

"ANY SUFFICIENTLY ADVANCED TECHNOLOGY IS INDISTINGUISHABLE FROM MAGIC."

ARTHUR C. CLARKE



---

---

---

---

---

---

---

---

dr. caleb lack's

PSY 4960/5960  
Science vs. Pseudoscience

What is science?

Vs

- EMPIRICISM -

- CONJECTURE -

science versus pseudoscience

---

---

---

---

---

---

---

---

dr. caleb lack's

Human Life Expectancy

Why has the average human lifespan doubled over the past 200 years?

Life expectancy at birth

Year	Females (Years)	Males (Years)
1830	45	40
1850	48	42
1870	50	44
1890	52	46
1910	55	48
1930	60	52
1950	65	58
1970	70	63
1990	75	68
2010	80	73

science versus pseudoscience

---

---

---

---

---

---

---

---

### Quick Quiz

True or false?

Most of us use only about 10% of their brain capacity

Drinking coffee can help you stay focused after heavy drinking

Hypnosis can help you recall things you've forgotten

If you're unsure on your test, it's best to stick with your initial answer

# FALSE!

---

---

---

---

---

---

---

---

### Common Sense?

- Look before you leap. ↔ He who hesitates is lost.
- Birds of a feather flock together. ↔ Opposites attract.
- Absence makes the heart grow fonder. ↔ Out of sight, out of mind.
- Better safe than sorry. ↔ Nothing ventured, nothing gained.
- Two heads are better than one. ↔ Too many cooks spoil the broth.
- The bigger the better. ↔ Good things come in small packages.
- Actions speak louder than words. ↔ The pen is mightier than the sword.
- Clothes make the man. ↔ Don't judge a book by its cover.
- The more the merrier. ↔ Two's company, three's a crowd.
- You're never too old to learn. ↔ You can't teach an old dog new tricks.

---

---

---

---

---

---

---

---

### Operational Definition

Science is

“A set of **methods** designed to describe and interpret observed or inferred phenomena, past or present, and aimed at building a **testable** body of knowledge open to **rejection or confirmation.**”

A toolbox of skills designed to prevent us from fooling ourselves

Learning to minimize your thinking errors

Self-correcting

---

---

---

---

---

---

---

---

## What Makes a Good Scientist?

- **Communalism** – a willingness to share data
- **Disinterestedness** – trying not to be influenced by personal or financial investments
- A tiny voice saying “**I might be wrong**”
- “Utter honesty – a kind of leaning over backwards”

Merton (1942)  
Sagan (1995)  
Feynman (1988)

science versus pseudoscience

---

---

---

---

---

---

---

---

## Quick Quiz

Write down the names of as many **living** scientists as you can, including their fields.

Why is this so hard?

Why aren't more scientists shown in the media?

What is a scientist?

science versus pseudoscience

---

---

---

---

---

---

---

---

## Operational Definition

- The scientific method
  - Is the steps involved in thinking scientifically
  - Is a guide, not a cookbook
  - Is hypothetic-deductive
  - Aims for objectivity
  - Leads us towards rationalism
  - Involves four main elements

science versus pseudoscience

---

---

---

---

---

---

---

---

### SM Generalizations

- **Hypothesis** – a testable statement accounting for a set of observations
- **Theory** – a well-supported and well-tested hypothesis or set of hypotheses
- **Fact** – a conclusion confirmed to such an extent that it would be reasonable to offer provisional agreement

---

---

---

---

---

---

---

---

### Elements of Scientific Thinking

- **Induction** – forming a hypothesis by drawing general conclusions from existing data
- **Deduction** – making specific predictions based on the hypotheses
- **Observation** – gathering data, driven by hypotheses that tell us what to look for
- **Verification** – testing the hypotheses against further observations to support or falsify the initial hypotheses

---

---

---

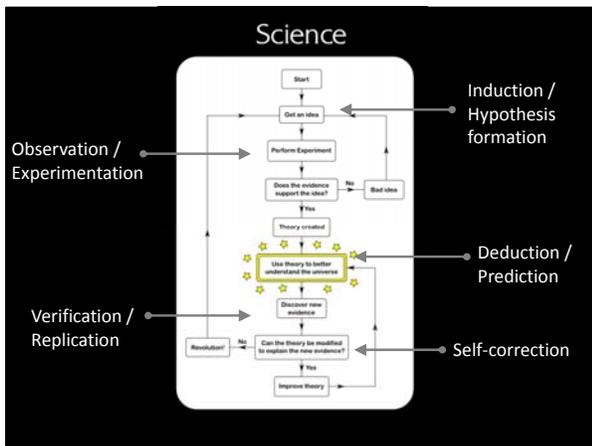
---

---

---

---

---




---

---

---

---

---

---

---

---

## What is a Theory?

- A theory is a model that ties together many hypotheses to explain outcomes, as well as generate new predictions
- OR
- Theories are general explanations, whereas hypotheses are specific predictions derived from these explanations

Meehl (1967)

| science versus pseudoscience

---

---

---

---

---

---

---

---

## Theory Misconceptions

“A theory explains one specific event”

“A theory is just an educated guess”

Why are these both **wrong**?

| science versus pseudoscience

---

---

---

---

---

---

---

---

## Critical Thinking Principles

- **Hume's dictum** – extraordinary claims require extraordinary evidence
- **Popper's falsifiability** – claims must be capable of being disproven and make risky predictions
- **Occam's razor** – if two explanations account for something equally well, we should generally pick the simpler one

Lett (1990)

| science versus pseudoscience

---

---

---

---

---

---

---

---

## Critical Thinking Principles

- **Replicability** – findings must be capable of being duplicated by independent researchers who follow the same “recipe”
- **Ruling out rivals** – findings consistent with several hypotheses require additional research to eliminate these hypotheses
- **Correlation isn't causation** – two things being associated doesn't mean one causes the other

Lett (1990)  
| science versus pseudoscience

---

---

---

---

---

---

---

---

## FILCHeRS

- The tools for scientific reasoning -
- Falsifiability
- Logically sound
- Comprehensive of all data
- Honestly evaluated
- Replicative
- Sufficiency of available evidence

Ruscio (2006)  
| science versus pseudoscience

---

---

---

---

---

---

---

---

## Non-science

- **Construct** – nontestable statement to account for a series of observations
- **Mysticism** – basing conclusions on personal insight that elude external validation
- **Dogmatism** – basing conclusions on authority rather than logic and evidence

| science versus pseudoscience

---

---

---

---

---

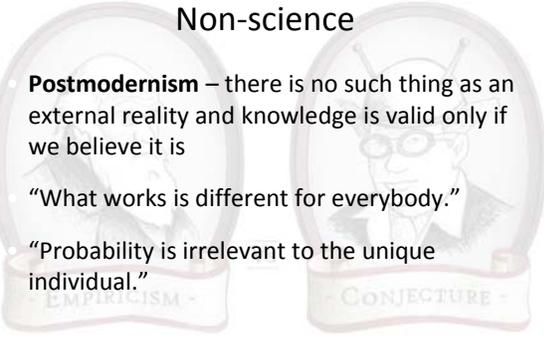
---

---

---

### Non-science

- **Postmodernism** – there is no such thing as an external reality and knowledge is valid only if we believe it is
- “What works is different for everybody.”
- “Probability is irrelevant to the unique individual.”




---

---

---

---

---

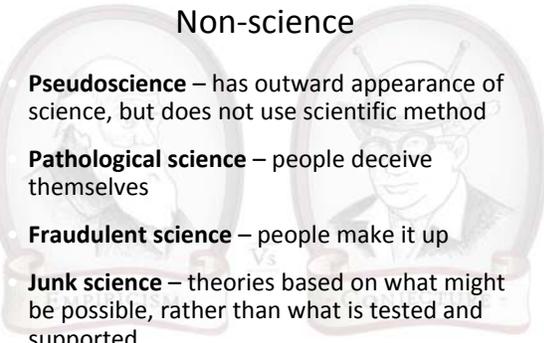
---

---

---

### Non-science

- **Pseudoscience** – has outward appearance of science, but does not use scientific method
- **Pathological science** – people deceive themselves
- **Fraudulent science** – people make it up
- **Junk science** – theories based on what might be possible, rather than what is tested and supported




---

---

---

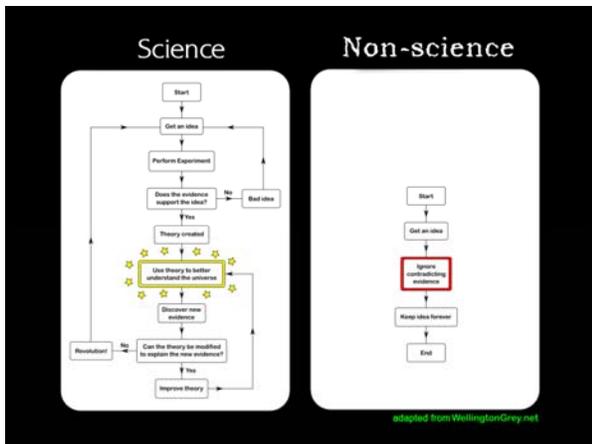
---

---

---

---

---



adapted from WellingtonGrey.net

---

---

---

---

---

---

---

---

dr. caleb lack's

## Quick Quiz

True or false?

Science is a body of knowledge consisting of all of the findings that scientists have discovered.

Science is the process of trying to find out how research is done.

A scientific hypothesis is a statement that can be tested as a scientific theory, or a theory that makes predictions.

**FALSE!**

science versus pseudoscience

---

---

---

---

---

---

---

---

dr. caleb lack's

## What is a Skeptic?

Write down what you think of when someone says he or she is a "skeptic."

Is this a positive thing?  
 Negative?  
 Neutral?

What are you personally skeptical about?

EMPIRICISM - CONJECTURE -

science versus pseudoscience

---

---

---

---

---

---

---

---

dr. caleb lack's

## Operational Definition

- A skeptic
  - Demands evidence for claims
  - Uses the scientific method to examine evidence
  - Is *not* a cynic
  - Is open-minded about new ideas
  - Must balance openness and closedness

*Sum ergo cogito* (I am, therefore I think)

EMPIRICISM - CONJECTURE -

science versus pseudoscience

---

---

---

---

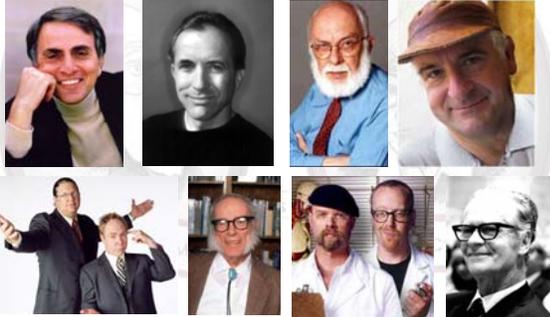
---

---

---

---

### Famous Skeptics




---

---

---

---

---

---

---

---

### Types of Skepticism

**Scientific skepticism** – are open to new ideas, are willing to change if presented with evidence; do not accept the word of authority figures as evidence




---

---

---

---

---

---

---

---

### Types of Skepticism

**Pathological skepticism** – marked by closed-mindedness and cynicism; guilty of the disconfirmation bias




---

---

---

---

---

---

---

---

## Limits of Science

- Science is not about final (ultimate) answers
- Science cannot draw conclusions about things it cannot measure or manipulate experimentally
- Science and scientists are committed to unemotional judgments by their choice to understand things rationally

Pigliucci (2002)

| science versus pseudoscience

---

---

---

---

---

---

---

---

## Final Thoughts

- Science is not infallible
- Science is, however, the best method we have for understanding the universe
- Anyone can be a scientist, all it takes is using the scientific method to evaluate claims

| science versus pseudoscience

---

---

---

---

---

---

---

---

Whoever tells the truth is chased from nine villages.



old Turkish proverb

---

---

---

---

---

---

---

---