What one of the following is NOT a natural polymer?

A. cellulose

B. silk

C. Meat

D. rubber

E. polyester

Other than natural polymers,

many polymers are synthetic, or man-made.

A major group of synthetic polymers are <u>plastics</u>.

Could you go one day without plastics?

How about now?

iPad mini

iPad 2

iPad
with Retina display

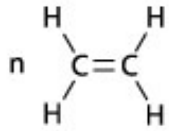
Where do we get all the synthetic polymers?

Most synthetic polymers are made from crude oil.

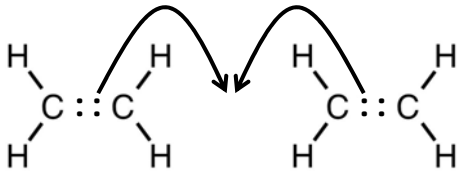
Synthetic polymers: from oil field to your home

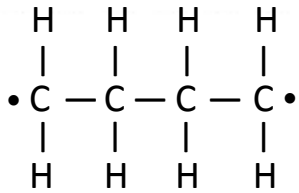
Monomers are obtained from crude oil

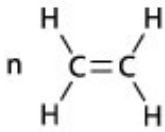
Monomers are turned into polymers



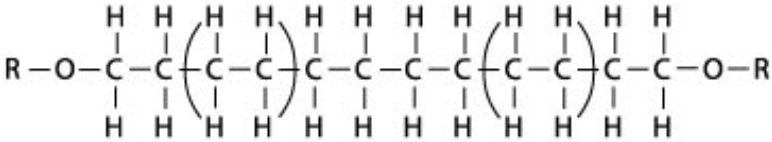
How are monomers turned into polymers?



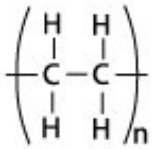




polymerization



or more simply



n = a very large integer

polyethylene

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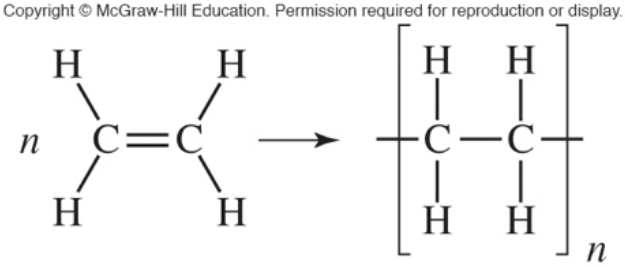


Ethylene **Poly-ethylene (PE)**

monomer **polymer**

The household item I brought today has the following sign on it:

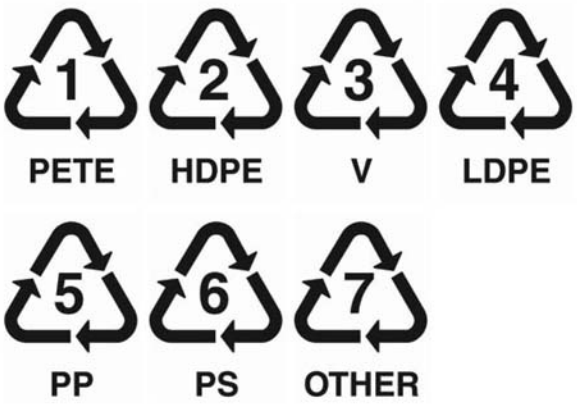
A.

B.

C.

D.

E. Others



Different types of plastics are made with different polymer materials.

Monomers for making different plastics

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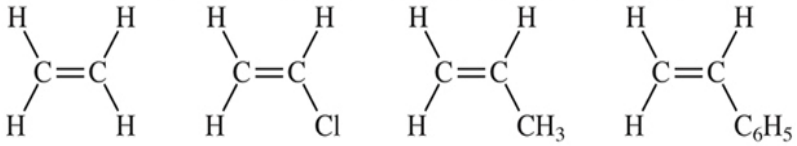

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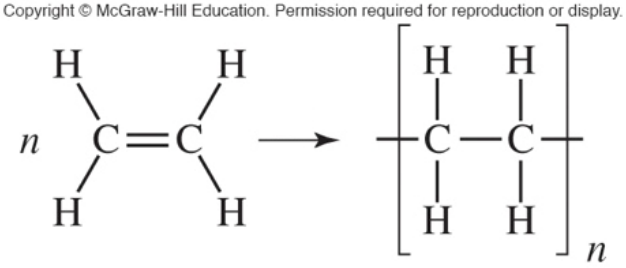

Ethylene **Poly-ethylene (PE)**

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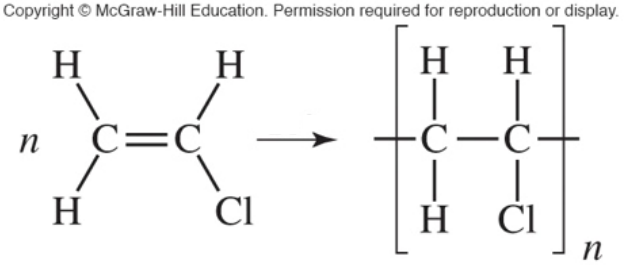
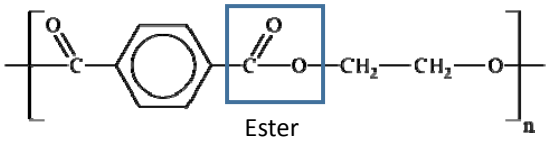


Vinyl chloride **Poly(vinyl chloride)**

Polyvinyl chloride



Polyethylene Terephthalate (PETE, or PET)

Polyester

Different types of plastics are made with different polymer materials.

The same type of polymer material can be made to have different properties?

What did you learn from this week's lab?

A. The properties of polymers can be changed by changing the proportions of material used to make them.
B. Different polymers can have very different properties.
C. Polymers with different properties can be used to make different useful consumer products.

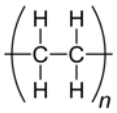
Other than the type of material,

the shape of polymers also affect their properties.

Different Shapes of Polymer

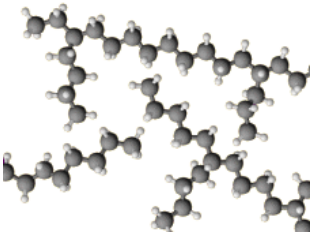
Linear | Branched | Cross-Linked | Network

- **Linear**
  - High Density Polyethylene (HDPE), PVC
- **Branched**
  - Low Density Polyethylene (LDPE)
- **Cross-linked**
  - Rubber
- **Network**
  - Nylon, Kevlar, epoxy

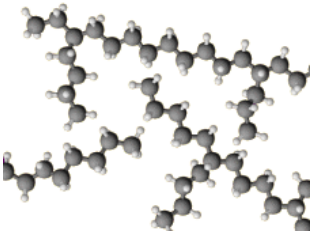


Chain Length n = 1000 – 2000

Low-Density Polyethylene (LD-PE)



Low-Density Polyethylene (LD-PE)



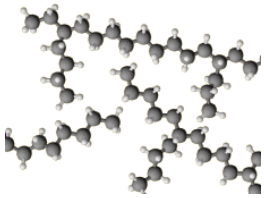
What type of chain is LD-PE?

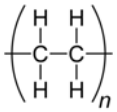
A. Linear
B. Branched
C. Cross linked
D. Networked

Low-Density Polyethylene (LD-PE)

What type of chain is LD-PE?

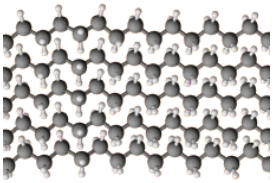
A. Linear
B. Branched
C. Cross linked
D. Networked





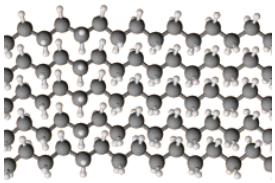
Chain Length n= 10,000 – 100,000

High-Density Polyethylene (HD-PE)



2
HDPE

High-Density Polyethylene (HD-PE)



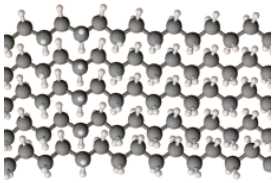
What type of chain is HD-PE?

A. Linear
B. Branched
C. Cross linked
D. Networked

2
HDPE

High-Density Polyethylene (HD-PE)

Linear Branched Cross-Linked Network

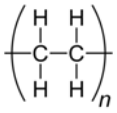


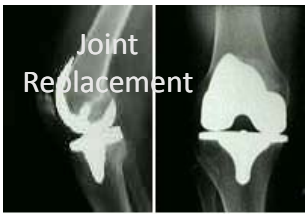
What type of chain is HD-PE?

A. Linear
B. Branched
C. Cross linked
D. Networked

– more rigid, tougher **– softer, more flexible**

Linear polymer chain **Branched polymer chain**



Chain Length n = 2 – 6 million units

Ultra-high-density polyethylene (UHD-PE)