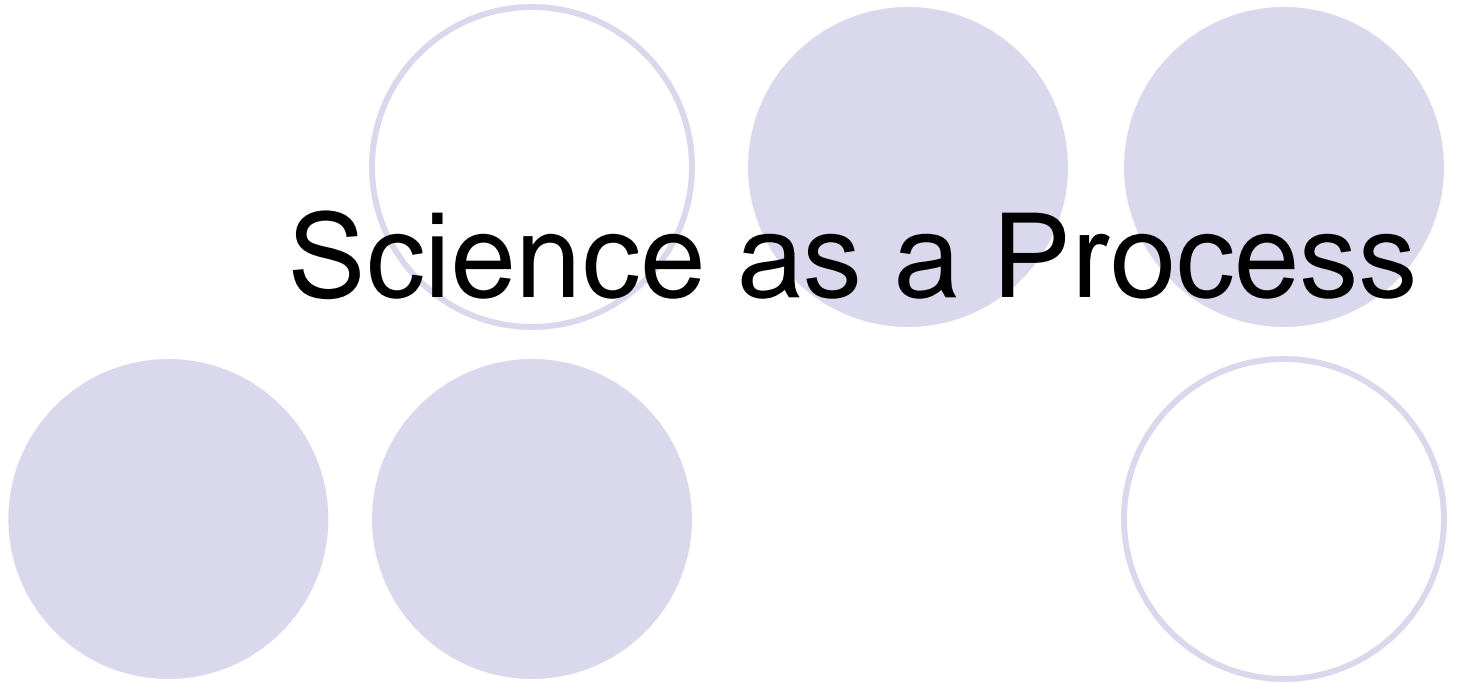# Science as a Process

- Science is a way of thinking, questioning, and gathering evidence
- It is a process of Inquiry

- Scientists make careful observations
- Record observations as data
- Form a hypothesis as a possible answer to a question
- Test their hypothesis and analyze their data

OBSERVING

FORMING HYPOTHESES

EVALUATING RESULTS

TESTING HYPOTHESES

ANALYZING DATA
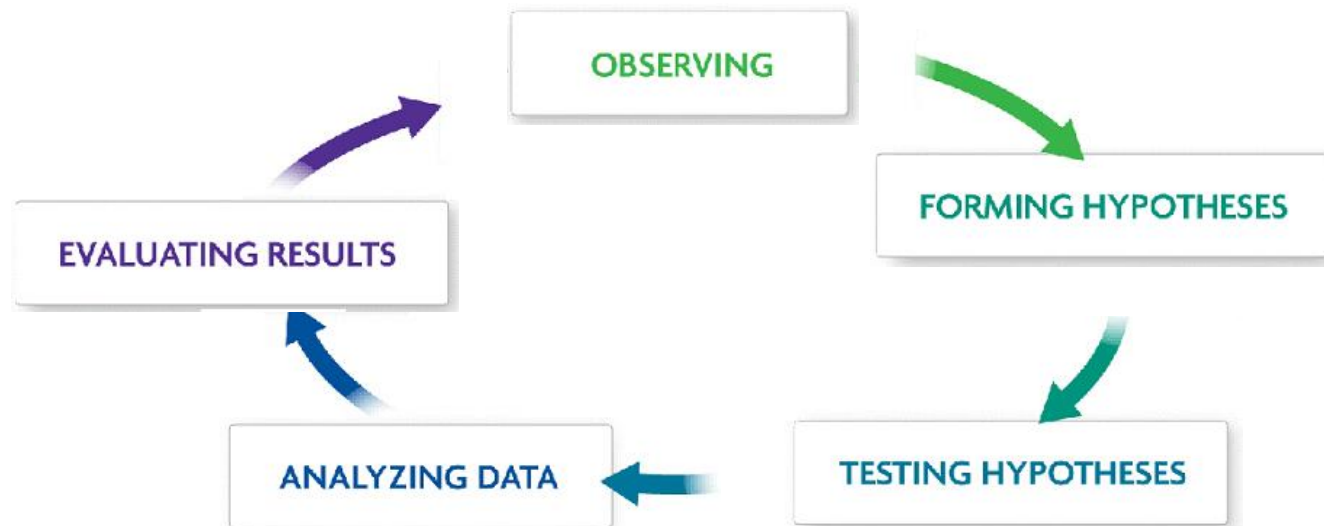
- To form a hypothesis you need…
  - credible, accurate, and relevant data
  - Inductive reasoning – using information from your own experiences
- A hypothesis may or may not be supported by experimental results

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- Experiments are used to test a hypothesis
- Experiments should only test one variable at a time.
- Observations allow scientists to describe a phenomena and to find what causes it

Recording Data

- Line graphs – used to show how one variable changes due to another variable
  - Good for multiple groups of data
- Pie graph – shows parts of a whole
- Bar graph – comparing things that are not parts of a whole

Accuracy vs. Precision

- **Accuracy** of a result is whether the values of an experiment agree with the true or accepted values
- **Precision** is a measure of whether measurements made in the same way agree with one another
  - It is possible to have good precision but poor accuracy

Accuracy vs. Precision cont…

Suppose you are aiming at a target, trying to hit the bull's eye (the center of the target) with each of five darts. Here are some representative pattern of darts in the target.
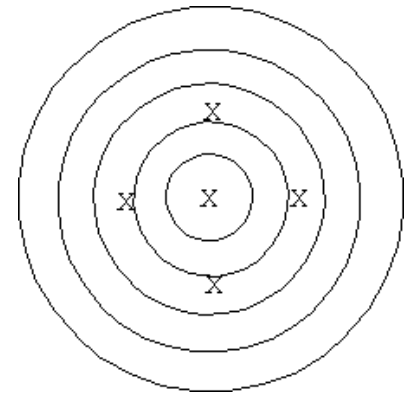
Neither Precise Nor Accurate

Precise, Not Accurate

Accurate, Not Precise
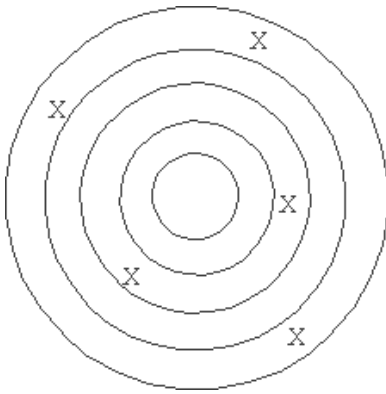
This is a randomlike pattern, neither precise nor accurate. The darts are not clustered together and are not near the bull's eye.
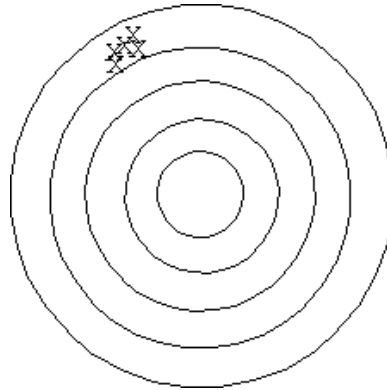
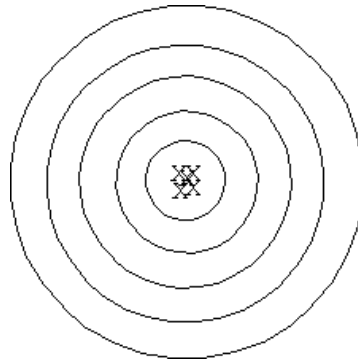This is a precise pattern, but not accurate. The darts are clustered together but did not hit the intended mark.

This is an accurate pattern, but not precise. The darts are not clustered, but their 'average' position is the center of the bull's eye.

# Accuracy vs. Precision Continued…

Precise and Accurate

This pattern is both precise and accurate. The darts are tightly clustered and their average position is the center of the

bull's eye.

- Independent variable are manipulated
- Dependant variables are observed and measured
- Control variables are other factors in an experiment that are constants or are kept the same
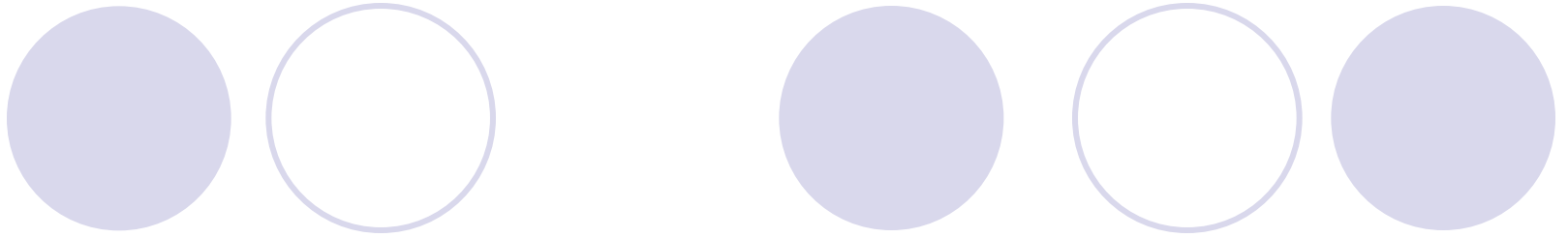
- Qualitative Observation – made using the senses, usually something you describe

- Quantitative Observation – made using measuring tool and usually a number

How to figure out what variables are what in an experiment!

- **D**ependant variable is the one that does the
- **R**esponding and is placed on the
- **Y**-axis

- **M**anipulated variable is the one that is
- **I**ndependent and is placed on the
- **X**-axis

(the one **I** change is the **I**ndependent variable and it causes the other variable to respond)

- Theories explain a wide range of observations and experimental results.
- A theory is supported by a wide range of scientific evidence.
- Theories can change based on new evidence.

New evidence shows that ulces are cause by bacteria
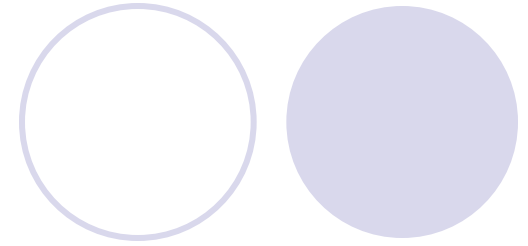
bacteria

stomach lining
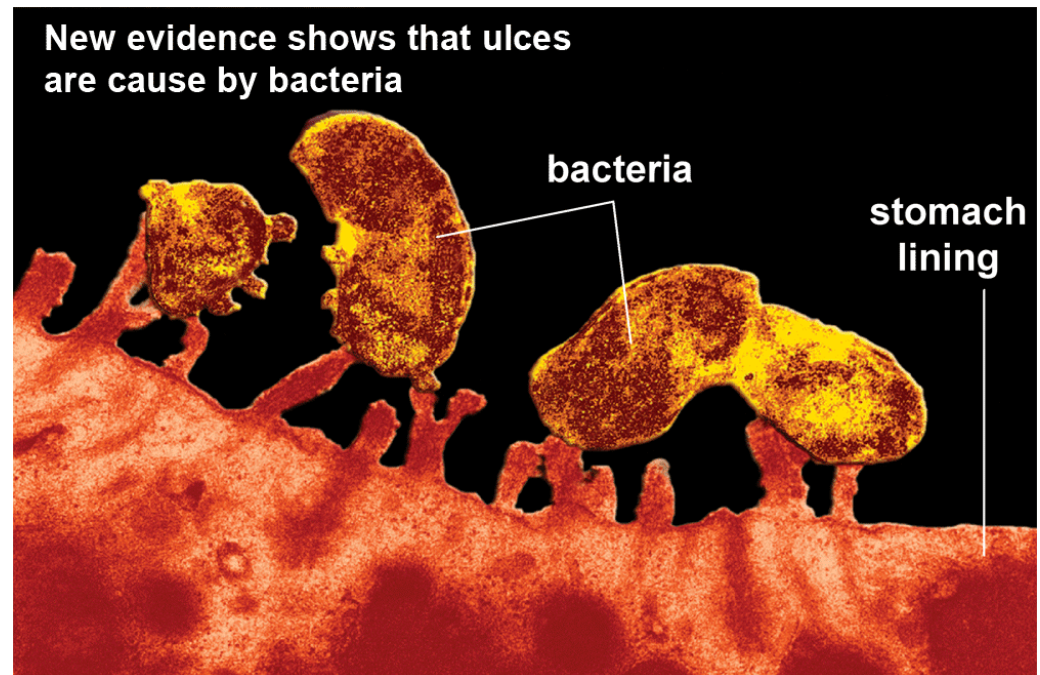
A GOOD Scientific Experiment:

- One variable changed at a time; everything else remains constant or controlled
- Repeated trials to eliminate error
- Organized and analyzed properly

Scientific Investigation vs. Technological Design

- Scientific Investigation
  - Asks a question
  - Designs an experiment
  - Evaluates by accept/reject hypothesis
- Technological Design
  - Identifies a need/problem
  - Implements design
  - Evaluates process did it meet criteria?