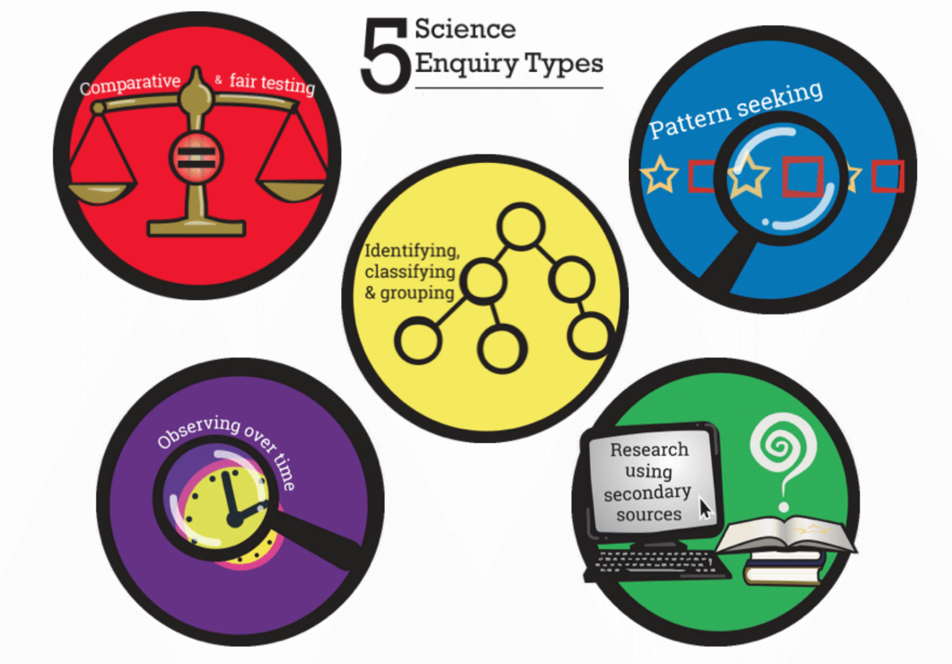


Science Investigation Policy and Guidance

February 2024

Reviewed: Spring Term 2024
Next Review Date: Autumn Term 2024

Last updated: February 2024

Contents:

Firs Primary School

Statement of intent

This policy is designed to act as a guide to all staff who teach science. This guidance explains the national curriculum's intent, non-negotiables when recording investigations, guidance to enhance learning and exemplars to aid clarity of tasks. This is a progressive document that covers the 5 enquiry types and what they should look like for year 1 up to year 6. There is also mention of the scientific skills that run through the science curriculum and how these are used within daily lessons to ensure children have the opportunity to work at an age-related standard for their year group, while raising awareness of science capital throughout the curriculum.

Red text denotes non-negotiables – these must be seen when completing this investigation type. They do not need to be all covered in every investigation. Pick 1-2 headings to focus on in-depth and write up. All of these should be covered by the end of the year.

Orange denotes optional areas to strengthen the children's skills within the science curriculum and English writing.

Italics indicate notes for the teacher

When this document refers to the 'curriculum', this is taken from [Science programmes of study: key stages 1 and 2 - The National Curriculum in England – September 2013.]

This policy document is made in conjunction with content from Ogden Trust © The Ogden Trust Making physics matter

Signed by:

______________________	Headteacher	Date:	______________________
______________________	Chair of governors	Date:	______________________

What are the 5 enquiry types?

Comparative and fair testing

Enquiries that are comparative tests have many similar features to fair tests in that one variable is changed, another variable is measured, and any other variables are controlled. 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.

Observation over time

The changes children observe can take place in seconds, minutes, hours, days, or over longer periods of time, such as weeks or months.
This type of enquiry lends itself to observing the natural world, but can also be used when comparing materials and observing physical processes.

Identifying, classifying and grouping

In this type of enquiry, children make observations and measurements to help them look for similarities and differences. This will help them to organise things into groups and make connections. Identifying and classifying enquiries are fantastic for promoting discussion and collaborative learning. 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.

Research and using secondary sources

Children get to use a range of secondary sources to help them find the answers to their 'big questions'. Alternatively, children could plan research tools, such as questionnaires and interviews, to collect their own data. Research enquiries help to develop children's scientific literacy, as children learn to compare and evaluate information from different sources. 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.

Pattern seeking

Pattern-seeking enquiries involve children making measurements or observations to explore situations where there are variables that they can't easily control. Often, pattern-seeking enquiries may be preliminary tests that lead to more systematic enquiries, such as fair tests or comparative tests. The key difference here is that pattern-seeking enquiries are not fair or comparative tests, because certain variables can't be controlled. Children may still identify a possible causal relationship from their data, such as 'the more you wind up a clockwork mouse, the further it will run', but they may find links between variables that can't be explained.

Curriculum intent – taken from the Primary curriculum

The nature, processes and methods of science

'Working scientifically' specifies the understanding of the nature, processes and methods of science for each year group. It should not be taught as a separate strand. The notes and guidance give examples of how 'working scientifically' might be embedded within the content of biology, chemistry and physics, focusing on the key features of scientific enquiry, so that pupils learn to use a variety of approaches to answer relevant scientific questions. These types of scientific enquiry should include: observing over time; pattern seeking; identifying, classifying and grouping; comparative and fair testing (controlled investigations); and researching using secondary sources. Pupils should seek answers to questions through collecting, analysing and presenting data. 'Working scientifically' will be developed further at key stages 3 and 4, once pupils have built up sufficient understanding of science to engage meaningfully in more sophisticated discussion of experimental design and control.

Key stage 1 - Statutory requirements

- 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 - Statutory requirements

- 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 - Statutory requirements

- 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 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.

Comparative and Fair Testing KS1

Guidance

Further guidance can be found here

Children should investigate a '**big question'**. Something the children may not know the answer to, therefore, they will need to complete an investigation to find out the correct answer to their question. Comparative tests tend to involve some sort of data collection; KS1 children may use tally charts to record their observations.

The report should be organised by writing with **subtitles**.
In KS1 books you would generally expect to see a **tally chart, pictogram, or block chart** when reporting a comparative test.
Children should **begin moving to standard units** e.g. cm, ml etc

Example: consider a car rolling down a ramp.

Support the children to identify what we can change:
Possible variables: the height of the ramp and the surface of the ramp – this could be picked for the children or they could choose which they would like to investigate (note their options should be realistic e.g. choosing from two or three choices).

Reference to **fair testing** where we **only change one thing (variable).**
Question: If I change the surface of the ramp, what will happen to the distance the car travels? Questions can be informed by children's questions in class and the teacher comes up with a question with the class supporting them. Children need to understand questions can be answered in different ways.

Recording of the learning

Children should be taught the following areas of the course of the year. By the end of the 2-year cycle, they should have discussed and had opportunity to conduct each one of these within key stages. Children do NOT need to record all of them within one lesson and should be taught as deemed appropriate by the class teacher for their class.

Question *(given by an adult but discussion held about questions they have)*

What I think will happen *(formerly a prediction)*

What we did *(a couple of sentences or a picture providing children can verbally describe)*

Results *(raw data e.g. tally or numerical values)*

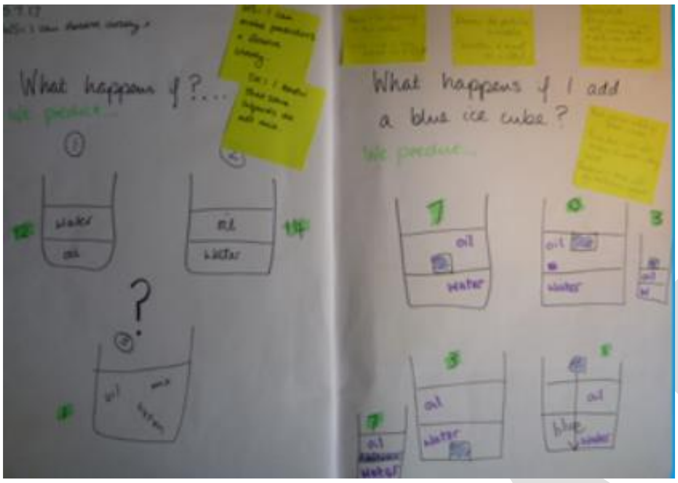
Results Chart (*bar chart or pictogram using templates)*

What I found out *(formerly a conclusion)*

Examples of investigations

- Which type of compost grows the tallest sunflower?
- Is our sense of smell better when we can't see?
- Do cress seeds grow quicker inside or outside?
- Which material would be best for the roof of the little pig's house?

Exemplars



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Comparative and fair testing

LKS2

<u>Guidance</u> Further guidance can be found here

Children **should decide which type of enquiry is appropriate**.
Children should investigate a ‘big question’. Something the children may not know the answer to, therefore, they will need to complete an investigation to find out the correct answer to their question. As children move through KS2, they should be using a **wide range of equipment** to make measurements. They begin to select the equipment for themselves.
They should learn what it means to **measure accurately** to 1 decimal place (up to 2DP where appropriate). Children will start using m, cm and mm to increase accuracy.

The report should be organised by writing with **subtitles**.
Children will **begin to independently plan** how to record the data, **using tables, keys, pictograms, and bar charts** to compare the measurements they make. Children can begin to use the bar charts to draw conclusions about what they have found out to be the answer to their ‘big question’.
Begin to use straightforward scientific evidence to answer questions or to support their findings.

With help, begin to look for **changes, patterns, similarities and differences** in their data
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, the mass of the car and whether the car is pushed.

Comparative test: If I change the car, what will happen to the distance the car travels?

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).

<u>Recording of the learning – Pick 1-2 to focus on during a lesson</u>

Question *(scaffolded by an adult based on their previous questions)*

Prediction

Equipment list *(children to begin independently selecting resources)*

Method *(simple bullet points – what will they change, keep the same and measure [decide on unit of measurement])*

Fair test *(identify whether this is a fair test or not – only changing one variable)*

Results *(raw data, table, chart, bar chart, key or detailed image/ drawing – appropriate scales may be required)*

Results chart

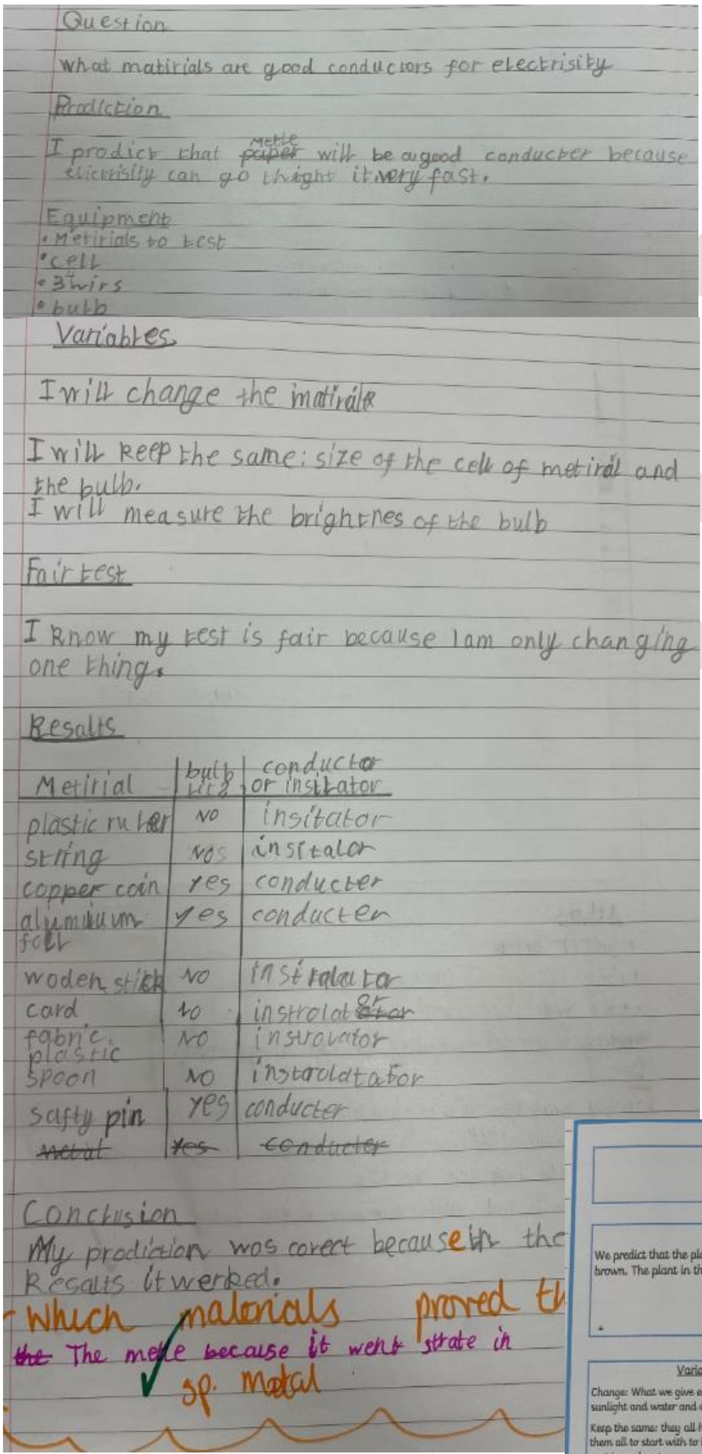
Conclusion

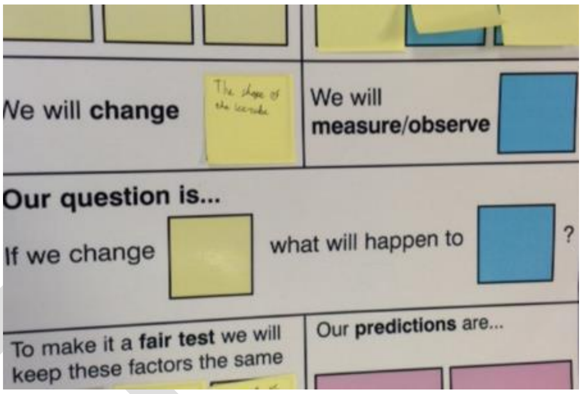
Evaluate *(what can be improved next time – was the test accurate?)*

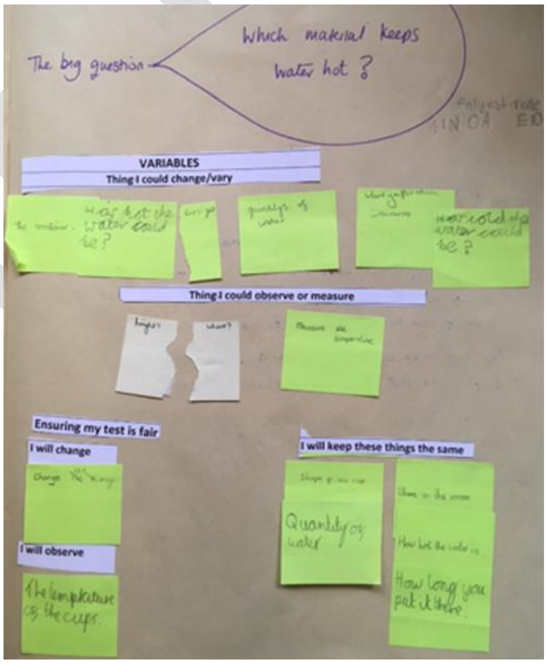
Examples of investigations

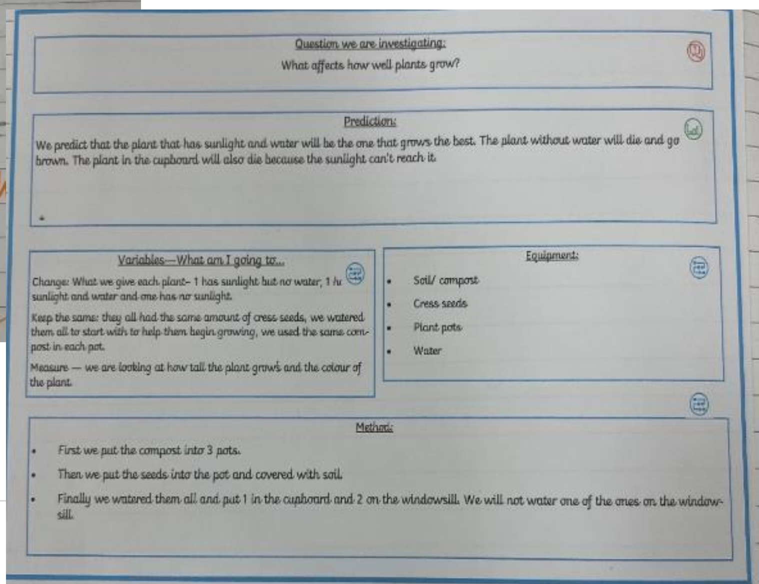
- Which conditions help seeds germinate faster?
- Which soil absorbs the most water?
- Does seawater evaporate quicker than fresh water?
- Which metal is the best conductor of electricity?

Exemplars








Question we are investigating:

What affects how well plants grow?

Prediction:

We predict that the plant that has sunlight and water will be the one that grows the best. The plant without water will die and go brown. The plant in the cupboard will also die because the sunlight can't reach it.

Variables—What am I going to...

Change: What we give each plant- 1 has sunlight but no water, 1 has sunlight and water and one has no sunlight.

Keep the same: they all had the same amount of cress seeds, we watered them all to start with to help them begin growing, we used the same compost in each pot.

Measure — we are looking at how tall the plant grows and the colour of the plant.

Equipment:

- Soil/ compost
- Cress seeds
- Plant pots
- Water

Method:

- First we put the compost into 3 pots.
- Then we put the seeds into the pot and covered with soil.
- Finally we watered them all and put 1 in the cupboard and 2 on the windowsill. We will not water one of the ones on the windowsill.

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Comparative and Fair testing

UKS2

Guidance

Further guidance can be found [here]

Children **should decide which type of enquiry is appropriate.**
As children move through KS2, they should be using an **increasingly wide range of equipment** to make measurements. They **independently select the equipment** for themselves.

They should learn what it means to **measure accurately and precisely** - to 2 decimal places (up to 3DP where appropriate) and take **repeat tests where appropriate**. They will need to take a **mean result** to ensure the comparison is accurate.

Children will independently plan how to record the data with increasing complexity; using scientific **diagrams and tables, bar and line graphs, keys, scatter graphs**.

Children to analyse data knowing which results are anomalies and look for changes, patterns, similarities and differences in their data. **Indicate the degree to which they trust** their results

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, and 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)?

Recording of the learning – Pick 2 areas to focus on during a lesson

Question *(based off children's prior questioning)*

Hypothesis *(using known information to state a reason why they think this)*

Equipment list *(children to independently selecting resources)*

Method *(statement about what you will do and the variables)*

- **independent** *(what you are changing)*
- **Dependent** *(what you are measuring)*
- **Controlled** *(what stays the same)*

Labelled diagram

Result *(tables, bar and line graphs, keys, scatter graphs)* –**identification of anomalies**

Accuracy/ reliability *(explain how this was accurate/reliable – number of tests, fair test?)*

Conclusion *(point and explain using scientific terminology)*

Evaluate *(what can be improved next time)*

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Examples of investigations

- How does the length of daylight hours change in each season?
- Which shoe has the greatest friction?
- Which shape parachute takes the longest to fall?
- Which type of fruit makes the best fruity battery?

Exemplars

Aim: How does the height of the drop affect the bounce of a ball?

Fair Test:

To make this a fair test, we will be only changing one variable which would be the height of the ball dropped from.

Independent variable:

We will change the height the ball is dropped from.

Dependent variable:

We will measure the height of the bounce from the ball.

Equipment:

Tennis ball · chair · clipboard

meter stick · paper · pen / pencil

Method:

Step 1 - Get the equipment needed.

Step 2 - Measure 20 cm.

Step 3 - Drop the ball at 20 cm, and catch it.*

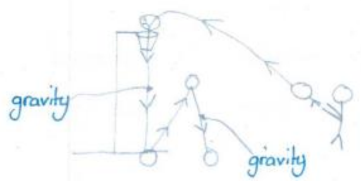
Step 4 - Measure and record it.

Step 5 - Repeat this until it gets up to 1m 60cm. (go up in 20 cm)

* When we came to doing our method we changed it slightly insted of us catching it we lyed on the floor and looked were the ball reache When we were catching the ball we were catching it wrong which was giving us wrong results.

Prediction:

I think the higher the ball is dropped from, the higher it will bounce. I think this because the higher it is the more gravitational pull it has. For example when I shoot in netball the gravity pulls it down causing me to score a goal.



What a great example to use! Super work

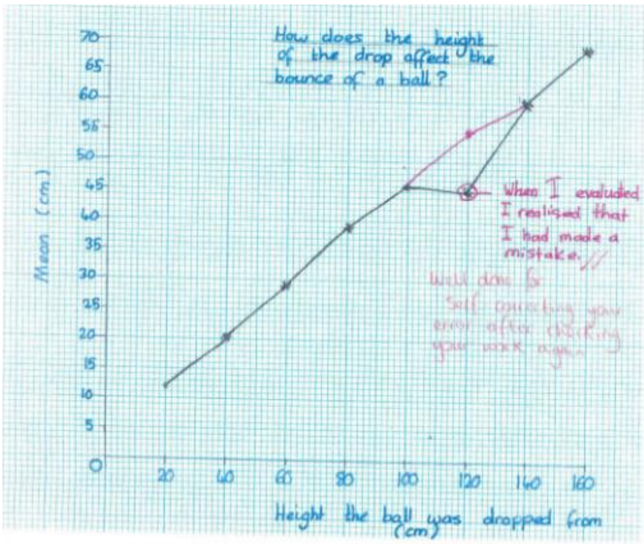


Table of Results:

Hieght (cm)	Try 1	Try 2	Try 3	Total
20	13cm	12cm	11 cm	12
40	21 cm	20cm	21 cm	20.6
60	28 cm	28cm	31 cm	29
80	39 cm	38cm	40cm	39
100	45 cm	44cm	49cm	48
120	55 cm	55cm	54cm	54.6
140	57cm	63cm	60cm	60
160	68cm	72cm	69cm	69.3

Accurate measuring and recording
Mean average

Conclusion:

Our results show that the higher the ball is dropped, the higher it will bounce. When the ball was dropped at 20cm it only bounced 12cm, but when it was 160cm it bounced 69.3cm. When it was high, gravity had more of pull over it. When it is higher it picks up more speed creating like a run up, to bounce.

I really like how you've explained this.

Evaluation:

At the end of our experiment we are very happy with our work. I would rate it 9/10. Next time we could improve on the distance the ball was dropped from. If we did do this it would give us more results.

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Comparative and Fair testing - Progression Write- up

Red text denotes non-negotiables over the duration of a 2 year cycle   Orange denotes optional areas   *Italics indicates notes for the teacher*

KS1	Notes	LKS2	Notes	UKS2	Notes
Question	*Question given by the adult*	**Question**	*scaffolded by an adult based on their previous questions*	**Question**	*based off children's prior questioning*
What I think will happen	*formerly a prediction*	**Prediction**	*begin to state why they think this using 'because'*	**Hypothesis**	*using known information to state a reason why they think this*
		Equipment list	*children to begin independently selecting resources – making systematic and careful measurements with standard units e.g m, cm, mm*	**Equipment list**	*children to independently select resources*
What we did	*formally a method a couple of sentences or a picture (providing children can verbally describe what they have done)*	**Method**	*simple bullet points – what will they change, keep the same and measure [decide on unit of measurement])*	**Method + variables**	*state what they will do – firstly, secondly – being precise about how they will do it e.g. ramp held at 40 degrees*
				independent *(what you are changing)* **Dependent** *(what you are measuring)* **Controlled** *(what stays the same)*	
Results	*raw data e.g. tally or numerical values – begin to move to standard units e.g cm*	**Fair test**	*simple statement to say how they know if it was a fair test*	**Labelled diagram**	*tables, bar and line graphs, keys, scatter graphs*
Results Chart	*bar chart or pictogram using templates to support*	**Result**	*raw data, table, chart, bar chart, key or detailed image/ drawing – appropriate scales may be required*	**Result + Anomalies**	*identify anomalies (odd ones out) and possible reasons for this*
What I found out	*formerly a conclusion scaffolded by an adult*	**Results Chart or labelled diagram**		**Accuracy/ reliability**	*explain how this was accurate/reliable – number of tests, fair test?*
		Conclusion	*simple statement (point and evidence – refer to the data table)*	**Conclusion**	*point and explain using scientific terminology*
		Evaluate	*what can be improved next time – was the test accurate?*	**Evaluate**	*what can be improved next time*

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Observation over time

KS1

Guidance — Further guidance can be found here

A key skill is **measuring**; measuring time in seconds, minutes, hours and days, but also measuring a variety of variables that they observe through the use of the naked eye or a magnifying glass/ microscope.
Children can record these within observation charts.

Many observing over time enquiries will involve children recording their observations in the form of **scientific drawings and labelling key features**; learning how to look closely and record details.
The **labelling of scientific drawings** helps children develop confidence in using a wide range of scientific vocabulary correctly.
Observing over time enquiries are an effective way of inspiring KS1 children to ask questions about the world around them and develop their sense of curiosity.

For younger children, keeping a diary of their observations with labelled drawings and observation notes for every day is a great application of their writing skills.

For longitudinal enquiries that might take place over the academic year, it works well to have a dedicated space to come back to their recordings where children add their weekly measurements, and a large graph that grows over the year to focus discussions and prompt questioning from children.
Other observing over time enquiries are more quantitative; and children will repeat measurements.
This kind of reporting provides opportunities for children to report their **conclusions** through an explanation text. A useful framework that supports children with this is point and evidence.

Recording the learning - Must include observation and one other heading

Question or heading

What I think will happen

Labelled diagrams/ images *(initial and or final snapshot)*

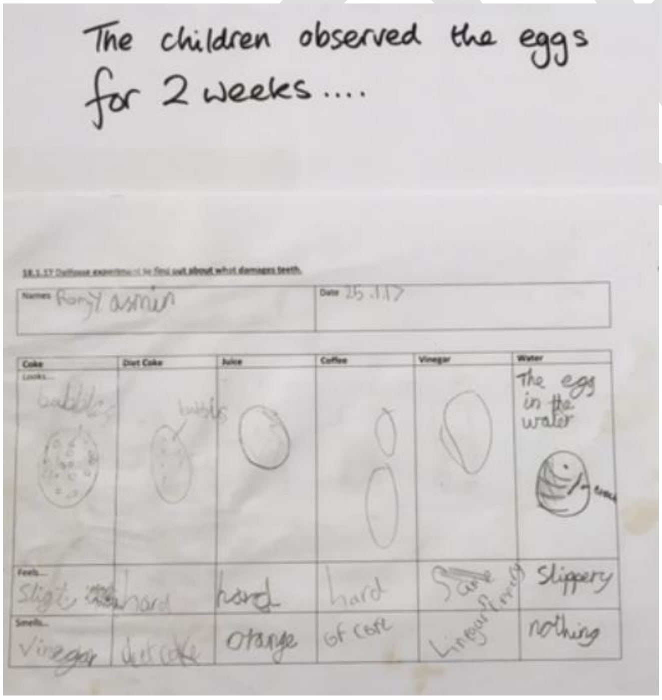
Observation – notes and images or data – running record

What I have found out *(what has been observed – formerly a conclusion)* ***Use point and evidence*** – *make a point about what they found and refer to their images and recordings*

Examples of investigations

- How does a daffodil bulb change over the year?
- How does my sunflower change each week?
- How does a tadpole change over time?
- How much food and drink do I have over a week?

Exemplars



Observation over time

LKS2

Guidance Further guidance can be found here

A key skill is **measuring**; measuring time in seconds, minutes, hours and days, but also measuring a variety of variables that they observe to change, such as temperature (°C), light levels (lux), and sound levels (dB). Children should be **somewhat accurate** when reading scales – **deciding whether it is appropriate to round or not.**
Recording can take place in data in tables, charts and graphs.

Many observing over time enquiries will involve children recording their observations in the form of **scientific drawings and labelling key features**.
The use of magnifying glasses and microscopes can help with developing this skill.
The labelling of scientific drawings helps children develop confidence in using a wide range of scientific vocabulary correctly.
For KS2 children, observations from these kinds of enquiries often enable children to make **predictions** about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.

Simple records could be kept for a short period of time using a template or journal.
For longitudinal enquiries that might take place over the academic year, it works well to have a dedicated display in the classroom, where children add their weekly measurements, and a large graph that grows over the year to focus discussions and prompt questioning from children.
Sometimes it may be detailed scientific **drawings with labels**, and descriptive writing of what they have observed. In some cases, their writing may end up being comparative, where they are examining differences and similarities in what they have observed in different situations.
Other observing over time enquiries are more quantitative; and children will repeat measurements, calculate averages, and create charts and graphs to explore changes.

Recording the learning - Must include observation and one other heading

Question or heading

Prediction

Labelled diagrams/ images *(initial and or final snapshot)*

Observation – notes and images or data – running record

Conclusion *(what has been observed)*

Point – *Point Children describe what they have discovered. What is their answer to their 'big question'?*

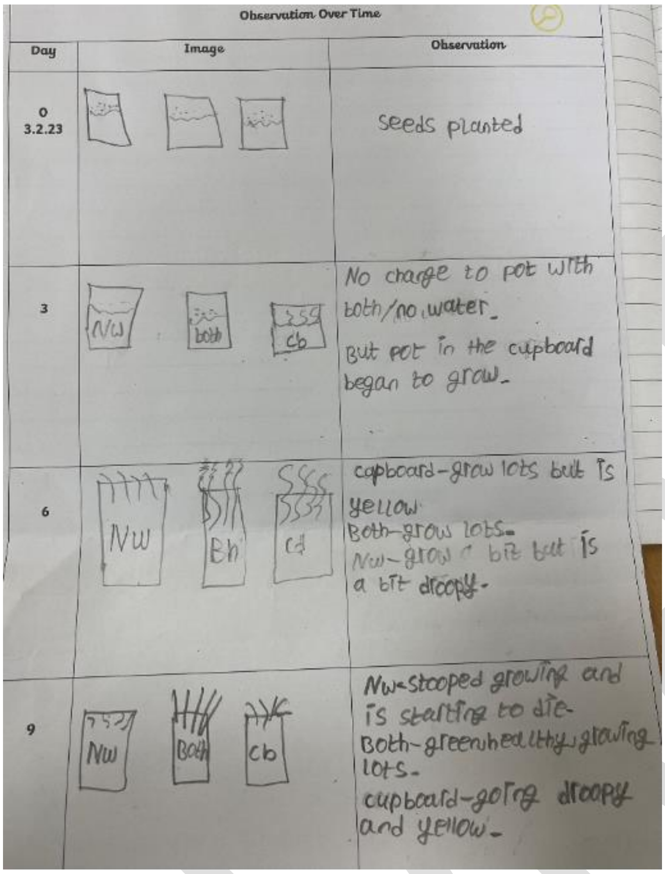
Evidence – *Refer to the table, notes or diagrams Children justify their answers by referring to the data they have collected, using data values with units and/or describing trends in graphs and charts.*

Explain - *Where possible children then use scientific ideas to explain what is happening.*

Examples of investigations

- What happens to celery when it is left in a glass of coloured water?
- Is the Sun the same brightness all day?
- How does an egg shell change when it is left in cola?
- Which material is best for keeping our hot chocolate warm?

Exemplars



Observation Over Time

Day	Image	Observation
0 3.2.23		seeds planted
3	NW both Cb	No charge to pot with both/no water. But pot in the cupboard began to grow.
6	NW Bh Cd	cupboard-grow lots but is yellow. Both-grow lots. NW-grow a bit but is a bit droopy.
9	NW Both Cb	NW-stooped growing and is starting to die. Both-green healthy growing lots. cupboard-going droopy and yellow.

Observation over time

UKS2

Guidance   Further guidance can be found here

A key skill is **measuring**; measuring time in seconds, minutes, hours and days, but also measuring a variety of variables that they observe to change, such as temperature (°C), light levels (lux), and sound levels (dB). **Increasingly accurate** recordings should be taken (up to 2-3 DP) with a **range of equipment**, including **log boxes**.

Recording can take place in data in tables, charts and graphs. Children could use log boxes to record this vast period of data over time.
Many observing over time enquiries will involve children recording their observations in the form of **scientific drawings** and labelling key features.
For KS2 children, observations from these kinds of enquiries often enable children to make predictions about how things might be, leading on to the planning of further comparative tests and fair tests to find out more.

Simple records could be kept for a short period of time using a template or journal, encouraging key vocabulary and high levels of accuracy – linking to the comparison between cycles.
For longitudinal enquiries that might take place over the academic year, it works well to have a dedicated display in the classroom, where children add their weekly measurements, and a large graph that grows over the year to focus discussions and prompt questioning from children.
Sometimes it may be detailed scientific **drawings with labels**, and descriptive writing of what they have observed.
Other observing over time enquiries are more quantitative; and children will repeat measurements, calculate averages, and create charts and graphs to explore changes.

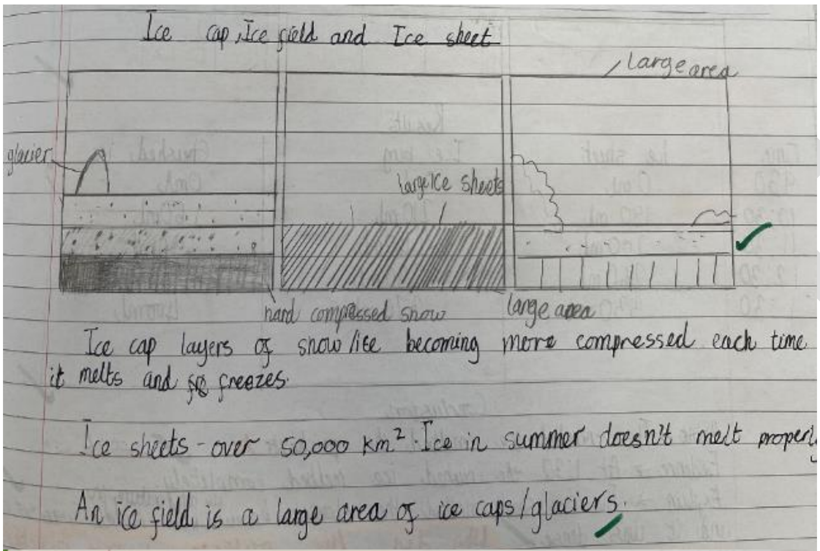
Recording the learning – observation and 2 other headings must be picked

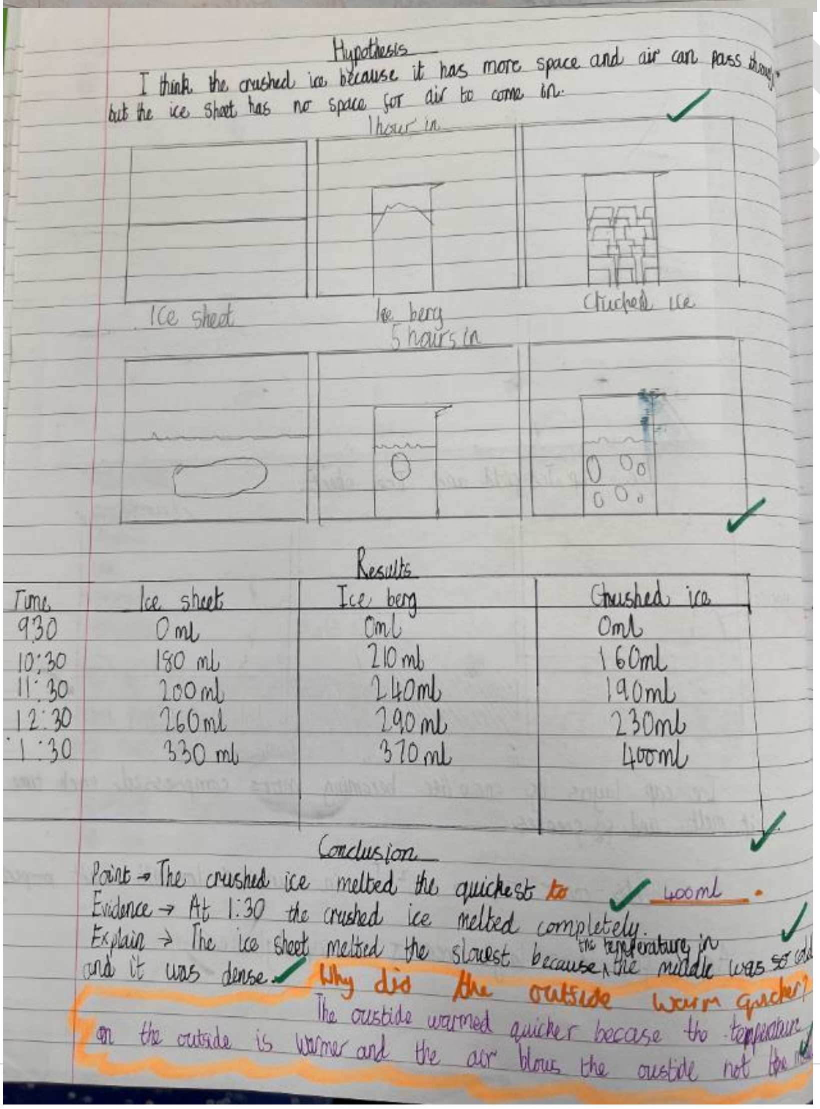
Question
Research (or previously conducted)
Hypothesis
Labelled diagrams *(initial and or final snapshot)*
Observation – notes and images or data – running record *(table with measurements, line graph, scatter graph)*
Conclusion or statement *(what has been observed)*
Point – *Point Children describe what they have discovered. What is their answer to their 'big question'?*
Evidence – *Refer to the table, notes or diagrams Children justify their answers by referring to the data they have collected, using data values with units and/or describing trends in graphs and charts.*
Explain - *Where possible children then use scientific ideas to explain what is happening. This will often require teacher input in advance.*
Where next? - *(chn to discuss what they would do now they know this information and what they could go on to do in a different test – such as a comparative one)*

Examples of investigations

- How does a nail in salt water change over time?
- How long does a pendulum swing for before it stops?
- What happens to a piece of bread if you leave it on the windowsill for two weeks?
- How does my heart rate change over the day?

Exemplars





Observation over time – Progression Write-up

Red text denotes non-negotiables Orange denotes optional areas *Italics indicates notes for the teacher*

KS1	Notes	LKS2	Notes	UKS2	Notes
Question or heading		**Question or heading**		**Question**	
What I think will happen	*Formerly a prediction*	**Prediction**		**Research**	*The research could have already been conducted in a previous lesson and make reference here*
				Hypothesis	
Labelled diagrams/ images	*initial and or final snapshot use key vocabulary*	**Labelled diagrams/ images**	*initial and or final snapshot key vocabulary*	**Labelled diagrams**	*initial and or final snapshot – key vocabulary*
Observation	*notes and images, data or running record*	**Observation**	*notes and images or data running record*	**Observation**	*notes and images or data – running record (table with measurements, line graph, scatter graph)*
What I have found out	*what has been observed – formerly a conclusion* ***Use point and evidence*** *make a point about what they found and refer to their images and recordings*	**Conclusion** **Point -** **Evidence –** **Explain -**	*Point - Children describe what they have discovered. What is their answer to their 'big question'?* *Refer to the table, notes or diagrams - Children justify their answers by referring to the data they have collected, Where possible children then use scientific ideas to explain what is happening.*	**Conclusion** **Point** **Evidence** **Explain**	*Point - Children describe what they have discovered. What is their answer to their 'big question'?* *Refer to the table, notes or diagrams - Children justify their answers by referring to the data they have collected, using data values with units and/or describing trends in graphs and charts.* *Where possible children then use scientific ideas to explain what is happening. This will often require teacher input in advance*
				Where next?	*chn to discuss what they would do now they know this information and what they could go on to do in a different test – such as a comparative one*

Identifying, classifying and grouping - KS1

Guidance

Further guidance can be found here

In KS1, children will be asking questions about the similarities and differences between things, which is a great opportunity to promote 'talk for learning' and encourage children to share their ideas. Children should be able to sort objects and images **based on given characteristics**. They may sort them into living and not living once they understand the definition. This is the first stage of grouping objects.

Identifying and classifying enquiries provide some of the best opportunities for children to make and **record detailed observations**. Younger children will be able to record what they see in the form of a **drawing**. For this to happen, children will need access to a variety of equipment that will support them in making closer observations; magnifying glasses, binoculars, telescopes, microscopes, and digital microscopes, will all help to develop children's skills in this area.

Developing useful **vocabulary** for children to use when identifying and classifying, as well as introducing new technical terms, is important. For children who find creating detailed drawings challenging, providing photographs of the objects that are being observed to label can be very helpful.
As this type of enquiry includes classifying and grouping, it is also an ideal opportunity for children to apply **mathematical skills in creating Venn diagrams**.

Can you sort these materials? Explain how you have grouped them. Young children may identify simple observable properties of materials such as hard/soft, rough/smooth, shiny/dull. How can we sort animals into groups? They 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).

Recording the learning – Must include all

Heading *(what do the groups show e.g. appearance, habitat or diet)*

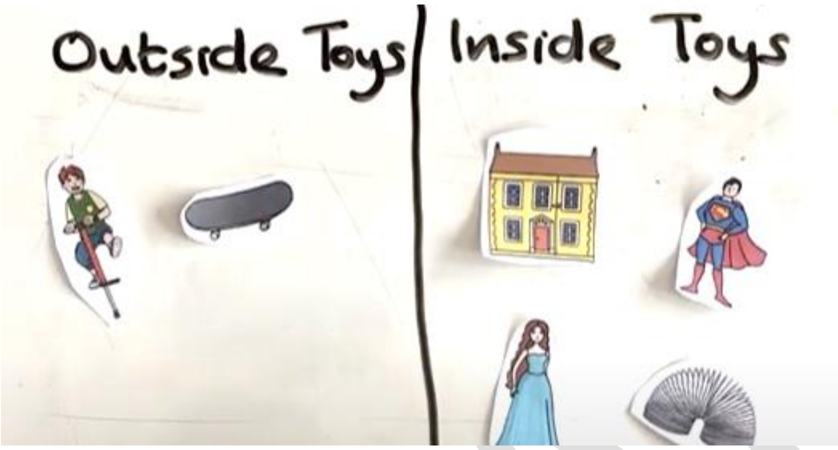
Category headings *(these could be given to children based of their questioning)*

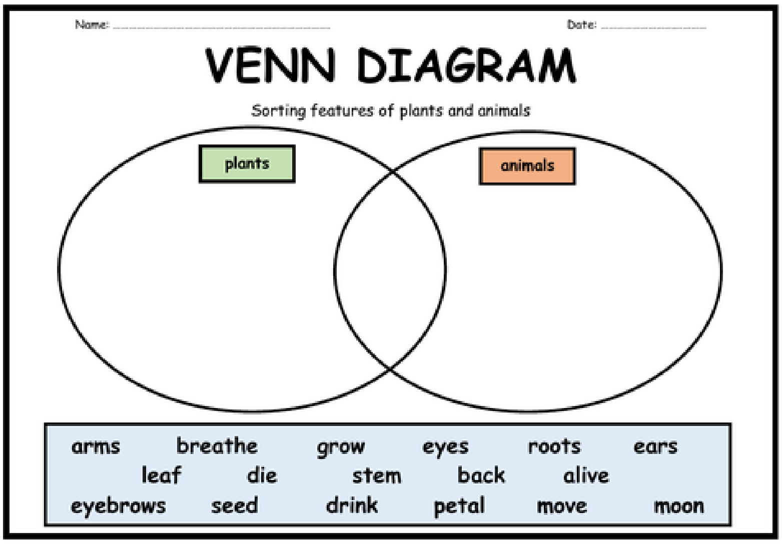
Objects to sort (***simple sorting piles or Venn diagrams***)

Examples of investigations

- How can we sort the leaves that we collected on our walk?
- How would you group these things based on which season you are most likely to see them in?
- Which offspring belongs to which animal?
- How would you group things to show which are living, dead, or have never been alive?

Exemplars





Identifying, classifying and grouping - LKS2

Guidance

Further guidance can be found here

Going into KS2, there is an increased focus on **measuring** and using data to answer 'big questions'. However, it does need to be regularly revisited. Children should continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing **reasoning and justification** when explaining how they have chosen to group things.

KS2 pupils will be expected to use **vocabulary** to create their own categories. This should be increasingly accurate, drawing on tests they may have already conducted – e.g. permeability. There may be more than 2 sub-headings for categories and beginning to challenge the children about their justifications.

Scientific diagrams need labels, so this is a great type of enquiry in which to focus on scientific vocabulary. Developing useful vocabulary for children to use when identifying and classifying, as well as introducing new **technical terms**, is important.
As this type of enquiry includes classifying and grouping, it is also an ideal opportunity for children to apply mathematical skills in creating **Venn and Carroll diagrams** to organise their findings.

Can you sort these materials? Explain how you have grouped them. Children 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.

Recording the learning – all red headings must be covered in one piece

Definitions of the headings they will use

Heading *(what do the groups show e.g. appearance, habitat or diet)*

Category headings *(children begin to choose suitable headings or discuss ways in which to categorise)*

Diagram *(there may be a diagram to show/ label details before they sort it)*

Objects to sort (***simple sorting piles, simple sorting keys and Venn diagrams and Carroll diagrams***)

Justification *(pick a few examples to justify why they have categorised it in this way)*

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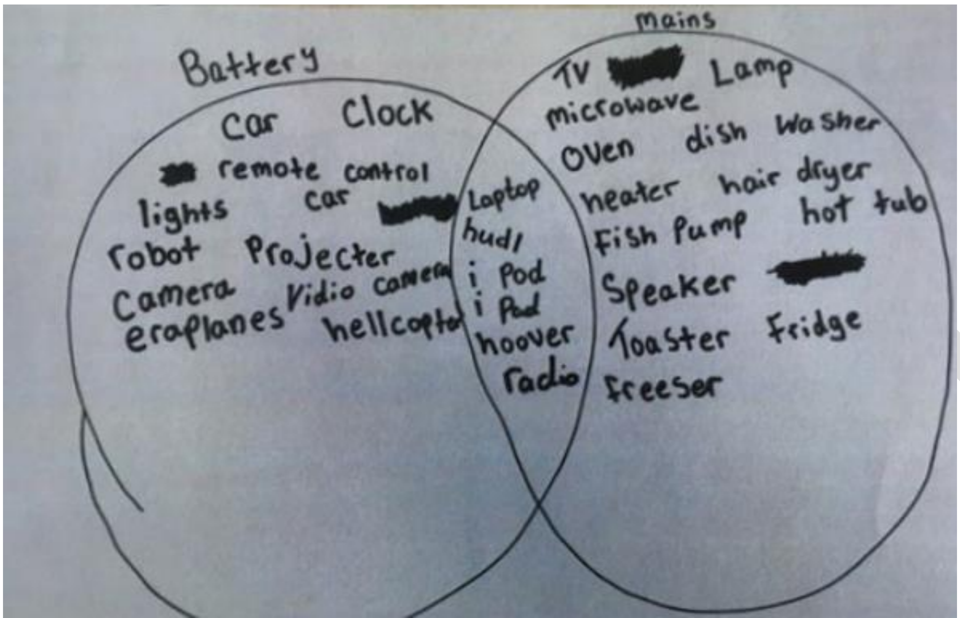
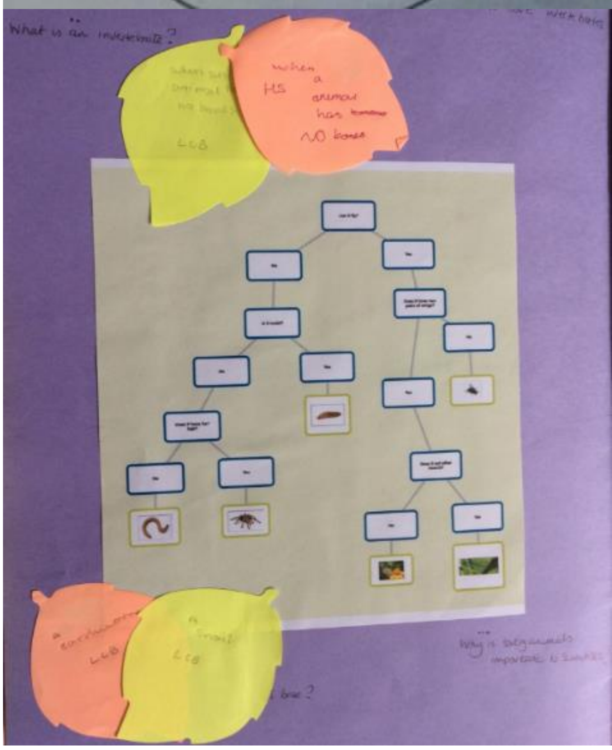
<u>Examples of investigations</u>

- How do the skeletons of different animals compare?
- How would you organise these light sources into natural and artificial sources?
- What are the names for all the organs involved in the digestive system?
- Can you group these materials and objects into solids, liquids, and gases?
- Exemplars





Identifying, classifying and grouping - UKS2

Guidance

Further guidance can be found here

Going into KS2, there is increased focus on **measuring** and using data to answer 'big questions'. However, it does need to be regularly revisited. Children should continue to build on their **observational** skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing **higher-order skills** in **reasoning** and **justification** when explaining how they have chosen to group things.
KS2 pupils will be **expected to design simple tests** to help them classify materials, as well as independently use a range of secondary sources to support them in identifying a range of living things. They will take **previous and current learning to engage with the sorting activity**.

Identifying and classifying enquiries provide some of the best opportunities for children to make and record detailed **observations**. Over their time, children become skilled in producing scientific drawings of their observations, increasing in fine detail as the years go on. For this to happen, children will need access to a variety of equipment that will support them in making closer observations; magnifying glasses, binoculars, telescopes, microscopes, and digital microscopes, will all help to develop children's skills in this area.
Scientific diagrams need labels, so this is a great type of enquiry in which to focus on scientific vocabulary.
Developing useful vocabulary for children to use when identifying and classifying, as well as introducing new technical terms, is important.
As this type of enquiry includes classifying and grouping, it is also an ideal opportunity for children to apply mathematical skills in creating **Venn and Carroll diagrams** to organise their findings. As children progress through KS2, they should be learning **identification keys** to help them with this type of enquiry, as well as learning how to create their own branched key.

How can we sort animals into groups? Older children, 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.

Recording the learning - all red heading must be taught in one piece

Definitions of the headings they will use

Heading *(what do the groups show e.g. appearance, habitat or diet)*

Category headings *(chosen by the children)*

Objects to sort (***Venn diagrams and Carroll diagrams and classification keys***)

Diagram *(there may be a diagram to show/ label details before they sort it)*

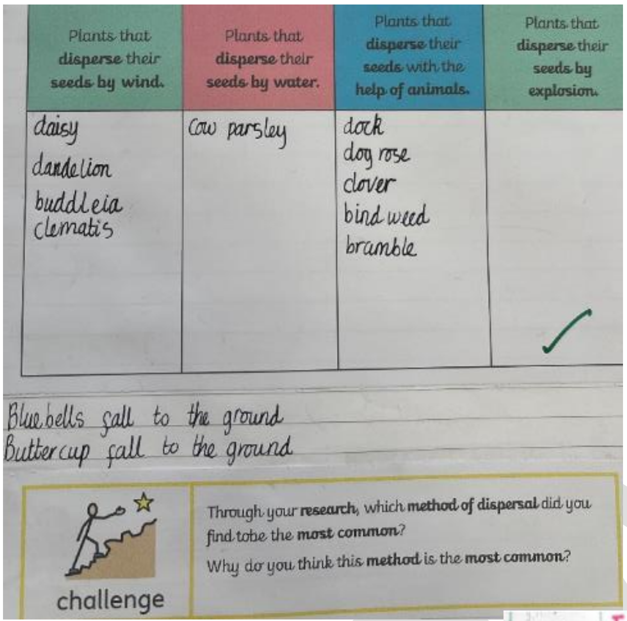
Test *(mini tests conducted or reference to prior learning to find out the answers)*

Justification *(pick ones that challenge the children – could this be in multiple categories – are they certain it goes in the category they have placed it in? Would they know how to conduct this test to be sure? Children to critically reason based on these known facts)*

Examples of investigations

- Compare this collection of animals based on similarities and differences in their lifecycle.
- How could you organise all the objects in the solar system into groups?
- How would you make a classification key for vertebrates/invertebrates or microorganisms?
- Compare the skeletons of apes, humans, and Neanderthals – how are they similar, and how are they different?

Exemplars

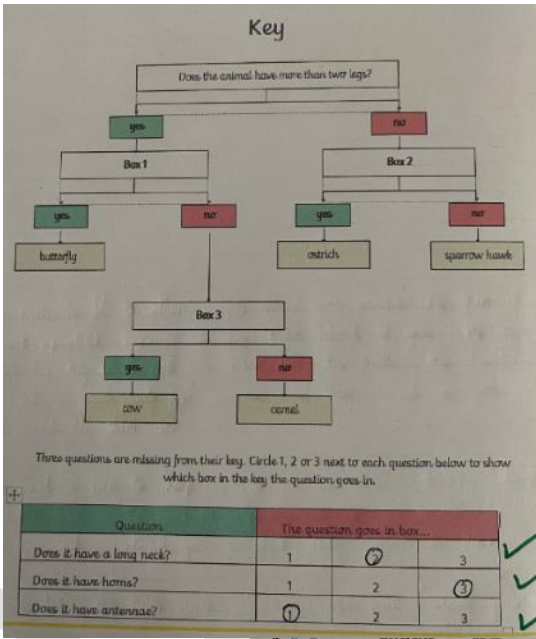


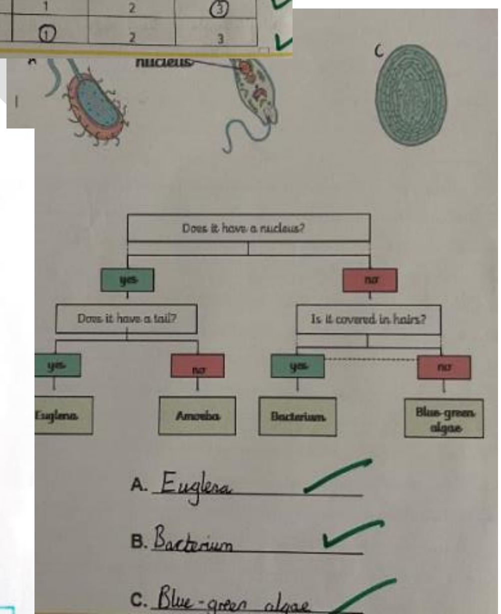
Plants that disperse their seeds by wind.	Plants that disperse their seeds by water.	Plants that disperse their seeds with the help of animals.	Plants that disperse their seeds by explosion.
daisy dandelion buddleia clematis	Cow parsley	dock dog rose clover bind weed bramble	

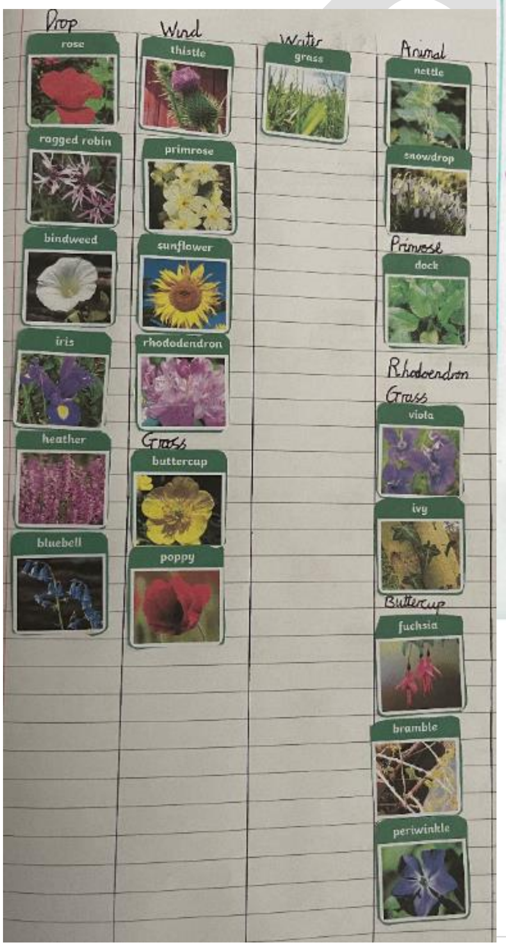
Bluebells fall to the ground
Buttercup fall to the ground

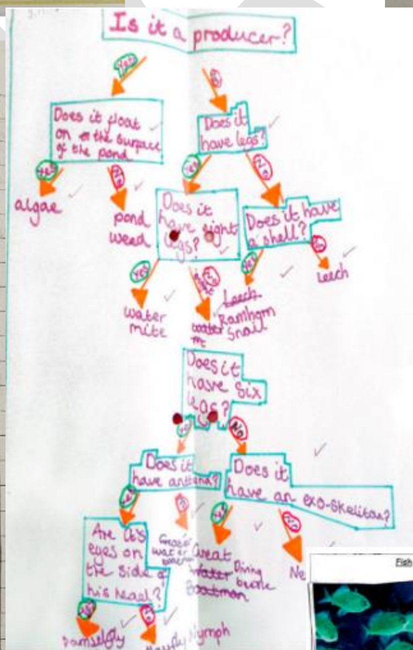
challenge

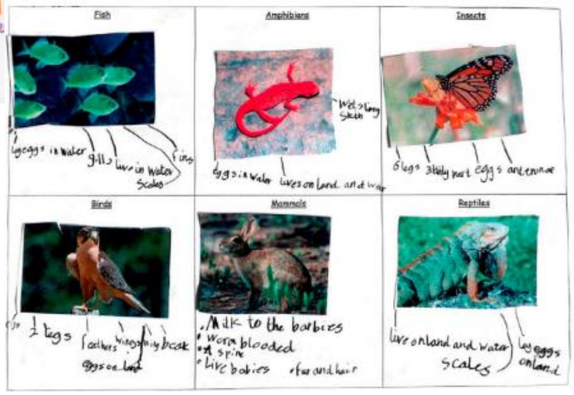
Through your research, which method of dispersal did you find to be the most common?
Why do you think this method is the most common?











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Identifying, classifying and grouping – Progression Write-up

Red text denotes non-negotiables Orange denotes optional areas *Italics indicates notes for the teacher*

KS1	Notes	LKS2	Notes	UKS2	Notes
Heading **Category headings** **Objects to sort**	*what do the groups show e.g. appearance, habitat or diet* *category could be given to children after they have discussed the learning* ***simple sorting piles or Venn diagrams***	**Definitions** **Heading** **Category headings** **Diagram** **Objects to sort** **Justification**	*Define some of the headings that are used or some of the more complicated items that are being sorted* *what do the groups show e.g. appearance, habitat or diet* ***Children should have increased ownership on the headings they choose*** *there may be a diagram to show/ label details before they sort it* ***simple sorting piles, simple sorting keys and Venn diagrams and Carroll diagrams*** *pick a few examples to justify why they have categorised it in this way*	**Definitions** **Heading** **Category headings** **Objects to sort** **Test** **Diagram** **Justification**	*Define some of the headings that are used* *what do the groups show e.g. appearance, habitat or diet* ***Headings should be chosen by children*** ***Venn diagrams and Carroll diagrams and classification keys*** *mini tests conducted or reference to prior learning to find out the answers* *pick ones that challenge the children to critically reason based on these known facts*

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Research using secondary sources KS1

Guidance

Further guidance can be found here

Using research to find the answers to 'big questions' allows children to practise and develop a range of skills. Reading for information and note-taking form an important part in this process.
Children will learn to use a range of secondary sources, including books, websites, and video, to find their information.
Where possible, children can listen to presentations from experts and science professionals to get their information, or ask them questions in interviews and letters.

Research enquiries allow children to be creative in how they present their findings. Depending on what they are researching, children can create **posters, leaflets, or fact files**. Alternatively, children can use multimedia to share their learning by creating videos! Research enquiries also support children in learning about how scientific ideas have changed over time, and this can lead to the creation of timelines in various forms. This type of enquiry is also ideal for learning about how real scientists work, both interesting characters from history, but also scientists working in your local community.

There are two forms of research – **Knowledge-based research and Development of Scientific ideas**

Recording of the learning

Knowledge-based research will contain a heading and research relating to the topic they are learning about. This can be presented in any way necessary.

Who was Mary Anning and what did she discover?

Development of scientific ideas - all red areas to be taught in one piece

Name of Scientist

Relevant images of discoveries and scientists

What are they famous for?

When did they make this discovery?

Key dates of discoveries or simple timeline

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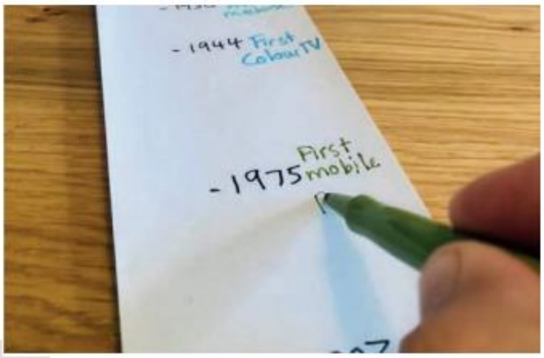
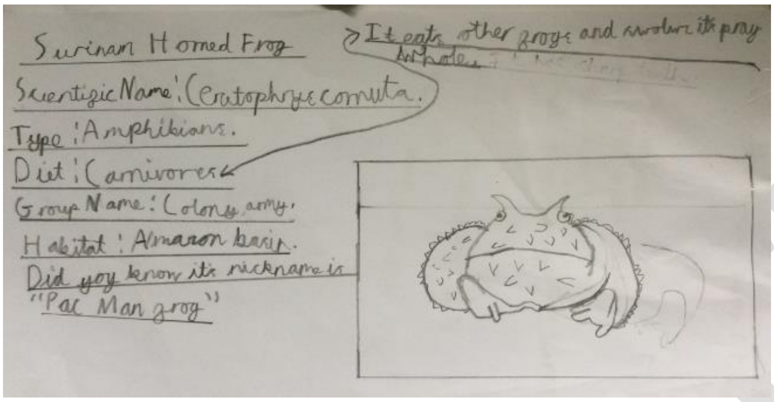
Examples of investigations **(knowledge based)**

- What are the most common British plants and where can we find them?
- Which materials can be recycled?
- How does a cactus survive in a desert with no water?
- How have the materials we use changed over time?



Exemplars



Research using secondary sources LKS2

Guidance   Further guidance can be found here

Reading for information and note-taking form an important part in this process but, as children become more skilled in carrying out independent research, they will learn to interpret the information they find and consider its relevance in answering their 'big questions'.

Children will learn to use **a range of secondary sources**, including books, websites, and video, to find their information.

Where possible, children can listen to **presentations from experts and science professionals** to get their information, or ask them questions in interviews and letters.

As children move into KS2, they should be finding more data in their research and using this to help answer questions; it is even better if they **start to collect their own data** through **questionnaires and interviews.**

Children begin to formulate their own questions in order to find the answer to their research.

Research enquiries allow children to be creative in how they present their findings. Depending on what they are researching, children can create posters, leaflets, or fact files. Alternatively, children can use multimedia to share their learning by creating videos!

Research enquiries also support children in learning about **how scientific ideas have changed over time**, and this can lead to the creation of **timelines** in various forms. This type of enquiry is also ideal for learning about how real scientists work, both interesting characters from history, but also scientists working in your local community.

There are two forms of research – **Knowledge-based research and Development of Scientific ideas**

Recording of the learning

Knowledge-based research will contain a heading and research relating to the topic they are learning about. This can be presented in any way necessary.

Who was Mary Anning and what did she discover?

Development of scientific ideas - all red areas to be taught in one piece

Name of Scientist

Type of scientist (astronomer, botanist, chemist, geneticist, marine biologist, microbiologist, physicist, computer scientist, psychologist, zoologist, forensic, educator)

Relevant images of discoveries and scientists

What happened before the discovery?

What discovery did they make?

How has this had an impact on lives today?

When did they make this discovery?

Timeline

Other relevant information about the scientist or their work

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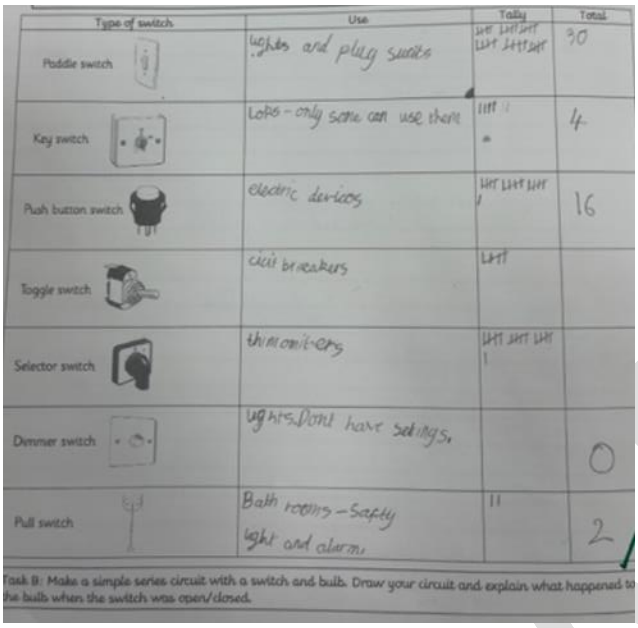
Examples of investigations **(knowledge based)**

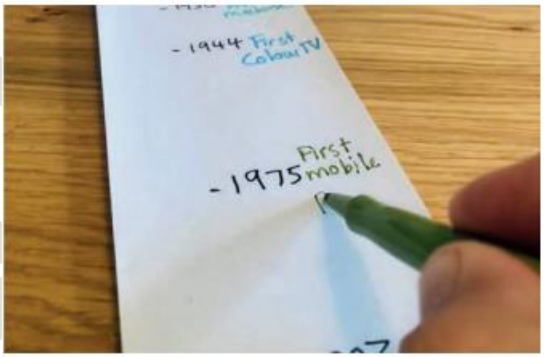
- What are all the different ways that seeds disperse?
- How have our ideas about forces changed over time?
- How do dentists fix broken teeth?

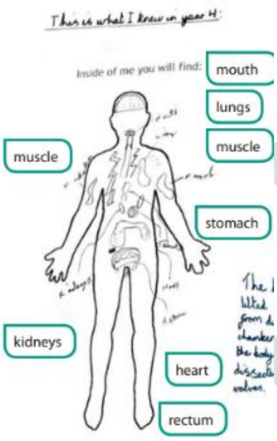
Exemplars



Type of switch	Use	Tally	Total
Paddle switch	lights and plug sockets	卌 卌 卌 卌 卌 卌	30
Key switch	Locks - only some can use them	||||	4
Push button switch	electric devices	卌 卌 卌 |	16
Toggle switch	circuit breakers	卌	
Selector switch	thermometers	卌 卌 卌 |	
Dimmer switch	lights. Dont have settings.		0
Pull switch	Bath rooms - Safety light and alarm.	||	2

Task B: Make a simple series circuit with a switch and bulb. Draw your circuit and explain what happened to the bulb when the switch was open/closed.





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Research using secondary sources UKS2

Guidance

Further guidance can be found here

As children become more skilled in carrying out **independent research**, they will learn to interpret the information they find and critically consider its relevance in answering their 'big questions'. Children will learn to use **a range of secondary sources**, including books, websites, and video, to find their information.

Where possible, children can listen to **presentations from experts and science professionals** to get their information, or ask them questions in interviews and letters.

It is even better if they start to **collect their own data** through **questionnaires and interviews**.

At this stage, children should also be encouraged to **evaluate** the quality of the information they have found and how well it has enabled them to draw conclusions.

There are two forms of research – **Knowledge-based research and Development of Scientific ideas**

Recording of the learning

Knowledge-based research will contain a heading and research relating to the topic they are learning about. This can be presented in any way necessary.

Who was Mary Anning and what did she discover?

Development of scientific ideas - all red areas to be taught in one piece

Name of Scientist

Type of scientist *(astronomer, botanist, chemist, geneticist, marine biologist, microbiologist, physicist, computer scientist, psychologist, zoologist, forensic, educator) – children to explain what this is*

Imagery

Other scientists involved

Before the discovery

Discovery made

After the discovery - Development of ideas

Impact on lives today

Timeline

Scientific skills *(what main skills were needed to complete this discovery?)*

Next steps for my research

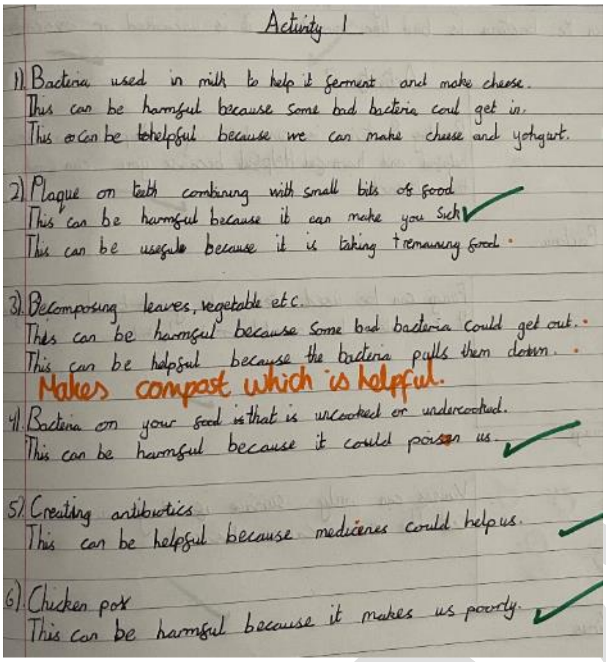
Level of importance *(evaluate the importance of this discovery)*

Other relevant information about the scientist or their work

Examples of investigations **(knowledge based)**

- What are the differences between the life cycle of an insect and a mammal?
- How have our ideas about the solar system changed over time?
- What do different types of microorganisms do? Are they always harmful?

Exemplars


Activity 1

1) Bacteria used in milk to help it ferment and make cheese.
This can be harmful because some bad bacteria could get in.
This can be helpful because we can make cheese and yoghurt.

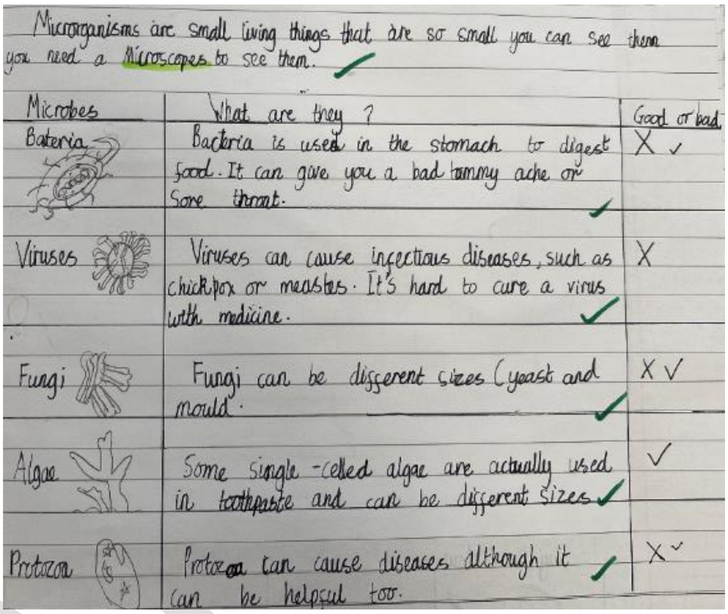
2) Plaque on teeth combining with small bits of food
This can be harmful because it can make you sick
This can be useful because it is taking remaining food.

3) Decomposing leaves, vegetable etc.
This can be harmful because some bad bacteria could get out.
This can be helpful because the bacteria pulls them down.
Makes compost which is helpful.

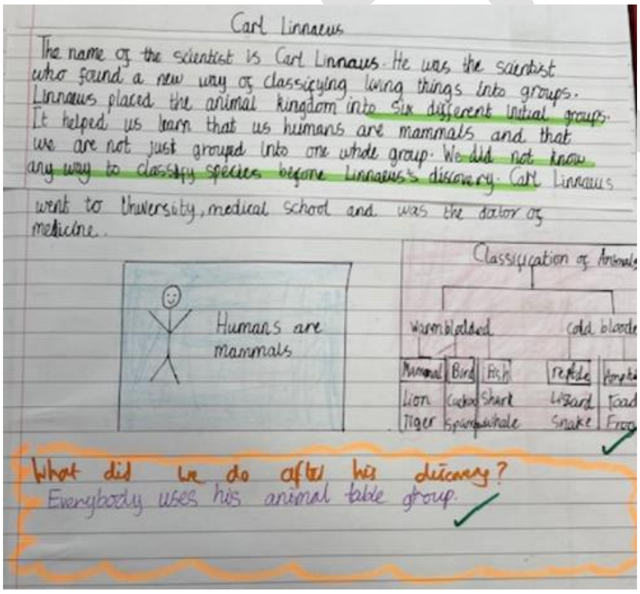
4) Bacteria on your food is that is uncooked or undercooked.
This can be harmful because it could poison us.

5) Creating antibiotics
This can be helpful because medicines could help us.

6) Chicken pox
This can be harmful because it makes us poorly.

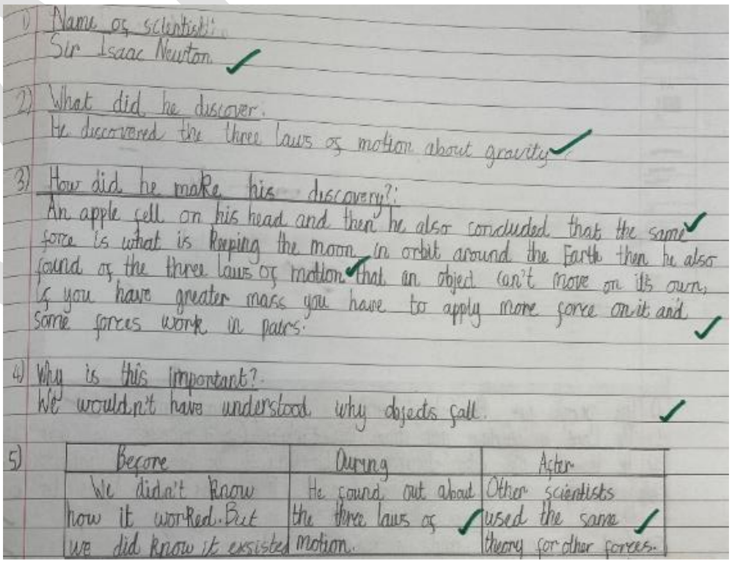

Microorganisms are small living things that are so small you can see them you need a Microscopes to see them.

Microbes	What are they?	Good or bad
Bateria	Bacteria is used in the stomach to digest food. It can give you a bad tummy ache or sore throat.	X ✓
Viruses	Viruses can cause infectious diseases, such as chickpox or measles. It's hard to cure a virus with medicine.	X
Fungi	Fungi can be different sizes (yeast and mould.	X ✓
Algae	Some single-celled algae are actually used in toothpaste and can be different sizes	✓
Protozoa	Protozoa can cause diseases although it can be helpful too.	X ✓


Carl Linnaeus

The name of the scientist is Carl Linnaeus. He was the scientist who found a new way of classifying living things into groups. Linnaeus placed the animal kingdom into six different initial groups. It helped us learn that us humans are mammals and that we are not just grouped into one whole group. We did not know any way to classify species before Linnaeus's discovery. Carl Linnaeus went to University, medical school and was the doctor of medicine.

What did he do after his discovery?
Everybody uses his animal table group.


1) Name of scientist:
Sir Isaac Newton

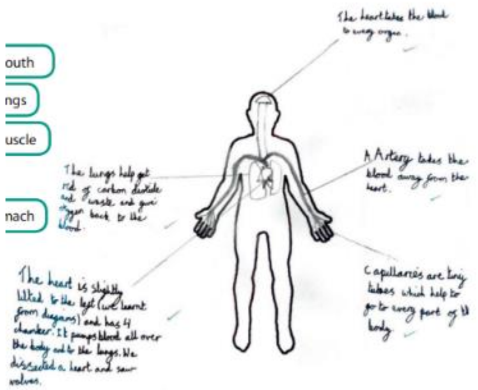
2) What did he discover?
He discovered the three laws of motion about gravity

3) How did he make his discovery?
An apple fell on his head and then he also concluded that the same force is what is keeping the moon in orbit around the Earth then he also found of the three laws of motion that an object can't move on its own, if you have greater mass you have to apply more force on it and some forces work in pairs.

4) Why is this important?
We wouldn't have understood why objects fall.

5)

Before	During	After
We didn't know how it worked. But we did know it exsisted	He found out about the three laws of motion.	Other scientists used the same theory for other forces.



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Research using secondary sources – Progression Write-up

Red text denotes non-negotiables Orange denotes optional areas *Italics indicates notes for the teacher*

KS1	Notes	LKS2	Notes	UKS2	Notes
Name of Scientist **Relevant images** **What are they famous for?** **When did they make this discovery?** **Key dates of discoveries or simple timeline**	*Image of scientist or discovery* *Useful if there were many progression points or advancements – this can be simple plotting of dates e.g. years*	**Name of Scientist** **Type of scientist** **Relevant images** **What happened before the discovery?** **What discovery did they make?** **How has this had an impact on lives today?** **When did they make this discovery?** **Timeline** **Other relevant information about the scientist or their work**	(astronomer, botanist, chemist, geneticist, marine biologist, microbiologist, physicist, computer scientist, psychologist, zoologist, forensic, educator) *E.g. before electricity what did we do?* *e.g. why is electricity so important?* *Key dates e.g. month and year if known* *Useful if there are multiple dates due to phased development*	**Name of Scientist** **Type of scientist** **Imagery** **Other scientists involved** **Before the discovery** **Discovery made** **After the discovery** **Impact on lives today** **Development of ideas Timeline** **Scientific skills** **Next steps for my research** **Level of importance** ***Other relevant information about the scientist or their work***	*astronomer, botanist, chemist, geneticist, marine biologist, microbiologist, physicist, computer scientist, psychologist, zoologist, forensic, educator –* ***children to explain what this is*** *E.g. before electricity what did we do?* *e.g. why is electricity so important?* *How have the ideas been developed since? Were any other famous scientists involved?* *what main skills were needed to complete this discovery?* *What could they research next? Why?* *evaluate the importance of this discovery – explain why*

Pattern Seeking
KS1

Guidance

Further guidance can be found here

In experiencing pattern-seeking enquiries, KS1 children will begin to look for patterns in their **measurements and observations**, and describe them both orally and in writing. They should also be **starting** to think about **cause and effect relationships**, and being encouraged to use appropriate vocabulary to discuss these.
KS1 learners will need more support with making decisions about what to observe or measure, but should still be challenged to make their own suggestions.

Pattern-seeking enquiries are a great opportunity for children to develop their measuring skills and look for different ways to record and analyse their data. In regularly practising this type of enquiry, children will make and record simple data values in KS1.
Year 1 and 2 children could be using **tally charts** to record, and then developing these into **pictograms to look for patterns**.
The data analysis that happens here provides a great opportunity for children to develop their conclusion writing; however, it also forms an ideal platform from which children can work on the development of predictions. In asking children to form predictions based on data from a pattern-seeking enquiry, the children can use the data they have collected to make those **connections**.

Recording of the learning – 1 subheading must be picked

Question

What I think *(prediction)*

Equipment

Observations *(just what the children can see – no reasons why)*

Results *(in the form of a table, tally)*

Pictogram or bar chart

Patterns and connections ***(connections – patterns they can see)***

Examples of investigations

- Does the wind always blow the same way?
- Is there a pattern in the types of materials that are used to make objects in a school?
- Which habitat do worms prefer – where can we find the most worms?
- Do magnetic materials always conduct electricity?

Exemplars

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Pattern Seeking
LKS2

<u>Guidance</u>

Further guidance can be found here

They should be thinking **cause and effect relationships**, and being encouraged to use appropriate vocabulary to discuss these. For pattern-seeking enquiries, KS2 children should be thinking for themselves when it comes to deciding what they should measure and observe, as well as making decisions about the most appropriate equipment to use to collect data. Whenever appropriate, KS2 pupils should be choosing to use a **data logger** to collect the most accurate data they can.

Children in KS2 should be using far more data analysis techniques to **spot patterns**, including using tabulated data and a **variety of charts and graphs.**
When describing the **relationships**, children should use data and **graphs to support their explanations.**
This type of enquiry works well as a preliminary test; so children can use their findings to form and justify their own predictions.

As they progress into KS2, children will be making measurements of quantities, such as length (cm), temperature (°C), volume (dB), and time (s), learning how to display this data accurately in tables, and then using bar charts to analyse their findings.
The data analysis that happens here provides a great opportunity for children to develop their conclusion writing. In asking children to form predictions based on data from a pattern-seeking enquiry, the children can use the data they have collected to justify their ideas for how things might be in a different but related situation, or even to generalise about how things might always be.

<u>Recording of the learning - 1 -2 subheadings must be picked</u>

Question

Prediction

Equipment *(children begin to select their own equipment)*

Observations *(just what the children can see – no reasons why)*

Results *(in the form of a table, tally **if your results weren't based on an observation table already**)*

Bar charts and graphs

Patterns and connections

Examples of investigations

- What colour flowers do pollinating insects prefer?
- What colour flowers do pollinating insects prefer?
- Are foods that are high in energy always high in sugar?
- Which room has the most electrical sockets in a house?

Exemplars

Pattern Seeking
UKS2

<u>Guidance</u> Further guidance can be found here

Measurements and observations are a key process within pattern seeking. KS2 children should be thinking for themselves when it comes to deciding what they should measure and observe, as well as making decisions about the most appropriate equipment to use to collect data.
Children in upper KS2 should be **challenged to think even more about their planning**, including **identifying the variables that they cannot control** and suggesting the potential impact those variables might have on the data they collect.
Whenever appropriate, KS2 pupils should be choosing to use a data logger to collect the most accurate data they can.
Children in KS2 should be using far more **data analysis techniques to spot patterns**, including using tabulated data and a **variety of charts and graphs**. When describing the **relationships**, children should **use data and graphs to support their explanations**.
Children can use their findings to form and justify their own predictions, going on to propose further investigations to test these predictions.

As they progress into KS2, children will be making measurements of quantities, such as length (cm), temperature (°C), volume (dB), and time (s), learning how to display this data accurately in tables, and then using bar charts to analyse their findings. By the time they get to upper KS2, children will be looking more carefully at the **accuracy of their measurements**, including measuring lengths to the nearest mm, or temperatures to the correct decimal place.

At this stage, children will be **selecting the most accurate measuring equipment** available and **repeating measurements to check the reliability** of their data. This will provide some great opportunities for children to regularly develop their skills in calculating the **mean, average and range of a data set**.
Upper KS2 learners will then go on to learn how to independently draw scatter graphs and line graphs of their data to help them describe the patterns they notice in a more quantitative way, again regularly practising mathematical skills.

<u>Recording of the learning - 2 subheadings must be picked</u>

Question

Hypothesis

Method – Variables *(pay particular attention to those that cannot be controlled – suggest what impact this will have on the data)*

Equipment *(children to select their own equipment)*

Observations *(just what the children can see – no reasons why)*

Results *(in the form of a table, tally – thinking about accuracy of measurements)* **Average/ mean/ range**

Relationships *(patterns and links)*

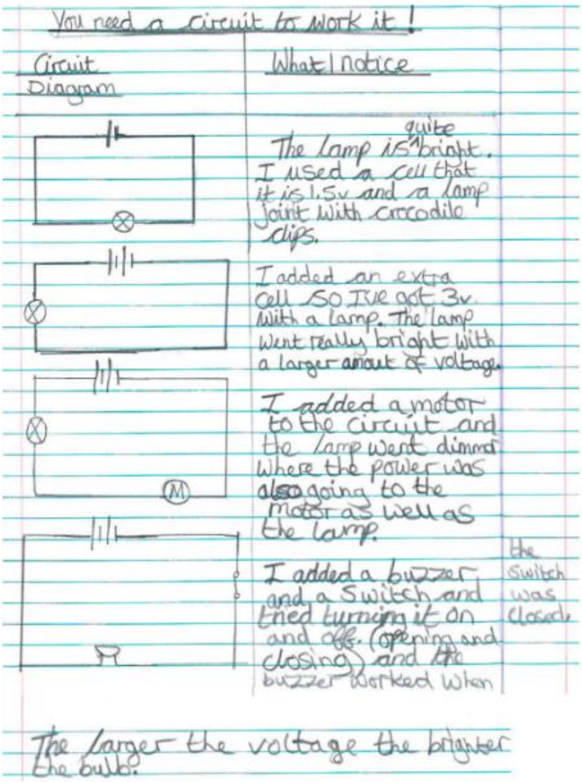
Graphs

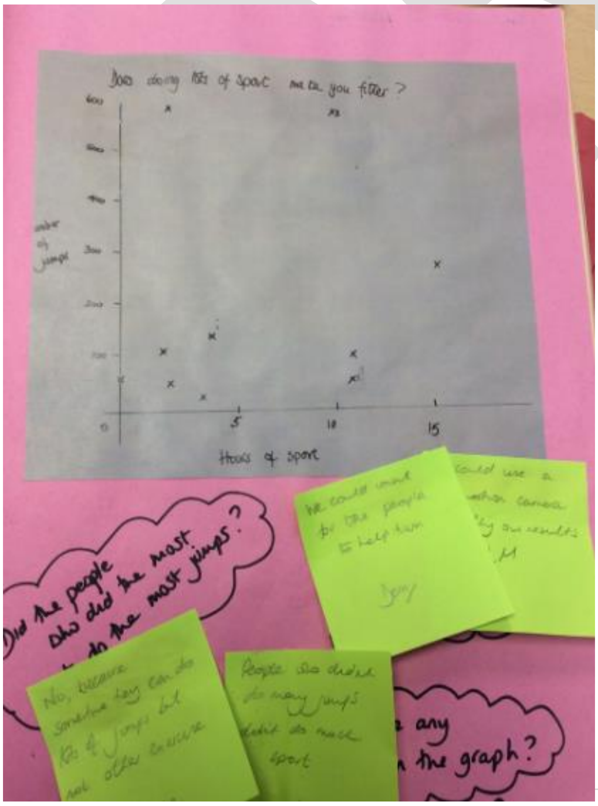
Further Investigations *(what could the children test for next)*

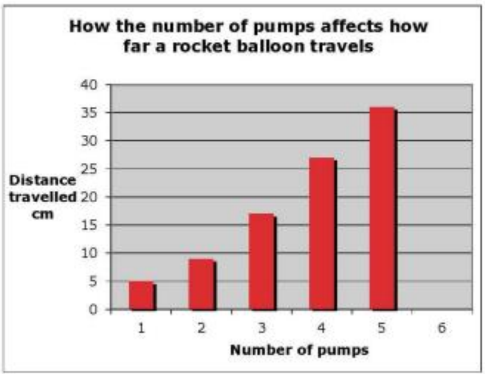
Examples of investigations

- Is there a relationship between a mammal's size and its gestation period?
- Is there a pattern between the size and shape of a bird's beak and the food it will eat?
- Is there a pattern to how bright it is in school over the day? And, if there is a pattern, is it the same in every classroom?

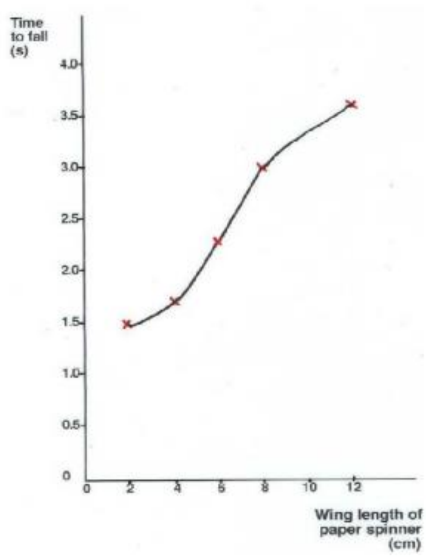
Exemplars







Comment: *more pumps send the rocket further.*



Comment: *spinners with longer wings take a longer time to fall*

Pattern Seeking – Progression Write-up

Red text denotes non-negotiables Orange denotes optional areas *Italics indicates notes for the teacher*

KS1	Notes	LKS2	Notes	UKS2	Notes
Question		**Question**		**Question**	
What I think	*Formerly a prediction*	**Prediction**		**Hypothesis**	
Equipment	*equipment may be given*	**Equipment**	*children begin to select their own equipment*	**Method – Variables Inc uncontrolled**	*pay particular attention to those variables that cannot be controlled – suggest what impact this will have on the data*
Observations	*just what the children can see – no reasons why* *start to include simple measurements or vocab e.g. small, taller, tallest*	**Observations**	*just what the children can see – no reasons why* ***include measurements***	**Equipment**	*children to select their own equipment – justifying why they have picked this – thinking about scale*
Results	*in the form of a table, tally*	**Results**	*in the form of a table, tally* ***if your results weren't based on an observation table already***	**Observations**	*just what the children can see – no reason why* ***include measurements***
Pictogram or bar chart		**Bar charts and graphs**	*use this to see clear patterns between the data collected Start to think about any that do not fit a pattern and why not*	**Results**	*in the form of a table, tally – thinking about accuracy of measurements* **Average/ mean/ range**
Patterns and connections		**Pattern and connections**	*A definitive answer about patterns or connections they can see*	**Relationships**	*patterns and links – similar to a conclusion*
				Graphs	
				Further Investigations	*what could the children test for next*

Working scientifically skills

Throughout this document, there is an emphasis on the scientific skills that children use. These should run through the curriculum at all ages. They are adapted accordingly to ensure children receive the correct vocabulary and develop these skills. These link to science capital and are essential skills they need to pursue a career in science.

<u>What are the scientific skills?</u>

Asking questions, predictions/hypothesises, planning, observation, measuring, recording, interpreting data and conclusions.

<u>How are they used in our school?</u>

The poster should be located on the working wall during a science lesson. This allows the children to visually see the symbols. They are being introduced into work whereby the teacher can refer to the symbol when talking about a specific section, to identify what skill is being focused on during that lesson. It is noted within practical investigations, it is most likely, all of the skills will be used. Within a lesson, the teacher will identify one or two skills to focus on to enhance the children's learning during that lesson. This may not be referred to directly in each lesson, but will be referenced where appropriate and continually developed across the curriculum.