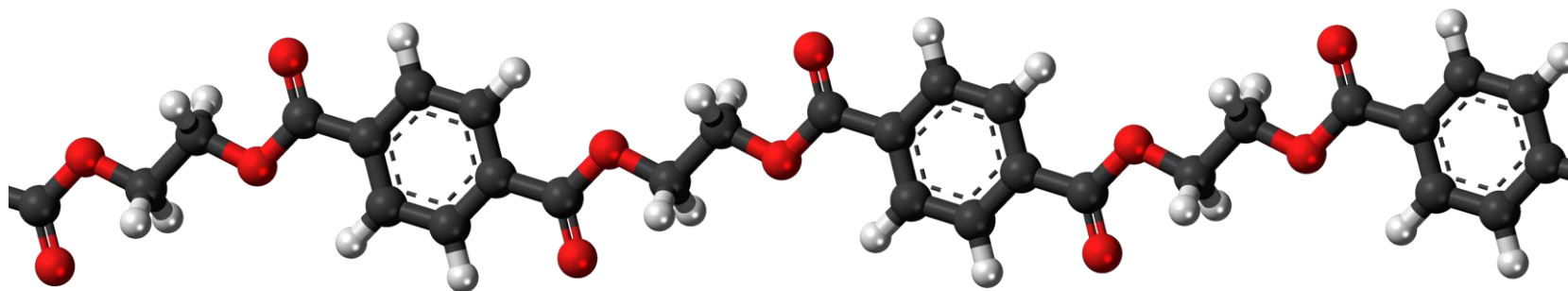


Polymers - Introduction



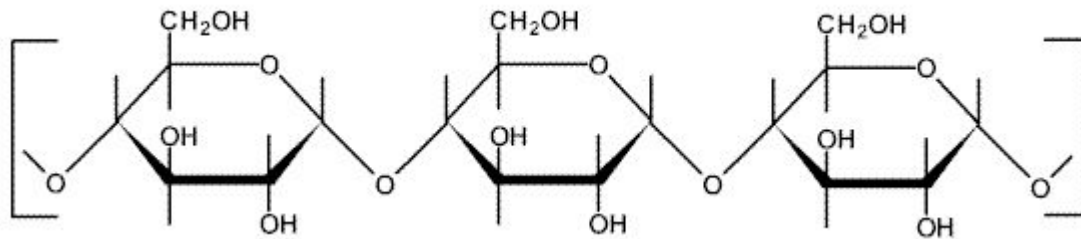
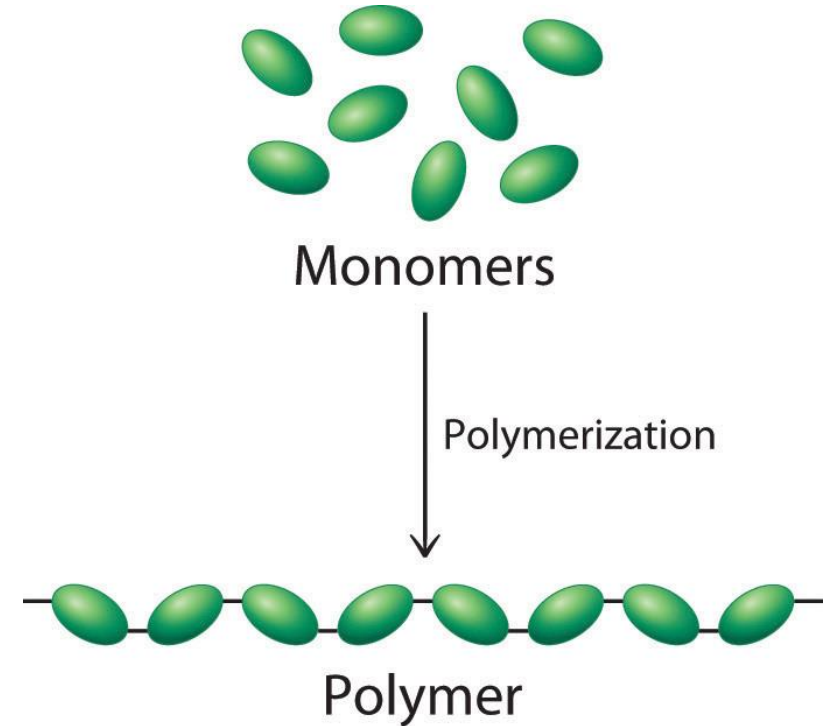
Instructor: Asst. Prof. Dr. Tanatorn Khotavivattana
E-mail: tanatorn.k@chula.ac.th

Recommended Textbook:

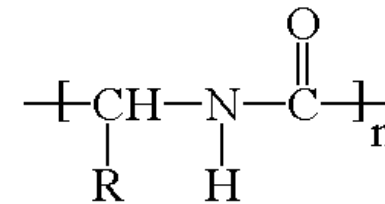
Chapter 26 in *Organic Chemistry*, 8th Edition, L. G. Wade, Jr., **2010**, Prentice Hall (Pearson Education)

Introduction

- **Polymer**: a large molecule composed of many smaller **repeating units** (the **monomers**) that are covalently bonded together
- **Polymerization** is the joining together of monomers to make polymers
- Polymers can be **naturally occurring** (e.g. polysaccharides and proteins) or **synthesised** in a laboratory (synthetic)

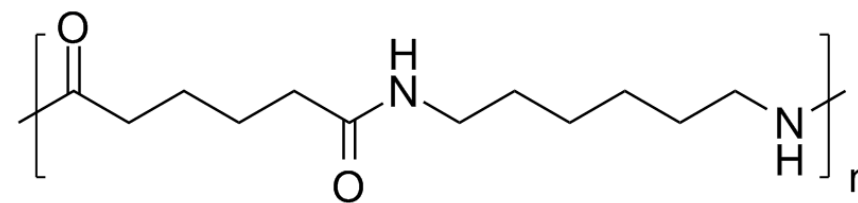


polysaccharides



proteins

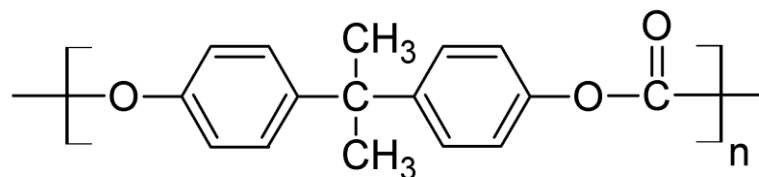
Synthetic Polymers



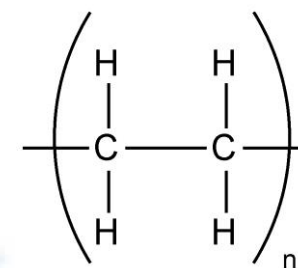
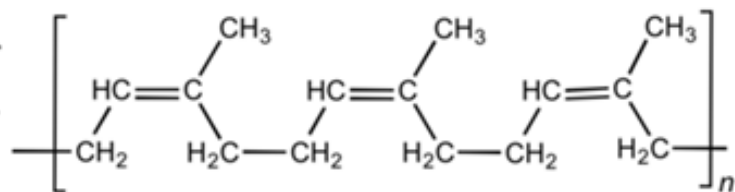
Nylon 6,6



Lexan



Rubber



Polyethylene

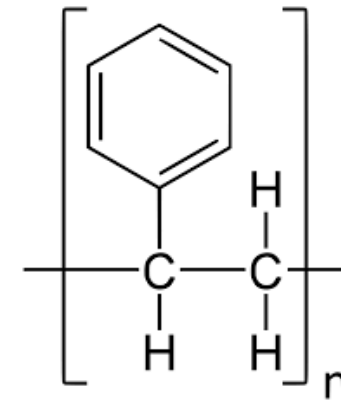
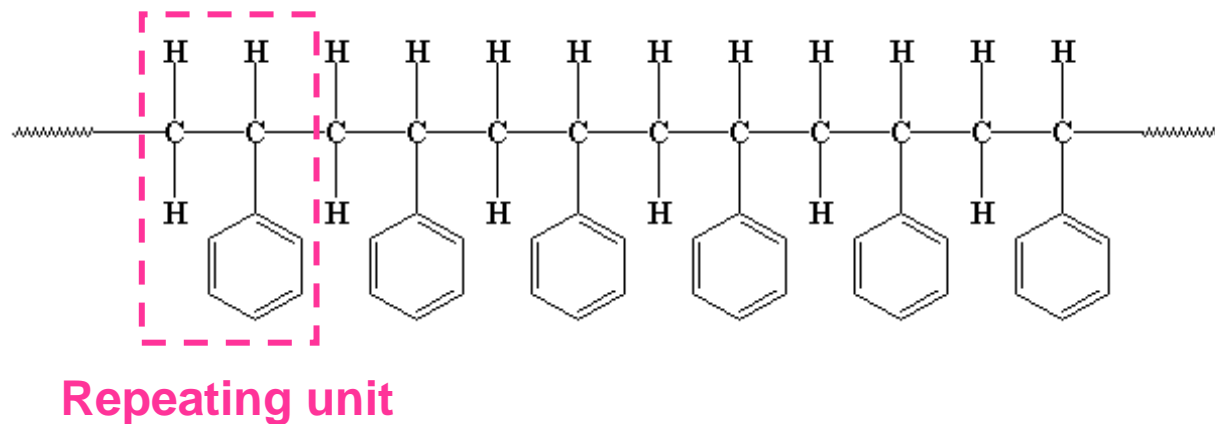
Homopolymers vs. Copolymers

- Polymers prepared by the polymerization of a **single monomer** are called **homopolymers**
- **Copolymers** are made by polymerizing two or more different monomers together



Molecular Formulae of Polymers

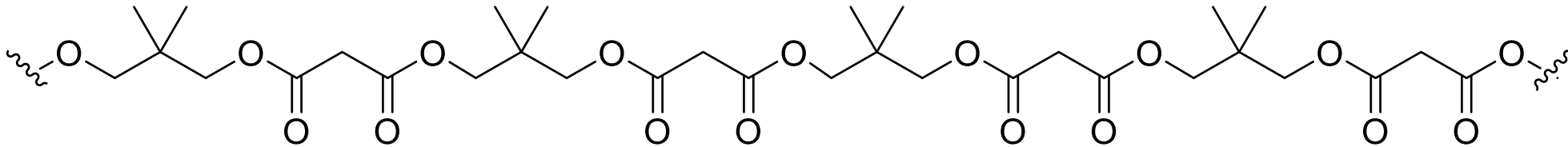
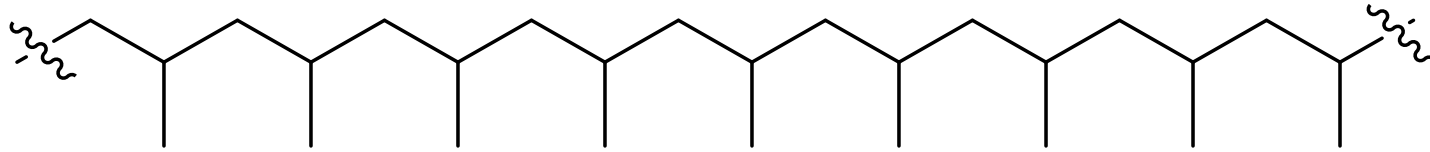
- Polymers generally have **high molecular weights** ranging from 10,000 to 1,000,000 g/mol
- Synthetic polymers are really mixtures of individual polymer chains of varying lengths, so the reported molecular weight is an **average value** based on the average size of the polymer chain
- By convention, the written structure of a polymer is **simplified** by placing **brackets around the repeating unit** that forms the chain



Simplified structure of polystyrene

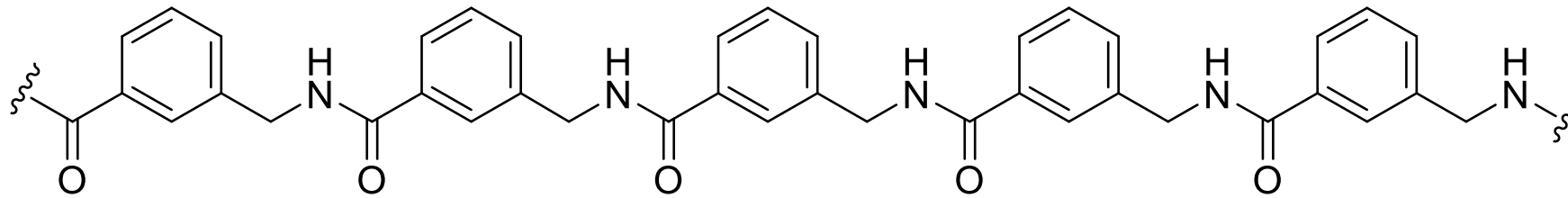
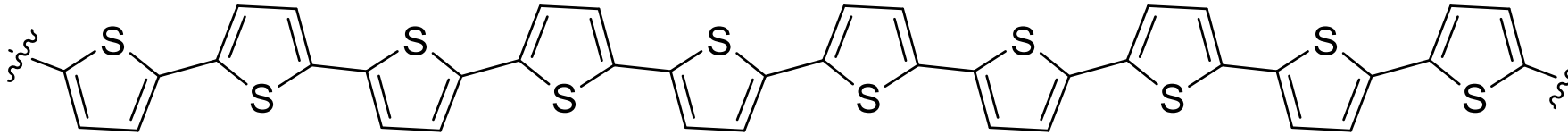
Molecular Formulae of Polymers - Examples

Draw the simplified structure of the following polymers



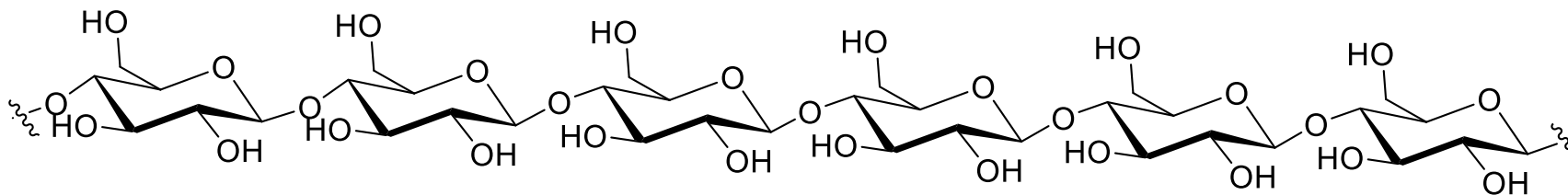
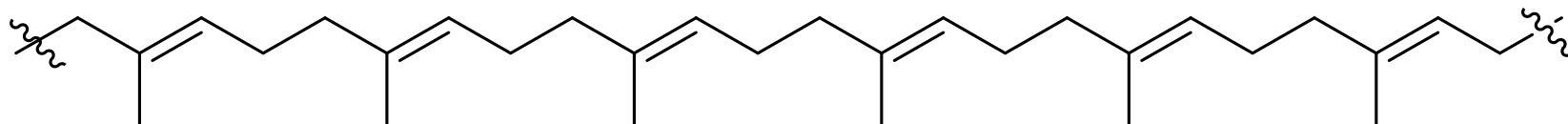
Molecular Formulae of Polymers - Examples

Draw the simplified structure of the following polymers



Molecular Formulae of Polymers - Examples

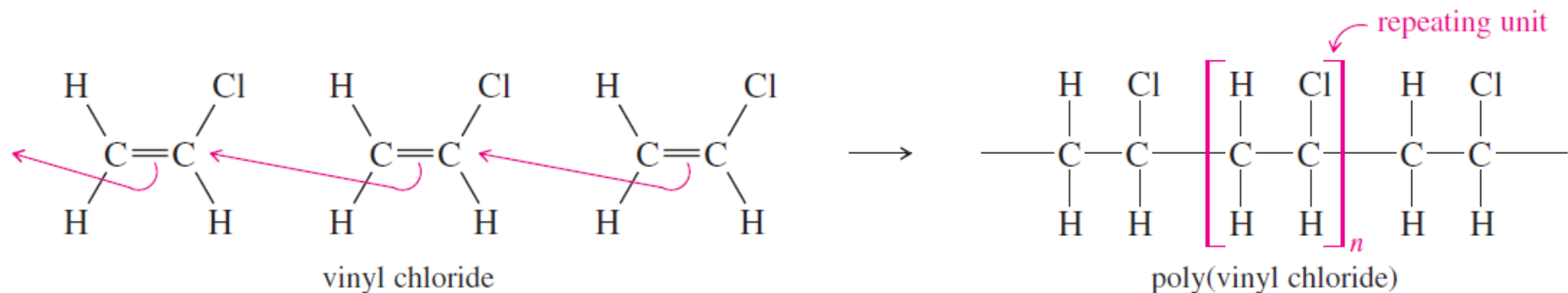
Draw the simplified structure of the following polymers



Classes of Synthetic Polymers

1) Chain-Growth Polymers

- Results from the addition of **one monomer at a time** to a growing polymer chain
- Normally, there is a **reactive intermediate** (cation, radical, or anion) at the growing end of the chain
- Chain-growth polymers are usually **Addition Polymers** (result from monomers adding together **without the loss of any molecules**)

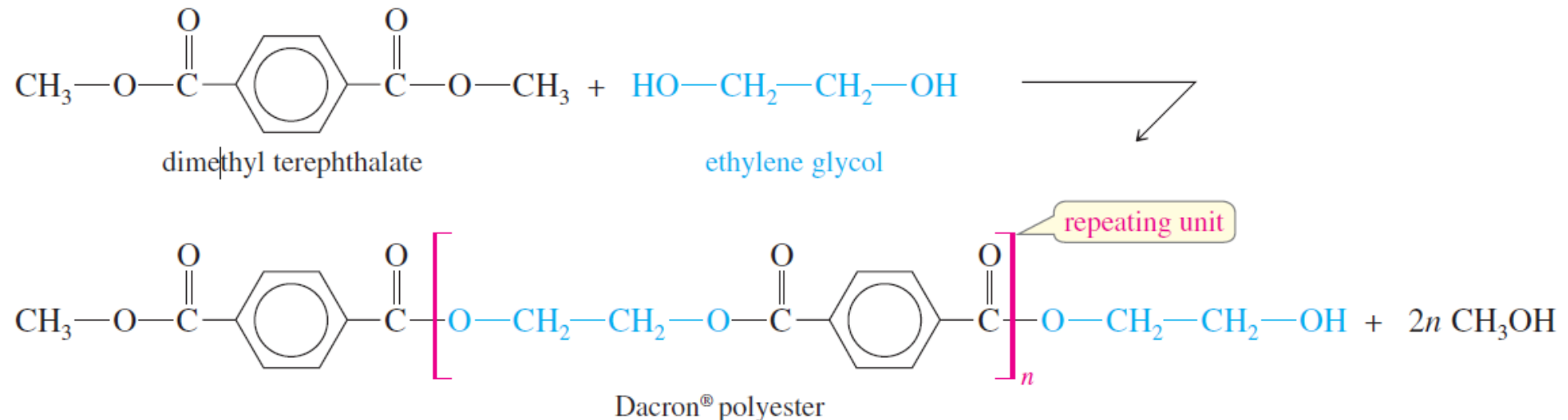


- Monomers for chain-growth polymerization are commonly **alkenes**; polymerization involves successive **additions across the double bonds**

Classes of Synthetic Polymers

2) Step-Growth Polymers

- Step-growth polymers are formed when **monomers containing two specific functional groups** react to each other
- In this method, any two reactive molecules can combine, so that monomer is not necessarily added to the end of a growing chain
- Most step-growth polymers are **Condensation Polymers**, bonded by some kind of condensation (bond formation with **loss of a small molecule** such as H₂O or HCl)



1) Chain-Growth Polymers

2) Step-Growth Polymers