Progression in Scientific Enquiry

Early Years	KS1	LKS2	UKS2
Characteristics of Effective Leaning • Show curiosity about objects, events and people • Engage in open-ended activity • Take a risk, engage in new experiences and learn by trial and error • Find ways to solve problems / find new ways to do things / test their ideas • Develop ideas of grouping, sequences, cause and effect • Use senses to explore the world around them • Make links and notice patterns in their experience **Understanding the World** • Know about similarities and differences in relation to places, objects, materials and living things • Make observations of animals and plants and explain why some things occur, and talk about changes • Comments and asks questions about aspects of their familiar world such as the place where they live or the natural world **PSE/SCSA** • Choose the resources they need for their chosen activities **Communication and Language** • Develop their own narratives and explanations by connecting ideas or events • Answer how and why questions about their experiences	• 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.	• 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.	• 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.

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 sider 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

STEM Learning Solutions Ltd

Explaining Science

Classification

	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

STEM Learning Solutions Ltd

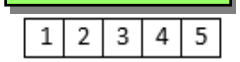
Designing Experiments

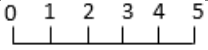
a

EYFS ⟶ KS1 ⟶ Secure			LKS2 ⟶ Secure		UKS2 ⟶ Secure ⟶		
Reception	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 6+**

Data

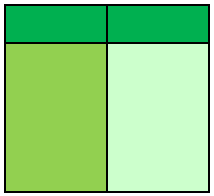
Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+
I can position numbers on a number track up to 20	I can position numbers on a number track up to 100	I measure **labelled** divisions on a number line (inc. in steps)	I measure unlabelled divisions on a number line (+ve values)	I measure **unmarked** 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
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)

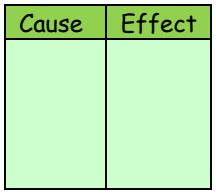


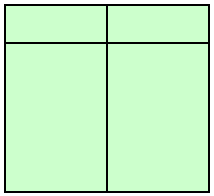


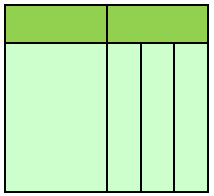
Tables

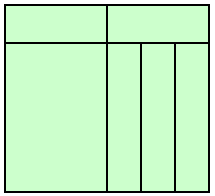
Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+
I use a simple table by recording in pictures & words	I use a simple table by recording in words and numbers	I **use** a simple table recording in words & numbers (inc. tally)	I use a frame to construct a simple table of results	I **construct** 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





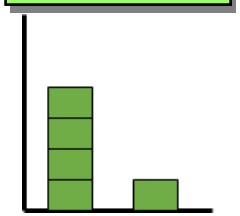


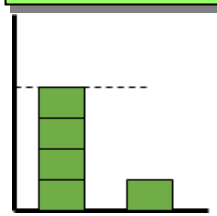


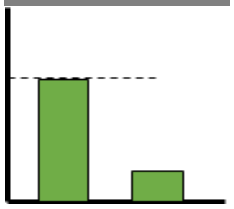


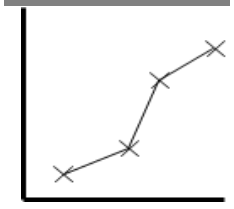
Graphs

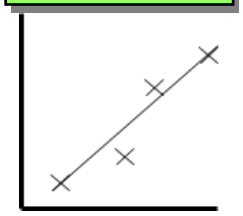
Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 6+
I use prepared pictograms to record my observations	I use a frame to add to pictograms & block charts	**I construct** simple pictograms & **block charts**	I use a frame to construct a bar chart (help)	I **construct bar charts** correctly (inc. 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
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











STEM Learning Solutions Ltd

Data, Tables & Graphs

	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 toll 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)

STEM Learning Solutions Ltd