

What is this thing called Science?

US 275 Scientific Ethics
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What is science?

- to many people, science is
 - memorizing facts
 - laboratory activities
 - research
 - boring...



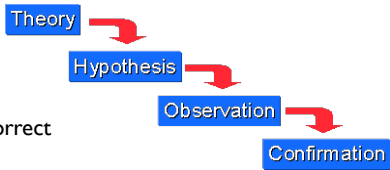
Science is

- a way of answering questions about the natural world
 - based on assumption that physical events are predictable and quantifiable
- exciting!



Deductive Reasoning

- Apply general rule(s)/premise(s)
 - to a specific situation
- If rules/premises are correct,
 - then conclusion will be correct



- often used in philosophy and mathematics <http://www.socialresearchmethods.net/kb/Assets/images/duct.gif>
- Deductive reasoning does not provide new information.

Deductive Argument

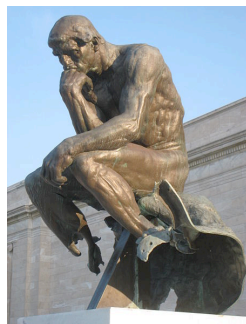
- If all carnivores have sharp teeth
- and if polar bears are carnivores
- Then, Polar bears have sharp teeth



Polar Bear (*Ursus maritimus*) cubs
U.S. Fish and Wildlife Service

Potential Problems with Deductive Arguments

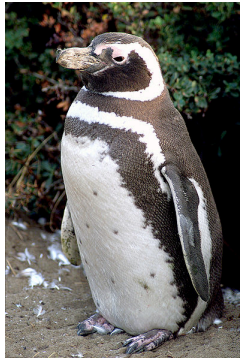
- We don't know all of the general rules (premises)
 - so they may be wrong
- what we do know, limits how we can apply them



Vandalized cast of Rodin's Thinker, Cleveland Museum of Art
Wikimedia Commons

Potential Problems with Deductive Arguments

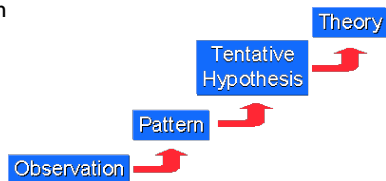
- If penguins are black and white
- and if some old TV shows are black and white
- Then, some penguins are old TV shows



Magellanic penguin near Punta Arenas, Chile
NASA AirSAR 2004 campaign

Inductive Reasoning

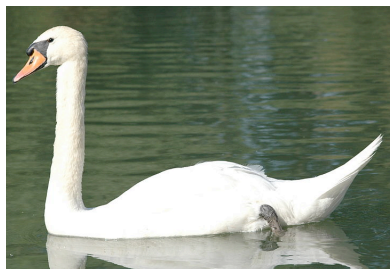
- use specific observations
 - to make general conclusion
- premises support probable conclusion
 - if good premises,
 - then unlikely conclusion is false



<http://www.socialresearchmethods.net/kb/Assets/images/induct.gif>

Inductive Argument

- All swans we have ever observed have been white.
- therefore, the next swan we see will be white



White Swan, *Cygnus olor*
Wikimedia Commons

Potential Problems with Inductive Arguments

- Inductive Reasoning
 - more open
 - generates more solutions
 - generates hypotheses that can be tested
- More likely to give false solutions than deductive reasoning



Version of the Thinker in Cleveland, damaged during anti-Vietnam War Protests
Wikimedia Commons

Potential Problems with Inductive Arguments

- All swans we have ever observed have been white.
- therefore, the next swan we see will be white
- However, we have not observed all swans,
 - it is possible that the next swan is black



Black Swan, *Cygnus atratus*
Wikimedia Commons

Cause and Effect

- Goal of science is to find the causal relationship
 - **CAUSE**
 - Why did it happen?
 - **the glass fell**
 - **EFFECT**
 - What happened?
 - **spilt milk**



Cause and Effect

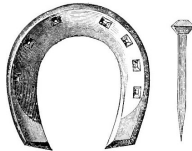
- Cause linked to the effect
 - hammer hitting glass causes it to break
- Cause happens before the effect
 - glass was not broken before hammer hits it
- without the cause, the effect won't happen
 - if hammer hadn't hit glass, it wouldn't have broken



<http://www.surfacecareusa.com/images/safety-film-hammer.bmp>

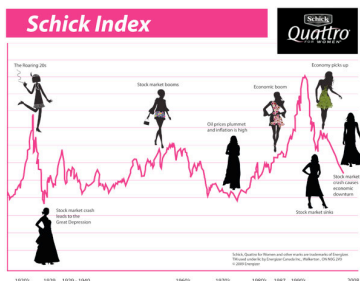
Cause and Effect: For Want of a Nail

*For want of a nail the shoe was lost.
For want of a shoe the horse was lost.
For want of a horse the rider was lost.
For want of a rider the message was lost.
For want of a message the battle was lost.
For want of a battle the kingdom was lost.
And all for the want of a horseshoe nail.*



Correlations

- When two things change at the same time
 - both could increase
 - or one could increase, while other decreases
- However,
 - could be a coincidence
 - could be something else affecting both observations



*Hemline Theory by economist George Taylor.
Strong correlation between skirt length and economy.
When economy doing well, skirts get shorter.
When economy drops, skirts get longer.*
<http://odetocapitalism.com/2010/09/14/girls-raise-your-hemlines-for-the-economy/>

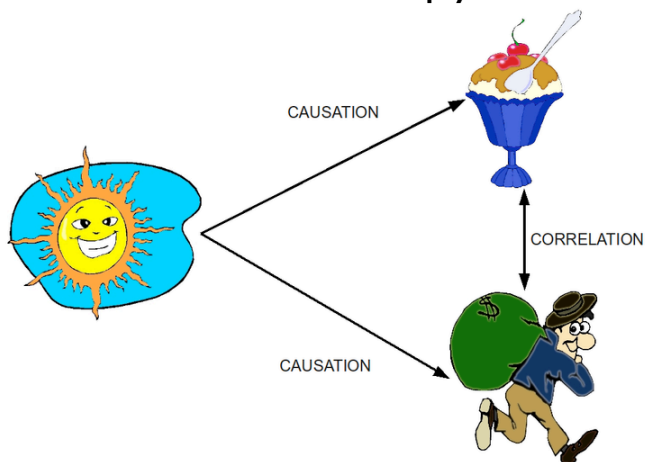
Problem with Correlations

US Postal charges drive Global Warming



El Nino incites wars and the Post Office controls temperature. (August 26, 2011) Tuscon Citizen.com
 Copyrighted by Jonathan DuHamel. Reprint is permitted provided that credit of authorship is provided and linked back to the source.
<http://tusconcitizen.com/sryheat/2011/08/26/el-nino-incites-wars-and-the-post-office-controls-temperature/>

Correlation does not imply causation



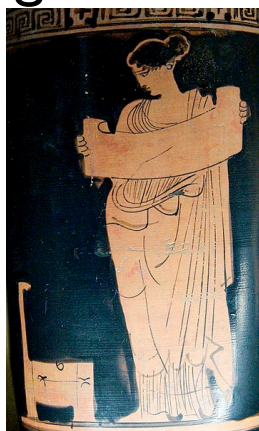
This is a drawing illustrating the relationship between correlation and causation. It depicts a correlation between ice cream consumption and crime, but shows that the actual cause is temperature. by Rcragun on Wikimedia Commons

Readings

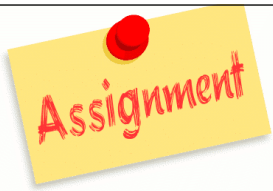
Understanding Science: How science really works.
http://undsci.berkeley.edu/article/0_0_0/us101contents_01

Sections:

- I. Understanding Science
- II. What is science
- V. The social side of science.
- VI Science and society



Musa reading a volumen (scroll), at the left an open chest. Attic red-figure lekythos, ca. 435-425 BC. From Boeotia. Wikimedia Commons



Everyday uses of scientific method

You are driving down the road when your car suddenly stops...

In your discussion group:

Use the scientific method to determine what caused the car to stop. Come up with different hypotheses (reasons) for why the car stopped and describe experiments that you can use to test whether or not that is the true cause.



Any Questions?

Email me at:
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<http://www.pippitbullennets.com/images/animated-question-mark.gif>