graphs as appropriate.

- **Your conclusions from the experiment.** Your conclusions should be fully supported by your data and address your hypothesis.

- **Discuss the reliability of your data and any factors that contribute to a lack of validity of your conclusions**. Also, include ways that your experiment could be improved if you were to do it again.