

Polymers

Why?

The paint in a picture, the sneakers on your feet, and the bottles for water that you drink are all examples of polymers that you encounter every day. What are these items made of and how are they manufactured?

Learning Objectives

- Define Polymer
- Explain the process of polymerization and its uses

Success Criteria

- Explain the difference between a monomer and a polymer
- Describe the characteristics of polymers

Resources

- Box of paper clips

Prerequisites

- Organic compounds
- Hydrocarbon
- Bonds
- Alkane
- Alkene
- Alkyne

Model 1

Table Q
Homologous Series of Hydrocarbons

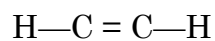
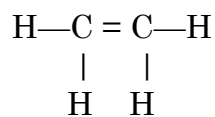
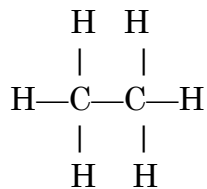
Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$
alkenes	C_nH_{2n}	ethene	$\begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array}$
alkynes	C_nH_{2n-2}	ethyne	$\text{H}-\text{C}\equiv\text{C}-\text{H}$

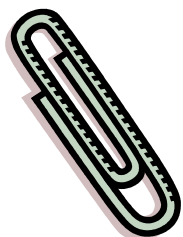
n = number of carbon atoms

<http://www.emsc.nysed.gov/osa/reftable/reftablearch/ChemRef1-7.pdf>

Key Questions

1. What element is found in all organic compounds?
2. What elements are found in hydrocarbons?
3. What are the names of the following simple hydrocarbons



Model 2

MONOMER

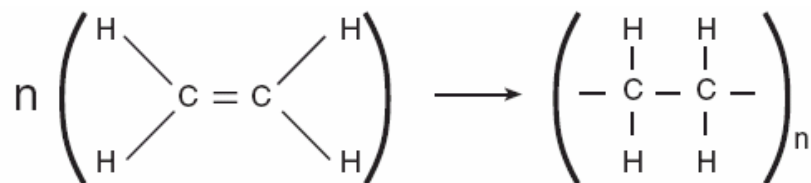


?

Using the paperclips to represent monomers, make a chain of 20 paperclips.

Key Questions

1. If the single unit in the model is called a monomer, what would you call a chain of the units?
2. Describe the difference between a monomer of paperclips and the chain of paperclips that you made.
3. What is the relationship between a monomer and a polymer?

Exercises

(n is a large number, generally > 2000)

1. Using the terms monomer, polymer and polymerization, describe in your own words what is happening in this reaction?

Activity

Create a polymer by mixing 8 grams of borax with 200 mL of warm water. Stir until the borax is dissolved. Let the solution cool to room temperature. In a small cup add 15 ml of white glue (e.g., Elmers[®] glue) and 15 ml of water. If you would like to add color to the glue, add a few drops of food coloring to the glue-water mixture. Mix 15 mL of the borax solution with the glue. Stir for 2 to 3 minutes until the water is absorbed.

[Note: At the end of this activity follow your teacher's instructions regarding disposal of the polymer.]

Key Questions

1. What are the characteristics of the polymer that you have created?
2. How do the properties of the polymer differ from the properties of the plain glue?
3. What could have happened on the molecular level to cause the change in consistency?

Research

1. Polymers are used to make many different materials. Name 5 parts of a car that are made using polymers.
2. Why is a polymer used in the windshields of airplanes and what kind of polymer is it?
4. Many foods used to be packaged in glass bottles. What kind of polymer now is used instead of glass?
5. What might be some of the economic side effects of the increased use of polymers in automobiles?

While many of the polymers in use today are man-made, there are many naturally occurring polymers that are encountered every day. Name three common natural polymers and a so