

**CLASSROOM ACTIVITY**

# A Sweet Petroleum Polymer

## OBJECTIVE

Students will be able to:

- **Examine** the chemical structure of different types of natural polymers to determine patterns.
- **Conduct** an investigation and **analyze** data to compare the amount of polymer in different types of chewing gum.

## OVERVIEW

In this investigation, students will discover that petroleum-based polymers are very strong, and humans have discovered how to make and use them for many things, including gum! Students will begin the lesson by examining several different types of natural polymers at the molecular level and identify them. Students will then investigate the amount of synthetic polymer in chewing gum by calculating and comparing the percentage of polymer remaining after chewing different types of gum.

## NATIONAL STANDARDS

### Next Generation Science Standards

- MS-PS1-3 Structures & Properties of Matter  
Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- MS-PS1-2 Chemical Reactions  
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical change has occurred.

### ITEA/ITEEA Standards for Technological Literacy

- Standard 19. Students will develop an understanding of and be able to select and use manufacturing technologies.  
M: Materials have different qualities and may be classified as natural, synthetic, or mixed.

## BACKGROUND

Crude oil is a mixture of hydrocarbons that formed from plants and animals that lived millions of years ago. Petroleum products are fuels made from crude oil and other hydrocarbons contained in natural gas. After crude oil is removed from the ground, it is sent to a refinery and is separated into different petroleum products including gasoline, jet fuel, waxes, and asphalt. Packaged baked goods often contain petroleum as a way of keeping them fresh and mold free. While regular flour, water, eggs, and sugar combinations go bad relatively quickly, mineral oil keeps them fresh for weeks. Polymers are very strong, and humans have discovered how to make and use them for many things. Plastics are human made polymers, but there are many natural polymers like cotton and wood made primarily from cellulose. Chewing gum is made of sweeteners, softeners, flavoring, and the base which is made from a petroleum-based polymer. Originally, the gum base was made from tree resins, but today synthetic polymers are used.

## KEY VOCABULARY

- Polymer
- Monomer
- Chemical engineer
- Law of conservation of mass
- Chemical change
- Physical change

## MATERIALS

- Images of natural polymers
- Capture Sheet—*A Sweet Petroleum Polymer*
- Various brands of chewing gum
- Digital balance

## TEACHER PREPARATION

- Image of the chemical structure for each of the following natural polymers:
  - DNA
  - Cellulose
  - Cholesterol
  - Triglyceride
  - Starch
  - RNA
  - Protein
- Copies of *A Sweet Petroleum Polymer* for each student

## PROCEDURE

1. Explain to students that they will be examining several types of polymers found in nature. Each of the four corners of the classroom will be labeled with a type of polymer (carbohydrate, lipid, protein, nucleic acid). Students will examine one polymer at a time and will walk to a designated corner of the classroom they predict as the answer. The students will form groups of 2–3 and share why they selected this option. After students share their arguments with the class, the instructor will announce the correct answer. The four-corner activity will continue until all polymers have been identified.
2. Ask students if they noticed any patterns among the different types of natural polymers. Show each image again and ask what elements they have in common.
3. Explain that some atoms, particularly carbon atoms, can join in long chains to form very long molecules called polymers. Polymers are formed from long chains of a smaller molecule, called a monomer. Synthetic or man-made polymers were first discovered in the late 1800's. Did you know that one of the ingredients in chewing gum is a synthetic polymer made from petroleum?
4. Explain to students that chemical engineers transform raw materials like crude oil into refined products like chewing gum. Chemical engineers apply the principles of chemistry, biology, physics, and math to solve problems that involve the production or use of chemicals, fuel, drugs, food, and many other products. Chemical engineers work in almost every industry and affect the production of almost every article manufactured on an industrial scale.
5. Explain to students that they will watch a short video to better understand the field of chemical engineering and some of the coursework students would take to obtain a degree in chemical engineering. Use this link to access the video and select chemical engineer/chemist.  
<https://stemcareerscoalition.org/employees/career-profiles>
6. Distribute the *A Sweet Petroleum Polymer* worksheet to each student and state that they will investigate the amount of polymer in various types of chewing gum. Show the students the different types of chewing gum that will be used for the investigation. Have students make a prediction as to what they think will happen to the mass of the gum after chewing for ten minutes. Do they think there will be a difference between the brands?
7. Allow students to work in groups of four to complete the investigation. Each student in the group should select a different type of chewing gum to investigate. Review the procedures with the students and demonstrate how the electronic balance works. Select an electronic balance that is sensitive because this will produce better results. The teacher should walk around the room to answer questions that students may have. Students may also need help calculating the percent of polymer.
8. Provide students the opportunity to compare their results with other groups in the class by inviting the students to write their percent of polymer for the type of gum they selected on the board. Calculate the class average for each brand of chewing gum and use the class averages to answer the analysis questions.
9. To close the activity, invite students to share their answers to the analysis questions before sharing the correct answers with them.

## EXTENSION

As an extension of this activity, students can research colleges in their state that offer chemical engineering programs, future employment trends, and median salaries of chemical engineers.

## Before We Begin

1. Predict what will happen to the mass of the gum? Why do you think this?
2. Do you think there will be a difference between the various brands? Why do you think this?

## Procedure

1. Place the gum in its wrapper and record its initial mass.
2. Unwrap the gum and save the wrapper.
3. Chew each piece of gum for at least ten minutes.
4. Dry the chewed piece of gum to the best of your ability and place it back on its wrapper.
5. Record the final mass and calculate the weight loss.
6. Use the formula to calculate the percentage of polymer.

Type of Gum	Initial Mass (g)	Final Mass (g)	Change in Mass (g)	Percent of Polymer (final mass/initial mass) X 100

## Analysis

1. Is this a chemical change or physical change? Provide evidence for your reasoning.
2. Do our results support the law of the conservation of mass? If the gum lost mass, where did this mass go? What remained after chewing?