

Intro to Evolution

Laws, Theories, Facts, Hypotheses
&
Understanding the Age of the Universe

Law vs. Fact

- **Fact**

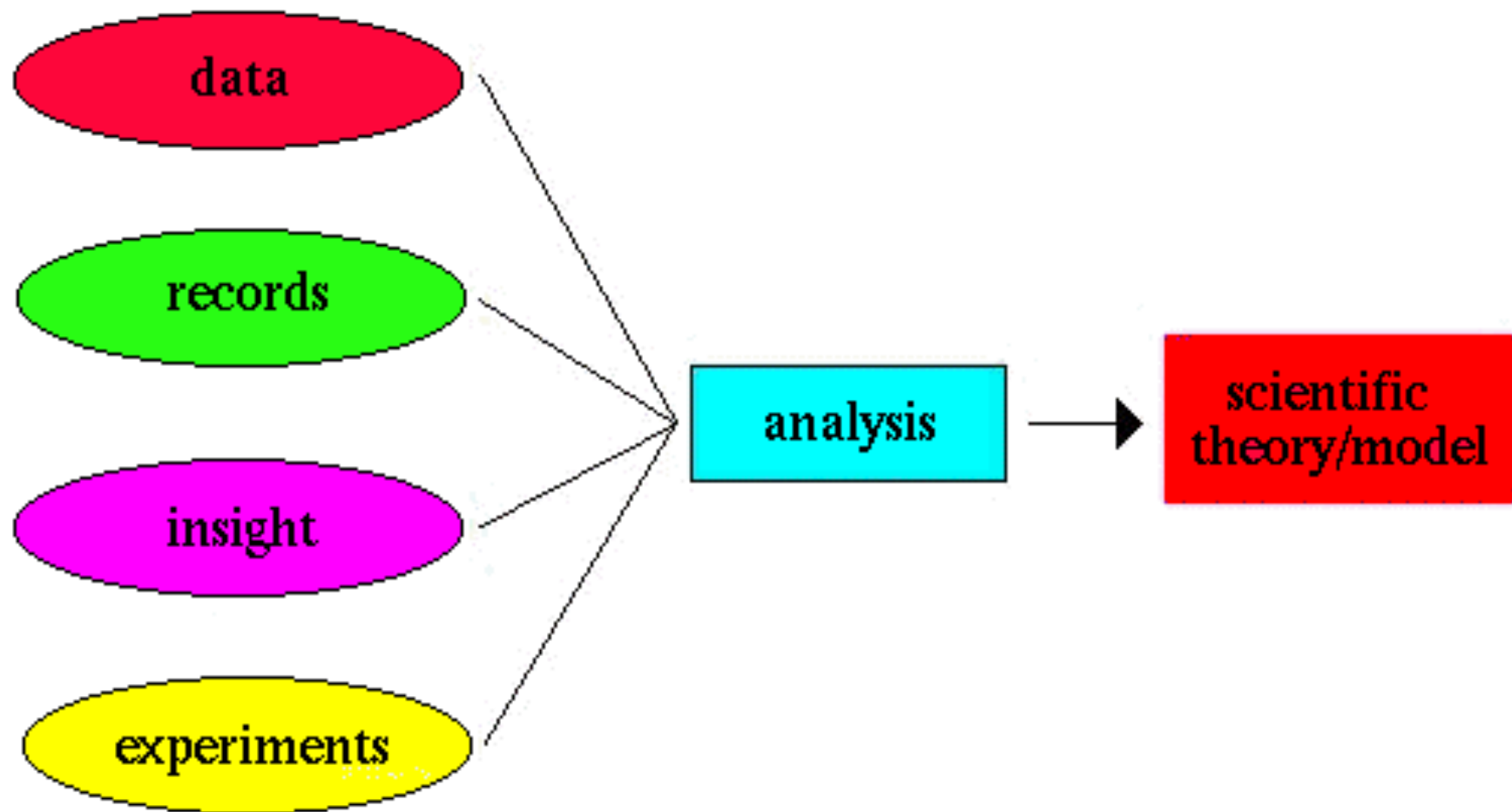
- Objective and verifiable
- Ex.: There are 1,000 grams in a kilogram

- **Law**

- Rule that describes a pattern in nature and what will always happen under specific conditions.
- Often numerical or a formula
- Example: 1st laws of thermodynamics (energy cannot be created nor destroyed)

Theory vs. Hypothesis

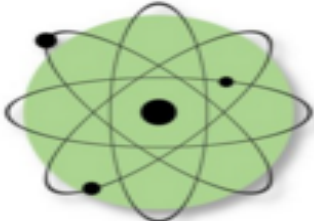

- **Hypothesis**
 - A proposed explanation based on (limited) evidence, can be tested.
- **Theory**
 - Well-substantiated explanation of some aspect of the natural world
 - Repeatedly tested and confirmed through observation and experimentation
 - **Explains facts**
 - Highest level of scientific knowledge
 - Not “just a theory”



1) ~~It is just a theory~~

- In everyday language, 'theory' might mean a hunch or a guess.
- For scientists, 'theory' refers to a well-supported explanation.
- Scientific theories and scientific laws are often confused.



Theories	Laws
Why something happens	What will happen
Explanation of nature	Predictable outcomes
Based on evidence	Based on evidence
Example: Atomic Theory	Example: Newton's Laws
	

Evolution - the *observation* that organisms including plants, animals, bacteria, and even molds change over time - depends on *theory* for an explanation.

Putting them together

- The **theory** of gravitation explains **how** gravity works.
- The **law** of gravitation allows us to **calculate** gravitational pull.
 - $F = G \times [(m_1 m_2) / r_2]$
- You use **facts** to fill in the formula for the law gravitation.
 - $m_1 = 5,972,000,000,000,000,000,000,000$ kilograms
- You use theories, laws, and facts to create a new **hypothesis**.
 - Based on the law of gravity and the mass of everything in the observable universe, there must be dark matter in order for there to be enough gravity to hold the universe together.

The Universe is Rad

Universe

- 13,820,000,000 years old
- Constantly expanding
- We can “see into the past” because light takes so long to travel – if we look at the Boomerang Nebula we see it as it was 5,000 years ago!

Earth

- 4,543,000,000 years old
- About 1/3 as old as the universe
- Earliest evidence for life is 4,100,000,000 years old
- Life has been on the planet for about 90% of the time

