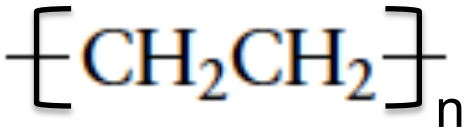
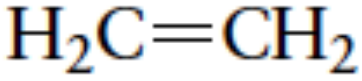
Polymers

- Polymers are also called macromolecules
- They have very large size and high molecular weight (10 kDa to 100 kDa)

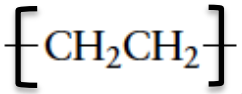
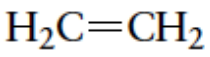
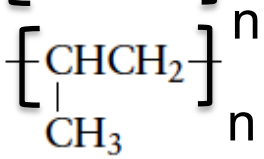
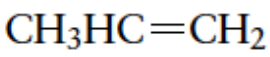
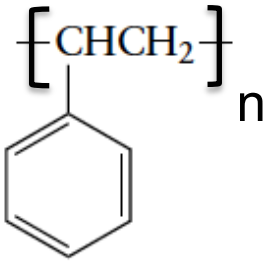
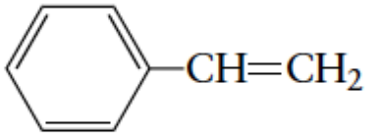
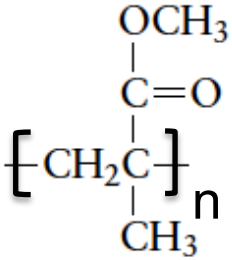
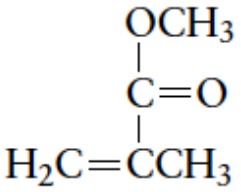
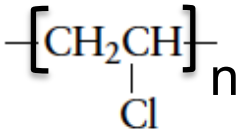
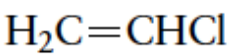
Ex. 

Polyethylene

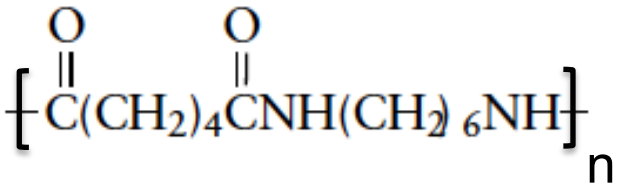
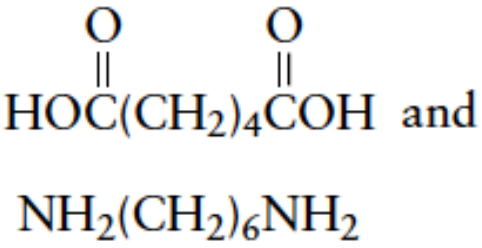
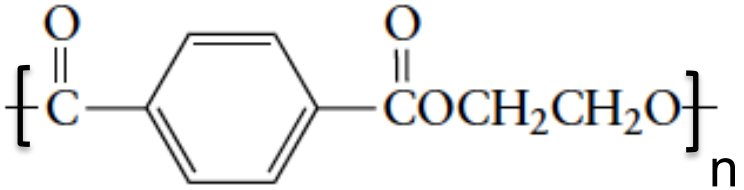
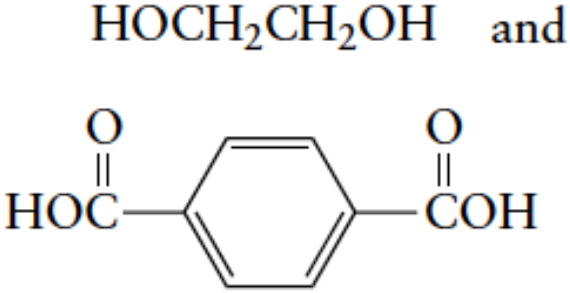
n = degree of polymerization

Synthesized from ethylene 

Polymers

Polymer	Repeat unit	Monomer(s)
Polyethylene		
Polypropylene		
Polystyrene		
Poly(methyl methacrylate)		
Poly(vinyl chloride)		

Organic Chemicals in the Environment

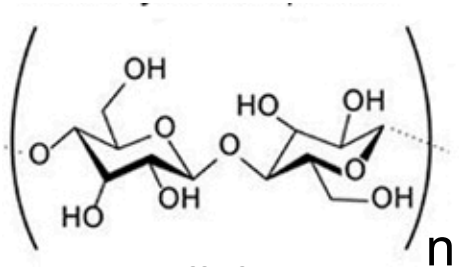
Polymer	Repeat unit	Monomer(s)
Nylon 66		
Poly(ethylene terephthalate) (PET)		

Polymers

- Many macromolecules are components of living systems

Proteins: polymers of amino acids

Starch and Cellulose: polymers of sugars



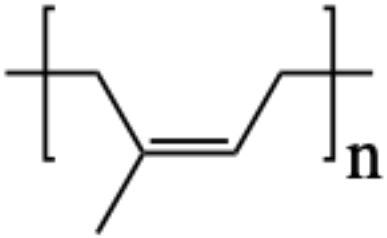
Cellulose

These naturally occurring polymers are biodegradable and will not cause long-term environmental problems

Polymers

- Natural rubber is not easily biodegradable

Major component



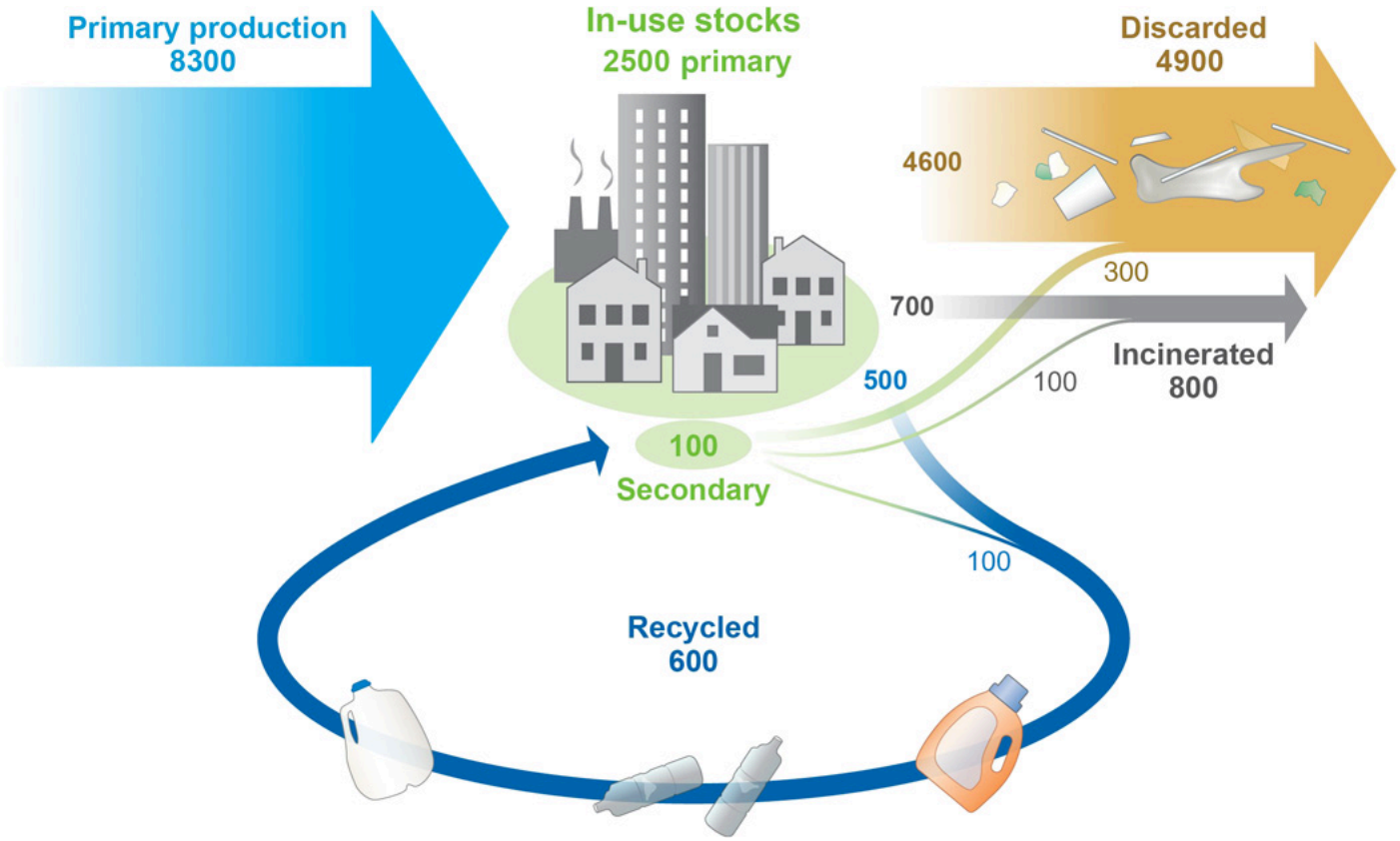
cis-1,4- polyisoprene

Highly resistant to water

Organic Chemicals in the Environment

Fate of polymers after use

Global production, use, and fate of polymers (1950 to 2015 in million metric tons)

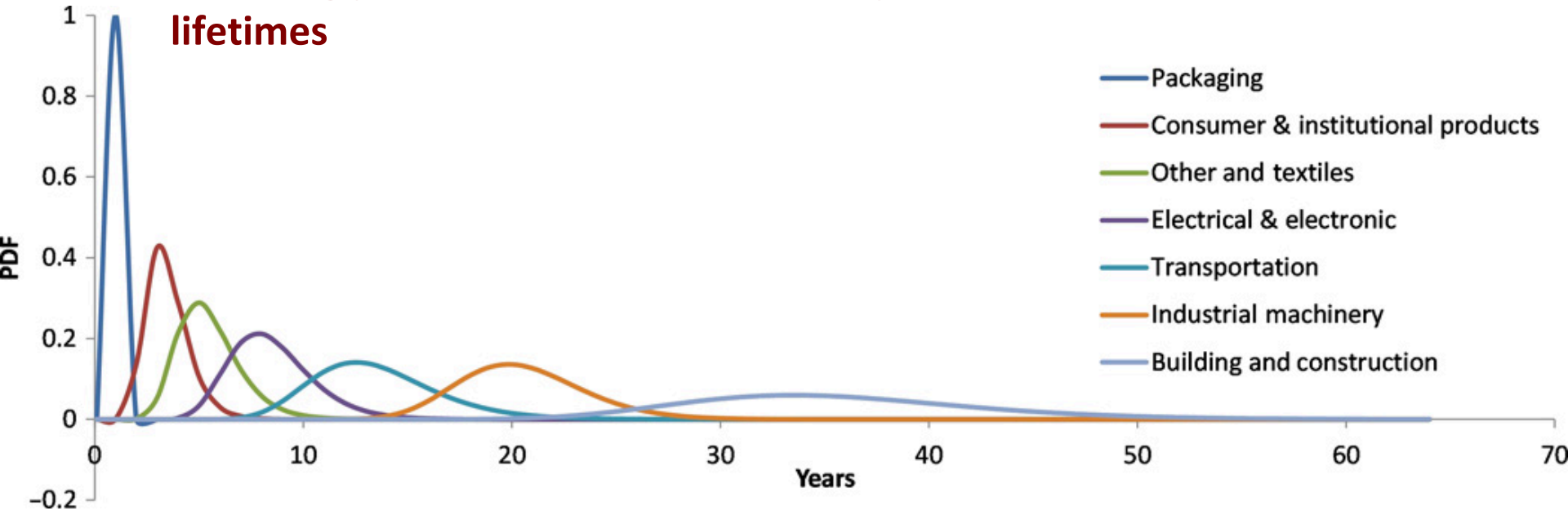


Reference: 10.1126/sciadv.1700782

Organic Chemicals in the Environment

Fate of polymers after use

How long plastics are in use before they reach the end of their useful lifetimes



- In 1990 25 million tons of plastics was manufactured in the United States, while during the same time period 16 million tons was placed in landfills (dumping yards)

Reference: 10.1126/sciadv.1700782

Organic Chemicals in the Environment

Fate of polymers after use

- Globally, only 18% of plastics waste are recycled, and 24% are incinerated
- 58% is placed in landfills (dumping yards)
- Relatively little decomposition takes place in landfills, so very little of this plastic material disappears with time (stable for more than 500 years)
- At current growth rates, the accumulation of plastics waste in landfills and/or in the natural environment is projected to reach nearly 12,000 Mt globally by 2050
- The total amount of plastics waste in the ocean is expected to grow from 50 Mt in 2015 to 150 Mt by 2025

Reference: https://dx.doi.org/10.1021/acssuschemeng.9b06635?ref=pdf

Organic Chemicals in the Environment

Fate of polymers after use

- It has been estimated that plastics kill or injure tens of thousands sea birds, seals, sea lions, and sea otters each year, and hundreds of whales, porpoises, bottlenose dolphins, and sea turtles

- A large portion of the reported fatalities are due to the entanglement of birds and mammals in the drift nets of commercial fishing boats

Possible solutions

- Development of biodegradable polymers
- Increase recyclability
- Reducing the usage of single use plastic