Easton Royal Academy: Science Handbook

One of the key drivers of our curriculum is the idea of discrete subject quality. We therefore teach science as a discrete subject and learners have a one hour science lesson on the timetable each week. Our science is taught in mixed age groupings and so this handbook should be read in conjunction with our 'progress in mixed ages' document as well as our science curriculum overview.

How is our curriculum structured?

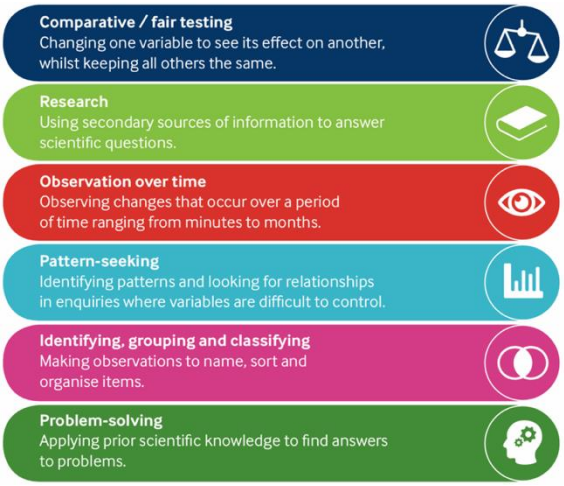
- EYFS science is taught as part of our EYFS curriculum and repeats each year.
- KS1 science is taught on a 2 year cycle so children may encounter a particular unit in year 1 or year 2, depending on the year they join.
- KS2 science is taught similarly, but with a 4 year cycle.

How do we build progression within a 2 or 4 year non-linear cycle?

- Objectives from NC have been put together into EYFS, KS1, LKS2 and UKS2.
- Progression comes from layered objectives within the same unit (which are repeated 2 years later). For example learning the basic parts of the digestive system (LKS2 objective) and describing the process in which nutrients and water are transported (UKS2 objective) might occur in the same unit. In our curriculum, children are exposed to the learning of both in a single unit but teachers achieve progression using our **mixed-age progression guide.** The same combination of objectives occurs again 2 years on in the cycle and in a different unit.
- This means learners have the opportunity to cover a concept (e.g how water is transported through the body) in more than one context, spacing learning over a period of time. The learning theories which support this approach are those which look at spaced repetition and interleaving of concepts.
- Progression also occurs within disciplinary knowledge and although children are working on the same unit, teachers have different disciplinary expectations of different aged learners.

How do we teach science?

Our Science curriculum teaches the **6 types of Science enquiry** set out by the PSTT. Each type of enquiry is shared with the children in their learning and on our classroom science displays. This enables children to make procedural links between units of study and build on their skills as scientists. Progression is set out for enquiry in the disciplinary knowledge progression section of our curriculum document and more detail about the skills can be found in appendix 1. Our Science units are based around a real life context or problem which gives purpose to learning and helps children to make connections between objectives and experience.



Appendix 1.

COMPARATIVE / FAIR TESTING

Comparative / fair testing
Changing one variable to see its effect on another, whilst keeping all others the same.

We might start talking about comparative or fair testing with children by first talking about what can be changed (the 'variables') and whether this might make a difference to the outcome.

For example, consider a car rolling down a ramp.

Ask the children: **What will affect how far the car travels?**

Possible variables: the height of the ramp, the surface of the ramp, what the wheels of the car are made from, the shape of the car, the mass of the car, whether the car is pushed.

Comparative test: If I change the car (the independent variable), what will happen to the distance the car travels (the dependent variable)?

Note: it is unlikely that you will have cars of different mass that are exactly the same shape, or cars of different shapes that are exactly the same mass, so this is a *comparative* test. You can compare different cars by keeping other variables the same. It is not a 'fair test' because at least two variables are being changed (e.g. mass and shape).

Fair test: If I change the surface of the ramp (the independent variable), what will happen to the distance the car travels (the dependent variable)?

RESEARCH

Research
Using secondary sources of information to answer scientific questions.

Pupils might use pictures, books, websites or information sheets that have been pre-prepared to help them to find out answers to questions about any area of science. They may visit a museum or talk to a visitor in school or parent about science.

Children particularly like learning using online materials. It is important that the websites children use are age appropriate and that children are not discouraged from their research by too much text or complex vocabulary. You will find some excellent websites through WOW Science which includes games, activities, apps, and videos.

Examples of research:

Why is drinking salt water bad for humans? Children could watch a film clip showing the effect of a salt solution on living cells.

How do some animals manage to live in salty water? Children could use a website to find out which animals are able to drink salt water and how they are able to do this.

Can you explain some notable features of some of the bizarre creatures that can be found in the deep-sea? How do these features help them to survive? Children could look at pictures in books or images easily obtained from the internet.

Can you name all the planets in the Solar System? Children could watch film clips or read texts in books or on websites to find out the answers.

How does skin change as you grow older? Children could take pictures of family members and compare them.

OBSERVATION OVER TIME

Observation over time
Observing changes that occur over a period of time ranging from minutes to months.

All sorts of questions can be answered through observation over time. The period of time might be seconds, minutes, days or even months depending on the question asked.

Examples of observation of time:

How do some materials change when they are heated? Children may investigate what happens to chocolate when it is heated for a few minutes and then cooled.

How do shadows change throughout the day? Pupils might observe the shadow they cast at different times of the school day.

Which drinks are bad for your teeth? Pupils might observe egg shells in different liquids for a few days.

What happens to frog spawn? Children might observe tadpoles developing for a few weeks.

What changes happen to a tree? Pupils might visit the same tree every month for a complete year.

PATTERN SEEKING

Pattern-seeking
Identifying patterns and looking for relationships in enquiries where variables are difficult to control.

Pattern seeking often starts with a question about a possible link between two events or phenomena (variables).

You may start by asking the children 'I wonder whether the smallest ...' or 'I wonder if the largest....'

To answer these types of questions, children will need to collect data: observing, measuring and recording events or systems. Or, they could collect data from secondary sources such as images or texts. Pattern-seeking enquiries provide excellent opportunities for children to learn about habitats, adaptation, growth, staying healthy (diet, exercise, disease), the weather, rocks and soils and the the solar system.

Sometimes, pupils will identify a **direct relationship** between two variables. For example, a shadow is taller when a light source is moved closer to the object. In this case, the tall shadow exists because the light has moved nearer the object: this is an example of a **causal relationship**. There are no other factors that can explain the relationship between the cause (the distance between the light and the object) and the effect (the size of the shadow).

Note: it is important that children understand that a direct relationship between two variables does not always mean a causal relationship exists. It is more common to find a direct relationship between two things that is not completely the result of one variable directly affecting the other.

In extreme cases, two variables can be related to each other without either variable directly affect the other. An example of this could be a relationship between children's height and their hair colour. For example, children might measure their height and record their hair colour on a numerical scale (1-5 representing black, dark brown, brown, pale brown, blonde) and conclude that 'in our class, the tallest children have the fairest colour hair'. This might be true but the tall children have not grown taller because they have blonde hair and their hair is not fair because they are tall. If you can find a direct relationship that exists that is clearly not a causal relationship, this is may help the children understand that not all relationships are causal.

Examples of pattern seeking:

Where do daisies grow? Children could count the number of daisies growing inside a hoop in different parts of the school grounds.

Do the biggest apples have the most seeds? Children could measure the mass or circumference of an apple and record the number of seeds inside.

Where do we find the most woodlice? Children could record the number of woodlice they find in different habitats.

Can children with the longest legs run fastest? There is often a child in the class who is smaller than average but can run faster than his/her peers. It is useful to find anomolies to these kinds of patterns and to discuss what other factors might be responsible for the effect. For example, this child may have more efficient muscles, larger lungs, do lots of sports.

How do musical instruments produce low notes? Is there a pattern? Pupils could look at the width of strings on a guitar, the number of holes covered on a recorder, or the volume of water in a glass bottle.

IDENTIFYING, GROUPING AND CLASSIFYING

Identifying, grouping and classifying
Making observations to name, sort and organise items.

Young children (ages 4 -5 years) perform simple grouping tasks, sorting items by simple observable features such as colours, shape and size. As children develop their knowledge of plants, animals and materials, they will sort and classify living things and materials using specific criteria. Older children may make charts or keys to help identify different animals and plants according to their observable features, and materials according to their properties.

Examples of identifying, grouping and classifying:

Can you sort these materials? Explain how you have grouped them. Young children (ages 5-7 years) may identify simple observable properties of materials such as hard/soft, rough/smooth, shiny/dull, whereas older children (ages 7-11 years) could compare and group materials according to transparency, electrical or thermal conductivity or solubility.

How are sounds made by musical instruments? Pupils could explore sounds made by string and wind instruments and identify and group the ways in which sounds are made. They could identify patterns, such as the thicker strings on a guitar produce the lower notes or shorter strings produce higher-pitched notes.

How can we sort animals into groups? Younger children (5-7 years) may group animals according to their appearance (e.g. number of legs, presence of fur or scales), their habitat (e.g. live in nest or a burrow), or their diet (carnivore, herbivores, omnivores). Older children (ages 7-11 years) with a greater knowledge of the features of vertebrate and invertebrate groups could identify and classify animals as fish, amphibians reptiles, birds, mammals or snails, slugs, worms, spiders and insects.

PROBLEM SOLVING

Problem-solving
Applying prior scientific knowledge to find answers to problems.

To help children develop independence in scientific enquiry, pupils should be encouraged to use their own initiative in problem solving. You might challenge your pupils directly with a question or show a particular phenomena and ask them to explain it. Often, posing problems with a real life context will stimulate children's interest and thinking. Practical Action provide resources that focus on global issues such as climate change, energy and food security. Several PSTT resources are also available which offer children problem solving challenges: Titanic Science, Chain Reaction, Learning Science Together and Standing On The Shoulders Of Giants.

Examples of Problem Solving:

How do chemical rockets work? This problem allows children to investigate a chemical reaction which produces gases and is described in the Titanic Science resources.

Design a device that creates a mechanical chain reaction. This problem allows children to explore forces and is described in Chain Reaction.

Who wrote the ransom note? This is one of the questions asked in Learning Science Together and encourages children to use chromatography to compare and contrast different inks.

What would you do next? This questions is asked in every chapter of Standing on the Shoulders of Giants to challenge children to consider what further questions they may want to ask and research after learning about a famous scientist's work.