

OCR 21st Century Core Science - Chemistry C2

MATERIAL CHOICES

C2.1 What different properties do different materials have?

- interpret information about how solid materials can differ with respect to properties such as melting points, strength (in tension or compression), stiffness, hardness and density
- relate properties to the uses of materials such as plastics, rubbers and fibres;
- relate the effectiveness and durability of a product to the materials used to make it;
- interpret information about the properties of materials such as plastics, rubbers and fibres to assess the suitability of these materials for particular purposes;
- with respect to data from the measurement of properties of materials:
 - uses data rather than opinion in justifying an explanation;
 - can suggest reasons why a measurement may be inaccurate;
 - can suggest reasons why several measurements of the same quantity may give different results;
 - when asked to evaluate data, makes reference to its reliability (i.e. is it repeatable?);
 - can calculate the mean of a set of repeated measurements;
 - from a set of repeated measurements of a quantity, uses the mean as the best estimate of the true value;
 - can explain why repeating measurements leads to a better estimate of the quantity;
 - can make a sensible suggestion about the range within which the true value of a measured quantity probably lies;
 - **can justify the claim that there is/is not a 'real difference' between two measurements of the same quantity;**
 - can identify any outliers in a set of data, and give reasons for including or discarding them;
 - can identify, in a plan for an investigation of the effect of a factor on an outcome, the fact that other factors are controlled as a positive feature, or the fact that they are not as a design flaw;
 - **can explain why it is necessary to control all factors thought likely to affect the outcome other than the one being investigated.**

C2.2 Why is crude oil important as a source of new materials such as plastics and fibres?

- recall that the materials we use are chemicals or mixtures of chemicals, and state examples;
- recall that materials can be obtained or made from living things, and give examples such as cotton, paper, silk and wool;
- understand that there are synthetic materials which are alternatives to materials from living things;
- interpret representations of rearrangements of atoms during a chemical reaction;
- understand that during the course of a chemical reaction the numbers of atoms of each element must be the same in the products as in the reactants;
- recall that crude oil consists mainly of hydrocarbons which are chain molecules of varying lengths made from carbon and hydrogen atoms only;
- recall that only a small percentage of crude oil is used for chemical synthesis;
- recall that the petrochemical industry refines crude oil to produce fuels, lubricants and the raw materials for chemical synthesis;
- understand that some small molecules can join together to make very long molecules called polymers and that the process is called polymerisation;
- understand that by using polymerisation, a wide range of materials may be produced;
- recall an example of a material that has replaced an older material because of its superior properties.

C2.3 Why does it help to know about the molecular structure of materials such as plastics and fibres?

- understand how the properties of solid materials depend on how the particles they are made from are arranged and held together;
- relate the strength of the forces between the particles to the amount of energy needed for them to break out of the solid structure, and to the temperature at which the solid melts;
- understand how modifications in polymers produce changes to their properties (see C2.1), to include modifications such as:
 - increased chain length;
 - cross-linking;
 - the use of plasticizers;
 - **increased crystallinity.**

C2.4 When buying a product, what else should we consider besides its cost and how well it does its job? How should we manage the wastes that arise from our use of materials?

- recall the key features of a life cycle assessment (LCA) including:
 - the main requirements for energy input;
 - the environmental impact and sustainability of making the material from natural resources;
 - the environmental impact of making the product from the material;
 - the environmental impact of using the product;
 - the environmental impact of disposing of the product by incineration, landfill or recycling;
 - **understand how the outcomes of a Life Cycle Assessment (LCA) for a particular material will depend on which product is made from the material;**
- when given appropriate information relating to a Life Cycle Assessment (LCA), compare and evaluate the use of different materials for the same job and the use of the same material for different jobs;
- in the context of a Life Cycle Assessment:
 - can distinguish questions which could be addressed using a scientific approach, from questions which could not;
 - can identify the groups affected and the main benefits and costs of a course of action for each group;
 - can explain the idea of sustainable development, and apply it to specific situations;
 - shows awareness that scientific research and applications are subject to official regulations and laws;
 - **can distinguish between what can be done (technical feasibility) and what should be done (values);**
 - **can explain why different courses of action may be taken in different social and economic contexts.**