

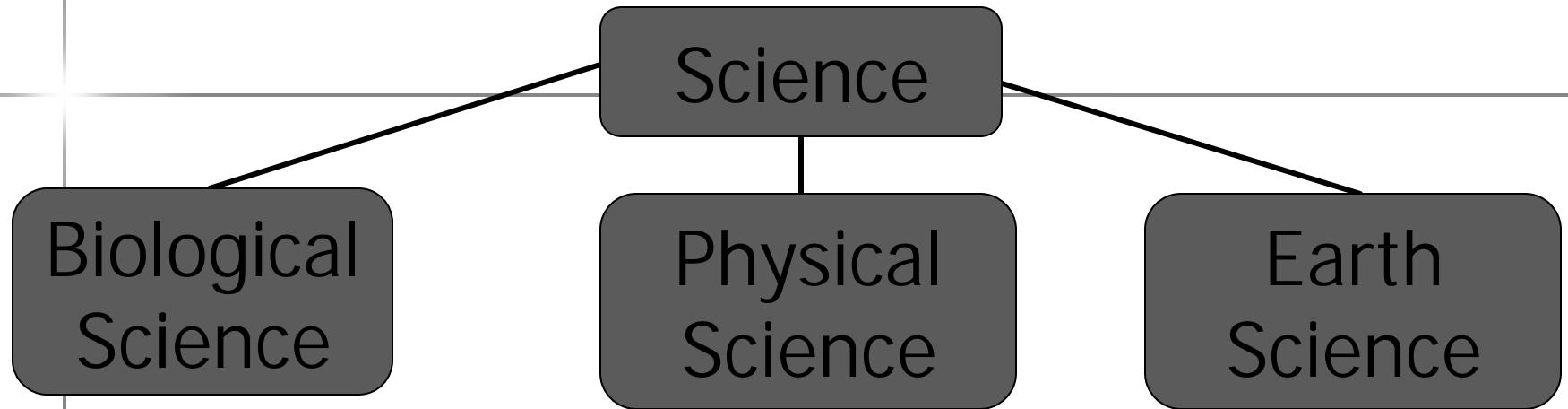
# Chapter 1

## Introduction to Science

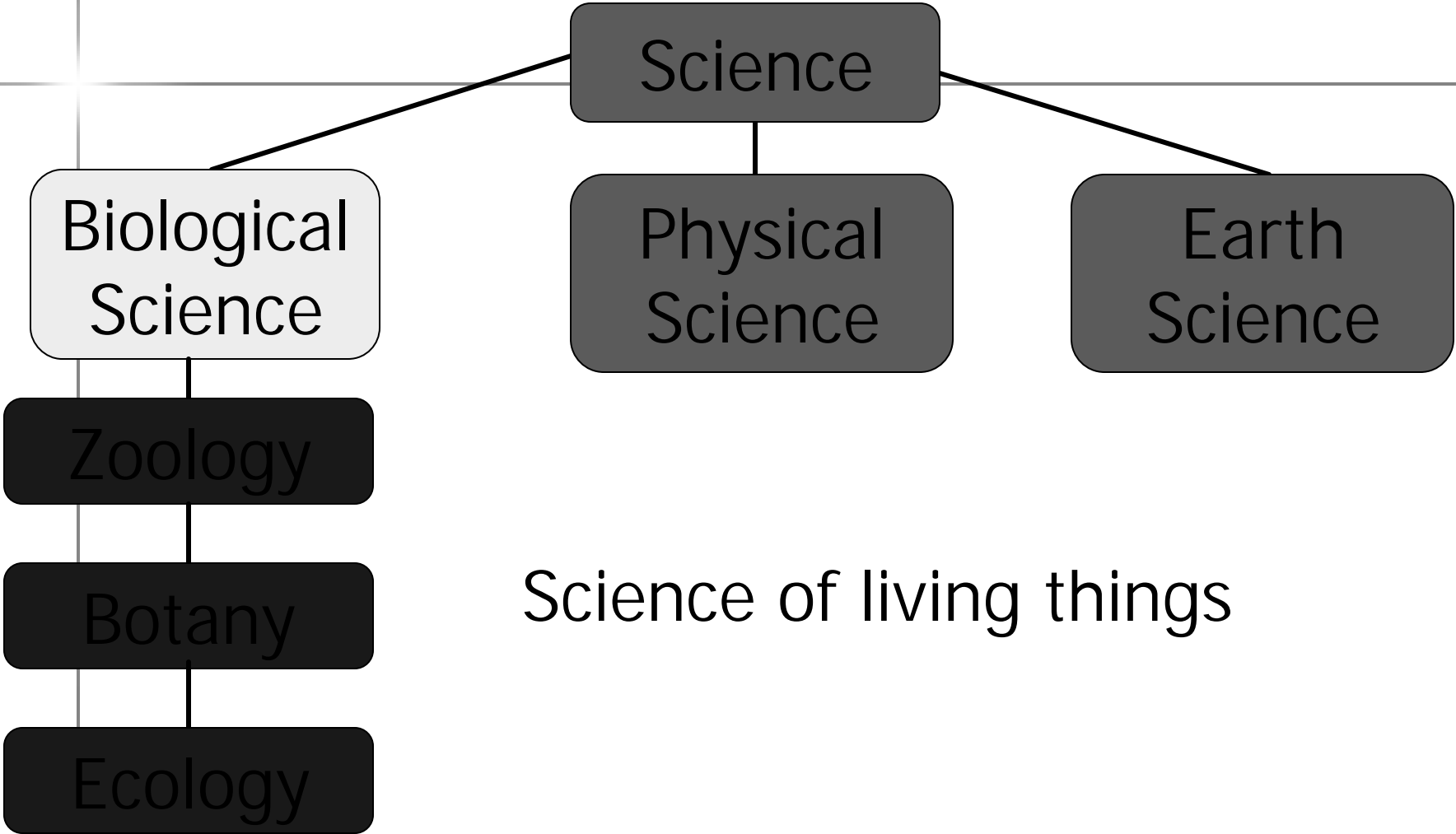
# What is Science?

- 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

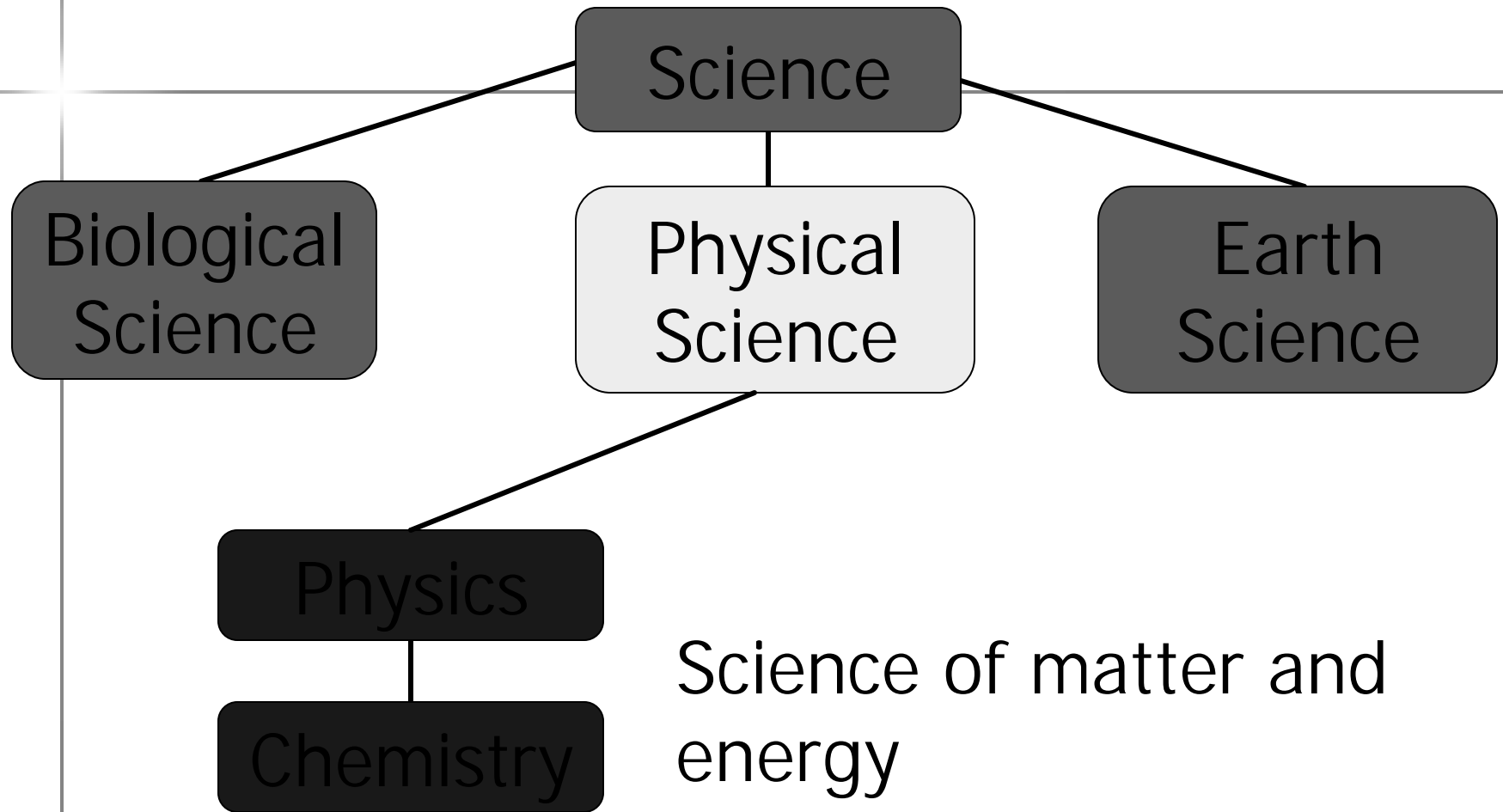
# Branches of Science



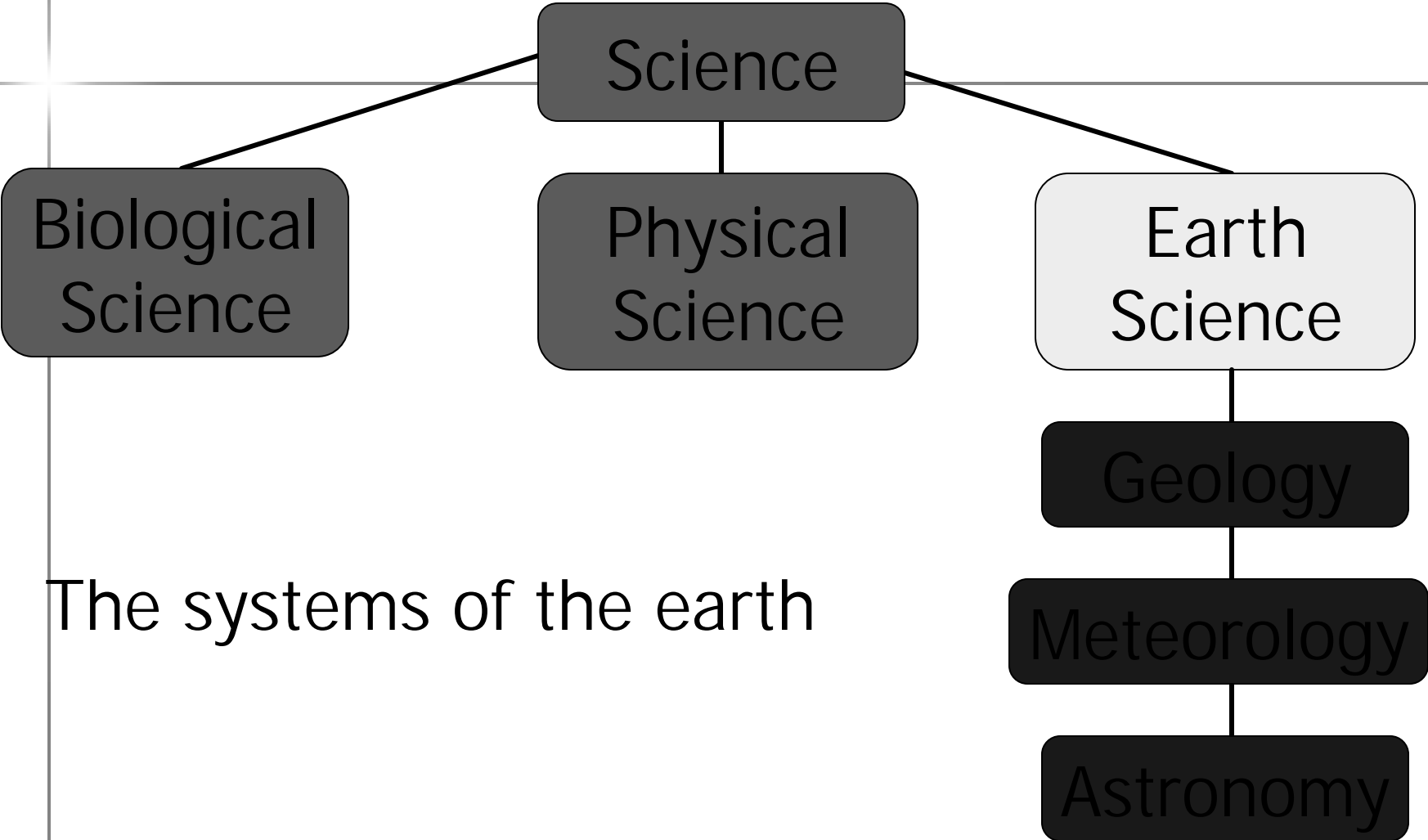
# Branches of Science



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# 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

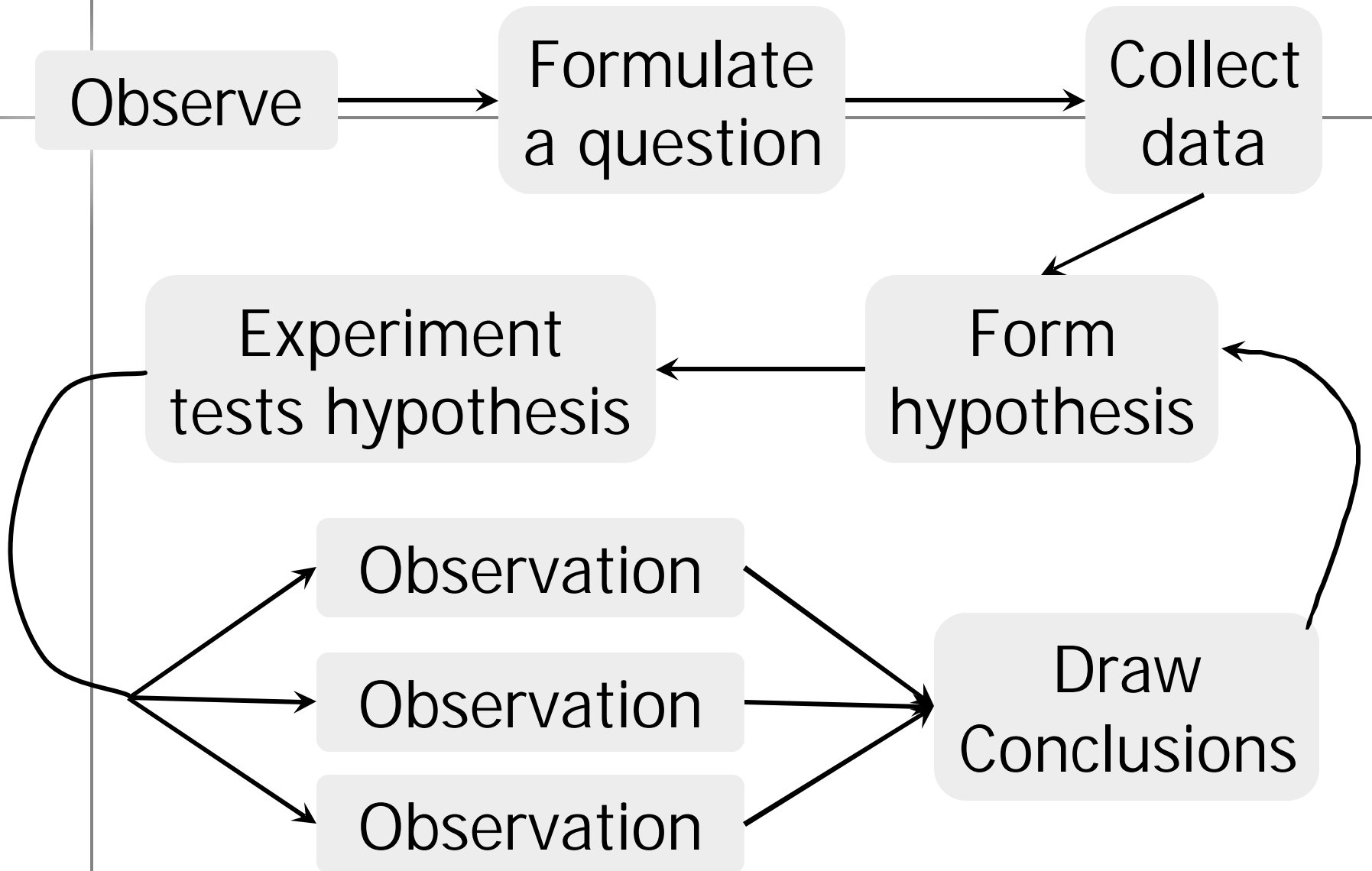
# The Scientific Method

- 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-	$\mu$	millionth	0.000 001

# Tables

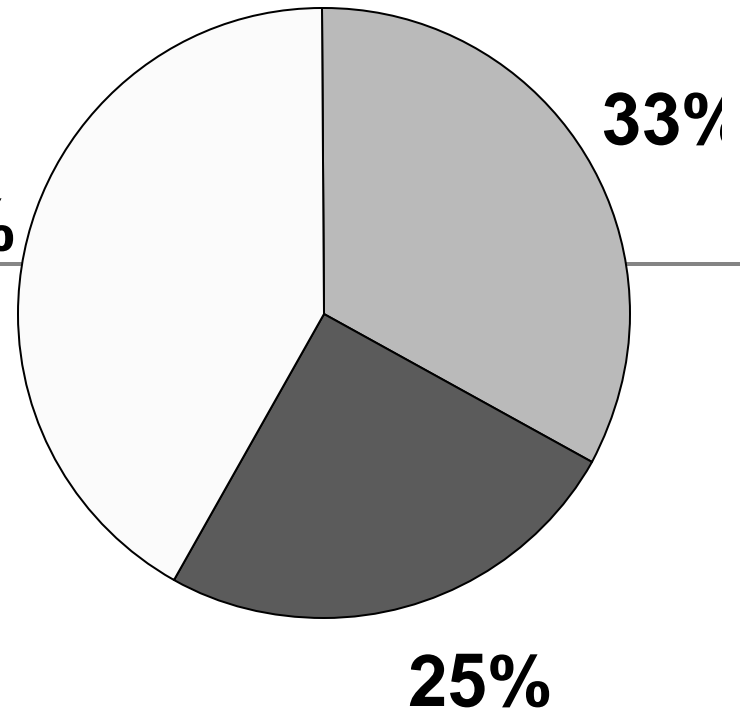
- Organizing data into groups
- Putting those groups into rows and columns
- Gives us an easy way to compare data

# 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

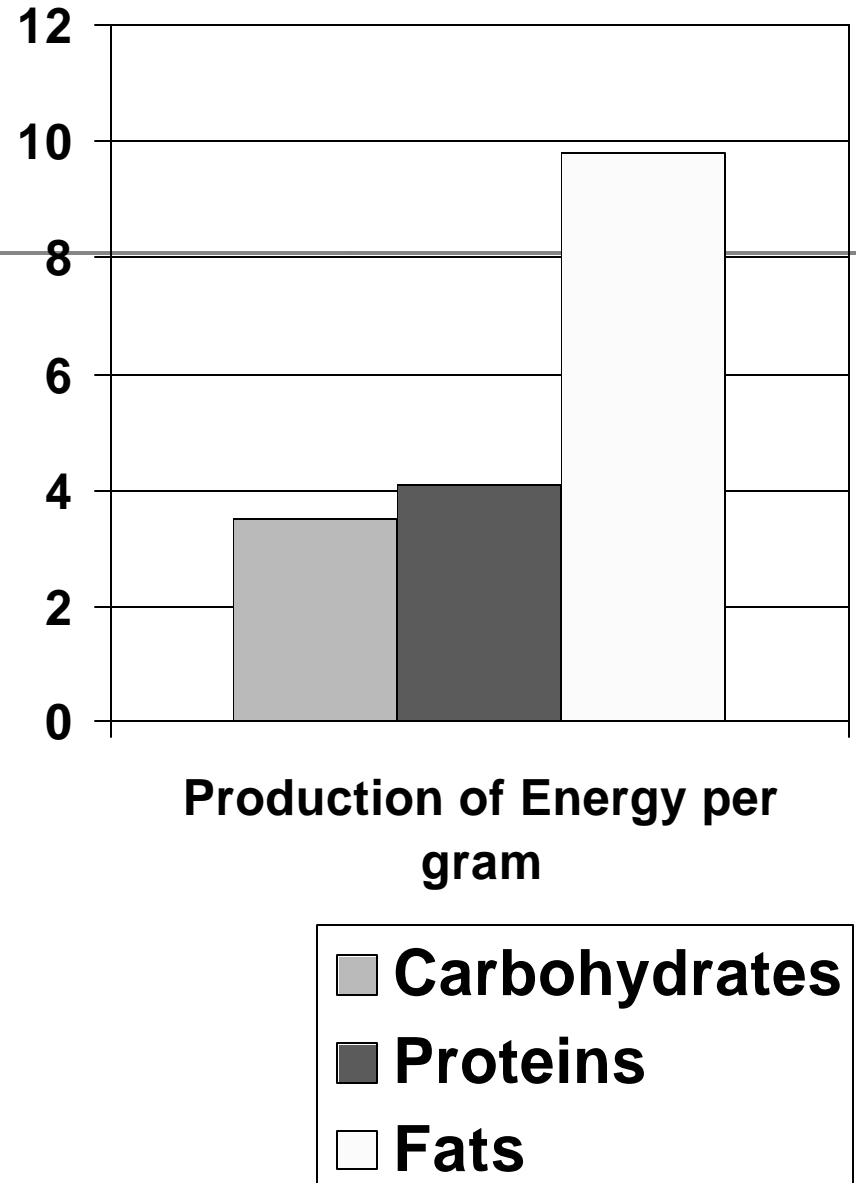
- Often called a pie chart
- divided into parts
- easy to compare to whole amount.
- Use several to show changes over time



- Buildings
- Transportation
- Industrial

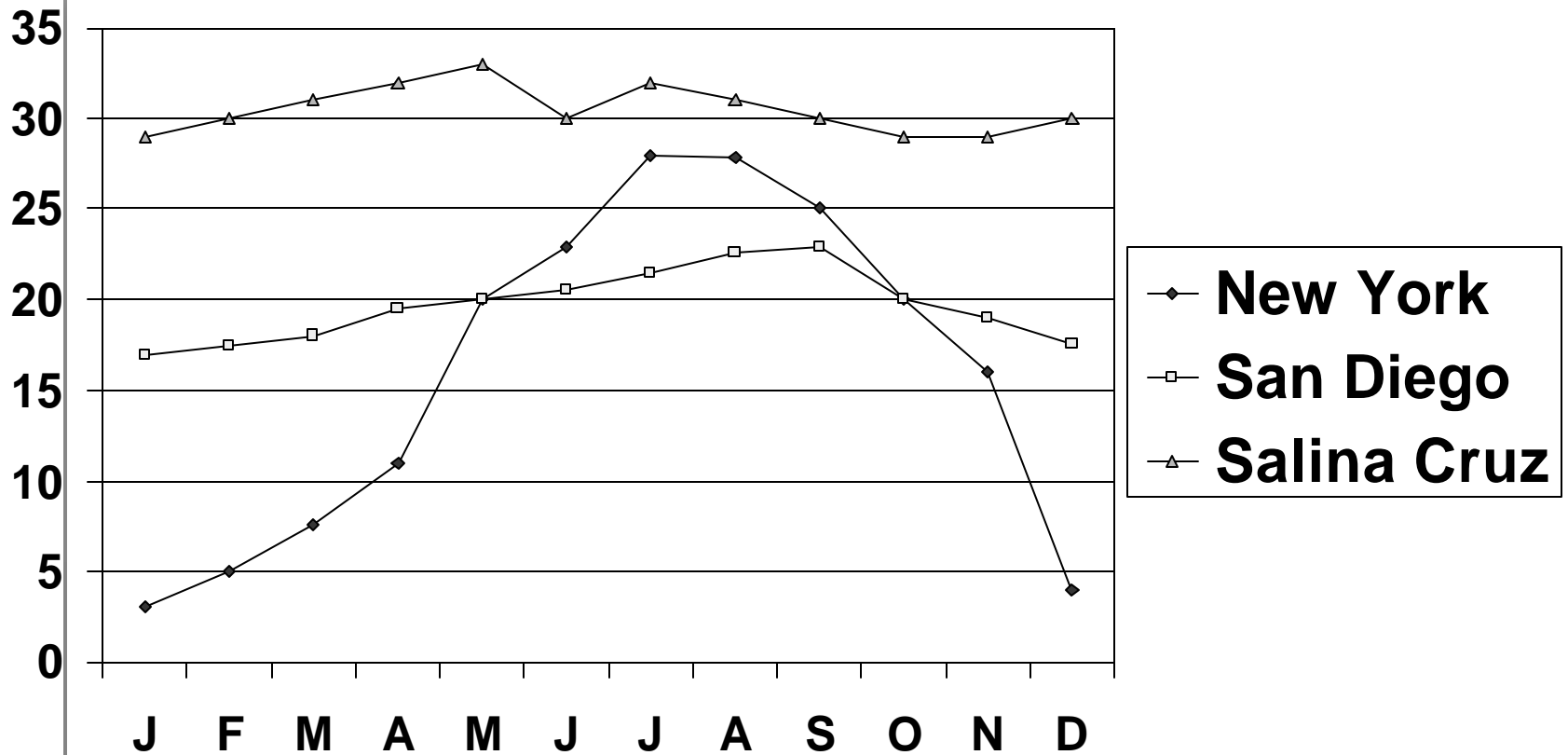
# Bar Graphs

- 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
- $1000 \text{ m} = 1 \text{ km}$

# Metric conversions

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

$$\text{Distance in m} = 5000 \text{ m}$$

# Metric conversions

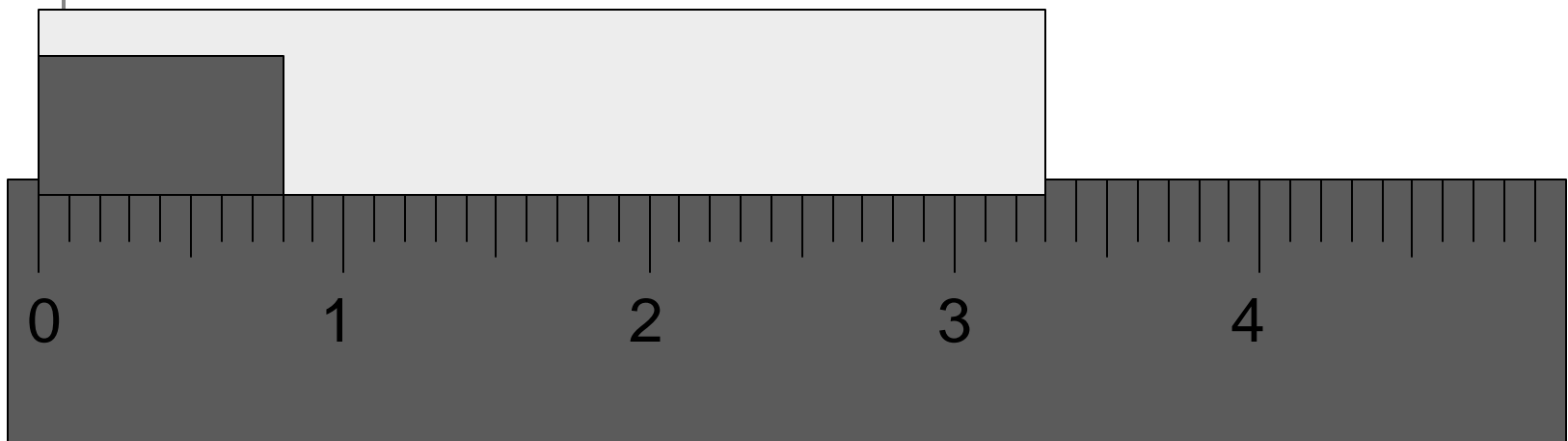
- The recommended daily requirement of vitamin C is 500 mg. How many grams is this?

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

$$\text{mass in g} = 0.5 \text{ g}$$

# Measuring length

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

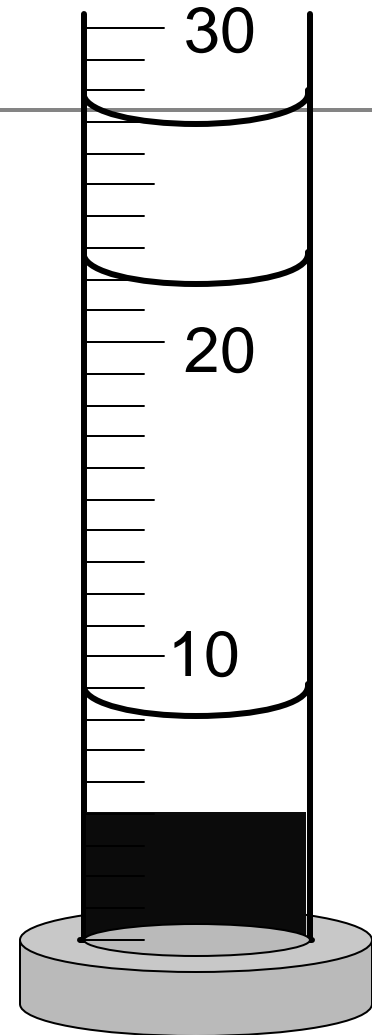


# Volume

- Liter a common unit
- 1 L about  $\frac{1}{4}$  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.
- 1 gram is defined as the mass of 1 cm<sup>3</sup> of water at 4 °C.
- 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

