

Introduction to Science



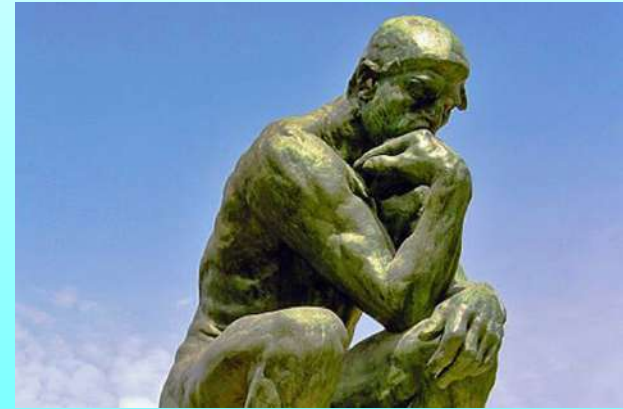
Outline

- What is science?
- Types of sciences
- Systems of measure
- Scientific measuring
- Scientific measuring – length
- Scientific measuring – mass
- Scientific measuring – volume
- Scientific method
- Parts of a science experiment
- Theory vs. Law

What is science?

- Science: a way to solve problems and answer questions
 - a way to understand the world we live in
 - usually end with –logy
 - meaning “the study of”
 - prefix of the word tells what it studies
 - example: entymology

↙ ↘
The study of insects



Types of Sciences

1. Biology – study of living things

2. Chemistry – study of chemicals and how they combine

3. Ecology – study of the environment

4. Microbiology – study of very small living things



Types of Sciences

5. Zoology – study of animals



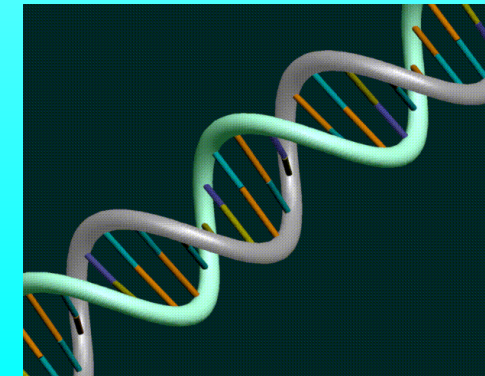
6. Archaeology – study of ancient artifacts and remains



7. Astronomy – study of outer space



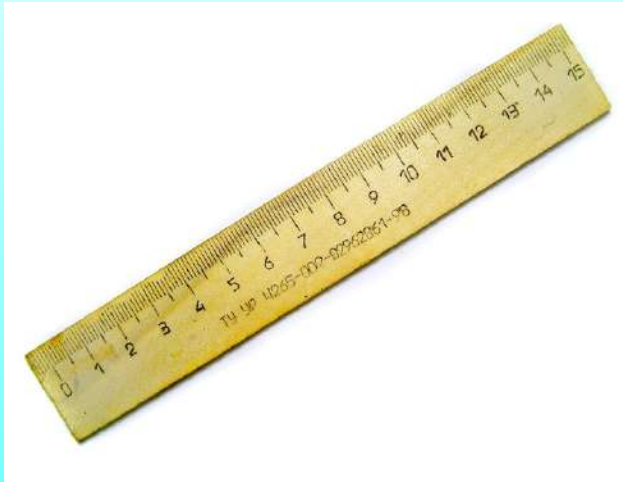
8. Genetics – study of genes/DNA



Systems of Measure

- 2 Common Measurement Systems
 - American System
 - system we use in the USA
 - examples of units: feet, yards, inches, pounds, gallons
 - Metric System
 - system used in all other countries of the world
 - used by scientists (we will use in class)
 - examples of units: meter, gram, liter, milliliter

Scientific Measuring



- 4 areas of scientific measuring (metric system)

- Length: distance from 1 place to another

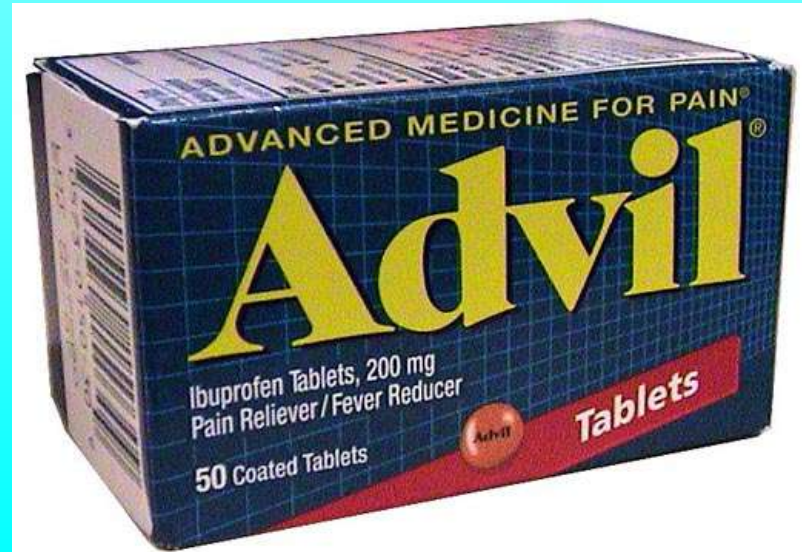
- units we use to measure

- Meter (basic unit)
- Centimeter
- Millimeter
- Kilometer

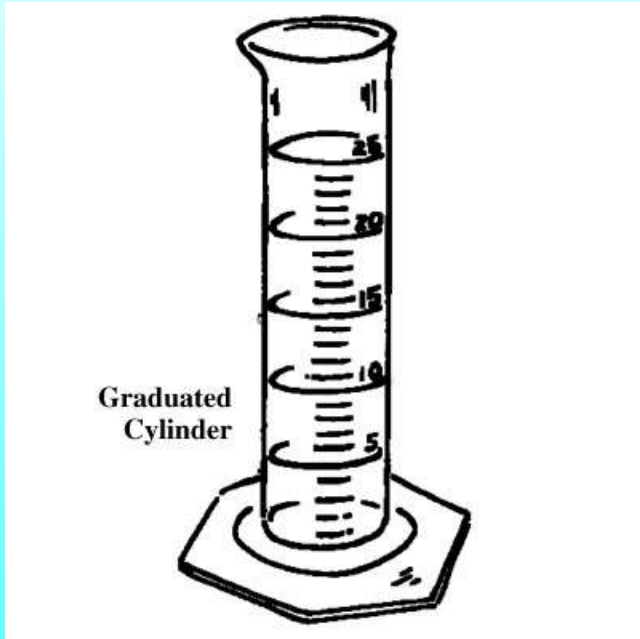


Scientific Measuring

- 4 areas of scientific measuring (metric system)
 - Mass: how much of something there is
 - units we use to measure
 - Gram
 - Milligram
 - Kilogram



Scientific Measuring

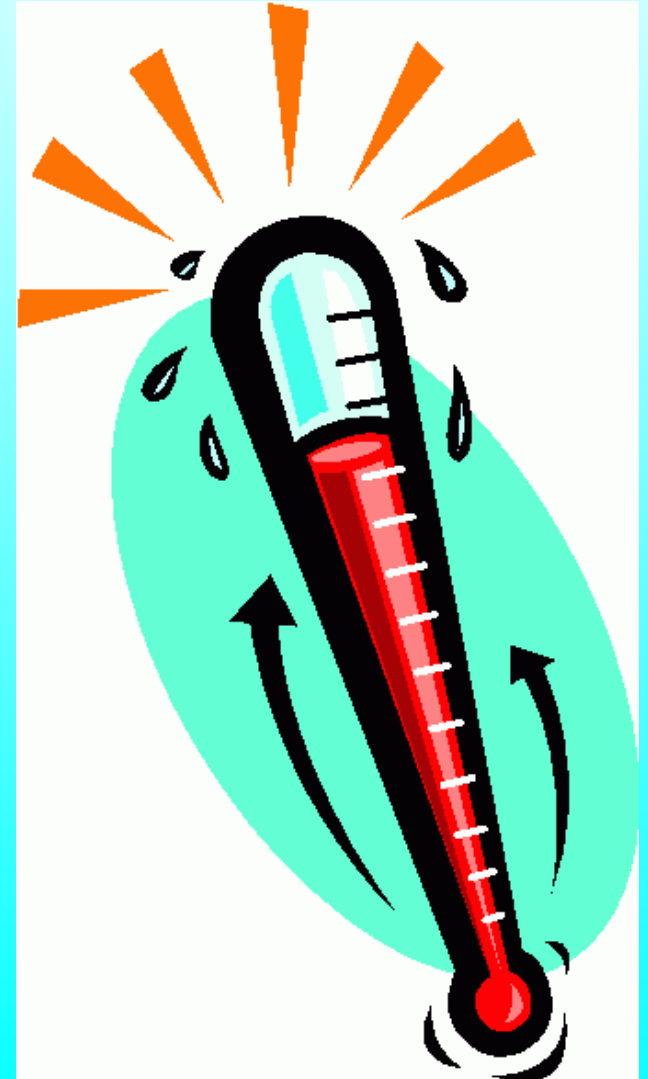


- 4 areas of scientific measuring (metric system)
 - Volume: amount of liquid an object can hold
 - units we use to measure
 - Liter
 - Milliliter



Scientific Measuring

- 4 areas of scientific measuring (metric system)
 - Temperature: how hot or cold something is
 - units we use to measure
 - Celsius



Scientific Measuring

- Metric system prefixes
 - Kilo = 1000
 - Hecto = 100
 - Deka = 10
 - Deci = $1/10$
 - Centi = $1/100$
 - Milli = $1/1000$

Scientific Measuring

- Metric system abbreviations
 - Meter = m
 - Kilometer = km
 - Hectometer = hm
 - Dekameter = dam
 - Decimeter = dm
 - Centimeter = cm
 - Millimeter = mm
- Metric system abbreviations
 - Gram = g
 - Kilogram = kg
 - Hectogram = hg
 - Dekagram = dag
 - Decigram = dg
 - Centigram = cg
 - Milligram = mg

Scientific Measuring

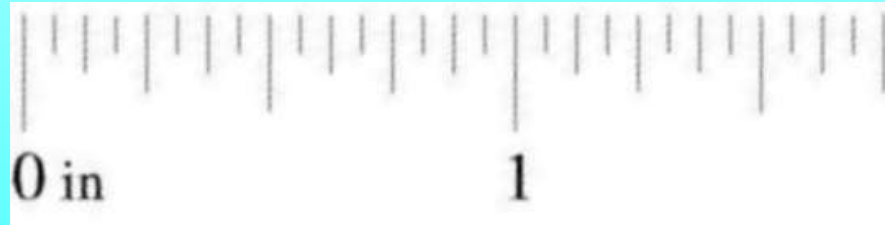
- Metric system abbreviations
 - Liter = L
 - Kiloliter = kL
 - Hectoliter = hL
 - Dekaliter = daL
 - Deciliter = dL
 - Centiliter = cL
 - Milliliter = mL

Scientific Measuring - Length

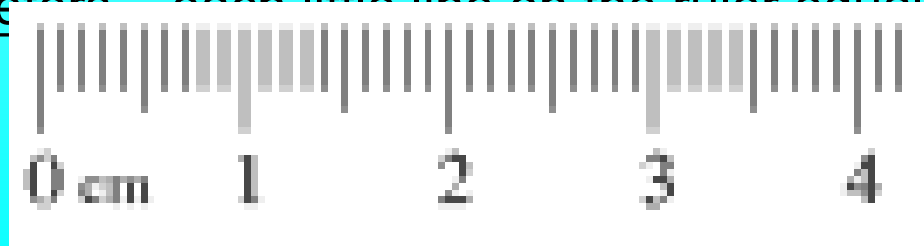
- Length: distance from 1 place to another
 - units used (both american and metric system)
 - American System – inches (in.), feet (ft.), yards, miles
 - Metric System – meter (m), centimeter (cm), millimeter (mm), kilometer (km)

Scientific Measuring - Length

- Length: distance from 1 place to another
 - how to measure – make sure your “zero” line is lined up with your starting point
 - inches – each little line on the ruler equals $1/16^{\text{th}}$ of an inch



- centimeters – each little line on the ruler equals .1 centimeters



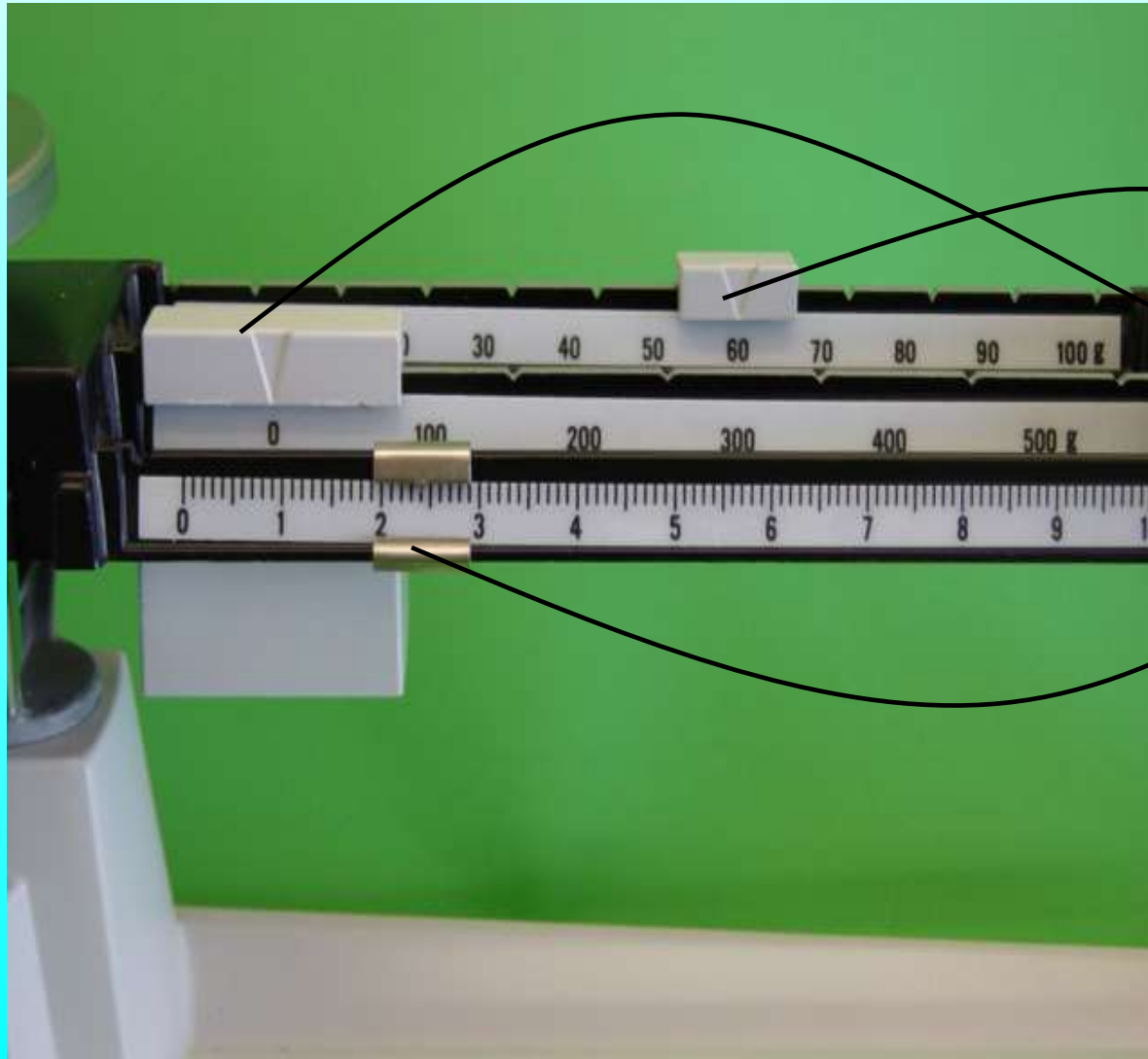
Scientific Measuring – Mass

- Mass: how much of something there is
 - Similar to weight
 - What instrument do we use to measure mass?
 - triple beam balance
 - Units used (metric system only)
 - Grams (g)

Scientific Measuring – Mass

- Steps for using the balances
 1. Place the object on the pan
 2. Move the sliders to determine the mass of the object
 - start with the largest slider and work your way down to the smallest slider
 - sliders must be in the notches
 3. Add up the numbers to determine the total mass

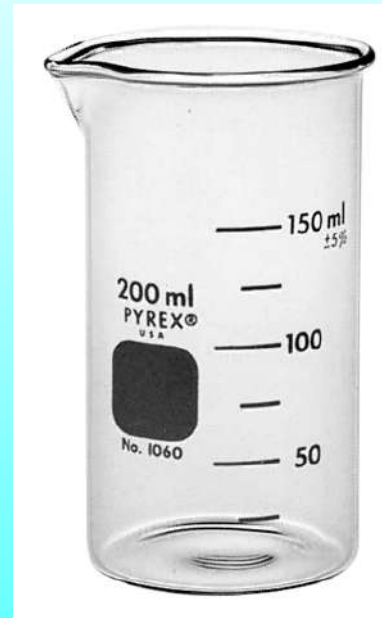
Scientific Measuring – Mass



$$0 + 60 + 2.4 = 62.4 \text{ g}$$

Scientific Measuring – Volume

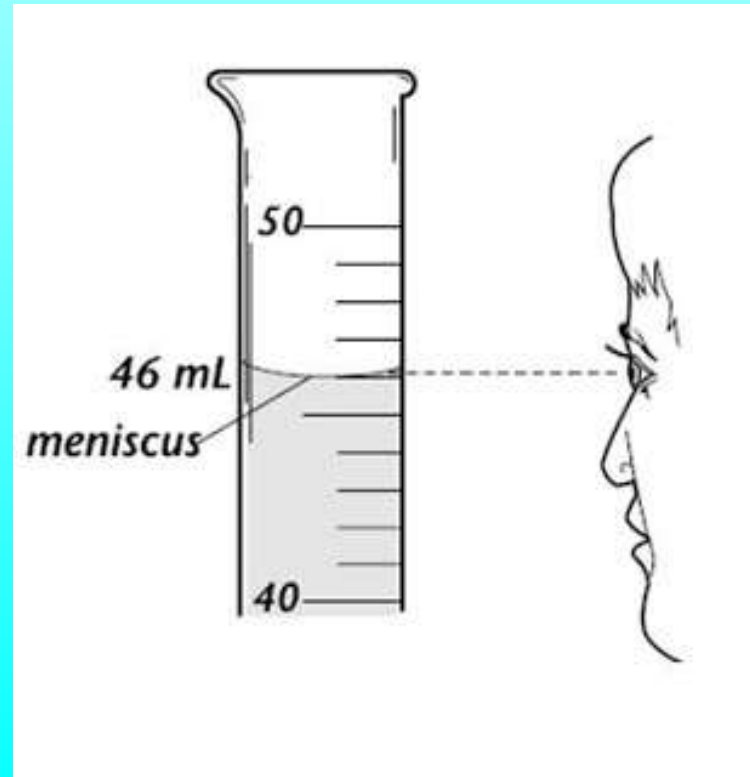
- Volume: amount of liquid an object can hold
 - What do we use to measure volume?
 - Beaker
 - Graduated Cylinder
 - Erlenmeyer Flask
 - Units used (metric system only)
 - Liters (L)
 - Milliliters (mL)



Scientific Measuring – Volume

– How to measure volume

- Read the bottom of the meniscus (curved line)
- Each little line equals 1 mL (if it is in between lines make it .5)



Scientific Method



- The scientific method is a way to solve problems using 6 steps
 - all scientists use the same process
- 2 important ideas
 - critical thinking: use skills to solve problems
 - separate important information from unimportant information
 - organization: the 6 steps that must be followed

6 Steps of the Scientific Method

1. State the Problem

- What do you want to figure out?

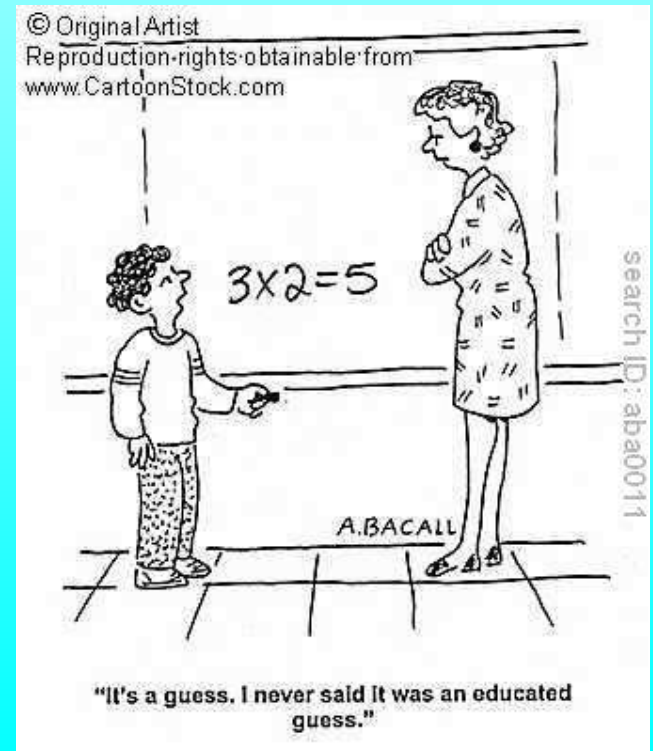


2. Research

- Gather information about topic

3. Make a hypothesis

- Hypothesis: an **educated** guess that can be tested
- What do you think will happen?

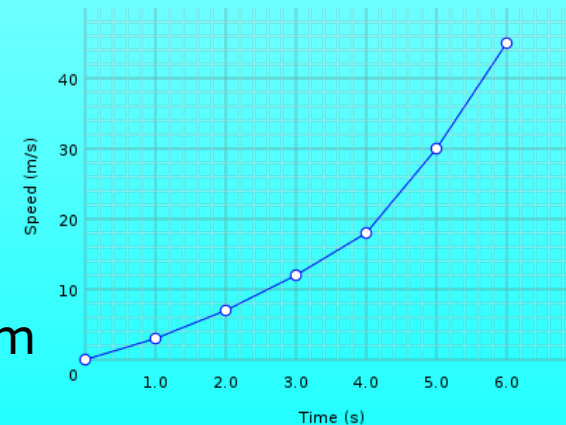


6 Steps of the Scientific Method

4. Design and conduct an experiment
– How will the hypothesis be tested?

5. Analyze data from experiment
– What did the experiment tell you?
– Data can be quantitative (numbers) or qualitative (observations)

6. Draw conclusions
– Was your hypothesis correct or incorrect?
• If correct, repeat your experiment to confirm results
• If incorrect, change your hypothesis and test again



Models of Scientific Method

- My example: Chemical reactions based on pH levels
 - State the problem
 - Will lemon juice cause milk to spoil faster than normal?
 - Hypothesis
 - If lemon juice is added to milk, then it will cause it to spoil faster than if nothing was added to it.
 - Experiment
 - Add 20ml of lemon juice to 100 ml of milk
 - Analyze data
 - Draw conclusions



Parts of a Science Experiment

- Control: what you compare your results to
 - Part of your experiment that remains the same
- Independent Variable: what you are testing in the experiment
 - Part of your experiment that is changed to cause some sort of effect
- Dependent Variable: what you are measuring
 - The effect caused by the independent variable

Theory vs. Law

- Scientists use experiments to develop theories and laws
- Scientific Theory: an explanation of how things happen based on scientific knowledge
 - Based on many experiments and observations
 - Accepted to be true, but can be changed based on new information
 - Example: Theory of Evolution
 - Explains how living things have changed over millions of years

Theory vs. Law

- Scientific Law: statement about how things work that is true all of the time
 - Tells what will happen
 - Example: Law of Gravity
 - Explains how objects exert a gravitational force (pull) on other objects