



Key Area: Properties of Plastics

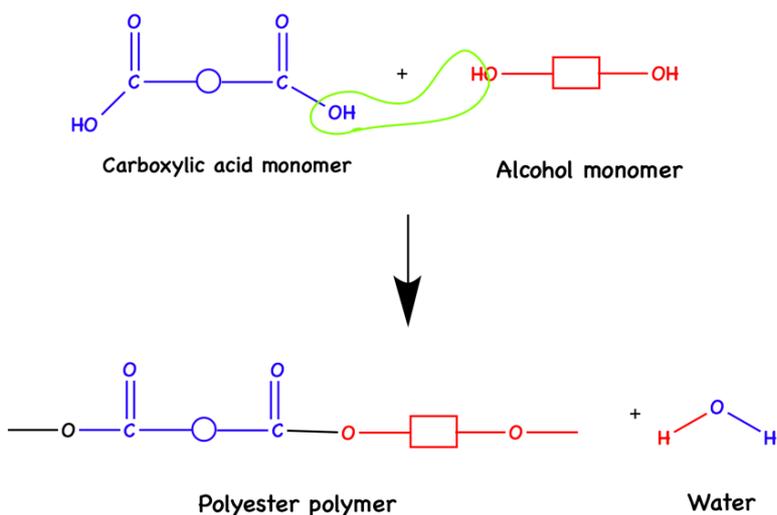
Learning Statement	😊	😐	☹️								
<p>Most plastics and synthetic fibres are made from crude oil.</p> <ul style="list-style-type: none"> Synthetic means that the fibre has been made by scientists and is not naturally occurring. Both natural and synthetic fibres are examples of polymers. 											
<p>There are advantages and disadvantages of using natural or synthetic materials.</p> <table border="1"> <thead> <tr> <th>Advantages of Plastics over Natural Materials</th> <th>Disadvantages of Plastics over natural materials</th> </tr> </thead> <tbody> <tr> <td>Lightweight and cheap</td> <td>Plastics made from finite resources (crude oil)</td> </tr> <tr> <td>Good thermal and electrical insulating properties</td> <td>Plastics burn to release toxic gases</td> </tr> <tr> <td>Plastics are non-biodegradable and can last a long time compared to natural alternatives</td> <td>Plastics are non-biodegradable and can be difficult to dispose of</td> </tr> </tbody> </table>	Advantages of Plastics over Natural Materials	Disadvantages of Plastics over natural materials	Lightweight and cheap	Plastics made from finite resources (crude oil)	Good thermal and electrical insulating properties	Plastics burn to release toxic gases	Plastics are non-biodegradable and can last a long time compared to natural alternatives	Plastics are non-biodegradable and can be difficult to dispose of			
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<p>A biodegradable plastic is one that can be broken down by organisms such as bacteria.</p>											
<p>There are 2 types of plastic: thermoplastic and thermosetting.</p> <ul style="list-style-type: none"> Thermoplastics melt on heating, as their polymer chains are not cross-linked. Thermosetting plastics keep their shape on heating, as their chains are cross-linked. 											
<p>Polymers are large molecules made from smaller molecules called monomers.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>monomer</td> <td>Small molecules which join together to form polymers</td> </tr> <tr> <td>polymer</td> <td>The long chain molecule made by the joining up of monomers</td> </tr> <tr> <td>polymerisation</td> <td>The process where monomers join together to form polymers</td> </tr> </tbody> </table>	Name	Definition	monomer	Small molecules which join together to form polymers	polymer	The long chain molecule made by the joining up of monomers	polymerisation	The process where monomers join together to form polymers			
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<p>There are 2 types of polymerisation:</p> <ul style="list-style-type: none"> Addition Condensation 											
<p>Addition Polymerisation</p> <p>In addition polymerisation small unsaturated monomers containing a C=C undergo addition reactions to form a saturated polymer.</p> <p>e.g.</p> $ \begin{array}{c} \begin{array}{ccccccc} \text{H} & \text{Cl} & \text{H} & \text{Cl} & \text{H} & \text{Cl} & \\ & & & & & & \\ \text{C}=\text{C} & + & \text{C}=\text{C} & + & \text{C}=\text{C} & & \\ & & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \\ \text{chloroethene} & & & & & & \end{array} \xrightarrow{\text{addition polymerisation}} \begin{array}{ccccccc} \text{H} & \text{Cl} & \text{H} & \text{Cl} & \text{H} & \text{Cl} & \\ & & & & & & \\ -\text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \\ & & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \\ & \text{poly(chloroethene)} & & & & & \end{array} \end{array} $											
<p>The polymer name starts with poly and then has the name of the monomer in brackets, for example ethene monomers polymerise to make poly(ethene).</p>											

Condensation Polymerisation

In condensation polymerisation monomers with functional groups at each end of the molecule undergo condensation reactions to form a polymer and water.

Making Polyester

Polyesters are chains of polymers that contain an ester functional group. They are made from a carboxylic acid monomer and an alcohol monomer.



Creative and Smart Materials Made from Polymers

- **Kevlar** is made by condensation polymerisation and is used in bullet proof vests. It is a very strong fibre but is lighter than any other material with the same strength.
- **Polyvinyl Alcohol (PVA)** is a soluble plastic that can be used to make laundry bags.
- **Poly(acrylate)** is a **hydrogel** that has special water absorbing properties which allows hydrogels to be used in a variety of applications such as nappies, contact lenses and as medical bandages.
- **Colour changing plastics** can be used in food packaging to let consumers know the condition of food inside.
- **Conductive plastics** are currently being researched which allow the development of flexible touch screens and e-paper in the near future.