Science

Biology:
The Study of Life

Third Edition

High School Lab Manual

Oak Meadow

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The Study of Life

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Lab Manual

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Lab Manual Introduction

Biology is the study of life, and the best way to learn biology is through active explorations. The experiments in this lab manual are a required part of Oak Meadow's *Biology: The Study of Life* high school course. They can also be used as a supplement to any biology course.

The lab instructions will prompt you to do things like answer questions, write observations, and record data both before and during the lab. For efficiency, there is usually space for you to write the information directly in this lab manual. At the end of the lab, in the Analysis and Conclusion section, there is information about what to share with your teacher for assessment.

You will need the lab kit materials listed below as well as a number of household items. A complete materials list for the lab manual is found in the appendix. Familiarize yourself with what you'll need so you can prepare in advance.

In addition, you can assume that paper and a pencil will be needed for most labs, and often water. Sometimes people are needed for your lab as well, but they are not listed as materials.

The following materials are included in the Biology Lab Kit (which is available in the Oak Meadow Bookstore).

beads (4)	pH indicator paper
beaker, 250 mL	pipe cleaners (4 colors, 12 total)
digital scale	plastic pipettes (5)
disposable gloves (20 pairs)	ruler
eyedropper	safety glasses
funnel	test tube
graduated cylinder, 100 mL	thermometer
magnifier	tweezers
microscope slides (2)	washers (5)
mosquito netting	

Some activities reference online resources, all of which can be accessed at www.oakmeadow.com/curriculum-links.

Review of Laboratory Safety

Throughout the course, you will conduct home experiments that are designed to give you a hands-on learning experience. All experiments need to be done in a safe manner, so it is important that you begin this course with a review of safe laboratory techniques.

1. Always wear closed-toe shoes when working in any laboratory setting.
2. Keep all nonessential items (such as bags, papers, food, cosmetics, lotions, etc.) out of the workspace.
3. Never eat, drink, or chew gum when working on labs.
4. Before every lab, read all the directions carefully. Make sure you understand the overall goal of the lab.
5. Check that all equipment and supplies are clean and in working order before beginning.
6. Gather all the equipment needed for the lab.
7. Always wear safety glasses and gloves when you are instructed to. (These are provided in your lab kit.)
8. If observing a living organism, do so from a distance, with respect for their natural environment.
9. Never conduct your own experiments, unless instructed. Follow the directions provided, and use the materials only as intended.
10. Dispose of all materials appropriately or place them back in your lab kit for future use. (Ask your teacher if you are unsure of the correct disposal method.)
11. Clean up your workspace and all equipment after each experiment. Since you are conducting these experiments at home (and possibly in your kitchen), it is critically important that you clean up your workspace before anyone else uses the area or food is prepared.
12. Wash your hands thoroughly after each experiment!

If at any point during this course you have questions about the laboratory directions or need assistance, stop working and contact your teacher immediately.

Name _____

LESSON

1

Lab: Walking Crooked

In this lab, you will use your own body to practice scientific inquiry. You will be following the steps of the scientific method. However, it is important to note that this is only one example of how scientific investigations are conducted. There are many variations that you will explore in this course. For example, if you do a survey on the number of bird species in your yard, is this still science? Yes! You are still controlling variables, setting up an investigation, and looking for an answer. As you work through this lab, keep an eye out for the components of the scientific method and the order of the steps so you can note differences in later labs.

Guiding Question

Can a blindfolded person walk in a straight line?

Pre-Lab Work

Complete this section before you start the lab.

1. Read the Materials and Procedure sections, and then answer the questions below. You may want to annotate key information.

   If you ever have questions or safety concerns about any lab, please check with your teacher before starting work.

   a. What is the independent variable?

   b. What is the dependent variable(s)?

   c. What is one constant in the lab?

2. Write a hypothesis.

3. Look at the data table in the Results section. Where will you record quantitative data? Where could you record qualitative data?

Materials

Note: In science, we use the metric system, which you'll see in the materials list below. (If you aren't using it yet, this is a good time to start.)

- measuring tape or string, 10 meters
- 5–10 small items, such as popcorn, pebbles, dried beans, etc.
- blindfold

You will also need a partner and a large space that is flat with even terrain.

Procedure

1. Using the measuring tape or string, mark a straight line 10 meters long. Leave it on the ground.
2. Stand at one end, facing the string. (If there is noise coming from a certain direction, you may need to control for this.)

   Take a photo of your setup.
3. When your partner says "Go," start walking slowly along the line toward the other end of the marked area—look straight ahead rather than down at the line you are following. Your partner will quietly walk behind you, dropping the small items as "bread crumbs" to mark your path of travel. When you get toward the end of the 10 meters (or if it becomes unsafe), your partner will say "Stop."

   Observe the results by viewing the line made by the markers.
4. Measure how far you strayed from the far end of the 10-meter path. Record your results in the data table below. Be sure to note whether you strayed to the right or left. You might also want to note if there was a continuous curve to the path you took.
5. Pick up the markers and return to the start. Have your partner blindfold you, and repeat the test. Record your data.
6. Now, switch places with your partner, and repeat the whole process. If you have more people available, you might want to do this with additional participants. Record all data.

Name _____

Biology—Lesson 1
Lab: Walking Crooked

Results

Record your results in the data table below (or use it as a model to create your own).

Data Table: Measuring Deviations from a Straight Line With and Without a Blindfold

Person	No blindfold		Blindfolded		Notes
	Distance strayed	Left or right	Distance strayed	Left or right	
1					
2					

Analysis and Conclusion: Post-Lab Questions

1. Keeping in mind the difference between testable and nontestable hypotheses, write a short paragraph that uses evidence from your data table to discuss whether or not the data supports your hypothesis.

   Note: In formal science writing, it is best to avoid "I" statements, such as "I believe" or "I think" or even "my data," because this can introduce bias and opinion into what should be objective writing. To avoid this, here are some sentence starters that you can use to help you (but you are not required to use these words):

   - "The data from the lab does/does not support the hypothesis that _____"
   - "In this lab, it was observed that _____, which does/does not support the hypothesis that _____"
   - "The data includes _____, which indicates that _____"

2. A test like this often results in more questions than you started with. Here are a few questions that might come up:

    - Why don't people walk straight?
    - Will one person always go the same direction?
    - Is there a predictable pattern if you are left- or right-handed?
    - Would this translate to different activities, such as paddling a kayak?

    What else do you wonder? Come up with at least three questions about this experiment that could be tested. There are many possible questions!

3. Submit the following to your teacher:

    - Responses to the pre-lab work
    - Photo of your setup
    - Your completed data table
    - Analysis and conclusion (post-lab questions)

Name _____

LESSON

2

Lab: Determining the pH of Common Substances

In this lab, you will investigate the pH of common household substances using pH indicator paper, which changes color depending on the pH of the solution being tested. As you do this lab, consider how this approach to scientific investigation differs from your experience in lesson 1.

Guiding Question

What is the pH of common household substances?

Pre-Lab Work

Read the Materials and Procedure sections, and then complete the tasks below before you begin the lab.

1. Choose the six substances you will test in the lab.

   Label the data table in the Results section with headings for Solution, Predicted pH, and Measured pH. List the six substances/solutions in the data table.

2. Water will be your control. Label this as Solution 7 in your data table.
3. Make predictions for the pH of each solution, and record them in your table. You can record a specific number or write acid/base/neutral.

Materials

- pH indicator paper
- disposable gloves
- 6 common household substances (you may choose from this list):
  - lemon juice
  - window cleaner
  - coffee
  - vinegar
  - bleach (wear gloves to avoid contact with bleach)

  - mouthwash
  - cola or other type of soda
  - milk
  - baking soda dissolved in water
  - orange juice (or other fruit juice)
  - tea
  - dish detergent
- water

Procedure

1. Test Solution 1 with pH paper by dipping one end of the paper *very briefly* into the solution. If you hold it in there too long, it will wash out the indicator. Give it just a quick dip, and then pull it out and compare that end to the color chart to read the pH.

   Record the pH in your table.

   Note: If the liquid will be later used for human consumption, pour a small amount into a clean, dry glass before testing. Dispose down the drain afterward. (If you are reusing the glass for multiple substances, it will need to be washed and dried each time to avoid contaminating the results.
2. Repeat this process with each solution, recording the pH in the data table.
3. Take a photo of your setup that includes your test solutions and used pH strips.

Results

1. Use the following data table (or one like it) to record your results.

Data Table: pH of Common Substances

1.		
2.		
3.		

Name _____

Biology—Lesson 2
Lab: Determining the pH of Common Substances

4.		
5.		
6.		
7.		

Analysis and Conclusion: Post-Lab Questions

1. Draw a pH scale similar to the one on page 50 of your textbook, with a range of 0 to 14 (acidic to basic). Label the pH scale with your solutions.

2. Summarize your findings, including the pH range you observed, how your results compare to your predictions, and what this indicates about how acidic or basic most household substances are.

3. Apply your pH knowledge: Why can't you measure the pH of cooking oil?

4. Submit the following to your teacher:
    - Photo of your setup
    - Your completed data table
    - Analysis and conclusion (post-lab questions)