

DOWN-TO-EARTH



STUDENT GUIDEBOOK

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DOWN-TO-EARTH STUDENT GUIDE

Before you begin

As you plan your Down-to-Earth research project, there are several steps you need to follow. The central focus of the activities in this project is use of the scientific method to answer questions and solve problems. This activity guide will take you step-by-step through a series of logical steps for making informed decisions. Key elements of this decision-making process, the scientific method, are:

- purpose
- hypothesis
- experimentation
- results
- conclusion



The scientific method will help you every step of the way through your Down-to-Earth project. Once you learn to use this decision-making process, you will see that there are no wrong ideas, wrong experiments, wrong results, wrong conclusions or wrong answers.

Getting started

To help you get started with your Down-to-Earth project, the step-by-step instructions you will see in this guide will be accompanied by examples from another project. The examples and the tidbits in it are provided for you to sample, not to duplicate. If you follow the steps outlined in this guide, your own project will be as well-designed as the example.

Ideas for research projects generally begin with background research into an idea focused on a specific topic. This preliminary research helps scientists identify the problem to be solved.

Azor is a planet in a galaxy far beyond ours. Azor is overpopulated. Azorians suffer from poor nutrition. Many food and fiber producers are increasing their use of chemicals. Skin cancers are highly visible. Safe drinking water is scarce. Affordable homes and good paying jobs are hard to find. If changes in their crop productions do not occur soon, life on planet Azor will vanish! A sense of hopelessness prevails throughout the land.

Problem Statement

To set the groundwork for your Down-to-Earth experiment, you need to come up with a problem related to food and fiber production. What would you have done if the Azorians had come to you and asked for assistance with their food supply? Choose any food or fiber crop you want to investigate. Think of ways to grow the crop under different conditions, so you can compare the outcomes.

To avoid starvation, increased pollution and health related problems, scientists from Azor turned to a team of Earth scientists for help. The team is headed up by a young Earth scientist, Dr. Gales. Agreeing to help the people of Azor means the problems of Azor have become scientific problems for Dr. Gales and her team.

Write down the problem statement for your Down-to-Earth experiment.

Decision time

Once you have a problem to solve, think about what type of experiment will help you find an explanation or answer to it. The purpose statement gives you a reason or the “why?” for what you plan to do. It becomes your project’s foundation.

Dr. Gales and her team have decided to use the following as their purpose statement: Will growing radishes using organic fertilizers and no chemical pesticides produce the highest quantity of radishes while having the lowest potential risk on human health and the environment?

Based on your Down-to-Earth problem and the food and fiber crop you plan to grow, write a purpose statement for your experiment:

The Hypothesis

The hypothesis comes next. The hypothesis is an “educated guess.” It is your prediction of what will happen during your experiment. The hypothesis will be your guide for planning the tests.

Dr. Gales and her team decided to use the following as their hypothesis: Growing radishes using inorganic fertilizer and alternatives to pesticides will produce the highest volume of radishes while having the lowest risk on human health and the environment.

Write down the hypothesis for your Down-to-Earth experiment. Make sure it contains information from your purpose statement.

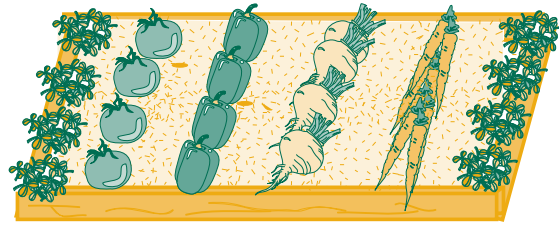
Watch your variables

Before you begin testing your hypothesis, you need to understand as well as decide what will be your “experimental group” and “control group”. Good Down-to-Earth experiments will have both. Keep this thought in mind as you proceed. The more experimental groups you have to compare with your control group, the stronger your conclusions.

The experimental group should be as much like the control group as possible, except for a variable — something you change because you think the change will have a measurable impact on the experimental group. This variable becomes your independent variable. It’s best to have only a single independent variable in your experiment. Having more than one independent variable makes for a more complicated experiment. There are no variables in the control group: all factors remain the same (constant).

Dr. Gales knows that her team can choose from a long list of independent variables for plant growth experiments. Possible variables include hours of light exposure, plant density, soil compaction, amounts of water received, insect control method, soil pH, and fertilizer use. Ultimately, Dr. Gales wants to find out if the use of various fertilizers (organic vs. inorganic) and pest control methods will cause her team to produce more, less, or the same amount of radishes as their control group. (More about the control later). Her team agreed that fertilizer use and pest control method would serve as their two independent variables.

Realize that your experiment can have “unknown” variables which may or may not influence your results. Be aware that they exist and that you might not be able to measure or explain their effect on the outcome of your experiment. You may need to analyze these other variables if your results don’t match your hypothesis.



List the independent variables that you will measure in your Down-to-Earth experiment.



Dr. Gales designed the following experiment for her team. Three plots planted with radishes will be tested. Plot I (the control or “normal level”) will receive water, inorganic fertilizer, and a pesticide. Plot II will receive water, organic fertilizer (cow manure) and alternatives to pesticides (insects and weeds will be hand picked). Plot III will receive water, inorganic fertilizer and alternatives to pesticides (same as Plot II). The radishes yield from all three plots will be measured once a week for ten weeks. All plots will be set up at the same time, be of equal size, and location. All will receive the same amount of water, sunlight and number of seeds per plot.

List the dependent variables that you will measure in your Down-to-Earth experiment.

Your experiment should also have a dependent variable. A dependent variable is called this because its change or reaction depends on what you do to your experimental group. In selecting a dependent variable, you choose an attribute which, according to your hypothesis, will change; and the change must be measurable in some way.

Dr. Gales and her team know that plants have many measurable variables, including: the amount of fruit production, stem height, leaf number, and sprout rate. Her team predicted (hypothesized) that the weight of radishes produced (their dependent variable) is dependent on two independent variables: fertilizer use and pest control method.

There will be many possible dependent variables for your Down-to-Earth experiment: amount of fruit production, stem height, leaf number, sprout rate, and other plant features. Remember that your list of possible dependent variables should include features that are measurable. List them:

Collect your data

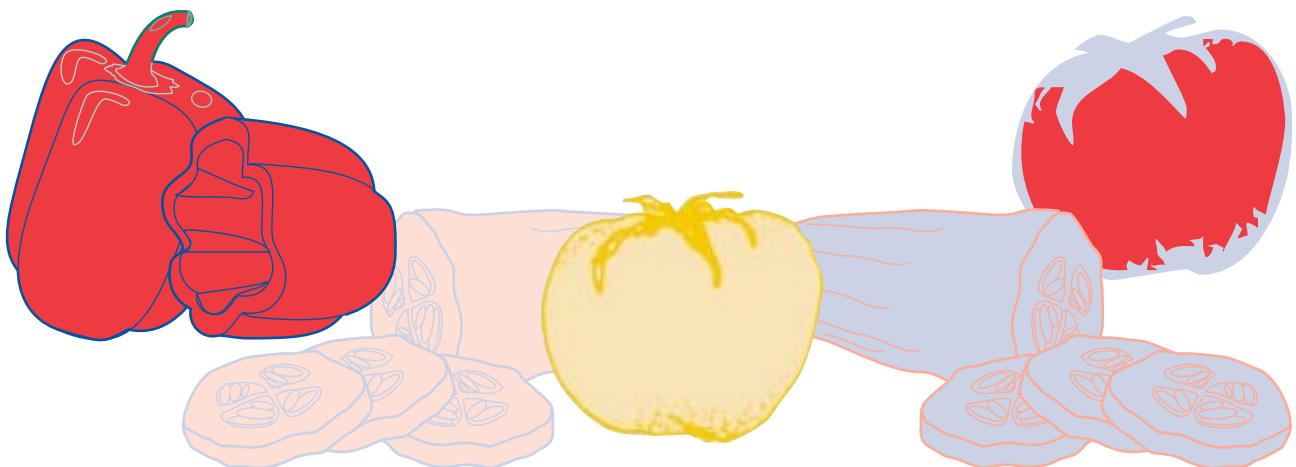
During an experiment, certain information must be collected. These pieces of information are your “data.” In most experiments, the data will be numbers which reflect changes in the dependent variable. The variables and the way you choose to measure them depend on what question your experiment is trying to answer.

As you collect data, you might begin to realize that your data is not supporting the hypothesis you stated. **THIS IS OKAY!** Just because the data collection does not support what you thought would happen does not mean that you have a bad experiment. Continue with your research!

It is important to collect all your data as carefully as possible. Why? This strengthens the accuracy of your findings. Record your data in a notebook, or use another convenient method. Collecting and interpreting your data will allow you to answer more questions about your hypothesis when you finish.

Once you have decided what variables you want to observe and measure, and how often you want to measure them, you can start your tests and collect your data.

Refer back to the list of the dependent variables for your Down-to-Earth experiment. How do you plan to measure changes in these variables that will occur in the course of the experiment? At what intervals will you record measurements?



Describe your results

Once you collect all of your data and analyze it, you are ready to state your results. Charts, graphs, and tables are a good way to show your data.

Dr. Gales and her team obtained the following results from their experiment: The total yield of radishes from Plot I was 1720 grams; Plot II 1781 grams; and Plot III 1859 grams.

Describe the results of your Down-to-Earth experiment.

Describe how you plan to show your Down-to-Earth results.

What are your conclusions

Once you have the results of your experiment, you can draw some conclusions based on what you have learned. Remember that even if the results do not support the hypothesis, the experiment is not wrong! It simply means that there are probably variables, other than the treatments, which may affect the outcome.

To make sure the people of Azor could easily understand the results of the experiment, Dr. Gales and her team plotted the growth rates of the radishes on a bar graph, and clearly labeled the three different production methods they had used.

Based on the results from their experiment, Dr. Gales and her team concluded: Growing radishes using inorganic fertilizer and alternatives to pesticides will produce the highest quantity of radishes while having the lowest risk on human health and the environment.

Review the results from your experiment. Write your Down-to-Earth conclusions.

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