

Grades 9-10
Curriculum-Embedded Performance Task
Strand II: Chemical Structures and Properties



Synthetic Polymers

Laboratory Investigation
Teacher Materials

Synthetic Polymers

Teacher Materials

This curriculum-embedded science performance task is related to the content standard and expected performances for high school, as described in the Core Science Curriculum Framework under Scientific Inquiry, Literacy and Numeracy, Strand II – Chemical Structures and Properties.

Targeted Content Standard

9.6 - Chemical technologies present both risks and benefits to the health and well-being of humans, plants and animals.

Targeted Scientific Inquiry, Literacy and Numeracy Standards

D INQ. 1 Identify questions that can be answered through scientific investigation.

D INQ. 3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

D INQ. 4 Design and conduct appropriate types of scientific investigations to answer different questions.

D INQ. 5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

D INQ. 6 Use appropriate tools and techniques to make observations and gather data.

D INQ. 7 Assess the reliability of the data that was generated in the investigation.

D INQ. 9 Articulate conclusions and explanations based on research data, and assess results based on the design of an investigation.

Learning Objective:

Students will investigate a synthetic polymer (polyethylene) and how the polymer can be processed to produce products with different characteristics.

Listed below are the suggested materials for the laboratory exercise. You may use additional materials if they are available.

Materials:

plastic dry cleaning bags
clear kitchen wrap
plastic sandwich bags
ball bearings (different masses)

sandpaper (coarse and fine)
empty coffee cans
rubber bands
ring stands or clamps

markers
safety goggles
ruler
scissors

Considerations:

Students will need some background information on the structure of polyethylene and the terminology used to describe the different arrangements of the polymer, for example low density polyethylene (LDPE) versus high density polyethylene (HDPE). The differences in the stress-strain behaviors of polyethylene in the products the students are investigating are due in large part to how the materials are processed. Background information on the processing of plastics and specific information about polyethylene may be found at these and many other sites:

<http://www.teachingplastics.org>

http://americanplasticscouncil.org/s_apc/index.asp

Teams of two students are ideal for laboratory work, but circumstances may necessitate teams of three students. Students will need a minimum of 90 minutes to complete this laboratory exercise if you expect their lab reports to be written during class time. You should allow at least 60 minutes of instructional time for the students to design and conduct their experiment and a minimum of 30 minutes for the students to write about their results. As an alternative, students can write the lab report for homework. These time frames are merely suggestions. Additional time is appropriate if the circumstances and the schedule at your school call for it. A sample scoring rubric is provided for your convenience or you can design one of your own.

This curriculum-embedded task can be integrated into a unit on polymer chemistry in any high school physical or Earth science course. The curriculum-embedded task is intended to be used as a formative assessment during the appropriate instructional unit. The Connecticut Academic Performance Test – Generation III will include some open-ended items that will assess scientific inquiry and communication skills in the same context as this task.

Curriculum-Embedded Laboratory Investigation Scoring Rubric

Statement of Problem and Hypothesis

- 3 The problem and hypothesis are stated clearly and completely. Clear identification of independent and dependent variables.
- 2 The problem and hypothesis are stated adequately. Adequate identification of independent and dependent variables.
- 1 The problem and/or hypothesis are poorly stated. Poor identification of independent and dependent variable.
- 0 The statement of the problem and/or hypothesis is very limited or missing altogether. No identification of independent and dependent variables.

Experimental Design

- 3 The experimental design matches the stated problem. Variables are held constant. The procedures are clear, complete and replicable. A control is included when appropriate.
- 2 The experimental design generally matches the stated problem. Attempt at holding variables constant is made. Procedures are generally complete. Minor modifications or clarifications may be needed.
- 1 The experimental design matches the stated problem to some extent. Little attempt to hold variables constant. Procedures are incomplete. Major modifications or clarifications may be needed.
- 0 The experimental design does not match the stated problem, is very incomplete or missing. There is no attempt to hold variables constant.

Data Presentation

- 3 Data are well organized and presented in an appropriate manner.
- 2 Data are organized and presented in an appropriate manner. Minor errors or omissions may be present.
- 1 Data are poorly organized or presented in an inappropriate manner. Major omissions or errors may be present.
- 0 Data are very poorly organized or presented in an inappropriate manner or missing altogether.

Conclusions

- 3 Conclusions are fully supported by data and address the hypothesis. Reliability of data and validity of conclusions are thoroughly discussed.
- 2 Conclusions are generally supported by data and address the hypothesis. Minor errors in interpretation of results may be present. Discussion of reliability of data and validity of conclusions is limited.
- 1 Conclusions are supported by data and address the hypothesis to a limited extent. Major errors in interpretation of results may be present. There is little discussion of the reliability of the data or validity of conclusions.
- 0 Conclusions are not supported by data, do not address the hypothesis or are missing. There is no discussion of the reliability of data or validity of conclusions.

Excellent performance	10-12 points
Proficient performance	7-9 points
Marginal performance	4-6 points
Unsatisfactory performance	0-3 points