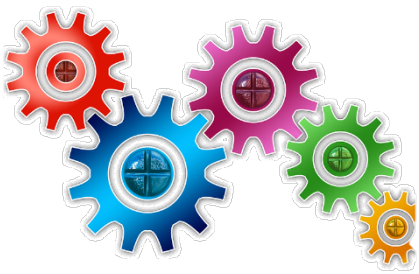
Science

The Science curriculum is designed to inspire curiosity in students so that they actively seek to be able to explain phenomenon in the world around them and learn about how scientists have discovered what we currently know and think. Within the teaching of Science, principles from the Education Endowment Foundation (EEF) (appendix item 1) 'Improving secondary Science' report is embedded alongside pedagogy distilled from evidence-based research.

How is the curriculum planned?

Through learning science, students are given a broad understanding of; the fundamentals of science, how scientists discover things, famous scientists and their discoveries and how science seeks to explain everything so they are well prepared for life in general and to take their science studies further if they choose to do so.

The knowledge and skills required from the Science National Curriculum (NC) are broken down into distinct units at both Key Stage 3 and Key Stage 4 but we try and look at the secondary Science curriculum as a 5-year journey. The assessment model we use has key performance indicators (KPIs) that exemplify what students should know and be able to do at any specific point over the 5 years.



In years 7 and 8, students cover the Key Stage 3 NC, introducing the main areas of Biology, Chemistry and Physics at a level that is suitable for them based on their prior attainment. (See appendix 2 for topics and order). Year 9 is the first year where students then begin to study AQA Combined Science or the three separate Sciences. Throughout, the key concepts in each Science are revisited and emphasised so that these are firmly known and memorised so they can be applied to unfamiliar contexts readily. For example, key concepts in Biology such as cells, transport, respiration and surface area are revisited many times in different contexts that are progressively more demanding. (Appendix 3 has the key concepts and when they are covered).

Where the science learning compliments the learning in other subjects, key vocabulary and approaches are used to explicitly build links in the students' schemas so that the learning in both areas reinforces each other and helps to make it more memorable. With Science this is most apparent in areas such as Geography (earth structure, pollution, population effects, limited resources), Maths (ensuring common approaches to work covered), PSHEE (development, reproduction and fertility control).

To ensure that all students (and especially the disadvantaged) acquire the cultural capital to help them be more successful in the future we ensure that they acquire the scientific vocabulary that they need to and are aware of the scientists involved in some of the biggest scientific discoveries such as Darwin, Newton, Faraday and Einstein.

How is the curriculum delivered/taught?

Alongside recommendation 1 from the EEF report which is focused on Preconceptions, *Constructivism* (as detailed by the Royal Society for Chemistry) underpins our pedagogical approach to teaching Science. Questioning is used to unpick preconceptions and then time is spent eliciting and challenging misconceptions to ensure that students have a solid foundation upon which they can construct their new learning. The link to prior learning and experiences not only ensures that students' misconceptions are cleared up but it also reinforces the prior learning in long term memory.

A range of activities and styles are used so that, where appropriate, practical activities and the use of models are built into the learning sequence so that students can experience scientific processes for themselves and link challenging concepts to models to help them understand these and embed them in their long-term memory.

Topics are routinely revisited to test understanding from prior learning, as well as that covered more recently, so that over time students meet the most important concepts and knowledge several times to both reinforce them and make them stick in a student's long-term memory. As a part of this, tests (end of topic, review lessons, exams and low stakes recall quizzes such as Science Giants, Retrieval Roulettes (appendix item 2) and Kahoot) give feedback to students so that they can use Personalised Learning Checklists (PLCs) to identify their strengths and areas that they still need to focus on. Teachers use the same feedback to identify areas that they can then review with the class where the assessments show that there are gaps or confusion in the learning.

Students are given constructive feedback that celebrates strengths but that is focused on the next steps in learning. Within lessons students are given time to act upon this feedback in line with the whole school policy. Throughout lessons teachers question individuals and give constructive verbal feedback – again focused on the next steps. Independent learning is used weekly and is built into the teaching sequence so that it compliments and reinforces the work covered in lessons.

In order to access scientific texts and literature students, need to be able to understand and use a wide range of subject-specific language. This is introduced gradually and the teachers will draw attention to new vocabulary and explore with students the component parts of words and how they link to other words. (For example, *photo* meaning *light* from the Greek phos/photos – in photosynthesis, photograph, photon, photobiotic). In their books, students keep a glossary of terms and are expected to refer to this as necessary. Students are expected to read scientific texts and with the teacher's support unpick the key parts of this for what it means and any areas they are confused about.

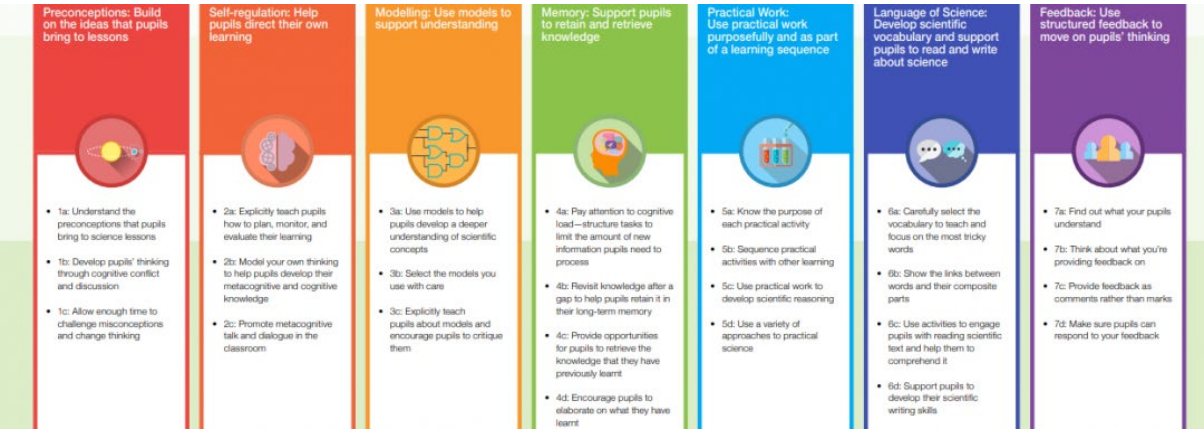
How is the curriculum assessed?

Science assessment is focused on students taking feedback and then having the skills to act upon it in a timely fashion so knowledge is embedded and can be linked to other areas of the curriculum. The use of detailed feedback sheets across the department enables students to link their learning to the PLCs on Google classroom as a record of their progress. The bi-modular approach to summative assessments also enables students to link and build their learning whilst supporting teacher in identifying misconceptions. (See example in appendix item 4.)

During Science lessons, standard practice is to carry out multiple levels of formative assessment to ascertain the conceptual understanding of students. This ranges from the use of examination questions to verbal questioning and finally the summative assessments. Teaching and learning across the department is aided by regular assessment of students' progress through PLCs. The key concepts (appendix item 3) are shared with staff so that knowledge is interleaved and through retrieval practice students develop a deeper understanding due to pedagogical approaches such as fortnightly reviews.

Appendix item 1

https://educationendowmentfoundation.org.uk/tools/guidance-reports/improving-secondary-science/

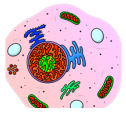


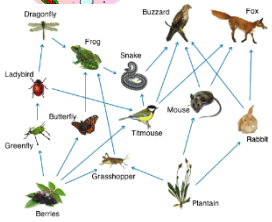
Appendix item 2

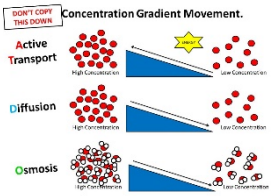
	Questions
1	What is the equation linking kinetic energy, mass and velocity?
2	What are the units of energy?
3	What are the units of mass?
4	What are the units of velocity?
5	What is the equation linking gravitationa field strength, gravitational potential energy and height?
6	What are the units of gravitational field strength?
7	What is the equation linking energy transferred, power and time?
8	What are the units of power?
9	What is the definition of power?
10	What is the equation linking power, time and work done?
	Answers
1	Ek= 0.5mv2
2	joules
3	kilograms
4	metres per second
5	Ep=mgh
6	newtons per kilogram
7	P=E/t
8	Watts
9	Power is the rate of transfer of energy or the rate of doing work
10	P=W/t

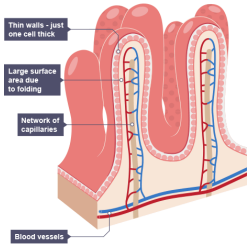
Appendix item 3

Key concepts in Biology

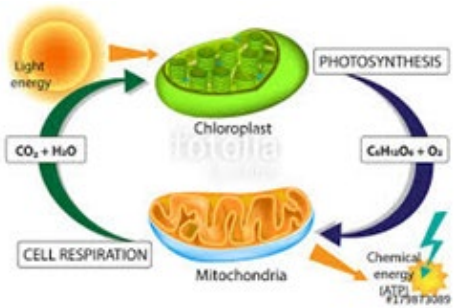




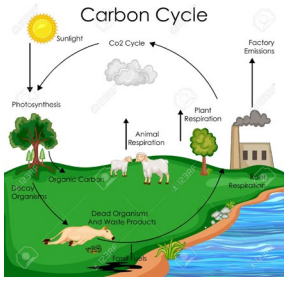


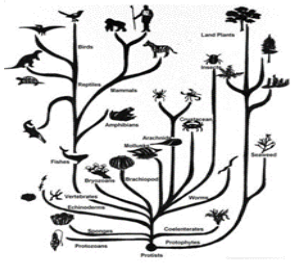


- Life processes depend on molecules whose structure is related to their function.
  - The fundamental units of living organisms are cells, which may be part of highly adapted structures enabling living processes to be performed effectively.
  - Transport within organisms and between cells is essential.
  - Surface area is a fundamental feature of most biological systems.
  - Living organisms may interact with each other, with the environment and with humans in many different ways.
- Year 7: Cells / genes and inheritance/ ecosystems
- Year 8 food and digestion/ plants/ speciation and sampling
- Year 9: bioenergetics/ infection and response
- Year 10: inheritance and variation and evolution/ Ecology. Chemistry: Using resources and chemistry of the atmosphere.
- Life on Earth is dependent on photosynthesis.
- Year 7: cells/ ecosystems/ earth and the universe/ development of the atmosphere / Gambia
- Year 8: plants/ respiration / speciation and sampling /
- Year 9: cell biology / bioenergetics/ organisation/ infection and response (triple or separate sciences)
- Year 10: ecology / rates of reaction / evolution and inheritance/ chemistry of the atmosphere / using resources for
- Year 11: organic chemistry/ chemical analysis/



- Organic compounds are used as fuels in cellular respiration.
- Year 7: cells/ breathing and muscles/ ecosystems/ earth and universe
- Year 8: food and digestion / respiration / chemical reactions and energy/ plants/ energy
- Year 9: cell biology/ bioenergetics/ organisation /
- Year 10: energy changes/ chemical changes/ quantitative chemistry / ecology
- Year 11: rates of reaction/ organic chemistry/ chemistry of the atmosphere/ chemical analysis
- The chemicals in ecosystems are continually cycling through the natural world.
- Key Stage 4 Year 11 : Chemistry of the Atmosphere -
  - : Using Resources
  - ; Ecology - Biodiversity & Waste
- Year 10 : Atomic Structure – Radioactive Decay
  - : Energy
  - : Bioenergetics
  - Year 8 : Energy – Generating electricity & Power stations., Alternative fuels
  - The characteristics of a living organism are influenced by its genome.
  - Key Stage 4 : Year 11 - Ecology – Competition
    - Sep Chemistry – Organic – Amino Acids – Organic
    : Year 10 – Inheritance, Variation & Evolution,
    Physics – Radioactivity link to Mutations
    : Year 9 - Infection & Response
    Cell Biology
    : Year 8 – Speciation & Sampling
    Year 9-11- Cell Biology
    - Genes & Inheritance

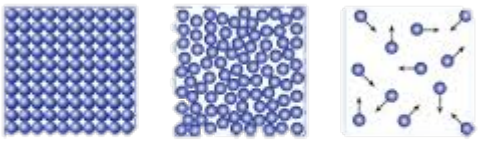




- Evolution occurs by a process of natural selection and accounts both for biodiversity and how organisms are all related to varying degrees.

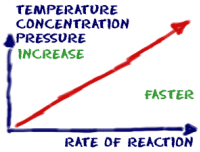
Key concepts in Chemistry

Matter is composed of tiny particles called atoms.



Yr 7 throughout where appropriate
Yr 9 Atomic Structure physics
Yr 9 Atomic structure and periodic table
Yr 9 Particle Model physics

There are trends in properties and reactivity of elements in the periodic table.
Yr 8 Periodic Table and atoms
Yr 9 Atomic structure and periodic table
Yr 9 Bonding and Structure

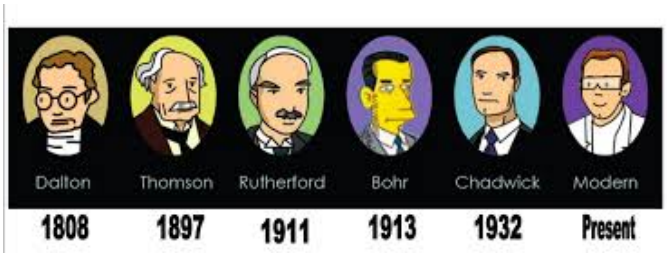


Reactions occur at different rates.
Yr 7 Solutions
Yr 7 Acids and Alkalis
Yr 8 Chemical reactions and Energy
Yr 9 Bioenergetics (Bio)
Yr 9 Energy Changes
Yr 9 Chemical Changes
Yr 10 Rates of reaction
Yr 10 Organic chemistry

Energy and mass are conserved in chemical reactions.

Earth's resources are finite and a sustainable and experimental approach is needed to secure these resources in future.

The scientific model is used to develop ideas such as atomic structure.



Appendix item 4

Inheritance and Ecology Higher Test

Name: _____

Class: _____

Date: _____

Time:	35 minutes	
Total marks available:	35 marks	
Marks:	Grade:	Number of marks needed for next grade:

Standard of work: A O B	ATL: A B C D	Previous ACT NOW completed? ☐	Previous ACT ALWAYS continued? ☐

Statements	WWW	Next steps
I can describe the structure of DNA and its role in storing genetic information inside the cell.		
I can describe the processes involved in the carbon cycle		
I can describe what fossils are, how they are formed and what we can learn from them		
I can explain how and why ecologists use quadrats and transects		
I can explain how scientific advances have led to the proposal of new models of classification, eg three-domain system.		

Spelling, punctuation and grammar	ACT NOW	ACT ALWAYS
Check your work for "Sp", "P" and "G". Find the correct versions of spellings on the whole class feedback slide. Write out below five times each. Continue on the page if necessary. Completed? ☐	1. Describe the structure of DNA and its role in storing genetic information inside the cell. 2. Describe the processes involved in the carbon cycle. 3. Describe what fossils are, how they are formed and what we can learn from them. 4. Explain how and why ecologists use quadrats and transects. 5. Explain how scientific advances have led to the proposal of new models of classification, eg three-domain system. Completed? ☐	A. Make your own science glams quiz with different levels of challenge and include answers. B. Describe examples of this principle manifesting itself in the world. C. Practice exam paper questions – copy and complete in your book. D. Choose a graphic organizer like a mind map to present the key ideas from these topics. E. Create your own exam questions and mark schemes. F. Relate the key ideas in this topic to those from previous topics using a mind map. Completed? ☐

Page 1 of 12