What is biology?

What is biology?

- Biology:
  - The science that studies living organisms

- What is science?
  - Process
  - A way of answering questions

What is science?

- A way of answering questions

  The Scientific Method
- Step 1:
  - Observation
    - My friend drinks a lot of juice and doesn't often get colds.
  - Question
    - What if the vitamin C in orange juice helps prevent colds?

What is science?

- Step 1:
  - Observation
    - People who don't drink pop (soda) seem to have fewer heart attacks
  - Question
    - Is there an association between pop drinking and heart health?

What is science?

- Step 2:
  - Hypothesis
    - What is a hypothesis?

    - A hypothesis is
      - 1. A statement
      - 2. Testable
      - 3. Falsifiable

What is science?

- Step 2:
  - Hypothesis
    - Consuming vitamin C reduces the risk of catching a cold.
  - Prediction
    - IF we give people lots of vitamin C, THEN they should get fewer colds than people without vitamin C.

What is science?

- Step 2:
  - Hypothesis:
    - Drinking pop increases your risk of heart disease.
  - Prediction:
    - IF someone drinks pop, THEN they are more likely to show symptoms of heart disease.

What is science?

- Step 3:
  - Experiment
    - Situations designed to test specific ideas.
      - May be manipulated situations
        - » Controlled experiments
      - May be careful observations
        - » Naturalistic experiments
    - Results in data
      - Information that can be used to evaluate hypotheses

What is science?

- Step 3:
  - Experiment
    - Test the hypothesis: Consuming vitamin C reduces the risk of catching a cold.
    - How would you design your experiment to show that ONLY vitamin C has an effect?

What is science?

- Step 3:
  - Experiment
    - Test the hypothesis: Drinking pop increases your risk of heart disease.
    - How would you design your experiment to evaluate this hypothesis?
      - The researchers answering this question were taking data as part of a larger study. They had long-term data on the habits of >6000 people who did not have heart disease at the start of the data collection.

What is science?

- Step 4:
  - Evaluate the data
    - Do they support your hypothesis?
    - Do they disprove your hypothesis?
    - Do they lead to more questions?

What is science?

- Step 4:
  - Evaluate the data
    - People on vitamin C supplements have more colds than people without
      - Disproves hypothesis
    - People on vitamin C supplements have the same number of colds as people without
      - Disproves hypothesis
    - People on vitamin C supplements have fewer colds than people without
      - Supports hypothesis

What is science?

- Evaluate the data:
  - People on vitamin C supplements have fewer colds than those without
    - Supports hypothesis
  - Why doesn't it prove it to be true?
    - Alternative hypotheses
      - Different immune systems
      - Different diets
      - Different metabolism of vitamin C
      - People who take supplements more likely to exercise

What is science?

- Step 4:
  - Evaluate the data
    - Drinking pop increases your risk of heart disease
    - Results
      - Individuals who consume pop are at higher risk for certain types of heart disease.
        - » What else might be affecting this risk?

What is science?

- Experimental controls
  - Variables that stay constant throughout all situations
    - If there are differences in different situations, it is NOT due to the controls
  - An experiment that is controlled is one that compares a baseline to a manipulated group.

What is science?

- Observation:
  - Chili peppers contain capsaicin- a chemical that makes them hot.
- Hypothesis
  - Directed dispersal hypothesis
    - Capsaicin deters seed predators, but not seed dispersers

Cactus mice are seed eaters.

Figure 1-10b Biological Science, 2/e

What is science?

Curve-billed thrashers eat chili fruits.

Figure 1-10c Biological Science, 2/e

- Directed Dispersal hypothesis
  - Mice and birds should respond differently to capsaicin
- Test
  - Present both with chiles
  - Present both with non-chiles

What is science?

- A process by which experiments are used to evaluate hypotheses.

- Hypotheses that are repeatedly tested and supported
  - Theories

Which of the following are good hypotheses?

- 1. People like Heinz ketchup better than Hunt's ketchup.
- 2. Why do birds fly south?
- 3. My car won't start because the battery is dead.
- 4. Stonehenge was built by magic.

How is science evaluated?

- Primary literature
  - Peer-reviewed
- Secondary literature
  - Subset of the primary literature
  - Interpreted
  - Affected by editorial decisions