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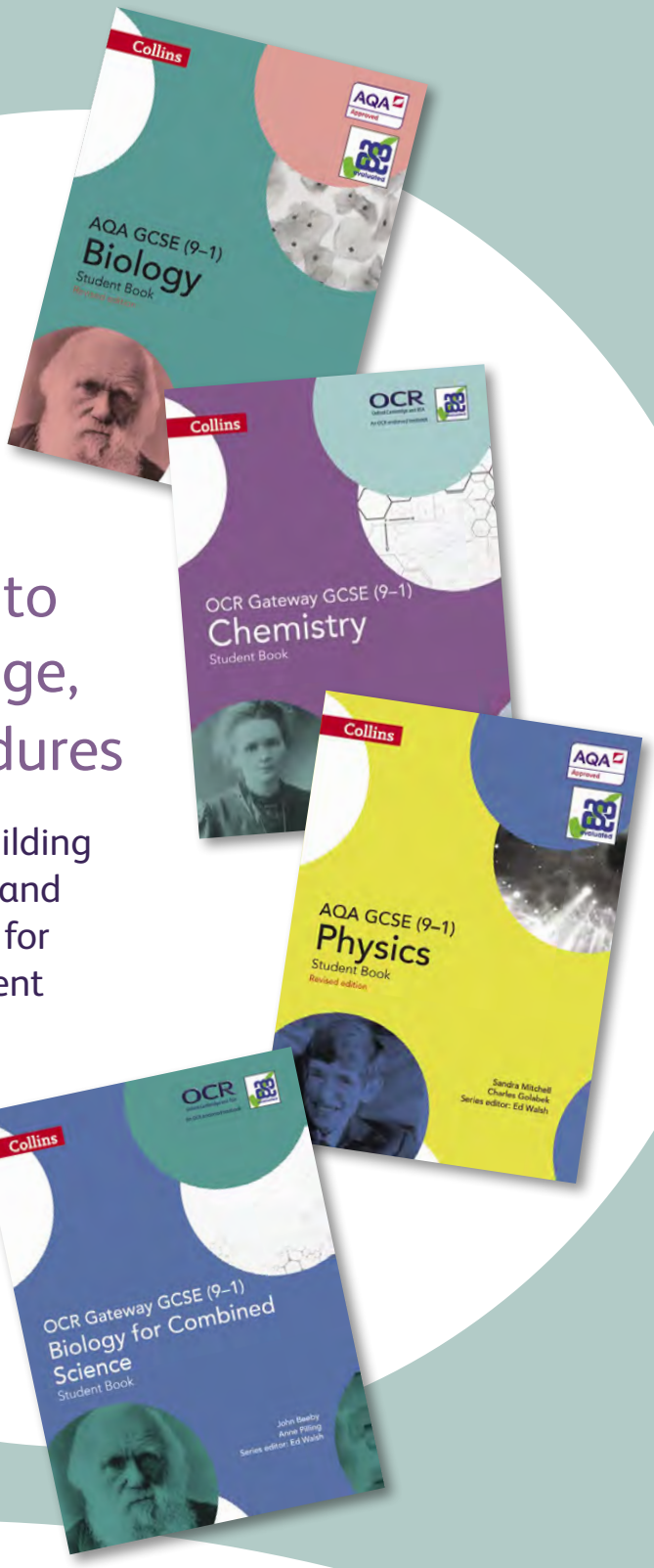

Deliver an ambitious and connected GCSE science curriculum to embed key knowledge, concepts and procedures

Achieve positive outcomes by building on what students already know and providing regular opportunities for retrieval practice and assessment

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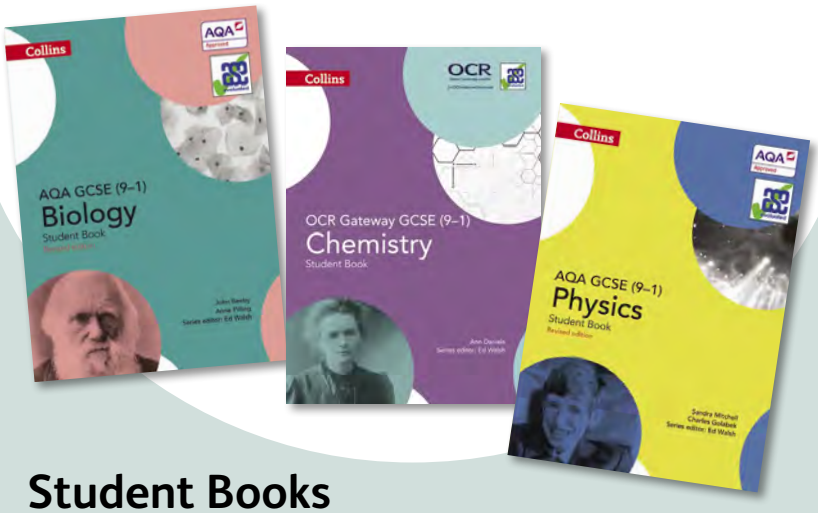
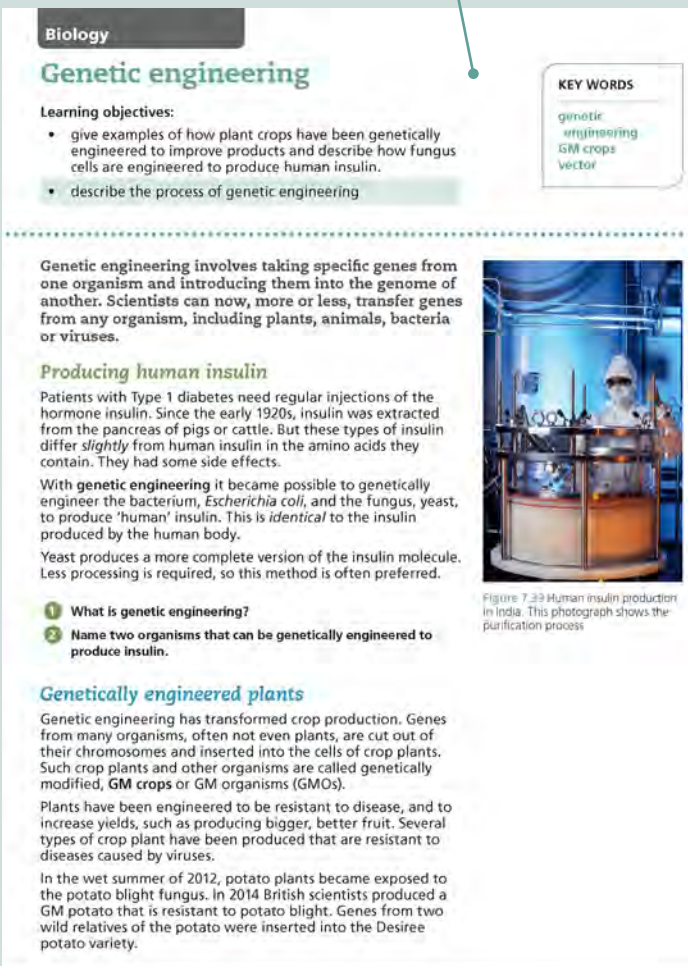


Student Books

- Create a coherent learning progression and deep understanding of science with carefully sequenced content
- Ensure practical and maths skills are planned into the curriculum with dedicated pages within each science discipline
- Highlight important threshold concepts that students must grasp before they can move on with their learning
- The AQA Student Books are approved by AQA and the OCR Gateway Student Books are endorsed by OCR so you can teach with confidence

Provide a clear delineation of content with a **precise focus on key concepts, knowledge and vocabulary**



Biology

Genetic engineering

Learning objectives:

- give examples of how plant crops have been genetically engineered to improve products and describe how fungus cells are engineered to produce human insulin.
- describe the process of genetic engineering

KEY WORDS
genetic engineering
GM crops
vector

Genetic engineering involves taking specific genes from one organism and introducing them into the genome of another. Scientists can now, more or less, transfer genes from any organism, including plants, animals, bacteria or viruses.

Producing human insulin

Patients with Type 1 diabetes need regular injections of the hormone insulin. Since the early 1920s, insulin was extracted from the pancreas of pigs or cattle. But these types of insulin differ *slightly* from human insulin in the amino acids they contain. They had some side effects.

With **genetic engineering** it became possible to genetically engineer the bacterium, *Escherichia coli*, and the fungus, yeast, to produce 'human' insulin. This is *identical* to the insulin produced by the human body.

Yeast produces a more complete version of the insulin molecule. Less processing is required, so this method is often preferred.

1. **What is genetic engineering?**
2. **Name two organisms that can be genetically engineered to produce insulin.**

Figure 7.39 Human insulin production in India. This photograph shows the purification process

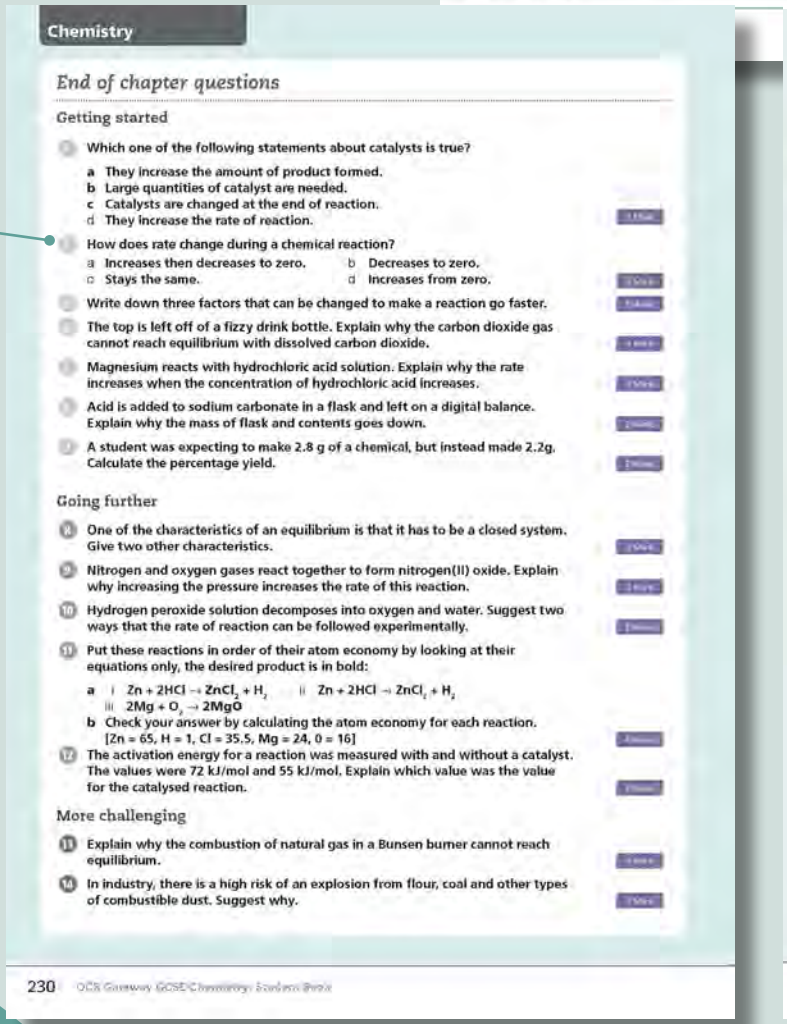
Genetically engineered plants

Genetic engineering has transformed crop production. Genes from many organisms, often not even plants, are cut out of their chromosomes and inserted into the cells of crop plants. Such crop plants and other organisms are called genetically modified, **GM crops** or GM organisms (GMOs).

Plants have been engineered to be resistant to disease, and to increase yields, such as producing bigger, better fruit. Several types of crop plant have been produced that are resistant to diseases caused by viruses.

In the wet summer of 2012, potato plants became exposed to the potato blight fungus. In 2014 British scientists produced a GM potato that is resistant to potato blight. Genes from two wild relatives of the potato were inserted into the Desiree potato variety.

Encourage knowledge retrieval and build application and evaluation skills with **differentiated end of chapter questions**



Chemistry

End of chapter questions

Getting started

1. Which one of the following statements about catalysts is true?
   a They increase the amount of product formed.
   b Large quantities of catalyst are needed.
   c Catalysts are changed at the end of reaction.
   d They increase the rate of reaction.
2. How does rate change during a chemical reaction?
   a Increases then decreases to zero. b Decreases to zero.
   c Stays the same. d Increases from zero.
3. Write down three factors that can be changed to make a reaction go faster.
4. The top is left off of a fizzy drink bottle. Explain why the carbon dioxide gas cannot reach equilibrium with dissolved carbon dioxide.
5. Magnesium reacts with hydrochloric acid solution. Explain why the rate increases when the concentration of hydrochloric acid increases.
6. Acid is added to sodium carbonate in a flask and left on a digital balance. Explain why the mass of flask and contents goes down.
7. A student was expecting to make 2.8 g of a chemical, but instead made 2.2g. Calculate the percentage yield.

Going further

8. One of the characteristics of an equilibrium is that it has to be a closed system. Give two other characteristics.
9. Nitrogen and oxygen gases react together to form nitrogen(II) oxide. Explain why increasing the pressure increases the rate of this reaction.
10. Hydrogen peroxide solution decomposes into oxygen and water. Suggest two ways that the rate of reaction can be followed experimentally.
11. Put these reactions in order of their atom economy by looking at their equations only, the desired product is in bold:
    a i $Zn + 2HCl \rightarrow \mathbf{ZnCl_2} + H_2$ ii $Zn + 2HCl \rightarrow \mathbf{ZnCl_2} + H_2$
    iii $2Mg + O_2 \rightarrow \mathbf{2MgO}$
    b Check your answer by calculating the atom economy for each reaction. [Zn = 65, H = 1, Cl = 35.5, Mg = 24, O = 16]
12. The activation energy for a reaction was measured with and without a catalyst. The values were 72 kJ/mol and 55 kJ/mol. Explain which value was the value for the catalysed reaction.

More challenging

13. Explain why the combustion of natural gas in a Bunsen burner cannot reach equilibrium.
14. In industry, there is a high risk of an explosion from flour, coal and other types of combustible dust. Suggest why.

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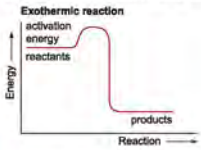
Worked example

1. **Explain how catalysts work.**
   They speed up a reaction because they lower t
2. **Draw the equation symbol used to show a r**
3. **Draw an energy profile to show the activati needed for a reaction to take place.**



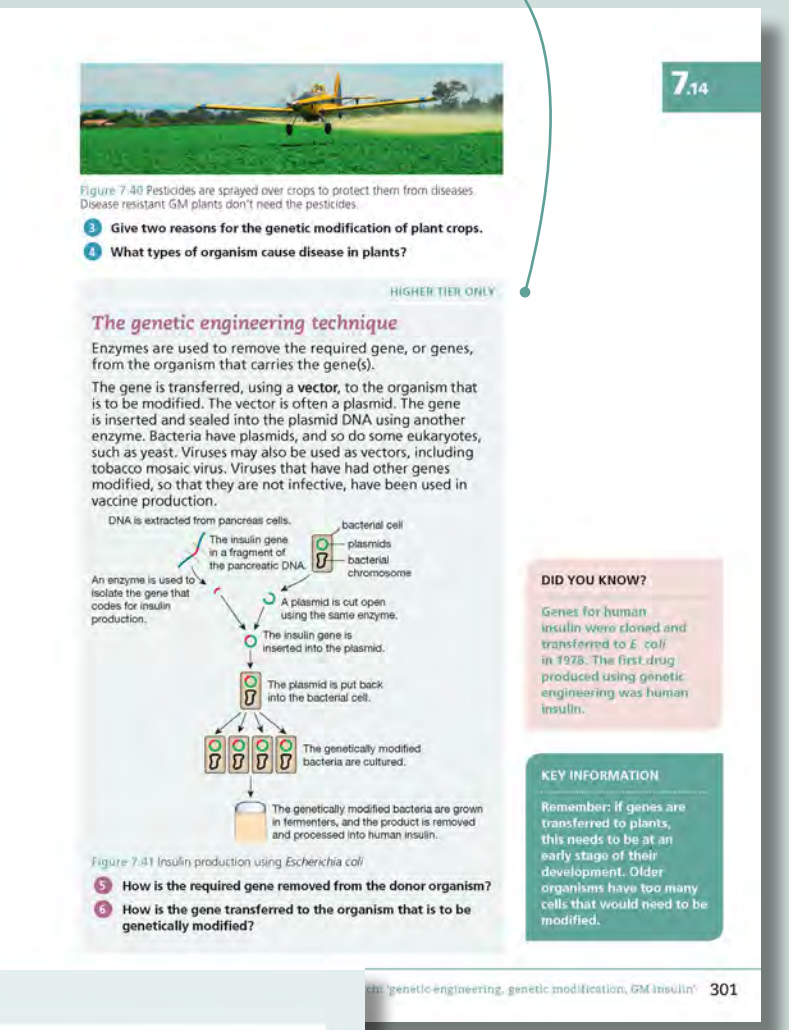
4. **Explain how increasing temperature increas reaction.**
   The particles move faster so hit each other mo
5. **Look at the table. Fill in the missing numbe pattern shown by this reaction at equilibriu percentage of product probably formed at what the owner of the factory making this**

Temperature in °C	100	200
% reactants at equilibrium	22	37
% products at equilibrium	78	63

The higher the temperature the less products so the owner should do this at a low temperatu

Sample pages from **AQA GCSE (9–1) Biology Student Book**, and **OCR GCSE (9–1) Chemistry Student Book**

Co-teach both Foundation and Higher tier with a single book



7.14

Figure 7.40 Pesticides are sprayed over crops to protect them from diseases. Disease resistant GM plants don't need the pesticides.

3 **Give two reasons for the genetic modification of plant crops.**

4 **What types of organism cause disease in plants?**

HIGHER TIER ONLY

The genetic engineering technique

Enzymes are used to remove the required gene, or genes, from the organism that carries the gene(s).

The gene is transferred, using a **vector**, to the organism that is to be modified. The vector is often a plasmid. The gene is inserted and sealed into the plasmid DNA using another enzyme. Bacteria have plasmids, and so do some eukaryotes, such as yeast. Viruses may also be used as vectors, including tobacco mosaic virus. Viruses that have had other genes modified, so that they are not infective, have been used in vaccine production.

Figure 7.41 Insulin production using *Escherichia coli*

5 **How is the required gene removed from the donor organism?**

6 **How is the gene transferred to the organism that is to be genetically modified?**

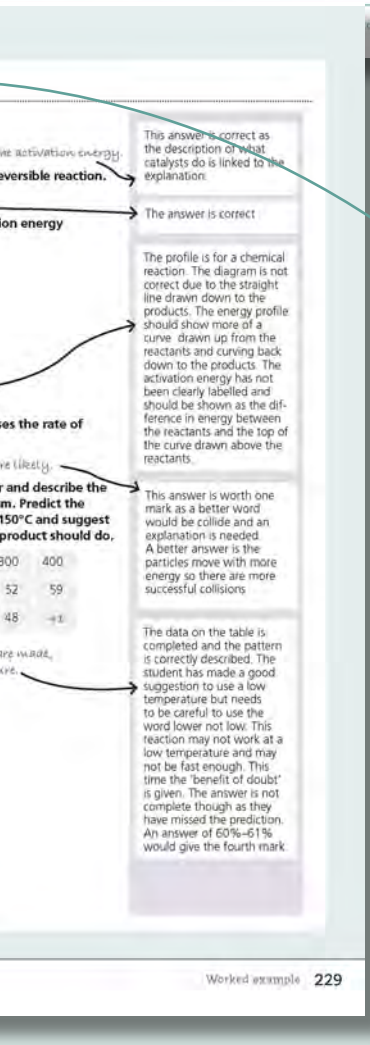
DID YOU KNOW?

Genes for human insulin were cloned and transferred to *E. coli* in 1978. The first drug produced using genetic engineering was human insulin.

KEY INFORMATION

Remember: if genes are transferred to plants, this needs to be at an early stage of their development. Older organisms have too many cells that would need to be modified.

ch: 'genetic engineering, genetic modification, GM insulin' 301



...e activation energy.
...eversible reaction.
...ion energy
...ses the rate of
...e likely.
...r and describe the ...m. Predict the ...150°C and suggest ...product should do.
300 400
52 59
48 +1
...re made. ...re.

This answer is correct as the description of what catalysts do is linked to the explanation

The answer is correct

The profile is for a chemical reaction. The diagram is not correct due to the straight line drawn down to the products. The energy profile should show more of a curve drawn up from the reactants and curving back down to the products. The activation energy has not been clearly labelled and should be shown as the difference in energy between the reactants and the top of the curve drawn above the reactants.

This answer is worth one mark as a better word would be collide and an explanation is needed. A better answer is the particles move with more energy so there are more successful collisions

The data on the table is completed and the pattern is correctly described. The student has made a good suggestion to use a low temperature but needs to be careful to use the word lower not low. This reaction may not work at a low temperature and may not be fast enough. This time the 'benefit of doubt' is given. The answer is not complete though as they have missed the prediction. An answer of 60%–61% would give the fourth mark.

Worked example 229

Encourage independent study with **worked examples** at the end of every chapter

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