The Nature of Science

People try to understand their surroundings

Mythology put a face on forces of nature

Scientists assume
- everything (universe) has the same basic rules
- rules discovered by careful, systematic study (Scientific Method)
- nature is a closed system (must explain without reference to "supernatural")

Science (Latin for "knowledge"):

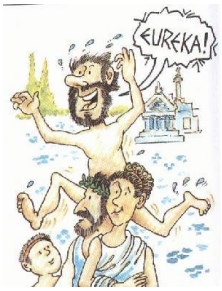
- A collection of knowledge or facts
  - data based on objects perceived by senses
    - qualitative = observed
    - quantitative = measured
  - data based on experience
- Practice or method of investigation

Major changes rarely occur in science
Science (model for understanding) controlled by data (observations)
Accepted science changes only when observations are different from theory
Testing, revising, & occasionally disregarding theories NEVER ENDS
(Science is "fallible and temporal")
Science is mix of CHANGE and CONTINUITY

Continual revision leads to more understanding, but NOT to ABSOLUTE TRUTH
- Not timeless, universal, necessary, or certain
- Not "that which can never be wrong"

Scientific Method useful because it:
- Offers reliable explanations
- Predicts behavior
- IT WORKS!

Scientific Method



Observation (watch, collect data)
Hypothesis (tentative explanation)
Experimentation (controlled testing)
Revise hypothesis to fit observations
Test (Observe) revised hypothesis
Repeat until THEORY (tested model) predicts observations

Theory vs. Law

Theory

Tested explanation
Tested model
Answers WHY
Never absolute

Law

Summary of observations (often an equation)
Not WHY …What is
No known exceptions

It's Only a Theory

Shouted (louder makes it more correct (g))
Derogatory tone (as if "theory" was somehow bad)

Consider:

Shannon's Information Theory (1948)
Mathematical Theory of Communication … best way to represent data is binary

Every Modern Digital Device is based on this THEORY

Einstein's Theory of Relativity (1916)

Describes how to measure time at high speeds
Over 20.000 satellites in orbit …
all depending on accurate time measurements to synchronize electronics

No Relativity Theory … Nothing using satellites

Theories Make the World Work!

An Example of Scientific Method

Observation - "Sweetness" of yams varies on cooking
Hypothesis Water temperature a factor
Experimentation
Cook yams at different temperatures;
Cool, then taste
Note:
< 70 ^{o}C, not too sweet
> 80 ^{o}C, not too sweet
70-80 ^{o}C, yams sweetest
Theory
Best to cook yams between 70 and 80 ^{o}C
Explanation
Yams contain starch (storage form of sugars)
< 70 ^{o}C, starch ➔ sugar slow
70-80 ^{o}C, starch ➔ sugars
> 80 ^{o}C, sugars ➔ starch
Recipes are chemical formulations … Cooking is "Kitchen Chemistry"