Science Rationale

God's Love in Action

Our children are at the heart of everything we do through **Christian values and relationships**. **Living and learning together** we celebrate the uniqueness and diversity of everyone in our family. We nurture a sense of **self belief, mutual respect and belonging** through Social Emotional Learning and academic excellence. We are dedicated to building the foundations for **happy and successful life-long learning**.

Contents

1. Curriculum Vision

Science at St Thomas is taught with the future of our children in mind. Here, we recognise that with society growing and the world we live in forever changing, the children of St Thomas need to acquire scientific knowledge, skills, and attitudes to prepare themselves for the modern world in which we live. Not all children will want to pursue a career with a scientific background, however we want all children to be equipped with critical thinking skills which allow them to navigate our complex modern world.

Here at St Thomas, we aim to provide all our children with a rich and engaging Science curriculum which enables all children to participate in an academic way. Ensuring children have a deep understanding and the opportunities to explore the world around is key to our curriculum. Our curriculum is tailored in a way in which supports the children as the seasons change and they progress throughout the academic year.

We strive for our children to be curious thinkers, so we encourage research-based learning, experiments, observations, key questions, and data analysis.

2. Intent

Why do learners at St Thomas CE Primary School need to study Science?

At St Thomas, it is our intention to provide children with a high-quality education and a passion for science. Our curriculum will enable children to become enquiry-based learners, collaborating through researching, investigating, and evaluating experiences. It will encourage respect for living organisms and the physical environment.

The pupils of St Thomas live in an increasingly scientific and technological age where they need to acquire scientific knowledge, skills, and attitudes to better prepare them for modern life. A scientist observes, questions, creates, hypotheses, experiments, records data, and then analyses that data, and by developing these skills the children of St Thomas will experience awe, wonder, curiosity, experimentation, and problem solving. Additionally, our pupils are

growing up in a world where there is a STEM skills shortfall, and we have a duty to prepare the next generation for jobs that are required to ensure our country and economy thrive.

What are the aims for the Science curriculum? (i.e., what do we want learners to be able to know and do by the time they leave St Thomas?)

Aims of the Science Curriculum

The national curriculum for science aims to ensure that all pupils:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics.
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.
- develop the essential scientific enquiry skills to deepen their scientific knowledge
- use a range of methods to communicate their scientific information and present it in a systematic, scientific manner, including I.C.T., diagrams, graphs and charts
- develop a respect for the materials and equipment they handle regarding their own, and other children's safety
- develop an enthusiasm and enjoyment of scientific learning and discovery

Working Scientifically

At St Thomas CE Academy children will gradually build on their scientific skills throughout the Key Stages based on National Curriculum expectations.

Key Stage 1:

- Asking simple questions and recognising that they can be answered in different ways.
- Observing closely, using simple equipment.
- Performing simple tests.
- Identifying and classifying.
- Using their observations and ideas to suggest answers to questions.
- Gathering and recording data to help in answering questions.

Lower Key Stage 2:

- Asking relevant questions and using different types of scientific enquiries to answer them
- Setting up simple practical enquiries, comparative and fair tests
- Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions

• Using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions

• Identifying differences, similarities or changes related to simple scientific ideas and processes

• Using straightforward scientific evidence to answer questions or to support their findings.

Upper Key Stage 2:

• Planning different types of scientific enquiries to answer questions, including recognising, and controlling variables where necessary

• Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate

• Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

• Using test results to make predictions to set up further comparative and fair tests

• Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations

• Identifying scientific evidence that has been used to support or refute ideas or arguments

Spaced Retrieval Practice Approach

Our science curriculum is delivered through a series of modules which are deliberately spaced throughout the academic year with opportunities to introduce and revisit key concepts. This approach enables staff to deepen pupil understanding and embed learning.

Our curriculum maps clearly show how our CUSP curriculum delivers (introduces and revisits) the National Curriculum expectations for science within and across year groups. All Science modules are identified on year group specific yearly overviews using green boxes.

Early Years

In Early Years, Science is taught through Knowledge and Understanding of the World. The children learn about the scientific world around them in their play and adult led activities. Our curriculum is designed to enable children to make sense of their physical world and community. Children are encouraged to be scientists by:

- Finding out about and showing curiosity and interest in features of objects, events and living things
- Describing and talking about what they see, including noticing similarities and differences
- Showing curiosity and asking questions about why things happen and how things work
- Showing understanding of cause-effect relations
- Noticing and commenting on patterns
- Showing an awareness of change
- Explaining their own knowledge and understanding, and asking appropriate questions of others
- Investigating objects and materials by using all of their senses as appropriate

3. Implementation

Modular knowledge approach Science is taught across each year group in modules that enable pupils to study key scientific understanding, skills, and vocabulary. Each module aims to activate and build upon prior learning, including EYFS, to ensure better cognition and retention. Each module is carefully sequenced to enable pupils to purposefully layer learning from previous sessions to facilitate the acquisition and retention of key scientific knowledge and skills.

In ensuring high standards of teaching and learning in science, we implement a curriculum that is progressive throughout the academy.

Children have access to key vocabulary and definitions to understand and readily apply to science and other subjects through cross curricular links. This then builds on the child's schema. Science is taught once a week for one hour.

Each unit builds upon prior knowledge which develops depth and understanding and shows progressions of skills

Children develop their scientific enquiry skills through exploring, questioning, predicting planning and carrying out investigations and observations to conclude their findings.

Children are given knowledge organisers at the beginning of each unit which details key information, dates and vocabulary. This is not used as part of an assessment but to support children in their development skills within Science.

Through using a range of assessments, differentiation is facilitated by teachers, to ensure that each pupil can access the Science curriculum.

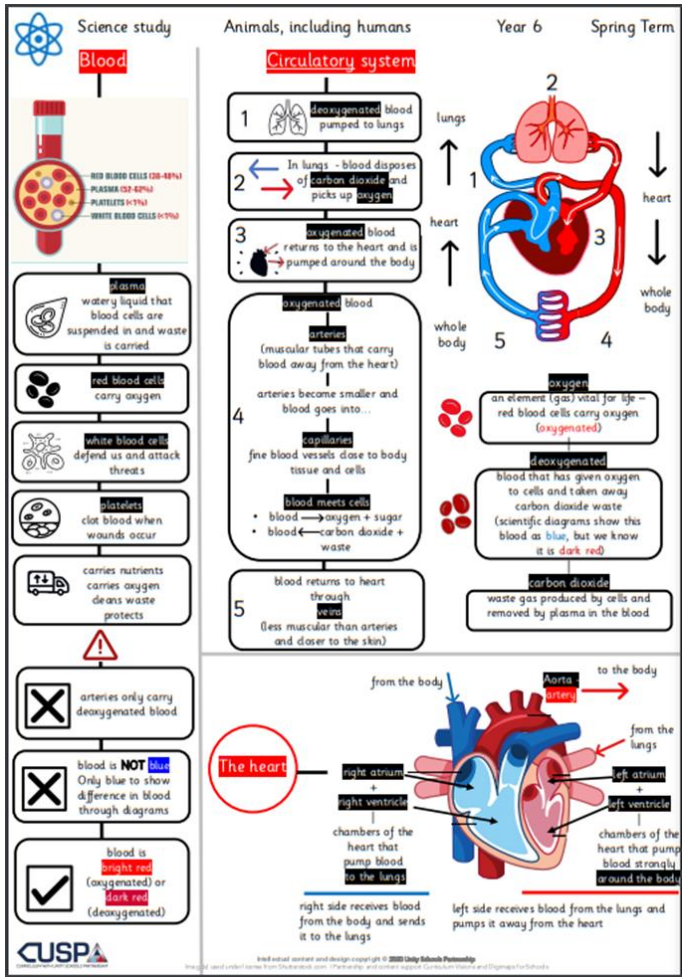
Each lesson is supported by:

- Do Now
- Prior knowledge retrieval activities
- Concept enquiry questions
- Hinge-point questions
- Exit ticket quizzes

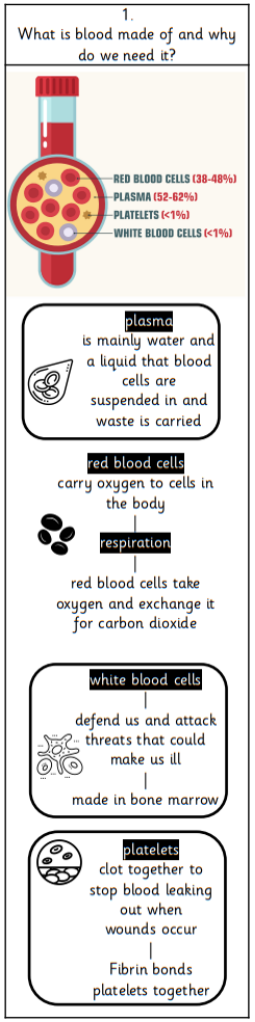
Feature	Function
Connect prior knowledge.	To recall prior learning related to the last lesson to help the child know and remember more and make connections within their learning. Taken from the whole module progression for science recall/retrieving knowledge so all children meet end points to pivot to their next year's learning.
Concept enquiry (Explain)	An enquiry discussion question or theory based around the lesson's learning. This probes children's understanding and misconceptions and allows time for discussion, debate, and initial ideas.
I do (Model example)	The class teacher will model substantive knowledge (and model the skills necessary for disciplinary knowledge) to achieve the sequenced learning objective for that lesson. The steps for learning will be explicitly taught through the teaching of success criteria.
We do (Guided attempt)	Using partner work, the children will practice the skills necessary to achieve the learning objective. The teacher will guide children in groups, individually or as a class. This is to be used as an 'Assessment for Learning' opportunity by the teacher to assess if the children are ready to move on.
You do (Independent application)	The children will complete an independent task (or work in a small group when completing an investigation) to show that they can independently apply the skills necessary to achieve the learning objective.
Hinge-point questioning	Around ¾ of the way through the lesson, the teacher will use a hinge-point question, which will probe their understanding. This is used as an 'assessment for learning' tool to identify which children need further support or 'reteach' to achieve the learning objective.
Exit ticket	An assessment question (linked to the learning objective) is completed independently at the end of every lesson. These questions are cumulative, allowing for continual retrieval of prior knowledge.

Knowledge organisers and Knowledge Notes

Accompanying each module is a Knowledge Organiser which contains key vocabulary, information and concepts which all pupils are expected to understand and retain. Knowledge notes are the elaboration and detail which help pupils acquire the content of each module. They support vocabulary and concept acquisition through a well-structured sequence that is cumulative. Each Knowledge Note begins with questions that link back to the cumulative quizzing, focussing on key content to be learnt and understood. Knowledge Organisers and Knowledge Notes are dual coded to provide pupils with visual calls to aid understanding and recall. Knowledge Organisers and Knowledge Notes are referenced throughout each module. In addition, pupils can access at home learning platforms that are used in school e.g. Curriculum Visions.



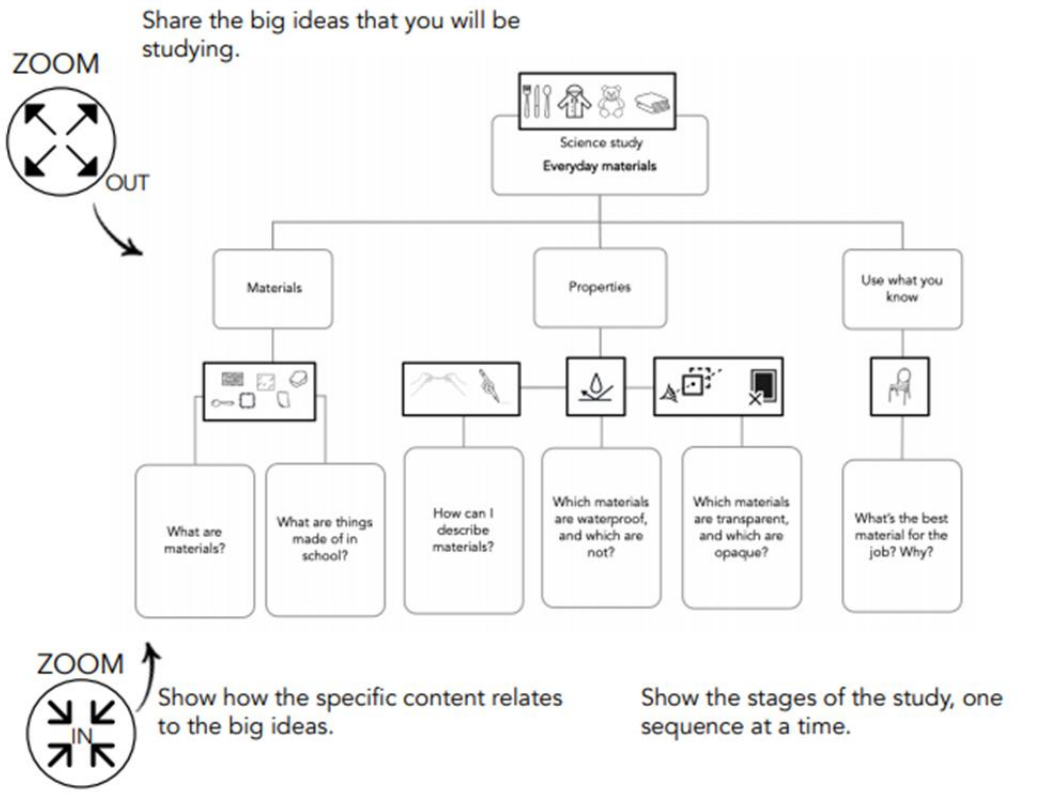
Year 6 Knowledge Organiser



Accompanying Year 6 Knowledge Note

The Big Ideas

At St Thomas we put an emphasis on sharing the big ideas with the children at the beginning of every module.



Asking simple questions and recognising that they can be answered in different ways	Observing closely, using simple equipment	Performing simple tests	Identifying and classifying	Using their observations and ideas to suggest answers to questions	Gathering and recording data to help in answering questions

Reading

Our Science curriculum is supported by a wealth of high quality online texts which support pupil's learning and develop their skills in accessing information from a range of sources.

Oracy

When discussing their findings or presenting information, pupils are encouraged to speak using full sentences and incorporating key scientific vocabulary. This is modelled by teachers e.g. using my turn, your turn.

Writing

Pupils are expected to write across all areas of the curriculum with teachers modelling how to write purposefully in each subject.

4. Impact and assessment

The impact of our curriculum leads to good progress over time, across key stages and in relation to a child's individual starting point. This allows children to have the foundations for understanding the wider world when completing their primary education. Our aim for science is to equip children with the skills needed to navigate an ever-changing world of science by immersing our students with scientific enquiry skills.

Assessment is an important tool when tracking children's progress. At All Saints Multi Academy Trust we use a bespoke tailor-made assessment tracker which follows children's progress from Year 1 up to Year 6. End of unit quizzes allow our teachers to complete the tracking tool and identify those who need more support before moving on in the unit of work. We also rely on formative assessment as this allows for misconceptions and gaps within their knowledge to be addressed quickly and efficiently.

Assessment tools

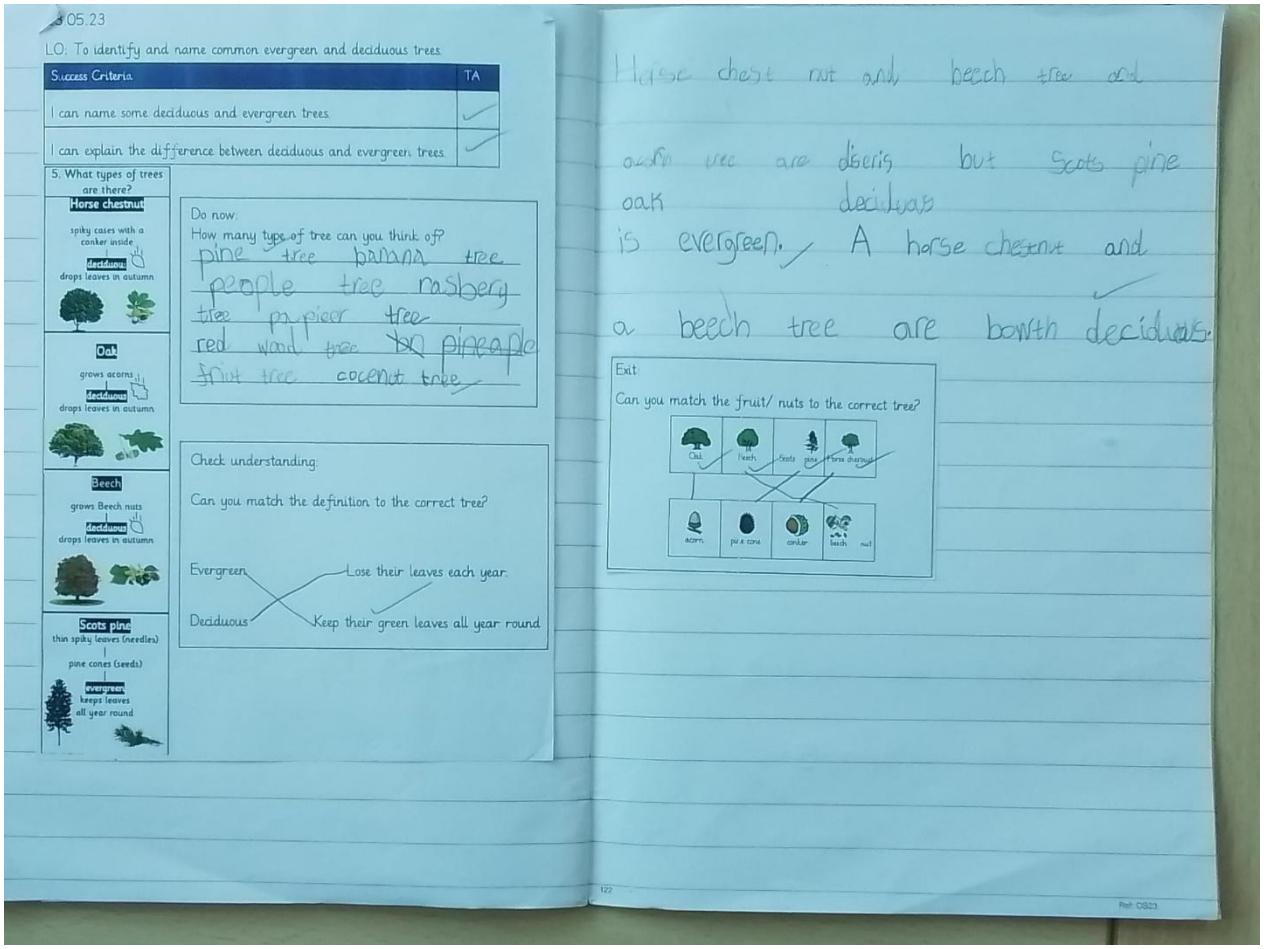
Assessment for learning strategies: Think-pair-share, AFL corners, cold calling, show-me boards, and probing questions.

Do Now questions are used to show independence of the children. These questions focus on knowledge the children should already now and be able to independently apply

Hinge-point questioning is used by teachers to assess 'hinge knowledge' which is essential for tackling misconceptions.

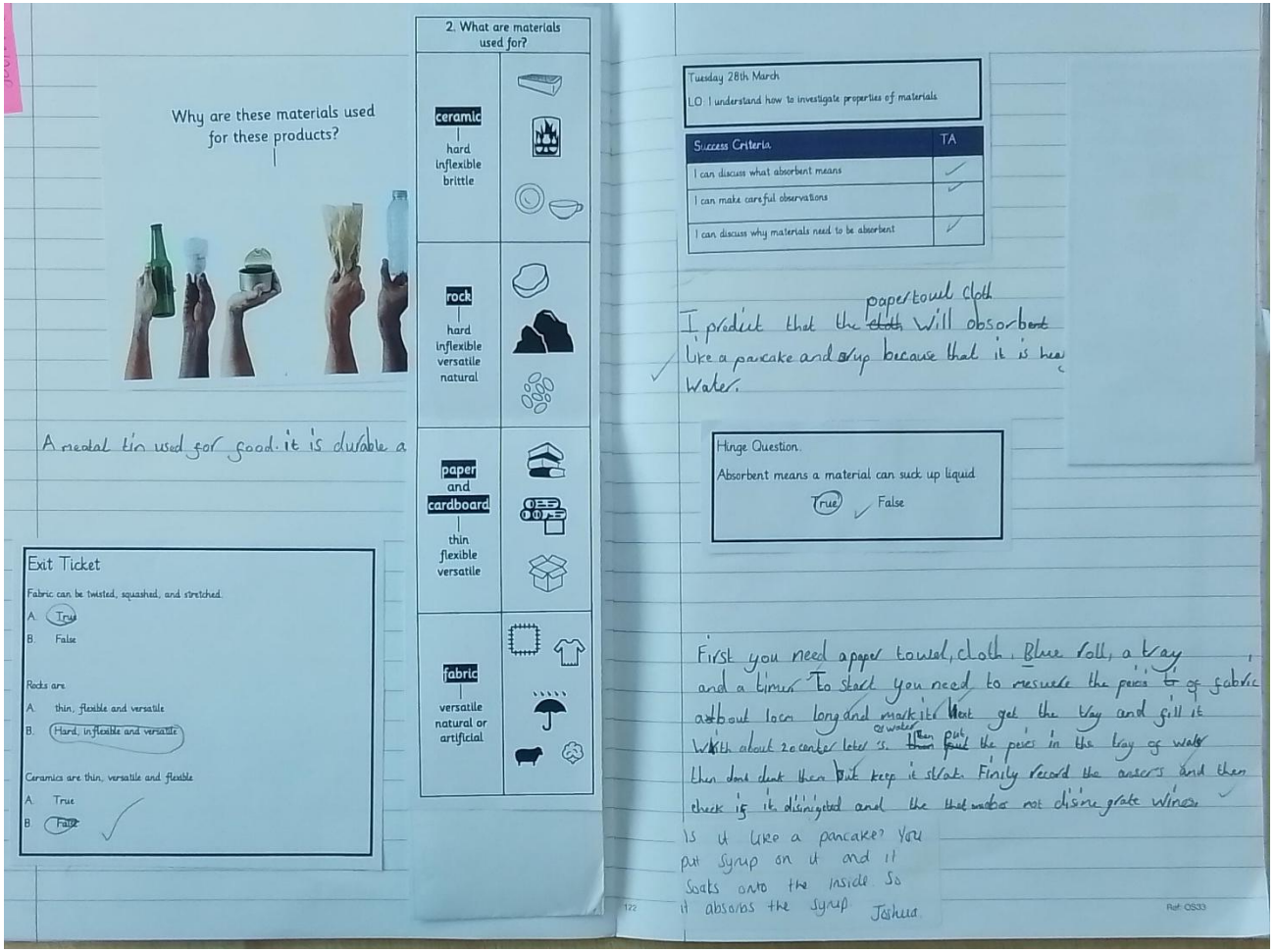
Exit Tickets link directly to each lesson learning objects assessing everyone's individual understanding every lesson and allowing for any misconceptions to be addressed in the next lesson.

Year 1



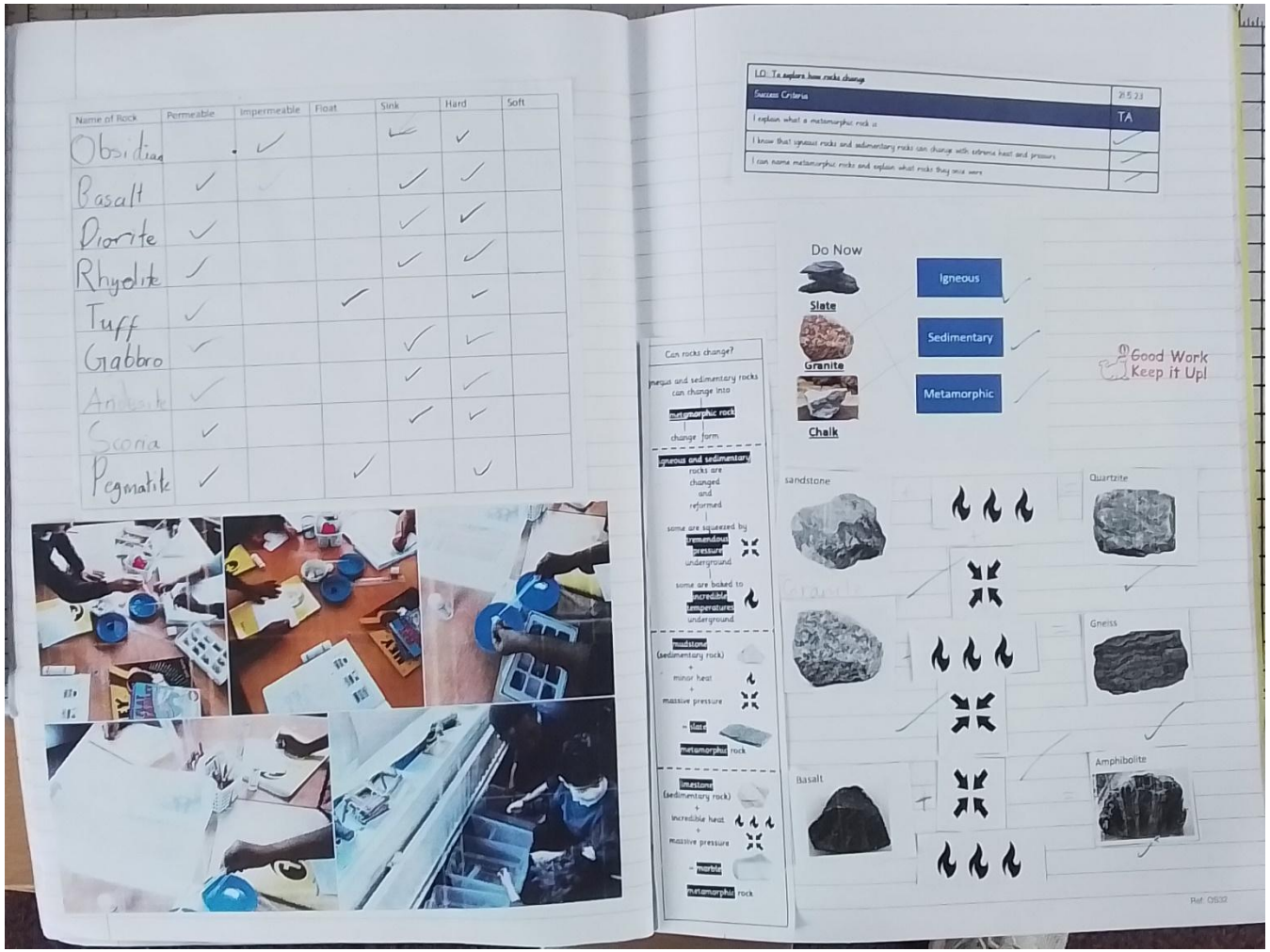
Year 1 expectation: identify and name different evergreen and deciduous trees.

Year 2



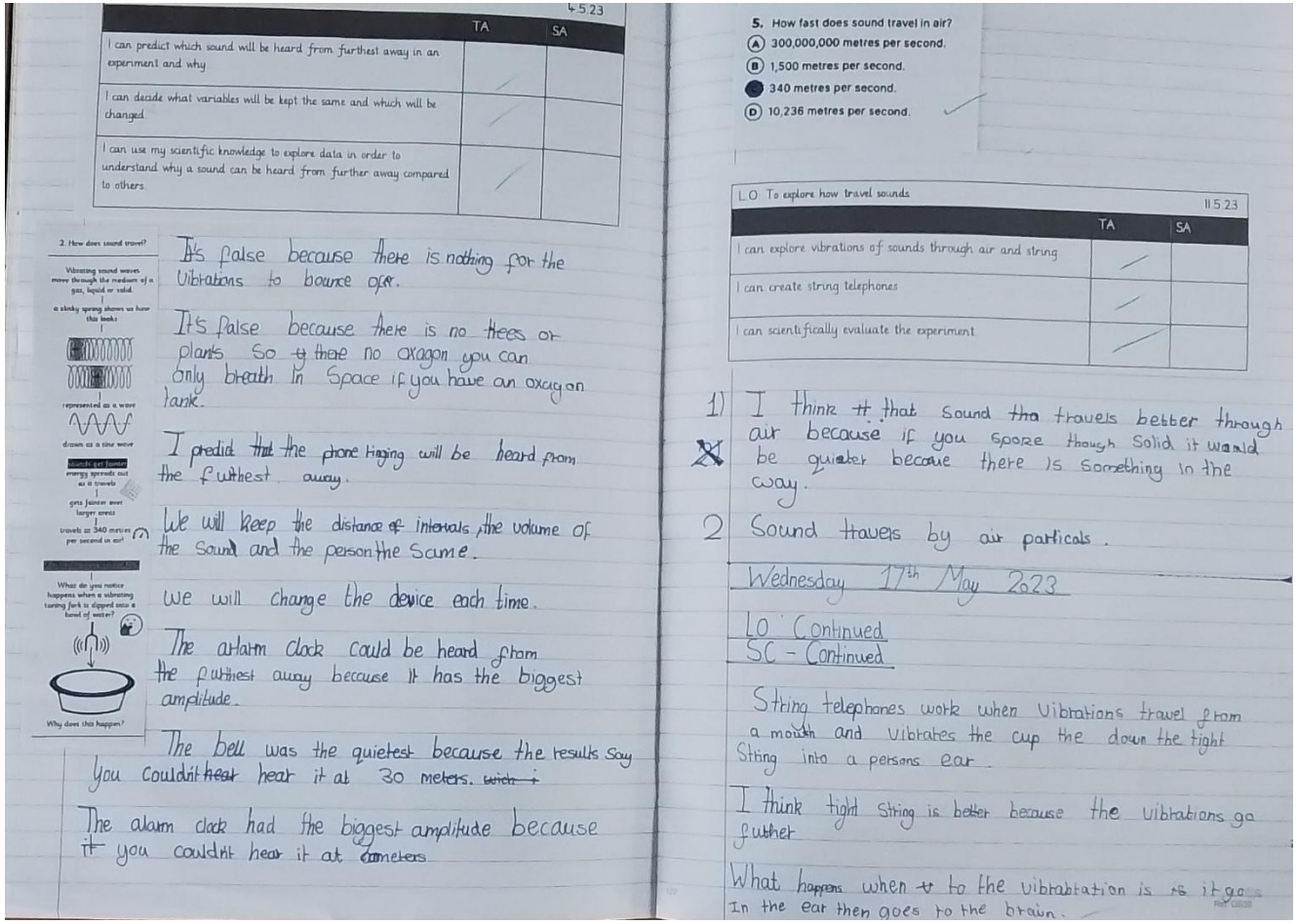
Year 2 expectation: identify what materials are used for and how absorbent they are.

Year 3



Year 3 expectation: to explore the changes that happen to rocks over time.

Year 4



4.5.23

	TA	SA
I can predict which sound will be heard from furthest away in an experiment and why	✓	
I can decide what variables will be kept the same and which will be changed	✓	
I can use my scientific knowledge to explore data in order to understand why a sound can be heard from further away compared to others	✓	

2. How does sound travel?

Vibrating sound waves move through the medium of a gas, liquid or solid.

a slinky spring shows us how this looks

represented as a wave

drawn as a sine wave

sounds get fainter energy spreads out as it travels

gets fainter over larger areas

travels at 340 metres per second in air

What do you notice happens when a vibrating tuning fork is dipped into a bowl of water?

Why does this happen?

It's false because there is nothing for the vibrations to bounce off.

It's false because there is no trees or plants so there no oxygen you can only breath in space if you have an oxygen tank.

I predict that the phone ringing will be heard from the furthest away.

We will keep the distance of intervals, the volume of the sound and the person the same.

We will change the device each time.

The alarm clock could be heard from the furthest away because it has the biggest amplitude.

The bell was the quietest because the results say you couldn't hear it at 30 meters. ~~with~~ i

The alarm clock had the biggest amplitude because if you couldn't hear it at 40meters

5. How fast does sound travel in air?

(A) 300,000,000 metres per second.

(B) 1,500 metres per second.

(C) 340 metres per second. ✓

(D) 10,236 metres per second.

L.O. To explore how travel sounds 11.5.23

	TA	SA
I can explore vibrations of sounds through air and string	✓	
I can create string telephones	✓	
I can scientifically evaluate the experiment	✓	

1) I think ~~it~~ that sound ~~tha~~ travels better through air because if you spoke though solid it would be quieter because there is something in the way. ✗

2 Sound travels by air particals.

Wednesday 17th May 2023

LO Continued

SC - Continued

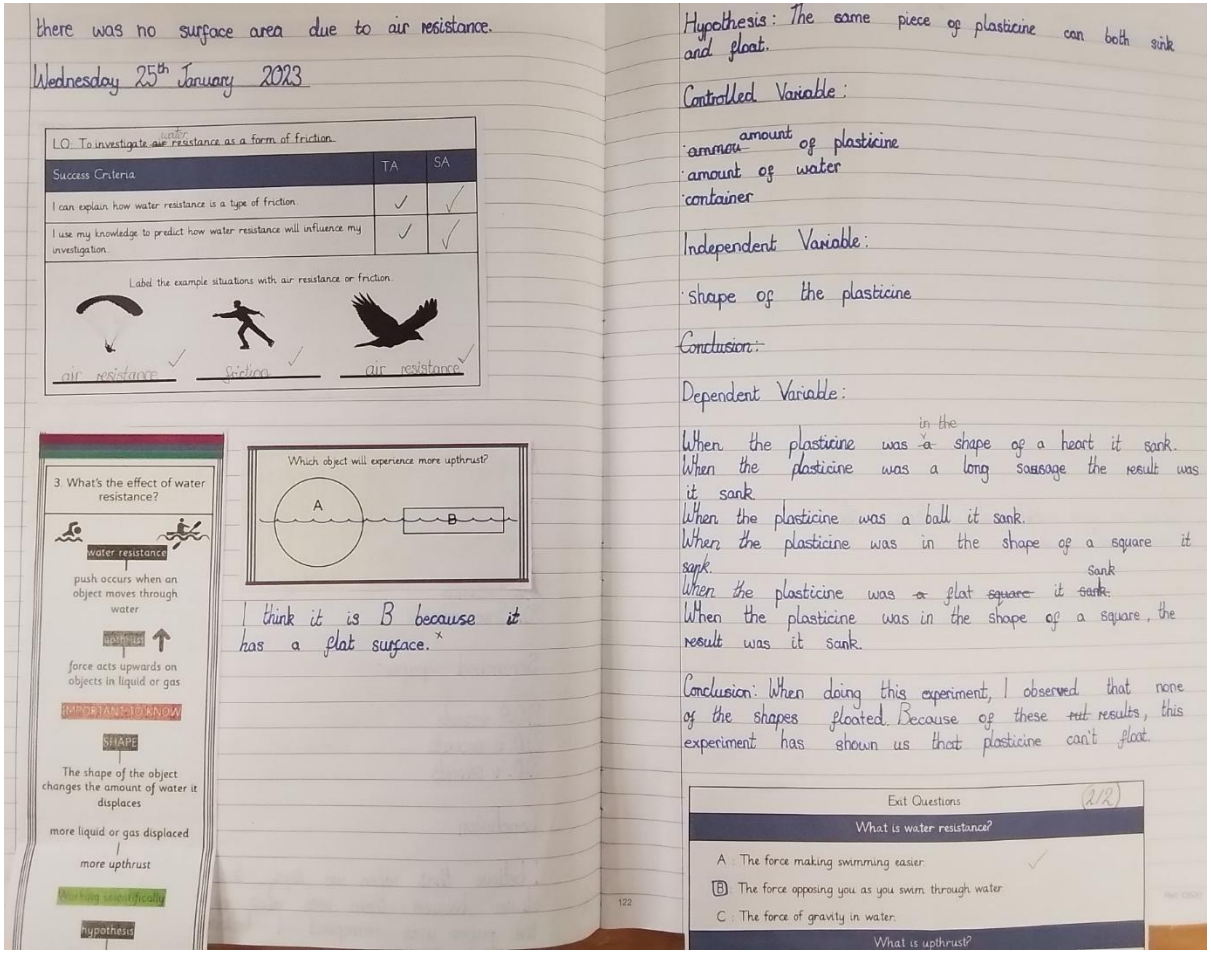
String telephones work when vibrations travel from a mouth and vibrates the cup the down the tight string into a persons ear.

I think tight string is better because the vibrations go further

What happens when ~~it~~ to the vibrabtation is ~~is~~ it go In the ear then goes to the brain.

Year 4 expectation: investigate the changes in sound as it travels different distances.

Year 5



there was no surface area due to air resistance.

Wednesday 25th January 2023

L.O. To investigate air resistance as a form of friction.

Success Criteria	TA	SA
I can explain how water resistance is a type of friction.	✓	✓
I use my knowledge to predict how water resistance will influence my investigation.	✓	✓

Label the example situations with air resistance or friction.

air resistance ✓ friction ✓ air resistance ✓

3. What's the effect of water resistance?

water resistance

push occurs when an object moves through water

upthrust

force acts upwards on objects in liquid or gas

IMPORTANT TO KNOW

SHAPE

The shape of the object changes the amount of water it displaces

more liquid or gas displaced / more upthrust

Working scientifically

Hypothesis

Which object will experience more upthrust?

A B

I think it is B because it has a flat surface.

Hypothesis: The same piece of plasticine can both sink and float.

Controlled Variable:

- ~~ammou~~ amount of plasticine
- amount of water
- container

Independent Variable:

- shape of the plasticine

~~Conclusion:~~

Dependent Variable:

When the plasticine was ~~a~~ in the shape of a heart it sank.
When the plasticine was a long sausage the result was it sank
When the plasticine was a ball it sank.
When the plasticine was in the shape of a square it sank.
When the plasticine was ~~a~~ flat ~~square~~ it ~~sank~~ sank.
When the plasticine was in the shape of a square, the result was it sank.

Conclusion: When doing this experiment, I observed that none of the shapes floated. Because of these ~~not~~ results, this experiment has shown us that plasticine can't float.

Exit Questions (2/2)

What is water resistance?

A. The force making swimming easier ✓

B. The force opposing you as you swim through water

C. The force of gravity in water.

What is upthrust?

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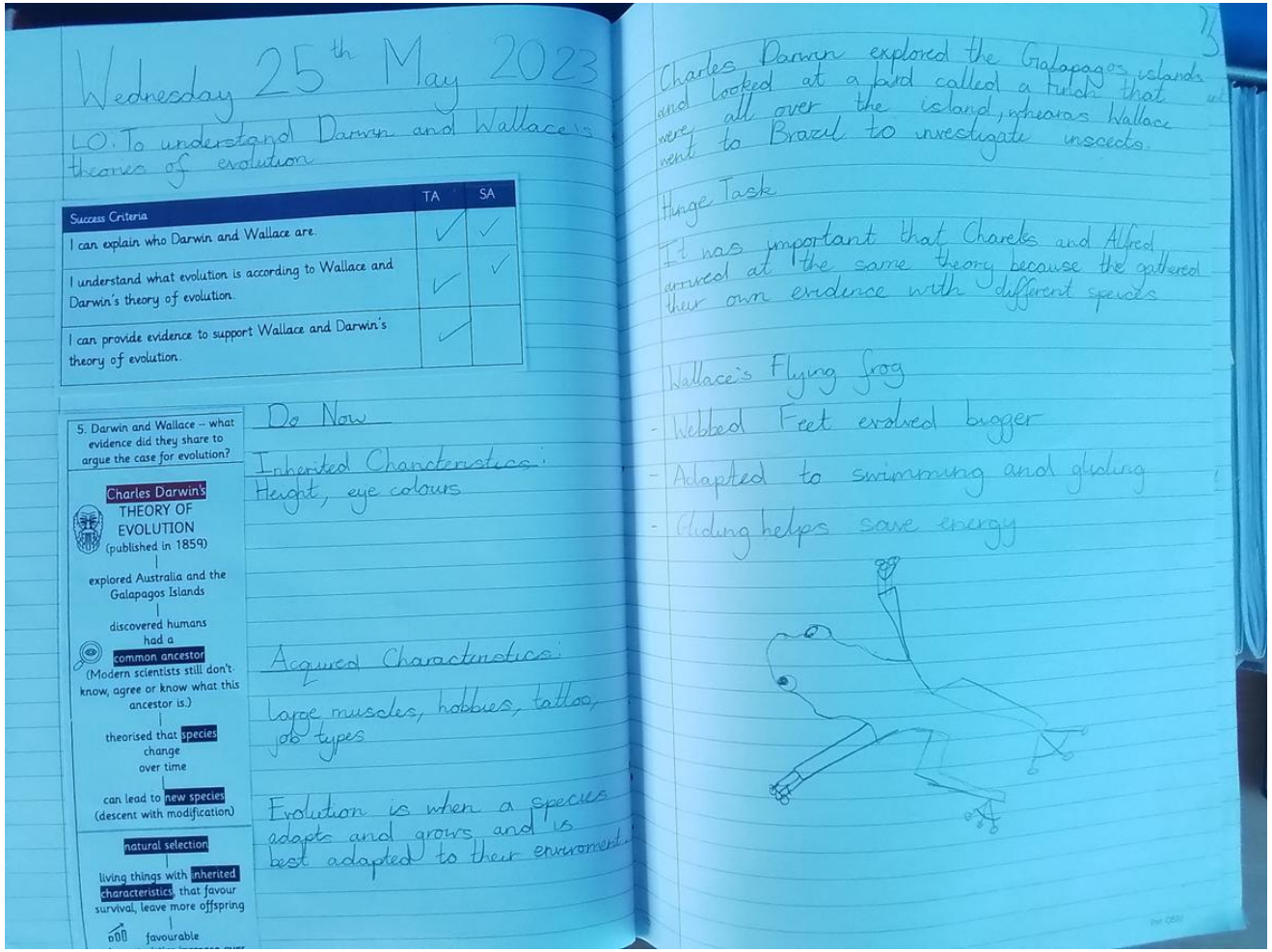
Year 5 expectation: investigate air resistance as a form of friction

Year 6



Wednesday 25th May 2023

LO: To understand Darwin and Wallace's theories of evolution

Success Criteria	TA	SA
I can explain who Darwin and Wallace are.	✓	✓
I understand what evolution is according to Wallace and Darwin's theory of evolution.	✓	✓
I can provide evidence to support Wallace and Darwin's theory of evolution.	✓	

5. Darwin and Wallace – what evidence did they share to argue the case for evolution?

Charles Darwin's THEORY OF EVOLUTION (published in 1859)

explored Australia and the Galapagos Islands

discovered humans had a common ancestor (Modern scientists still don't know, agree or know what this ancestor is.)

theorised that species change over time

can lead to new species (descent with modification)

natural selection

living things with inherited characteristics that favour survival, leave more offspring

favourable

Do Now

Inherited Characteristics:
Height, eye colours

Acquired Characteristics:
large muscles, hobbies, tattoo, job types

Evolution is when a species adapts and grows and is best adapted to their environment.

Charles Darwin explored the Galapagos islands and looked at a bird called a finch that were all over the island, whereas Wallace went to Brazil to investigate insects.

Hinge Task

It was important that Charels and Alfred arrived at the same theory because the gathered their own evidence with different species

Wallace's Flying Frog
- Webbed Feet evolved bigger
- Adapted to swimming and gliding
- Gliding helps save energy

Year 6 expectation: identify the evidence that Darwin and Wallace shared to argue the case for evolution.

5. Reasonable adjustment and SEND

We believe that the CUSP curriculum architecture, that is built around retrieval practice and spaced retrieval practice, combined with evidence-led teaching and generative learning tasks that are appropriately scaffolded are essential components in answering Barry's question.

Support staff play a vital role in universal quality first teaching. The principles of instruction, vocabulary teaching and generative learning tasks are universal in a school. All staff should be using and deploying these research-facing strategies.

1) Universal Quality First Teaching (embedded within all classrooms) Teacher / Subject Leads / Curriculum / LA's									
Structured, pre-planned and prepared sequence of lessons. | CUSP resources and Learning Questions	**Positive, high expectations, and aspirations for all.** | Specific praise and reward Behaviour Policy / Classroom Routine	**Explicit Vocab teaching and choice of language.** | Knowledge organisers, vocabulary mats / strips, dual coding	**Explicit Modelling and demonstration** | My turn Our turn Your turn working walls	**Clear chunked instructions supported with visuals / actions**	**Multi-sensory activities** | manipulatives	**Review, repeat, recall, retrieve** | Do now	**Frequent checking of understanding** | retrieval practice cumulative quizzing	**Flexible groupings** | Talk partners, LA or teacher working with specific groups	**Accurate and continued assessment** | constructive and instant feedback at the point of learning

How are rocks formed?

igneous made from cooled molten rock - lava or magma

molten rock rock that is so hot it becomes liquid

lava is molten rock above the earth's crust

magma is molten rock under the earth's crust

rocks are **natural** and not made by humans

Not a rock	Yes - a rock
x concrete x brick x stone blocks	✓ boulders ✓ pebbles ✓ stones

Igneous rocks are hard:

basalt
granite
pumice
obsidian

DEFINE WHAT A ROCK IS

TEST HARDNESS OF ROCKS

Edited and reasonable adjustment made, bespoke to the learner or learners →

How are rocks formed?

igneous rock cooled liquid rock

molten rock hot liquid rock

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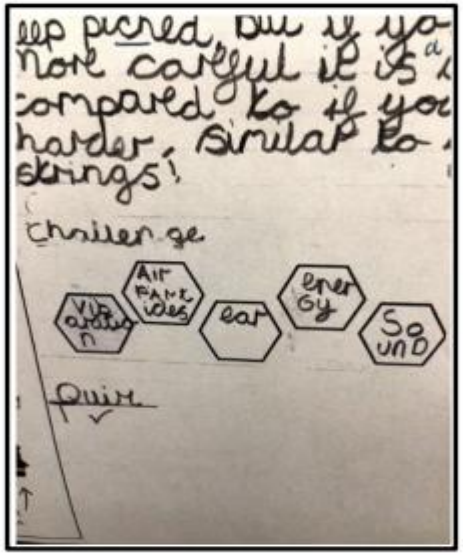
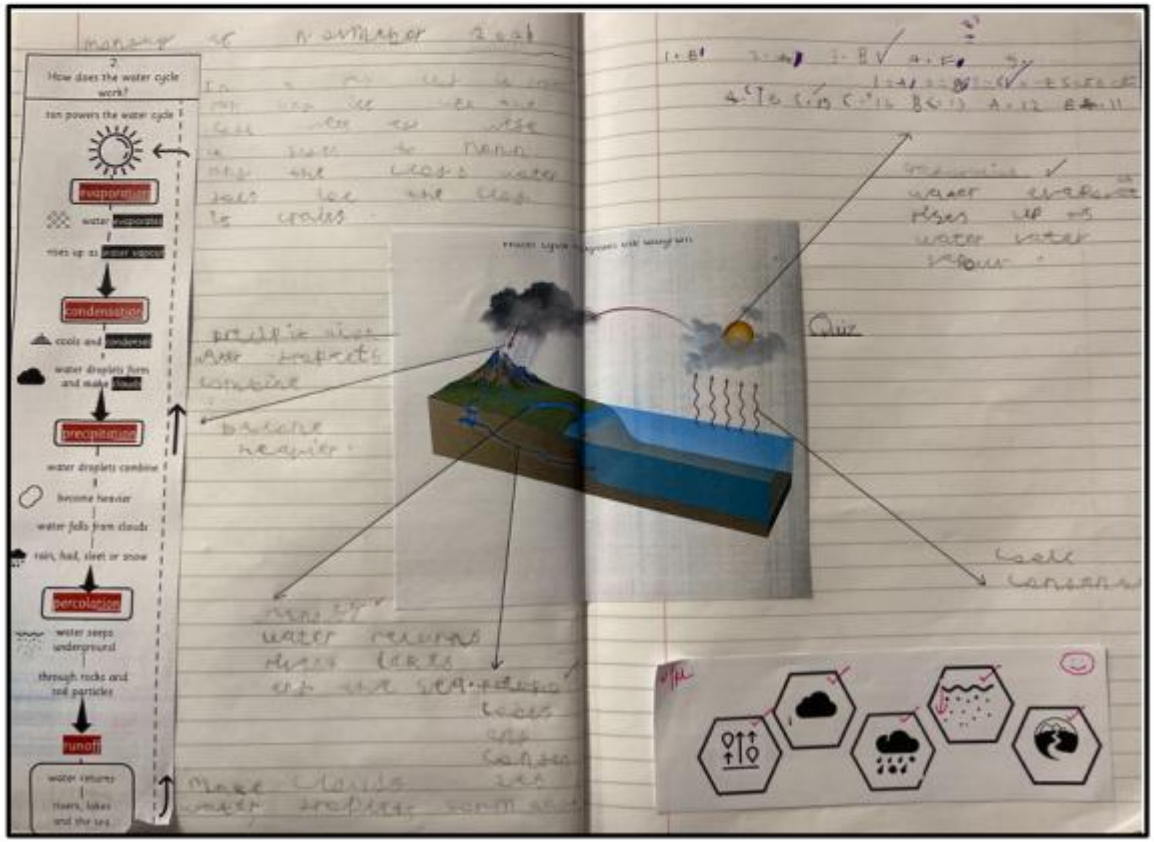
DEFINE WHAT A ROCK IS

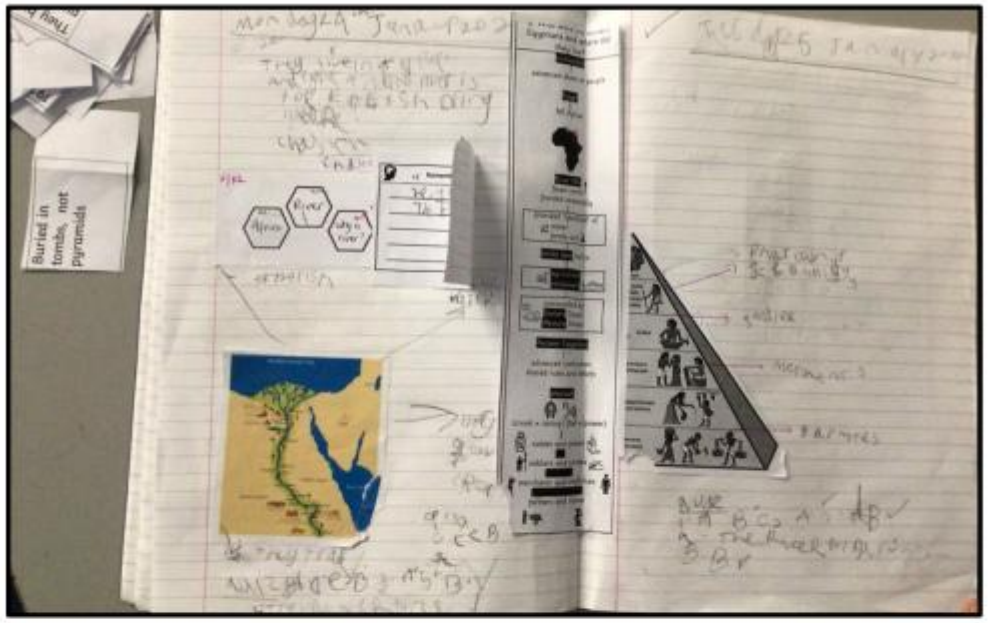
TEST HARDNESS OF ROCKS

Oral Rehearsal: Allows pupils to formulate and practice responses before recording or writing these down.

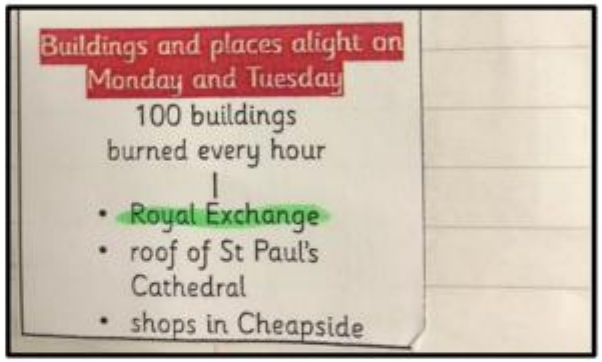


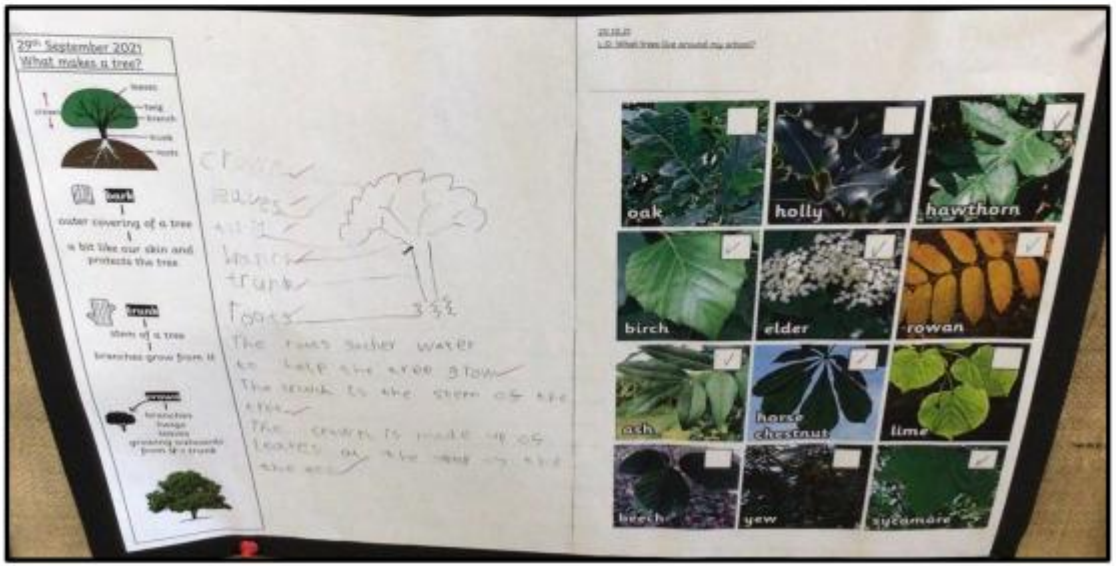
Pathways: Enable pupils to record and verbally share their knowledge and understanding, removing the pressure of extended writing.





- Chunk Knowledge Notes into manageable sections
- Highlight key vocabulary
- Dual coding
- Annotation





- Alternative ways of recording
- Teachers knowing and adapting to meet their learners' needs
- Targeting additional input to lower attaining pupils and those with SEND

6. Staff CPD

All teaching staff receive 1:1 instructional coaching, delivered by a trained coach from the senior leadership team. These fortnightly meetings follow a programme based around cognitive load theory and quality first teaching. Staff questionnaires and audits are completed at two points in a year, to signpost subject knowledge support. Subject leaders have a 1:1 session, each half term, with senior leaders, to develop action plans and support for their curriculum area. Teachers also receive 1:1 coaching with either the subject lead or our lead practitioner in planning and delivering a science unit.

Teachers are provided with:

- Completed knowledge organisers
- Detailed medium term planning
- Access to resources and planning from CUSP Science.