Scientific Thinking

Thinking Like a Scientist

- Scientific thinking begins with observation.
- Observation is the process of gathering information about events or processes in a careful, orderly way.

Scientific Method

- Involves a series of steps that are used to investigate a natural occurrence:
  1. Observe things.
  2. Ask a question.
  3. Form a hypothesis.
  4. Set up a controlled experiment
  5. Collect data and Analyze Results
  6. Draw a conclusion.

1. Observe things.

- What do you observe in this picture?
- Inference or conclusion: based on observations.

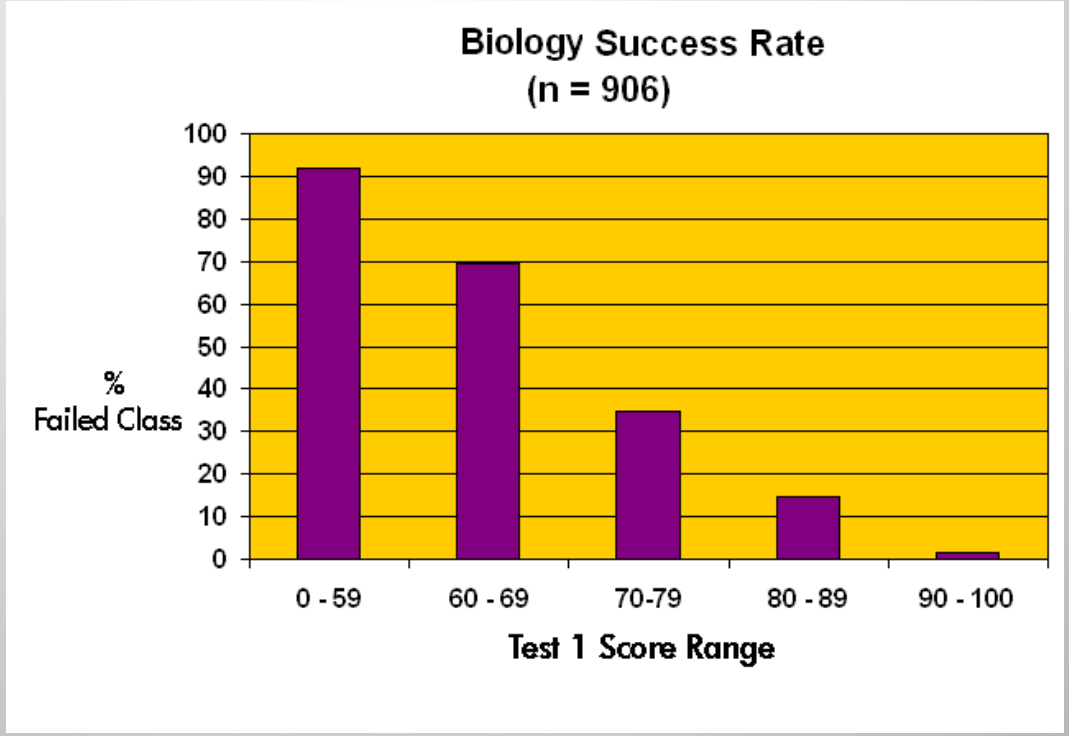
1. Observe things.

Scientists use data to make inferences.

An **inference** is a logical interpretation based on prior knowledge or experience.

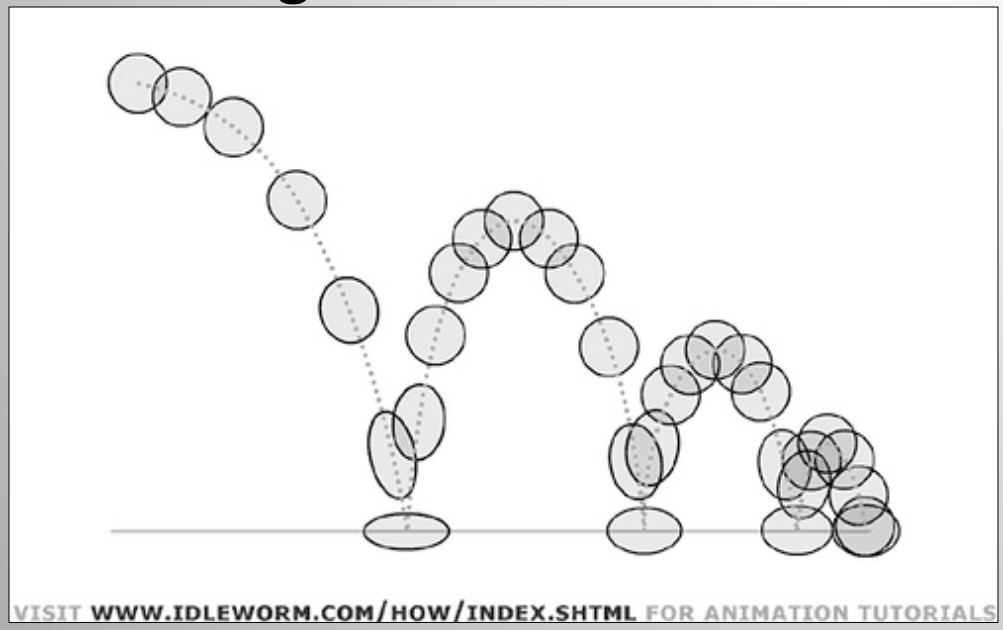
1. Observe things.

- The information gathered from observations is called data.
    1. Quantitative data
    2. Qualitative data



2. Ask a question.

- Careful observations lead to questions.
- Your question should **compare things**.
  - Does the height you drop a ball from affect the height it bounces?



3. Form a hypothesis.

- What we think will happen in the experiment.
- A statement that expresses the expected answer.
- A hypothesis can be proven right ***OR*** wrong.
- "If…, then…" statement.
  - **If** we drop the ball from a greater height, **then** the ball will bounce higher.

3. Form a hypothesis.

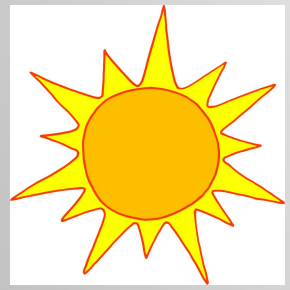
- How do scientists test hypotheses?
- A hypothesis should be tested by an experiment in which only one variable is changed at a time.

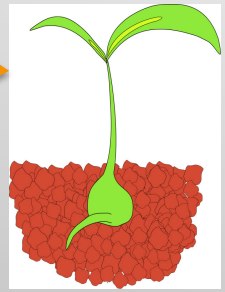
4. Set up an experiment

- Tests the hypothesis to answer your question.
- Compares the independent variable to the dependent variable.
- Experiments can only test one dependent variable at a time.

Variables, Example

- Growth of Plants: does more sun make a difference?
- 8 hours of sun vs. 4 hours of sun. Which plant will grow more quickly?





Dependent Variable
= growth of plant.

Independent Variable
= amount of sun.

Variables

- A variable is something that changes.
- 2 types of variables:
  - Dependent = value changes depending on other factors; value is NOT known at the beginning of the experiment.
  - Independent = *we* change, manipulate; value is known at the beginning of the experiment.

Controls

- A control is something that is kept constant.
- Controls are kept the same through the experiment:
  - What did we control in our 'ball height' experiment example?
- **Controlled Experiment: tests only 1 variable**.
  - Why is this important?

5. Collect and Analyze Results

- Run experiment and collect data
  - Drop ball from certain height and record bounce height.
  - Drop ball from a different height and record bounce height.
- How do the results compare?
  - Does the height you drop a ball from affect the height it bounces?

6. Conclusion Statement

- Presents findings of the experiment.
- Was hypothesis correct? Incorrect?
  - Does the height you drop a ball from affect the height it bounces?
- Hypothesis is either supported or not.
- If hypothesis is wrong, a new one can be stated and tested.

Question Everything!

- **<u>Scientific understanding is always changing.</u>**
- Good scientists are skeptics who question both existing ideas and new hypotheses.