CUSP SCIENCE Handbook

|

SINGLE AGE SEQUENCE

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KEY STAGE NARRATIVE

KEY STAGE 1

Pupils study the **Seasons** and develop an early conceptual understanding of how **day becomes night**. An understanding of change over time connects to the study of **Plants, including trees**. This focus enables children to associate trees as belonging to the plant kingdom and notice the changes deciduous trees go through connected to the seasons.

Contrasting that study, pupils learn about **Animals, including humans**. Non-examples of plants are used to contrast the features of an animal.

Pupils are introduced to **identifying and classifying materials**. Scientific terms, such as transparent, translucent and opaque are taught explicitly through vocabulary instruction and pupils make further sense by applying it to what they know and then to working and thinking scientifically tasks. This substantive knowledge is enriched by pupils' use of disciplinary knowledge through scientific enquiry.

To sophisticate their understanding, Year 1 pupils revisit the study **Animals, including humans** as a retrieval module and deepen their knowledge through revisiting and thinking hard through increasingly challenging tasks.

As pupils progress through KS1, new knowledge is integrated with pre-existing understanding. For example, in Year 2, the study of **Living things and their habitats** and **Uses of everyday materials**, engages pupils to integrate and draw upon their knowledge of **Animals, including humans** as well as **Plants**, and the study of **Materials**. New substantive knowledge is constructed and made sense of through **Working and Thinking scientifically** tasks.

KEY STAGE 2

In CUSP Science, substantive knowledge is always present and acts as a precursor for pupils' understanding. This will enable them to successfully apply disciplinary knowledge. In KS2 we introduced disciplinary scientific terms, including:

- variable
- independent variable
- dependent variable
- controlled variable

These give structure to working and thinking scientifically tasks in relation to the substantive knowledge taught in that specific study.

"what scientists observe, or choose to control in an experiment, depends on what they know. For example, classifying flowering plants scientifically requires knowledge of floral parts to place specimens in appropriate groups. However, classifying insects requires knowledge of body parts."

Ofsted Research Series: Science, 2021

In KS2 CUSP Science, we have defined these terms:

- **variable** - the things that can change in a science experiment.
- **independent variable** - the *variable* that is changed by the scientist.
- **dependent variables** - are the things that the scientist watches closely for to see how they *respond* to the change made to the *independent* variable.
- **controlled variables** - the things that a scientist wants to remain the same and not change so they can see how the independent variable reacts.

LOWER KEY STAGE 2

The unit on **Rocks** is studied and connected with prior knowledge from 'Everyday materials' in KS1. A study of **Animals, including humans** is built upon from KS1 and contrasts the physical features with the functions they perform, including the skeleton and muscles.
Rocks is revisited again to sophisticate and deepen pupils' knowledge, advancing their understanding.

Forces and magnets are introduced and connect with KS1 materials, including twisting, bending and squashing. Contact and non-contact forces are taught and understanding applied through Working and Thinking Scientifically. The abstract concept of **Light** is made concrete through knowing about light sources and shadows. **Plants** are studied to develop a more sophisticated understanding of their parts and functions, including pollination.

A study of **Living things and their habitats** pays close attention to classification and is directly taught using prior knowledge to ensure conceptual frameworks are secure. Explicit vocabulary instruction supports pupils to deconstruct words for their component meaning, for example in<u></u>vertebrate. **Animals, plants and environments** are connected in this study with a summary focusing on positive and negative change.

Electricity is introduced. Substantive knowledge is taught so that pupils acquire understanding about electrical sources, safety and components of a single loop circuit. Practical tasks give pupils the opportunity to think using disciplinary knowledge in the context of variables. Pupils make sense of what they know by testing, proving and disproving hypotheses.

Animals, including humans focuses on the sequence of digestion, from the mouth to excretion. Misconceptions, such as digestion begins in the stomach, are pre-empted, limited and represented as non-examples.

States of matter and **Sound** are taught using knowledge of the particle theory. Acquiring substantive knowledge about 'states' of matter supports pupils to understand how solids, liquids and gases behave. This knowledge is connected further to geographical studies of the **Water cycle** and life processes. Practical scientific tasks and tests help pupils build a coherent understanding of the particle theory by applying what they know through structured scientific enquiry. Misconceptions, such as 'liquid particles are slightly more separated than gas and less compacted than solids' are addressed.

UPPER KEY STAGE 2

In the study of **Properties and changes of materials**, it is important that pupils reuse and draw upon their understanding of states of matter. This prior content eases the load on the working memory to process and make sense of new knowledge, including solutions, mixtures, reversible and irreversible changes.

Change is also studied **within Animals, including humans**, focusing on growth and development of humans and animals.

Earth in Space develops the conceptual understanding of our place in the universe. This study unwraps misconceptions, including the Moon changing shape, the Sun moving across the sky and how seasons occur.

A study of **Forces** sophisticates the substantive knowledge acquired in KS1 and LKS2. New content, including air resistance and water resistance is studied. Force multipliers, such as levers are studied to understand how we can be efficient with effort. For example, a spanner with a long handle multiplies the force and makes it easier to turn a bolt than spanner with a shorter handle. Simple machines, such as pulleys are also studied as force multipliers – they move the load through a greater distance with the same energy being used. Enhancing this study of **Forces**, pupils learn about Galileo Galilei 1564 - 1642 (considered the father of modern science).

Living things and their habitats focuses on differences in life cycles of living things and how they reproduce. This study also contrasts previous scientific thinking. Pupils contrast how people in the past thought and constructed understanding, in the absence of scientific evidence, to explain things they didn't understand. Maria Merion is the significant scientist studied, she observed closely and carefully drew insects undergoing biochemical metamorphosis. David Attenborough describes Maria Merion as one of the most important contributors to the field of entomology.

A further study of **Living things and their habitats** enables pupils in UKS2 to revisit and add to their understanding of classification through the taxonomy created by Carl Linnaeus. More complex animals are studied, including invertebrates such as Myriapods and Echinodermata (starfish and Sea urchins) as well as Arthropods such as Crustacea, Arachnids, and Insects.

Light is revisited and taught with advanced substantive knowledge. This is physics study with a focus on the properties of light, not the biology of the eye.

The study of **Animals, including humans** enables pupils to add new knowledge to their mental models of biological systems. Circulation, the components of blood and the mechanism of the heart is connected to healthy living through diet and exercise. Many of these science studies are enriched and conceptual frameworks extended through the deliberate curriculum choice to study charts and graphs in Maths, food in Design Technology or reuse and retrieve substantive knowledge in other contexts, such as in writing.

Further retrieval learning modules are deployed, so that pupil knowledge can be advanced and sophisticated to increase their depth of understanding.

Electricity is enhanced with an advanced study of electrical circuits. New substantive knowledge is acquired in the context of the particle theory, which was previously studied. Working and Thinking scientifically tasks help to deepen and make sense of new learning, such as the concept of electricity and the way we explain it using terms such as charge, potential difference and flow.

Evolution and inheritance introduces two significant scientists - Charles Darwin and Alfred Wallace as pioneers of scientific thinking in the field of evolution. This study draws on how misconceptions may have been arrived at to explain the past and how theories explain significant change, over time. Substantive concepts, including adaption and variation are taught explicitly through vocabulary and clarity is achieved through worked examples. This supports pupils to use this substantive knowledge in a disciplinary way.

IMPORTANT CONSIDERATIONS

1. Through excellent teaching and generative tasks, the connection between the scientific content and the context needs to be made relevant to the everyday lives of children.

2. Through great teaching of CUSP Science, we must encourage pupils to be curious learners who are inquisitive, ask questions and think hard.

3. CUSP Science seeks to empower pupils to ask relevant scientific questions as well as begin to answer them using substantive and disciplinary knowledge.

We've worked very hard to make sure that the CUSP Science resources support these important considerations and more.