- 1. What is science?
- Science is about finding explanations for why things happen or what makes things work.
- An **explanation** is not a guess, there has be some basis for it.
- Careful **observation**, including **measurement** where possible, can suggest what may be happening.
- In some cases it is possible to make a change and observe what happens.

4. Repeats, repeatable and reproducible

- Repeating an experiment enables us to calculate an average and shows the experiment is repeatable. A measurement is repeatable if the same scientist uses the same method and gets the same result.
- What people expect to happen can influence what they observe. It is good for the same experiment to be **repeated** by a different person. If they get the same result then the measurement is **reproducible**.

6. Graphs

value.

- Data can be displayed in a graph to help identify **trends** or **correlations**.
- Data points should be marked with a **cross.** The plotted points should **fill at least half the paper**.
- Axes should be labelled with the variable and the unit.
- The **line of best fit** can ignore **anomalous data** and can form a **curve**, not just a straight line.

- 2. Hypothesis and prediction
- A **hypothesis** is a possible **explanation** or reason for why something happens.
- A **prediction** is what a scientist thinks will happen if **the independent variable** in an experiment is changed.



3. Variables

- The **independent variable** is the variable the scientist changes to observe what happens.
- The **dependent variable** is the one which is measured to see if changing the independent variable had an effect.
- The **control variables** are kept constant so that the result can only be the effect of changing the independent variable.

5. Recording data

• Data should be recorded during any practical work; this is normally in a table. Tables should have:

KS3 Spine

Scientific method

- Clear headings with units
- Independent variable in the first column
- $\circ~$ No units in the body of the table
- $\circ~$ Consistent number of decimal places

8. Conclusion and evaluation

- A conclusion contains a description and explanation of any trends or patterns in the data. It also looks back at the hypothesis and related prediction to see if they were correct.
- An evaluation looks at the data to see how precise or accurate it is. It identifies any anomalous data and identifies sources of error in the method.

7. Averages and decimal places
Calculating an average in science usually involves finding the mean, but can also include the mode or median

- When calculating a mean, make sure the answer never has more **decimal places** than any of the data values you used.
- When rounding up, use the **deciding digit** to decide whether to round up or down.

Science KS3 Scientific method

Glossary:

- Accurate Close to the real value.
- Anomalous Something which does not fit the trend or pattern.
- Control variable Variable which is kept the same to ensure a 'fair test'.
- Correlation Relationship between two variables.
- Decimal places number of digits after the decimal point.
- Dependent variable Variable which is monitored or measured.
- **Digit** number.
- Explanation Reason why something happens.
- Hypothesis An idea or explanation which is tested.
- Independent variable Variable which is changed.

Line of best fit

Passes through as many points as possible, roughly equal number of points end up on each side.

Mean

Add them all together and divide by how many values you have.

Median

Put the data in numerical order, then choose the middle one.

Mode

Most frequently occurring value

- Precise Repeats are close together.
- Prediction What you think will happen if the independent variable in an experiment is changed.
- Repeatable Method repeated by the same scientist to produce same results.
- Reproducible Repeated by a different scientist to get the same results.
- **Trend** Pattern in the data.

Extension: use flash cards or mind

maps to revise key words above.

Activities

 Look at the dartboard below. The shots were precise but not accurate. Explain why.



A student carried out an experiment to investigate the effect of temperature on the speed of a reaction. They put their data into a results table.

Time seconds	repeat	average	Temperature
130	129	129.5	15°C
196	194	195	10°C
39	37	38	35°C
21	19	20	45°C
7	7	7	60°C
290	289	289.5	5°C

- a) What feedback would you give the student to improve their table?
- Draw a better version of the results b) table.
- State the trend in the data. c)
- d) Plot a graph of the data.
- Look at the following data:

5, 7, 3, 6, 11, 6, 7, 7

- a) Find the **mean** of the data
- b) Find the **mode** of the data
- Find the **median** of the data. c)



- A scientist noticed that tomato plants in the sun produced larger tomatoes than tomato plants grown in the shade.
 - a) Write a prediction for an experiment to investigate the effect of light on the growth of tomatoes.
 - b) Identify the independent and dependent variables.
 - c) What control variables might you need to consider?

QUICK QUESTIONS:

- 1. What is the difference between repeatable and reproducible?
- 2. What is the difference between mean, mode and median?
- 3. What does the term 'anomalous' mean?
- State the rules for drawing a results table. 4.
- State the rules for plotting a graph.
- State the three types of variable. 6.
- What is an evaluation?





Science KS3 Scientific theories and models

Glossary:

Conference

Meeting of people to discuss a shared interest. Usually has presentations to large numbers of people.

- **Directly proportional** When x is doubled y is doubled.
- **Explanation** Reason why something happens.
- Hypothesis An idea or explanation which is tested
- Inversely proportional When x is doubled y is halved.
- Journal An official magazine where the articles have been peer reviewed before publishing.
- Linear relationship
 Forms a straight line on a graph y = mx
 + c
- Mathematical Formula Mathematical relationship between variables.
- Model Method of explaining an idea.

Observation

- Something that is seen or observed.
- Peer review Evaluation of work by experts.
- Physical model Model which can be touched.
- Prediction
 What you think will happen if the independent variable in an experiment is changed
- Theoretical model Model which cannot be touched.
- Theory
 Explanation based on facts that have
 been repeatedly confirmed through

observation and experiment.

Trend

Overall pattern in the data e.g. 'As the *independent variable* is increased the *dependent variable* decreases.'

Activities

- The model of the atom has changed over time. The following scientists have contributed science which has caused changes to the model. For each scientist, research the discovery they made and how the model changed from John Dalton's solid sphere model.
 - a) J.J. Thomson
 - b) Ernest Rutherford
 - c) Neils Bohr
 - d) Erwin Scrödinger.
- The particle model is used to help explain the states of matter. The particles are all represented as solid spheres. Evaluate this model.
- The word 'theory' has a different meaning in everyday life.
 - a) Explain what is meant by 'a scientific theory'.
 - Explain how the meaning of the word 'theory' is different in every day life.
 - c) Why do you think the two different meanings cause confusion when scientists are talking about their work?
- Why is it important for scientists to discuss and publish their work in journals and at conferences?



- What do you think the term non-linear means? Explain your answer.
- Look at the following graph:



Distance / m

What trend does the data show?

- a) Is the relationship linear or nonlinear? Explain your answer.
- b) Is the relationship proportional? Explain your answer.

QUICK QUESTIONS:

- 1. What is a scientific theory?
- 2. What is a hypothesis?
- 3. What happens to scientific papers before they are published in a scientific journal?
- 4. What happens to a model when new evidence emerges?
- 5. What is the difference between inversely proportional and directly proportional?



Extension: use flash cards or mind maps to revise key words above.