Science
Coordinator: G Roberts

Important Terms

Curriculum drivers shape our curriculum breadth. They are derived from an exploration of the backgrounds of our students, our beliefs about high-quality education and our values. They are used to ensure we give our students appropriate and ambitious curriculum opportunities

Curriculum breadth is shaped by our curriculum drivers, cultural capital, subject topics and our ambition for students to study the best of what has been thought and said by many generations of academics and scholars.

Our curriculum distinguishes between subject topics and threshold concepts. Subject topics are the specific aspects of subjects that are studied.

Threshold concepts tie together the subject topics into meaningful schema. The same concepts are explored in a wide breadth of topics. Through this 'forwards-and-backwards engineering' of the curriculum, students return to the same concepts over and over, and gradually build understanding of them.

For each threshold concept a number of **Milestones**, each of which includes the procedural and semantic knowledge students need to understand the threshold concepts, provides a progression model.

Knowledge categories in each subject give students a way of expressing their understanding of the threshold concepts.

Knowledge webs help students to relate each topic to previously studied topics and to form strong, meaningful schema.

Pedagogy is the method and practice of teaching, especially as an academic subject or theoretical concept.

Our Curriculum Drivers

Specialist Pedagogies

Powerful Knowledge

Flexible Curriculum Pathways

S.M.S.C.

Vocabulary

Flexible Curriculum Pathways

At Melland we have Flexible Curriculum Pathways. These pathways at their core are the Pre-formal, Semi-formal and Formal pathways. Each of these core pathways are ambitious, carefully sequenced, well-considered and progressive.
Each pathway has its own curriculum but they are part of a greater learning continuum with each student getting a personalised curriculum to meet their academic and personal development needs. There are some shared aspects, for example, Skills for Life, careers education, SMSC, Fundamental British Values, personal safety, health education and Preparation for Adulthood.
Students can move between the pathways or experience elements of more than one.

Specialist Pedagogies

We use research and training to ensure our staff are equipped with specialist pedogeological knowledge to meet the needs of all our students. All staff understand the needs of students with SEND and they use informed specialist methodologies to deliver accessible and aspirational learning opportunities for all. The specialist pedagogies required can be different depending on the Key Stage, pathway or subject.

Powerful Knowledge

Powerful knowledge refers to the essential knowledge and cultural capital that students may not typically acquire from everyday life. It requires expert teaching and explicit content delivery to prepare students for adulthood and life beyond education. It introduces them to the best that has been thought and said and will help engender an appreciation of human creativity and achievement. Students acquire bespoke and targeted powerful knowledge based on their pathway or personalised curriculum.

Vocabulary

Vocabulary is important as it helps shape our thinking. The explicit teaching of vocabulary is essential for our students as they may not acquire vocabulary incidentally through indirect exposure.
All our students benefit from developing their vocabulary. Our curriculum strikes an appropriate balance between functional vocabulary and enriching vocabulary. The development of vocabulary is not restricted to academic development but also enriches personal development.

S.M.S.C.

Students and their well-being are at the core of our school curriculum.
Having SMSC as a driver allows us to bring into focus how our curriculum helps encourage our students to become successful learners, confident individuals and responsible citizens and ensures we do not lose sight of it.
Our overarching ethos for SMSC encompasses personal development across the whole curriculum and supports us in providing opportunities for students to explore themselves and discover their identity. Additionally, it equips them with strong values for living in an increasingly diverse world.

Quality of Education

Intent, Implementation, Impact

Vision

Our vision is for our students to become independent and effective communicators of their thoughts and opinions. To face life's challenges head on and be equipped to overcome them.

Intent - Implementation - Impact

Aims

The aims of our curriculum are to:

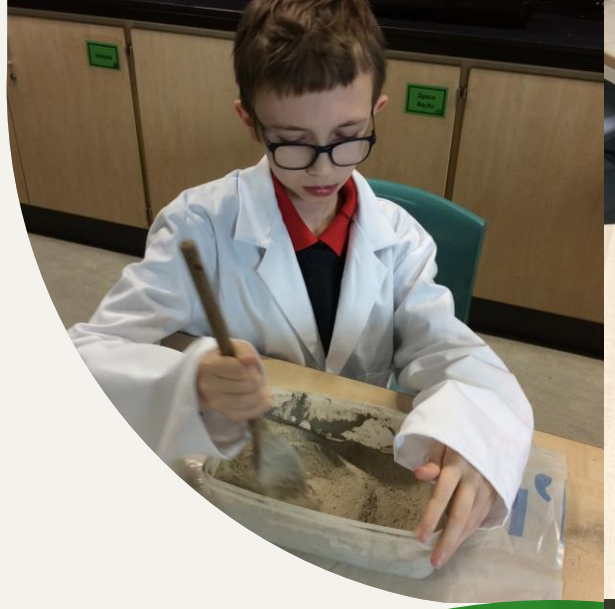
Provide students with experiences that will **stimulate their curiosity** and allow them to understand the world around them.

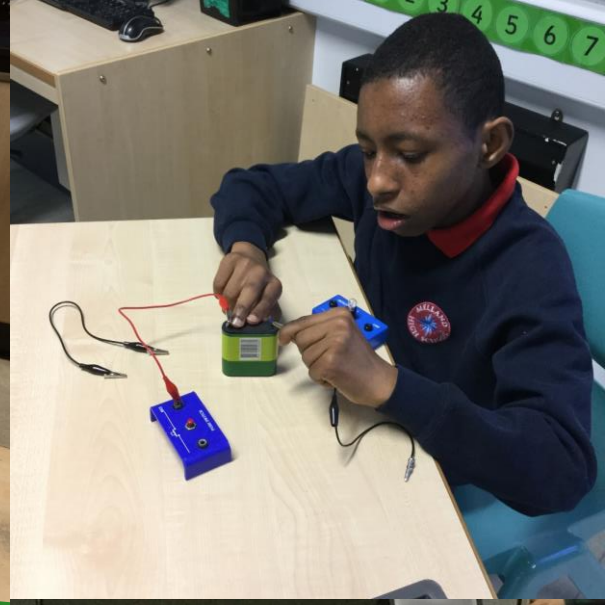
Provide our students with **context** for the principles of science making it **relevant to them**, their life and their future.

Retain and develop **skills** that will help them throughout their lives.

Make **connections** between different scientific phenomena and concepts.

To apply **scientific reasoning** to their everyday life.



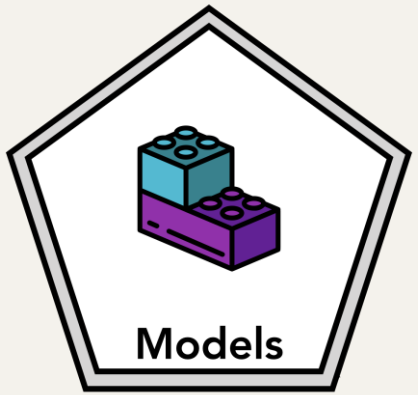


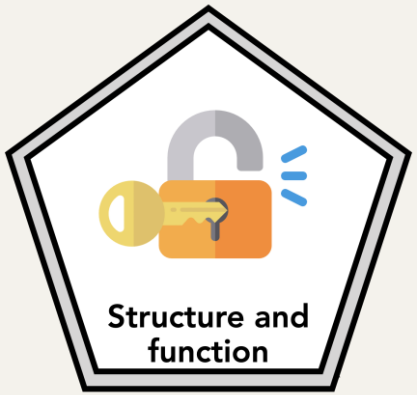
Essential Characteristics of a Scientist

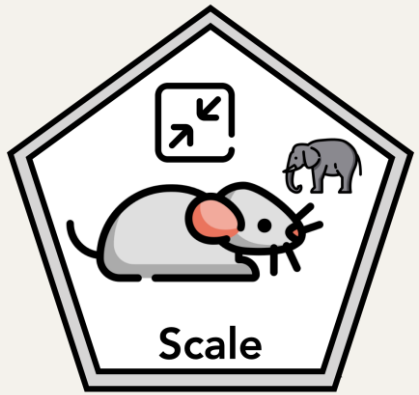
Curious	Patient	Courageous
Detail-Orientated	Creative	Persistent
Communicative	Open-Minded	Critical Thinker

Threshold Concepts in Science

Based on all the research done a number of threshold concepts in general science can be highlighted. It is worth pointing out that threshold concepts do not have to meet all the characteristics defined, but should be a challenging journey of thought.
These concepts are:





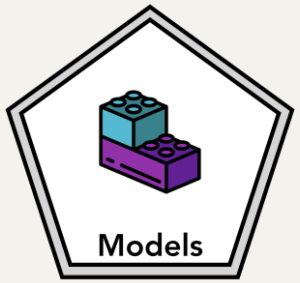


Intent - Implementation - Impact

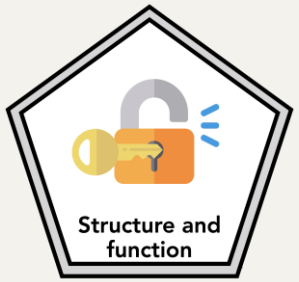
Threshold Concepts in Science

Scientists have a habit of organizing and classifying natural phenomena. Things can be arranged in hierarchies or grouped by their characteristics. This idea that everything can be categorized into one or more organizational structures is a common theme through all scientific disciplines.

A system is a set of things working together as parts of a mechanism or an interconnecting network; a complex whole. In science, systems often involve matter ,energy and information that move though pathways.



Due to the abstract nature of many aspects of science the use of models to represent concepts is common. However, understanding that representation can be very challenging.



In nature there is a strong relationship between the characteristics of something and what it does. Being able to infer what something does by examining its characteristics is a key part of investigative approaches.

In the world there are many different things such as living and non-living things. All things have distinct properties, in the natural world these properties can vary continuously.

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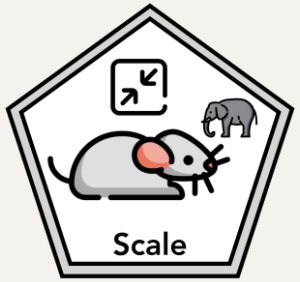
Intent - Implementation - Impact

Threshold Concepts in Science

Causality is linked to one of the main principles of science, finding a reason, or cause, for something that occurs (effect). Through all experimentation students can learn that action can result in reaction.



Everything in existence varies in some form or another, whether it be size, quantity, energy etc. There are many ways to quantify these differences, such as using a ruler. However understanding the difference in size between a bacterium and an elephant can be very difficult.

The world and the universe in which it exists is constantly undergoing change. Some of these changes can be spontaneous, but many take place slowly over a long period of time.

Many of the diverse aspects of the world are obvious, i.e Colours, living/non-living. Digging deeper into this highlights the importance of diversity in nature.

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Science Curriculum

The science curriculum 'Experience Science' is bespoke and informed by:

The National Curriculum

The British Science Association

The Key

Chris Quigley Education

Research, knowledge and expertise of staff

Experience Science

The Experience Science curriculum is a broken down and reformed version of the science national curriculum.

Topics are not taught under a heading of biology, chemistry or physics. Instead themes are used to provide context to the learning taking place.

The themes are; Our Body, Our Environment, Into the Stars, Getting Around, Making Things and Our Food.

Over all the themes there is a breadth of each scientific discipline.

Intra-curricular links are identified, creating opportunities for retrieval. This enables students to use their long-term memory, improving their learning.

Curriculum Content

The science curriculum has been created with the main aim of breaking down the walls that can sometimes be created by compartmentalization.

We ensure that an equal diet of biology, chemistry and physics is taught. This is done through subject matter that is relevant to our learners and not specifically one scientific discipline.

i.e The topic 'My Body' will cover biology by looking at cells, chemistry by examining chemicals in the body and physics by taking a closer look at how light enters the eye.

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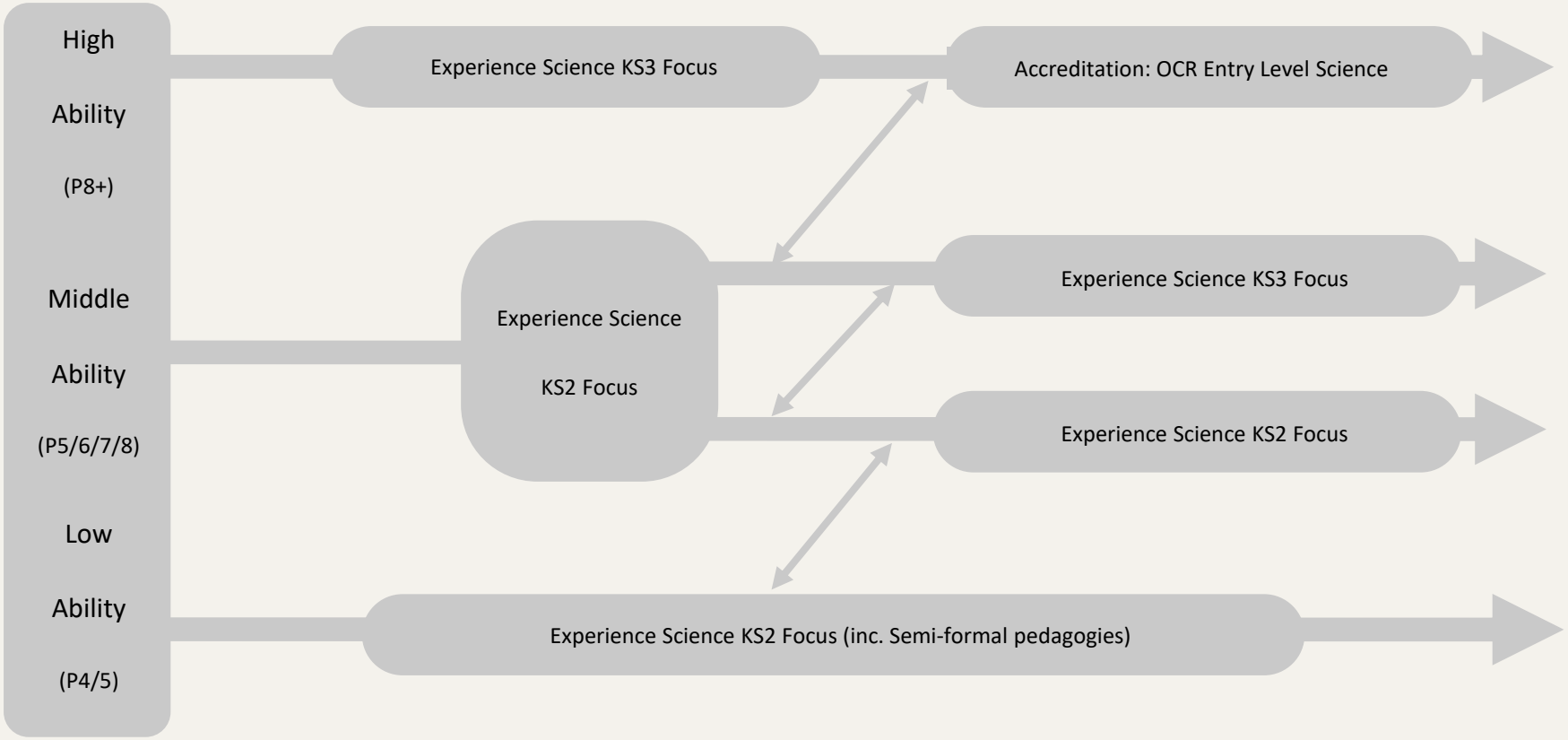
Accreditation

In KS3 students following the accreditation pathway will be prepared for the rigor and expectations of an entry level qualification. This includes taking short practice assessments and developing their practical ability.

At KS4 students will work hard to attain the minimum number of ‘points’ from end of unit assessments in addition to a piece of formally assessed practical work.

There has been a 100% pass rate for the OCR entry level science qualification.

Formal Curriculum Pathway



Intent - Implementation - Impact

Planning

LONG TERM

This focuses on a strategic overview of the year. Providing a forward vision focusing on broad progression. It also provides a pathway from KS3 to KS4.

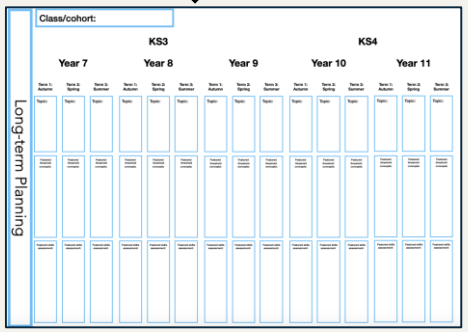
MEDIUM TERM

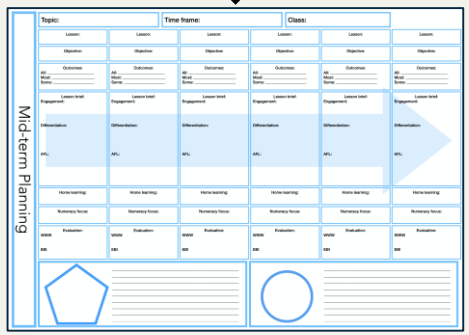
The design of the medium term plan brings the concept of sequencing to the forefront of the plan. It also highlights what specific threshold concept and skills assessment strand is featured.

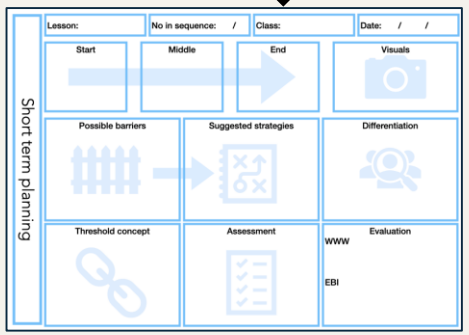
SHORT TERM

This short lesson plan takes the focus off the obvious aspects of planning. Identifying specific barriers to learning before hand and providing possible strategies.

Click the images for more detail







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Intent - Implementation - Impact

Long term planning

Long-term Planning

Academic year:	Class/cohort:	
Term 1: Autumn	**Term 2: Spring**	**Term 3: Summer**
Topic:	Topic:	Topic:
Featured threshold concepts:	Featured threshold concepts:	Featured threshold concepts:
Featured skills assessment:	Featured skills assessment:	Featured skills assessment:
Links to…	Links to…	Links to…
Intended sequence:	Intended sequence:	Intended sequence:

To return click here.

Intent - Implementation - Impact

Mid-term planning

Mid-term Planning

Topic: Our environment - Ecosystems	Time frame: Half term	Class: KS3 B,C,D KS4 B,C,D	For printing		
Lesson: Animals	Lesson: Habitats	Lesson: What do they eat?	Lesson: Food chains	Lesson: Food webs	Lesson: Biomass
Objective: To explore the different types of animal that exist	Objective: To explore the places animals live	Objective: To explore the food animals eat	Objective: To explore the feeding relationships of animals	Objective: To explore how feeding relationships relate	Objective: To explore how energy and mass pass along a food chain
Outcomes: All: Name 10 different animals Most: Identify key characteristics of some animals Some: identify similarities and differences of animals	Outcomes: All: Name 3 different habitats Most: Identify animals that live in key habitats Some: Describe the differences and similarities of habitats	Outcomes: All: Define herbivore, carnivore, omnivore Most: Group animals into 'what they eat' categories Some: Identify similarities between animals in each group	Outcomes: All: Identify a 'producer' Most: Identify a predator-prey relationship Some: Create a chain of 3 or more relationships	Outcomes: All: Describe the feeding relationship in a food chain Most: Link 2 food chains together Some: Deduce impact of changes to food web	Outcomes: All: Identify a food chain Most: Add numerical values to food chains (i.e energy transferred) Some: Create a pyramid of biomass/numbers
Lesson brief: Starter: Guess the animal Introducing different types of animal Main: Favourite animal collage Sharing knowledge of animal with others, using technology. Plenary: Kahoot - What is it? Recall new animals learned	Lesson brief: Starter: Guess the habitat Introducing different types of habitat Main: Habitat scene Grouping animals into habitats, create/develop knowledge of where animals live Plenary: Kahoot - where does it live? Review learning, recall animals and their habitats	Lesson brief: Starter: Odd one out - animals in habitats Recall from previous lesson Main: Group animals into feeding group Creating catalogue of animals with different diets Plenary: Kahoot - What does it eat? Review learning, recall what animals eat	Lesson brief: Starter: Guess the animals, and what it eats Recall from previous 2 lessons Main: What do I eat, what eats me? Matching animals in their food chain, creating idea of feeding relationships. Plenary: Links in a chain Review learning, problem solving	Lesson brief: Starter: Guess the animals, what it eats and where it lives. Recall from previous 3 lessons Main: Linking it together Identifying feeding relationships and linking them together, problem solving Plenary: What if? Deducing consequences of disruption to a food web, problem solving	Lesson brief: Starter: Spot the food chain Recall from previous lesson Main: Why do we eat? Developing reasoning, understanding reason for consuming food Plenary: Which is the correct pyramid? Recall learning, developing vertical thinking
Home learning: Watch 'Planet Earth' and 'Planet Earth 2' at home on BBC iPlayer with family and discuss habitats, feeding relationships and the different kinds of animals that exist.					
Numeracy focus:	Numeracy focus:	Numeracy focus: Grouping	Numeracy focus: Sequencing	Numeracy focus: Sequencing	Numeracy focus: Energy values, scale of pyramids

There are a number threshold concepts that could be utilised in this topic. i.e. organisation, variation, diversity, cause and effect

Organisation will be threaded though lessons by grouping animals and habitats in different ways.
i.e animals grouped by habitat, by what they eat, by predator/prey

Students will be required to utilise many skills but their ability to communicate what they have discovered/learned will be the key focus this topic.
Students are familiar with habitats and animals and so should not be held back by vocabulary and it will be easier from them to communicate their findings.

To return click here.

Short term planning

Short term planning

Lesson:	No in sequence: /	Class:	Date: / /
Start	Middle	End	Visuals
Possible barriers	Suggested strategies	Differentiation	
Threshold concept	Assessment	Evaluation WWW EBI	

To return click here.

Cultural Capital

Introduced by French thinker Pierre Bourdieu in the 1970s, **cultural capital** refers to the social and **cultural** knowledge that can help a student have an advantage in social life.

In science, students' study about themselves and the world they live in. Additionally, by developing an awareness and appreciation for the 'scientific method' they grow more capable of going further.

Research and CPD

In order to develop a strong bespoke curriculum and assessment system for our students a great deal of research took place.

We have worked with educational consultant Chris Quigley to develop our curriculum drivers as well as providing vital training regarding 'threshold concepts'.

Our research

The science curriculum implements threshold concepts as well as a complex spiral curriculum plan based on intra-curricular links allowing interleaving as well as allowing students to make connections between different scientific concepts.

Intent - **Implementation** - Impact

Use of Technology

During science lessons technology can be utilised in several ways:

Accessibility
It can be used a tool to make science more accessible to a variety of learners.

Exploration
It can be used to immerse students in a particular concept.

Research
Students can use technology to help them discover information for themselves.

Examples of technology used in science:

- iPads
- Virtual Reality (Oculus Rift)
- Visualizer
- Apple TV
- Desktop Computers & Laptops

Specialist Equipment

In science we have a variety of specialist equipment that helps our students grasp abstract concepts as well as develop their investigative skills.

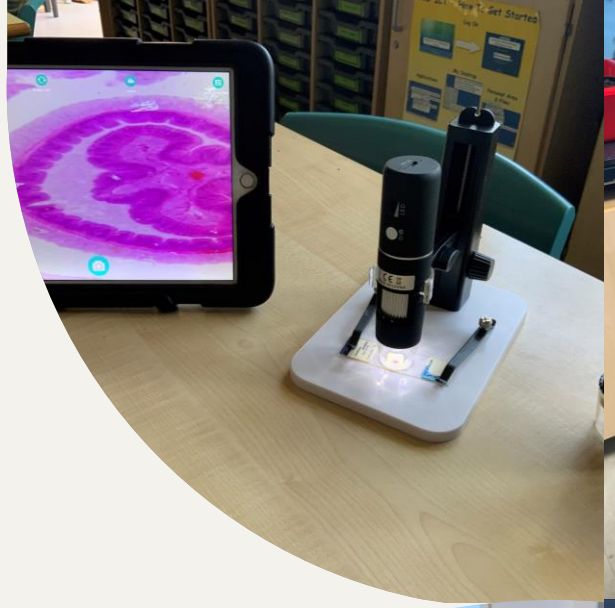
For example:

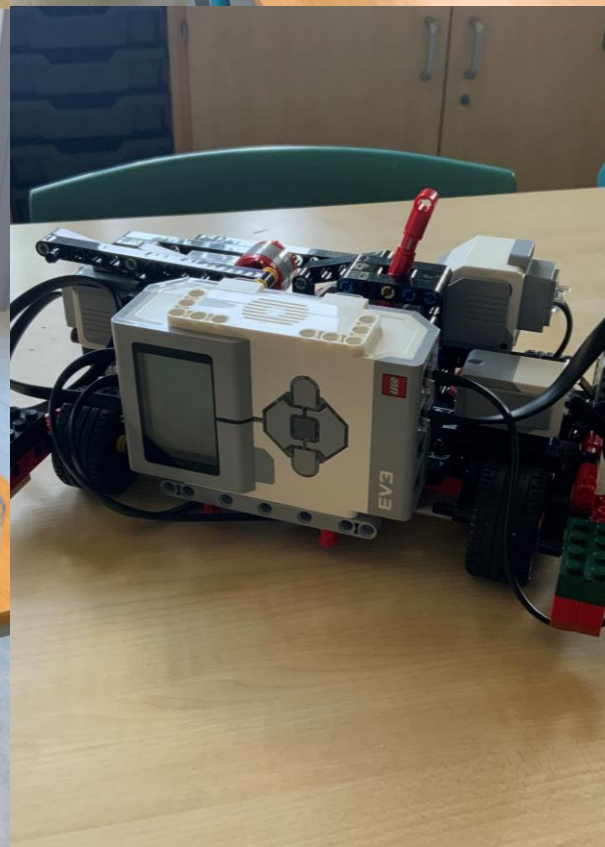
Scale models

Various laboratory equipment

Wifi-Microscopes

LEGO Mindstorm





Pedagogy

We use research and training to ensure our staff are equipped with specialist pedogeological knowledge to meet the needs of all our students. All staff understand the needs of students with SEND and they use informed specialist methodologies to deliver accessible and aspirational learning opportunities for all. The specialist pedagogies required can be different depending on the Key Stage, pathway or subject.

Our pedagogy has been informed by personalised training opportunities from providers such as:

- The Alliance for Learning
- Chris Quigley Education
- This also includes training from our own specialist SEND outreach team.

Vocabulary

Within the formal curriculum pathway Tier 2 and Tier 3 words are at the forefront of students learning.

Within science the specialist (Tier 3) words are grouped into basic, intermediate and advanced to ensure that students cognitive load is not pushed beyond its limits.

Our Bodies – Skeleton – Word list example

	Basic	Intermediate	Advanced
Types of Skeleton & Our Skeleton	Bone Skull Spine X-ray Limb Rib Broken	Skeleton Ribcage Pelvis Fossil Mineral	Skeletal Vertebrate Invertebrate Anatomy Endoskeleton Exoskeleton Cartilage
X-Rays	X-ray Bone Picture	Absorb	Electromagnetic spectrum Wavelength
Blood	Blood Cell Bone	Plasma Red-blood cell White blood cell Platelet Donate Bone marrow	Centrifuge

This word list will be used by staff to appropriately plan which vocabulary to teach.

Reading

Students' ability to understand and use specialist vocabulary is not only embedded in the science curriculum but it is also assessed under the 'scientific literacy' strand of the skills assessment.

Reading is encouraged in every lesson, with key words highlighted and paired with visuals.

Reading literature of a scientific nature will build vocabulary and scientific literacy.

Intent - **Implementation** - Impact

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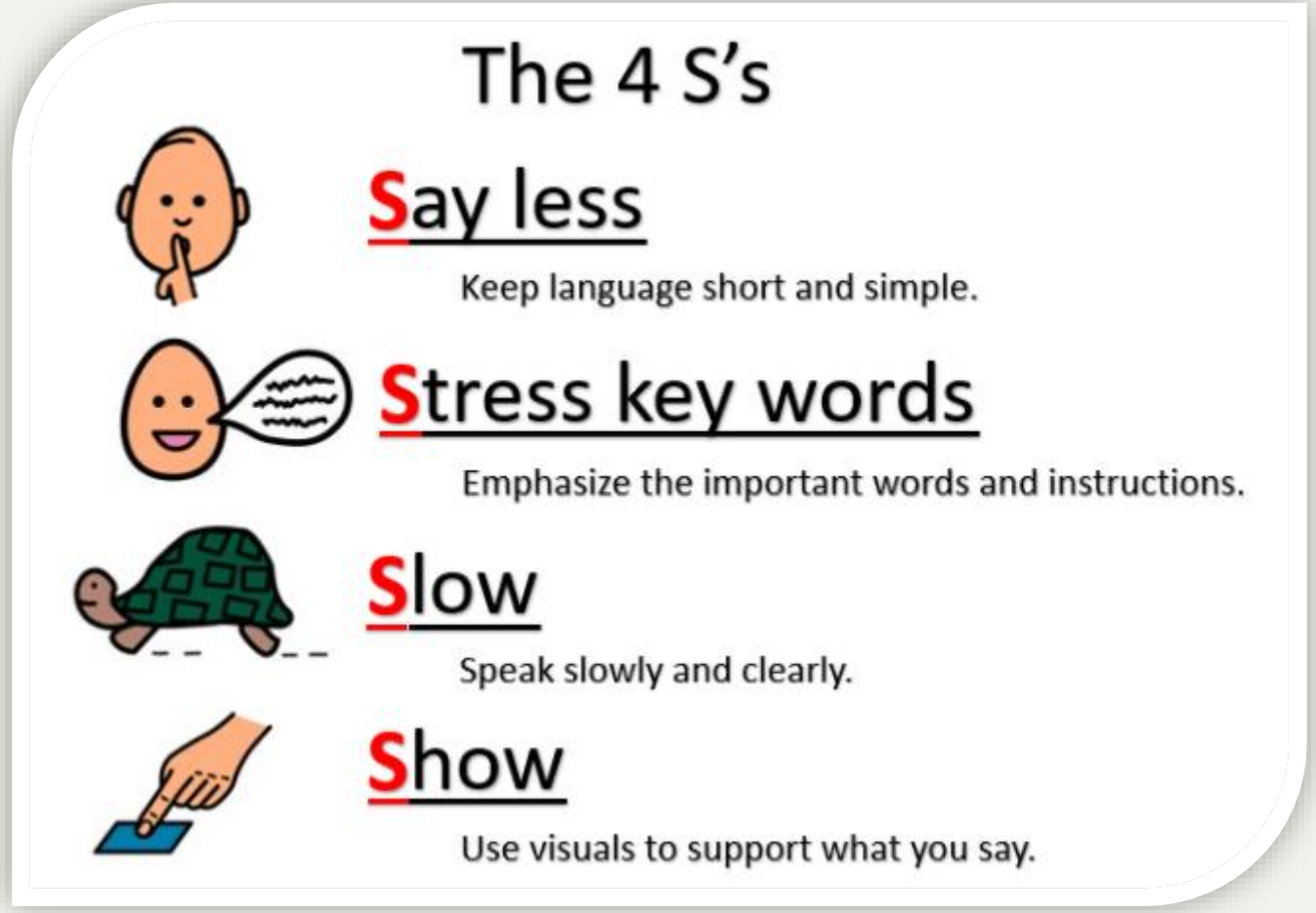
Science and Total Communication

Use of models assists in understanding concepts without words.

Using clear, simple language.

Words/Pictures/Symbols help students understand instructions



At MHS we use a total communication approach. This means that we strive to find and use the right combination of communication methods for each student.

Intent - **Implementation** - Impact

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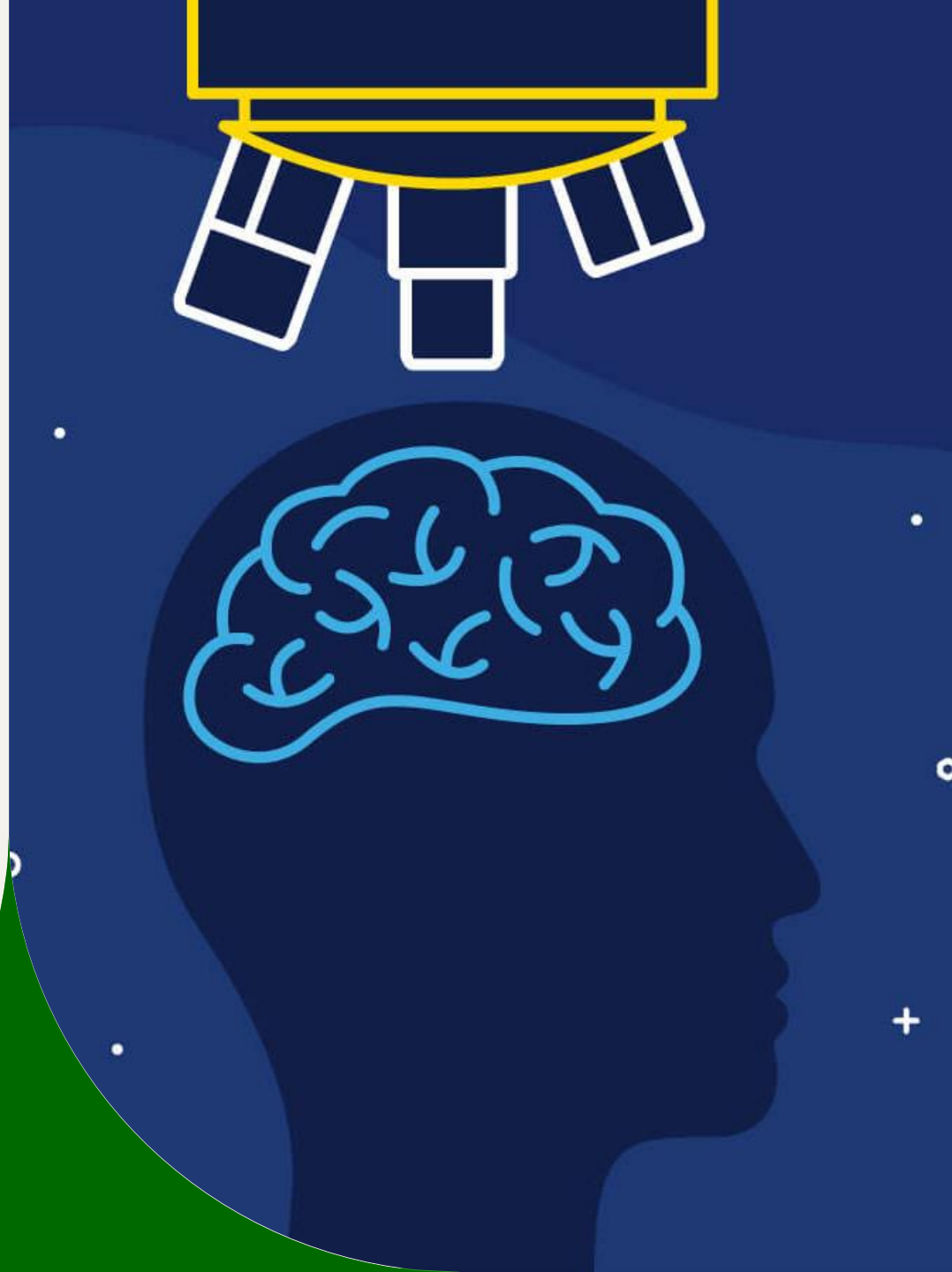
Summative Assessment

Knowledge is assessed through Proof of Progress (POP) tasks. They are employed strategically throughout an academic year.

POP tasks provide evidence of progress towards specific curriculum milestones. A culmination of them provides an overall picture of a students progress within science.

In addition to knowledge, scientific skills are monitored and assessed using a bespoke assessment system. The skills developed in science lessons will serve our students in their future.

Students working towards a science accreditation are assessed with formal end of unit tests. These take place every 3-4 weeks and combine to make a grand total worth 70% of the course.



Assessing Skills

The assessment system has been developed internally and informed by a number of assessment systems. Primarily, it resembles APP (2009/10) although it takes an approach that progress within each skill area is not hierarchical.

Focussing on these skills during curriculum delivery will provide consistent and constant reinforcement with the aim of providing a solid foundation for students life after education.

- Observation
- Communication
- Scientific Numeracy and Literacy
- Investigative Approaches
- Thinking Scientifically
- Health and Safety

Quality Assurance

Within all formal curriculum pathway subjects an internal quality assurance cycle takes place.

One aspect of this is the **Subject Evaluation Form** (SEF). This is completed after a period of reflection by the subject coordinator, usually at the end of an academic year. Its purpose is to highlight **good practice** and **areas for development**.

Specific QA that takes place in science is:

Accreditation moderation (Internal and external)

Lesson observations

Learning walks

Scrutiny of work

Moderation of POP tasks

Progress meetings

Coordinator meetings

Pupil comments

i like sciencebecause

Of experiments

I like science

because

I learn a lot

I like science because

I Like Learning about

space and the Planets

I like science because it's the best.

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Personal Development

British Values and Science

DEMOCRACY

Take the views and opinions of others into account

Take turns and instructions from others

RULE OF LAW

Understand the importance of safety rules when working scientifically

Make choices when planning an investigation

INDIVIDUAL LIBERTY

Working independently

Expressing personal opinions during debatable issues

TOLERANCE

Scientific discoveries have come from other cultures

Religious beliefs often compete with scientific understanding

MUTUAL RESPECT

Work as a team

Discuss findings

Offer support and advice to others

SMSC and Science

SPIRITUAL

Looking for meaning and purpose in natural and physical phenomena

Wonder about what is special about life

An awareness of the scale of living things from the small micro-organism to the largest

The interdependence of all living things and materials of the Earth.

Emotional drive to know more and to wonder about the world

Wonder at the vastness of space and the beauty of natural objects

MORAL

Students to become increasingly curious

Development of open mindedness to the suggestions of others

Scientific developments may give rise to moral dilemmas

Considering the environment

SOCIAL

Group practical work

Team working skills and to taking responsibility

Taking responsibility for their own and other people's safety

Understanding that science has a major effect on the quality of our lives

Consider the benefits of scientific developments and the social responsibility involved

CULTURAL

Scientific discoveries as a part of our culture

Scientific discoveries of other cultures

Scientific discoveries by a wide range of men and women in many different cultures

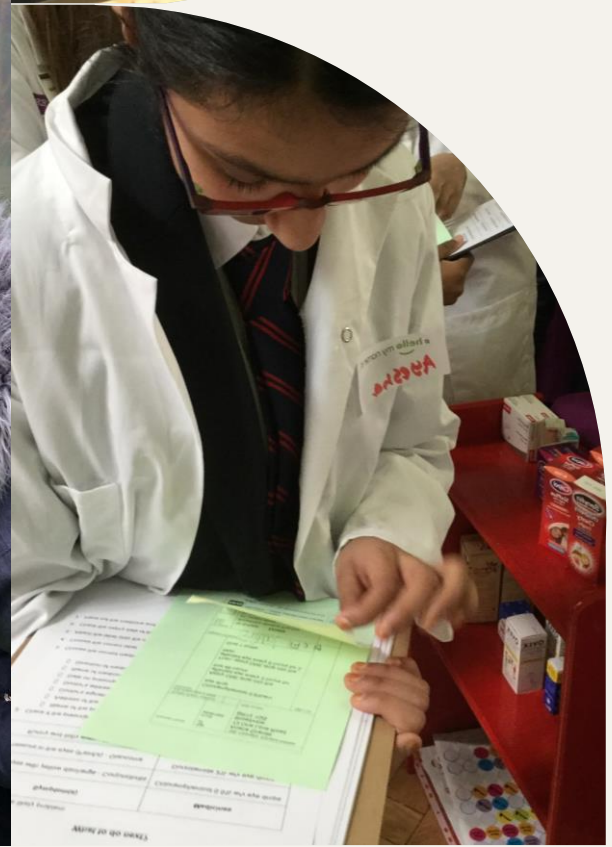
Environmental issues are central to science.

Enrichment

Our students are invited annually to an event celebrating ‘British science week’.

We also celebrate this in school though specialized STEM lessons. STEM stands for Science, Technology, Engineering and Mathematics. At its core, simply means educating students in the four specific disciplines.

Having strong inter-curricular links also allows our students science education to be enriched throughout whole formal curriculum.



Careers and Work Related Learning

The assessment system used in science was created with careers and students next steps in mind.

The skills themselves were selected so that students would develop vital tools to become more independent.

Within the ‘Experience Science’ curriculum guide each topic has opportunities to further explore careers in more detail.

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Skills for life

The Manchester City Council 'Skills for Life' is a universal approach that promotes the use of a common language to describe five key skills and a commitment to increase opportunities for children and young people to practice, reflect and record these skills.

In Manchester, Skills for Life is not only needed for young people and employers but also, for the cultural capital of our city.

The development of this work is as a way of supporting our children and young people to have the skills to be able to grow up happy, healthy, safe and successful.

Celebrating Achievement

Celebrating students achievement is a key part of our culture at MHS. In science, achievement is celebrated through:

- Awarding House Points
- Formal Awards Assemblies
- Postcards Home
- Tokens of Achievement i.e. stickers, stamps