Primary Science Teaching Trust

# Guide to Types of Enquiry

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

**Research**
Using secondary sources of information to answer scientific questions.

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

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

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

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

# What do we mean by ‘types of enquiry’?

Whichever curriculum your school follows, over the course of an academic year, pupils should carry out several investigations which involve different types of enquiry:

- comparative / fair testing
- research
- observation over time
- pattern seeking
- identifying, grouping and classifying
- problem solving

# Which type of enquiry should I choose?

It is important that over the course of a year, children are given the opportunity to carry out many different types of investigations.

Some topics lend themselves to particular types of enquiry. For example, in biology-related topics such as seasonal change or plant growth an investigation involving close **observation over time** might be most appropriate. In physics-related topics such as forces (e.g., Which magnet is strongest? Which surface is least slippery?) a **comparative or fair test** might be what is needed to find out.

However, there is no rule about which type of enquiry is best suited to each topic and there is no expectation that children carry out all these types of enquiries within each science topic. You will find that there is often overlap between types of enquiry.

Note: it is not essential that children can name the type of enquiry from the list given here.

# Where can I see examples of types of enquiry?

All types of science enquiry can be recorded by the teacher in a floorbook.

Visit PSTT’s **Floorbooks** webpage to see examples of children carrying out different types of enquiry and to find out more about using floorbooks in your classroom.

# Comparative / fair testing

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

It can be confusing to know whether an investigation is a comparative test or a fair test.

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 down the ramp?**

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)?

In this investigation, only one car is needed. The surface of the ramp is changed but all the others possible variables remain the same. As only one variable is changed, we can say that this is a fair test.

# 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 **WOWScience** 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 use books or 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 eggshells 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 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 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 anomalies 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 with a question or show a particular phenomenon and ask them to explain it. Posing problems with a real-life context can stimulate children's interest and thinking.

Several PSTT resources are available which offer children problem solving challenges: **Titanic Science, Chain Reaction, Learning Science Together** and **Standing On The Shoulders Of Giants.**

**Practical Action** also provide resources that focus on global issues such as climate change, energy and food security.

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.