SCIENTIFIC PROCESS

Introduction to Scientific Process

Scientific Process

- Listen to the sound “Chirp, chirp, chirp”
- It is one of the hottest nights of the summer and your bedroom windows are wide open.
- The noise from the crickets is louder than most nights.
  - ***Could the crickets be chirping more because of the heat?***
  - ***How could you find out?***

Scientific Process

- As you lay in bed, listening to the crickets chirping you probably are not thinking much about science.
- But, you are thinking just like a scientist would
- You made observations, heard the loud chirping of the crickets, and felt the heat of the summer night.

Scientific Process

- Your observations led you to infer that heat might cause increased chirping.

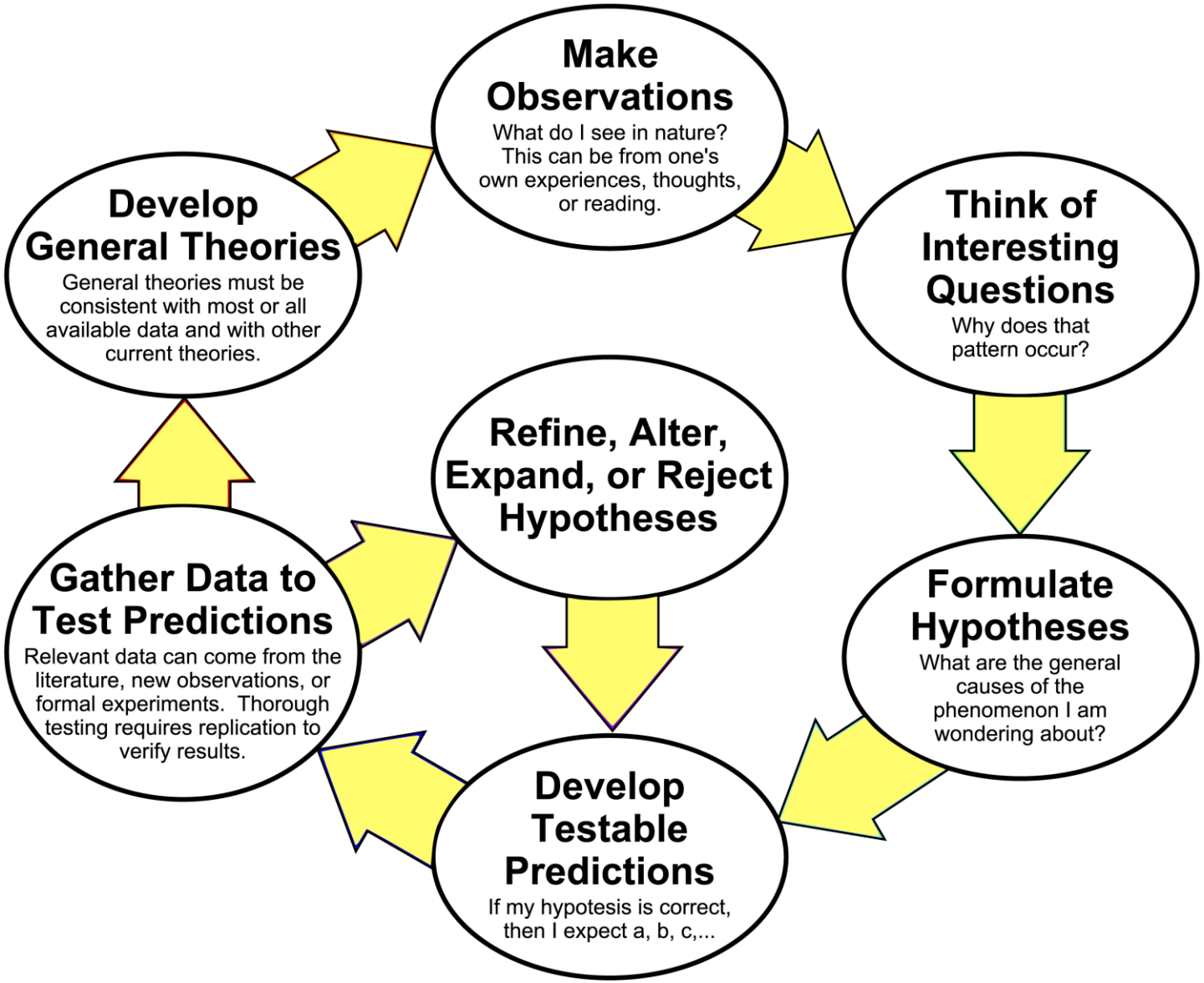
- You might even make a prediction:
  - ***"If it's cooler tomorrow night, the crickets will be quieter."***

What is the Scientific Process?

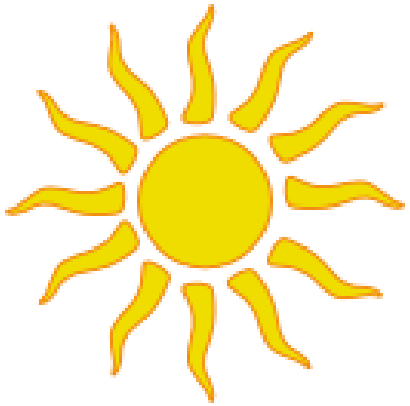
- The ways in which scientists study the natural world and propose explanations based on observations and experimentations.
  - ***Also called Scientific Method***

- Could be used to find out whether there is a relationship between the air temperature and crickets' chirping

The Scientific Method as an Ongoing Process



Scientific Process



- Often begins with a problem or question about an observation.

- In the case of the crickets:
  - ***"Does the air temperature affect the chirping of crickets?***

Scientific Process

- Formulate a *hypothesis*
  - A proposed explanation for an observation that can be tested with a controlled experiment.

- A good hypothesis is always written as a statement like this:
  - **“If…, then…, because…”**

Hypothesis Format: “If…, then…, because"

- After the word “If”…explain what will change in the experiment.
  - Include the *Independent Variable*

In the case of the crickets:

- ***“If the temperature is hotter outside…***

Hypothesis Format: “If…, then…, because"

- After the word “then”…write what you will expect to happen as a result of that change
  - The effect
  - Include the *Dependent Variable*

In the case of the crickets:

- ***“… then cricket chirping will increase…”***

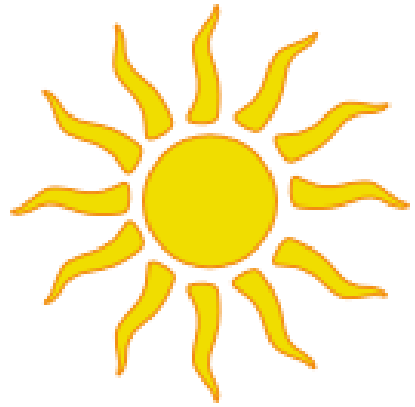
Hypothesis Format: “If…, then…, because"

- After the word “because”…explain why you think the result will happen
  - Logical reasoning why

In the case of the crickets:

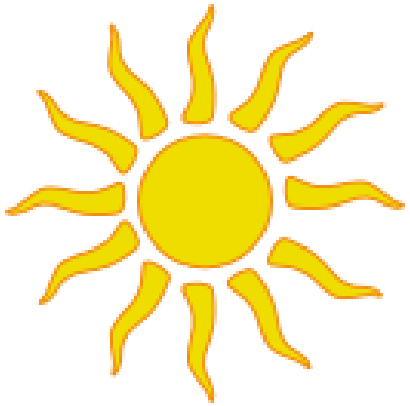
- ***“… because they are more active.”***

Hypothesis Format: “If…, then…, because"



- ***“If the temperature is hotter outside then cricket chirping will increase because they are more active.***

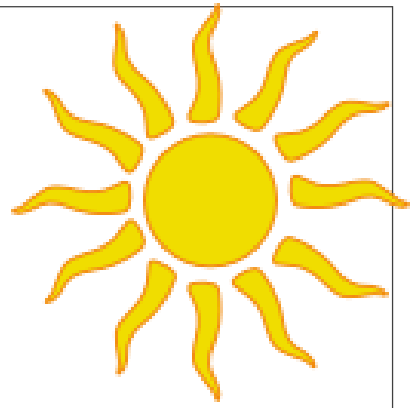
Scientific Process



- Design an *experiment* to test your hypothesis
- An experiment in which only one variable is manipulated at a time is called a *controlled experiment*.

- In the case of the crickets:
  - ***Observe crickets at different air temperatures***

Independent Variable

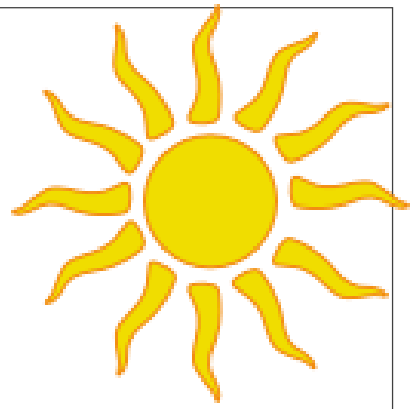


- Also called the ***Manipulative Variable***
- The factor that is purposely changed
- Limited to <u>only one</u> in an experiment

In the case of the crickets:

- Air Temperature

Dependent Variable

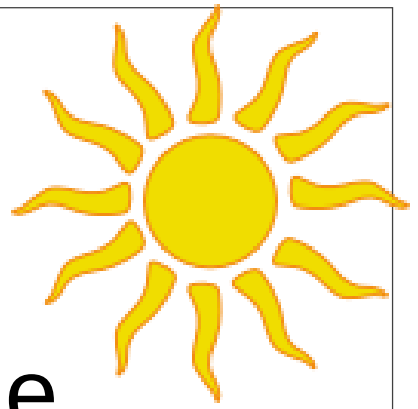


- Also called the ***Responding Variable***
- The factor that is measured or observed in an experiment

In the case of the crickets:

- Number of Cricket chirps

Control Variables

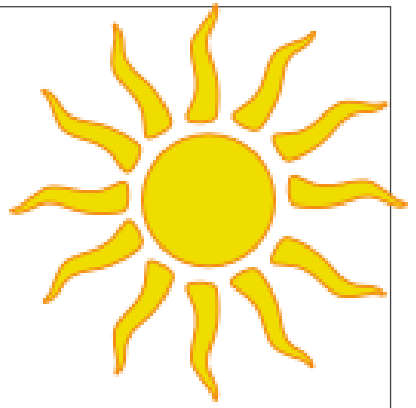


- Factors that are kept the same (constant) for all groups
- Important so that scientist is assured that the changes are due only to the changes in the Independent variable

In the case of the crickets:

- Kind of crickets
- Type of container you test them in.
- Same food

Experimental Group

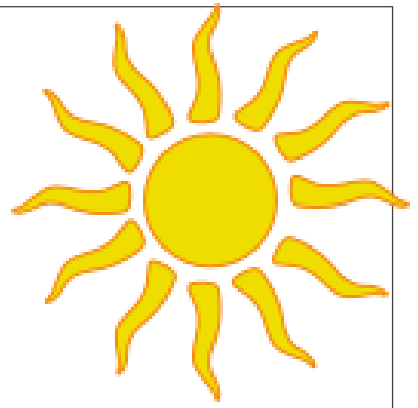


- The group exposed to the independent variable.
- Shows the effect of the variable being tested

In the case of the crickets:

- Crickets exposed to warmer temperature

Control Group

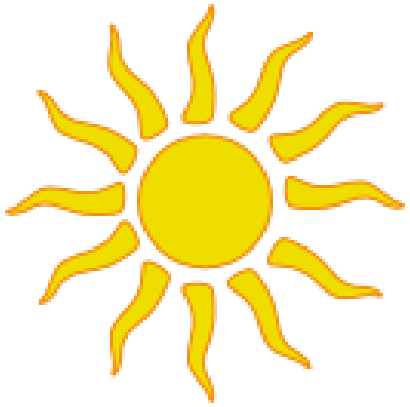


- The group that does NOT receive the independent variable
- All other conditions stay the same as the experimental group
- Used to <u>compare</u> results

In the case of the crickets:

- Crickets exposed to average temperature

Scientific Process

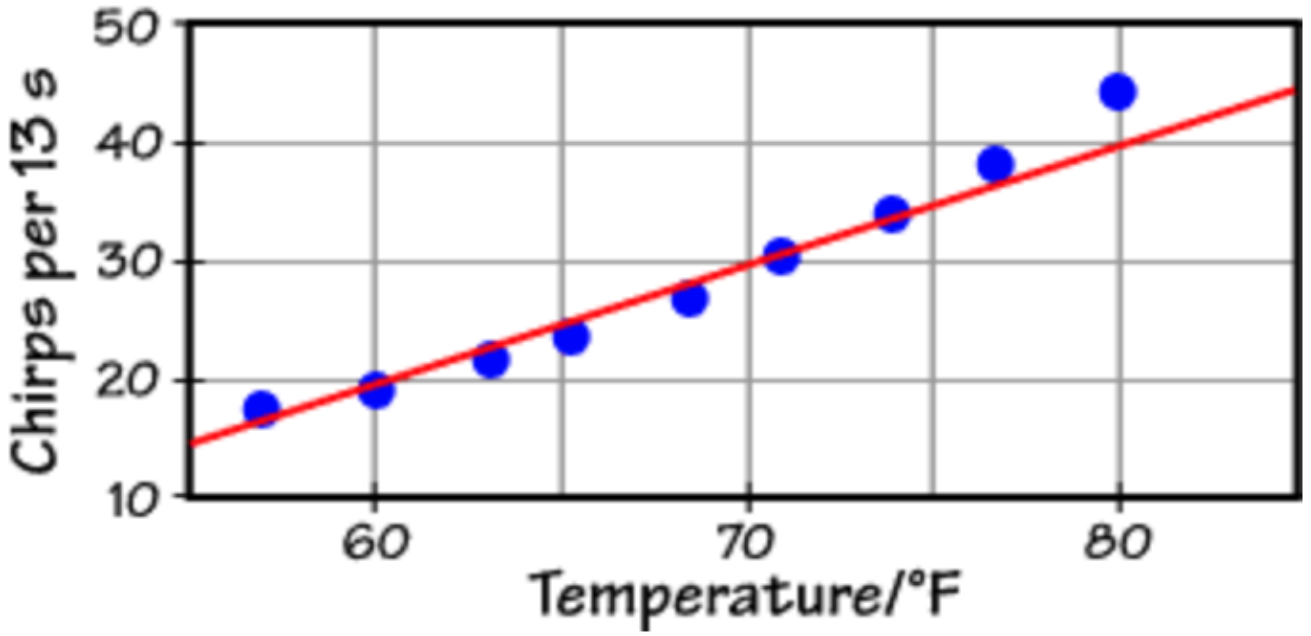


- *Collect and Interpret Data*
  - ***Quantitative data*** *can be counted, measured, or expressed using numbers*
  - **Qualitative data** includes characteristics and descriptive

- In the case of the crickets:
  - ***Number of chirps per minute***

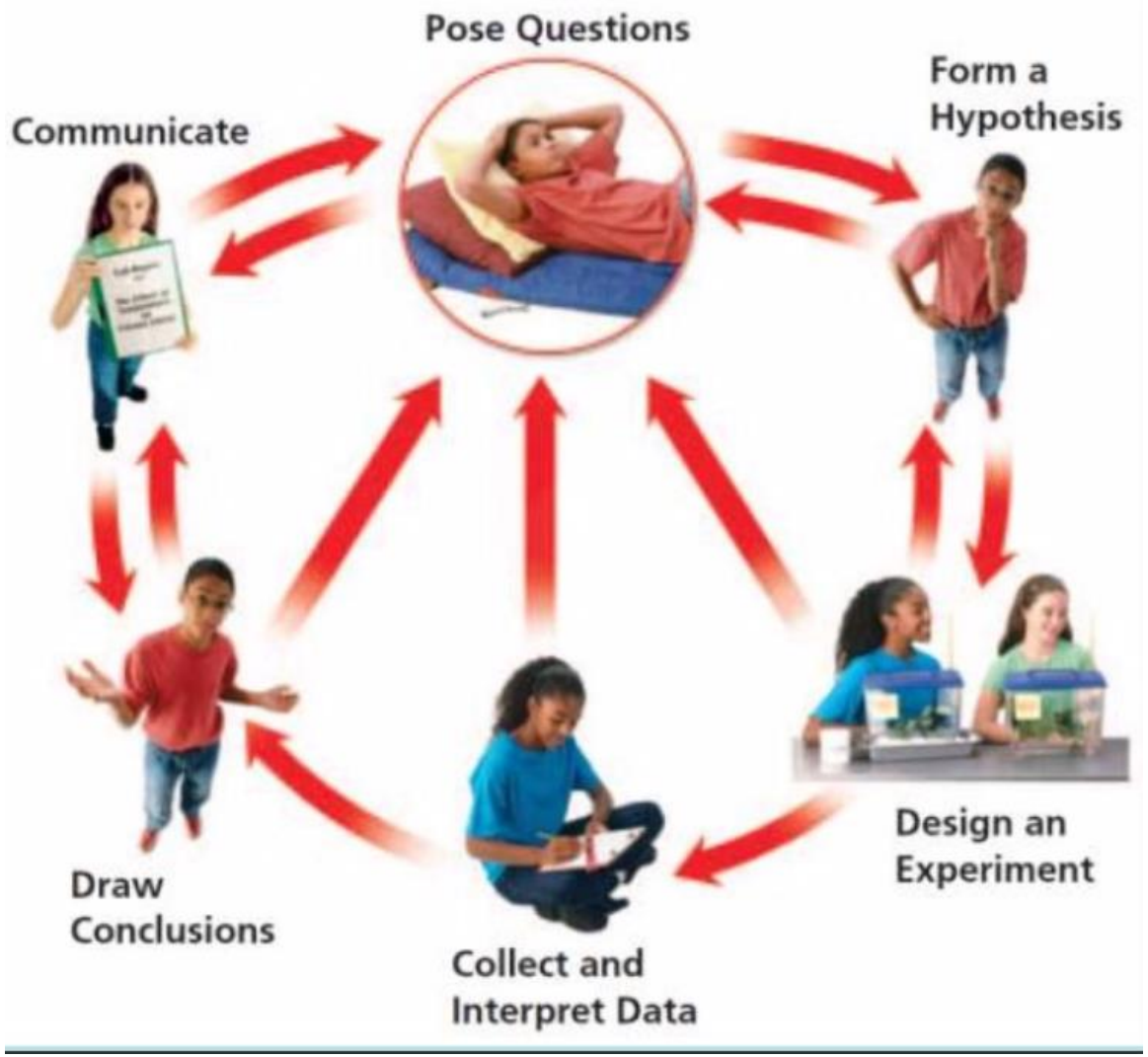
Scientific Process

- *Collect and Interpret Data*
  - *Graph results to reveal patterns or trends in data*



Scientific Process

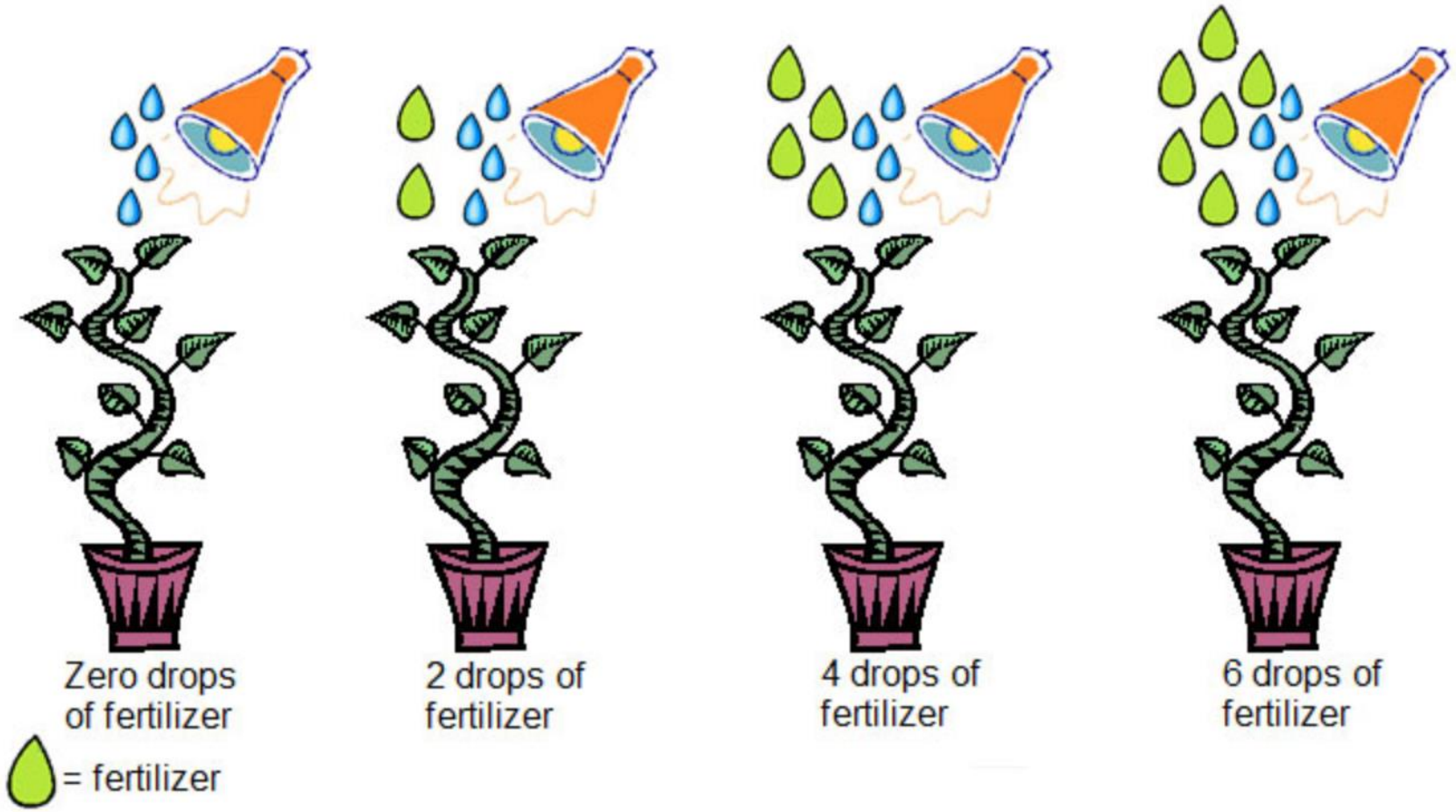
- *Form Conclusion & Communicate results*
  - A summary of what you learned from an experiment
  - Does the data support or reject the hypothesis?
  - Often leads to new questions, new hypothesis, and new experiments



SCIENTIFIC PROCESS IS NOT A RIGID SEQUENCE OF STEPS!


PRACTICE PROBLEMS

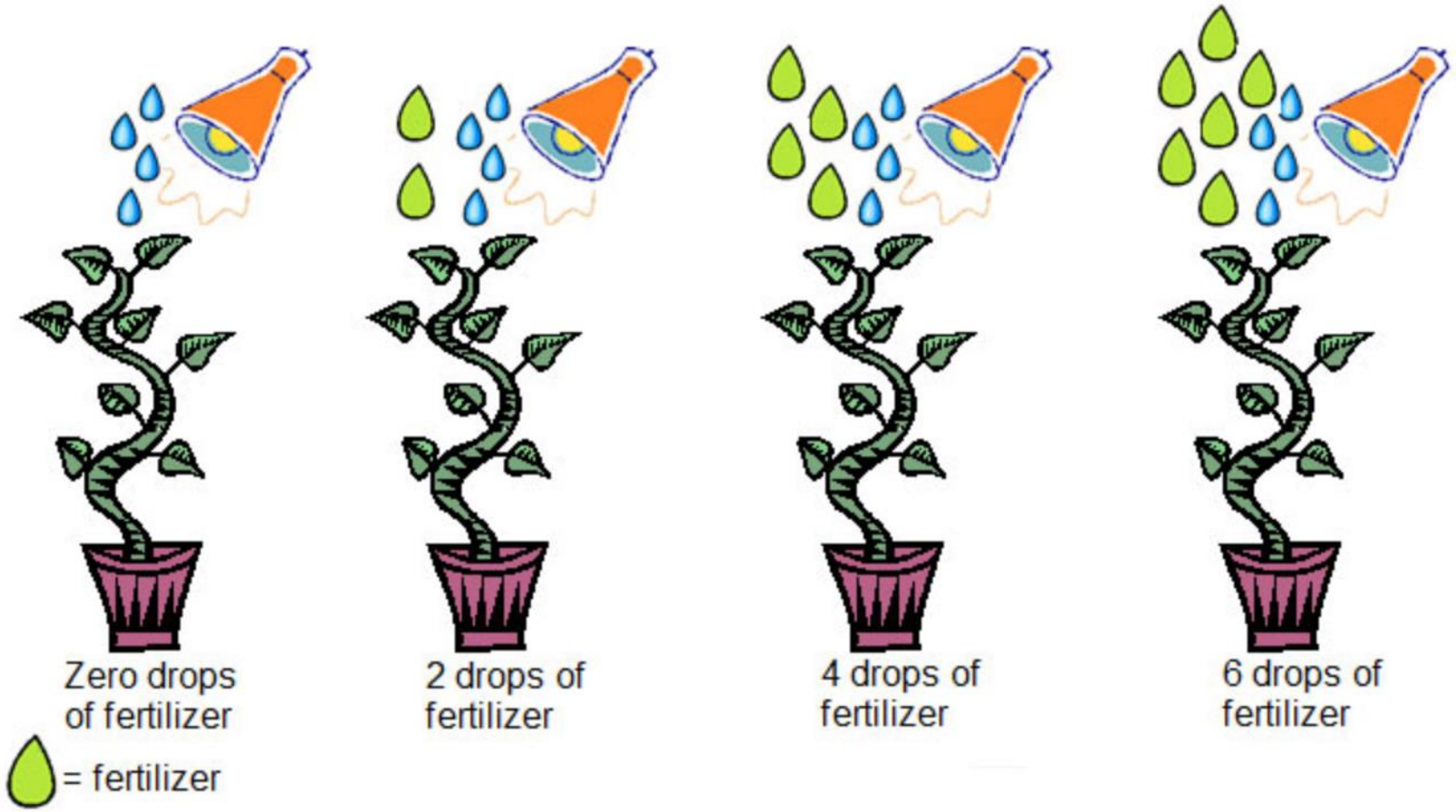
Fertilizer and Plant Growth Experiment



What question is being asked by this experiment?

- Does the amount of fertilizer affect plant growth?

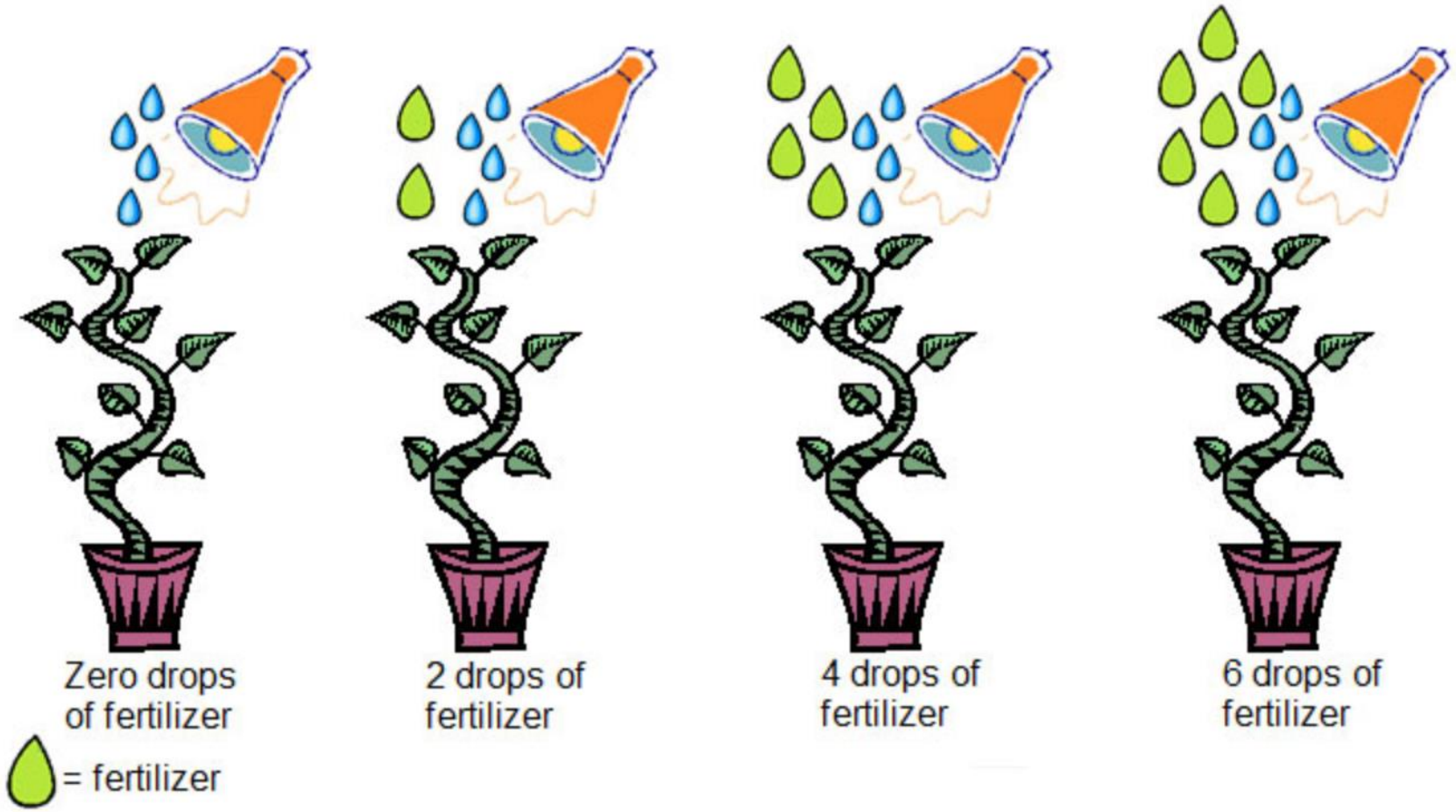
Fertilizer and Plant Growth Experiment



Write a hypothesis for the experiment

- **If** plants are given more drops of fertilizer **then** they will grow taller **because** fertilizer provides nutrients to the plant.

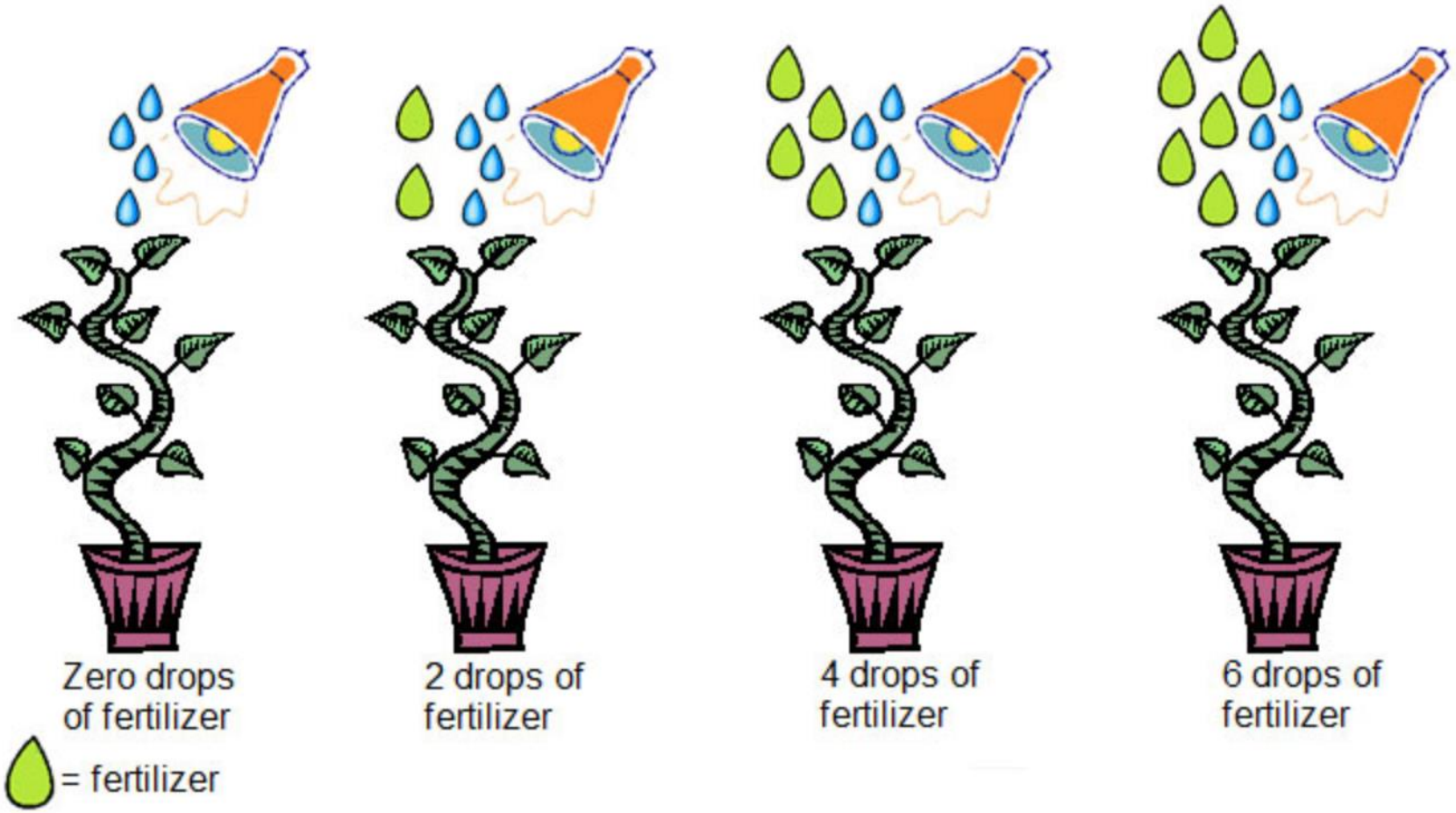
Fertilizer and Plant Growth Experiment



What's the Independent Variable?

- The amount of fertilizer

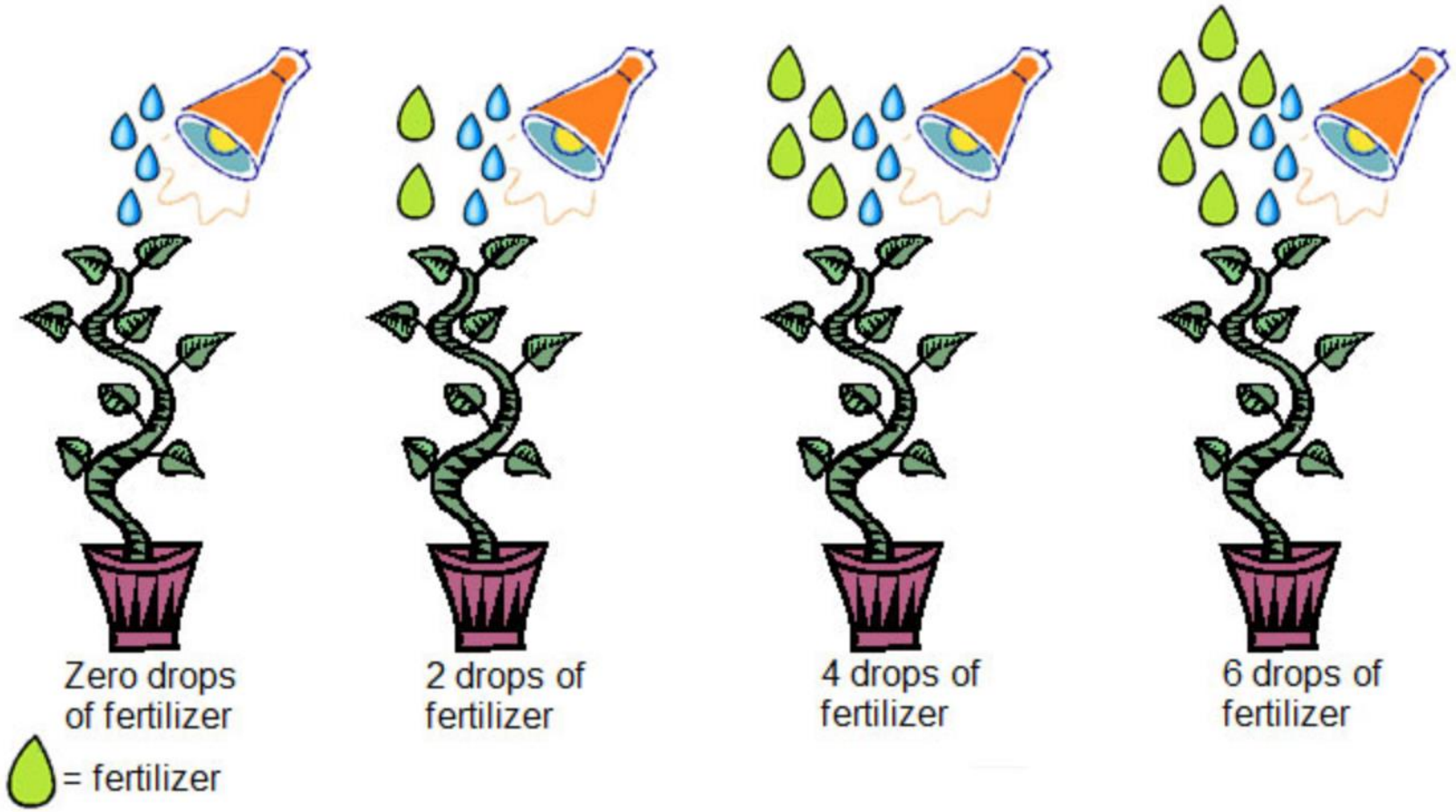
Fertilizer and Plant Growth Experiment



What's the Dependent Variable?

- The height of each plant

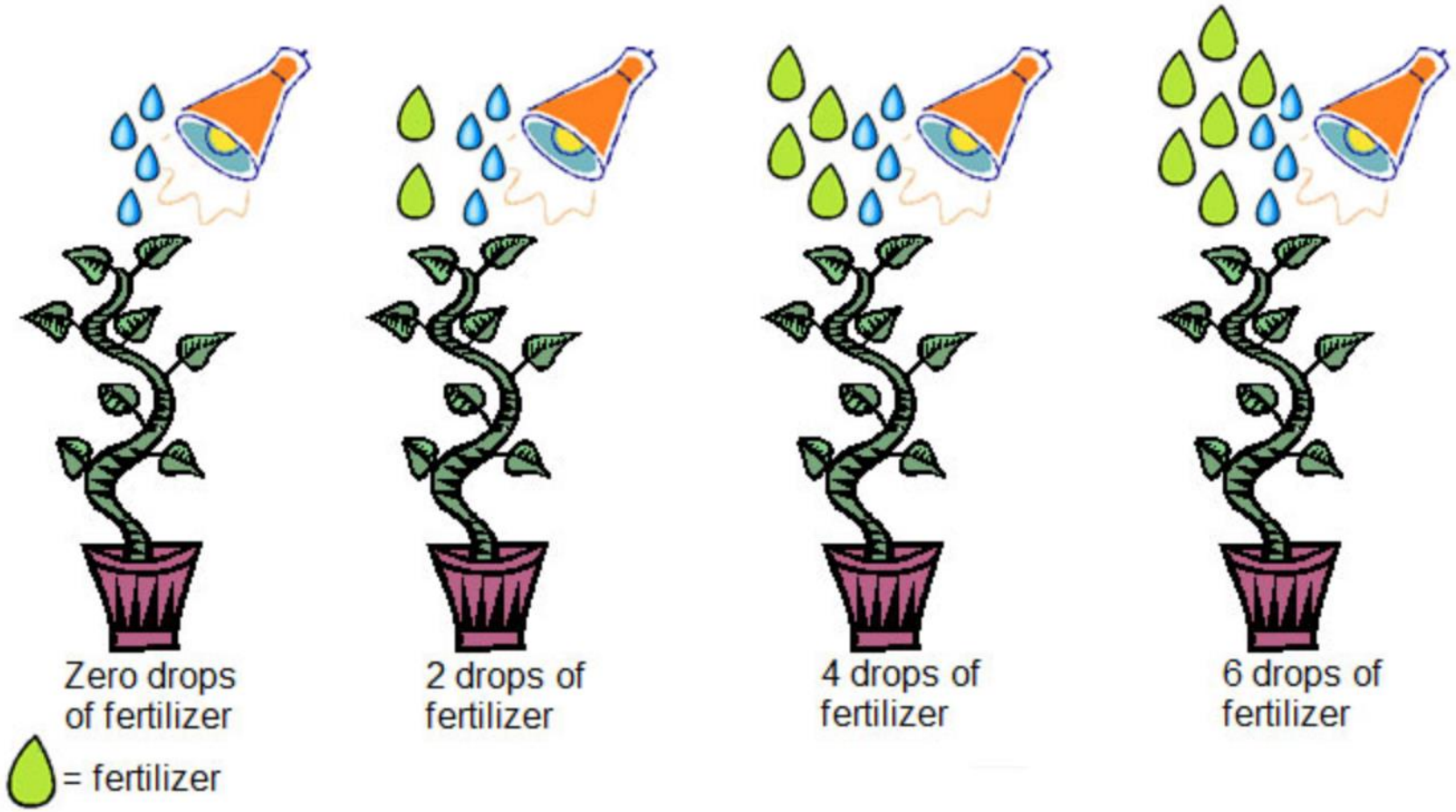
Fertilizer and Plant Growth Experiment



What are the Control Variables?

- Type of Plant
- Amount of Water
- Amount of Light
- Type of pot
- Type of soil

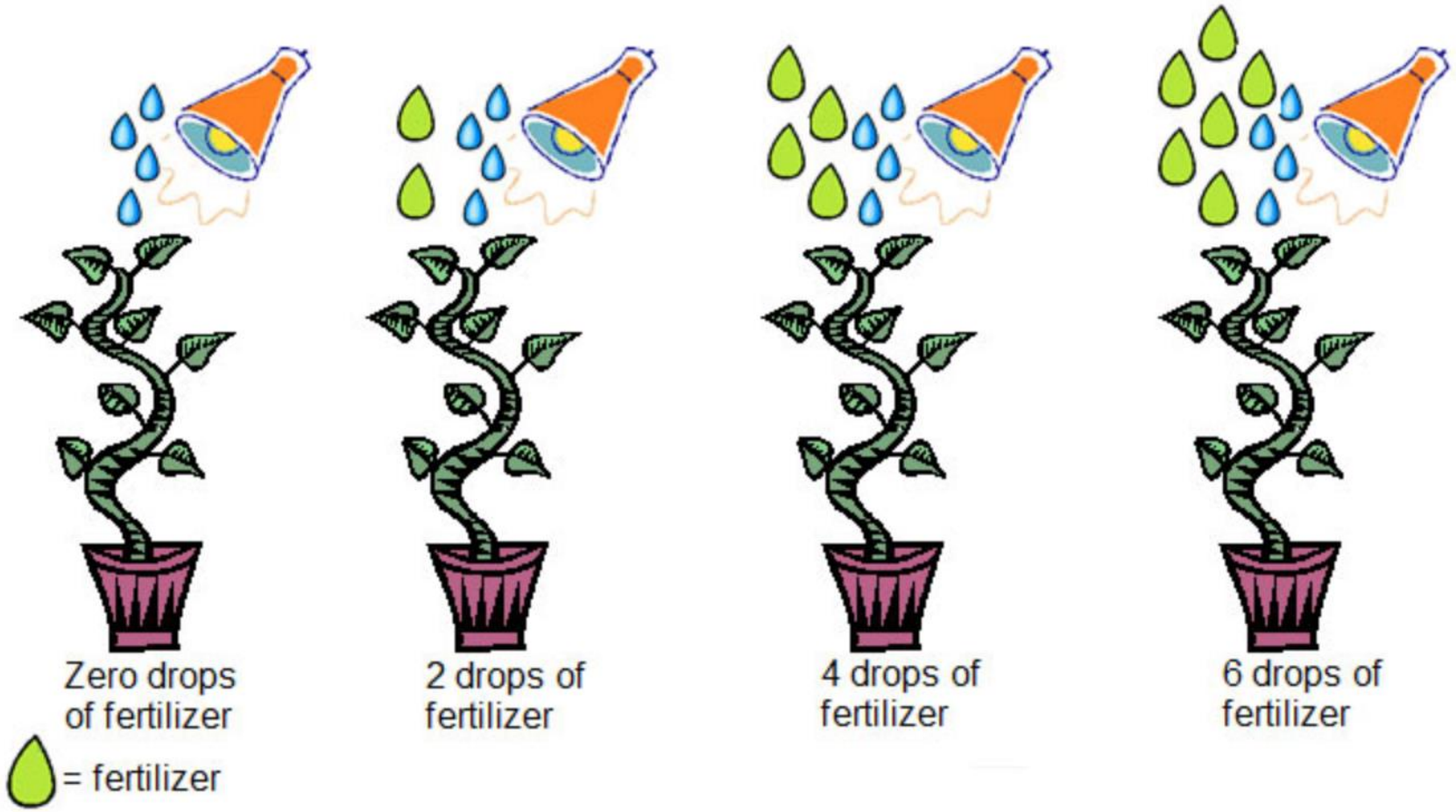
Fertilizer and Plant Growth Experiment



What are the experimental groups?

- Groups with 2, 3, 6, drops of fertilizer

Fertilizer and Plant Growth Experiment



What is the control group?

- Group that does not receive the fertilizer

Practice Problem

Identify the independent and dependent variables in each investigation.

How does the angle of a ramp affect the distance a skier will travel?

Practice Problem

Identify the independent and dependent variables in each investigation.

Will plastic, metal, or wooden cups keep drinks warm longest?

Practice Problem

Identify the independent and dependent variables in each investigation.

What happens to the height a ball bounces when it is dropped on different surfaces?

Practice Problem

Identify the independent and dependent variables in each investigation.

How does the temperature of water affect the time it takes for sugar to dissolve?