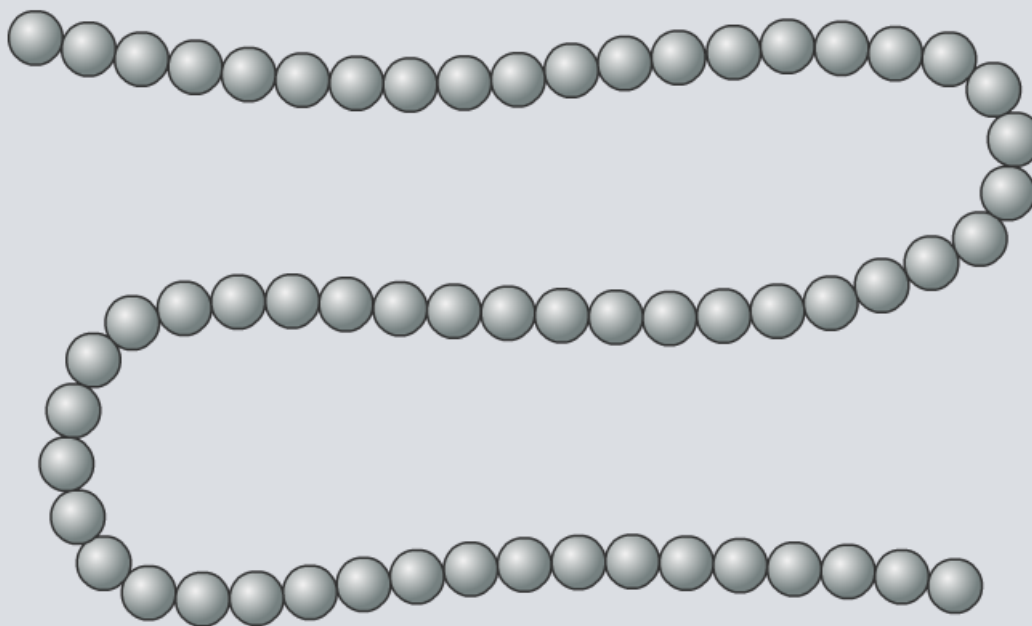
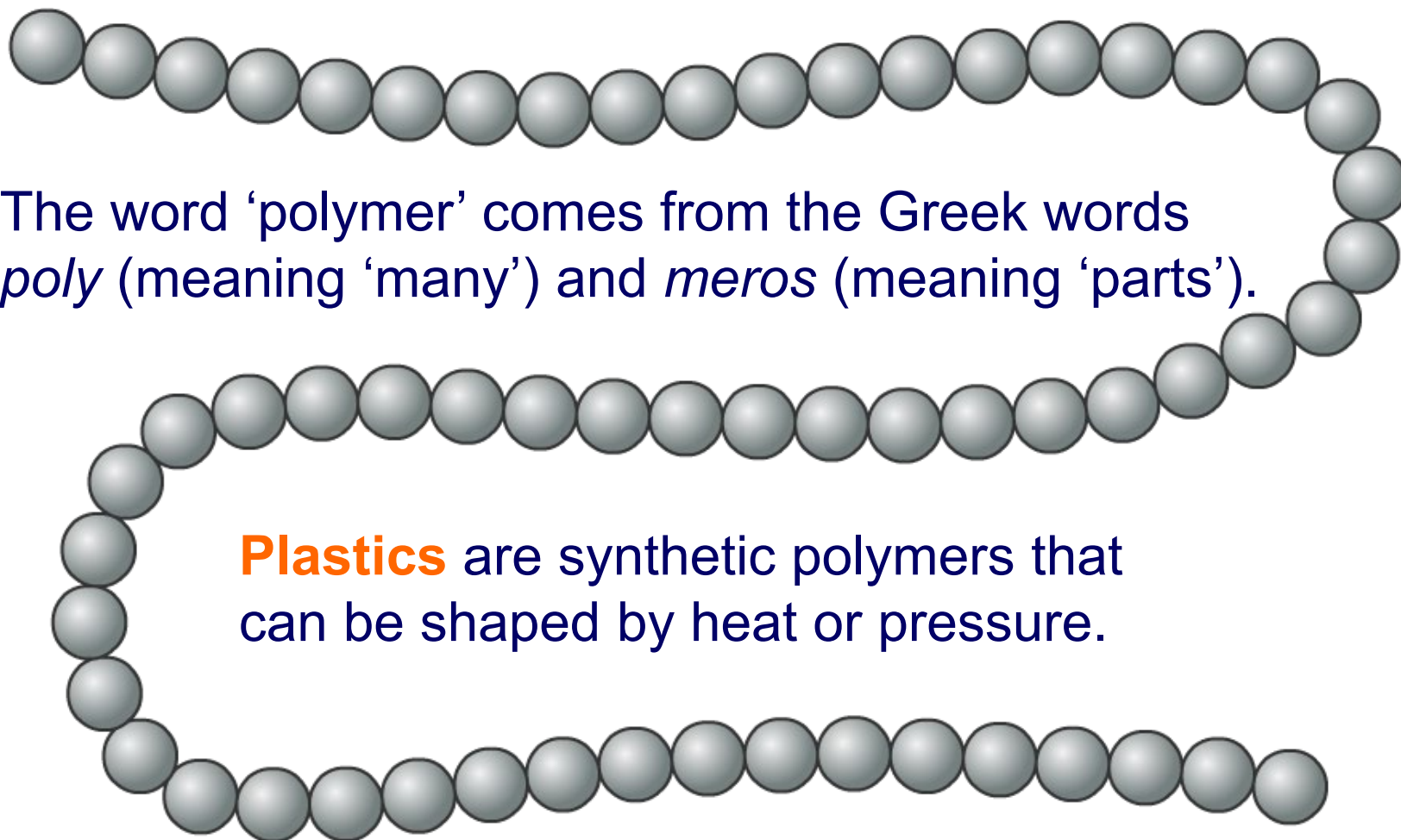


## Polymers



# What are polymers?

**Polymers** are very large molecules made when hundreds of **monomers** join together to form long chains.



The word 'polymer' comes from the Greek words *poly* (meaning 'many') and *meros* (meaning 'parts').

**Plastics** are synthetic polymers that can be shaped by heat or pressure.





Which polymers are natural and which are synthetic?

natural

synthetic

Kevlar



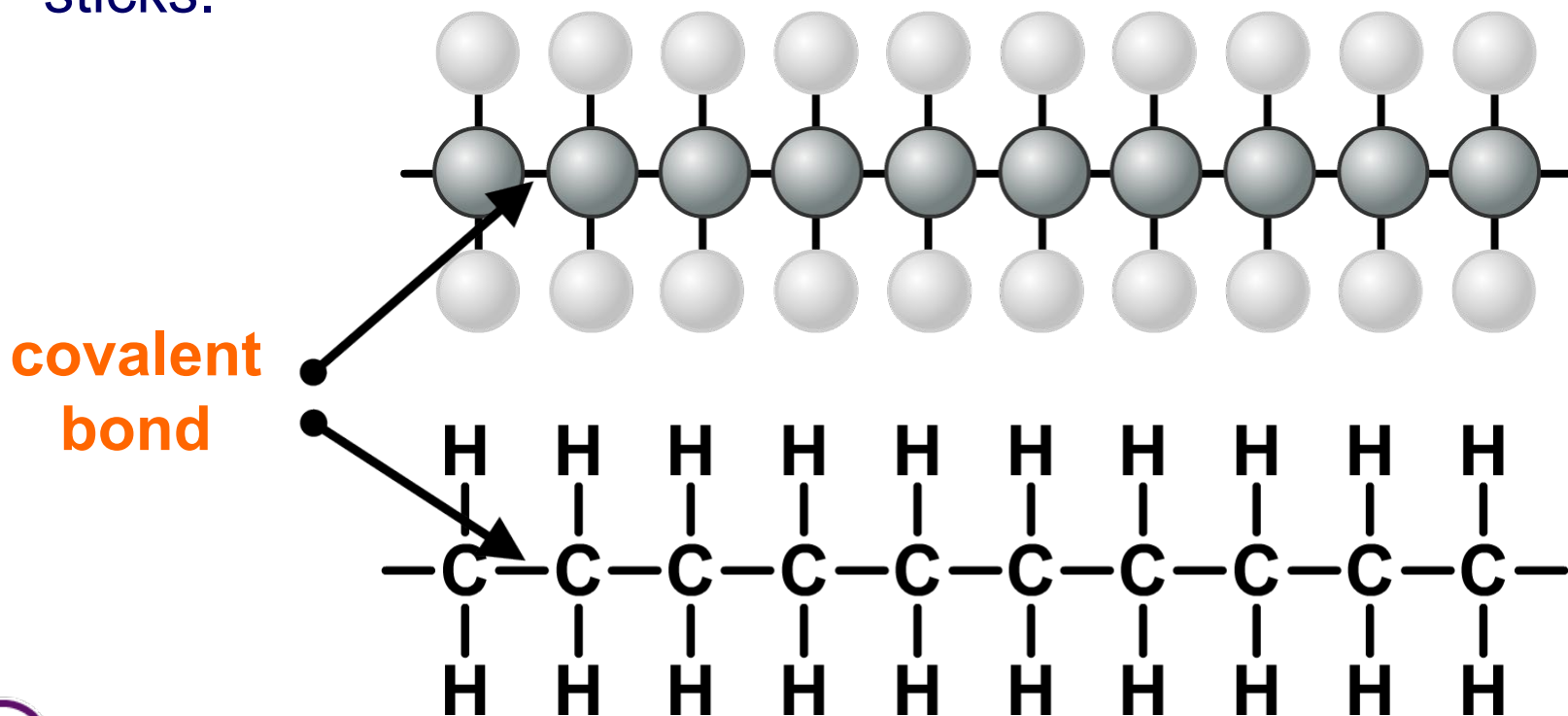
solve



# What keeps the chain together?

The monomers in a polymer are joined together by **covalent bonds** between atoms.

In a covalent bond, each atom shares one or more electron with another atom. The bonds are sometimes shown as sticks.

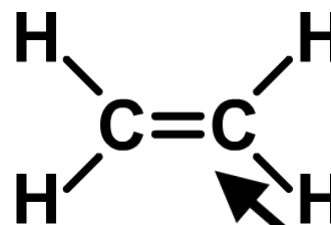


# What are polymers made from?

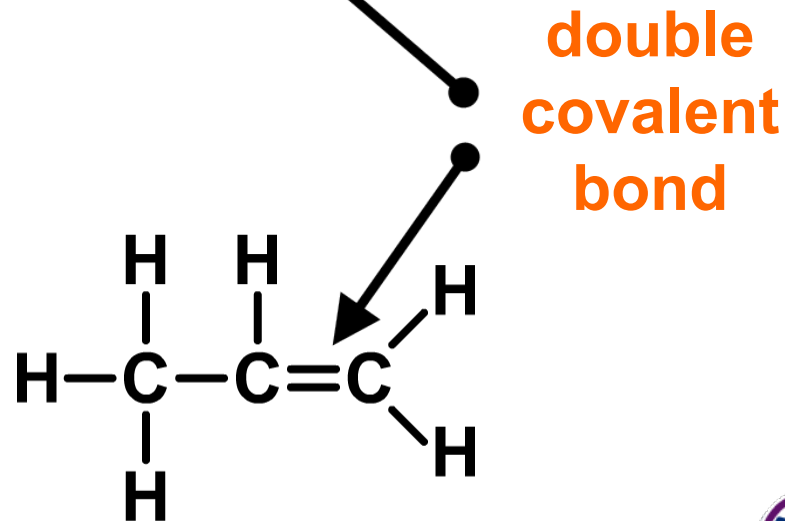
Many polymers are formed from **alkenes**, which are a family of hydrocarbon molecules with the general formula  $C_nH_{2n}$ .

Alkenes contain at least one double covalent bond between carbon atoms. The double bond makes them very reactive.

- The simplest alkene is **ethene** ( $C_2H_4$ ).



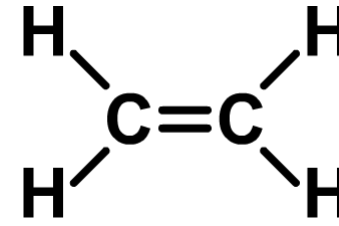
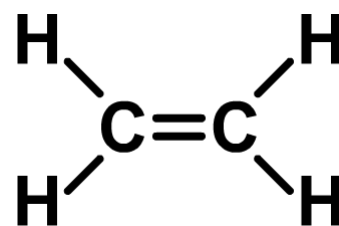
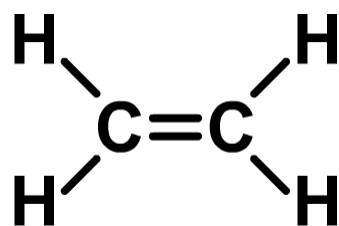
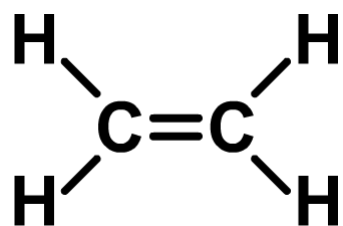
- The second simplest alkene is **propene** ( $C_3H_6$ ).



# Addition polymerization

Polyethene (sometimes called polythene) is a polymer made from ethene.

The process by which polyethene and other polymers is made is called **addition polymerization**. This is because many monomers (ethene molecules) are added together.

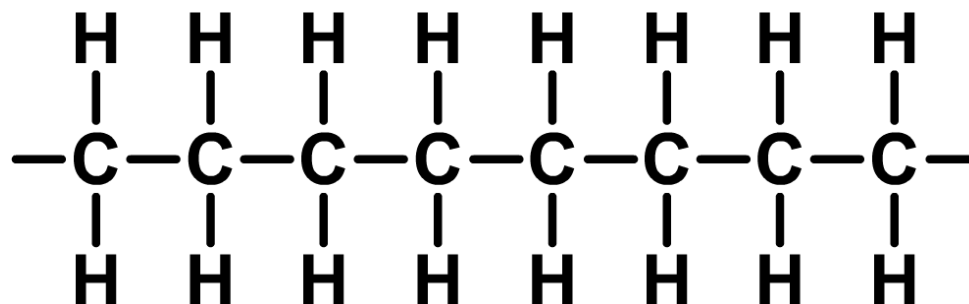


monomers



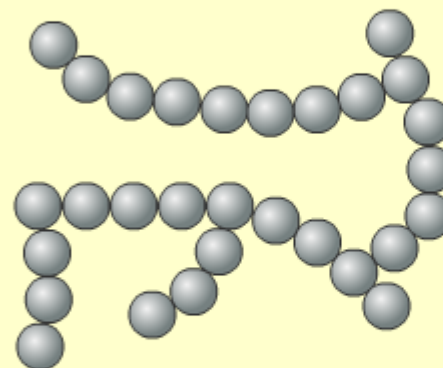
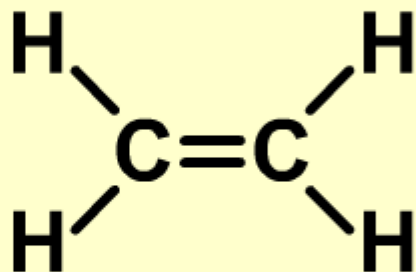
addition polymerization

polymer



## The polymerization of ethene

How does ethene polymerize to become polyethene?



Click "**start**" to find out.

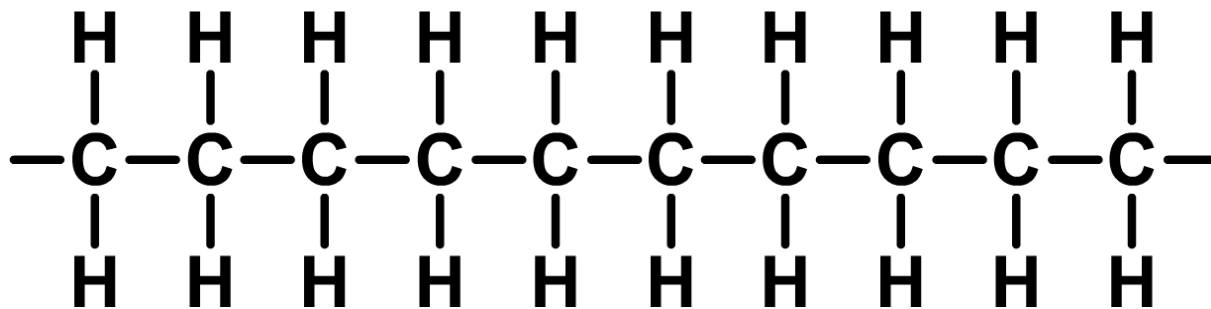
**start**



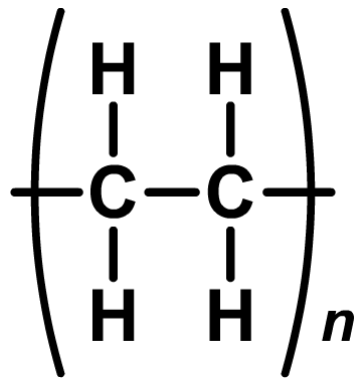
# Drawing polymers – shorthand formulas

Polymers contain thousands of molecules, so how can their structures be easily drawn?

Part of the polymer molecule can be drawn:



A better way is to show a **shorthand formula**:



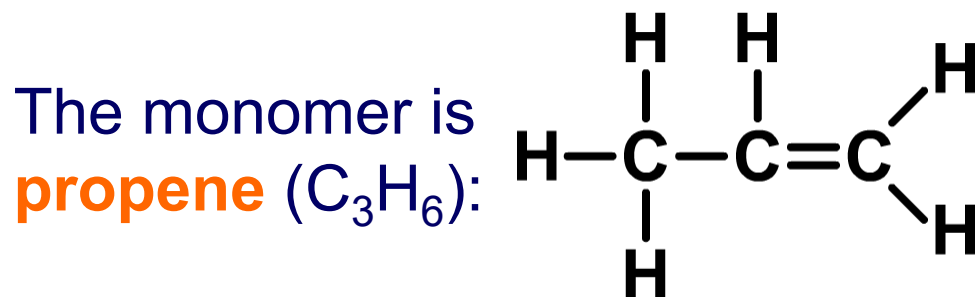
The '*n*' means that the polymer contains a very large number of the repeating unit shown in the brackets.



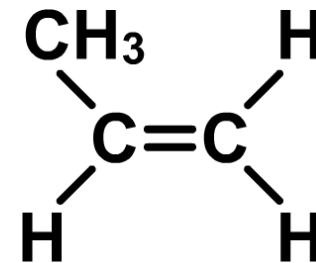


# What's the polymer?

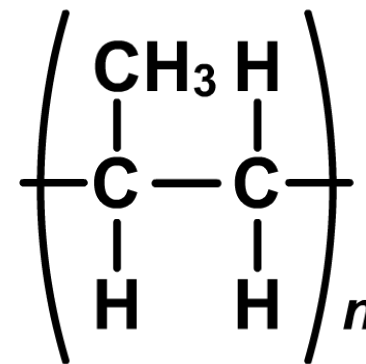
What is the shorthand formula for polypropene?



which can be drawn as:



1. Draw two C atoms that were in the **double** bond with a **single** covalent bond.
2. Draw the brackets and the '*n*.'
3. Add the links outside the brackets.
4. Add the atoms that were attached to each C atom of the double bond.

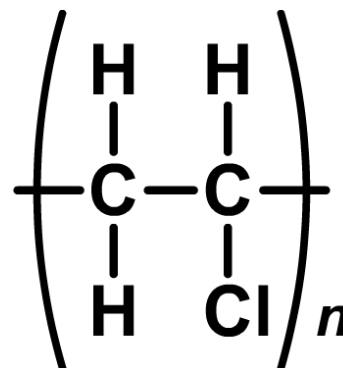


**polypropene**

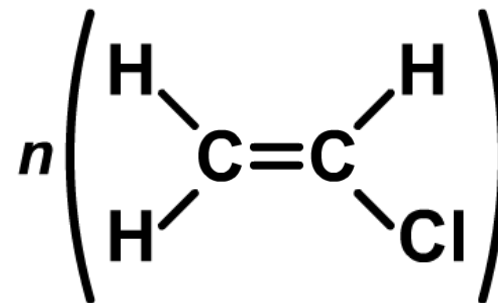


# What's the monomer?

What is the monomer of **polyvinylchloride** (PVC)?



1. Draw two C atoms joined with a **double** covalent bond.
2. Add the atoms attached to each C atom.
3. Draw the brackets and the 'n.'



The equation for the reaction can be drawn as:

