

DESIGNING EXPERIMENTS

Identifying Constants

Except for the independent and the dependent variables, every other factor in a properly controlled experiment must remain unchanged. When you control an experiment in this way, you know that any differences between groups or conditions are due to changes in the independent variable. To investigate the effect of temperature on the rate at which steel wool rusts in the presence of vinegar, you must be sure that the only difference in conditions between the samples of steel wool is the temperature of the environment.

Constants are all of the factors that must be identical across all of the groups you are comparing. For the example above, the constants in the experiment would include the amount and kind of steel wool, the amount and strength of vinegar, the time the steel wool is soaked in the vinegar, the size and type of container used to hold the moist steel wool, and the amount of light and humidity in each environment.

Identify the constants in the following investigations.

1. Hypothesis: If more plant food is added to pond water, then the algae will grow larger, because algae growth depends on the nutrients in plant food.

Independent variable: amount of plant food added to pond water

Dependent variable: amount of algae growth

Operational definition: size (in mm) of biggest algae clump

Constants: _____

2. Hypothesis: If different types of liquids are poured on limestone, then some of them will cause the limestone to dissolve, because some types of solutions react with the compounds in limestone.

Independent variable: type of liquid

Dependent variable: dissolving of limestone

Operational definition: dissolving does or does not occur

Constants: _____

3. Hypothesis: If different types of metal are warmed and put into containers of water, then the water temperatures in the containers will change at different rates, because materials that are better conductors transfer heat more quickly.

Independent variable: type of metal

Dependent variable: rate of temperature change

Operational definition: time, in minutes, for the water's temperature to increase by 10°C

Constants: _____

4. A student sought to discover the best household material for absorbing oil. He used cotton balls, a kitchen sponge, some paper towels and some wax paper to clean up 5 mL of olive oil he had spilled on a brick. No matter what he did, an oily spot remained on the brick. Describe how he could change this into a controlled scientific investigation, and identify the constants in the investigation.

Challenge Evaluate the following experimental design.

A student wanted to investigate the relationship between the amount of available light and growth of bean seedlings during a one-week period. The student placed four identical seedlings in a sunny kitchen windowsill. She built a chickenwire frame around and over each seedling. On one frame she wrapped a layer of cheesecloth; on another she wrapped two layers of cheesecloth; on a third she wrapped three layers of cheesecloth and on the fourth she wrapped four layers of cheesecloth. She measured the height of each seedling after a week to determine how much they had grown.
