**Chapter 1 – Science Skills (Pages 1-30)**

Prentice Hall – Physical Science: Concepts in Action, Copyright 2004

***Section 1.2 – Using a Scientific Approach (pages 7-11)***

*Key Concepts:*

* What is the goal of a scientific method?
* How does a scientific law differ from a scientific theory?
* Why are scientific models useful?

*Vocabulary:*

1. Scientific method
2. Observation
3. Hypothesis
4. Manipulated variable
5. Responding variable
6. Controlled experiment
7. Scientific theory
8. Scientific law
9. Model

*Consider this scenario:*

* You are outside and it begins to rain. You have no umbrella, but there is a building roughly 100 yards away from your current location. You do not want to get soaked by the rain. What do you do? Do you walk to the building – or do you run? Why?
* Let’s consider the options:
  + You choose to run: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* + You choose to walk: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* You now have a question that you can try to answer with a scientific approach. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Scientific Methods*

* In order to answer questions about the world around them, scientists need to get information
  + **scientific method**:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The goal of any scientific method is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Making Observations:
  + Scientific investigation often begins with **observation:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Repeatable observations are known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + EXAMPLE: When you walk or run in the rain, you get wet.
    - In addition: standing in the rain leaves you much wetter than walking or running in the rain.
  + Combine observations to form a question: How does your speed affect how wet you get when you are caught in the rain?
* Forming a hypothesis:
  + **Hypothesis**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - For a hypothesis to be useful, it must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Form of an If-then-because statement: **If** you run in the rain rather than walking, **then** you will get less wet **because** you will spend less time in the rain resulting in less contact.
* Testing a hypothesis:
  + Scientists \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to test their hypothesis.
  + Variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Experiment to test if speed affects how wet you get in the rain.
      * Variables include your speed, your size, the rate of rainfall, and the amount of water that hits you.
      * Your hypothesis states that one variable, speed, causes a change in another variable, the amount of water that hits you.
    - **Manipulated Variable** (independent): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * The speed with which you walk or run
    - **Responding Variable** (dependent): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * The amount of water that you accumulate
  + To examine the relationship between a manipulated variable and a responding variable, scientists use **controlled experiments:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - While the responding variable is observed for changes, all other variable are kept \_\_\_\_\_\_\_\_\_\_\_\_\_\_, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Page 9 – In 1997, two meteorologists conducted a controlled experiment to determine if moving faster keeps you drier in the rain.
      * Both scientists traveled 100 yards by foot in the rain
        + One walked, one ran
      * Measured mass of clothes before and after – provides data on how much water accumulated
      * Controlled variables:
        + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – same height and build
        + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – began at same time, during same rainstorm, following same path
        + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – identical clothes
* Drawing Conclusions:
  + Scientists gathered some convincing data:
    - Walking Scientist
      * Accumulated 217 grams of water
    - Running Scientist
      * Accumulated 130 grams of water
  + Conclusion: Running in the rain keeps you drier than walking – about 40% drier!!!
    - Now you have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to support your hypothesis!
    - But what if the scientific data does not support your hypothesis?
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Developing a Theory:
  + Once a hypothesis has been supported in repeated experiments, scientists can begin to develop a **scientific theory:** ­­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Theories are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!
      * Instead, they become stronger if the facts continue to support them.
      * However, if an existing theory fails to explain new facts and discoveries, the theory may be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Scientific Laws*

* After repeated observations or experiments, scientists may arrive at a **Scientific Law**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Example: Newton’s Law of Gravity describes how two objects attract each other by means of a gravitational force.
    - This law has been verified over and over.
    - However, scientists have yet to agree on a theory that explains how gravity works.
* A scientific law describes an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of such a pattern is provided by a scientific theory.

*Scientific Models*

* *Consider this scenario*: You are on vacation in New York City for the first time. You would like to visit Central Park – the problem is, you have no idea how to get there. What do you do?
  + Ask someone
  + Search the internet
  + Consult a map
    - A map is a type of **model**, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Scientific models make it easier to understand things that might be too difficult to observe directly.
    - Examples of models?
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – small scale model of the earth
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – model of only the bones of the human body
      * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – allow us to see things very small.
* Models should be continued to be used until experiments/tests shows that the model is wrong.
  + Over the years, scientists ­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the time over and over.
    - Earth is flat
    - Sun revolved around the earth

***Section 1.3 – Measurement (pages 14-20)***

*Key Concepts:*

* Why is scientific notation useful?
* What units do scientists use for their measurements?
* How does the precision of measurements affect the precision of scientific calculations?

*Vocabulary:*

1. Scientific notation
2. Length
3. Mass
4. Volume
5. Density
6. Conversion factor
7. Precision
8. Significant figures
9. Accuracy
10. Thermometer

*Measurement:*

* How old are you? How tall are you? How much does that cost?
  + The answer to these questions are all measurements
    - Measurements are important in both science and everyday life.

*Using Scientific Notation*

* How many stars do you see? How many blades of grass are in the picture? How many grains of sand are there?



* Scientists often work with very large or very small numbers.
  + For example, the speed of light is about 300,000,000 meters per second. The average snail has been clocked at a speed of only 0.00086 meters per second.
  + Instead of having to write all of the zeroes in these numbers, you can use a shortcut called **scientific notation**: ­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Example: 300,000,000 can be written as 3 x 108 – the exponent, 8, tells you that the decimal point if really 8 places to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the 3.
    - Example: For numbers less than one, the exponent is written as a negative.
      * 0.00086 written in scientific notation becomes 8.6 x 10.4.
      * The negative exponent tells you how many decimal places there are to the \_\_\_\_\_\_\_\_\_\_\_ of the 8.6
  + Scientific notation makes very large or very small numbers easier to work with.
  + When writing numbers in scientific notation, there should only be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the left of the decimal – you may need to adjust your answer to proper scientific form when performing calculations.
    - Example: 26.3 x 106 should be written as 2.63 x 107

*Math Using Scientific Notation*

* Adding/subtracting numbers written in scientific notation
  + Adjust the exponents so that they are the same
  + Add or subtract the whole numbers
  + Adjust the answer in proper scientific notation
* Multiplying numbers written in scientific notation
  + Multiply the whole numbers
  + Add the exponents
  + Adjust the answer so it is in proper scientific notation
* Dividing numbers written in proper scientific notation
  + Divide the whole numbers
  + Subtract the exponents
  + Adjust the answer so it is in proper scientific notation

*SI Units of Measurements*

* For a measurement to make sense, two things are needed:
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Most units you are familiar with (inches, miles, feet, gallons, degrees Fahrenheit) are not used in science.
  + Scientists use a set of measuring units called SI, or the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + By using only one system of measurements, scientists can easily interpret one another’s data.

*Base Units and Derived Units*

* SI is built upon seven metric units, known as base units.
  + **Length**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **mass:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- |
| **Quantity** | **Unit** | **Symbol** |
| **Length** | Meter | m |
| **Mass** | Kilogram | kg |
| **Temperature** | Kelvin | K |
| **Time** | Second | s |
| **Amount of a substance** | Mole | mol |
| **Electric current** | Ampere | A |
| **Luminous Intensity** | Candela | cd |

* Derived units are made from combinations of base units.
  + **Volume**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Volume of a rectangle = length x width x height
      * Each of these measurements is made in meters = meter x meter x meter or cubic meters (m3)
  + **Density**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Density of an object = mass / volume
      * Mass is measured in kilograms and volume in cubic meters = kilograms per cubic meter (kg/m3)

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| --- | --- | --- |
| **Quantity** | **Unit** | **Symbol** |
| **Area** | Square meter | m2 |
| **Volume** | Cubic meter | m3 |
| **Density** | Kilograms per cubic meter | kg/m3 |
| **Pressure** | Pascal (kg/m∙s2) | Pa |
| **Energy** | Joule (kg∙m2/s2) | J |
| **Frequency** | Hertz (1/s) | Hz |
| **Electric Charge** | Coulomb (A∙s) | C |

*Metric Prefixes*

* The metric unit for a given quantity is not always a convenient one to use.
  + Example: the time it takes for a computer hard drive to read or write data – also known as seek time – is in the range of thousandths of a second: 0.009 seconds.
    - A more compact method is to write it our as a metric prefix: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - 0.009 seconds can become 9 milliseconds (9 ms)

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| --- | --- | --- | --- | --- |
| ***Prefix*** | ***Symbol*** | ***Meaning*** | ***Multiply Unit by*** |  |
| *Giga-* | *G* | *Billion (109)* | *1,000,000,000* |  |
| *Mega-* | *M* | *Million (106)* | *1,000,000* |  |
| ***Kilo-*** | ***k*** | ***Thousand (103)*** | ***1000*** | ***King*** |
| ***Hecto-*** | ***h*** | ***Hundred (102)*** | ***100*** | ***Henry*** |
| ***Deca-*** | ***da*** | ***Ten (101)*** | ***10*** | ***Died*** |
| ***BASE UNIT*** |  |  |  | ***By*** |
| ***Deci-*** | ***d*** | ***Tenth (10-1)*** | ***0.1 or (1/10)*** | ***Drinking*** |
| ***Centi-*** | ***c*** | ***Hundredth (10-2)*** | ***0.01 or (1/100)*** | ***Chocolate*** |
| ***Milli-*** | ***m*** | ***Thousandth (10-3)*** | ***0.001 or (1/1000)*** | ***Milk*** |
| *Micro-* | *µ* | *Millionth (10-6)* | *0.000001 or (1/1,000,000)* |  |
| *Nano-* | *n* | *Billionth (10-9)* | *0.000000001 or (1/1,000,000,000)* |  |

* ***Conversion factor:*** *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
  + *Example: Mount Everest is 8848 meters – how many kilometers is this?*
    - *The prefix kilo- tells you that there are 1000 base units in one Kilo-unit (1000 meters in one kilometer)*
    - *This gives us two conversion factors to use:*
    - *1 km / 1000 m OR 1000 m / 1 km*

|  |  |
| --- | --- |
| *8848 ~~meters~~* | *1 kilometers* |
|  | *1000 ~~meters~~* |

*= 8.848 kilometers*

*Limits of Measurement*

* How much time does it take?
  + We need some class volunteers:
    - 1 with an IPhone stop watch
    - 1 with a regular analog watch
    - 1 with the classroom clock
    - 1 with a provided stop watch
    - 3 people who can do 10 push-ups
* **Precision:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Which time was the most precise?
* **Significant Figures:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The fewer the significant figures, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the measurement is.
  + How do we determine the number of significant figures in a number?
    - Atlantic/Pacific Rule
    - Decimal ABSENT: start on the ATLANTIC side of the number and locate your first non-zero, count it and every number to the left of it.
    - Decimal PRESENT: start on the PACIFIC side of the number and locate the first non-zero, count it and every number to the right of it.
  + How many significant figures does each time have?
  + Significant Figure Calculations:
    - When you make calculations with measurements, the uncertainty of the separate measurements must be correctly reflected in the final results.
    - The precision of a calculated answer is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Addition/Subtraction
      * When adding or subtracting numbers, count the **NUMBER OF DECIMAL PLACES** to determine the number of significant figures.
      * The answer cannot **CONTAIN MORE PLACES AFTER THE DECIMAL POINT THAN THE SMALLEST NUMBER OF DECIMAL PLACES** in the numbers being added or subtracted.
    - Multiplication/Division
      * When multiplying or dividing numbers, count the **NUMBER OF SIGNIFICANT FIGURES.**
      * The answer cannot **CONTAIN MORE SIGNIFICANT FIGURES THAN THE NUMBER BEING MULTIPLIED OR DIVIDED** with the **LEAST NUMBER OF SIGNIFICANT FIGURES.**
* **Accuracy:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + We need some more volunteers – dartboard accuracy and precision

*Measuring Temperature*

* **Thermometer:**  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **Read:** How it works: thermometer on page 21
* Temperature Scales:
  + Fahrenheit (°F)
  + Celsius (°C)
  + Kelvin (K) – SI base unit for temperature
    - A temperature of 0 K, or 0 Kelvin, refers to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that can be reached – converts to -273.15 °C or -459.67 °F
      * Lowest natural air temperature ever recorded on earth: July 21, 1983 at the Russian Vostok Station in Antarctica: -89.2 °C or -128.6 °F
    - Kelvin has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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|  | **Fahrenheit (°F)** | **Celsius (°C)** | **Kelvin (K)** |
| **Water boils** | 212 | 100 | 373 |
| **Human body** | 98.6 | 37 | 310 |
| **Average Room** | 68 | 20 | 293 |
| **Water freezes** | 32 | 0 | 273 |
| **Lowest Possible** | -459.67 | -273.15 | 0 |

* Temperature Conversions
  + Converting from °F to °C
    - °C = (5/9)(°F-32.0°) OR °C = °F + 40 x (5/9) – 40
  + Converting from °C to °F
    - °F = (9/5)( °C) + 32.0° OR °F = °C + 40 x (9/5) – 40
  + Converting from °C to K
    - K = °C + 273
    - How do you convert from K to °C? °F to K OR K to °F?

***Section 1.4 – Presenting Scientific Data (pages 22-25)***

*Key Concepts:*

* *How do scientists organize data?*
* *How can scientists communicate experimental data?*

*Vocabulary:*

1. *Slope*
2. *Direct proportion*
3. *Inverse (indirect) proportion*

*Organizing Data*

* Scientists can organize their data by using \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + These tools make it easier to spot patterns or trends in the data that can support or disprove a hypothesis.
* Data Tables
  + The simplest way to organize data is to present them in a table.
  + Tables can relate variables – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Line Graphs
  + A line graph is useful for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + In a line graph, the manipulated variable is generally plotted on the horizontal axis (x-axis)
  + The responding variable is plotted on the vertical axis (y-axis)
  + Data points are typically connected using a line
    - The steepness, or **slope**, of the line is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Slope = rise / run
      * Rise represents the change in the y-variable (y2 – y1)
      * Run represents the change in the x-variable (x2 – x1)
    - **Direct proportion:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * When one doubles, the other doubles
    - **Inverse (Indirect) Proportion:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * When one doubles, the other is cut in half
* Bar Graphs
  + A bar graph is often used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + This type of graph makes it easy to see comparisons between different data.
* Circle Graphs
  + A circle graph is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Each piece of data is represented as a percentage of the whole unit.

*Communicating Data*

* Scientists can communicate results by writing in scientific journals or speaking at conferences.
* Different scientists may interpret the same data differently – this is the basis for peer review: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_