Principles of Science

Definition of Science  “To Know”

Refers to knowledge that can be demonstrated Objectively In concrete, factual realm of reality

Distinctions

• From Humanities and Arts
  – Values
  – Aesthetics
  – Appeal to sense of beauty or importance
  – Evokes emotional response

• From Law
  – Values
  – Justice, right and wrong
  – ethics

• Theology and Religion
  – Spiritual
  – Supernatural
  – Explanation of all things
  – Certainty

Characteristics of Science

• Objectivity
  – Hypotheses
  – Multiple working hypotheses
  – Uncertainty
  – Disproof

Distinctions

• Theology and Religion
  – Spiritual
  – Supernatural
  – Explanation of all things
  – Certainty

Early science such as geometry and astronomy was connected to the divine for most medieval scholars. The compass in this 13th century manuscript is a symbol of God’s act of creation.

Characteristics of Science

• Uncertainty
• Joy of Inquiry
• Authority – not a criterion for science

Personification of “Science” in front of the Boston Public Library
The Scientific Principle

• “Natural Law”
• Definition – A generalization based on fact gathering, experimentation and inductive reasoning (usually) that can be used to predict individual cases or to derive other principles
• Similar to an axiom

The Scientific Principle

• Inductive and deductive reasoning
• The scientific theory
  – Hypotheses substantiated by evidence
  – More involved and complicated than principle
  – Similar to a theorem

History of the Philosophy of Science

• Growth over centuries and now
• Many contributors
• Many debates and controversies

ARISTOTLE
384-332 BC

1. “Objective reality”
   Concrete and factual
   “A equals A”
   Perceived by senses
   Distinguishes realm of natural science
2. Classification of reality
   Individual object
   Species
   Genus

GALILEO GALILEI
1564-1642

1. Defended Copernican Universe
   (Sun centered not earth centered)
2. Fossils in mountains
   (once covered by sea)
3. Mathematics and the real world
4. Causes and Effects
   (no inherent purposes)

Sir Francis Bacon
1561-1626

Scientific Method

1. Gather data by Observation and measurement
2. Formulate hypothesis
3. Experimentation
4. Conclusions
Hypotheses and Theories must
1. Explain the data
2. Predict outcomes
3. Coordinate with other generalizations already accepted

JOHN STUART MILL
1806-1873

Defined Scientific Principles
1. Generalization from experience
2. “induction by simple enumeration”
3. Nothing can be proved beyond all doubt

Multiple Working Hypotheses
1. Adoption of many hypotheses
2. Elimination
3. Lack of bias, favoritism

THOMAS C. CHAMBERLIN
1843-1928

Responsibilities of the Scientist
• Objectivity
• Systematic Analysis
• Multiple Working Hypotheses
• Experimentation, Observation, Confirmation
• Interpretation
  – Synthesis
  – Development of theories and models