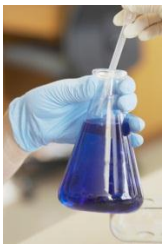
Nature of Science Reference Charts

Lab Safety

Special clothing may be needed in the science lab:

- **Gloves protect your hands.**



- **Safety goggles protect your eyes from splashes or flying objects.**

- **Lab coats or lab aprons protect your skin and clothes from spills.**

- **Wear shoes that cover your feet or shoe coverings.**

- **Be careful with loose long hair, loose clothing, or dangling jewelry.**

Always follow your teacher's instructions:

- **Follow directions for how to do the lab.**
- **Follow instructions in an emergency.**
- **Do not try to guess what to do if you're not sure; ask your teacher for help.**

Doing Experiments

Hypothesis: an informed explanation that can be tested.

Prediction: what you expect will happen.

Process for creating a hypothesis and making predictions using your hypothesis:

1. **Question: Start with a question about how the world works.**
2. **Research: Learn about the topic so that you are informed.**
3. **Hypothesis: Come up with an informed explanation for your question.**
4. **Predictions: See what predictions your hypothesis leads to, so that it can be tested.**
5. **Experiment: Do an experiment to test whether your hypothesis is supported by evidence.**

How scientists create a theory:

- **It begins as a hypothesis (an informed explanation that can be tested).**
- **If evidence supports the hypothesis, other scientists will agree with the hypothesis.**
- **When many scientists agree with the hypothesis, it is called a theory.**
- **If nearly all scientists agree with the theory, it may be called a principle or a law.**
- **The theory is adjusted if new evidence is found.**

SI Units

Scientists use the SI system of units.

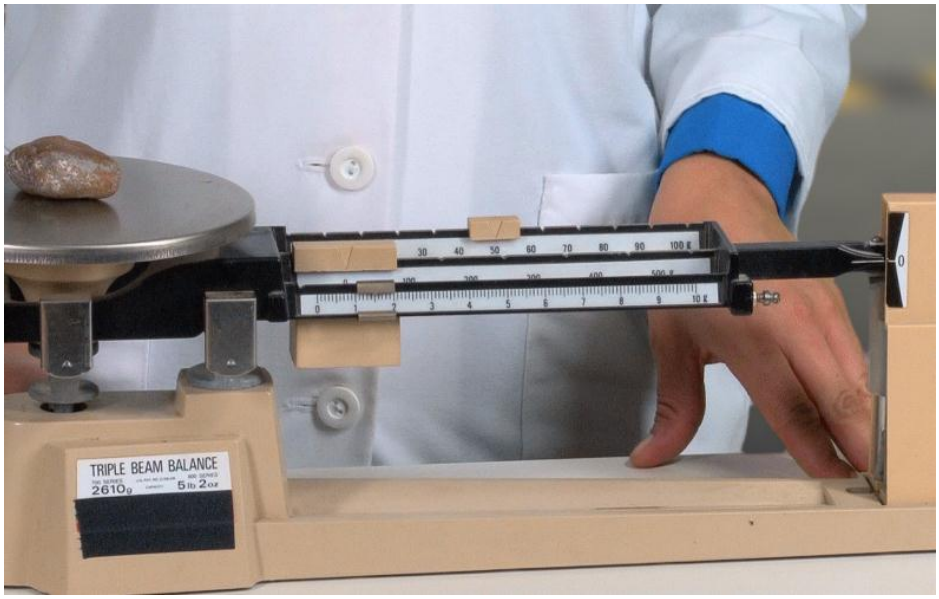
The SI system of units includes prefixes that modify the basic unit.

- **centi = hundredth**
- **milli = thousandth**
- **kilo = thousand**

Some SI Units

Quantity	Unit	Unit abbreviation	Measured using…
time	second	s	stopwatch
length	meter	m	meter stick or tape measure
temperature	degree Celsius	°C	thermometer
mass	gram	g	scale or balance

Triple-Beam Balance



To use a triple-beam balance:

1. **Make sure the pointer lines up with the white line labeled 0.**
2. **Put object on the pan.**
3. **Move the largest slider over until the balance tips to the right.**
4. **Move the largest slider back slightly until the arrow on the slider lines up exactly with a number on the beam.**
5. **The balance should be level or tip back to the left.**
6. **Repeat steps 3, 4, and 5 for the second-largest slider, and then for the smallest slider.**
7. **The balance should now be level, and the pointer should line up with the white line labeled 0.**
8. **Add up the values below each slider to get the object's mass in grams.**

Variables and Data

Scientists study the relationship between scientific variables—how one variable affects other variables.

Independent variable: the variable that is changed by the scientist.
- **not affected by other variables**
- **also called the test variable**

Dependent variable: the variable scientists observe for changes.
- **affected by the independent variable**
- **also called the outcome variable**

Controls: things that are kept constant during an experiment.

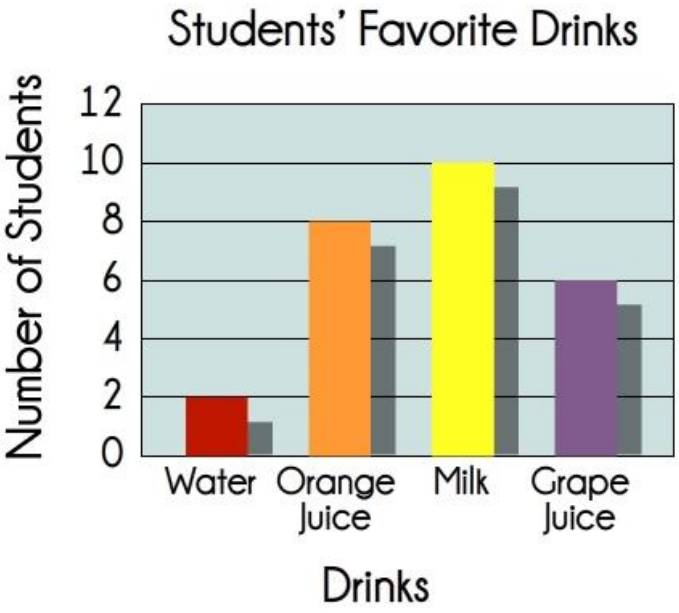
There are several common mathematical tools used to help analyze data:
- **Mean: the average.**
  - **found by adding up all your numbers, then dividing by how many numbers you had**
  - **often used to represent a set of data as a single number**
- **Median: the middle number.**
  - **if you have an even amount of numbers, the median is the number halfway between the two middle numbers**
  - **if the median and mean are close to one another, it often indicates that the mean is a good representation of the whole data set**
- **Mode: the number that appears most often.**
  - **tells the most common measurement**
- **Range: the largest number minus the smallest number.**
  - **tells you how much variation is in your data set**

Types of Graphs

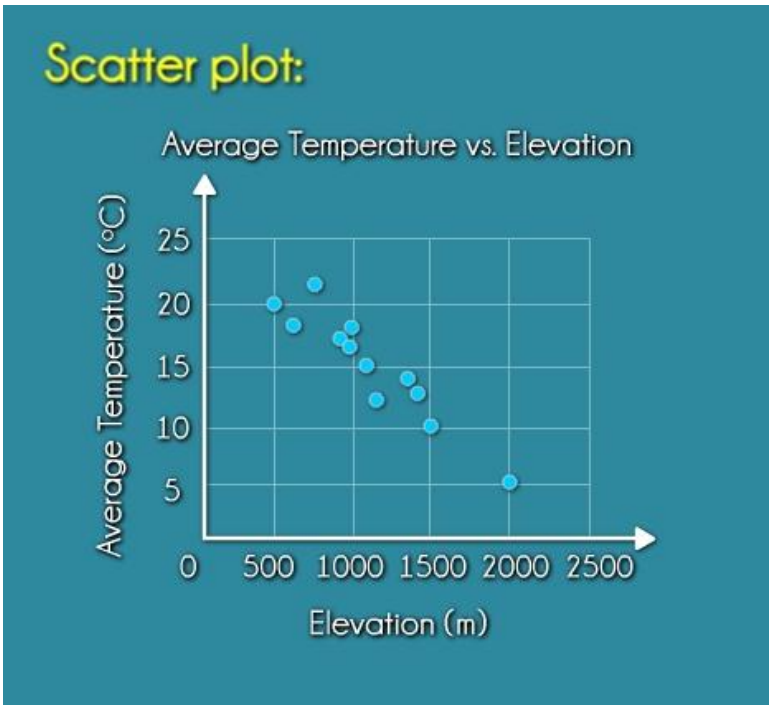
To create a graph:
1. **Pick the type of graph based on what kind of data you have and what you want to show most clearly.**
2. **Create your graph, including appropriate axes, titles, and labels.**
3. **Add your data to the graph, making sure to be as exact as possible.**

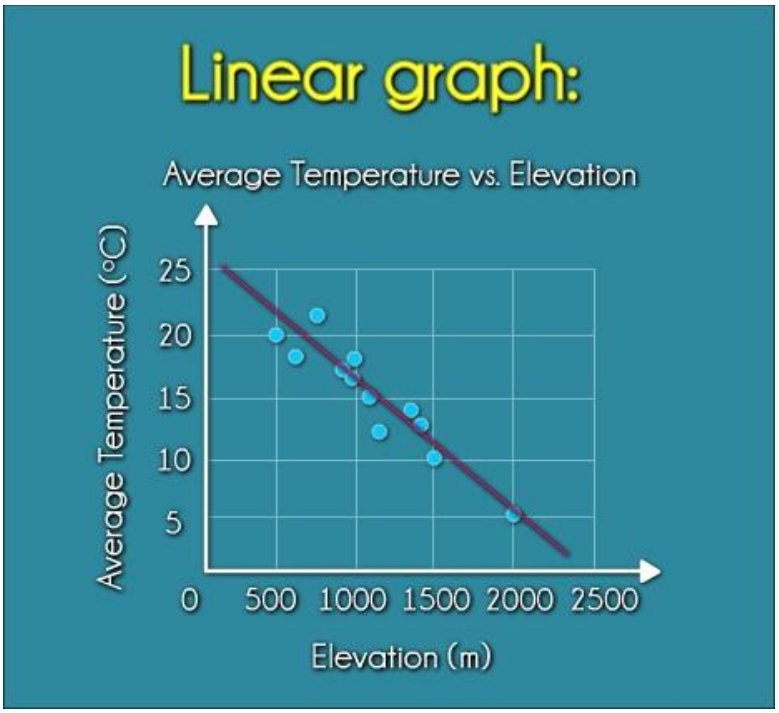
Circle graphs compare parts of a set of data to the whole set.

Bar graphs compare parts of a set of data to each other.



Scatter plots and line graphs show the relationship between two different variables.





Some Types of Scientific Models

- **Physical model: a real-life object that shows some features of the modeled object or system.**
- **Prototype: a model that works like the real object (at least partly); built before the real object to make sure it will work.**
- **Analogy: a comparison between an object or system and something familiar.**
- **Mathematical model: a model that uses math to represent an object or system.**
- **Computer model: a model that uses calculations on a computer to represent an object or system.**

Doing Research

Where can you find information?

- **books**
- **journal or magazine articles**
- **professional scientists attend conferences.**
- **Internet sources**

Reliable source: a source of information that can be trusted to be accurate.

Always think about whether a source is reliable.

- **Look for information from expert scientists.**
- **Look for information that several expert sources agree on.**
- **Always be skeptical when you hear new information.**

Don't copy information directly from another source. Paraphrase it or quote it.

Cite your sources. Explain where the information came from.

Presenting Results

When presenting results, think about:

- **Purpose: why you are presenting the results.**
- **Audience: who will be getting the information.**
- **Tone: how you write about or present something.**

Written reports may be:

- **a summary of other scientists' results**

- **an explanation of the results of a new experiment**
    - **for example, a lab report**

A lab report should include:

- **the question you investigated**
- **your hypothesis**
- **your step-by-step procedure**
- **the data you collected**
- **your conclusions**

An oral presentation is NOT just reading aloud a written report.

- **You may have to summarize the main points of a written report.**
- **Have a visual aid (something for the audience to look at).**
- **Practice your presentation.**
- **Make eye contact with the audience.**
- **Use notes.**