Physical and chemical change

5.1 Physical change is a change in shape or appearance

Teacher notes (pages 80–81)

Introducing the chapter

Chemistry is the study of how substances react with one another and how the properties of substances can be used in everyday life. In particular, chemical reactions can be used to produce new substances and new materials. Industrial chemists look at processes that allow us to make new substances, whereas material scientists design and determine uses for these new substances.

Matter can undergo a number of different types of changes. Physical changes are where matter undergoes a change in state, such as from solid to liquid, or a change in shape, such as breaking glass. Chemical changes occur when there is a change in the chemical make-up of the substances involved and a new substance is formed.

Teaching tips: Physical change

Remind students that in a physical change, the substance doesn’t actually change; the same particles are just rearranged into a different pattern. Use the common examples mentioned in the text of a cut diamond, melted chocolate and frozen ice.

Teaching tips: Student understanding

Questioning of students or a pre-test would be useful in revealing students’ understanding and any misconceptions. The hands-on activities provided in this chapter are recommended in order to engage students with this topic.

Differentiation

For less able students:

This section contains many new terms. As such, a cloze activity or the creation of flash cards could be beneficial.

For more able students:

Ask students to list as many reversible reactions as they can; these could be drawn and annotated.

Additional activity: Physical change

To emphasise that in a physical change the substance doesn’t actually change, ask students to enact a simple physical change. An example of this could be melting chocolate or freezing ice, either at home or in the classroom. Ask students to come up with their own ideas for this activity.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Chemical and physical changes**  
This video explains the difference between physical and chemical change.

5.2 Chemical change produces new substances

Teacher notes (pages 82–83)

Introducing the topic

Chemistry is all around us, whether we notice it or not. Chemical reactions occur when plants photosynthesise, when organisms respire and when rocks are weathered by chemicals within rainwater. When a chemical change occurs, the original (reactant) particles are rearranged to form new substances (products) with new properties.

Teaching tips: Chemical changes

An interesting example of a chemical reaction in everyday life is the use of hot and cold packs. These can be bought from most pharmacies and are often used for sporting injuries. The plastic packs are kept at room temperature until activated. You activate them by snapping a capsule inside the plastic pack and shaking it to mix the two chemicals (usually a liquid and a solid powder). The two substances combine and either produce heat (an exothermic reaction) or cold (an endothermic reaction). Students can then discuss the rate of the chemical reaction (it happens very fast) and how and why endothermic and exothermic reactions take place.

Differentiation

For less able students:

Students may need to clarify their understanding of the term ‘chemical’. Similar terms, such as substances, materials, matter, particles and molecules, will have been encountered, all meaning much the same thing. Students should be advised to consider the context in which the word is used rather than being confused by the word itself.

For more able students:

More able students may benefit from listing as many chemical reactions as they can. Once they have created their own list they should share this with a partner, then a whole class list can be collated on the board.

Additional activity: Common misconceptions

Discuss some common misconceptions about chemical reactions with the class such as the following:

• ‘The original substance vanishes ‘completely and forever’ in a chemical change.’ (In fact, the original substance can be reproduced if the reaction can be reversed under the necessary conditions, and the original substances are just altered.)

• ‘Mass is conserved, but not the number or species of atoms.’ (In fact, atoms are not created or destroyed in standard chemical reactions; therefore, the number and species of atoms do not change, and mass is also conserved.)

• ‘Energy is used up or created in chemical reactions.’ (In fact, energy is released or stored in the form of chemical bonds between atoms.)

• ‘A new substance with new properties does not contain the same particles as the original substances.’ (In fact, a new substance is the result of particle rearrangement.)

• ‘A chemical reaction is not an interaction of ingredients, but one ingredient that plays an active role.’ (In fact, substances can react together to form new substances that are quite different in their properties.)

• ‘Oxygen or air is an enabling ingredient in the burning process, but is not consumed in the process.’ (In fact, combustion is a chemical reaction.)

• ‘Reactants retain their identity in a chemical reaction.’ (In fact, reactants are rearranged to form the product.)

Additional activity: Use of images

Students could be asked to carefully examine the images in this section that reinforce the explanations of chemical changes. Students could think and then share their thoughts about how each is an example of a chemical change rather than a physical change.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Chemical changes**  
This website contains information about chemical changes and many links to other sites with more information.

5.3 Chemical reactions can break bonds and re-form new bonds

Teacher notes (pages 84–85)

Introducing the topic

A chemical change can also be described as a chemical reaction. In chemical changes or reactions in substances, the atoms can separate from each other and bond together in new combinations to form new substances.

Teaching tips: Common misconceptions

• ‘Substances have an ongoing history, so that a gas formed in a chemical reaction is thought to have been present in some form in the initial ingredients.’ (In fact, a gas is a possible product of a chemical reaction.)

Differentiation

For less able students:

It should just be necessary to identify whether a particular reaction is a chemical change without the need for the chemical equation.

For more able students:

Stronger students can attempt to write chemical equations for all chemical changes.

Additional activity: Chemical equations

Students could be asked to find examples of chemical reactions in books or on the Internet. From these examples, students could use colour coding to identify the reactants and products. They could also suggest why reactants are always written on the left of the arrow and products on the right. Students may also benefit from a discussion about why all scientists follow the same format when communicating information about reactions.

Additional activity: Cooking techniques

Ask students to consider, from their personal experiences, the different chemical changes produced by different cooking techniques. Cooking techniques may include roasting, toasting, baking, frying, sautéing, blanching, boiling, poaching, steaming, microwaving, simmering, reducing or grilling. A discussion could be started with comparisons between the same products cooked in different ways. Ask students what evidence they have from their own knowledge of chemical changes taking place during cooking. Colour and texture change are the most likely responses; however, smell may also indicate a chemical change. Other examples from cooking could be used to conduct the same analysis.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**The chemistry of fireworks**  
This website contains quite high-level information about the essential components of fireworks.

5.4 Heat can speed up a reaction

Teacher notes (pages 86–87)

Introducing the topic

The rate of a reaction can be sped up or slowed down. A number of factors affect the rate of a reaction. These include the particle size, temperature and concentration of substances and the presence of catalysts. The particle model helps us understand this more clearly.

Teaching tips: Video

The behaviour of particles under different conditions is best considered a visual topic, and the use of models and video is recommended. A starting good video is included below in the ‘Going further’ section.

Differentiation

For less able students:

Students may understand enzymes better if they think about enzymes in saliva. Why can we eat a huge hamburger and not make ourselves sick? Enzymes begin breaking the food down while it is still in our mouths.

For more able students:

Stronger students may wish to investigate enzymes further including how they only work with certain reactants.

Additional activity: Act it out

Split students into three groups and ask them to come up with a way to act out the effect of particle size, temperature and concentration, assigning one characteristic to each group. For example, the group responsible for demonstrating temperature could show that with increased temperature, they start to become excited and run around (carefully) bumping into more particles (students).

Additional activity: Burning steel wool

Ask students what they think will burn faster – a solid lump of steel or steel wool? Steel wool will burn faster and can demonstrate how particle size can affect the rate of chemical reactions. This can be done as a demonstration in class.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Chemicool: Chemical reaction rates**  
This website explains the differences in chemical reaction rates.

5.5 Many substances exist because of the work of scientists

Teacher notes (pages 88–89)

Introducing the topic

This topic looks at how chemistry is used in industry to create the materials that surround us, such as the clothes we wear, medicines, gadgets, glues, dyes and countless more products that we use every day. It can be easy for students to forget how much we rely on manufactured products in our lives. These important products only exist because of the work of scientists, changing them from their original states to ones that we can use.

Teaching tips: The work of pharmacists

All students should be familiar with going to the chemist (pharmacy) for medications and many may know the work of a pharmacist (or even have a parent who is a pharmacist or who works in a pharmacy). Confirm this knowledge with students and extend it to prompt the training a pharmacist has undergone and what their job entails. The discovery of penicillin is a very interesting story and one that could be sourced and explored further through video if desired.

Differentiation

For less able students:

Ask students to list all the manufactured products they use and encounter every morning before they leave for school.

For more able students:

Stronger students could research and present on the recycle, reuse, reduce movement, which aims to reduce the amount of rubbish people send to landfill.

Additional activity: Chemists

Students will more than likely have preconceived ideas about what a chemist really is. A class discussion might be able to tap into these thoughts, which will include misconceptions. Towards the end of working with this concept, another class discussion may assist in clarifying the actual definition(s) of a chemist. In reality, a chemist is any person who works with and/or studies chemicals. This can be applied in many ways in many fields, and hence the likelihood of varying preconceptions.

Additional activity: Chemistry in cosmetics

Ask students to research how cosmetics are made. Why is chemistry such an important part of creating cosmetics? What are some of the issues in the cosmetics industry (e.g. animal testing)?

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**What do chemists do for a living?**  
This video shows some of the activities undertaken by chemists.

5.6 Physical and chemical changes are used to recycle household waste

Teacher notes (pages 90–91)

Introducing the topic

Understanding the difference between physical and chemical reactions can help us understand which objects can be recycled. Objects that undergo physical reactions can easily be recycled because the reactions are reversible and new shapes can be formed. Chemical reactions can be used to create new materials that can be used again.

Teaching tips: Plastics

It can be good to revisit plastics with students. Plastics are synthetic materials, which means they have been made artificially. Each of the small parts of plastics are called monomers (mono = one). The monomers are linked together to make polymers (poly = many).

Additional activity: Decomposition timeline

Ask students to create a timeline that shows how long common things take to break down in nature. Some common objects to include could be newspaper, a plastic shopping bag, egg cartons, a plastic milk bottle, an aluminium can, disposable nappies and glass bottles.

Additional activity: Recycling

Ask students to research the most bizarre ways of recycling they can find, for example, paper made from animal poo. From using old bottles to make beautiful art and turning old plastic into bridges, it’s all been done!

Assessment

Ask students to prepare a survey for other students or family members about one of the following topics:

• How much ‘stuff’ do they buy each week? What happens to this stuff? Is it thrown away, given away or re-purposed? The ‘Story of stuff’ video (see below) says that approximately 99% of the ‘stuff’ we buy is thrown away within six months. What evidence can you gather to support this hypothesis?

• How efficiently are individuals in your community recycling? What kinds of things are they recycling? What could they be doing better?

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

**Story of stuff**  
The ‘Story of stuff’ is an excellent video for students and educators. It uses animation and clear story telling to explain the problems with manufacturing ‘stuff’.