

WHAT IS SCIENCE?

- **One of many approaches to understanding the world in which we live.**
 - Others include philosophy, art, faith, etc.
 - Different approaches are not mutually exclusive competitors, but rather are complementary.
- **It is a body of knowledge and a way of thinking that describes the order within the natural world and the causes of that order.**
 - Organization of ideas based on observation.
 - Modern science (since ~1500's) expresses the organization of ideas in unambiguous mathematical terms, which makes the ideas easier to verify, or more importantly disprove, by experiment.
 - Scientific Method:
 1. Recognize a question or problem.
 2. Make an educated guess – hypothesis – to the answer.
 3. Predict the consequences that will be observable if the hypothesis is correct, and that will be absent if the hypothesis is not correct.
 4. Perform experiments to see if predicted consequences occur.
 5. Formulate the simplest possible rule that organizes the hypothesis, predictions, and experimental observations.
 - Scientific method is not the only way of doing good science.

SCIENTIFIC TERMS

- **Fact**
 - Common usage: something (idea, information) unchangeable and absolute
 - Scientific usage: revisable data that is generally agreed upon by competent observers of the same phenomenon.
 - e.g. a dropped item will fall to the earth
 - Old fact: universe is unchanging and permanent
 - Revised fact: universe is expanding and evolving
- **Hypothesis**
 - Common usage: a guess
 - Scientific usage: an *educated* guess
 - e.g. in the absence of air resistance, all objects fall at the same rate
- **Law**
 - Common usage: a rule that must be obeyed
 - Scientific usage: a hypothesis that has been tested over and over without contradiction
 - e.g. Universal Law of Gravity: $F \sim m_1 m_2 / d^2$
- **Theory**
 - Common usage: a guess
 - Scientific usage: synthesis of a large body of information, including well-tested and verified hypotheses

- e.g. General Theory of Relativity (combines laws regarding gravity, light, etc.)
- **Model**
 - Common usage: a representation of something else
 - Scientific usage: abstract representation of a theory
 - e.g. planetary model of the atom

IMPORTANT CHARACTERISTICS OF SCIENCE

- **Hypothesis must be testable to being shown wrong (not being shown right!)**
 - Science is one of the only disciplines where the goal is to prove ourselves wrong.
 - Scientific hypothesis: atoms are the smallest particles of matter
 - Non-scientific hypothesis: space is permeated with an undetectable essence; Albert Einstein was the greatest physicist of the 20th century; intelligent life exists on other planets
- **No scientific model is right or wrong; they are useful or non-useful**
 - All are incomplete and imperfect
 - In a strong sense, we are not concerned with what is “true,” or what something actually “is.” Rather we are concerned with what is the most useful representation or description of natural *behavior*.