

**Scientific Investigation
Experimental Design
Promotion Benchmark 1 Lesson Review
Student Copy**



Vocabulary

Independent Variable - The item being tested in the experiment; it is intentionally changed by the experimenter.

Dependent Variable – The item being measured in the experiment; it is directly affected by the independent variable.

Constant – One or more factors associated with the experiment that do not change or are not allowed to vary throughout the procedure.

Control – The part of the experiment that is used as a comparison for the independent variable; it is unchanged from its normal circumstances.

Repeated Trials – The number of specimens on which the same experiment is performed.

Review for Promotion Benchmark 1:
*Identifies the components of experimental design:
independent variable, dependent variable, constants,
controls, and repeated trials*

When scientific questions are investigated, the experimental procedure provides a detailed record of exactly how the experiment was performed. The basis for the experiment is often summarized in a shorthand form called an Experimental Design Diagram (EDD). Two pieces of information highlighted in the EDD are the independent variable and the dependent variable.

- The **independent variable** is a factor in the experiment that is intentionally changed by the experimenter.
- The **dependent variable** is the factor being measured in the experiment; its value is expected to change as a result of changes in the independent variable.

Once the independent and dependent variables have been defined, this information can be used to develop a title and hypothesis for the experiment. The title of the experiment is expressed as, “The Effect of the independent variable on the dependent variable. A hypothesis is written as, “If the independent variable (state the condition), then the dependent variable (make a prediction as to how it will change)).

For example, we may wonder if adding a higher concentration of fertilizer to tomato plants would produce more tomatoes (fruit). The independent variable in the experiment would be the concentration of fertilizer applied to the tomato plants; the dependent variable would be the number of tomatoes (fruit) the plants produced. The title for this

experiment would be “The Effect of the Concentration of Fertilizer on the Number of Tomatoes Produced”. A possible hypothesis could be “If the concentration of fertilizer is increased, then the number of tomatoes produced will increase”.

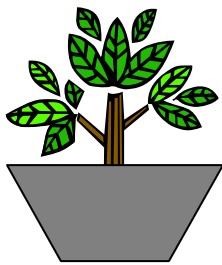
Before performing the experiment, other factors that could change need to be identified so they can be maintained at the same level, or held constant, throughout the experiment. In the tomato experiment, important **constants** would be the: (1) size and kind of plants at the beginning of the experiment (several plants will be needed for the testing); (2) composition and amount of soil in the pot; (3) size and kind of pot; (4) kind, temperature, and amount of water given to the plants; (5) frequency the plants are watered; and (6) amount of sunlight available to the plants.

Often, the experiment includes a controlled specimen. A **control** is a comparable experiment that receives the zero level of treatment of the independent variable. In the experiment described above, the control would be a tomato plant (the same type and starting size as the others) that received no fertilizer. The number of tomatoes produced by plants treated with fertilizer can then be compared to the number of tomatoes produced by plants that received no fertilizer to help determine the impact of treating the plants with fertilizer. It is important to note that during some types of experiments there is no opportunity to have a comparison experiment; when this happens, there is no control.

The last thing that must be recorded is the number of specimens on which the same experiment is performed. This is referred to as **repeated**

trials. It is important to repeat an experiment several times to make sure the scientist obtains consistent results. In order to do repeated trials for the tomato plant experiment, we would have to increase the number of tomato plants used so that multiple plants received the same concentration of fertilizer.

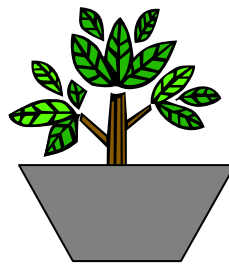
This is what the experiment would look like at the beginning:



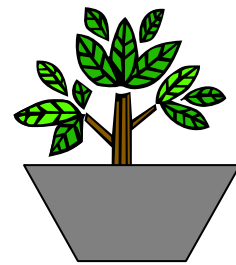
Tomato Plant A
10% Fertilizer



Tomato Plant B
20% Fertilizer



Tomato Plant C
30% Fertilizer



Tomato Plant D
No Fertilizer
“Control”

The Experimental Design Diagram (EDD) that summarizes this experiment appears on the next page.

Experimental Design Diagram

Title:

The Effect of the Concentration of Fertilizer on the Number of Tomatoes Produced

Hypothesis:

If the concentration of fertilizer is increased, then the number of tomatoes produced will increase.

Independent Variable (IV):

Concentration of fertilizer

Levels of the IV (Label the level of the IV which will act as the control, if there is one.)	<i>10% Fertilizer</i>	<i>20% Fertilizer</i>	<i>30% Fertilizer</i>	<i>No Fertilizer</i>
repeated trials	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>

Dependent Variable (DV):

Number of tomatoes produced

Constants: (Be sure to include measurements where needed.)

Size and kind of plant

Composition and amount of soil

Size and kind of pot

Kind, temperature, and amount of water given to plants

Frequency plants are watered

Amount of sunlight available to plants

Review for Promotion Benchmark 1

Directions: Read the following scenario. Then, identify the independent variable, dependent variable, constants, control, and repeated trials. Use the space provided after the reading to record your answers.

Joe and Melissa wanted to find out what type of surface would allow a toy car to roll the fastest. To answer their question, they designed an experiment. They found a piece of wood to use as a ramp to roll the toy car down. Then, they thought of several different types of surfaces to put on the ramp. Joe thought they should try carpet and sandpaper; Melissa suggested they try the wood that the ramp was built with and waxed paper. They decided to roll the car down each of the four surfaces 10 times. They would use the collected data to calculate an average speed for each surface. They wanted to control the distance the car traveled, so they marked the “start” line at the top of the ramp and made another line for the “finish” 1½ meters away. After they set up the equipment, they did their experiment.

1. What was the independent variable in this experiment?

2. What was the dependent variable in this experiment?

3. List the constants that were needed in order to perform the experiment.

4. How many repeated trials were there?

5. Was there a control to this experiment? If so what was it?
