What is Science?

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Science

Science

Science is about adding new knowledge to the world

- Non-Scientific Method
  - Intuition/Believe
  - Consensus
  - Authority
  - Casual observation (humans do *selective* observation)
  - Weak argumentation

The previous methods are subjective and biased

Science

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Science is about adding new knowledge to the world

- Scientific Method
  - Systematic Observation
  - Statistics
  - Formal Logic (good argumentation)
- Six Principles:
  - Objective
    - Clear concepts, assumptions, procedures,...
    - No matter who conducts the study
  - Empirically Testable (observation)
  - Falsifiable
  - Replicability
  - Transparency
  - Logically consistent

Scientific Attitude

Science has a strong Social component (team work)

- **Critical** (willing to get constructive feedback)
- **Open** (willing to accept critics)
- **Transparent** (willing to socialized your ideas)

Some definitions

- **Hypothesis**:
  - describes patterns and general relations
  - become more certain as more and more observations support them
- **Law**: very precise description (often mathematical equation)
- **Observation**:
  - accuracy relative to its purpose
  - does not describe/explain general relations
  - Purpose: confirm or contradict hypothesis
- **Explanation**:
  - Human understanding
  - Comes along with the hypothesis
  - important for knowledge improvement (progress)
- **Theory**: coherent set of well supported hypothesis
  - closest thing to certainty that we have
  - **In Science there is no certainty. Only provisional best explanations**

Types of Research

We can (roughly) distinguish three types of activities:

- **Basic Research:** Understanding the world
- **Applied Research:** Discovering how to take advantage of our understanding of the world
- **Development and Innovation:** Making applied research readily available

The frontier is not clear at all.

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When a new technology arises the bulk of research slowly moves from Basic to Innovation (see Computer Science)

Some Milestones and Keywords in the History of (Philosophy of) Science

- **Greek Scholars** (400 BC).
  - Look for **Natural Explanation of phenomena** (as opposed to Divine Explanation)
  - **Metathinking** (being aware of our cognitive processes)

Some Milestones and Keywords in the History of (Philosophy of) Science

- **Greek Scholars** (400 BC).
  - **Plato**. **Rationalism**. Myth of the cave
    - We cannot trust observation (our perceptions are fictitious)
    - Knowledge can only be gained by reasoning
  - **Aristotle**. Knowledge has to be gained by observation and reasoning
    - First **Empiricist**
    - First formalization of reasoning (Formal Logic)
    - premises are learned from observation

Some Milestones and Keywords in the History of (Philosophy of) Science

- **Enlightment** (1600). Separate Science from Theology
  - Galileo. **Systematic Observation**
  - Hume (1730). Skepticism. **Problem of Induction**: We never know if the next observation will satisfy the claim

Some Milestones and Keywords in the History of (Philosophy of) Science

- **Modern Science** (1900).
  - Idealism (1830). Focus on the Fundamental Nature of Being (Metaphisics). Too theoretical. Useless in practical
  - **Logical Positivism** (Wien Circle). Science= study of **meaningful** statements
    - Meaningful: it must be possible to determine the truth (**verification principle**)
    - Two types of statements: **Analytic** (definitions+ verifiable by formal logic), **Synthetic** (verifiable by observation)
    - It is not allowed to reason about unobservables
  - **Logical Empiricism**. A statement is useful if it is falsifiable.
    - relax verification principle by **confirmation**
    - allow unobservables (for convenience)
  - **Constructive Empiricism**.
    - Science attempts to construct empirical adequate theories
    - Unobservables are allowed
    - Scientific claims are true only as far as the observables go along