Mastery in Science
Using big ideas to make cognitive links from year 7 to year 11
Welcome to **Mastery in Science**!

We have worked with lots of teachers, examiners and subject experts to put together a comprehensive pathway to help you with planning your teaching from year 7 right up to year 11 and beyond.

Read through this guide to see how mastery can support you with broadening the science curriculum and diversity links in science, and how to use the short formative assessment grids to help support students’ learning.

**What is Mastery in Science?**

*Mastery in Science* is a way to teach the KS3 and GCSE subject content that uses big ideas to encourage deep understanding of key concepts. It is designed to link content together in a logical and steady way from year 7 to year 11. The big ideas are introduced in year 7 where students secure their knowledge in each key theme.

Our Mastery pathways are structured to:

- consolidate previous knowledge
- add an extra layer of deeper understanding each time a big idea is visited
- include regular formative assessment points to identify areas to support learning.
Why science matters

Learning about science and the world around us should be engaging, relevant and thought provoking. We have interwoven a range of links through our mastery pathways to help students engage with their learning, and broaden their understanding of science in everyday life:

- dedicated STEM careers videos to inspire learners and showcase the diverse applications of science based careers
- STEM Careers poster outlining a wide variety of future careers in science to serve as a reminder of all the opportunities available to students
- links to our Future Skills for Employability framework which is designed to equip today’s learners with the future skills needed to flourish in tomorrow’s world of work
- encouraging diversity in science by exploring our fantastic ‘Scientist of the Month’ series, including special featured scientists such as Alan Turing in Pride month, and lots more exciting spotlights to complement learning in Black History Month.

What are the big ideas in Mastery?

There are three big ideas in each of biology, chemistry and physics. These are developed each year, and are always referred to in the content and details to show how the learning links to the bigger picture.
Overview of content

This is an overview of one of the journeys for students from year 7 to year 11. There is one journey for each of biology, chemistry and physics (separate science version, and combined science versions).

You will be able to use these journeys to access the topics by clicking on the relevant ones. As you can see, the colours relate to each big idea in each subject.
Formative assessment in Mastery

Formative assessment is a fundamental part of mastery in science. Students must show that they have mastered concepts before more complex applications and ideas are built into the big ideas each year.

We have developed two options for teachers to help with formative assessment in mastery. These are quick-response questions designed to determine whether students have mastered the main points before moving on to the next big idea. They are designed to draw on content they have just been taught, as well as link to content that would have been in a previous topic. This helps to ensure previous learning isn’t forgotten, and is built upon every year.

1. **Rewind grids:** use the built-in question grids to quickly determine students’ understanding of a topic each week.

2. **Tassomai:** buy in to the bespoke Tassomai quizzes, which have been tailored for our mastery course, to access the rich feedback from student responses and see how well they have grasped prior learning, and mastered new content.

Delving into the detailed pathways

Each topic outlined in our overviews is designed to be the equivalent of approximately a week of teaching material. Here’s a topic in miniature to show you what this looks like, and take you through some of the embedded features in the pathway.

Use this section to see what the prior knowledge of the topic is, and what’s going to be covered in this topic.

This section highlights any misconceptions, and links lesson content to our Future Ready framework, getting students ready for the world of work!

This is your main reference point. Topic titles here will match the subject journeys, and the numbering reflects teaching order.

See how the content in this topic links to Programme of Study, and Working Scientifically skills.
Diversity Debate: Percy Julian (see scientist of the month) attended De Pauw and Harvard University. He was named Chicago’s Man of the Year in a Chicago Sun-Times poll, but his home was bombed and burned when he moved to the all-white suburb of Oak Park (ref: Britannica). Was this right? How do you think the residents of Oak Park felt?

Teaching ideas / links to resources

Opportunities for extension: Investigate the effect of different coloured light on the rate of photosynthesis.

Exemplifying Mastery! This section has lots of images that you can use to see how well your students have grasped the content. A visual way to represent the learning that is taking place!
Rewind grid

<table>
<thead>
<tr>
<th>This topic</th>
<th>Enzymes (Y9)</th>
<th>Photosynthesis (Year 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give the equation for photosynthesis.</td>
<td>Carbon dioxide + water [\rightarrow] glucose + oxygen</td>
<td>State where in a plant cell photosynthesis occurs.</td>
</tr>
<tr>
<td>1 point</td>
<td>1 point</td>
<td></td>
</tr>
<tr>
<td>Describe the effect of rate limiting factors on the rate of photosynthesis.</td>
<td>Describe the effect of high temperature on enzymes.</td>
<td>Describe the features of palisade cells.</td>
</tr>
<tr>
<td>3 points</td>
<td>3 points</td>
<td></td>
</tr>
<tr>
<td>Explain how hydrogen carbonate indicator can be used as a quantitative measure of photosynthesis.</td>
<td>Explain the effect of temperatures below the optimum on enzyme activity.</td>
<td>Explain the similarities and differences between flowering plants and conifers.</td>
</tr>
<tr>
<td>5 points</td>
<td>5 points</td>
<td></td>
</tr>
</tbody>
</table>

Rewind grid answers

<table>
<thead>
<tr>
<th>Carbon dioxide + water [\rightarrow] glucose + oxygen</th>
<th>Substrate</th>
<th>In the chloroplast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate limiting factors prevent the rate of photosynthesis increasing beyond a point causing the rate to plateau. Rate limiting factors include light intensity, carbon dioxide concentration and temperature.</td>
<td>High temperatures denature enzymes, changing the shape of the active site.</td>
<td>Palisade cells are in the upper part of the leaf, they have a large surface area to absorb sunlight and contain a lot of chloroplasts for photosynthesis.</td>
</tr>
<tr>
<td>Hydrogen carbonate indicator is sensitive to small changes in pH. If the rate of photosynthesis is high then carbon dioxide is used in the reaction, the pH increases (less acidic) and the indicator changes to a purple colour. If the rate of photosynthesis is low the net level of carbon dioxide increases as it is released through respiration. The pH decreases (becomes more acidic) and the indicator turns yellow.</td>
<td>Below the optimum temperature for the enzyme particles have less kinetic energy. There is less chance of a collision between the enzyme and the active site. Less enzyme-substrate complexes are formed and the rate of reaction is lower.</td>
<td>Both have roots and xylem as well as the general features of plants including cellulose cell walls, multicellular and autotrophic (synthesize their own food). Flowering plants reproduce using flowers and have large flat leaves. Conifers reproduce using cones and have needle-like leaves.</td>
</tr>
</tbody>
</table>

Register for a network event

- Sign up to our Mastery networks in the Autumn term to learn about how you can use the mastery course to help your planning.
- Register on the website to receive all the details you need to get started with Mastery in Science, and also to speak to our curriculum consultants.

Sign up to find out more