

How science really works??

The Inductive Method:

1. formulate hypothesis
2. apply for grant
3. perform experiments or gather data to test hypothesis
4. alter data to fit hypothesis
5. publish

The Deductive Method:

1. formulate hypothesis
2. apply for grant
3. perform experiments or gather data to test hypothesis
4. revise hypothesis to fit data
5. backdate revised hypothesis
6. publish

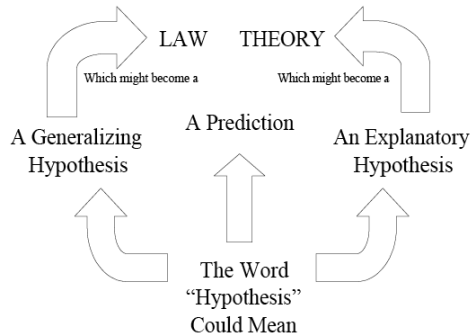
(From "Science Made Stupid", by Tom Well)



Myths about Science (I)

○ "It's just a theory"

- Theory = "best explanation for the available evidence".
- Overwhelming evidence doesn't stop it being a theory...
- ...but lack of evidence does.



Examples:

We have a "law of gravity"
...but no "theory of gravity"

We have a "theory of evolution"
...but no "law of evolution"



Myths about Science (II)

- “Scientists follow the scientific method”
 - There is no one method
 - Many methods available...
 - ...and all of them have known flaws
 - Scientists use imagination, creativity, prior knowledge, perseverance...
- “Scientific knowledge is general and absolute”
 - Empirical Induction used to build evidence
 - Scientists often get it wrong...
 - ...but Science (as a process) is self-correcting
 - All scientific laws and theories have limited scope
 - E.g. biological theories probably only apply on our own planet
 - E.g. laws of physics don't apply at the subatomic level



What will you accept as knowledge?

- Positivist (or “Post-positivist”)
 - Knowledge is objective
 - “Causes determine effects/ outcomes”
 - Reductionist: study complex things by breaking down to simpler ones
 - Prefer quantitative approaches
 - **Verifying (or Falsifying) theories**
- Constructivist/Interpretivist
 - Knowledge is socially constructed
 - Truth is relative to context
 - Theoretical terms are open to interpretation
 - Prefer qualitative approaches
 - **Generating “local” theories**
- Critical Theorist
 - Research is a political act
 - Knowledge is created to empower groups/individuals
 - Choose what to research based on who it will help
 - Prefer participatory approaches
 - **Seeking change in society**
- Eclectic/Pragmatist
 - Research is problem-centered
 - “All forms of inquiry are biased”
 - Truth is what works at the time
 - Prefer multiple methods / multiple perspectives
 - **seeking practical solutions to problems**



Meta-theories (theories about theory)

- Logical Positivism:
 - Separates discovery from validation
 - Logical deduction, to link theoretical concepts to observable phenomena
 - Scientific truth is absolute, cumulative, and unifiable
- Popper:
 - Theories can be refuted, not proved;
 - only falsifiable theories are scientific
- Campbell:
 - Theories are underdetermined;
 - All observation is theory-laden, biased
- Quine:
 - Terms used in scientific theories have contingent meanings
 - Cannot separate theoretical terms from empirical findings
- Kuhn:
 - Science characterized by dominant paradigms, punctuated by revolution
- Lakatos:
 - Not one paradigm, but many competing research programmes
 - Each has a hard core of assumptions immune to refutation
- Feyerabend:
 - Cannot separate scientific discovery from its historical context
 - All scientific methods are limited;
 - Any method offering new insight is ok
- Toulmin:
 - Evolving Weltanschauung determines what is counted as fact;
 - Scientific theories describe ideals, and explain deviations
- Laudan:
 - Negative evidence is not so significant in evaluating theories.
 - All theories have empirical difficulties
 - New theories seldom explain everything the previous theory did

