Introductory Chemistry 2 Notes

The Scientific Method Quick Review Notes

- I can identify and describe the steps of the scientific method.
- I can distinguish between the independent and dependent variables.
- I can identify the control group and the experimental group.

The Scientific Method

Everyone uses parts of the scientific method everyday, whether they realize it or not!

Steps of The Scientific Method

1. Make an observation.
   -You need to be aware of your surroundings!

2. Based on your observations, state the problem in the form of a question.

Steps of The Scientific Method

3. Once you have a question, you need to do research.

4. Based on your research, you form a hypothesis.

Steps of The Scientific Method

5. Next, you design and conduct experiments to test your hypothesis.

6. Analyze the data you collected during the experiment.

- Organizing data into charts and graphs is useful for this step.

Steps of The Scientific Method

7. Based on your data, you draw conclusions.

    - This means you accept or reject your hypothesis.

The Scientific Method

- A hypothesis is an *educated* guess that answers your question.
- Experiments should be designed as a step by step process.
- Experiments should prove or disprove the hypothesis.

The Scientific Method

- If you reject your hypothesis, did you waste your time?

The Scientific Method

- Experiments should be repeated to verify results. *Doing an experiment once is not good enough!* You should include multiple trials.

The Scientific Method

- A variable is any factor in an experiment that can be changed.
- What would be the variables if we were to grow plants?

The Scientific Method

Independent Variable

- The independent variable is the factor you choose to change or manipulate.

Dependent Variable

- The dependent variable is what you want to measure.

What Makes A Great Experiment?

1. Control Group

- The control group has no variables that change, life is normal.

- The control group gives you something to compare your results to.

What Makes A Great Experiment?

2. A large sample size. The more times you repeat things the better!

3. One variable that changes between the control and experimental group.

- Changing one variable at a time ensures you know what caused the results.

Review questions

1. What is a hypothesis?
2. Why should experiments be repeated?
3. What is the purpose of an experiment?
4. What is useful for organizing data?
5. Why are control groups important?
6. Why can you only change one variable at a time?

The Metric System & Scientific Notation

- I can convert between different units of the metric system using the ladder method.
- I can identify the different units of SI measurement.
- I can put numbers into scientific notation.
- I can take numbers out of scientific notation.

The Metric System Notes

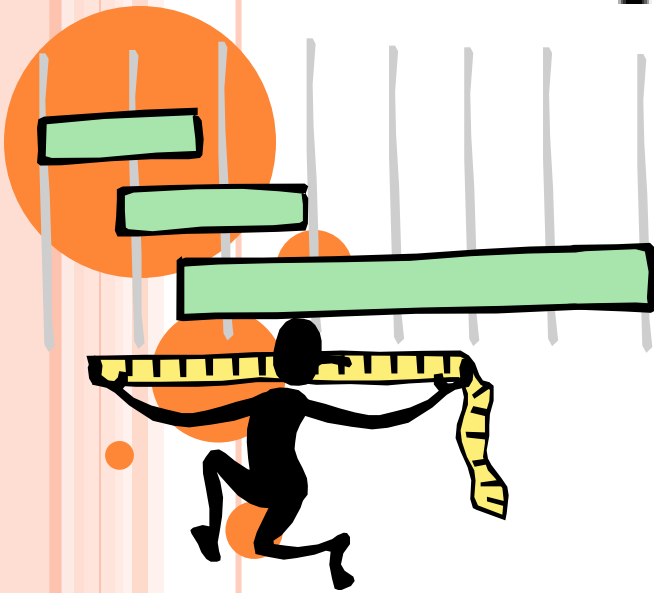
- Accuracy is extremely important in all areas of science.
- Measurements are a way to gather data.

- The SI System is the International System of Measurement.
- The SI system is used because it develops an international standard.
- It is based on the metric system and it is easy to use because it is based on powers of 10.

Quantity	SI Base Unit	Symbol	Non-SI unit	Symbol
Length	Meter	m		
Volume	Meters cubed	m^3	Liter	L
Mass	Kilogram	kg		
Time	Second	s		
Temperature	Kelvin	K	Celsius	C

Pre-fix	Symbol	Scientific Notation
Mega	M	10^{6}
Kilo	k	10^{3}
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	μ	10^{-4}
Nano	n	10^{-6}
Pico	p	10^{-7}

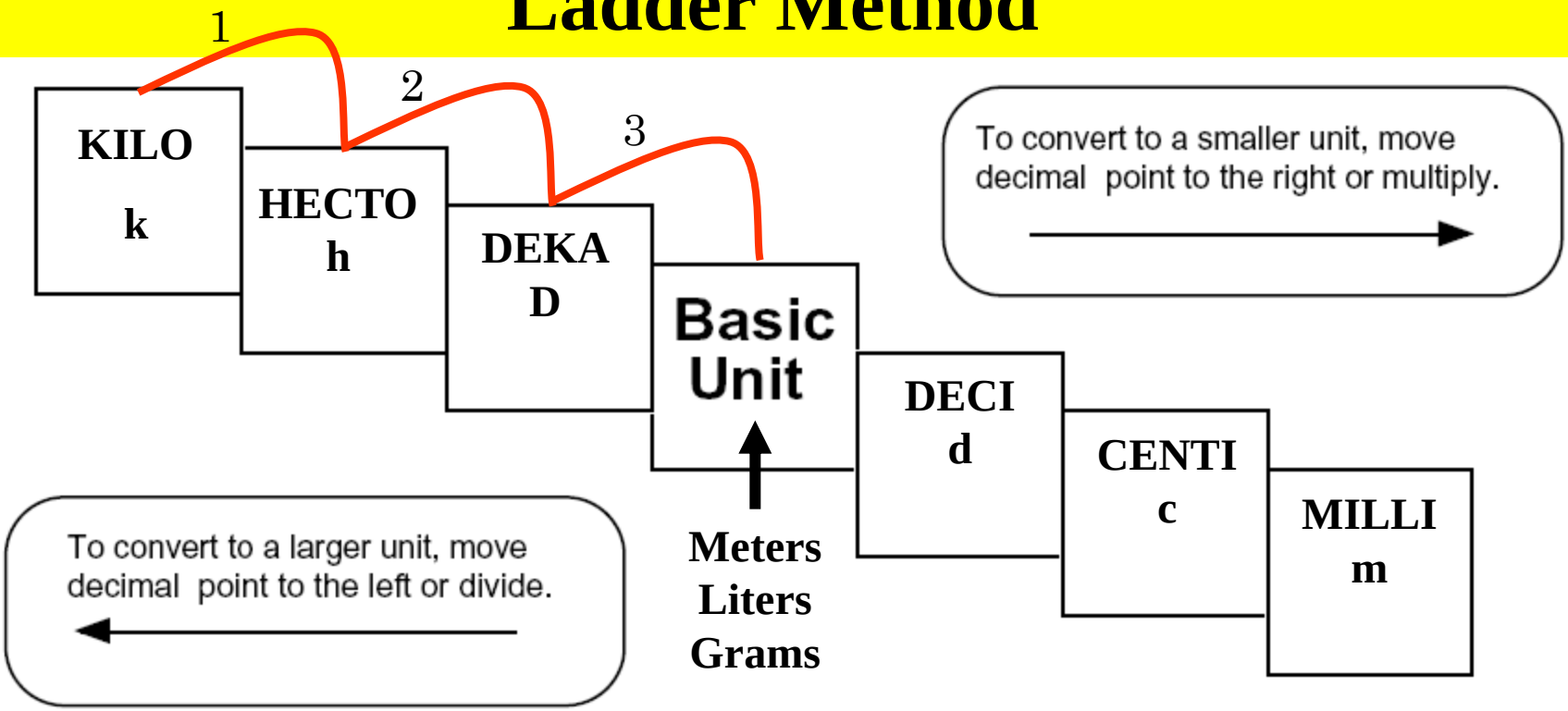
Metric Mania



Metric Conversions
Ladder Method

T. Trimpe 2008 http://sciencespot.net/

Ladder Method



How do you use the "ladder" method?

1st – Determine your starting point.

2nd – Count the "jumps" to your ending point.

3rd – Move the decimal the same number of jumps in the same direction.

4 km = _____ m

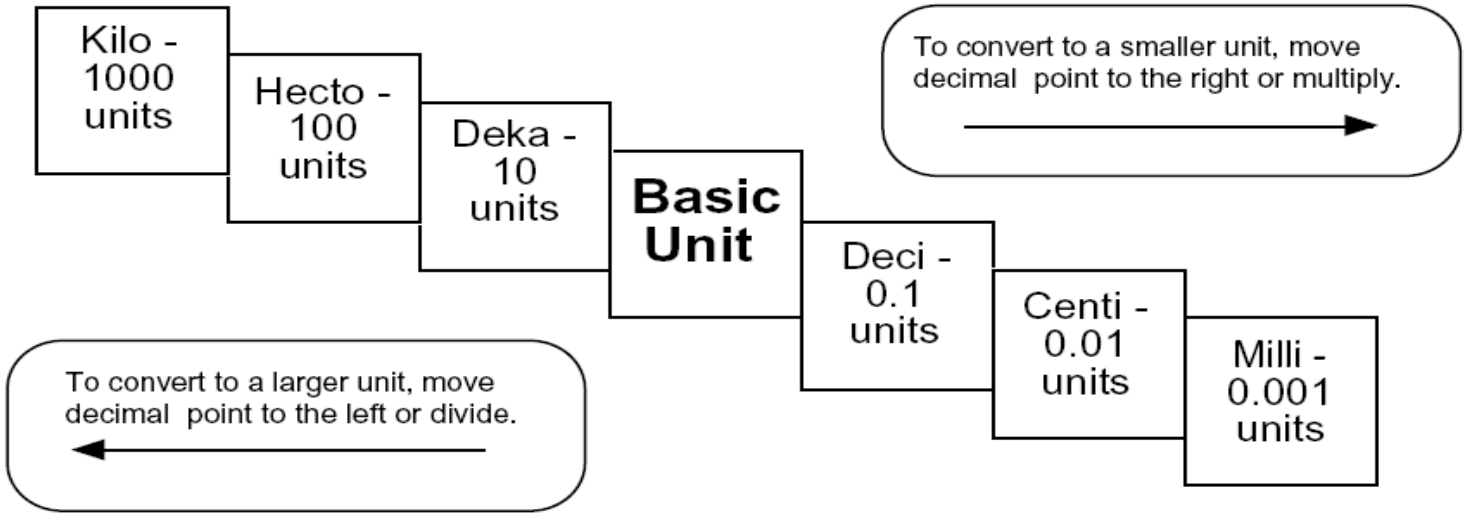
Starting Point Ending Point

How many jumps does it take?

4. _. _. _. = 4000 m

1 2 3

Conversion Practice



Try these conversions using the ladder method.

1000 mg = _____ g

1 L = _____ mL

160 cm = _____ mm

14 km = _____ m

109 g = _____ kg

250 m = _____ km

Compare using <, >, or =.

56 cm ◯ 6 m

7 g ◯ 698 mg

Scientific Notation

- I can convert numbers into scientific notation.
- I can convert numbers into regular notation from scientific notation.
- I can explain why scientific notation is useful.

- Why is scientific notation useful?

Scientific Notation

- Many of the numbers used in chemistry are extremely small or large.
- Therefore, it is important you understand scientific notation.

- Give an example of a number written in scientific notation.

Scientific Notation

- In scientific notation, the number is written as two parts.
- The first part is a number between 1 and 9.

Scientific Notation

- The first part cannot be a number that starts or ends with a zero.
- Zeros can be in between but not at the beginning or end.

Scientific Notation

- The second part is an exponent, written as a power of 10.
- What is an exponent?

- Prediction: What does the exponent tell you?

- Prediction: What does the sign of an exponent tell you?

- The exponent tells you how many places to move the decimal point.
- Example: 2.6×10^3

_____ is the exponent and tells you to move the decimal _____ places.

Scientific Notation

- The power of the exponent tells you which way to move the decimal point.

Scientific Notation

Positive Exponent

- A positive sign tells you to move the decimal to make the number larger than one.

Negative Exponent

- A negative sign tells you to move the decimal point to make the number smaller than one.

Scientific Notation

Examples:

3.1×10^{-3}

6.25×10^{4}

Scientific Notation

- Putting numbers into scientific notation requires moving the decimal point so there is only one number in front of it.

***Remember, the first number cannot be a zero.

- If you don’t see a decimal point in a number, where is it?

- If you don’t see a decimal point, it is at the end of the number.
- Example: 798

- To put numbers into scientific notation:

1. Move the decimal point so only one number (not a 0) is in front of it.
2. Count the number of places you had to move the decimal point.
3. The number of places you moved the decimal point becomes your exponent.

- The sign of the exponent depends on your original number.
- If the number was bigger than one, the sign is positive.
- If the number was less than one, the sign is negative.

Examples

- Write out the following in regular notation:

1. 6.02×10^{-5}

2. 2.365×10^{6}

3. 1.95×10^{-3}

4. 9.89×10^{4}

- Put the following into scientific notation:

1. 265000
2. 0.356
3. 0.0000754
4. 33000

Review questions

- Why is scientific notation useful?
- What does the exponent in scientific notation tell you?
- What does the sign of an exponent tell you?
- When the exponent is negative in scientific notation, it tells you the real number is _____ than one.
- Put the following numbers into scientific notation:
  0.00000571

  10000000000
- Put the following numbers into regular notation:

2.66×10^{7}

9.87×10^{-4}

Matter

- I can define matter, mass, and volume
- I can list the three states of matter.
- I can describe the characteristics of the different states of matter.
- I can define and give examples of chemical and physical changes and properties.
- I can calculate density.

- Define the following in your own words:

  Matter

  Mass

  Volume

Matter

- Matter is anything that has mass and takes up space.
- The mass of an object is the amount of matter the object contains.

Matter

- Volume is the amount of space an object occupies.
- There are four states of matter. They are solid, liquid, gas, and plasma.

Solids

- Solids have a definite shape and volume.
- Solids have order to their structures.

Liquids

- Liquids have a definite volume.
- However, the shape of a liquid changes.
- The shape of a liquid depends on the container it is in.
- Liquids flow freely.

Gases

- Gases have no definite shape or volume.
- Gases expand to take the shape of their containers.
- Gases have low densities.
- There are fewer gas particles in a gas compared to a liquid or solid.

Plasma

- Plasma is the most abundant state of matter in the universe.
- Plasma is a superheated gas that has free moving electrons.
- Plasma is different from a gas, because it is made up of groups of positively and negatively charged particles.

Plasma

- Like a gas, plasma does not have a definite shape or a definite volume.
- Unlike gas, under the influence of a magnetic field, it may form structures such as filaments, beams and double layers.
- Examples of plasma on Earth: Lightning, Neon Signs, Florescent Lights.

Changes in State

- Heating or cooling a sample of matter results in changes of state.
- When a solid becomes a liquid, it is melting.
- When liquids become solids, it is freezing.

Change of state

- What causes a change of state? Give an example of a change in state.

Changes in State

- When liquids become gases, it is evaporation.
- When gases become liquids, it is condensation.
- Gases can go directly to solids through deposition.
- Solids can go directly to gases through sublimation.

- Prediction: What is a physical property?
- Prediction: What is a chemical property?

Matter

- Physical properties are characteristics that can be observed without altering the identity of the substance.
- Examples include: Color, solubility, odor, density, melting point, etc.

Matter

- Chemical properties are characteristics that can't be observed without altering the identity of the substance.
- Examples include: rusting and burning

- Prediction: What type of change, a physical or chemical change, would change the identity of a substance?

Physical Changes

- Physical changes do not change the identity of a substance.
- Examples of physical changes include: cutting, melting, freezing, breaking, etc.

Chemical Changes

- Chemical changes or chemical reactions do alter the identity of the substance.
- Examples of chemical change include: burning, rusting, cooking, decomposing, explode, fading, etc.

Conservation

- A chemical change produces a new substance from what existed before.
- Like energy, matter is neither created or destroyed in any process.

Matter

- This is known as the law of conservation of matter.

Density Notes

- I can write the formula for density.
- I can calculate density.
- I can explain why a substance floats.

- Density is a ratio of mass to volume.
- Density is a physical property and can be used to identify a substance

- Will the density of copper always be the same? Why or why not?

- The formula for density is
  - $D = \frac{M}{V}$
- Density is a characteristic property that depends on the type of substance not the amount.

Why does something float on water?

Why do things float?

- To float on water, the density of an object must be less than water.
- A helium balloon floats because it is less dense than air.

- When you heat most substances, what happens to their volume?
- When most substances are heated, what will happen to their densities? Why?
- Can you name a substance that expands when it freezes?

- In general, when substances are heated, their density decreases because volume increases but mass stays the same.

- The exception to this rule is water.
- The density of water is 1g/ml.
- Water, when cooled, expands.
- When it expands, the volume increases.

- Increasing the volume causes the density to decrease.
- Therefore, ice is less dense than water, and ice floats!

- Review Questions
- What is the formula for density?
- Is density a physical or chemical property? Why?
- Explain why a substance floats in water.
- Explain what happens to volume when a substance is heated.
- Explain why ice floats on water.