Chapter 1

Introduction to Physical Science

Skills Scientists Use

- Science is the study of the natural world. Scientists use the skills of observing, inferring and predicting to learn more about the natural world.
- Observing means using one or more senses to gather information.
- Inferring is when you explain your observations.
- Predicting means making a forecast of what will happen in the future based on the past experience or evidence.

The Study of Matter and Energy

- Physical science is the study of matter, energy, and the changes they undergo.

- Branches of Physical Science
- Chemistry is the study of the properties of matter and how matter changes.
- Physics is the study of matter, energy, motion, and forces and how they interact.

Scientific Inquiry

- Scientific inquiry refers to the different ways scientists study the natural world.
- The process that scientists use in inquiry include posing questions, developing hypotheses, designing experiments, collecting and interpreting data, drawing conclusions, and communicating ideas and results.

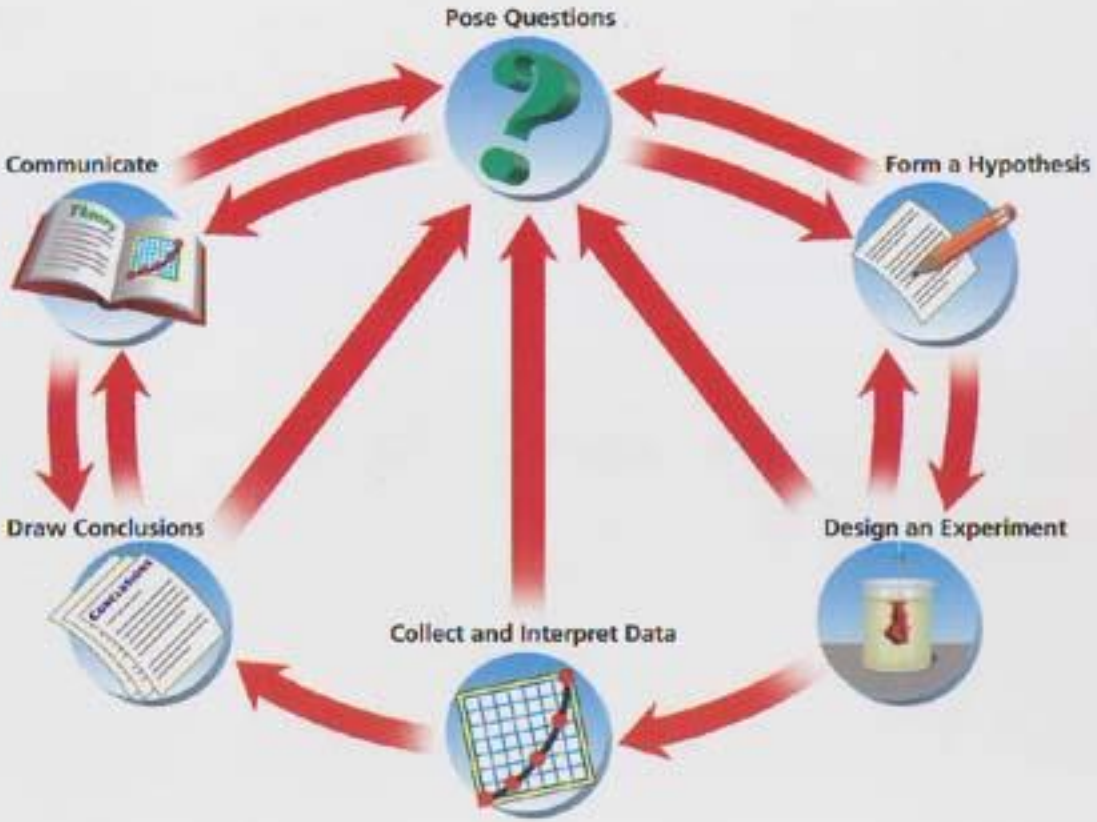
The Process of Inquiry

- Posing questions
  - A hypothesis is a possible answer to a scientific question or explanation for a set of observations.
- Designing an experiment
  - A parameter is a factor that can be measured in an experiment.
  - In a well-designed experiment, only one variable parameter is purposely changed: the manipulated variable. The variable parameter that is expected to change because of the manipulated variable is the responding variable.

The Process of Inquiry Continued!

- An investigation in which only one parameter is manipulated at a time is called a controlled experiment.

8.4 The Nature of Inquiry



The Process of Inquiry Continued!

- Collecting and Interpreting Data
  - Data are facts, figures, and other evidence gathered through observations.
  - A conclusion states whether or not the data supports the hypothesis.
  - Communication is sharing ideas and conclusions with others through writing and speaking.

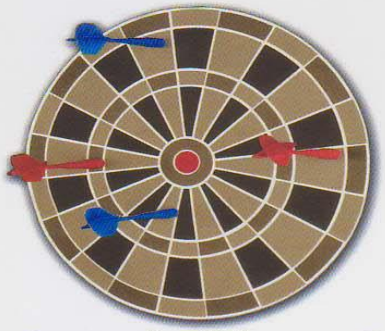
How Science Develops

- Scientists use models and develop theories and laws to increase people's understanding of the natural world.
- A model is a picture, diagram, computer image, or other representation of an object or process.
- A scientific theory is a well-tested explanation for a wide range of observations or experimental results.
- A scientific law is a statement that describes what scientists expect to happen every time under a particular set of conditions.

Mathematics and Science

- An estimate is an approximation of a number based on reasonable assumptions.
- Scientists must sometimes rely on estimates when they cannot obtain exact numbers.
- Accuracy refers to how close a measurement is to the true or actual value.
- Reproducibility refers to how close a group of measurements are to each other.
- Scientists aim for both accuracy and reproducibility in their measurements.

8.8 Accuracy and Reproducibility



Neither Reproducible nor Accurate

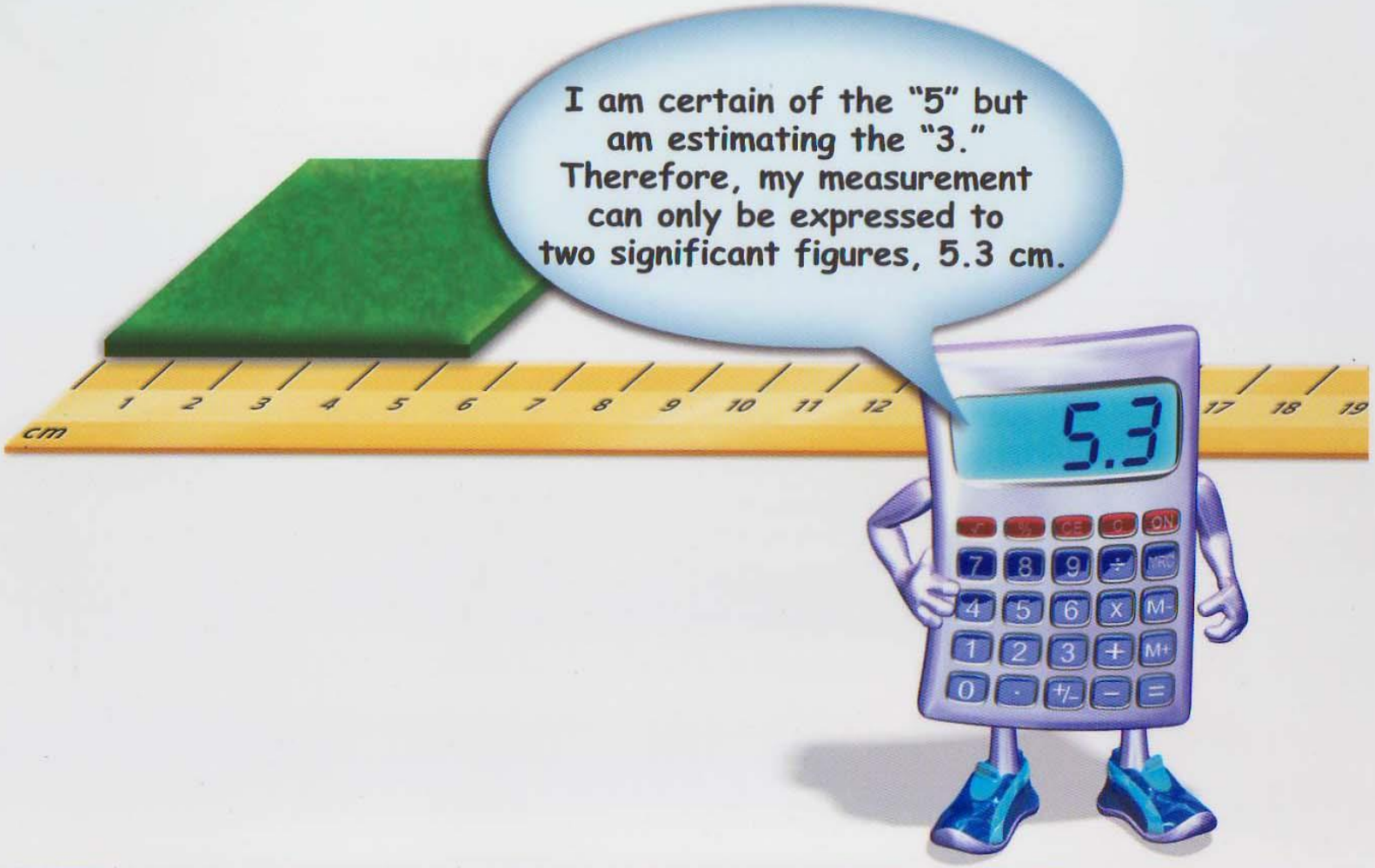
Reproducible but Not Accurate

Both Reproducible and Accurate

Significant Figures and Precisions

- Significant figures in measurement include all of the digits that have been measured exactly, plus one digit whose value has been estimated.
- Precision is a measure of the exactness of a measurement.
- Scientists use significant figures to express precision in their measurements and calculations.

8.9 Significant Figures



Sample Problem

- To find the area of a surface, multiply its length by its width. Suppose a sheet of paper measures 27.5 cm by 21.6 cm. What is its area?

Solution

- A = L x W
- 27.5 cm x 21.6 = 594 cm^2

Practice Problem

- What is the area of a ticket stub that measures 3.5 cm by 2.2 cm?

Solution

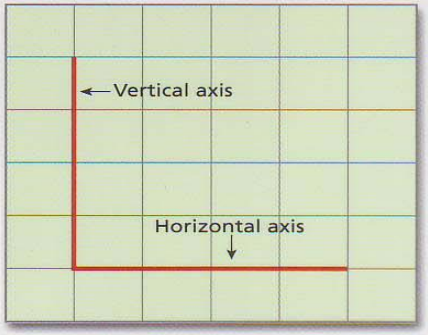
- $A = L \times W$
- $3.5\ cm \times 2.2\ cm = 7.7\ cm^2$

Graphs in Science

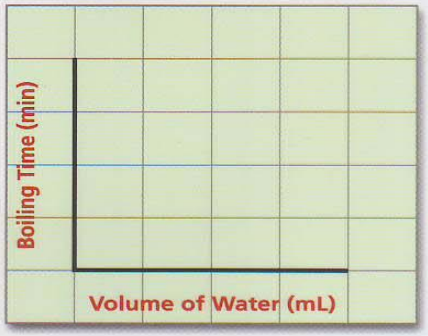
- You can think of a graph as a “picture” of your data.
- Line graphs are used to display data to show how one variable (the responding variable) changes in response to another variable (the manipulated variable).

8.10 Plotting a Line Graph

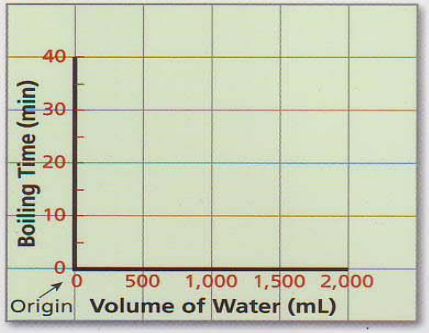
1 Draw the Axes



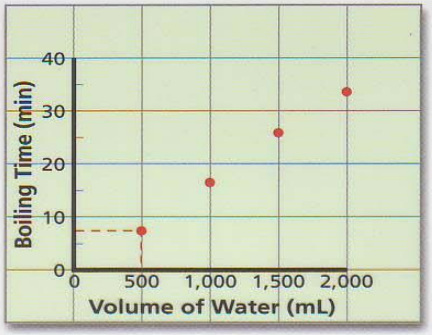
2 Label the Axes



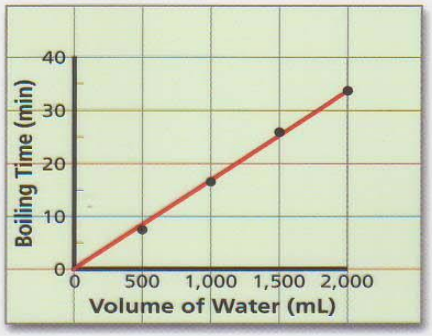
3 Create a Scale



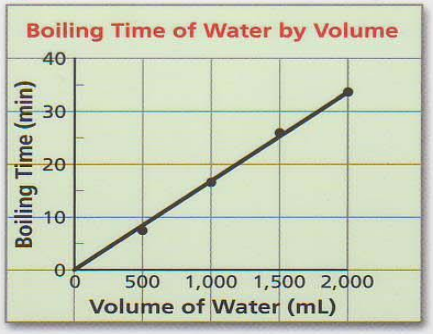
4 Plot the Data



5 Draw a Line of Best Fit



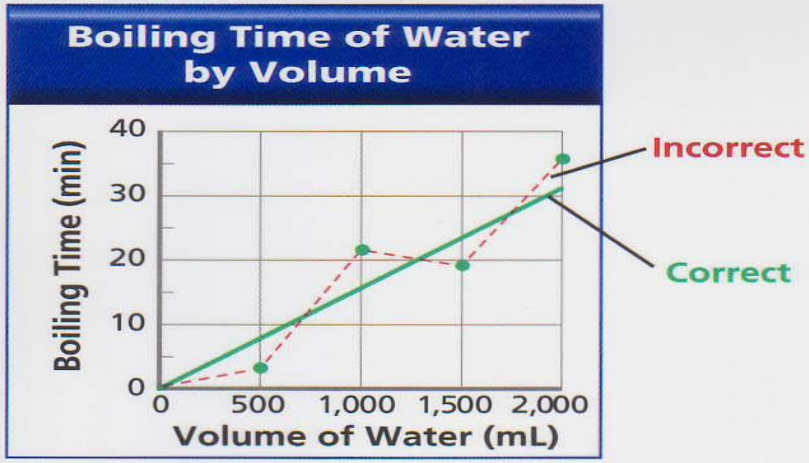
6 Add a Title



Graphs Continued

- A line graph in which the data points yield a straight line is called a linear graph.
- A line of best fit emphasizing the overall trend shown by all the data taken as a whole.

8.11 Drawing a Line of Best Fit



Tips for Drawing a Line of Best Fit

- If the data points seem to follow along a straight line, draw a straight line.
- Include as many data points as possible directly on the line.
- For data points that don't easily fit on the line, try to have the same number of points above the line as below the line.

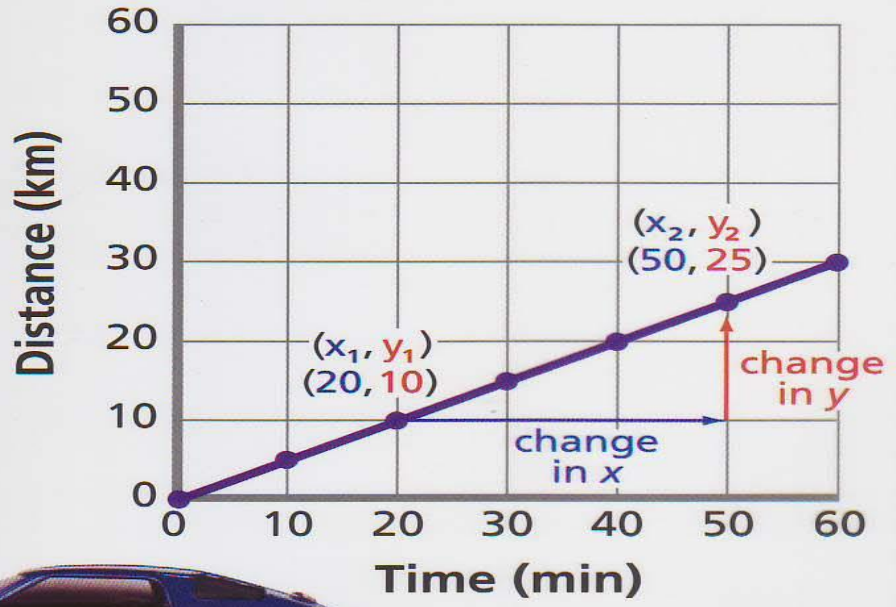
Slope

- The slope of a graph line tells you how much y changes for every change in x.
- Slope = Rise / Run or $Y_2 – Y_1 / X_2 – X_1$

- A nonlinear graph is a line graph in which the data points do not fall along a straight line.
- Line graphs are powerful tools in science because they allow you to identify trends and make predictions.

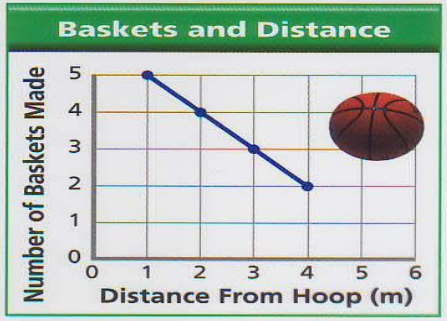
8.12 Slope

Distance Traveled Over Time

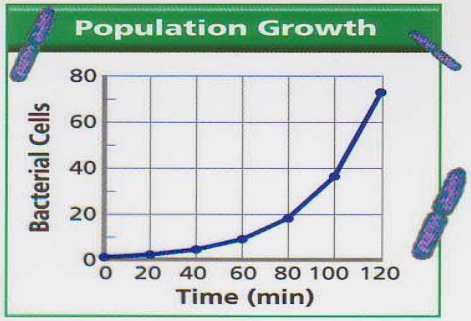


8.13 Trends in Graphs

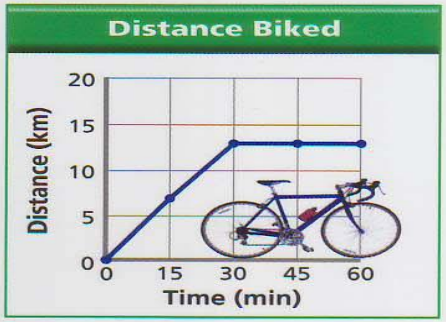
A Linear Trend



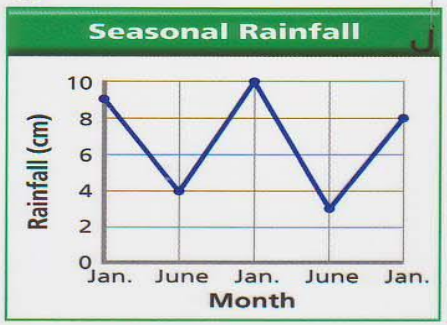
B Nonlinear Trend



C Nonlinear Trend



D Nonlinear Trend



E No Trend