Scientific Measurement

Video Notes
In this lesson you will

• Define length, mass, volume, time and temperature
• Name the SI unit for each and an instrument use to measure each
• Make measurements using the correct unit as well as the correct number of significant digits
Chemistry

• Relies on precise measurements

• How many
  ◦ Ounces are in a cup
  ◦ Meters are in a kilometer
  ◦ Feet are in a mile
  ◦ Ounces are in a pound

• This is a lot to keep up with, so we use a standard system of measurement.
The English System

• Old system
• Evolved over the years into a standard system of measurement
• 12 inches equals a foot (instead of the old method of measuring the king’s foot)
• Inch
• Ounce
• pound
The Metric System

• Used in most countries outside the US and Great Britain

• Some examples are used in the US
  ◦ Liter (like a 2 liter of drink)
  ◦ mm (like 35 mm of film)
International System (SI)

- Measuring system used in science.
- AKA- Metric System
Length

• The distance between 2 points
• Base unit- Meter (m)
• Instrument- meter stick or metric ruler
• Example of use: a road sign stating the distance. Most other countries measure distance in km (kilometers)
Mass

- Amount of matter in a substance
- Base unit: gram (g)
- Instrument: balance
- Example: one paperclip is one gram
Volume

- Amount of space an object occupies
- Base unit- liter (L)
- Instrument- metric ruler (measuring a solid), Graduated cylinder (measuring a liquid)
- Example- a 2 Liter bottle measure the volume of a solid, liquid, or gas. The amount of the substance in the bottle will always be 2 liters.
Time

- Interval between two occurrences
- Base unit: second (s)
- Instrument: stopwatch
- Example: watching the clock to see when class is over
Temperature

• Average kinetic energy of a substance
• Base unit — °C (degree Celsius) or a K (Kelvin)
• Instrument- Thermometer
• Example- taking your temperature if you are sick
Measuring Example

• Measure the width of your textbook. Be sure to use cm

• A measurement includes both a **number** and a **unit**.
Significant Figures

- Use decimals (not fractions)
- Use metric units only in science (not inches, ounces, miles, etc)
- Significant figures - measured numbers plus one estimated number
Examples of Volume Measurements

- Volume of a liquid - use a graduated cylinder (measure in mL)

- Volume of a solid - regular or irregular
  - Rectangular solid - $V = L \times W \times H$
  - Cube has a side length of 3 cm - $V = L \times L \times L$ or $3 \times 3 \times 3$ or $27$ cm$^3$
  - Rectangular solid has a length of 5.0 cm, width of 3.0 cm and a height of 1.0 cm. The volume is 15 cm$^3$
  - Irregular solid - like a rock - water displacement
Water Displacement

• Record any amount of water in a graduated cylinder in mL (remember significant figures)
• Drop the rock into the water
• Record the new water measurement
• Subtract the first water measurement from the second water measurement
• The change in water measurement is the volume for an irregular solid
Mass

- Many kinds of balances
- Triple beam balance is most popular
- Digital balances are easiest to use (usually measures to the hundredths place)

When taking the mass of a liquid, be sure to measure the mass of the liquid in its holder (a cup). Then measure the cup only. Subtract the mass of the cup from the mass of the cup and water. The result will be an accurate mass measurement of the water only.
Tricky Fact

• $1 \text{ cm}^3 = 1 \text{ mL}$
Chemistry Quiz

• CR1- Which of these is a quantitative observation?
  ○ A. the candle is 2.0 cm long
  ○ B. the wick of the candle is curled at the top
  ○ C. the wax contains carbon and hydrogen
Chemistry Quiz

- CR2. Chemistry is the study of
  - A. candles
  - B. the metric system
  - C. reactions
  - D. matter
Chemistry Quiz

1. The instrument used to measure mass is the
   - A. graduated cylinder
   - B. ruler
   - C. balance
   - D. stopwatch
Chemistry Quiz

2. What is the volume of a cube if each side measures 2.0 cm?
   - A. 8.0 cm
   - B. 8.0 cm³
   - C. 2.0 cm
   - D. 6.0 cm³
3. A graduated cylinder has 20.0 cm³ of water in it when a marble is dropped in. The water level rises to 21.5 cm³. What is the volume of the marble?

- A. 20 cm³
- B. 21.5 cm³
- C. 1.5 cm³
- D. 41.5 cm³
4. The process used to find the volume in question 3 is called:
   - A. water displacement
   - B. water subtracting
   - C. irregular volume