

Experimental Design Outline

Integrated Science 1

8/09

Redwood High School

Name

Period

All experiments have certain components in common. Throughout the year we will be using what is called a “Design Outline” to label and identify the parts of any scientific experiment. This handout will guide you in using this type of outline.

Consider the following scenario:

After studying about recycling, members of John’s biology class investigated the effect of various recycled products on plant growth. John’s lab group compared the effect of different aged grass compost on bean plants. Because decomposition is necessary for release of nutrients, the group hypothesized that older grass compost would produce taller bean plants. Three flats of bean plants (25 plants/flat) were grown for 5 days. The plants were then fertilized as follows: (a) Flat A: 450 g of 3-month-old compost, (b) Flat B: 450 g of 6-month-old compost, and (c) Flat C: 0 g compost. The plants received the same amount of sunlight and water each day. At the end of 30 days the group recorded the height of the plants (cm), and plant health was described.

Useful Definitions

Hypothesis: a prediction about the relationship between the variables that can be tested. Often written as an “if”, “then” statement.

Independent Variable (IV): the variable that is purposefully changed by the experimenter.

Dependent Variable (DV): the variable is being measured - and that responds to the I.V.

Constants (C): all factors that remain the same throughout the experiment.

Control: the standard for comparing experimental effects.

Repeated Trials: the number of experimental repetitions, objects, or organisms tested at each level of the independent variable.

Design Outline

Title: The Effect of Different Aged Compost on Bean Plant Growth.

Hypothesis: If older compost is applied, then plant height will be taller

Independent Variable I.V: Age of Compost

Levels of I.V. (2 or more plus the control, which must be identified)	3 month old compost	6 month old compost	No Compost (control)		
Number of trials you will conduct for each I.V. level	25 plants	25 plants	25 plants		

Dependent Variables: describe **quantitative** and **qualitative** data
 Quantitative Measurements: Height of plants (cm)
 Qualitative Measurements: Plant Health description

Constants: Amount of light, amount of water, amount of compost

Practice Experimental Organizers

1. It's Getting Hot in Here!

Ester became interested in insulation while her parents new house was being built. She decided to determine which insulation prevented heat loss the best. She filled each of 4 jars half full with hot, 90 degree water from the tap. She sealed each jar and inserted a thermometer though the top of each jar. Then she wrapped each jar with a different kind of insulation labeled A, B, C, and D. Type A was the type her parents were using and she thought this kind was best. Ester then put the Jars in a cool, dark closet in her house. Every minute for 10 minutes, she measured the temperature of the water in each jar. She repeated her experiment 5 times.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V.
(2 or more plus the control,
which must be identified)

Number of trials you will conduct for each I.V.
level

Dependent Variable(s):

Quantitative Measurements:

Qualitative Measurements:

Constants:

2. Metals and Rusting Iron

In chemistry class, Allen determined the effectiveness of various metals in releasing hydrogen gas from hydrochloric acid. Several weeks later, Allen read that a utilities company was burying lead next to iron pipes to prevent rusting. Allen hypothesized that less rusting would occur with the more active metals. He placed the following into separate beakers of water: a) 1 iron nail; b) 1 iron nail wrapped with an aluminum strip; c) 1 iron nail wrapped with a magnesium strip; d) 1 iron nail wrapped with a lead strip. He used the same amount of water, equal amounts (mass) of the metals, and the same type of iron nails. At the end of 5 days, he weighed the rust generated from each nail. He also recorded the color of the water for each level of the independent variable.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variable:
Quantitative Measurements:
Qualitative Measurements:

Constants:

3. Let There Be Snow!

Randy is a very experienced snowboarder who has been sponsored by Burton for 3 years and gets free decks and bindings from them each year. Randy loves his snowboard and wants to find a brand of wax that will ensure him optimum performance during races. Randy decided to test 4 brands of wax, labeled Wax A, Wax B, Wax C, and Wax D. To begin, he applied one thin coat of wax brand A to his board and rode a chairlift up to the top of Squaw Valley. He measured a 500 meter course and rode his board straight down the hill without turning or slowing down. He then recorded the time in seconds it took to reach the finish line. Randy repeated his experiment ten times for each different type of wax.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variables:
Quantitative Measurements:
Qualitative Measurements:

Constants:

4. I Love Popcorn!

Jason wanted to find out how he could increase the number of popcorn kernels that pop when cooked. He hypothesized that more kernels would pop if he used more oil. To test this, he placed 100 kernels of “Pop Rite” popcorn into a popcorn popper that contained different amounts of oil. He used the following amounts of oil: 5 ml, 10 ml, 20 ml, and 30ml. He used 5 ml of oil as the control. He conducted the test 3 times for each amount of oil. He then counted the number of kernels that had popped. Each time he heated the oil for 2 minutes and cooked the popcorn for 4 minutes.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variables: Quantitative Measurements: Qualitative Measurements:

Constants:

■ ADDITIONAL Practice Experimental Design Scenarios

5. *Aloe vera* and Planaria

Jackie read that *Aloe vera* promoted healing of burned tissue. She decided to investigate the effect of varying amounts of *Aloe vera* on the regeneration of the worm planaria. Using a sterile scalpel she cut the planaria in half to obtain 10 parts (5 heads and 5 tails) for each experimental group. She applied 15 milliliters of *Aloe vera* for each of the following concentrations: 0%, 10%, 20% and 30% to each group. All planaria were maintained in a growth chamber with identical food, temperature, and humidity. On Days 5, 10, and 15, Jackie observed the regeneration of the planaria parts and categorized development as full (5), partial (3) or none (0). The overall healthiness each worm part was described in paragraph form.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variables:
Quantitative Measurements:
Qualitative Measurements:

Constants:

6. Perfumes and Bees' Behavior

Joanna read that certain perfume esters would agitate bees. Because perfume formulas are secret, she decided to determine whether the unknown Ester X was present in three different perfumes by observing the bees' behavior. She began by testing a perfume known to have Ester X. She then proceeded to test the remaining three perfumes. Each perfume was tested individually by placing a saucer containing 10 ml of the perfume three meters from the beehive. She then recorded the time required for the first 5 bees to emerge from the hive and hover around the saucer. She also made observations on bee behavior. After a 30 minute recovery period, she tested the second, third and fourth perfumes. All experiments were conducted on the same day when the weather conditions were the same.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variables:
Quantitative Measurements:
Qualitative Measurements:

Constants:

7. Hole Height and Squirting Distance

Susie wondered if the height of a hole punched in the side of quart-size milk carton would affect how far from the container a liquid would spurt when the carton was full of liquid. She used 4 identical cartons and punched the same size hole in each. The hole was placed at a different height on one side of each of the containers. The height of the holes varied in increments of 5 cm, ranging from 5 cm to 20 cm from the base of the carton. She put her finger over the holes and filled the cartons to a height of 25 cm with a liquid. When each carton was filled to the proper level, she placed the carton in the sink and removed her finger. Susie measured how far away from the carton's base the liquid had squirted when it hit the bottom of the sink. Susie repeated this procedure 3 times for each carton. Each carton was identical, and the liquid was water for each trial.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variables:
Quantitative Measurements:
Qualitative Measurements:

Constants:

8. Mashed Potato Color

Gloria wanted to find out if the color of food would affect whether kindergarten children would select it for lunch. She put food coloring into 4 identical bowls of mashed potatoes. The colors were red, green, yellow and blue. Each child chose a scoop of potatoes of the color of their choice. Gloria did this experiment using 100 students. She recorded the number of students that chose each color. Gloria also observed, and recorded, their body language while the students ate the mashed potatoes. Gloria made sure that only kindergarten age children participated, she also made sure that each child received the same amount of potato in the same size and color bowl.

Title:

Hypothesis:

Independent Variable I.V:

Levels of I.V. (2 or more plus the control, which must be identified)					
Number of trials you will conduct for each I.V. level					

Dependent Variables:
Quantitative Measurements:
Qualitative Measurements:

Constants:
