Induction
(Caution: slippery, yet used frequently)

Intro:

Some everyday examples (add your own):

- return to the restaurant that has provided good food/service & avoid others
- see teenagers in the park = it's noisy over there
- see a young black man in handcuffs on tv →he's dangerous

How many of your inductive beliefs are true?? Is it easier to see the prejudice & short-sightedness in others, but fail to recognize the "inertia of ignorant induction" in ourselves?

The logical leap:

Deduction moves from the general to the specific while induction moves from the specific (some cases) to the general (all cases). Because of this nature of induction, a kind of leap takes place → more is being inferred than the evidence can absolutely guarantee. In short, with induction, nothing follows necessarily (recall that deductive reasoning *necessitates* a conclusion whereas inductive reasoning *suggests* a conclusion).

EVEN THOUGH THE PREMISES OF AN INDUCTIVE ARGUMENT MAY BE TRUE, THE CONCLUSION CAN STILL BE FALSE!

> e.g. The bus has always stopped at my corner, so I would assume that it would stop here today. But past evidence does not guarantee the truth of the general inference as projected into the future.

People draw different inferences from the same facts, others draw new and creative inferences from familiar facts, and still others draw erroneous inferences from facts which seem to stare them in the face.

What's up with the stuff on the table?? ***(classroom)***

What counts as and justifies a reliable inductive inference??

Many contend that without the inductive leap from experience to generalization, the world would make no sense. Yet, because of it...

- ***our conclusions about the world are usually founded upon a small amount of all the cases there are or could be***
- ***evidence for an inductive inference confirms a conclusion only to a more or less probable degree***
- ***no more can be claimed for induction, logically, than that a conclusion is reasonable to believe in light of all that we know***

Generalizations:

Is it wrong to generalize, to put things into classes? Don't we find this effective from a young age (matches are hot & a frowning parent means trouble)? Each new experience helps to form new generalizations, to strengthen or modify old ones. Isn't this the most human of activities, to carry our past experience forward with some expectation of the world's regularity? Don't we have a burning need to make sense of it all by finding some order? But as we begin to think of the world more systematically (in school, for instance), we are asked to back up our opinions with facts. This, in turn, prepares us for entering a professional discipline where an even stronger warrant of evidence is demanded. So, in what ways can we make reliable generalizations in order to evaluate assertions across any discipline of study (or just to live our lives more "reasonably")?

"All swans are white."

> Is it fair to assume this if I've never seen evidence to the contrary?
> What happens when I visit Singapore & see a black swan?

So, what should we require of ourselves (as "ideal knowers") if we wish to be conscientious about the justification of our claims?

- a sufficient number of cases
- causes that are fairly representative
- consistency with other beliefs

With the swan example, the first & second criteria are not adequately met. So, are we going to walk around lacking any confidence in our ordinary experience? When is enough evidence enough evidence? We can begin to recognize a need for sufficient and representative samples to analyze. Maybe we need to tackle things differently when dealing with the physical world vs. the social world of humans. Can't we make some pretty sweeping assertions about uniformity in nature (e.g. don't stones fall at the same rate in Japan as they do in Mexico)? Does is get stickier when we address human behavior?

What kind of generalizations do we make about ourselves & others? We can throw around some pretty flimsy ones (Men can...women can't...Blacks are...Whites are not). When we experienced the terrorist acts in Oklahoma City & Atlanta, how quick were we to generalize it as activity from outside our shores (many even jumped to presume Middle East involvement). Don't we detest it when a loose generalization is made about "our own group"?

What about language again? Before we can even begin to assess how true or false a generalization may be, we have to dissect the language. What about "Boys are better at math than girls"? How many boys? Some? Most? All? What can "some" and "most" mean? How many of what age group would support this? What would count as a counter-example? What is meant by "better" or "math"?

Simple generalizations are actually quite complex.

Causes:

Beyond just classifying the world into descriptive generalities, inductive reasoning also involves making claims about the causal relationship between two classes. Most of us cannot stand to have mysterious things that lack explanation, and we'll go so far as to accept almost any causal explanation rather than do without one (superstitions?).

A cause is the total of all factors which make an event occur, but don't we tend to focus on one or a few of the causes? Don't we limit our investigation at times just to maintain our sanity? Consider the following:

A while back, in Malaysia, in an effort to kill off mosquitoes, an American technologist sprayed woods and swampland with DDT. Result? Cockroaches with ate poisoned mosquitoes were so slowed in their reactions that they could be eaten by a variety of tree-climbing lizards which, sickened in turn, could be eaten by cats, which promptly died of insecticide poisoning. The cats having died, the rat population began to increase; as rats multiplied, so did fleas; hence, the rapid spread of bubonic plague in Malaysia. But wait; there's more. The tree-climbing lizards, having died, could no longer eat insects which consumed the straw thatching of the natives' huts. So, as Malaysians died of plague, their roofs literally caved in above their heads.

So, where do we draw the line on causes? Some have suggested the notions of identifying "necessary"(N) and "sufficient"(S) conditions. The necessary condition must be present for an effect to occur while the sufficient condition is one way, in itself, to make something happen.

- What are the necessary & sufficient conditions of being an OHS graduate?
- What are the necessary & sufficient conditions of being a U.S. citizen?
- What are the necessary & sufficient conditions of being President?

John Stuart Mill offered the following procedure for establishing causes. It's not infallible, but may be useful for checking supposed causal relationships.

Definitions of Mill's Methods (from *About Thinking*)

Method of Agreement. If one and only one relevant circumstance is common to all cases in which the effect occurs, then this circumstance is the cause or associated with the cause.

Method of Difference. If two situations are alike in all relevant respects but one, and if the effect occurs in one instance and not in the other, then the difference is the cause or is associated with the cause.

Joint Method of Agreement and Difference. A circumstance present in all instances in which the effect occurs and invariably absent when the effect does not occur is the cause or is associated with the cause.

Method of Co-variation. When one circumstance varies in a regular manner whenever some other circumstance varies, then there must be some sort of causal connection between the two.

Method of Residues. When part of an effect remains unexplained by known causal circumstances, then an additional circumstance(s) must be sought to account for the unexplained portion of the effect.

A brief illustration (with a bit of levity to underscore the need to identify truly relevant factors):

Monday	Scotch & soda	Drunk
Tuesday	Bourbon & soda	Drunk
Wednesday	Rye & soda	Drunk

Aha! Soda makes me drunk!

Some problems in identifying causes:

In 1886, a young Dutch physician, Dr Christian Eijkman, was sent abroad to investigate the microbe responsible for beriberi, a disease widespread in Southeast Asia. After several years of little progress, the doctor happened to notice that a mysterious event had taken place among the chickens in the area adjoining the laboratory. For a time the chickens had been stricken with a fatal paralysis similar to beriberi, which just as suddenly ceased to afflict them. Inquiry showed that some months earlier the chickens had been fed polished rice, the more expensive grains from which the outer husk is removed. Later, a new cook, wishing to economize, had switched back to the cheaper unpolished rice, whereupon the disease promptly disappeared. Since the disease in the chickens produced symptoms similar to beriberi in humans, Dr Eijkman asked himself whether people suffering a high incidence of beriberi were also populations for whom polished rice was the staple food. He noted that India, South China, Indonesia, the Philippines and parts of South America and Japan were areas where polished rice was the staple food and where, as well, beriberi was common. Other regions without a diet of polished rice were not troubled with the same malady.

We must also be cautious about coincidences or correlation taken as causes:

to work with the statement, supported by Linus Pauling, the Nobel bio-chemist, that "Massive doses of Vitamin C (250 to 10,000 mg per day) prevent colds". Does this mean that everyone or only some people who take this amount will ward off a cold? Is it a strong claim against catching any cold whatsoever or the weaker one of merely increasing immunity? Most of us are habitually not very critical of such ambiguous claims especially those promoted in the media by advertising. The current preoccupation with diet and its effects on beauty and well-being is an excellent source for stimulating classroom discussion of causal accounts.

Analogies:

An argument by analogy is based on a comparison between two things where the number of key similar and relevant characteristics is high and the number of differences is low or absent. For example, scientists working with lab animals reason by analogy that findings can be extrapolated to humans. If "A" has M N O P Q + R and "B" has M N O P Q…then I infer the probability that "B" has R also.

There are some pitfalls here. How can we identify key similarities, etc.? Some suggest that analogies should never be taken as proofs or conclusions, but as starting points to begin thinking. Others see greater value in them (see Stern-Gerlach experiment below). Take, for example, uses in these areas:

- **ethics:** a given situation is considered parallel to another for which a moral principle is binding

- **history:** drawing comparisons between the past & present (how many times have we heard politicians say, "History teaches us …"?) Comparisons of Bosnia to Auschwitz or the Gulf War to Vietnam fit this model, too.

Try this: Accept the analogy that your school life parallels what's expected of you in the "real world." Your studies = your job; your grades = your salary. The taxation system of the real world requires, then, that you share some of your money/grades with those less fortunate & in danger of failing. (False Analogy??)

Conclusion:

What constitutes sufficient justification remains a matter of continuous debate. Does a metaphor (analogy) open or shut the window on reality? Is the scientific method cleaner? The questions remain. However, continuing the quest for intellectual honesty (i.e. exploring generalizations for implicit inferences and reflecting on their worth in the face of new experiences *vs.* grabbing & holding fast to generalizations & following its dictates without question), should make us better equipped and enriched.

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The Stern–Gerlach Experiment (from *Reasoning*). One of the classic models in the history of science is the so–called planetary model of atomic structure. This was the view that the atom could be conceived of rather as a miniature solar system, with a nucleus that was extremely heavy compared with the "planets" swinging around it (which correspond to the electrons). These planetary electrons would be in relatively stable orbits, at distances from the nucleus which were very, very great compared to the diameter of the planets ... Notice that nobody was suggesting that all the properties of the solar system were shared by the atom. For example, there was no suggestion that the planetary electrons had satellites. In this particular case, an experiment know as the Stern–Gerlach experiment, produced results quite impossible to explain on any know model of the atom including the simple planetary model. Then somebody thought of the fact that in the solar system, the planets not only revolve around the sun, but they also revolve around their own axes. Suppose that one were to postulate the same in the atom, that is, suppose that each electron had some spin as well as a rate of revolution about the central nucleus. This would clearly give the system of dynamic properties different from one in which the electron had no significant spin; for example, they would have a store for energy due to the rotation in orbit. Hence, the results of interactions between streams of bombarding particles – or strong magnetic fields – and atoms would be different. It turned out that this difference was just about right to explain the results of the Stern–Gerlach experiment.