

Grade 6

Basic Life Science

Teacher Manual



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Lesson

1

Science and the Scientific Method

Key Concepts

- Scientific method
 - question
 - hypothesis
 - procedure
 - observations (results)
 - conclusions
- Controlled experiments and variables
- Sample Experiment: The Effects of Caffeine on Sleep Patterns

ASSIGNMENT SUMMARY

- ☐ Analyze the caffeine experiment.
- ☐ Test your power of observation.
- ☐ Choice assignment
- ☐ Complete lesson 1 test.



Your Thoughts

What is the variable in this caffeine experiment? Remember, the variable is the part of the experiment that changes while everything else stays the same, or is controlled. Discuss your ideas with a parent or friend.

Assignments

1. Analyze the caffeine experiment. Use the four questions below to assess the caffeine experiment described in the last section. Think carefully about aspects of the experiment that could be more controlled or where errors might arise. Write a few sentences in response to each question.
 - a. Did the experiment really do what it was intended to do?

All experiments in this course should be written up using the scientific method format. Please refer to this lesson for guidance when completing assignments in future lessons.

- b. Could the method be improved so that it would have better results? How?
- c. Does the experiment suggest other experiments that might be undertaken? What are they?
- d. How can the information or process apply to personal life or experiences? This would answer the questions: “What does it all mean?” or “So what?”

This beginning lesson is challenging because it requires developing a scientific way of thinking. Encourage students as they grapple with what may be a new skill.

- 2. Test your power of observation. Go outside and collect 13 to 20 rocks, sticks, leaves, or other items that can be easily collected. Don't look at them too carefully. Place them in a box or basket and cover the opening. When you have paper and a pencil at your side and are ready to make your observations, take off the covering and reveal the objects. Give yourself one minute to carefully observe as much as you can about the objects and their placement using only your sight, but don't write down anything yet. When the minute is up, cover the items again and give yourself three minutes to write as much as you can remember about what you observed. How many objects did you remember? Could you remember very many details about them? Did some objects remain in your memory more vividly than others?

Now try this again with the same or a different set of items. Give yourself only a minute again, but this time touch the items in addition to looking at them. At the end of the minute, write or draw (or both) what you remember. How did your observation change? How did your sense of touch increase or decrease what you could remember? For an extra challenge, have someone else collect items for you so that until they are revealed, you don't know what the objects are. Challenge someone else with the objects you gathered and see how their observations differ from yours. Some people are great at remembering lots of detail about a few things, while other people are quick to learn just one thing about many objects.

Choice Assignment

Choose **one** of the following projects.

- A. **To Be a Scientist.** If you could be any kind of scientist, what kind would you be? Why? To be the scientist of your dreams, you can imagine you are any age, have any amount of money, and travel anywhere you need to. Aim to write about a page of three to five paragraphs to answer these questions.
- B. **Scientific Experiment.** If you were going to conduct any scientific experiment, what would it be? What would your hypothesis be? If you can do the experiment, do it. If not, imagine the outcome and write what you think it would be. Use the five components of the scientific method to describe your experiment and its outcomes: Question, Hypothesis, Procedure, Observations, and Conclusion.
- C. **Survey Experiment.** Some scientific experiments are surveys, which means the scientists get their answers through interviewing people. Create or design a survey about something you want to know. The survey can be one question or many. Carry out your survey with at least ten

people you know. You might want the survey to be confidential and tell the people to put it in your mailbox without their name on it. Sometimes having confidential surveys lets people feel they can be more honest and not be judged for their answers. Use the five components of the scientific method to describe your survey and its outcomes: Question, Hypothesis, Procedure, Observations, and Conclusion.

- D. **Animal Observation.** If you have an animal at home, spend some time observing it. When does it like to sleep? To play? Pose a hypothesis about its behavior. Observe it and see if you made correct assumptions. Example: “My dog likes to eat when my family eats,” or “My cat only plays with yarn when someone is moving it.” Do not try experiments that could hurt the animal or make it uncomfortable. Use the five components of the scientific method to describe your informal experiment and its outcomes: Question, Hypothesis, Procedure, Observations, and Conclusion.

Test Questions

1. What is controlled in a controlled experiment? Provide an example.

In a controlled experiment, all the variables but the one being tested are controlled. This means they are made consistent in every trial. Variables in a plant experiment might include the amount of sunlight, temperature, amount of water, size of pot, or soil composition.

2. Come up with three questions that could lead to a scientific experiment.

Answers will vary. Students are encouraged to think broadly about any topic of interest. They may come up with questions about animal behavior, plant growth, nutrition, bike safety, or any other aspect of their lives. Science is everywhere!

3. Come up with a hypothesis to test each of the three questions you posed in the last question.

The hypotheses should be in statement form, expressing an idea that is testable. For instance, a hypothesis such as “My dog likes me better than my sister because I’m the one who feeds him,” is not testable, but “My dog will come when I call more frequently than when my sister calls” is a testable hypothesis. Here are other examples of testable hypotheses:

- **A sunflower seed planted in a large pot will grow taller than one planted in a small pot.**
- **It is easier to focus on a task after eating a snack than when hungry.**
- **A bicycle is easier to maneuver with a heavy load if the load is carried in a bicycle basket rather than in a backpack worn by the cyclist.**

4. What are the five steps of the scientific method? Briefly explain each step.

1. Question: in order to form a hypothesis, a question is asked about a phenomenon or behavior that has been observed.

- 2. Hypothesis: the hypothesis is an educated guess as to the cause or reason for the unexplained behavior or phenomenon.**
 - 3. Procedure: a controlled experiment must be developed and performed, which reduces or eliminates the variables in order to increase the veracity of the results.**
 - 4. Observations or results: data from the experiment are recorded.**
 - 5. Conclusion: a conclusion is developed based on interpretation of the results.**
5. Explain the difference between results and conclusion in a scientific experiment.
- Results are the recorded observations from an experiment. A conclusion is an interpretation of the meaning of the results.**

Learning Assessment

These assessment rubrics are intended to help track student progress throughout the year. Please remember that these skills continue to develop over time. Parents and teachers can use this space to make notes about the learning the student demonstrates or any skills that might need work.

SKILLS	Developing	Consistent	Competent	Notes
Displays focused observation skills				
Demonstrates knowledge of the scientific method				
Shows understanding of controlled experiments and variables				
Forms a hypothesis based on previous knowledge				
Explains the steps of the scientific method				
Reflects on experiment process and ways to gain more accurate results				



The Environment

Key Concepts

- Environment
- Observation and change

ASSIGNMENT SUMMARY

- ☐ Record your observation-specific environments.
- ☐ Choice Assignment
- ☐ Complete lesson 2 test.



Your Thoughts

What are some parts of your environment that you know are there but that you can't see? Discuss your ideas with someone and listen to their ideas.

Assignments

1. For this exercise you will be observing three different environments. Pick two places that are natural areas where you can be relatively close to nature. The third place can be anywhere—it's your choice.

Sit quietly in each of these places for at least 15 minutes. You are to relax and observe your environment. Pay attention to what you see, hear, smell, and feel. When you are finished, record your observations about each place and what types of things you noticed happening around you. Be specific and describe as many details as you can. Be sure to include any thoughts or feelings that you had while you were observing your environments. You will use these observations for an assignment in lesson 3, so keep them in a safe place.

- a. Visit one of the natural places early in the morning before the world is busy.
- b. Visit the other natural place at dusk, close to the time when the sun sets.
- c. Visit the third place at any time you choose.

Ideally, the student will have a chance to experience the environment as a whole before reflecting on the specifics. That is why we ask the student to take notes and record

observations and feelings *after* the experience of being in each place, rather than during. Be sure that the student keeps a copy of this observation to use in the next lesson.

Choice Assignment

Choose **one** of the following projects.

These activities will give you practice in making observations.

- A. **Weather Journal.** Keep a weather journal for five days. In each entry, describe the cloud patterns, the times the sun and moon rose and set, the temperature, the wind patterns, and any other observations. When the five days are over, answer the following questions:
 - Was there one day that was your favorite in terms of the weather? Which day was it? What was the weather like?
 - If you had the power to make the weather patterns any way you wanted for a week, what would the days be like? Write up your dream weather report for a week's time.
- B. **Evening Observations.** How often do you observe the outside environment at night? One evening, at least an hour after the sun has set, go outside without any source of light (no flashlight or candle). If you can, stay out for 20 minutes. Take notice of the changes in your eyesight as it adjusts to the dark. Do you hear different noises at night than you do during the day? Count the number of night sounds you hear or night sights you see. Any surprises? Anything new? Write down your observations when you come back inside. (If you live in a place where there are lots of lights at night, try to find a special time to visit a very dark place at night.)
- C. **Blindfold Project.** Go outside with someone you really trust who is willing to be blindfolded. Taking turns, one of you will be blindfolded and the other will act as the seeing-eye guide. The partner who can see should remain beside the blindfolded one, and the two of you should take five minutes to take in what is around you. You can then switch roles. Using your senses of hearing, feeling, tasting, and smelling, what do you observe differently when you can't see? What changes in the environment do you think you would be more aware of during the change of seasons if you were truly blind? What things are you able to notice as a seeing individual? Write two paragraphs describing your observations—one for when you were blindfolded, and one for when you could see. Write a third paragraph explaining the differences between the two ways of observing.

Test Questions

1. Write a definition of *environment* in your own words.

The environment refers to everything around us. Students will hopefully be able to convey that in their responses.

2. In what ways do YOU react to changes in your environment? List and describe at least three ways. (Example: How do changes in the weather affect you?)

Students may mention reacting to changes in the weather, in the daylight, or in the social environment (such as acting differently when playing with friends or visiting with grandparents). Students should provide specific examples with their answer.

3. Do all living things change? List changes that you have observed in three living things in your environment recently. (Example: If the season is changing, have you noticed animals around you losing or gaining their winter fur?)

Yes, all living things change. Examples mentioned might include seeing leaves change color and fall off trees, wildlife growing fatter in preparation for winter, children growing taller, or grass growing longer.

4. Do nonliving things change? List changes that you have observed in three nonliving things in your environment recently. (Example: How has the sky changed today?)

Nonliving things often change very slowly, but examples might include the shape of a coastline or river after a storm or rainy season, a rotting tree stump being slowly decomposed, a crack in a boulder or sidewalk widening as a plant pushes through it, or the shape of a sand dune changing over time.

Learning Assessment

These assessment rubrics are intended to help track student progress throughout the year. Please remember that these skills continue to develop over time. Parents and teachers can use this space to make notes about the learning the student demonstrates or any skills that might need work.

SKILLS	Developing	Consistent	Competent	Notes
Displays focused observation skills				
Records observations in detail				
Shows awareness of change in the natural world				



The Seedling

Key Concepts

- Root systems
- Buds

Assignments

1. Carefully pull up one of each of the seedlings from the last lesson. Notice that they do not look exactly the same, but they are all similar in that they have three main parts. If you have a magnifying glass or a microscope, examine the seedlings' roots to see if you can identify the root hairs. Using the diagrams and text in this lesson, identify each of the parts of each seedling. How are the root structures different? Are they fibrous or taproot systems? Record your observations.

Students' answers will vary, but be sure that their description of the plant's parts includes stems, leaves, and roots.

2. For this assignment, you will need a head of cabbage or a Brussels sprout (which is like a tiny cabbage and is closely related), a bunch of celery, and a bulb of garlic. Ask for parental assistance, if needed, to slice each of them in half, top to bottom. Draw a picture of the exposed parts of each and label the parts that you can identify. (Then use the vegetables for your dinner, if you like!)

Drawings will vary, but be sure they are labeled. The discovery in this assignment will be in identifying and noting the variety and utility of terminal buds and the tiny lateral buds that have not yet developed because we harvest the terminal buds before lateral buds can grow.

3. Explain the functions of the parts of a green plant:
 - a. Leaves

The leaves increase surface area for catching the maximum amount of sunlight to make food.

ASSIGNMENT SUMMARY

- ☐ Observe and describe plant roots.
- ☐ Draw and label a picture of the parts of different plants.
- ☐ Explain the functions of the parts of a green plant.
- ☐ Choice assignment
- ☐ Complete lesson 6 test.

b. Stem

The stem connects leaves, which make food, and roots, which absorb water and minerals. Each of these plant parts needs what the other gets so the stem is the transport system. It also holds up the leaves, moving them to where there is light.

c. Roots

The root system anchors the plant in the soil.

d. Root hairs

The tiny root hairs vastly increase the surface area and absorb water.

e. Bud

A bud keeps growth on hold until the time is right, and then starts new growth for both stems and leaves.

f. Bud scale

Bud scales are special tiny, hard leaves that protect lateral buds.

Choice Assignment

Choose **one** of the following projects.

- A. **Inspect Roots.** If you have a yard or access to a nearby field, go outdoors with a trowel or small shovel and find some common grasses and weeds that you can recognize, such as dandelions, clover, and the grass in your lawn or field. Dig up a small clump or a single plant of at least three different types. (Be careful not to break off the root when you dig it up.) Gently shake off the soil and examine the root structures. Look more closely with a magnifying glass. Does it have one main taproot, or many smaller, fibrous roots? Draw a color picture of each plant with its roots and label the type of root structure for each plant. (After you finish, you can replant the plants if they are not too wilted. Be sure to give them some water, as they will have dried out.)
- B. **Research Carnivorous Plants!** In the beginning of this lesson, you learned that plants are the only organisms that can make their own food. While this is true, there are some plants that trap and digest other organisms (usually insects). Using books found at your local library, or internet resources, find out what specialized mechanisms these plants have that enable them to capture and eat bugs. Write a three-paragraph paper describing how they do this. Use the names of some of the plants you learned about. Do any of these plants live near you? Have you ever seen any? Please refer to the introduction for suggestions about how to complete a research paper. Don't forget to proofread your work and to write a works cited page.
- C. **Identify Edible Roots and Shoots.** Make a list of all the vegetables, grains, and fruits that your family eats. Then take a trip to a grocery store and look for the plants on your list. Try to identify what part of a plant each of the food items represents. Write down the part next to each name. Some foods might be hard to figure out. When you eat broccoli, for example, you are eating

clusters of tiny flower buds. If that green broccoli head had been left in the field where it grew, in a few days it would have become a mass of yellow flowers! Which plant parts are there more of on your list? Probably, your family eats a mixture of roots, stems, leaves, buds, flowers, and seeds of all types.

- D. **Witness Plant Power.** Try a true test of the amazing power of roots. For this activity you will need several beans, plaster-of-Paris, and a paper cup. Soak the beans overnight to prepare them.

When the beans have been soaked, pour plaster-of-Paris (which should be prepared as a liquid according to the instructions on the package) into a paper cup, filling it about halfway. Then place a few beans on the plaster and continue to fill the cup. Be sure the beans are located halfway down.

In a few days, you will be witness to a plant's strength and determination to grow! (The plants should have broken through the plaster-of-Paris. If they did not, be sure you soaked the beans overnight and prepared the plaster correctly.)

Test Questions

1. What are the two main types of root systems? Describe each one in your own words.

The two main types of root systems are tap root and fibrous. Fibrous root systems consist of many thin, branched roots, which are all similar in size. Tap root systems usually have one large, main root with many secondary roots growing off it in all directions.

2. What are the main functions of roots in green plants? Name and describe three functions.

Roots absorb water and minerals from the soil through tiny root hairs. Roots provide structure and support for the plant so that it won't fall over or get blown away. Roots also serve as a storage area for food, such as minerals and carbohydrates, which help the plant grow.

3. What role do leaves play in the function of a plant?

The leaves spread out to create more surface area to collect energy from the sun, which the plant needs to make food.

4. Name at least three parts of plants that are commonly eaten by humans. Give two examples of each.

Hopefully, students will think of their own examples based on what they commonly eat. Some examples might include the following:

Buds: Brussels sprouts, cabbage, celery

Roots: turnips, carrots, beets

Leaves: lettuce, kale, spinach

Flower buds: broccoli, cauliflower

Seeds: beans, sunflower seeds

Learning Assessment

Use assessment rubrics to track student progress and to make notes about the learning the student demonstrates or any skills that might need work.

SKILLS	Developing	Consistent	Competent	Notes
Displays focused observation skills				
Records observations in detail				
Collects data over time				
Creates accurate, labeled, scientific drawings				
Demonstrates knowledge of root structure and function in plants				
Identifies functions of roots and leaves				



Soil and Nutrients

Key Concepts

- Fertilizers and bacteria
- Compost

Assignments

1. Go to a local garden center or nursery, and find three different types of fertilizers, both man-made (chemical) types and natural (organic) types made from earth and ocean materials, such as composted manure and seaweed. For each type, list the name, then research and write down the following:
 - a. Recommended uses
 - b. Source of the materials and types of minerals in each
 - c. How to apply and how much should be applied

Finding out about fertilizers is a tangible key to learning about the trace minerals that plants need to complete the process of making food from sunlight and water. The student is asked to find three different fertilizers and to list the recommended uses of each of them.

Examples:

Cotton Seed Meal (for shrubs):

Nitrogen 6%

Phosphate 2%

Potash 2%

Apply 5 pounds for 100 sq. ft.

Green Lawn (for starting lawns):

Nitrogen 13%

Phosphate 25%

Potash 12%

Sulphur 3%

Spread and rake 40 pounds for 10,000 sq. ft.

ASSIGNMENT SUMMARY

- ☐ Research three different types of fertilizers.
- ☐ Consider different elements of gardening.
- ☐ Identify soil composition.
- ☐ Choice assignment
- ☐ Complete lesson 7 test.

2. Do you have a flower or vegetable garden? If your answer is yes, answer the following questions. If your answer is no, your exercise will take the form of an interview. Find a friend or neighbor who has a garden. Write down this person's name and relationship to you. (If you cannot find a friend or neighbor who gardens, you may call a local nursery and interview a worker or manager there.) Answer the following questions:
- What kinds of plants (vegetables, flowers, etc.) do you grow?
 - How do you keep the soil in your garden healthy and fertile so that plants will grow?
 - Do you use fertilizers? If so, what types are used? How often are they used?
 - Do you compost your kitchen or other wastes? If so, what types of things do you put into your compost?

One of the benefits of this exercise, in which the student asks questions about gardening practices, is that it asks them to organize and communicate information well, in both verbal and written formats. Another is that the student will learn very specific facts about horticulture and soil care.

3. Retrieve a sample of the soil you used for your seedling experiment in lesson 5. Examine it closely with a magnifying glass. Identify as many different “things” in it as you can. Try to determine the composition of the soil using fractions (e.g., sticks and twigs make up about $\frac{1}{5}$ of the soil) or percentages (e.g., rotted leaves are about 50% of the total). Draw or describe your findings below.

Since potting soil can be fairly homogeneous, students may want to dig up soil from outside for this assignment. A close look at soil will reveal some surprises. You cannot see minerals, spores, bacteria, and other microorganisms in the soil. Looking at soil taken from very different places will demonstrate some of the variables.

Choice Assignment

Choose **one** of the following projects.

- A. **Create Compost.** It is often difficult to imagine banana peels, eggshells, orange rinds, apple cores, leaves, and live plants turning into nutrient-rich compost for your garden. To witness the beginning stages of the breakdown of organic matter, try the composting ideas listed below. Feel free to create your own combinations!

For all of these combinations, use clear containers that can be sealed, such as plastic bags or clear jars. Number your samples and record what is in each of them. Leave a notepad by the samples so you can record the changes you observe over time. For this experiment, you will need to use rich garden soil, because it contains the microorganisms necessary to break down the plant material. Potting soil has been sterilized and won't work as well.

Sample #1: For this sample, use a variety of fruit and vegetable matter, such as vegetable peels, banana peels, apple cores, etc. Do not add any meat or dairy products to your compost. Add a handful of soil to this container.

Sample #2: Instead of food waste, collect grass clippings, leaves, small twigs, any small dead plants you may have indoors or out, and a handful of soil.

Sample #3: Fill the third container with nonorganic (not living) matter, such as tin, plastic, Styrofoam, or other similar items. Add a handful of soil.

Sample #4: (Optional) Create your own mixture and add a handful of soil.

Space the containers and put them in a place that receives sunlight, such as by a window. You can hang the containers so that you can watch what happens at the bottom, but don't worry if you're unable to do this. Once the samples are made and sealed, make predictions (hypotheses) as to which will break down first, then second, then third, and then fourth. Record your predictions. Observe and make recordings every few days for about three weeks. After three weeks, look at your results and write a conclusion for each hypothesis you made. Explain whether your predictions were correct and describe your observations. Write up your report using the scientific method format. When you are through with your samples, deposit them in the appropriate places.

B. **Research Different Home-Composting Methods.** There are many different ways to use your kitchen and garden wastes to create “brown gold” (as gardeners call compost), including worm composting, which has become quite popular with people who live in apartments and don't have a big garden space! Using books found at your local library or using internet resources, research different home-composting methods and write a one- or two-page report describing each method. Be sure to begin your report with a basic explanation of how microorganisms create compost. Draw diagrams or sketches of different types of compost structures. Include a paragraph describing which type of composting method would work best for your family.

C. **Soil Squirmlers.** For this activity you will need the following:

- Funnel
- Small piece of steel wool (without cleanser in it)
- Clear glass jar or cup filled with an inch or two of water
- Two cups of rich garden soil
- Magnifying glass
- Light with an incandescent bulb

Once you have the materials, put the steel wool into the wide end of the funnel. The narrow end of the funnel should face down in the clear container with water. Arrange it so the funnel is a few inches above the water, not touching it, and in a balanced position. (One way is to use a wire

clothes hanger to make a stand for the funnel to sit in.) Then put the soil on top of the steel wool in the funnel.

The whole setup should be placed about six to ten inches under the light. You should find that the creatures from the garden soil, in attempting to move away from the heat of the light, fall into the water. Use your magnifying glass to examine the water and soil. Write up your observations into a one-page paper. Include descriptions of any living organisms as well as a few sketches.

Test Questions

1. Explain the functions of soil in terms of how it is used by a plant.

Soil provides stability and holds water around the roots, as well as tiny amounts of air, which the plant needs in order to breathe. Soil also provides nutrients in the form of minerals.

2. Explain the difference between “dirt” and healthy, living soil.

Healthy soil is a substance containing many living organisms, including fungi, bacteria, worms, insects, and other animals. Healthy soil is also rich in organic matter and nutrients. Dirt may contain none of these living and fertilizing components, but simply may be a sterile medium.

3. How do organisms in soil help plants get nutrients that they need to grow? Give an example of one type of organism that does this.

One type of organism that helps plants get nutrients from soil is nitrogen-fixing bacteria, which transforms nitrogen into a form usable by plants. This is one example, but the student may use others.

4. Why is organic matter important to healthy soil?

Organic matter is essential to healthy soil because many soil organisms depend upon it for food. Also, as organic matter decomposes, it releases nutrients into the soil.

Learning Assessment

Use assessment rubrics to track student progress and to make notes about the learning the student demonstrates or any skills that might need work.

SKILLS	Developing	Consistent	Competent	Notes
Demonstrates knowledge of soil composition				
Shows understanding of different composting methods				
Demonstrates awareness of the relationship between healthy soil and healthy plants				
Displays focused observation skills				
Records observations in detail				
Collects data over time				