



'Together we grow'

Emmaville Primary School

Science Policy

Science Co-ordinator: Kit Saddington

Rationale

Science is an important core subject in our school as it provides the foundations for understanding the world. Through building key knowledge, concepts and skills, pupils should be encouraged to develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to explain what is occurring through conceptual models and practical activities that progressively build a deep understanding of the science curriculum and 'Working Scientifically'.

Through the teaching of science we aim to encourage our children to develop inquisitive and enquiring minds through the use of scientific investigations. We want the children to understand how science has changed our lives and is vital to the world's future prosperity. We aim to develop 'Science Capital' within the school - the measure of the school's engagement with science; how much we value it and how much it connects to our lives. This in turn supports our 'STEM Capital', and how our children will engage with, and aspire to careers within, Science, Technology, Engineering and Maths as they grow older. This, of course, directly helps to build our 'Cultural Capital', giving our children the greatest possible knowledge, experiences and aspirations within the world around them.

Children will study a number of different scientific topics; science will often take them outdoors into the local environment where they will be able to develop and practice investigational and observational skills. They will record and interpret findings and form and test hypotheses. Emmaville's Science Curriculum is built on National Curriculum coverage, and throughout their time at our school, pupils will acquire knowledge and understanding of the world around them.

Aims and Objectives - Intent

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

- develop scientific knowledge and conceptual understanding of science
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them

- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future

At Emmaville Primary School, our aim is to enthuse, develop and challenge pupils through an engaging and progressively structured science curriculum and teaching approaches where pupils:

- Develop lively and enquiring minds through their ability to question and argue rationally and to apply themselves to tasks
- Attain competency and confidence in science that will enable them to contribute to our local and global communities
- Acquire the knowledge and skills relevant to subsequent stages in their education, adult life and employment

Approaches to learning - Implementation

At Emmaville, teachers provide balance in teaching approaches, and the planned sequence of work throughout the school encourages pupils to use prior knowledge when approaching new work. The National Curriculum for Science is used as a framework for science content, skills and pupil expectations at our school. To support our key principles, we will deliver this curriculum through:

- A skills-focussed approach to teaching that ensures an appropriate and flexible challenge within the classroom. This approach is called '**dual objective planning**' in which the key scientific skills are taught alongside the contextual content of lessons. The Science National Curriculum states that "*Working and thinking scientifically ... must always be taught through the substantive science content*". This is supported by the explicit use of dual objective planning.
- Conceptual threads called 'science models' that link topics and support progressively deeper learning. There are four science models that span the curriculum: Energy Transfer, Force Arrows, Particles and 'Big Picture' models (Advanced Organisers). These models are key to the children's understanding, and using them to develop links between science topics will help them to better make sense of the world around them. Being able to explain what they observe and experience via the scientific models is the basis for deeper understanding and further enquiry.
- Five key science skills that support both knowledge / conceptual development and Working Scientifically to match pupil performance to national Key Stage expectations -
 - Explaining Science (the language, information and key scientific models used to explain ideas and thinking in science)
 - Classification (the sorting, grouping and categorising of the world around us, in order to make links in our scientific thinking)
 - Designing experiments (the skills needed in order to make predictions, select equipment and design suitable ways to test our ideas)

- Data, Table & Graphs (making sense of our observations through organising data in tables and graphs)
- Making Conclusions (the ability to see patterns and use them to describe and explain what have observed, and suggest ways to improve)

(See Appendices 1-4)

The children will be able to work independently, in mixed ability pairs, and in groups, allowing all children access to the curriculum. A variety of teaching methods best suited to activities and interests of the pupils will be used, including teacher demonstrations, whole-class/group/paired discussions, role-play activities, video clips and animations, focused investigations and experiments, close observations and many practical experiences.

- **At Foundation Stage**, children engage in active learning experiences to ensure that they develop skills and knowledge that will later be useful in the study of Science.
- **At Key Stage 1**, pupils observe, explore and ask questions about living things, materials and physical phenomena. They begin to work together to collect evidence to help them answer questions and to link this to simple scientific ideas. They begin to evaluate evidence and consider whether tests or comparisons are fair. They use reference materials to find out more about scientific ideas. They share ideas and communicate them using scientific language, drawings, charts and tables with the help of ICT if it is appropriate.
- **At Key Stage 2**, pupils learn about a wider range of living things, materials and physical phenomena. They make links between ideas and explain things using simple models and theories. They apply their knowledge and understanding of scientific ideas to familiar phenomena, everyday things and their personal health. They think about the effects of scientific and technological developments on the environment and in other contexts. They carry out more systematic investigations, working on their own and with others. They use a range of reference sources in their work. They talk about their work and its significance, using a wide range of scientific language, conventional diagrams, charts, graphs and ICT to communicate their ideas.

Science Across the Curriculum

- English - the skill of Explaining Science links very closely to English curriculum: speaking and listening to learn, discuss and explain; reading scientific information and vocabulary; writing coherently and with confidence to describe, predict and explain
- Mathematics - observations within science lessons often result in the collection of data, and the formulation of graphs and charts
- Computing - data logging and graphing programmes are used from the creation of simple pictograms to more complex scatter graphs. In upper KS2, knowledge of circuits and control is extended with the use of Raspberry Pi units

- Foundation subjects - History is integral to understanding how our scientific perception has changed in many topics, including Forces, Micro-organisms and the Solar System. It also underpins the work done by pioneering scientists, such as Isaac Newton and Jane Goodall. Geography is supported by science in many ways too - the water cycle, rocks and soil, comparing habitats in different locations, etc. Art has links via the exploration of light, colour and shadows, while Technology draws from scientific understanding of electricity and materials, and Music has close links to our understanding of sound.

Assessment - Impact

Science assessment is on-going and formative. It happens in the classroom as part of the normal teaching process. It informs lesson pitch, differentiated intervention and future planning. The key document to support this process is the Science Assessment Boards which provide criteria matched to year group expectation (see Appendices 1-4).

Topic based oral/activity/classwork/homework are used to inform on science knowledge and areas of individual/group misconception. Marking should comply with the school policy and should include:

- 'short-term' topic-specific comments to correct misconceptions/errors and to drive progress within that topic. Work should then show short-term improved knowledge and accuracy within that topic.
- 'long-term' skill-specific comments to match work to skill criteria (see Assessment Board) and to drive progress between topics. Work should then show improved skill/model development, matched to expectations, over time. Progress will be recorded using 'Science Rockets' (see Appendix 5).

The Role of the Co-ordinator

- To take the lead in curriculum development in consultation with the headteacher, staff and governors;
- To monitor the teaching of Science in the school, ensuring that there is sufficient coverage and progress in the subject;
- To lead curriculum meetings;
- To attend Science network meetings and relevant courses, including links with cluster schools, to improve science provision;
- To support staff by providing information, training and advice;

- To ensure that there are appropriate resources to support the Science curriculum via regular audits and requisitions.
- To liaise with the school's link governor (Jonathan Lancashire - Parent Governor) as and when appropriate

Date policy reviewed: September 2022

Review Date: December 2023

Primary Science Assessment Board	Knowledge & Understanding			Working Scientifically				
	Explaining Science	Classification		Designing Experiments	Data, Tables & Graphs	Making Conclusions		
	EYFS -----> KS1 -----> Secure		LKS2 -----> Secure		UKS2 -----> Secure ----->			
	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+
Explaining Science	I remember simple facts about science with help	I remember some simple facts about science	I remember relevant science facts with some confidence	I use science ideas & facts to describe & explain	I show a developing K&U of science ideas & concepts	I show a clear K&U of science ideas & concepts	I show a secure K&U across all KS2 topics (facts & concepts)	I show a deeper 'mastery' of K&U across KS2
	I use science words during an activity with help	I use & remember relevant science words during activity	I use & remember science words over time (short term)	I remember science words I have used before (longer term)	I use simple science words correctly (meaning; apply)	I begin to use complex science words correctly	I use complex science words correctly (fluency)	I use complex science words accurately & fluently
	I describe what is happening using words & actions	I describe what is happening using science with help	I use science to describe / recall what I have seen	I begin to use science models to describe (sequence)	I use science models to describe (what, where)	I use science models to describe & begin to explain (why, how)	I use science models to describe & explain (why, how, logical)	I begin to apply science models to explain new events
	I use appropriate pictures & words to label items	I add science word labels (help) to diagrams	I add science labels & information (help) to diagrams	I add science labels & information to diagrams	I annotate diagrams to help describe & explain	I begin to draw & annotate my own diagrams	I draw & annotate my own diagrams to describe & explain	I draw & annotate my own diagrams (flow; complex)
	I begin to select facts to use in an answer with help	I select science facts to use in an answer with help	I select relevant science facts to use in an answer	I link relevant facts together in an answer	I 'cluster' related facts together into points (recalled)	I select & prioritise facts to create an argument/answer	I present a clear & logical argument / answer	I present an extended & logical argument / answer
Classification	I sort using instructions or pictures	I sort by using simple yes/no statements	I use simple spider keys with obvious differences	I use large spider keys with obvious differences	I use a range of spider keys with fine differences	I construct spider & use number keys	I construct both spider & number keys	I construct both spider & number keys (complex)
	I group by familiar features (size, colour, shape, etc)	I group by difference or similarity	I group by difference, similarity or change	I create groups for sorting (create criteria)	I create appropriate groups for sorting (create criteria)	I group & sub-group by easily observation (create criteria)	I group & sub-group by fine observation (create criteria)	I group & re-group using combinations of criteria
	I use my senses to identify properties of materials	I link properties of materials to an application (help)	I link properties of materials to an application	I combine properties required for an application (help)	I describe combined properties required for an application	I explain how properties suit an application	I explain the science behind a range of properties	I describe how material properties can change

	EYFS → KS1 → Secure			LKS2 → Secure		UKS2 → Secure →		
	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+
Prediction	Observed Variables Categoric Data (words) - Charts				Design	Measured Variables Continuous Data (numbers) - Graphs		
	I suggest what might be the 'best' or 'worst'	I suggest what might happen with help	I suggest what might happen in my investigation	I predict cause & effect (causal prediction)	I predict a trend (relationship prediction)	I use K&U to explain my prediction (relationship)	I reason K&U to make a hypothesis (relationship)	I reason K&U to generate a testable hypothesis
Equipment	I use a range of everyday items to investigate	I use a limited range of science equipment correctly (help)	I use a range of science equipment correctly	I select suitable equipment for the task	I select & use suitable equipment for the task	I select equipment with the right scale for the task (help)	I select & use equipment with right scale for the task	I select & use equipment for increased precision
	I work safely when given instructions (some supervision)	I notice risk (help) & can list some common dangers	I notice risk in my investigation & know common dangers	I predict obvious risk & act on safety suggestions	I predict obvious risk & work safely (mostly)	I begin to plan to minimise risk & work safely (consistently)	I plan to minimise risk & describe safe use of equipment	I predict & control a range of risks independently
Design	I suggest an idea to investigate with help	I suggest an idea to investigate & ask questions	I suggest an idea to investigate from observations	I identify cause & effect in my investigation	I plan a fair test by selecting variables to change & measure	I plan a fair test & ensure controlled variables kept same	I plan a reliable fair test (use of variable terminology)	I plan a reliable fair test with increased precision
	I'm aware that factors change in an investigation	I begin to identify variables in an investigation	I identify variables in investigations (label & describe)	I suggest a suitable data range for a variable	I suggest a data range & interval for a variable	I suggest a data range, interval & sufficient readings	I plan to collect repeat readings (>3) & calculate mean	I plan to reduce error by care of measurement
	I follow short demo & spoken instructions (help)	I follow short demo, spoken & picture instructions	I follow short spoken & written instructions in order	I follow written instructions & write a simple method	I design & write a simple ordered method (from plan)	I design & write an ordered method (controls variables)	I design & write an ordered reliable method (repeats)	I design & write a reliable method (repeats; precision)

Exploring:
Ideas are tried out to see what happens.
Can lead to further investigation

Identification & classification:
Sorting into groups

Observing & measuring over time:
Over short (seconds / minutes) or long (days / months) periods of time

Surveys:
Counts or measurements by category

Fair testing:
One variable changed; others are kept the same. Cause & effect

Comparative testing:
Fair test comparing categories / conditions

Use the **Design Board** to develop the experimental thinking process

Appendix 3 – Dual Objectives Board: Making Conclusions

	EYFS → KS1 → Secure			LKS2 → Secure		UKS2 → Secure →		
	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+
Patterns	I recognise, create & describe simple patterns (e.g. size)	I recognise, create & describe simple number patterns	I describe simple features & patterns in data & charts	I describe simple patterns in data, charts & graphs	I describe simple patterns, trends & relationships in data	I describe patterns, trends & relationships in data	I describe changing patterns, trends & relationships	I compare changing patterns, trends & relationships
	I begin to use 'more or less', etc to compare observation	I use 'more or less' to compare numbers	I see obvious differences in sets of numbers	I see subtle differences in sets of numbers	I see differences (error) in repeated data	I spot anomalous data that doesn't fit the pattern	I spot anomalous data & explain from the method	I deal with anomalous data to increase reliability
Conclusions	I talk about changes that I observe during activities	I describe the changes that are happening	I describe the changes that have happened	I describe my results by linking cause & effect	I describe trends & begin to use science to explain	I use data in my conclusions & use science to explain	I use 1°/2° data & science ideas in my conclusions	I use a range of data in conclusions & models to explain
	I explore 'what if ..' questions through play	I explore different ways to do things through play	I suggest a different way to do things with help	I suggest improvements to my method	I suggest sensible improvements to my method	I identify strengths & weaknesses & improvements	I suggest limitations (data) & practical improvements	I suggest limitations (use data) & justify improvements

Working Scientifically – word lists

KS1

- Axis** = reference line drawn on a graph to show the range of data for each variable (shows values)
- Block chart** = visual tool to show data/counts as bars built up by adding component blocks. Used to compare data visually
- Cause** = the variable we chose to change in an investigation
- Data** = a measured or counted outcome for a variable (numbers)
- Effect** = the variable that changes when we change the cause
- Experiment** = investigation that looks for a link between variables (fair or comparative test)
- Observation** = sensed outcome for a variable (described in words)
- Pictogram** = chart that uses pictures to represent data
- Prediction** = suggests what might happen based upon prior knowledge or experience (not a guess)
- Results table** = way of presenting data from an investigation
- Risk** = dangers when doing an investigation, using equipment or working in an area
- Standard units** = a quantity of a variable that is used as a standard measure (e.g. litre, meter, gram, etc)
- Variable** = a factor that can change

LKS2 (plus KS1)

- Bar chart/graph** = visual tool that uses bars to compare discrete data
- Comparative test** = fair test comparing discrete differences
- Conclusion** = the answer you give to a question (based upon data)
- Continuous data** = values are numbers (result from counting/measuring)
- Coordinate** = used to plot data (x/y) on a graph
- Data interval** = numerical gap between data points for a variable
- Data point** = a coordinate for a variable
- Data range** = maximum & minimum values for a variable
- Discrete data** = values are distinct/separate (e.g. male/female; counts)
- Fair test** = an investigation where only one variable is changed (cause); all others are kept the same and at their best value
- Line graph** = visual tool that shows a relationship trend between two continuous variables (it is essentially a scatter graph)
- Method** = ordered sequence of steps taken during an investigation. It can be written or in diagram form
- Prediction (correlation/relationship)** = describes the expected trend for two variables (cause & effect) that are linked
- Prediction (scientific/causal)** = suggestion as to what might happen based upon prior knowledge, experience or observation. Links the cause with the predicted effect. Does not have to describe the trend
- Spider key** = branching classification key where each branch has a yes/no choice (dichotomous key) leading to further choices
- Trend** = the outcome when two variables (cause & effect) are linked

UKS2 (plus KS1/LKS2)

- Anomalous data** = data that does not fit a pattern
- Controlled variable** = variables kept at the same value so they do not influence the dependent variable in a fair test

Making Conclusions

- Data set** = vales for repeated data
- Data spread** = variation of the data away from a mean (often due to imprecise measuring or when the controlled variable have not been kept the same)
- Dependent variable** = changed (effect) as a result of changing another. This is observed or measured and demonstrates a relationship in a fair test
- Hypothesis** = a reasoned prediction based upon theory, experience or direct observation
- Independent variable** = chosen variable (cause) changed in a fair test.
- Mean** = 'average' value from a data set
- Number key** = classification key that is a written, condensed version of a spider key
- Precision** = how similar your repeated data is (good technique & equipment choice)
- Primary data** = your experimental data or observations from an investigation
- Reliability** = if your data can be repeated (i.e. no error). Can be improved through collecting repeated values and calculating a mean
- Results table (complex)** = Table that contains multiple columns to show repeated data, calculations or a variety of features of a variable
- Risk assessment** = formal assessment of risk leading to improved safety recommendations or change in practice
- Secondary data** = researched data or observations. It can also be data gathered from others doing a similar experiment. Used to compare/support
- Trend line** = line drawn roughly between coordinates to show the trend (does not have to go through all data points)
- Valid data** = reliable, accurate & no bias or error (we are measuring what is expected)

EYFS			KS1			LKS2			UKS2		
Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+	Year 5	Year 6	Year 6+	
Data	I can position numbers on a number track up to 20	I can position numbers on a number track up to 100	I measure labelled divisions on a number line (inc. in steps)	I measure unlabelled divisions on a number line (+ve values)	I measure unmarked divisions on a number line (+ve values)	I measure divisions on a number line past zero (-ve values)	I scale up/down a number line (axis) & decide on limits	I scale up/down a number line (axis) confidently			
Tables	I use non-standard units to measure & compare	I measure in non-standard & compare e.g. heavier/lighter	I measure standard units (inc. length, mass, capacity)	I measure/compare values in standard units	I measure/convert values in standard units (inc. time)	I measure/convert values in standard units (inc. area)	I measure/calculate with standard units (inc. area & volume)	I calculate compound units (e.g. acceleration)			
Graphs	I use a simple table by recording in pictures & words	I use a simple table by recording in words and numbers	I use a simple table recording in words & numbers (inc. tally)	I use a frame to construct a simple table of results	I construct a simple table to compare cause & effect	I use a frame to construct a complex table of results	I construct a complex table to show repeated data	I construct complex tables to include calculations			
Graphs	I use prepared pictograms to record my observations	I use a frame to add to pictograms & block charts	I construct simple pictograms & block charts	I use a frame to construct a bar chart (help)	I construct bar charts correctly (inc. numerical axis)	I use a frame to construct a graph & can scale axes (help)	I construct graphs & can scale at least one axis independently	I construct graphs & can scale each axis confidently			
Graphs	I add to pictograms by counting up	I add to block charts by counting up	I use the scale on a block chart to add the correct blocks	I draw bars on a bar chart (one axis coordinate)	I plot coordinates on a graph in the first quadrant	I join plotted coordinates with straight lines	I plot mean values & draw a trend line for linear data	I plot mean values & draw a trend line for non-linear data			

Name

Science Rockets



Explaining Science

Classification

Designing Experiments

Data, Tables & Graphs

Making Conclusions

The graphic consists of five large, vertically oriented ovals, each representing a science skill. To the left of each oval are three stars indicating achievement levels: three stars (***) at the top, two stars (**), and one star (*). Below each oval is a set of three colored shapes: a trapezoid, a rectangle, and another trapezoid. The colors for the five ovals are yellow, orange, pink, green, and blue, respectively. The shapes are positioned at the bottom of each oval, suggesting a rocket's base or a level of progress.