

Science: A Way of Knowing

Chapter 1

Great Idea:

Science is a way of asking and answering questions about the physical universe

Chapter Outline

- The Role of Science
- The Scientific Method
- Other Ways of Knowing
- The Organization of Science

The Role of Science

The Role of Science

- Making Choices
 - Ask questions, make observations, form conclusions
 - Applied in a more formal, quantitative way equals science



Why Study Science?

- Most powerful tool for understanding
- Incorporates basic ideas and theories
- Provides framework for new questions
- Provides unparalleled view of order and symmetry of the universe and its workings

The Scientific Method

Observation

- History
 - Greek Philosophers
 - Middle Ages
- Observation-no manipulation
- Experiment-manipulation

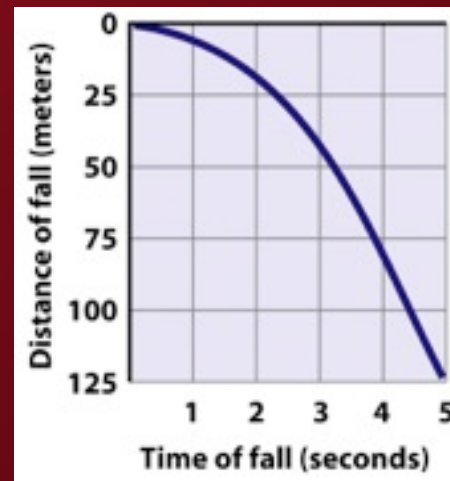


Identifying Patterns and Regularities

- Measurement-better description
- Data-table or graph
- Patterns emerge
- Describe:
 - In words
 - In equation form
 - In symbols

Table 1-1 Measurements of Falling Objects

Time of Fall (seconds)	Distance of Fall (meters)
1	5
2	20
3	45
4	80
5	125



Mathematics: The Language of Science

- Description
 - General
 - Mathematical
- Mathematics
 - Equation
 - Description



Facts, Hypotheses, Laws, Theories

- Fact
 - Confirmed observation
- Hypothesis
 - Educated guess
- Law
 - Description of nature
- Theory
 - Well-substantiated description

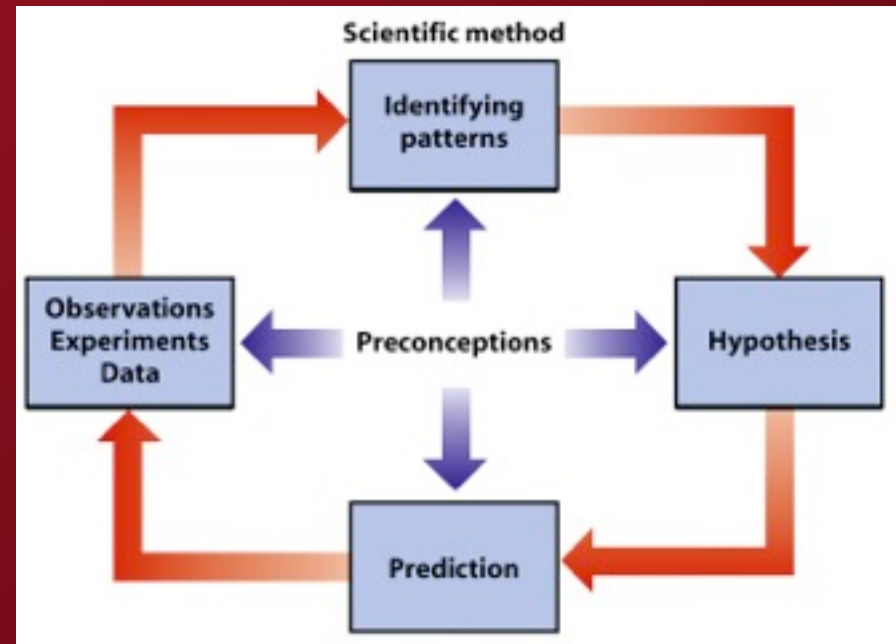
Prediction and Testing

- Predictions
 - Hypothesis, Theory, Law
 - Must be quantitatively testable
- Testing
 - Do not prove or disprove
 - Define range of validity
- Every law and theory of nature is subject to change, based on new observations



The Scientific Method in Operation

- Cycle
 - Not rigid
- Believe results
 - No preconceptions
- No true starting place
- Results must be reproducible
- Cycle is continuous



Other Ways of Knowing

Different Kinds of Questions

- Cannot always use scientific method
- Art
 - Use to address age of painting
 - Not for beauty etc.
- Religion
 - No conflict between science & religion
 - Faith vs. experiment

Pseudoscience

- Pseudoscience
 - Belief, dogma
 - Ideas not testable
- Evaluation of a claim
 1. Are the 'facts' true as stated?
 2. Is there an alternative explanation?
 3. Is the claim falsifiable?
 4. Have claims been tested?
 5. Do claims require unreasonable changes in accepted ideas?



The Organization of Science

Divisions of Science

- Disciplines
 - Historical
 - Modern
- Approach
 - Field researcher
 - Experimentalists
 - Theorists



The Branches of Science

- Physics
 - Fundamental aspects of nature
- Chemistry
 - Atoms in combination
- Biology
 - Living systems
- Astronomy
 - Objects in space
- Geology
 - Earth

The Web of Knowledge

- Center
 - Laws of nature
 - Apply to all areas
- Areas Interconnected
 - All branches integrated



Basic Research, Applied Research, and Technology

- Basic Research
 - Expand knowledge
- Applied Research
 - Direct application
 - Technology
 - Conservation
 - Medicine



Funding for Science

- US Government
 - \$130 billion
 - NSF, NIH, DOE, DOD, EPA, NASA, NOAA
- Apply for funds
 - Grant proposal
 - Ranked by independent scientists
 - Highly competitive

Table 1-3 Your Tax Dollars: 2006 Federal Science Funding

Agency or Department	Funding (in millions of \$)
Department of Agriculture	2,394
Department of Defense	73,039
Department of Energy	8,608
Department of the Interior	629
Department of Transportation	841
Environmental Protection Agency	573
Homeland Security	1,281
National Aeronautics and Space Administration	11,367
National Institutes of Health	27,749
National Institutes of Standards and Technology	438
National Oceanographic and Atmospheric Administration	661
National Science Foundation	4,123
Nuclear Regulatory Commission	64
Smithsonian Institution	140

Communication Among Scientists

- Collaboration
- Scientific Meetings
- Peer reviewed Journals
 - Cornerstone of science