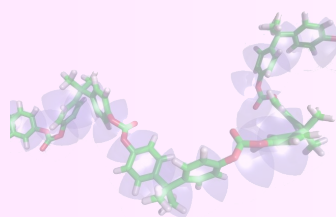


AN INTRODUCTION  
TO  
POLYMERS  
AND  
MATERIALS SCIENCE

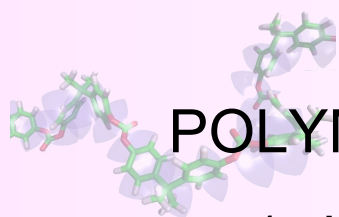


The simplest definition of a polymer is a useful chemical made of many repeating units.

AAAAAAAA

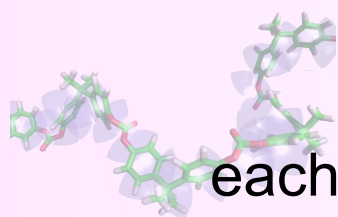
OR

AB-AB-AB-AB



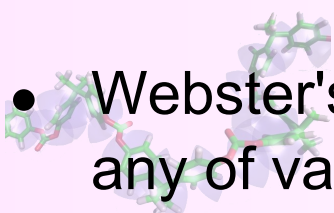
## POLYMERS CAN LINK

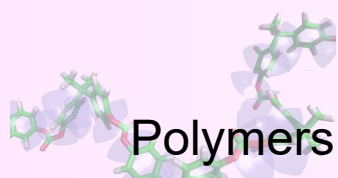
- 1-dimensionally (like a chain)
- 2-dimensionally- 2 chains
- or 3-dimensionally-
  - > up and down
  - > diagonally
  - > and sheets



each repeating unit is a "mer" or  
basic unit

Many mers= poly-"mer"

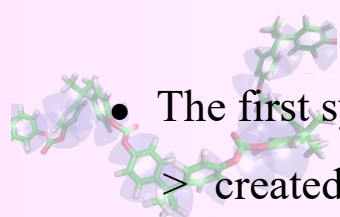
- 
- Webster's Dictionary defines polymers as: any of various complex organic compounds produced by polymerization, capable of being molded, extruded, cast into various shapes and films, or drawn into filaments and then used as textile fibers.



Polymers are both man-made and occur in nature.

Manufactured polymers can be three-dimensional networks that do not melt once formed.

Such networks are called THERMOSET polymers.



- The first synthetic manufactured plastic was Bakelite,
  - > created in 1909 for telephone casing and electrical components.
    - The first manufactured polymeric fiber was Rayon
      - > from cellulose
      - > in 1910
  - Nylon was invented in 1935
    - > while pursuing a synthetic spider silk.

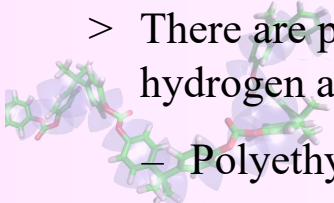
## Structure



Many composed of hydrocarbons, compounds of carbon and hydrogen.

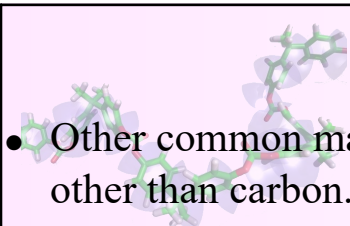
- > long chains of carbon atoms that are called the backbone of the polymer.
- > Because of the nature of carbon, one or more other atoms can be attached to each carbon atom in the backbone.

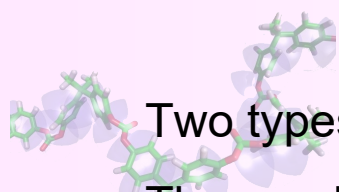




> There are polymers that contain only carbon and hydrogen atoms; examples:

- Polyethylene,      -polypropylene
- polybutylene,      -polystyrene
- polymethylpentene
- Polyvinyl chloride (PVC) has chlorine attached to the all-carbon backbone.
- Teflon has fluorine attached to the all-carbon backbone.

- 
- Other common manufactured polymers have backbones that include elements other than carbon.
    - > Nylons contain nitrogen atoms in the repeat unit backbone.
    - > Polyesters and polycarbonates contain oxygen in the backbone.
    - > There are also some polymers that, instead of having a carbon backbone, have a silicon or phosphorous backbone.
      - These are considered inorganic polymers.
      - One of the more famous silicon-based polymers is Silly Putty®.



Two types of manufactured polymers:

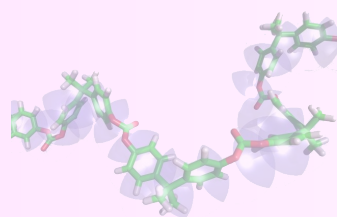
Thermoplastic: once the polymer is formed it can be heated and reformed over and over again.

Thermoset: cannot be remelted. Once these polymers are formed, reheating will cause the material to ultimately degrade, but not melt.

## Characteristics of Polymers

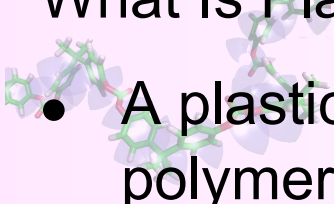
most polymers have the following general attributes:

1. Resistant to chemicals
2. Thermal and electrical insulators
3. Generally light in weight with significant degrees of strength
4. Polymers can be processed in various ways
5. Seemingly limitless range of characteristics and colors
- ~~6. Usually made of petroleum, but not always~~
7. Can be used to make items that have no alternatives from other materials



# PLASTICS

## What Is Plastic?

- 
- A decorative graphic of a molecular structure, possibly a polymer chain, with green and purple spheres representing atoms and red lines representing bonds. It is positioned behind the first bullet point.
- A plastic is a type of synthetic or man-made polymer
  - similar in many ways to natural resins found in trees and other plants.



