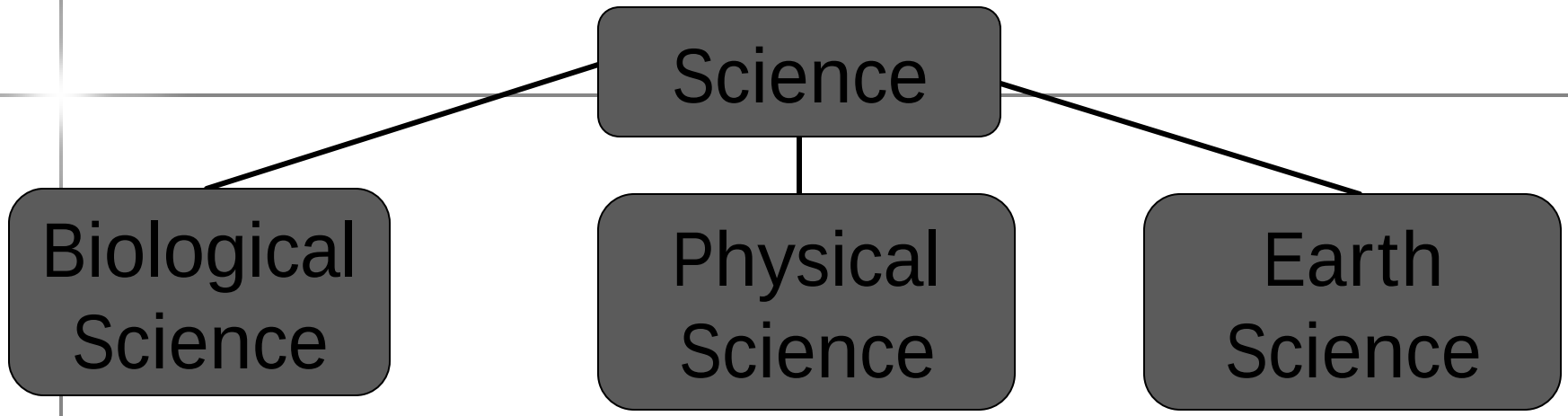
Chapter 1

Introduction to Science

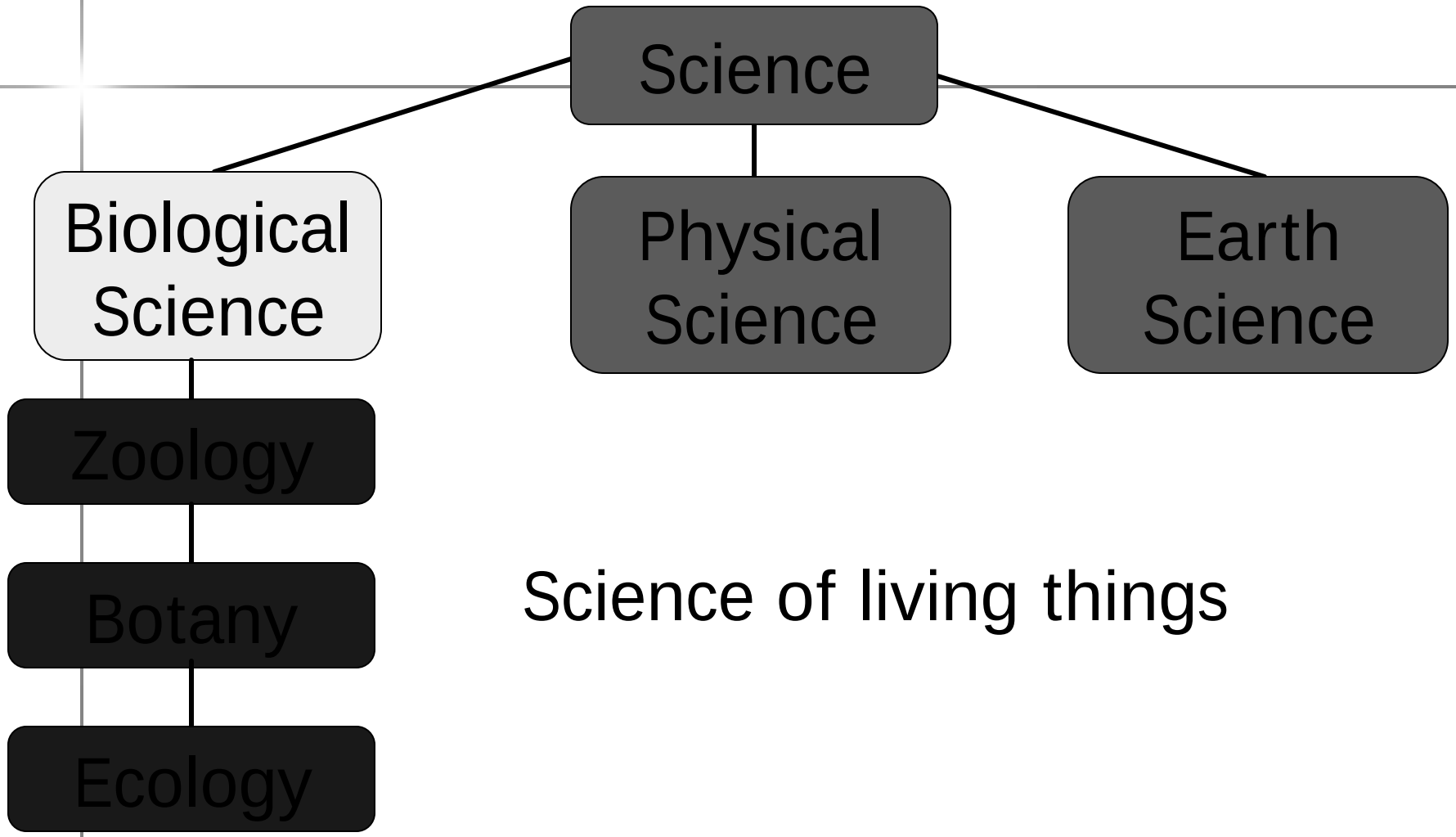
What is Science?

- Science is what scientists do
- Science is trying to explain the world around us
- Science is a way of thinking
- “Science is a system of knowledge based on facts or principles
- Book talks about “social science”
- We prefer social studies

Branches of Science

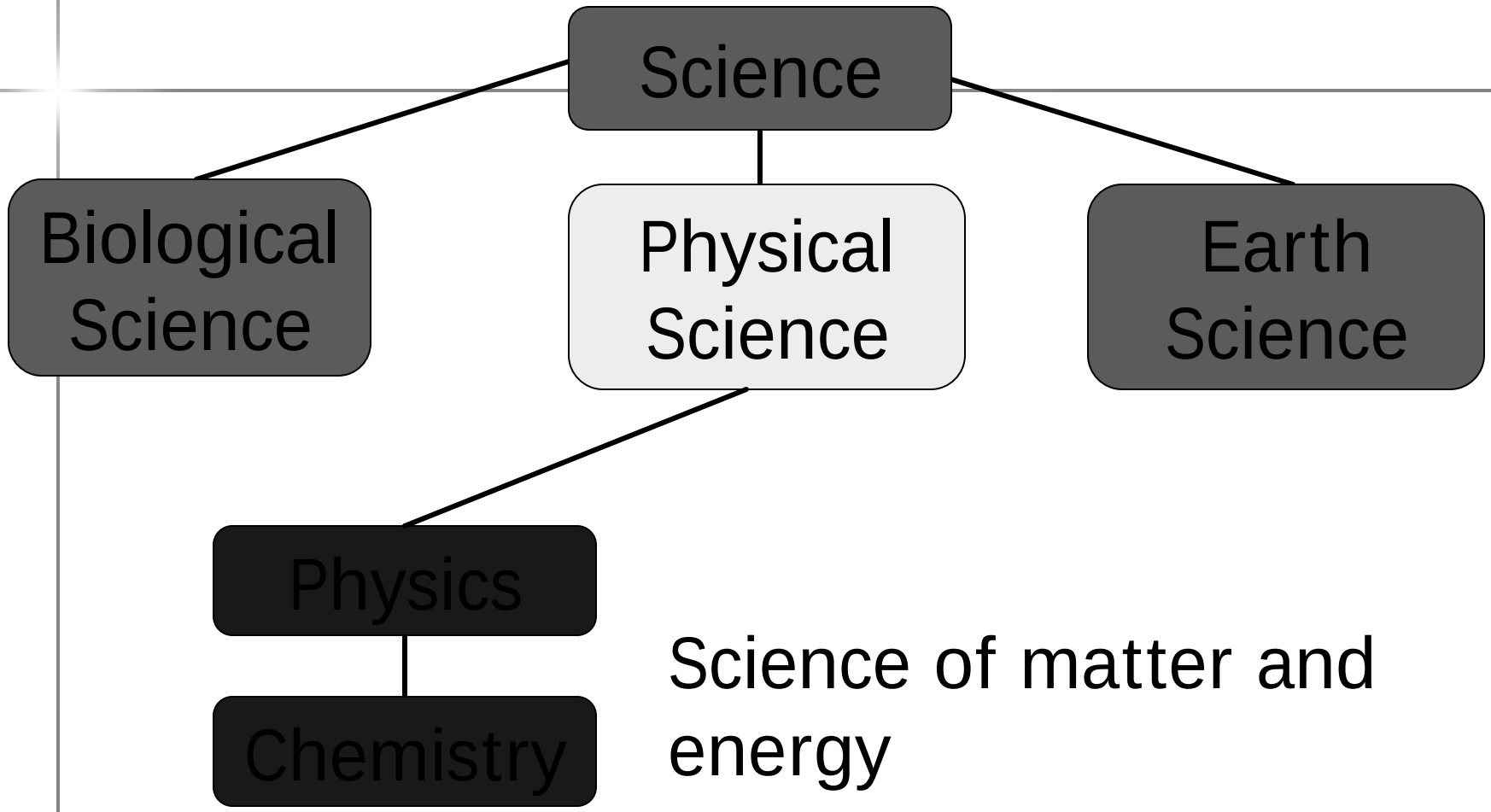


Branches of Science



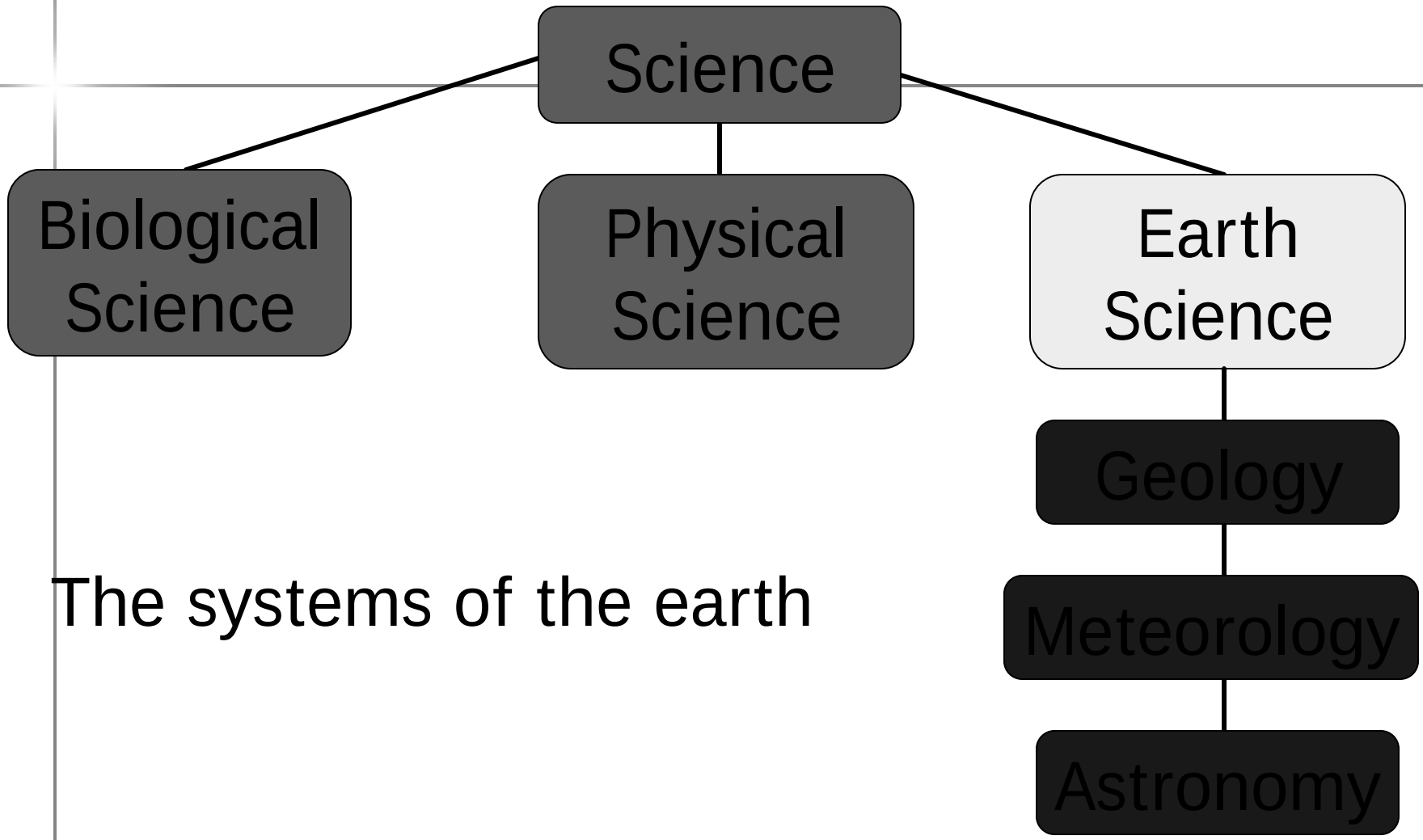
Science of living things

Branches of Science



Science of matter and energy

Branches of Science



The systems of the earth

Branches of Science

- There are many more branches to biological and earth sciences
- The three categories overlap
- Biochemistry
- Astrobiology
- Geophysics

Science and Technology

- Pure Science - search for scientific knowledge
- Technology – application of science
- Two are interrelated
- Technology develops new tools for investigating nature
- New science leads to new applications

Scientific Theory

- A reasoned explanation tested by many observations and experiments
- Tells why things are
- Three things
  - Must explain clearly and simply
  - Must be repeatable
  - Must be able to make predictions
- Theories can be changed or modified by new evidence

Scientific Laws

- Describe what happens
- Quantitative – use numbers and equations to describe
- Often equations are part of the law
- Mathematics is a universal language

Law vs. Theory

Law	Theory
Describes how	Explains why
Summarizes observations	Agrees with observations
Usually an equation	Predicts new discoveries

Observations

- Qualitative – describe with words
  - Hot , red, large
- Quantitative – describe with numbers
  - 100° , 10 meters, 3.46 grams
- Scientists prefer quantitative
- Easy to agree upon
- No personal bias

Models

- A representation of some object or event
- Made to better understand it
- Often used if real thing is too big, small or complex.
- Come in a variety of forms
  - Physical models
  - Diagrams
  - Computer models

The Scientific Method

- A way of thinking about and solving problems
- It is a logical method
- You do it all the time

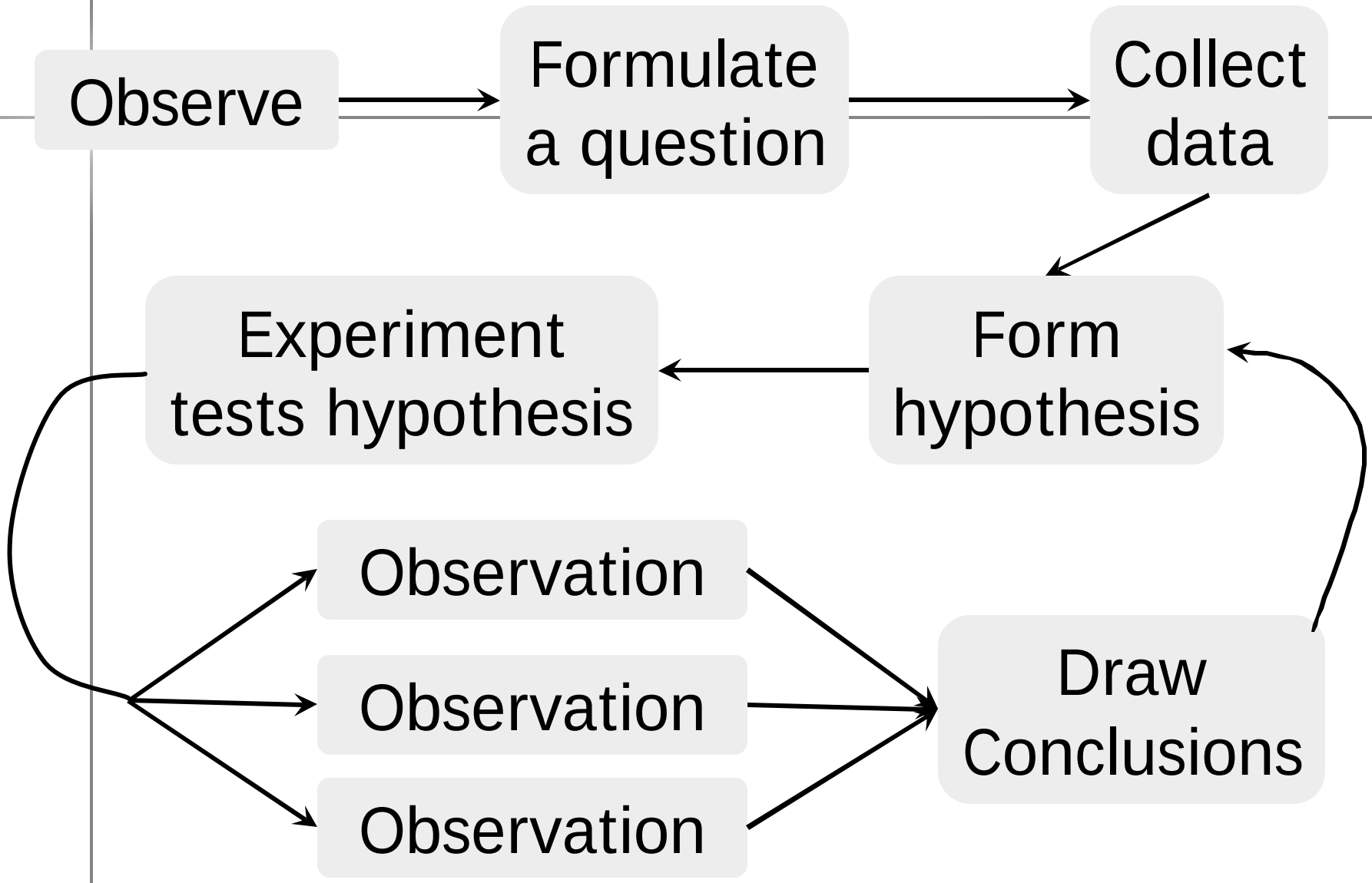
The Scientific Method

- Starts with observation- can be anything
- Question – what do you want to know?
- Gather data- what is already known
- Form hypothesis- a possible explanation
- Design experiment to test hypothesis
  - This is the hard part

The Scientific Method

- Experiments generate more observations
- Allow us to draw conclusions about hypothesis
  - Support the hypothesis or not
  - If not modify hypothesis

The Scientific Method



The Scientific Method

- Does not always work this way, but gives a way of guiding our thinking
- Hard part is testing only one variable at a time.
- Changing only one thing at a time
- If you change more than one, you don’t know which one is the cause

Measurement

- A number without a unit is meaningless
- It is 4 long
- 4 what?
- Scientists use the metric system or SI for *le System Internationale d'Units*
- Makes sharing data easier

Metric System

- Measurements have two parts
- Base unit and prefix
- Prefixes multiply or divide the base units by multiples 10
- Prefixes are the same for all units

Base Units

Quantity	Unit	Abbreviation
Length	meter	m
Mass	gram	g
Temperature	kelvin	K
Electric current	ampere	A
Amount of substance	mole	mol
Luminous intensity	candela	cd

Prefixes

Prefix	Symbol	Meaning	As a number
kilo-	k	thousand	1,000
mega-	M	million	1,000,000
giga-	G	billion	1,000,000,000
deci-	d	tenth	0.1
centi-	c	hundredth	0.01
milli-	m	thousandth	0.001
micro-	μ	millionth	0.000 001

Tables

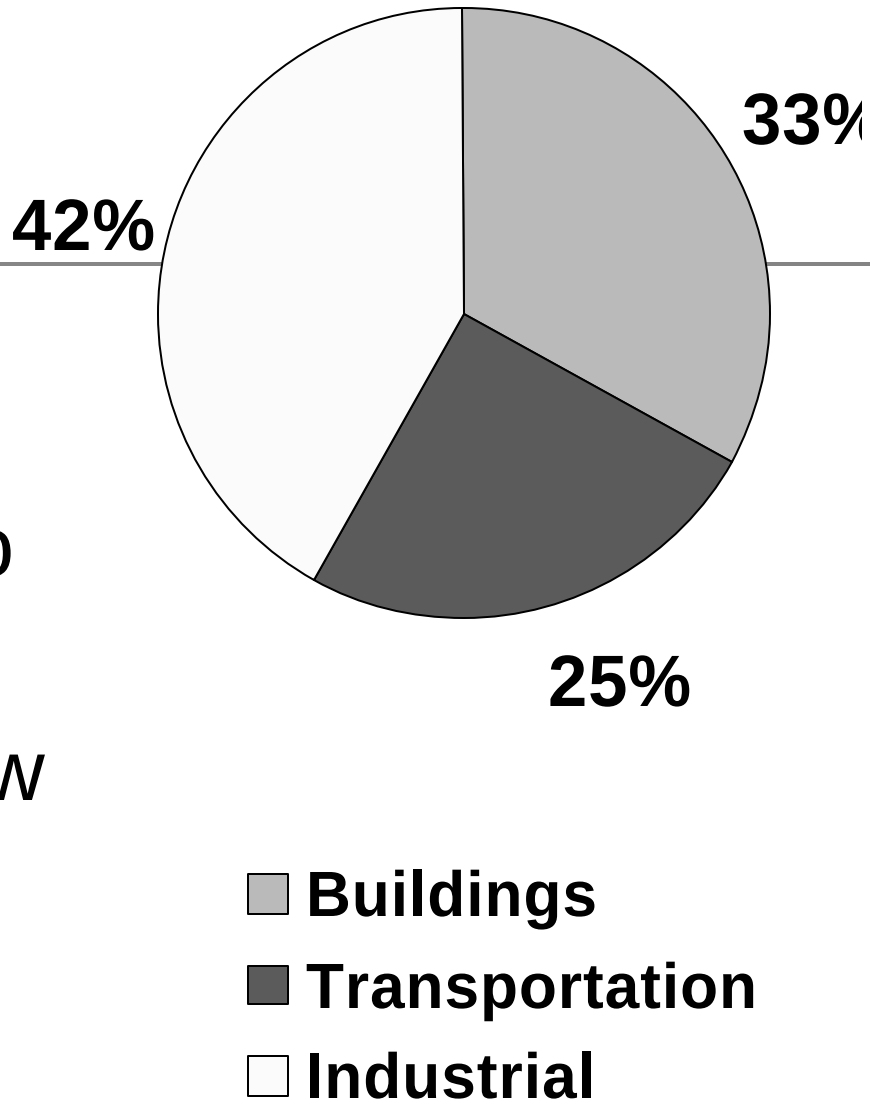
- Organizing data into groups
- Putting those groups into rows and columns
- Gives us an easy way to compare data

Graphs

- Give a visual representation of data
- Summarizes data.
- Two types of variables
  - Independent variable the thing you have control over
  - Dependent variable the thing that you don’t have control over.
- Three types of graphs line, bar, and circle

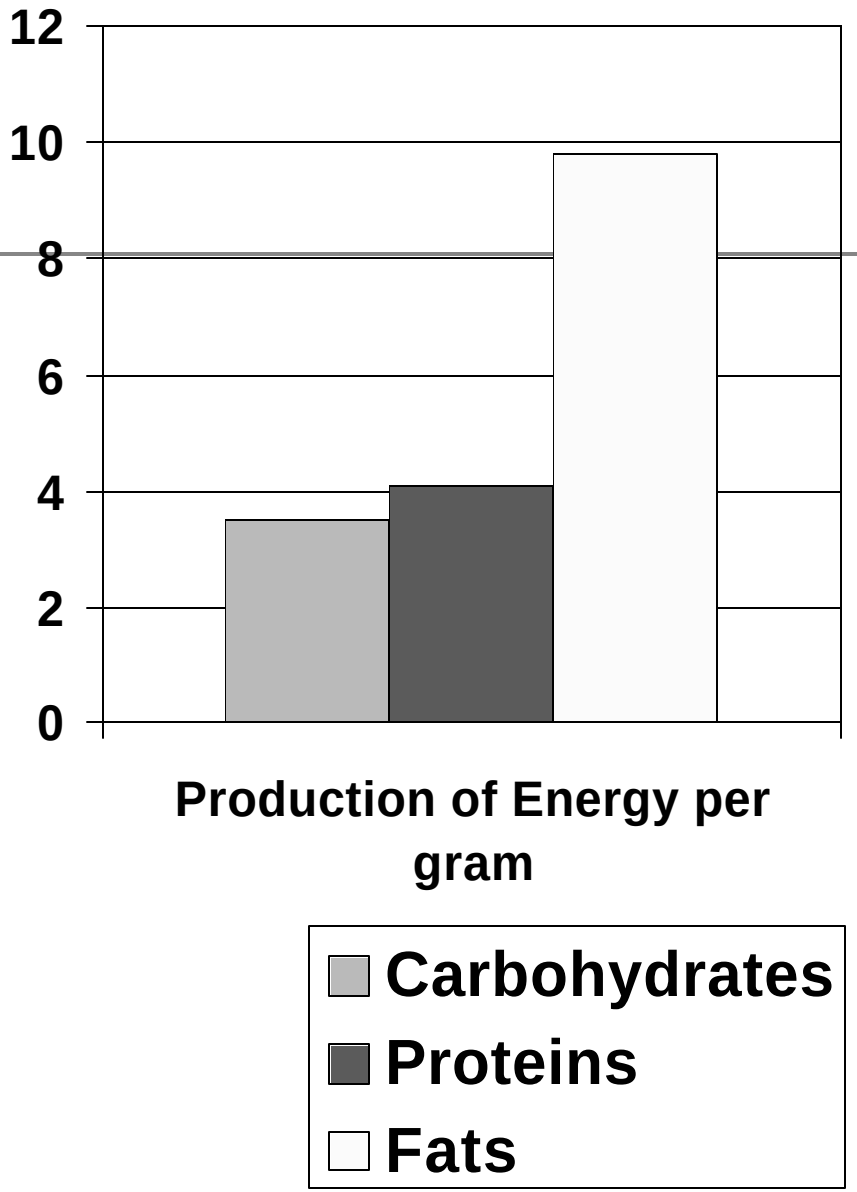
Circle Graphs

- Often called a pie chart
- divided into parts
- easy to compare to whole amount.
- Use several to show changes over time



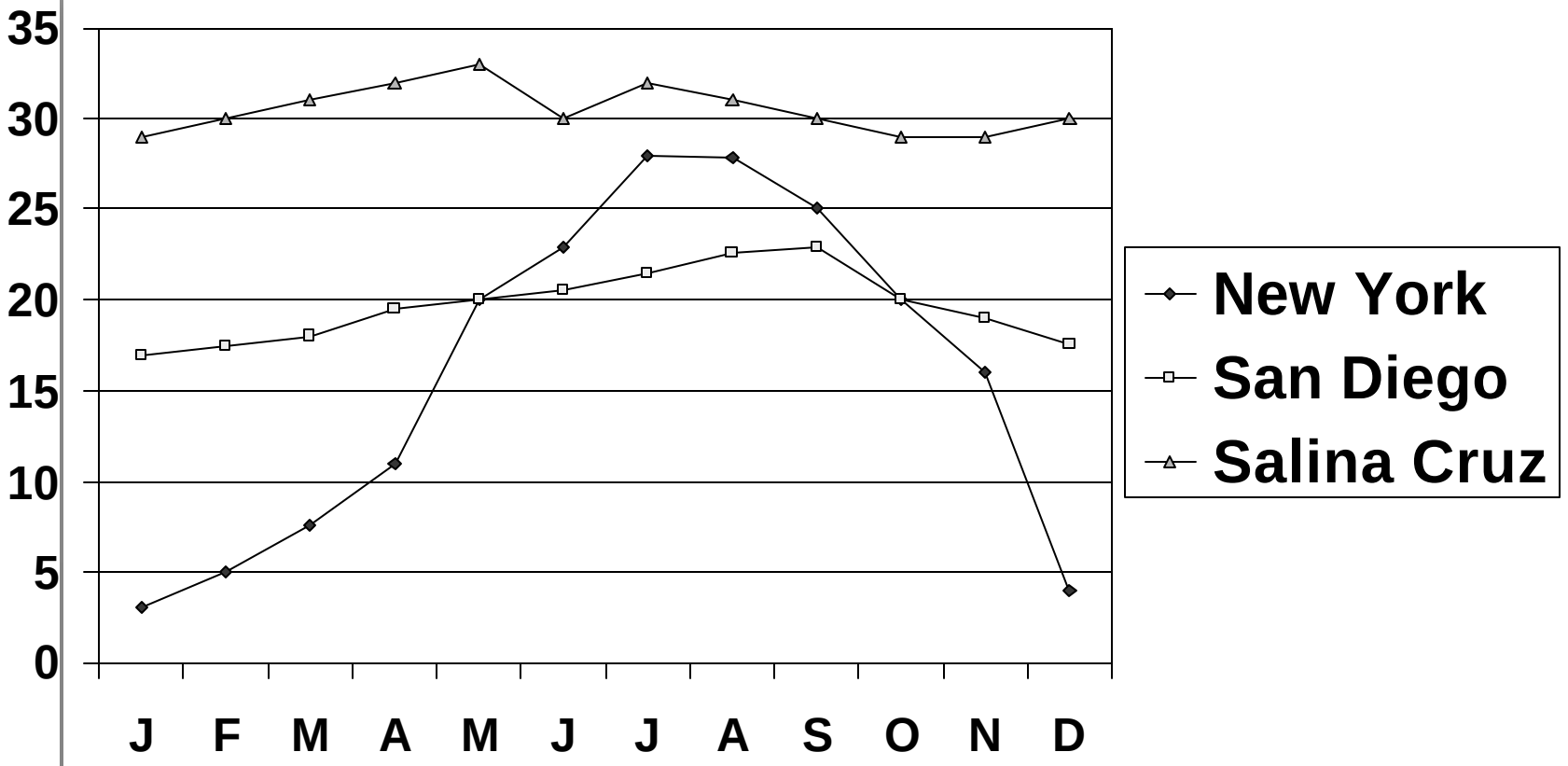
Bar Graphs

- Bar Graphs- wide columns used things like weight, height , and length.
- Compare quantities



Line Graphs

- Line Graphs- compares sets of data, show change and patterns over time.



Graphs include

- A title
- Labeled axes
- A consistent scale.

Metric conversions

- Changing the unit
- Does not change the size of the measurement
- If the unit gets bigger the number gets smaller
- If the unit gets smaller the number gets bigger
- Math with multiples of 10
- We will cancel out units to make sure we set the problem up right

Metric conversions

- A common race is the 5 K, which is 5 km. How many meters is this?
- Given unit -km
- Unit wanted –m
- The unit gets smaller, so the number must get bigger
- 1000 m = 1 km

Metric conversions

$$\text{Distance in m} = 5\ \cancel{\text{km}} \times \frac{1000\ \text{m}}{1\ \cancel{\text{km}}}$$

Distance in m = 5000 m

Metric conversions

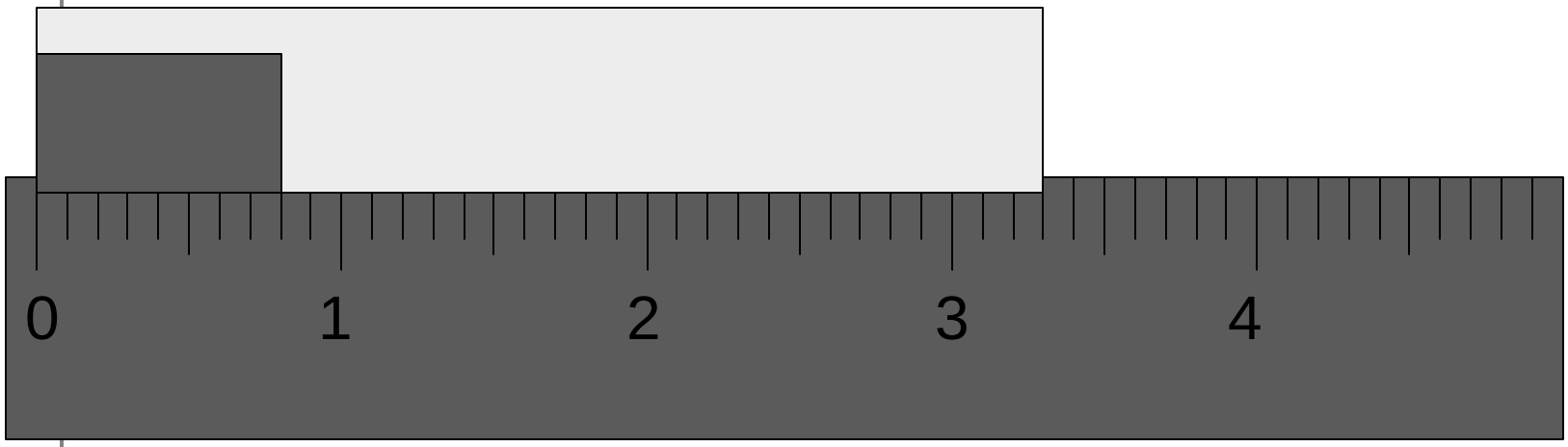
- The recommended daily requirement of vitamin C is 500 mg. How many grams is this?

$$\text{mass in g} = 500\ \cancel{\text{mg}} \times \frac{1\ \text{g}}{1000\ \cancel{\text{mg}}}$$

mass in g = 0.5 m

Measuring length

- Use a ruler
- Line up from zero not the end of the ruler
- Small divisions are millimeters

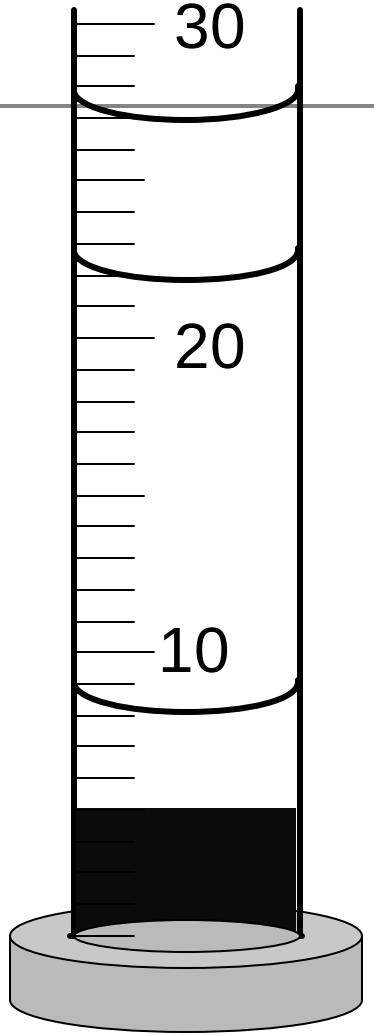


Volume

- Liter a common unit
- 1 L about 1/4 of a gallon - a quart
- 1 mL is about 20 drops of water or 1 sugar cube

Measuring Volume

- Use a graduated cylinder.
- The water will curve in the cylinder.
- Hold it level with your eye.
- Read the bottom of the curve.
- Measures in milliliters mL.

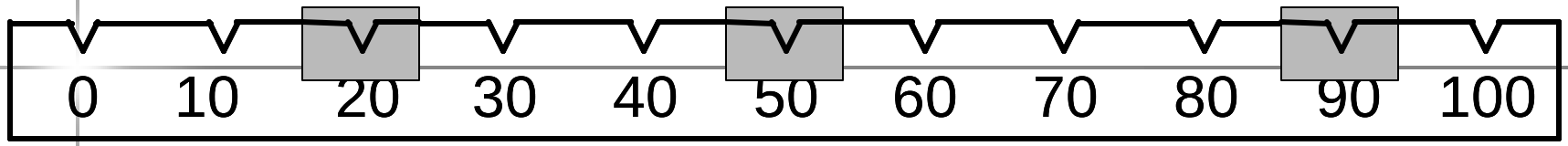


Mass

- weight is a force, is the amount of matter.
- 1gram is defined as the mass of 1 cm^3 of water at 4 ºC.
- 1 kg = 1 L of water
- 1 kg = 2.5 lbs
- 1 g = 1 paper clip
- 1 mg = 10 grains of salt or 2 drops of water.

Measuring Mass

- Use a triple beam balance
- First balance it at zero.
- Then put item on
- Then move one weight at a time
- When balanced, add up the weights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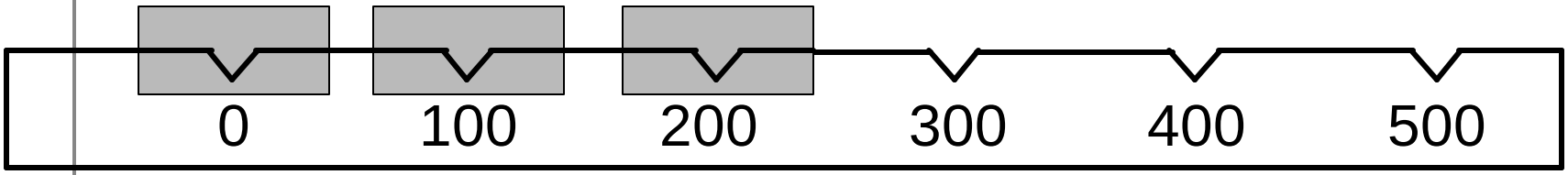
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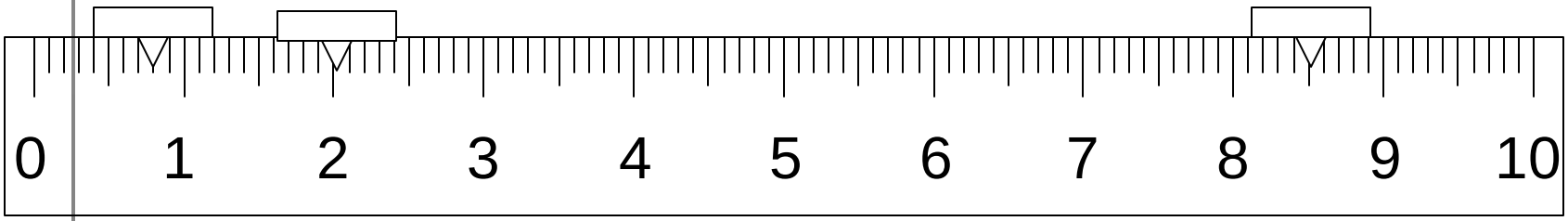
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