

What is Science – Chapter 1

- Scientific method
- Examples of the scientific method
- Hypotheses, theories and laws
- Models in the sciences
- Science and pseudoscience
- Science and Society

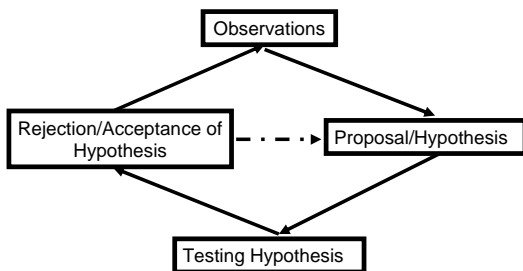
Scientific Method

- Framework for scientific pursuits
- Definition: specific and accepted methodology for investigating how natural systems operate

Physics → Astronomy → Chemistry → Biology



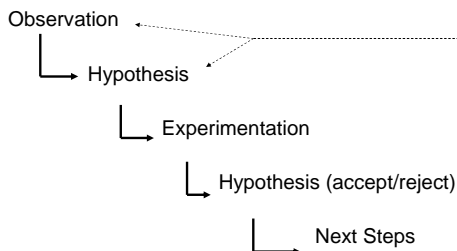
Scientific Method



Scientific Method: Attributes

- Creative intellectual pursuit
- Deductive reasoning
- Observationally based
- Hypothesis formulation
- Hypothesis testing: accept or reject
- Peer review: review, publication and dissemination (openness of process)
- Essential and common feature of graduate education in all disciplines

Scientific Method: Process



Scientific Method: Some Examples

- State hypothesis and devise an experiment to test hypothesis
 - Cosmetic creams and reduce the threat of UV-B radiation
 - West Nile Virus is transmitted by mosquitoes
 - Poison ivy causes an allergic reaction
 - Continents on the Earth's surface are adrift
 - Atoms are composed of small particles that are positively and negatively charged
 - Climate can be affected by carbon dioxide in the atmosphere

Poison Ivy



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Hypothesis: On exposure to poison ivy, an allergic reaction is elicited that results in rash and irritation

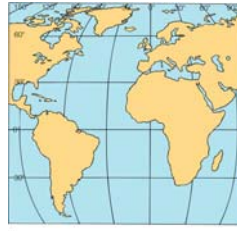
Testing of Hypothesis:

Acceptance/Rejection of Hypothesis:

Next Step: Out of the 1000's of chemicals in poison ivy, what specific chemical is responsible for the allergic reaction

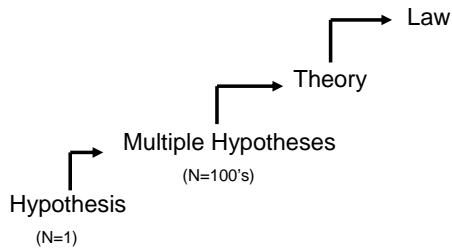
New Hypothesis:

Continental Drift



Hypothesis: In the geological history of the Earth, the continents were merged into one large land mass that subsequently broke and drifted apart into isolated continents

Hypotheses, Theories and Laws: A Hierarchy (of sorts)

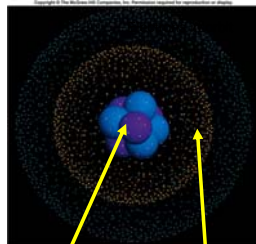


Hypothesis, Theory and Law

- Hypothesis
 - > N=1 with specific focus and specific experimentation
- Theory (a select few)
 - > N=100's of individual hypotheses
 - > Very broad and integrating explanation of how the natural world operates
 - > e.g., seafloor spreading, evolution, atomic structure, cell theory
- Law (even fewer yet)
 - > Overarching relationship that explains a recurrent array of observations in nature
 - > e.g., thermodynamics, motion (Newton)

Models in the Sciences

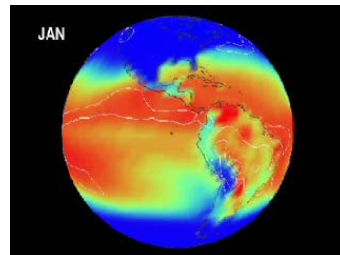
- Conceptual models based on observations
 - Example: Dynamics of family interactions
 - Example: Structure of the atom (protons, neutrons and electrons)



Protons and Neutron

Electrons in orbits

Climate Models



Frequency of Natural Disasters



Science and Pseudoscience

- Science: underpinned by scientific method
 - Open and peer-reviewed process
- Pseudoscience: underpinned by _____?
 - Define "pseudo"
 - Not subject to scientific method
 - Not peer-reviewed
 - Not based on hypotheses
 - Not driven by experimentation
 - Selective use/abuse of data
 - e.g., astrology, nutrition supplements, weight loss, fountain of youth remedies, etc.

Science and Society

- Special cases of science and society
 - Theory of evolution
 - Theory of Intelligent design
 - Theory of creationism
 - Theory of hierarchy and emergent properties
 - Pluto as a planet

Chapter 1 – On Your Own

- Units of length, mass and time
- Metric Prefixes
- Density and its units