

## The Scientific Method

### Observation

Observe the world around us (objective vs. subjective observations).

### Question

The question raised must have a “simple,” concrete answer that can be obtained by performing an experiment.

### Literature Review/Search

Search to determine if your question has been researched by other scientist.

### Hypothesis

This is a tentative answer to the question: a testable explanation for what was observed. The scientist tries to explain what caused what was observed.  
(Null ( $H_0$ ) & Alternate ( $H_A$ ))

### Prediction

A **prediction** is the expected results if the hypothesis and other underlying assumptions and principles are true and an experiment is done to test that hypothesis. If ...then....statements.

**Deductive reasoning** flows from general to specific. From general premises, a scientist would extrapolate to specific results: if all organisms have cells and humans are organisms, then humans should have cells. This is a **prediction** about a specific case based on the general premises.

**Inductive reasoning** goes from a set of specific observations to general conclusions: I observed cells in x, y, and z organisms, therefore all animals have cells

### Experiment

The scientist **performs an experiment** to see if the predicted results are obtained. If the expected results are obtained, it supports (but does **NOT prove**) the hypothesis. All experiments must have the following criteria:

- Controlled experiment
- Controlled group or variable
- Experimental group or variable
- Quantitative data (vs. qualitative)
- Repeat, repeat, repeat

### Analysis

Decide which statistical test to implement. Examples include:  
 $\chi^2$  (Chi-squared), t-test (one or two-tailed), ANOVA, etc...  
Statistically valid or acceptable ( $p > 0.05$ )

### Discussion

Limitations and reasons for results.

### Conclusion

Decide what the data and analysis mean and what to do next.