These new editions of OCR Twenty First Century Science have been written for the new OCR GCSE Twenty First Century Science (9–1) specifications. They support your students with the new, more demanding content and increased maths requirements, as well as the suggested practical activity groups.

**Written side-by-side with the new specifications**

Working in partnership with the University of York Science Education Group (UYSEG), who have produced the Twenty First Century Science suite of specifications, these new resources have been devised and written alongside the new specifications. Student Books are available for the new Biology, Chemistry, and Physics specifications, as well as Combined Science.

**Making assessment and progress tracking easy**

Twenty First Century Science provides at least one activity or assessment item for every assessable learning outcome of the specification, providing teachers with evidence of their students’ progress during and at the end of a sequence of teaching.

**Prepare for the new practicals**

Practical skills are highlighted throughout the Student Books, and there is a chapter dedicated to exam technique. There is also a bank of practical activities on Kerboodle.

**Building maths skills**

Worked examples and practice questions are incorporated throughout the Student Books and on Kerboodle to support your students with the new increased maths requirements. Kerboodle also has direct links to MyMaths.co.uk, the most popular maths learning platform in the UK.

**Plenty of practice questions**

Multiple-choice, maths, practical and practice questions are included throughout.

**Independent learning**

Student-facing resources encourage independent learning and support progression to A Level.

**How to evaluate**

Order your OCR Twenty First Century Science Evaluation Pack (978 019 837526 5) by emailing schools.orders.uk@oup.com and quoting K43684.
With the new linear GCSEs you may have concerns about how to monitor your students’ progress and support their learning over two or three years. OCR Twenty First Century Science has built-in assessment to help students understand where they are in their learning, supporting your formative assessment with specially created, research-informed assessment items.

In developing these new editions of the OCR Twenty First Century Science GCSE course the University of York Science Education Group (UYSEG) have used the backward design approach to curriculum design (Wiggins and McTighe, 2005) and also drawn on ideas from the BSCS SE Instructional Model (Bybee et al., 2006).

**Built-in research-informed assessment**

Reassurance every step of the way

Every assessable learning outcome (ALO) in the specification has at least one associated evidence of learning-item, in the form of a question, task, activity, or practical.

Engaging storylines bring the course and assessment alive

The Twenty First Century Science specifications include storyline narratives based on the ever-changing stories of science in the world around us. The Student Books use these narratives from the specification alongside the clearly defined learning outcomes to create an engaging and rigorous route through GCSE Science for future scientists and scientifically literate citizens.

**Linking learning to assessment**

The backward design approach places assessment at the heart of the planning process, to ensure that the intentions of the assessable learning outcomes in the specification are clear to teachers. You can think of it as designing the course by reverse engineering.

Using this approach the UYSEG project team identified tasks and activities that provide evidence of progress in learning during and at the end of teaching. They then identified the teaching activities that will bring about that learning.

### Learning intention

<table>
<thead>
<tr>
<th>Teaching activities</th>
<th>Evidence of progress in learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2.</td>
</tr>
</tbody>
</table>

1. What do we want students to learn?
3. What are the activities that will help that progress?
2. What are the questions and tasks that will provide evidence of progress in students’ learnings?

### Purpose Approaches

#### Introduction
- Engage students using short activities that promote curiosity in scientific questions
- Assess prior knowledge and expose misconceptions

#### Explanation
- Use a variety of activities, including practical work and questioning, to develop scientific explanations
- Students use their current knowledge to explore new questions
- Support students to demonstrate their new understanding and skills

#### Application
- Introduce new contexts to challenge students’ understanding of key concepts
- Students broaden their understanding by applying their ideas in new ways

#### Evidence
- Use formative assessment techniques to monitor progress throughout each section of work
- Students check their own understanding and skills using self-check items

**Specification**

**Student Book**

**Kerboodle**

**Course content**

**Evidence of learning items:** questions, tasks, activities, practicals
Student Books

The Student Books provide support for lesson delivery, assessment, and differentiation, written by the University of York Science Education Group specifically for the 2016 specifications.

Why study radioactive materials?

- Understanding the basic principles of radioactive decay.
- Learning about the properties and uses of radioactive elements.
- Applying radioactive concepts to real-world problems.

What you already know

- Knowledge of atomic structure and isotopes.
- Basic understanding of nuclear reactions.

The Ideas about Science covered in this chapter are highlighted here to aid students' scientific literacy.

The Science boxes explain the types of science covered in this chapter, and why they are important.

You should know

This is a summary of the main ideas in the chapter.

Students can use this as a starting point for revision.

Worked example: Calculating percentages

1. The height of a group of people is given in the table below. What is the maximum height and the mode of the heights?

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>2</td>
</tr>
<tr>
<td>165</td>
<td>1</td>
</tr>
<tr>
<td>167</td>
<td>3</td>
</tr>
<tr>
<td>168</td>
<td>1</td>
</tr>
<tr>
<td>185</td>
<td>1</td>
</tr>
</tbody>
</table>

Find the maximum height:

- Step 1: Identify the heights in the table.
- Step 2: Compare the heights to find the maximum.
- Solution: The maximum height is 185 cm.

Find the mode:

- Step 1: Identify the heights in the table.
- Step 2: Count the frequency of each height.
- Step 3: Identify the height with the highest frequency.
- Solution: The mode of the heights is 167 cm.

Science explanations

B3 Living together – food and ecosystems

Science explanations

1. Plants use light to make food. Plants need light to make energy for themselves. How can this be used to help people?

2. People can make use of plants to produce energy. How can this be done?

C2 Chemical patterns

<table>
<thead>
<tr>
<th>Table</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
</tr>
<tr>
<td>B</td>
<td>23</td>
</tr>
<tr>
<td>C</td>
<td>34</td>
</tr>
</tbody>
</table>

Review questions

Students can use these practice questions to test how well they know the topics covered in the chapter.

Questions

1. Describe the pattern in electronic structures for the first 20 elements of the Periodic Table.
2. Explain how the discovery of germanium supported Mendeleev's decision to leave gaps in his Periodic Table.
3. Predict the number of electrons in the outer shell of a tellurium atom. Then explain why iodine and tellurium are not placed in the Periodic Table in mass number order.

Worked examples

- Using simple shapes or analogies to represent complex ideas.
- Applying models to real-world situations.

Model boxes highlight the use of a representational, descriptive, or mathematical model in the science.

Ramped practice questions at the end of each section require students to apply their knowledge.

Find out about boxes

- List the key points covered in each section.

The keywords from each section are given and defined in the Glossary.

Why study? sections explain why the content of each chapter is relevant to scientists and to everyday life.

Find the maximum height and the mode of the heights.

- Step 1: Identify the heights in the table.
- Step 2: Compare the heights to find the maximum.
- Step 3: Identify the height with the highest frequency.

Finding the best estimate

- Using the mean, median, and mode to represent data.

What observations were made during the experiment?

- Describe the key findings and conclusions from the experiment.

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B1: You and your genes

What is the genome and what does it do?

Assessable learning outcomes

Maths support is available, including links to helpful resources on MyMaths.co.uk

MyMaths

The UK's most popular digital solution for GCSE Science

OCR Twenty First Century Sciences Kerboodle provides unrivalled digital support for the new 9–1 specifications, with a bank of resources, activities, and an online assessment package.

Explain and Apply

A wide range of activities and practicals support the Introduce, Explain, Apply, Evaluate model. The worksheets help build the knowledge and skills needed for the new practical exam questions, and cover all of the new practical activity groups.

Maths and literacy skills support

Student literacy activities support and build literacy skills

MyMaths

Maths calculation worksheets provide worked solutions and ramped practice questions, including an exam-style question

Includes exclusive links and access to resources on MyMaths.co.uk

Maths skills interactives include step-by-step worked solutions and practice questions with feedback
This pie chart shows the proportion of different elements in the atmosphere?

- Nitrogen (78%)
- Oxygen (21%)
- Argon (1%)
- Carbon Dioxide
- Other gases, including water vapour

In the atmosphere:

- Oxygen is essential for the survival of most living organisms.
- Other gases, including water vapour, contribute to the greenhouse effect.
- The air in the atmosphere consists mainly of two elements: nitrogen and oxygen.

These simplifications mean that there are limitations to what the basic model can explain.

In the solid state, the particles are close together and unable to move away from their neighbours.

In the liquid state, the particles are also close together but can slide past each other.

In the gas state, the particles are far apart and move freely.

How has the Earth’s atmosphere changed over time, and why?

- The atmosphere has changed significantly over time due to various factors such as volcanic eruptions, comets hitting the Earth, and human activities.
- The composition of the atmosphere has changed over time, with the percentage of oxygen increasing over millions of years.
- The Earth’s atmosphere has been shaped by the process of photosynthesis, which uses carbon dioxide and releases oxygen.

Resources are built into each section, presentation, including practical activity sheets, animations, and interactive evidence of learning activities.
About the University of York Science Education Group

The University of York Science Education Group (UYSEG) was established in 1983, and has a national and international reputation for research and for the development of evidence-informed school science curricula.

UYSEG aims to make a sustained, positive impact on the outcomes of both formal and informal science education through:

- high-quality research that has an impact on policy and practice
- the development and evaluation of evidence-informed curricula that illustrate the importance of science
- use of context-led approaches and emphasis on scientific literacy.

Project Director – Mary Whitehouse
Mary Whitehouse has taught physics and science in schools and colleges and has a wealth of experience in science curriculum development. In collaboration with OCR and Oxford University Press she has developed the Twenty First Century Science specifications and accompanying resources. With a focus on the relationship between assessment and teaching she was Chief Examiner for GCSE Physics and for GCSE Twenty First Century Science during the pilot stage. She joined the University of York in 2009 and is Project Director for Twenty First Century Science.

Project Manager – Alistair Moore
Alistair Moore has worked as Qualification Leader for GCSE Biology and Human Biology at an awarding body, and as Qualifications Manager for the GCSE Twenty First Century Science suite. He led the redevelopment of Twenty First Century Science for first teaching in 2011. With a background in immunology and biotechnology, he joined the University of York in 2013 and is Project Manager for Twenty First Century Science.