Fifth Grade Science Overview

	First Semester	Second Semester
Science	*BASIC ENVIRONMENTAL SCIENCE* Scientific inquiry Indicator species Wetlands model Metric conversions Ecosystem diversity Biomes Water cycle Astronomy Renewable and non-renewable sources Energy conservation	*BASIC LIFE AND PHYSICAL SCIENCE* Weather patterns Classification systems Human body structures and systems States of matter Types of energy Principles of physics

Grade 5

Science Coursebook

Oak Meadow

Oak Meadow, Inc.
Post Office Box 615
Putney, Vermont 05346
oakmeadow.com

Table of Contents

Introduction

Lessons

Appendix

Introduction

Welcome to Fifth Grade Science

In this course, you'll be introduced to many of the most fascinating branches of science, starting with the practice of science itself. You'll get many opportunities to become a scientist yourself. You'll make lots of observations, use the scientific method, and carry out experiments. This course is loaded with fun independent projects you can do at home, with materials you probably already have around the house.

This course revolves around environmental science, which helps us understand the workings of our planet and the life upon it. This field is especially crucial today as we search for solutions to the environmental problems facing us. Many fields of science contribute to environmental science, such as biology and chemistry, as well as economics and politics. Throughout the year, you will develop a respect for how everything is interrelated in the environment on Earth.

In this course, you'll focus on many of Earth's amazing creatures and the places they live. You'll learn how each tiny element in the environment has a role to play in the great tapestry that is our home planet. This study will take you on a journey across all branches of science, including conservation ecology, weather, astronomy, human anatomy, physics, and modern technology.

Study Tips

Here are some tips to help your learning experience go more smoothly:

- Before you begin, look over this book to become familiar with how it is set up. Look at the table of contents, and scan a few lessons. This will give you an idea of what to expect this year.
- When you begin a new lesson, always read through all of the assignments and activities first to get an idea of what you will be doing in that lesson, and then do the reading assignment before completing any written assignments. You will find that the lesson content is organized to make this easy—read through everything and when you get to the reading selection, read that in its entirety, and then you are ready to go back and do the written assignments, activities, experiments, etc.

- Use the assignment checklist at the beginning of each lesson to mark each completed assignment and to see what still needs to be done. This will help you plan your time well.
- It is important to find a notebook, binder, or expandable file to keep your work in, so that nothing gets lost. Be sure to keep everything until the end of the school year.
- You are encouraged to make or acquire a weekly student planner and use it each week to help organize your work and stay on track with your assignments.

Reading and Writing in Science

Many of the lessons in this coursebook have a great deal of reading to do before you begin the written assignments. Keep in mind that you don't have to do everything in one day! You might want to break up the reading into two days, or do the reading one day and the assignments, activities, and experiments on other days.

Sometimes, while you are reading, you might come across an unfamiliar word. Keep a small dictionary near you whenever you read so you can look up words quickly. If you want to keep reading and look it up later, just circle the word so you can find it easily. Sometimes you can get a pretty good idea of what a word means by the way it is used in a sentence. When you look it up, go back to the original sentence to see how the word was used. This will usually give you a new insight into what you were reading.

Throughout the year, you will be composing a variety of short and long written answers and research reports, as well as writing down your findings and conclusions based on your experiments. Clear, expressive, accurate writing is essential for a scientist! When writing short answers, it is important to always use complete sentences and restate the question in your answer so that it makes sense even without the question. For example, if the question is "What is a cell?" instead of answering, "The building block of life," you might write, "A cell is the building block of all living organisms."

This year, you will be expected to use your skills in revising, editing, and proofreading when you write essays and reports. After you write a rough draft, revise it to make sure it includes everything you want to say, and that it is organized so the information flows in a logical order. Once you have revised it, you edit your work to correct any errors in spelling, grammar, capitalization, and punctuation. Then you create a final version of your report. Proofreading comes at the very end, when you read your final report one last time to catch and correct any lingering errors. When writing essays or reports, always save your rough draft as well as the final version of your paper. This helps you see how much your writing is improving, and gives your teacher, parent, or tutor important information about your developing skills.

Below you will find notes on how this coursebook is set up. Please go over this material with your parent. (There's also a section below for your parent to read.)

Science is all about questions and discoveries—we hope the year ahead gives you a new way of looking at the amazing world around us!

How the Course Is Set Up

This coursebook is divided into 36 lessons. Each lesson will include the following sections:

Assignment Summary: You'll find a checklist of assignments at the beginning of each lesson. This lets you check off assignments as you complete them and see at a glance what still needs to be done.

Materials List: Each lesson includes a materials list, divided by project or activity. There is a complete list of materials in the appendix, as well.

Learning Assessment: At the end of each lesson, you will find a learning assessment form for the parent/teacher to keep track of student progress and stay attuned to the key competencies that are being developed. Some parents may want to create their own rubrics or bypass formal assessment entirely for the time being. The learning assessment forms can provide an easy way to document your development for reporting purposes.

For Enrolled Students: This section is for families who are enrolled in Oak Meadow School and sending their work to an Oak Meadow teacher. It provides information and reminders about how and when to submit work.

For the Parent

The year ahead is filled with new, exciting discoveries for your child. We hope you enjoy sharing in the excitement of these discoveries.

It is important for you to look ahead to the coming weeks and see what materials will be needed so that you can acquire them ahead of time. You will find a full materials list in the appendix. Here are a few items that are especially important in supporting your child's learning:

- Microscope and slides (you may be able to borrow one from a library, school, or friend)
- Magnifying glasses (2)
- Student dictionary
- Colored pencils

In addition to the assigned reading, this course requires students to use additional reference materials. Help your child learn how to find a variety of research sources in the library, including encyclopedias, magazines, and nonfiction books on a variety of related topics. If your child will be doing research online as well, help them learn how to identify reputable sites (from news or educational organizations, such as CNN or National Geographic, or those ending in *.org*, *.edu*, and *.gov*) and to find sites that are appropriate for their reading and comprehension level.

Each lesson will usually take about four or five hours to complete (approximately one hour per day for one week). You can expect your child to work independently at some times and to need you to be fully involved at other times. Of course, some students will work more quickly and others may need more time. Encourage your student to work at their own pace, without rushing and just trying to "get it done." The learning process is the most important element, and students should be reminded to take their time and do their best work with each assignment and project.

Throughout the year, we urge you to stay responsive to your child and make adjustments along the way based on your child's interests and needs. Your sincere interest in both your child and in the subject material will help nurture the spark of learning. The Oak Meadow curriculum is not solely focused on filling children with facts, but in helping parents and children become more intelligent human beings, able to respond thoughtfully, imaginatively, and effectively to the world in which they live.

Assessment Measures in Home Learning

Assessments in home learning are usually done through a combination of informal observation, the creation of a portfolio of student work, and cumulative activities that are designed to evaluate your student's learning. You can use the learning assessment form included at the end of each lesson to record daily or weekly notes in order to document student progress and the learning process. Things that would be important to note are what aspects are challenging or difficult, what aspects your student has a natural affinity toward, what questions the student asks, what new ideas spring up during the course of the week, and what new discoveries or progress on a skill were made. These notes will help you to keep track of your student's progress and know where and when extra help is needed.

Educators use both formative and summative assessments to gauge student learning and track it over time, and this course is designed for you to do the same. *Formative assessment* happens each week, "forming" as you watch your student work. Each week you will notice where your student struggles, where more time is needed to grasp a concept or practice using a new skill, which aspects of the work are particularly enjoyable or easy. These observations will help inform your next steps. Using ongoing formative assessments, your teaching support can adapt to your child's needs as the year unfolds. *Summative assessment* provides a summary of the student's learning at a particular point. Research papers, science tests, and cumulative projects all offer the opportunity for summative assessment.

Assessing your child's progress will become a natural part of your work each week. As the months pass, you will begin to understand how far your child has come. Keeping anecdotal notes throughout the year will provide you with a comprehensive picture of your child's development.

Information for Students Enrolled in Oak Meadow School

As an enrolled student, your child will benefit from regular feedback and support from your Oak Meadow teacher. Your Oak Meadow teacher is also available to help with questions you may have about assignments or about your child's progress. Communication is essential to developing a great relationship with your teacher during the school year.

If you are enrolled in Oak Meadow School, you'll find a reminder at the end of each lesson that instructs you on how to document your student's progress and when to submit your work to your Oak Meadow teacher. Continue working on your next lessons while you are waiting for your teacher to send feedback on your student's work. After you have submitted the first 18 lessons, you will receive a first-semester evaluation and grade. At the end of 36 lessons, you will receive a final evaluation and grade.

Submitting Work to Your Oak Meadow Teacher

You are welcome to submit your student's work using email, Google docs, or postal mail. You will find detailed instructions on how to submit your work in the Oak Meadow Parent Handbook.

Here are a few tips:

- Please make sure to carefully label each submission. Teachers receive many submissions each week, and we want to make sure your child's work is accounted for.
- If you send work through the postal mail, be sure to include a self-addressed, stamped envelope so your teacher can return the work to you. Receiving the return package from your teacher is an exciting part of the distance learning relationship for many children, and we want to make sure the materials make it back to you in a timely manner. Because regular postal mail is not tracked, it's important to keep copies of everything you send.
- If you choose to send work digitally, Microsoft Word documents, a shared Google doc, and Adobe Acrobat PDFs are the easiest formats for our teachers to work with. When in doubt, please check in with your teacher to determine the best format for receiving work.
- If an assignment asks for an audio or video recording of your student performing, reciting, or giving an oral presentation, you can make digital recordings using a camera, computer, or cell phone, and send your recordings to your teacher. If you do not have the equipment to make a digital recording, discuss other options with your Oak Meadow teacher.
- It is a good idea to keep track of when lessons are submitted and returned. With so many important pieces of work going back and forth in the mail, mistakes do occur, and a good record-keeping system helps clear things up. You can use a weekly planner for this purpose.

When both the family and the teacher keep to a regular schedule for submitting and returning lessons, everyone benefits, especially the student. Timely feedback, encouragement, and guidance from a teacher are key elements for all learners, and this is especially important in distance learning.

All Set for Science!

We believe that childhood is a valuable period, and nothing is gained by hurrying through it. We suggest that you relax and enjoy these lessons with your child, using them as a springboard to further explorations and an opportunity to spend many enjoyable hours together.

We wish you and your child a successful and rewarding year of learning!

Lesson 1

Scientific Inquiry

Science is all around us. All children are natural scientists, looking at the world around them and trying to make sense of it. Children experiment all the time: What happens when you hit a pile of blocks? What happens if you keep filling a cup with water? What happens when you step on the cat's tail? As we grow, we answer these questions and move on to more sophisticated questions, such as "Why is the sky blue?" or "What is inside your eyeball?" This is the beginning of scientific inquiry.

Science is defined as a branch of knowledge involving systematic observation, experimentation, and induction. In plain speaking, this means that scientists make an observation, and then ask a question about this observation. They then perform an experiment and draw some conclusions based on the results of their experiment.

Reading

Read "The Scientific Method" and "Bird Beaks as Tools" (both found in Reading Selections at the end of this lesson).

Assignments

1. After reading about bird beaks, collect as many pictures of birds as you can. Arrange your bird pictures according to beak type, and group the different beak types together.

   Paste the pictures on a piece of paper, grouped according to beak types, and then draw pictures of the food that each bird eats, using the information in "Bird Beaks as Tools" as a reference. Alternately, you might like to make up a game that matches each bird with its food.

ASSIGNMENT SUMMARY

- ☐ Read "The Scientific Method" and "Bird Beaks as Tools."
- ☐ Collect pictures of birds and group them according to beak type.
- ☐ Make a guess about the bird's diet based on its beak.
- ☐ Observe birds and make predictions about their diets.
- ☐ Experiment: Bird Beaks

MATERIALS

- ☐ **Experiment: Bird Beaks**
  Birdseed (at least two kinds)

2. Observe the birds in your backyard or a local park. Ask yourself what type of food each bird might eat based on the shape of its beak. Make a list of at least three different types of birds you observe (if you don't know the type of bird, just describe it as well as you can, particularly its beak shape). If you can't observe birds directly, find three different pictures to use. Create a hypothesis for each that predicts which types of food the bird will prefer.

Experiment

Bird Beaks

Design a simple experiment to determine which types of food the birds you've observed actually eat. One way to do this is to purchase different types of birdseed and set up "feeding stations." For instance, you might wonder, "Will only birds with triangle-shaped beaks eat sunflower seeds?" Or you might ask, "If I put out two different types of birdseed, one with shells and one without, will the birds that eat from each pile of seed have different types of beaks?" You can pose whatever question you like! Once you decide on your question and make a prediction about what will happen, brainstorm ways to test your hypothesis.

List the steps of the scientific method, and follow them one by one as you carry out your experiment. Try to remove as many variables as you can. For instance, in this experiment, a variable might be the location of the birdseed. If one pile of birdseed is raised off the ground (where birds feel safe) and one is on the ground near the dog's resting spot, how might this variable (location) affect your experiment results? You want to make everything the same except for the one thing you are testing.

After conducting your experiment, write a few sentences about what happened during each step of the scientific method. What are your conclusions? How could your experiment be improved?

Reading Selections

The Scientific Method

The *scientific method* is the set of rules that scientists use to try to make sense of the world around us. Every day in our own lives we make observations to try to find the answers to inquiries, just like scientists do. However, in our day-to-day lives there are many factors affecting our results or conclusions, like whether or not we are late for school or have missed breakfast. These factors will influence our ability to notice things in our world and interpret them accurately. If you are in a hurry, you may not notice that flock of birds that feeds in your yard every morning.

A scientist is usually trying to figure out the effect of one particular factor on something. This means that a scientist will set up a *controlled experiment* to try to test an idea. A controlled experiment means that you are testing one thing at a time, so you want only one variable in each experiment. Variables are aspects of the experiment that might change (thereby possibly changing the outcome of the experiment). Some examples of variables are time of day, temperature, type of plant or animal, type of food, amount of sunlight or air, etc.

A scientific experiment will always follow the steps of the scientific method:

Observation/Question: A question is formed about something that you have noticed. The question should be brief, clear, and "testable." This is the *observation*.

Hypothesis: A guess or prediction is made about what the answer to the question might be. This is called a *hypothesis*.

Experiment: A step-by-step process is developed to test the hypothesis. It is important to try to have as few variables as possible so that you will be able to answer your original question. When performing the experiment, all the variables are taken into account.

Results: Observations are recorded describing what happened during the experiment. These are called the *results*. Sometimes the results of an experiment are not clear or not what was expected! The important thing is to notice what happened.

Conclusions: Comparisons are made between the hypothesis (the original question and what was expected to happen) and what actually did happen. The *conclusion* notes how the variables may have affected the experiment results.

Bird Beaks as Tools

Have you ever noticed how different the beaks of birds are? Some are long and straight; some are short and fat. Others seem very strange, like a toucan's, or a pelican's big pouch-like beak. Why do you think birds have such a variety of beaks? The answer is because they eat different things. A toucan's beak is designed to pluck whole fruits off of trees. A pelican's beak makes it possible for the pelican to scoop up fish like a net. The shape and size of its beak enables the bird to eat what it wants.

Let's look at some other examples. Ducks have bills with a sieve-like edge that strains out water and allows the duck to capture plants and small aquatic organisms. Warblers have small beaks that can pick small insects off tree bark. Hummingbirds have long thin beaks that act like straws to make it easy to gather nectar from deep inside a flower.

A cardinal has a triangle or cone-shaped beak. The beak's shape and size make it useful for cracking open seeds and nuts, which is what cardinals like to eat. If you were to see another bird with a similar beak (like a grosbeak, finch, or an indigo bunting), you could reasonably guess that they eat the same foods.

However, a cardinal's beak would not be very useful for catching fish or frogs. What birds have a good beak for that purpose? Herons, egrets, and kingfishers do. These birds have beaks that are like spears, and that is how they use them. Herons stand very still while staring at a certain spot in the water. When a fish or other water creature swims close enough, the heron reaches out with a lightning quick movement and (with luck) stabs the fish with the end of its beak. Herons and egrets then usually flip the fish around so they can swallow it. Kingfishers, while they have similar beaks, are too small to stand in the water, so they wait on a branch or hover over the water until they see something that they want to eat. Then they dive headfirst into the water and stab the fish.

Raptors (eagles, hawks, falcons, owls, and vultures) also have special beaks, which are curved and hook-shaped. This enables them to cut or tear their food. Raptors usually eat small mammals, like mice or rabbits, or reptiles, but depending on their size may eat grasshoppers, deer, or other birds. However, these birds do not use their beaks to catch their food. Instead they use the talons on their feet. Then they take their meal somewhere and tear it apart with their beaks.

Birds would have a hard time trying to eat foods for which their beaks were not well-suited. It would be like trying to eat soup with a fork! Bird beaks are perfectly adapted for eating their preferred foods.

FOR ENROLLED STUDENTS

You will be sending your student's work from this lesson to your Oak Meadow teacher at the end of lesson 2. In the meantime, feel free to contact your teacher if you have any questions about the assignments or the learning process. You can use your assignment summary checklist and the learning assessment form to keep track of your student's progress. You will be sending this documentation to your teacher every two weeks (with each submission of student work).

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 skills that need work.

SKILLS	Developing	Consistent	Competent	Notes
Demonstrates knowledge of the scientific method				
Demonstrates knowledge of experiment variables				
Displays focused observation skills				
Forms a hypothesis based on previous knowledge				
Follows the steps of the scientific method				
Records observations in detail				
Draws conclusions based on results				
Reflects on experiment process and ways to gain more accurate results				
Sorts and classifies information according to different variables				

Lesson

2

Scientific Ways of Knowing

Have you ever watched frogs hopping or tried to catch them to take a closer look? Watching how frogs move, how they eat, where they live—these are all scientific inquiries! Frogs usually manage to keep one hop ahead of kids, but are they managing to stay ahead of pollution? In this lesson, you'll find out more about frogs, and then you will design an experiment to answer a question about frogs in your neighborhood.

ASSIGNMENT SUMMARY

- ☐ Read "Scientific Ways of Knowing" and "Frogs."
- ☐ Make a prediction about the local frog population.
- ☐ Consider how humans affect the environment.
- ☐ Complete a science test.
- ☐ Experiment: Frog Population

Reading

Read "Scientific Ways of Knowing" and "Frogs" (found in Reading Selections).

Assignments

1. After completing the frog experiment in this lesson, make a prediction about the frog population based on what you observed. What did you discover? Are frogs in your pond in trouble? Can you think of any other explanations for what you found? Can you think of ways to help the frogs in your area to keep a healthy population?

   Support your findings with evidence. That means you will give specific examples of why you believe what you say, and what led you to have this opinion.

   Note: if your experiment lasts longer than two weeks, just complete this assignment when your experiment ends.

2. Write a paragraph about the ways humans have affected the environment, both for good and bad. Do some research on this topic so you can back up your thoughts with facts (support your opinion). Include any ideas you might have for ways that people could change their behavior to help the environment.

3. Complete the science test (found after the experiment).

Experiment

Frog Population

Design an experiment to determine if the frog population in your neighborhood is healthy and growing or having any problems. Find a pond in your neighborhood where you can observe frogs. You may want to record data from your pond site for several weeks, so it should be a place you can visit frequently. The spring is the mating and egg-laying season, but frogs may be found throughout the summer and fall. They may be hibernating in your area in the winter.

Choose a "clue" from the following list to research, and use as the basis for your hypothesis.

- **Habitat destruction.** This can include roads that were built where frogs have to cross to reach their breeding ponds. You may need to talk to older adults to learn about how the landscape used to look.
- **Pollution, pesticides, acid rain.** You may want to talk to farmers or landowners around your pond. You could test the pond water's acidity.
- **Ultraviolet (UV) radiation.** Since this affects mainly the egg production and viability, you might conduct a frog count to see how many are hatching and making it to adulthood.
- **Competition and predators.** After doing a frog survey, can you identify any non-native frogs?

Brainstorm ways to design an experiment that will answer your question. Collect your data (pieces of information), and record your observations.

Report the results of your investigation by listing the five steps of the scientific method (question, hypothesis, experiment, results, and conclusion) and writing a couple of sentences about what you did for each step.

Science Test

Complete the following test to show what you have learned. Answer any questions in complete sentences.

1. List the five steps of the scientific method, and explain each one.
2. Explain why variables must be taken into account in a controlled experiment.
3. List three different types of bird beaks, and describe how they are related to the bird's diet.
4. Describe a frog's life cycle.

5. What is an indicator species? Why are frogs an indicator species?
6. List four things that can cause problems for frogs, and explain why each is a problem.

Reading Selections

Scientific Ways of Knowing

Science is a work in progress. This means that when scientists see something that puzzles them, they develop a hypothesis to explain the puzzle. The next step is to design an experiment to test their hypothesis. Throughout this process, remember that scientists are people, so their lives and beliefs may influence their thinking. The only thing that is absolutely true in science is that nothing is absolutely true. When people first began looking at the stars in the sky and trying to make sense of our world's place among those stars, it was believed that Earth was the center and all the other planets revolved around Earth. This is how the human eye perceived the movement that was the rising and setting of the sun.

Copernicus and Galileo

In 1543, Nicolaus Copernicus revived the theory that the sun was the center of the universe, and all of the planets, including Earth, revolved around it. This is called the *heliocentric* (sun-centered) theory. The heliocentric theory was first advanced by Aristarchus in the 3rd century BCE. He lived on the island of Samos, off the coast of Turkey. His theory did not survive long, being discredited by Aristotle. Aristotle "disproved" the heliocentric theory by asking, "If Earth is spinning on an axis, why don't objects fly off into space?" and "If Earth is in motion around the sun, why doesn't it leave behind the birds flying in the air?"

Copernicus was also discredited and disbelieved when he once again put forward the sun-centered theory. Scholars and scientists of the time believed that Earth was the center of the universe and that man was one step removed from God, therefore superior to all other animals on the planet. To accept any other idea might question humankind's superiority. It was not until the middle of the 17th century that Copernicus's ideas were defended by scientists like Galileo Galilei and finally accepted. This is an example of how people's beliefs can influence the scientific theories that are considered acceptable.

Many scientists today accept an assumption that the ancient Greeks put forth: Whatever they are, the basic truths of the universe are "laws" that do not change—only our ideas about them change. Remember, this is an *assumption*. Keep in mind that in the 14th century, people "knew" that Earth was the center of the universe, and it took 300 years before anyone changed their minds about this idea.

Facts and Opinions

There are several ways of "knowing" and of processing information. We can start with facts. A *fact* is something that has actually happened or is unquestionably true. It is a fact that the sun rises in the east every morning. People also have *opinions*, about which they may feel very deeply. These may be based on facts or not. It is more what seems true, or probable. "It is my opinion that it is going to rain today."

Scientists, like all of us, are constantly making observations. Usually, when we are observing our environment, we notice things that have changed. These observations can form the basis of our opinions. Maybe we observe that the sky is overcast (a fact that everyone can agree on), and we form the opinion that it will rain. We also can draw *inferences* from information that is known or even assumed. Inferences are guesses based on information. Here are some examples of inferences:

> The sky looks overcast and the weather report called for rain, so I think it is going to rain soon.
>
> My friend said he's bored, so I bet he will want to go the park with me.
>
> You look upset.

These are all inferences—not fact or opinion, but guesses we make based on what we observe or know. This is how our minds work. But just because we *think* something (that it will rain, or our friend will want to go to the park, or someone is upset) doesn't mean it will happen or it is true.

So, how do scientists know whether or not their conclusions are true? Think back to the scientific method. Once the scientist has made an observation and developed a hypothesis, they will then design an experiment to test the hypothesis. If the experiment is well-designed, then other scientists could repeat the same process and get the same results. If this happens, then the first scientist is reasonably sure that the results are accurate and the conclusions are true. By showing that the same results can be brought about again and again, the experiment results will be accepted by other scientists, and eventually by other people as well.

Frogs

What are frogs? Frogs are small animals belonging to a group called *vertebrates* (animals with backbones), in a subgroup known as *amphibians*. Amphibians live part of their lives in the water and part on land. Amphibians are cold-blooded animals. This means that their body temperature is the same as the surrounding temperature in the environment. Snakes and reptiles are cold-blooded too. Amphibians absorb water through their skin, so they don't have to drink water! Frogs have strong back legs that help them leap forward great distances. Their front legs are short, and are used to prop the frog up when it is sitting. Frogs have webbed feet to help them swim fast. The largest frog in the world is the goliath frog of West Central Africa, and it can grow to be more than one foot long. The smallest frog is the Cuban pygmy frog, and it is about one-half inch long. The largest frog in America is the bullfrog, which grows up to six inches long.

Frogs live all over the world, except in Antarctica. Most frog species, however, prefer warmer climates. Therefore, most frog species are found in the tropics. Frogs are usually found in or near water. This does not mean that all frogs live in water: some frogs only go to water to mate and lay their eggs. Some frogs live in trees, and others burrow underground. Frogs that live in places with a cold winter will hibernate, either burrowed in the ground or buried in the mud at the bottom of a pond, until the weather warms up again in the spring.

The life cycle of frogs is very interesting. The males and females mate, and the female lays her eggs in the water. The eggs hatch within 3–25 days, depending on the type of frog and on the temperature of the water (warmer water results in faster hatching). The eggs are usually covered with a jellylike substance as a protective coating. When they hatch, the baby frogs are called *tadpoles* or *polliwogs*. They look like little fish because they don't have legs yet. They have a tail, which helps them swim, and gills through which they breathe. Most tadpoles eat plants and decaying animal matter, but some will eat frog eggs and other tadpoles. As time passes, first the back legs grow, then the front legs. The tail slowly disappears, and the young frog hops up onto land.

Frogs eat mostly insects and small animals, like earthworms, minnows, and spiders. They flip out their sticky tongue, get the food, and pull back the tongue. Frogs swallow their prey whole, and hunt mostly at night.

Perhaps you have heard frogs croak or "sing." Why do frogs sing? It is the male frogs that sing. They are the ones with the loud voice. The males sing to attract females for mating and to stake out their territory. Female frogs have voices too, but they are much softer.

The place in which an animal can be found is called its *habitat*. Most frogs need two different habitats, within easy reach of each other. They need dry land with cover for protection and a good food supply. They also need a nearby pond in which to lay their eggs and allow their tadpoles to grow up into frogs.

Since frogs breathe air through their skin, and water passes through as well, they are very sensitive to pollution in their habitat. If there are toxins (poisons) in the water or air, the frogs will easily absorb these toxins directly into their bodies. This can make them sick. Frogs are called an *indicator species* because a frog's health may tell us a lot about the health of its environment. If frogs are doing well, then the water quality is high, and pollution is under control. If frogs are not doing well, we should see that as a wake-up call.

There are several things that can cause problems for frogs (and ultimately for the whole habitat or ecosystem):

- **Habitat destruction:** With the logging of forests, especially rain forests, and the draining of wetlands for agriculture and building, frogs are losing their habitats at a rapid rate.
- **Depletion of the ozone:** Changes in the ozone layer of Earth's atmosphere means that more ultraviolet rays from the sun come through to Earth. This causes changes in temperature, which can interfere with the frogs' egg development.
- **Pollution, pesticides, and acid rain:** Since frogs take in water and air through their skin, they are especially sensitive to environmental pollution. These toxins can result in deformities as the frogs grow.
- **Competition and predators:** Non-native "sport" fish that are released in rivers and lakes for fishing can eat tadpoles and wipe out entire frog populations. The Cuban tree frog was accidentally brought into the United States with a shipment of fruit, and since has been eating smaller native frogs.

It's important for us to think and talk about how people's behavior affects the environment. Since the human population has grown so large, we have had an increasing impact on the natural world. We have expanded our roads and housing into areas that were once wild and undisturbed. We have increased our use of natural resources, using them up faster than they are renewed. On the other hand, in recent years, people have been working hard to reestablish endangered species and bring back populations of animals that were almost gone, like the buffalo and wolf. People can have a powerful impact on the environment, for good or bad, and it's up to every person to do their part to take care of Earth, which is home to every living thing.

FOR ENROLLED STUDENTS

If you have any questions about how to structure your frog experiment, please contact your teacher.

At the end of this lesson, you will be sending the first batch of work to your Oak Meadow teacher along with your assignment summary checklist and the learning assessment forms, or any alternate form of documentation. Include any additional notes about the lesson work or anything you'd like your teacher to know. Feel free to include questions with your documentation—your teacher is eager to help.

If you have any questions about what to send or how to send it, please refer to your parent handbook and your teacher's welcome letter. Your teacher will respond to your submission of student work with detailed comments and individualized guidance. In the meantime, proceed to lesson 3, and continue your work.

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 skills that need work.

SKILLS	Developing	Consistent	Competent	Notes
Demonstrates knowledge of the scientific method				
Demonstrates knowledge of experiment variables				
Displays focused observation skills				
Forms a hypothesis based on previous knowledge				
Follows the steps of the scientific method				
Records observations in detail				
Draws conclusions based on results				
Reflects on experiment process and ways to gain more accurate results				
Sorts and classifies information according to different variables				

Lesson

6

The Web of Life

Reading

Read "Energy in Ecosystems" (found in Reading Selections).

Assignments

1. After completing the reading assignment, make a list of eight different things that you eat. Describe the food chain for each food.
2. Using the eight food chains you identified above, draw a food web that shows how all these things are connected. Take your time to draw your food web carefully, in color, and label each segment of it. Make it clear how things are related.
3. Make a list of the plants and animals you would raise if you were a farmer. Explain why you chose each of them.
4. Complete your mold growth experiment. Did you see any mold growth? Did different types of molds grow on different foods? Describe the changes as carefully and accurately as you can. Perhaps you will measure the mold growth in terms of length and width, or perhaps you will estimate how much of the item is covered with mold (10%, 50%, etc.). Try to be as exact as you can. In addition, make drawings of the different kinds of molds that you grew.

   When you are finished with your experiment, be sure to put your sealed bags into the garbage. Don't open them because some kinds of mold are dangerous to breathe. Remember, safety first!

   Conclusions: Did the placement (warm + light, warm + dark, cold + dark) have any effect? Why do you think that the food needed to be dipped in water?

   For each step of the scientific process, write one or two sentences about what you did, what you observed, and why you think it happened.

ASSIGNMENT SUMMARY

- ☐ Read "Energy in Ecosystems."
- ☐ List the food chain for different types of food.
- ☐ Draw a food web.
- ☐ List plants and animals you would raise on a farm.
- ☐ Complete the science test.
- ☐ Write the results of your mold experiment.

Science Test

1. Describe two different environments.
2. Explain the difference between a food chain and a food web.
3. How does each and every food chain begin?
4. How does each and every food chain end? Why is this such an important step in the food chain?
5. Define producers, consumers, scavengers, and decomposers. Explain the role of each in the environment.
6. Why are plants so important to Earth?
7. What happens to energy in each step of the food chain?
8. Why do some people want to keep the human food chain short by eating grains instead of meat?
9. Explain diversity in an ecosystem and why it is important.

Reading Selections

Energy in Ecosystems

Living things move, grow, and change. Even nonliving things change and move. What causes all of these things to happen? *Energy* is what is needed for anything to grow, move, or change.

It takes energy to light and heat your house, to make your car run, and to cook your food. It takes energy for you to move from one place or from one position to another. It takes energy for you to use your eyes and for your brain to read this page. In fact, everything you do, whether it is breathing, sleeping, eating, walking, working, or digesting, takes energy.

All plants and animals need energy to grow, work, move, and keep warm. These things have to get their energy from where they live. Therefore, their ecosystems must contain some form of energy for them to use.

Food Chains

Ecosystems must get energy from something too. Where do you think the energy comes from? It comes from the sun! All of the energy, all over the world, in all its different forms, began as energy from the sun.

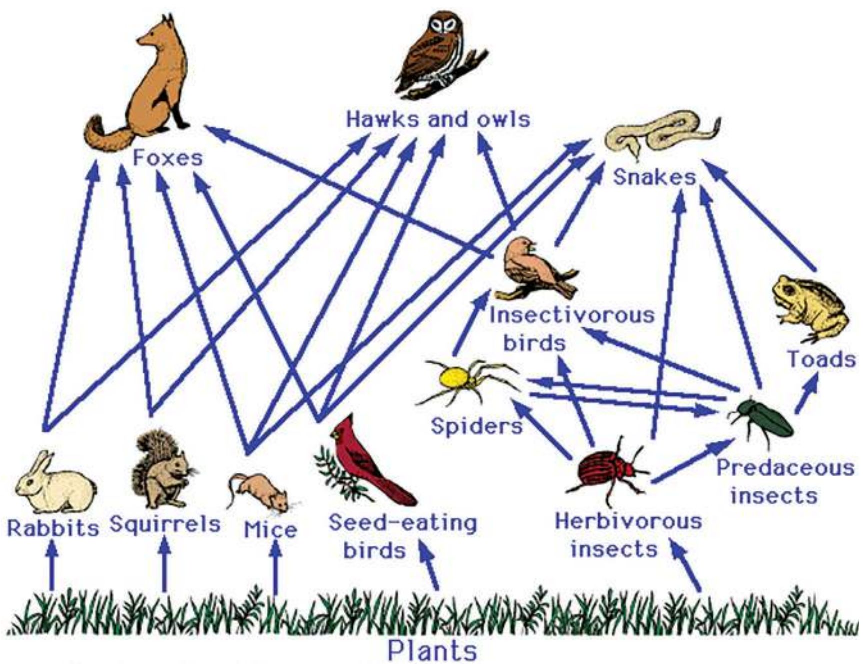
When it comes to energy and living things, plants have a very special job. Only plants can take the energy from the sun and turn it into food energy for themselves and other living things. First, a plant takes in sunlight and changes it into food for itself. This food is a type of sugar called a *carbohydrate*. When a plant takes sunlight to make food, the process is called *photosynthesis*. "Photo" means light; "synthesis" means combining different materials into something new. Photosynthesis changes sunlight and air into sugar. Without photosynthesis, there would be no life on Earth.

Many animals get their energy from plants. Food energy in plants is passed on to animals when they eat plants. This energy then moves on to other animals when they eat the animals that ate the plants. This is how energy moves through an ecosystem. It starts with the sun, moves on to plants, then to animals that eat the plants, then to animals that eat animals and then to other animals that eat those animals. It's a long chain, starting with the sun.

Every time you eat anything, you are eating part of the sun's energy. Think about an apple. The apple tree used sunlight to make food to grow strong and healthy, and fed the developing apples with this energy. What about a chicken sandwich? If you eat a chicken sandwich, you are getting energy from eating a chicken that got its energy from eating seeds and bugs that got their energy from the sun.

The way the energy moves from the sun to living things is called a *food chain*.

Producers, Consumers, Scavengers, and Decomposers



The food chain always starts with the sun. The first link in the chain is between the sun and plants. Because plants are the only things that can make their own food from sun energy, they are called *producers*.

The next link in the food chain is the animals that eat plants. These animals are called *consumers*. Grasshoppers, rabbits, and cows are all consumers. There are many other consumers. They all eat plants. You are a consumer too. You eat salads, vegetables, and plants of many different kinds.

Some consumers eat only other consumers. Foxes eat rabbits, snakes and owls eat mice, and most birds eat bugs and worms of one type or another. Some consumers eat both producers and consumers—both plants and animals. Bears eat fish, roots, and berries. You might eat oranges, beans, carrots, and some type of meat or fish.

Eventually all consumers die. What happens to them? They are eaten by scavengers and decomposers. *Scavengers* are animals who specialize in eating only other animals that have died. Most scavengers do not kill their own food. Vultures, hyenas, and certain kinds of ants, beetles, and worms are scavengers. They are very important because they provide a sort of clean-up service for an ecosystem.

Decomposers, as we learned in the previous lesson, are those tiny living things that eat dead plants and animals. Decomposers are the final link in a food chain. This makes them very important because it is they who break dead things down into soil so that plants can use them to begin another food chain.

Food Webs

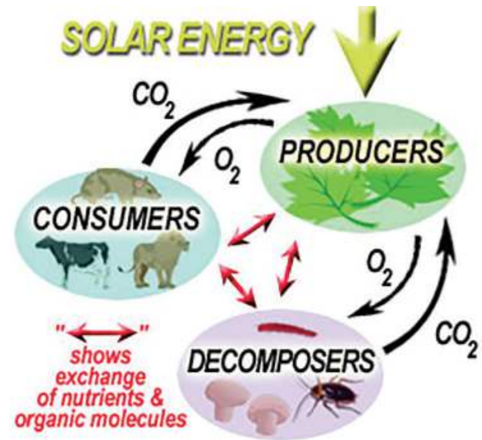
Most animals eat more than one type of food. Grasshoppers eat more than one kind of plant. Foxes eat mice, rabbits, and squirrels. You probably eat lots of things. Each of the things you eat are part of separate food chains, but they all combine together to show all of the eating relationships in your life.

When you eat corn, you are part of one food chain. When you eat fish, you are part of another. In the first, energy goes from the sun, through the corn, and to you. When you eat fish, the sun energy goes through a plant growing in a river or ocean, to smaller fish that are then eaten by the bigger fish you eat. All the different things you eat are connected through you, so you are a common link in many different food chains.

An ecosystem has many, many different food chains that all have common links. Most animals are part of many food chains. All of these food chains together make up a *food web*. Each and every ecosystem, whether it is a desert, forest, or river, has many food chains and one big food web containing all of the chains in the ecosystem.

Losing Energy

In a food chain, not all of the energy a plant gets from the sun makes it all the way to the decomposers at the end of the chain. In fact, very little of the energy makes it that far. Lots of energy gets used along the path of a food chain. Actually, 90% of the energy is used within each link in the chain. The plant uses most of the energy it gets from the sun to grow, to move water and nutrients through its stem and leaves, and to move itself around to get as much of the sunlight on itself as it can. When a bug eats this plant, it stores only 10% of the plant's energy in its own body. When a bird eats the bug, it gets only 10%



of the energy that the bug stored in its body. You can see that by the time the sun energy gets to the bird, it gets only 1% (that's 10% of 10%) of the energy that was in the plant.

Just think how little of the energy is left when you eat a bird! At the end of a food chain, there just isn't much energy left. Notice that there are many, many more bugs in the world than there are people. With every step in a food chain, there are fewer animals because there is less energy to go around.

But where does all of that energy go? Energy is necessary for living creatures to grow, to move, to keep warm, and to reproduce. When you walk, run, or swim, you use energy. Every time an animal breathes, it is using energy to do it. This energy changes form into heat energy that leaves the living thing. Where does it go? This heat energy escapes into the environment. It goes into the air or water around the animal.

Conserving Energy in Food Chains

Here's some food for thought. Do you know anyone who doesn't eat meat? In some countries where there are many, many people, very few people eat meat. That's because there are so many people to feed, and there just isn't enough energy around to feed them all meat at the end of a long food chain. There is just too much energy lost along the way. These countries have to keep food chains short so that as many people as possible can eat. Grains and legumes are the primary sources of nourishment in such countries.

Animals have to do the same thing. The more animals there are, the more energy is needed to keep all of them alive. Animals that have large populations have to keep their food chains short in order to keep that large population alive and healthy. Insect food chains are really short. There are more insects than any other type of living thing. There are lots of bugs that eat bugs, but not as many as there are that eat plants. At the other end of the food chain, large animals that eat other animals have much smaller populations. Look at lions, tigers, and bears, and notice that their populations are relatively small. In fact, there are so few of some particular types of animals that they are considered rare, threatened, or endangered.

Short food chains are really good for animals. That includes people. There are many doctors and nutritionists who believe that we'd all be a lot healthier if we ate less meat. Some think we should eat no meat at all. There are many health reasons for this. One important reason is that it would let our planet feed more people if we fed fewer cows on the grains that people could be eating. It takes about eight or nine cows a year to feed the average meat eater. Each cow needs one acre of green plants, corn, or soybeans a year. If it takes nine acres of plants a year just to make the meat you eat, that's a whole lot more than the half an acre it would take to feed you if you didn't eat meat. The amount of grain needed to provide meat for one person is enough to feed 20 people sufficient grain to live for a year.

Years ago, when an animal was raised for meat on the family farm, all parts of the animal were used. For example, when a pig was killed in the fall, this helped to ensure that the family survived the long winter. The pig would be killed and cut up into various parts (chops, ribs, etc.). The leftover parts were ground up into sausage meat and stuffed into cleaned-out intestine casings. The fat was rendered and made into lard for baking or tallow for candles. There was no thought of waste. This "use it up, wear it out, make do, or do without" philosophy conveyed a respect for the animals' loss of life, and minimized the impact of eating meat.

Today, most of us do not live on the family farm, and many people eat meat at almost every meal. Most of this meat originates from huge animal farms and slaughterhouses where the animals are treated as part of the machinery. There are options to purchase meat grown in a more humane manner, on smaller farms and without the use of growth hormones. We can choose to eat less meat and to support farmers who raise healthy animals in an ethical manner. This is good for the environment and good for your health!

Ecosystem Diversity

Although there are some relatively simple food webs, a forest or ocean food web will be quite involved and contain many living things. All plants and animals in an ecosystem would have to be included in a food web of that ecosystem.

One very important thing to remember about ecosystems is that the bigger the food web, the stronger and less fragile the whole ecosystem will be. An ecosystem works best when it has *diversity*; that means there are lots of different plants and animals in it.

Imagine an ecosystem that has only one type of plant. What would happen if something happened to that one kind of plant? A sickness or disease could attack the plant. It could spread from one plant to another, and cause all of them to get sick or die. Some diseases can spread quickly throughout an ecosystem. If many or most plants in an ecosystem died, it would be a very bad situation for all of the animals that depend on those plants for their energy. All of the consumers in that ecosystem would be in trouble because if there is not enough food for plant eaters, there won't be enough of the plant eaters to provide food for the consumers who eat them. In a simple food chain, every level of the food chain suffers when something happens to the producers.

A good, healthy, stable ecosystem has many different types of food. If one food source vanishes, animals that eat many different types of food can merely eat more of something else. If animals can change from one type of food to another, then changes in the ecosystem will have little effect on the rest of the consumers in the food web.

You may love to eat corn chips. If for some reason, you woke up one day to find that no corn chips existed any longer, you could eat potato chips instead. Or you might decide to eat an apple or an orange. Because we have many foods to choose from in our ecosystem, we are still in good shape even when one type of food disappears. We can always eat something else if we want to. The more kinds of things there are to eat, the better.

However, not all people (or other animals, for that matter) are fortunate enough to have many different food choices. Consider what happened in Ireland in 1845. At that time, people in Ireland ate mostly potatoes. This was because potatoes grew so well there. Because so many potatoes could be grown easily, many families and farms grew only potatoes.

Between the years 1780 and 1845, the population of Ireland grew from 4,000,000 people to 8,500,000. The population more than doubled in 65 years because there was so much food, and so many potatoes. But in 1845 all of that changed. A virus came to Ireland on a plant that was brought on a ship from another part of the world. When the virus reached Ireland, it found lots and lots of its favorite food—potato leaves. The virus lived on the leaves of potato plants, causing the leaves to wilt and die. With no leaves to capture the sun's energy, the potatoes could get no energy for growing, so they rotted and died. For five years potatoes would not grow, and during that time many people had little or no food.

With no other type of food to fall back on, many people had no food to eat at all. During those five years, 1,000,000 people died from starvation in Ireland. Another 1,000,000 people left the country. Many of them moved to the United States, where there was more food.

In the United States, there are many types of food to choose from. The country is large, and has many different climates and plenty of fertile land. But many farmers grow only one single type of crop on their land. The biggest farms in the United States grow corn, soybeans, or wheat, but rarely all three. Farmers find that it is cheaper to grow just one type of crop. But is it really a good idea? Many farmers today find that growing a few or many different types of crops is safer, smarter, and more profitable in the long run. If something should go wrong with one kind of crop, the others will continue to produce the food we all need to live.

FOR ENROLLED STUDENTS

Please submit your student's work to your Oak Meadow teacher at the end of this lesson. Make sure all the assignments are completed (you can use the assignment checklist to help you organize your submission). Contact your teacher if you have any questions.

Learning Assessment

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

SKILLS	Developing	Consistent	Competent	Notes
Differentiates between producers, consumers, scavengers, and decomposers				
Demonstrates knowledge of food chains and food webs				
Shows awareness of the importance of diversity in an ecosystem				
Draws detailed, labeled illustrations				
Makes clear and detailed comparisons				
Demonstrates knowledge of the scientific method				
Displays focused observation skills				
Forms a hypothesis based on previous knowledge				
Follows the steps of the scientific method				
Records observations in detail in text				
Draws conclusions based on results				
Reflects on experiment process and ways to gain more accurate results				
Measures with accuracy and records accurate measurements				

Lesson

17 Conserving Earth's Resources

Reading

Read "Recycling" and "Food and Hunger" (found in Reading Selections).

ASSIGNMENT SUMMARY

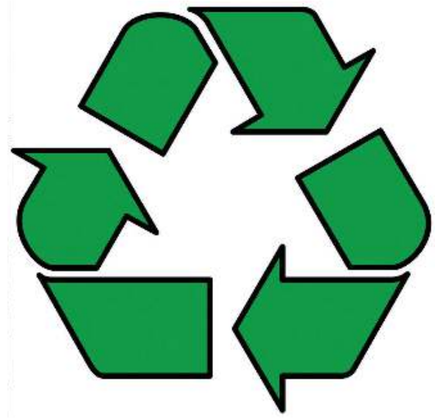
- ☐ Read "Recycling" and "Food and Hunger."
- ☐ Keep track of what you eat, and assess your diet.
- ☐ Complete an assignment related to the reading.
- ☐ List recycled and plastic materials in the home.
- ☐ Reflect on how to take care of Earth.

Assignments

1. Keep a record for one week of everything you eat. Each day, check to see if you had food from each of the food groups (carbohydrates, proteins, vitamins, and minerals). If you did not, eat a more balanced assortment of foods the next day. At the end of the week, assess your diet. Do you think you have a healthy diet? Why or why not? What areas do you think you could change? Would these changes have a positive effect on the environment? How?
2. Choose one of the following projects to complete:
   a. Do service stations recycle motor oil in your community? Visit or call three service stations to find out. Where do they take it, and what is done with it there? Report your findings.
   b. Learn about the use of hemp as an alternative to cutting down trees for paper.
   c. Compare a piece of recycled paper and a regular piece of paper. Do you see any difference? If so, what is it?
3. Make a list of items in your home that are made of recycled material. Make a list of items that are made of plastic, and write down ideas for alternate materials that could be used for these items.
4. You have learned many ways to be a good caretaker of Earth so that our planet remains a healthy, safe place in which to live. Reflect on what you have learned and which things feel most important to you. Write your thoughts in a paragraph, or express them in an artistic form (a drawing or painting, a poster, a poem, etc.)

Reading Selections

Recycling



Although the United States has only six percent of the world's population, we use fifty percent of the world's resources. The only way we can stop this overuse and waste of our resources is if everybody does their part. Each of us needs to recycle so we do not use up more of our natural resources. It takes less energy and fewer resources to recycle something than to make something using all new materials. Most communities have recycling centers for paper, glass, metals, and plastics.

Learn how to recycle light bulbs, old windows, mirrors, and other glass. When you recycle glass, it is broken up into tiny bits and then melted down and mixed with new glass. Aluminum foil, pie plates, and frozen food trays may be recycled along with aluminum cans.

In addition to recycling, we should all think about ways to reduce the amount of trash we generate. There are many things we can do. Each of us can use a cloth bag when we shop so that we do not use paper or plastic bags. When we no longer have need of old things, we can have a garage sale, donate to a thrift store, or give them to someone else. Don't throw your old things away! You can donate your old books to the library or the children's ward of your local hospital.

Hopefully you have been composting your kitchen scraps this year. If so, you should have a nice compost heap by now. Composting is another way to keep waste out of our landfills, enrich the soil, and use the land in a more productive way.

Remember, plastic is not biodegradable. Look around your house so see how many items you have that are plastic. When these items break or wear out, are there ways to replace them with nonplastics?

Here are some things you can do:

- Use beeswax crayons, which contain a lesser amount of petroleum (a fossil fuel) than regular crayons.
- Use water-based paints.
- Use recycled paper.
- Use water-based markers and glue.
- Avoid Styrofoam. Use packing materials that can be recycled or are biodegradable.
- Use rags instead of paper towels.
- Buy compact fluorescent (CFL) light bulbs.
- Buy a live tree for Christmas, and plant it.
- Pick up litter along the roadside, and recycle it or dispose of it properly. Use gloves to protect your hands and your health.
- Buy or make wooden toys instead of buying plastic ones. If you have plastic ones already, take good care of them so they last a long time. When you're done with them, pass them on to another child who might enjoy them.

Food and Hunger

The growth in human population has put enormous demands on our ability to supply everyone on the planet with enough food to eat. In addition to this increased need for food, our soils are depleted and therefore our foods are not rich in the vitamins and minerals we need for good health. Many starving and malnourished people die from diseases that would not kill a properly nourished person.

What can you do about both of these problems? You can learn to grow your own vitamin and mineral-rich food just as the people in ancient civilizations did. We have learned from history that in many of these civilizations, each family had its own small garden plot. They learned how to take maximum advantage of very little space. They also knew how to rotate crops and enrich the soil so they could eat healthy food. Families in many countries around the world are still doing this today. China gave priority to environmentally sound agricultural development, and today they lead the way with organic farming. You might be surprised to know that you could grow an organic garden in as small a space as four feet by four feet that could supply all of the vegetable needs for one person.

In our civilization we are eating fewer and fewer plants, and more and more animals. This habit demands that more of our land be turned into grazing land and more land be dedicated to growing grain for livestock feed. This same land could feed many people if it were used to grow grains and vegetables for human consumption. Many people do not include meat in their diets and still have very healthy diets. We can get all of the vitamins, minerals, and protein we need for a healthy body by eating grains, legumes, vegetables, fruits, and nuts, and very small amounts of meat or fish (or none at all). As our population increases, it's important to look at how changing our eating habits can create more food for those who need it.

FOR ENROLLED STUDENTS

Continue to use your weekly planner, assignment checklist, and learning assessment form to help you organize your lessons and track your student's progress.

Learning Assessment

Use this assessment form to track your student's progress over time.

SKILLS	Developing	Consistent	Competent	Notes
Demonstrates understanding of recycling				
Identifies elements of Earth stewardship				
Shows understanding of connection between food and healthy environment				
Tracks the movement of the moon and stars over time				
Draws detailed, labeled illustrations				
Makes clear and detailed comparisons				
Demonstrates knowledge of the scientific method				
Displays focused observation skills				
Forms a hypothesis based on previous knowledge				
Follows the steps of the scientific method				
Records observations in detail in text				
Draws conclusions based on results				
Reflects on experiment process and ways to gain more accurate results				
Measures with accuracy and records accurate measurements				

Lesson

23 Body Tissues

Reading

Read "Body Tissues" (found in Reading Selections).

Assignments

1. Do some research to learn what a neuron looks like. Draw a picture of a neuron, and label all of the organelles within.
2. Choose one of the following fingerprint projects:
   a. "Lift" your prints! Using a pencil, rub a *very* black square on a white piece of paper. Make sure the square is shiny black. Rub your thumb, print-side down, onto the square. Take a piece of tape, and put the sticky side onto the black part of your thumb. Press the tape down. Now remove the tape from your thumb, and tape it onto a piece of white paper. Wash your hands with soap and water. Use a magnifying glass to study your fingerprint. Describe your fingerprint. Does it have arches, loops, and/or whorls?

   b. Another fun way to look at your fingerprints is to *blow them up*! Press your thumb onto an ink pad, and then press your thumb onto an uninflated balloon. Now, blow up the balloon, and see your fingerprint magnified. Write a description of your fingerprint.

   c. Take the fingerprints of your friends and family members. See if you can put them into their respective categories; arches, whorls, or loops. Which category do most of your fingerprints fall into? Which category do the fewest fall into?

ASSIGNMENT SUMMARY

- ☐ Read "Body Tissues."
- ☐ Draw and label a neuron.
- ☐ Choose a fingerprint project.
- ☐ Make a list of family blood types.
- ☐ Describe the purpose of five different organs.
- ☐ Activity: Muscle Model

MATERIALS

☐ **Muscle Model**

2 strips of cardboard, 3 × 6 inches
4 paper clips
tape
hole punch
1 red balloon and 1 blue balloon

3. Make a list of all of the blood types in your family. Try to find out your own blood type, if you can. See who could donate blood to you, if you needed it.
4. Make a list of five organs in your body. Describe the job of each one.

Activity

Muscle Model

Materials:

2 strips of cardboard, 3 × 6 inches

4 paper clips

tape

hole punch

1 red balloon and 1 blue balloon (do not inflate)

1. Create the “arms” of this model by taping the cardboard strips together, making a joint that will bend like your elbow joint. One strip represents your upper arm, and the other strip represents your lower arm. You can even trace your hand and tape it to the end of the lower arm.
2. Punch a hole in each cardboard strip to create “muscle insertion points.” The hole for the “lower arm” cardboard strip will be 1.5 inches from the taped “joint.” In the other “upper arm” cardboard strip, make another hole 1.5 inches from the top edge (imagine this like your shoulder joint).
3. Pierce the ends of each balloon with the paper clips, so there is a paper clip attached to both ends of each balloon. Attach the red balloon on one side of the “upper arm,” with one paper clip slipped in the hole at the “shoulder” end. Stretch the balloon across the taped “elbow,” so the second paper clip can insert in the hole in the “lower arm.” Flip the cardboard over to attach the blue balloon on the *opposite side* of the red balloon in the same way.
4. Play with the muscle model, and bend the “arm” at the “elbow.” Notice that when you do this, the red balloon becomes shorter, or contracts, while the blue balloon stretches out, or relaxes. The red balloon represents how the biceps works, and the blue balloon shows how the triceps works with it. Feel how your muscles contract when you move and bend your own arm!

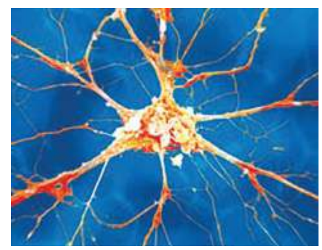
Reading Selections

Body Tissues

Bacteria, archaea, and protists are one-celled organisms. All of their functions are carried out within that one cell: reproduction, eating, digesting food, and excreting. Larger animals and plants have many cells, which are all different shapes and sizes. The cells all still have jobs to do, but they work in specialized "teams." For example, there are specialized muscle cells and bone cells in animals, and in plants there are specialized leaf cells. These cells all have different shapes that help them do their jobs.

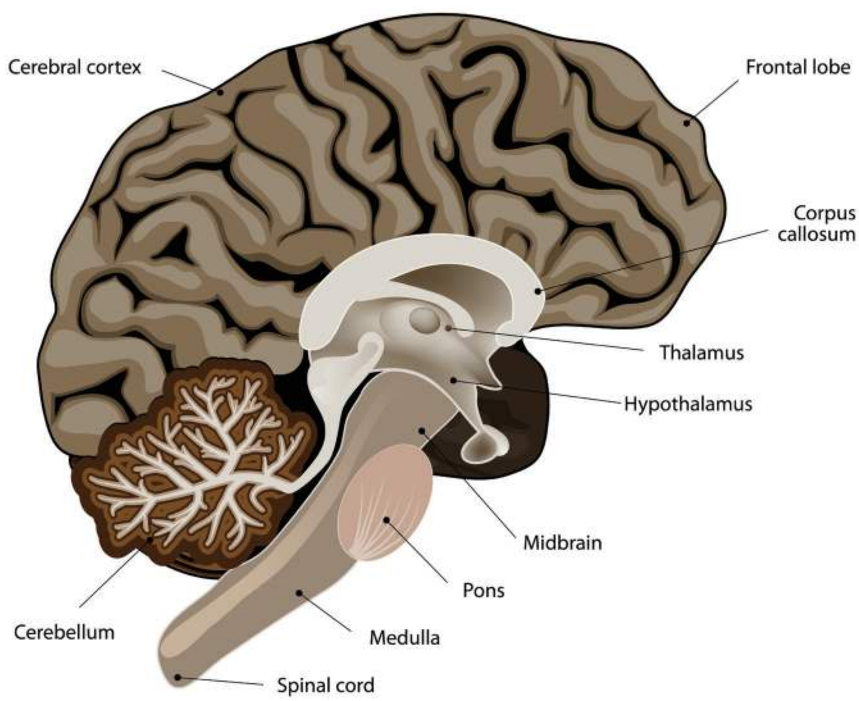
Cells that are on the same team look alike. These groups of cells are called *tissues*. The word *tissue* means "to weave" in Latin, indicating that the cells are woven together in their common function. The different types of tissue are nerve, muscle, epithelial, and connective.

You've Got a Lot of Nerve . . . Tissue



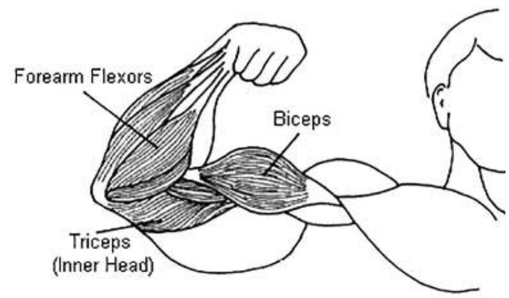
Nerve tissue carries messages throughout the bodies of animals (humans included). These messages come "from the top," your brain. This is a big bundle of nerve cells. The brain directs all activities in the body through the nerve cells. At the same time, messages are being relayed back to the brain, which interprets them and decides what to do with the information. If you touch a hot stove, the message zips up to your brain, and the brain instantaneously sends back the message *Ouch! Move away!*

The brain of an adult person weighs about three pounds. If you want to imagine that in more familiar terms, there is enough room inside your skull to hold the contents of a can of soda. Your brain takes



care of a lot of jobs. Is the human brain really big, compared to other animals' brains, relative to their body size? Not really. But one big difference seems to be that a human brain has a very bumpy, folded-up cerebral cortex (the outer layer of the cerebrum). This is the part of the brain that handles thought, memory, language, reasoning, voluntary movement, information processing . . . the part that you are using right now!

Muscle Tissue

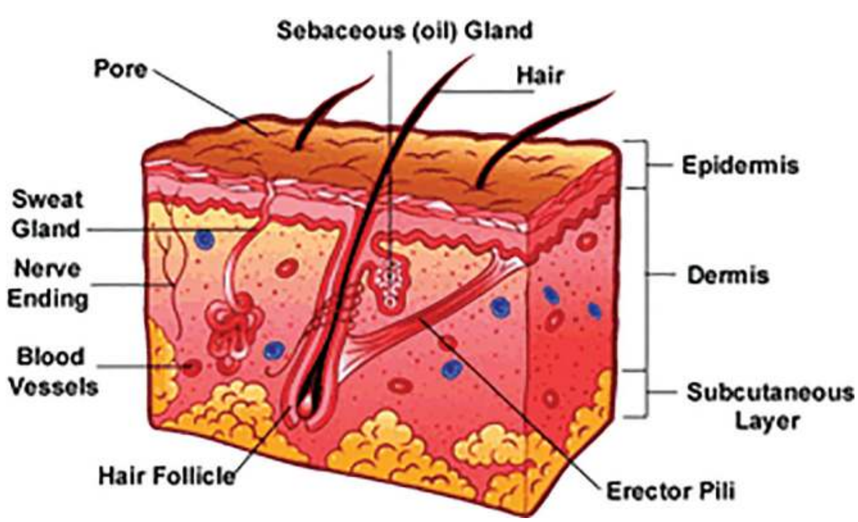


Muscle tissue is responsible for your every move. There are three types of muscle tissue: smooth, cardiac, and skeletal. The *skeletal muscles* move the skeleton. They make up 50% of your body weight. These are *voluntary muscles*, meaning that we control them. There are some muscles that we do not control, and these are the *smooth muscles*. These muscles are in all of the "hollow places" in your body, like the inside of your stomach. These muscles are striped like a grid, so they can move in all directions. The other type of muscle tissue in our bodies is the *cardiac muscle*. These muscles squeeze the walls of the heart, pumping blood throughout the body. They do this 100,000 times every day!

Muscle and bone tissues work together to move bones. When a muscle that is attached to a bone becomes shorter (contracts), it pulls on the bone and moves it. Let's take a look at the muscles in your arm. You have two muscles that move your arm. The *biceps* are in your upper arm, located on the top, and are used to flex, or bend the arm. The *triceps* are also in your upper arm, located on the bottom. These are used to extend, or raise your arm.

Epithelial Tissue

These tissues are the big protectors in the body. They make up the skin, the inside of the lungs and sinuses, and the lining of the stomach. The epithelial tissue keeps harmful things out of the body and



protects organs inside the body. In other words, your skin keeps your insides in, and the outside out. It is waterproof, stretchy, and the largest sensory organ in your body. The skin on your body may seem very thin and light, yet put all together it weighs about five pounds!

Your skin comes in layers. The outer layer is called the *epidermis*, from the Latin meaning "on the skin." This is the layer of skin that is constantly dying, falling off, and renewing. It is estimated that a person will lose about 40 pounds of skin throughout their lifetime! These little bits of dead skin also make up 90% of household dust. The next layer is called the *dermis*. This is where the sweat glands are, along with the nerve endings, hair follicles, and blood vessels. This is the part of your skin where the pigment *melanin* is produced. This pigment darkens your skin and protects it from strong sunlight. Beneath both of these layers of skin is the *subcutaneous* layer, which is basically made up of fat. This fat acts like a cushion, protecting you if you bump into something. It also keeps you warm.

One of the many unique things about you is that you have fingerprints that are unlike anyone else's on Earth. All people have fingerprints. Even some animals have fingerprints. Animals that grasp things with their hands get a better grip if they have fingerprints. Gorillas and other primates (not chimpanzees, though) have fingerprints, as do koalas. Only humans and gorillas have unique fingerprints, though.


arch


loop

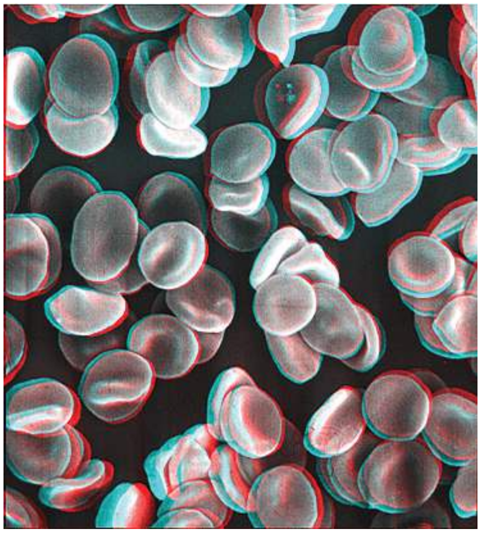

whorl

Fingerprints are made up of little cone-like bumps that connect the dermis with the epidermis. This is how food and oxygen gets to the outer skin. These bumps are arranged in parallel rows that form swirling patterns. There are three general types of patterns. There are *arches* (55% of the population in the U.S.), *loops* (60-65% of the population), and *whorls* (30-35% of the population). Even though people share these patterns, there are no two fingerprints that are exactly alike. Even identical twins have different fingerprints! If you were to lose the skin on your fingertips, your fingerprints would grow back in the exact same pattern as the one you were born with.

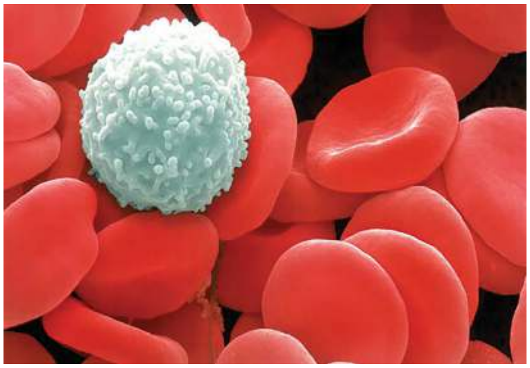
Fingerprints were used as signatures on pottery in ancient Japan. The patterns were first described by Marcello Malpighi in the 1600s. William Herschel in India collected fingerprints of his friends and family as "keepsakes." He noticed that they were unique, and that they did not change over the years. He also used fingerprints for pensioners to "sign" for their payments, thus eliminating the possibility of fraud. However, fingerprints were not used by police to solve crimes until the 1800s.

Connective Tissue

You can guess what job the connective tissues perform; they hold things together! They give support and structure to the body. Examples are tendons, ligaments, cartilage, bone, fat, and blood. Blood? What is that doing in there? Well, it does "provide support" in that it transports food to the body, and removes wastes. Let's "go with the flow" and find out more about your blood.



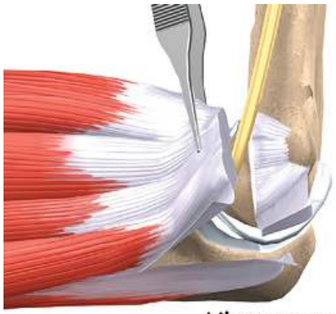
Your blood is made up of many parts. The red blood cells give it its red color. These cells are shaped like shallow bowls, and they are very flexible. They have to be, since they need to squeeze their way in and out of capillaries. *Capillaries* are the minuscule blood vessels where all of the big exchanges take place: wastes, oxygen, nutrients, and carbon dioxide. The main job of the red blood cells is to transport oxygen from the lungs to the body. The oxygen is carried by a special protein called *hemoglobin*.



There are also white blood cells in your blood. These are the infection fighters. There are a certain number of white blood cells in your blood normally, and you produce more when you have an infection. Measuring the number of white blood cells you have is one way doctors can determine if you are sick. The white blood cells kill invading bacteria by eating them.

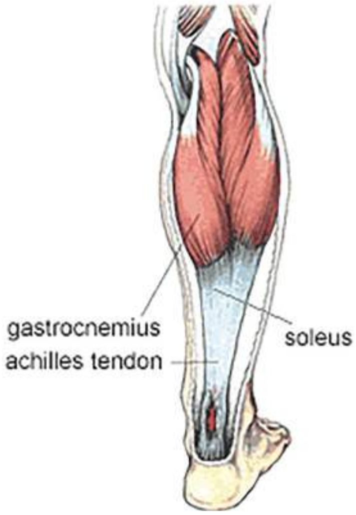
The other parts of your blood are *platelets* and *plasma*. The platelets help your blood clot if you get a cut. They stick to the wound and form a platelet plug. The plasma is a clear, yellowish fluid that is 90% water. The plasma carries food to the cells and transports wastes away from the cells. When you get a cut and lose some blood, your body quickly makes some more. Where does the blood come from? It is made in your bone marrow. Most of the bones in children's bodies produce blood. This changes as you age, and in adults the blood is only made in the bones of the spine, the breastbone (sternum), the ribs, the pelvis, and small parts of the upper arm and leg.

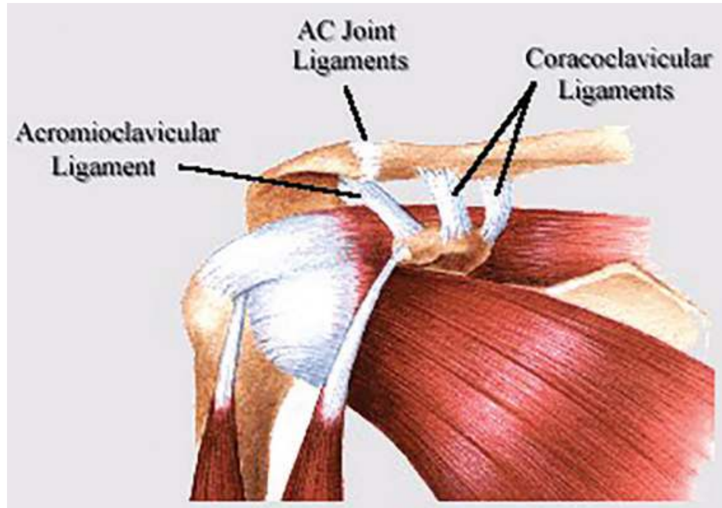
Bones hold you up and protect your brain and internal organs. A baby starts out with 270 soft bones. These fuse and harden up until age 20 to 25, and as adults we have 206 bones. A bone is made up of a hard outer layer, which is incredibly strong. Inside of this layer is a spongy layer, or the *marrow*. This is where your blood is produced, and nutrients and waste move.



Ulnar nerve

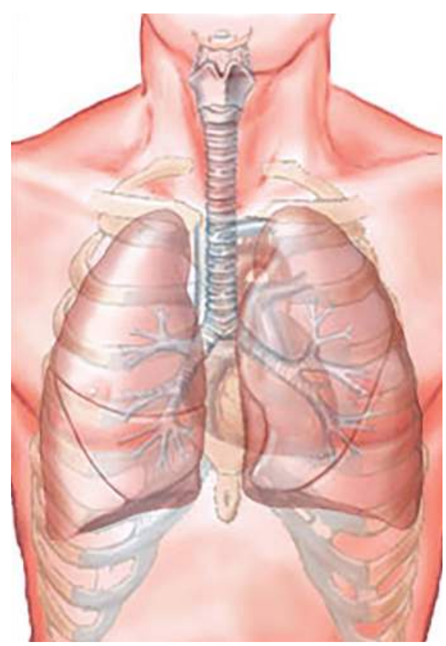
What is your "funny bone"? It is actually not a bone at all. Your *ulnar nerve* is very close to the surface near your elbow. When you bump it you feel that tingling pain, which is really a little paralysis of the nerve. The term "funny bone" was first used by a punster back in 1840. The Reverend Richard Barham referred to this knobby end of the *humerus* bone as the "humourous bone"—the funny bone.





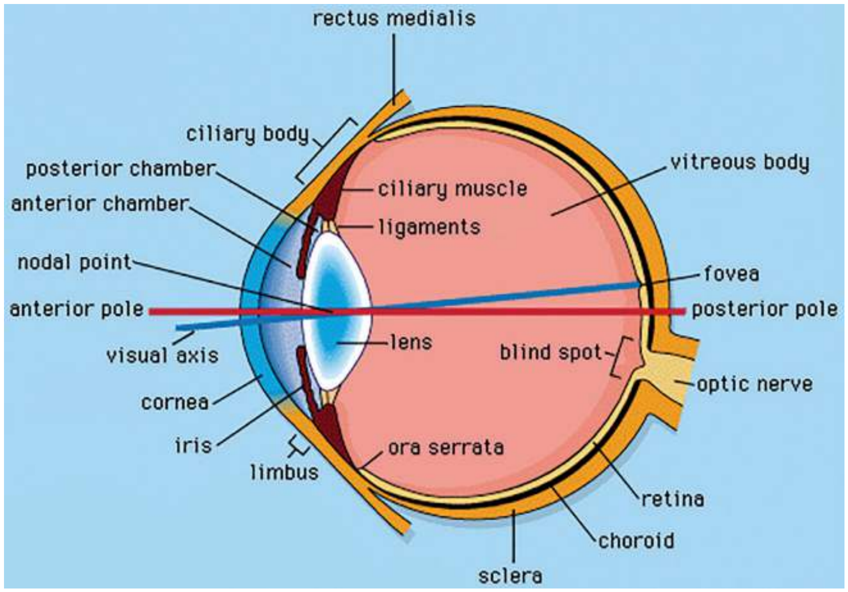
Your bones may hold you up, but they don't move you. Your muscles move you, and these muscles are attached to your bones by tissues called *tendons*. If you look at the top of your hand, those bands that stick up are tendons. You can watch them get longer and shorter as they pull your finger bones. Bones are attached to other bones by long straps called *ligaments* that wrap around the joints. Some joints, like the ones in your spine, move a little. Some joints, like the ones in your hips, elbows, or knees, move a lot. Some joints, like the ones in your skull, don't move at all.

Adipose tissue, or fat tissue, is loose connective tissue that stores fat. Why would the body want to do that? Fat is actually essential to the proper functioning of your body. Fat is a concentrated source of energy for sports and playing. Fat is part of your nerve cells. Your brain is 60% fat! Some essential vitamins are fat soluble, which means that we can only use them if they are accompanied by fat. What else does fat do? It cushions our internal organs, keeps us warm in cold weather, and keeps our skin and hair healthy. Fat has gotten a bad reputation, but it is an essential part of a balanced diet. Good sources of fat are grains, sunflower seeds, walnuts, olive oil, avocados, and cold-water fish (like trout).



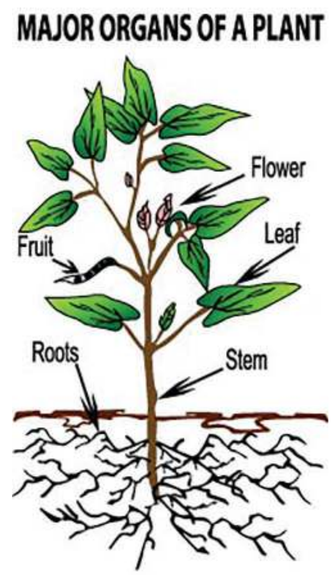
Organs: Tissues Working Together!

A group of tissues that works together is called an *organ*. It can be made up of similar tissues, or different types of tissues that work together. These organs have special jobs to do. For example, your eye is an organ. All of the tissues in your eye work together so that you can see. Your tongue is an organ that allows you to taste, your lungs are organs used in breathing, and your stomach is an organ used in digestion.



Your eye is an amazing organ. Your eye acts somewhat like a camera. Whenever you look at something, light is reflected from that object to your *cornea*. The cornea acts together with the lens and *vitreous* in your eye to send and focus the light onto the *retina*. Oddly, the image is upside down. The retina converts the light into impulses that can be sent to the brain through the optic nerve. The brain then translates the image into a right-side-up picture. All of this happens so quickly and constantly that we take our sight for granted. If you have ever shut your eyes and tried to walk around your room, you will have noticed how much we depend upon our eyes to manage in the world.

Plants have organs too! Plant tissues working together form organs that get special jobs done. The roots of a plant are organs that take in food and water for the plant, and hold the plant in the soil. The plant stem is an organ that transports food and water from the roots through the plant. Leaves are the plant's food-making organs, and the flowers are the plant's reproductive organs.



FOR ENROLLED STUDENTS

Please contact your teacher if any questions arise.

Learning Assessment

Use this assessment form to track your student's progress over time.

SKILLS	Developing	Consistent	Competent	Notes
Demonstrates knowledge of classification system for living organisms				
Identifies examples of different types of tissues				
Identifies the purpose of various body organs				
Demonstrates knowledge of characteristics of life				
Identifies the function of various parts of a cell				
Predicts weather based on observations				
Tracks the movement of moon and stars over time				
Draws detailed, labeled illustrations				
Makes clear and detailed comparisons				
Demonstrates knowledge of the scientific method				
Displays focused observation skills				
Forms a hypothesis based on previous knowledge				
Follows the steps of the scientific method				
Records observations in detail in text				
Draws conclusions based on results				
Reflects on experiment process and ways to gain more accurate results				
Measures with accuracy and records accurate measurements				

Appendix

Materials List by Lesson

LESSON	PROJECT	MATERIALS
1	Experiment: Bird Beaks	birdseed (at least two kinds)
3	Experiment: Wetlands Model	2 large aluminum roasting pans sand modeling clay grass or grain seeds soil carpet scraps ground pepper twigs or branches
4	Magnification	2 magnifying glasses microscope and slides (optional) onion craft stick pond water
4	Thermometer	tap water rubbing alcohol clear, narrow-necked plastic bottle food coloring clear plastic drinking straw modeling clay
4	Experiment: Mold Growth	3 types of leftover food 3 plastic ziplock bags magnifying glass
5	Forest Mural	poster board or large piece of paper
5	Make a Compost Pile	container with lid, mesh wire, or other structure worms (optional) agricultural lime
5	Experiment: Decomposition	orange peel lettuce leaf apple core craft stick plastic spoon small plastic bag quarter or other coin shovel

LESSON	PROJECT	MATERIALS
7	Birdfeeder and Birdbath	birdseed, pinecones, peanut butter, etc. shallow dish or planter
8	Experiment: Ant Behavior	oil-based food, such as peanut butter sugar-based food, such as jelly or honey protein-based food, such as a piece of meat
12	Water Usage	gallon jug (or quart) ruler bucket cup
12	Experiment: Evaporation	2 bowls of equal size screen or cheesecloth saucepan
13	Make a Sundial	large piece of cardboard or wood (2–3 feet square) dowel or stick, 6–12 inches long marker
14	Solar System	marble walnut golf ball acorn basketball soccer ball softball small grapefruit
15	Resources Poster	magazines and newspapers
15	Air Pollution	index cards coconut oil, sunscreen, or lotion string hole punch
19	Weather Station	outdoor thermometer rain gauge (or cup and ruler) barometer (optional) compass

LESSON	PROJECT	MATERIALS
19	Wind Vane	index card or sturdy art paper straw tape pencil pushpin
20	Dew Point	glass ice water thermometer
20	Experiment: Cloud in a Bottle	clear plastic bottle with a cap match
21	Edible Cell Model	Jell-O fruits and candies of your choice
22	Classified Information	wide variety of items for sorting
23	Muscle Model	2 strips of cardboard, 3 × 6 inches 4 paper clips tape hole punch 1 red balloon and 1 blue balloon
24	Beady Neuron	flexible wire (string or yarn can also be used) colored beads one large bead pipe cleaners (optional)
24	Three-Dimensional Brain	flour water cream of tartar oil salt red food coloring

LESSON	PROJECT	MATERIALS
24	Brain Cap	newspapers white paper flour glue (flour and water mixed to thin consistency) balloon marker paints and brush scissors
25	Socktopus	1 long sock stuffing (cotton balls, batting, or the other sock) marker (or stick-on eyes) scissors yarn
27	Experiment: Properties of Gravity	pairs of objects made of the same material in different sizes (one small and one large) 2 apples
28	Conduction and Convection of Heat	ice cubes metal pie pan plate (not metal) paper towel aluminum pie pan food coloring water liquid hand soap that has a pearly or metallic appearance
28	Experiment: Heat Trap	cardboard box plastic wrap glass of cool water aluminum foil scissors or utility knife tape timer thermometer

LESSON	PROJECT	MATERIALS
29	Expansion and Contraction	small glass bottle quarter small dish of water plastic gallon jug, with lid hot water
29	Surface Tension	sewing needle small dish of water liquid dishwashing soap coins glass of water
29	Experiment: Expansion and Contraction in a Gas	1 hard-boiled egg, cooled and peeled wide-mouth glass bottle with an opening slightly smaller than the egg vegetable oil strip of paper match
30	Reflection and Refraction	flashlight 2 mirrors spoon clear glass of water coin straw
31	Playing with Sound	plastic food wrap saucepan medium-sized bowl wooden spoon uncooked rice plastic ruler drinking glasses of various sizes pencil several empty plastic bottles
32	Electromagnetic Fields	compass
32	Static Electricity	2 balloons string

LESSON	PROJECT	MATERIALS
32	Lemon Battery	lemon zinc nail copper nail (or a thick piece of copper wire)
32	Experiment: Electrical Circuit	2 D batteries tape short piece of electrical wire flashlight light bulb
33	Bernoulli's Principle	balloons drinking straw
33	Air Pressure	thin piece of wood about 18 inches long ruler pencil 2 balloons (they must be identical in size) tape rubber band 2 pushpins string or thread
33	Airfoil	sheet of stiff paper short drinking straw tape or staples thread or thin string electric hair dryer pencil
33	Experiment: Bernoulli Ball	electric hair dryer ping-pong ball
35	Bending Light	clear plastic 1-liter bottle glass bowl or baking dish nail or screwdriver laser pointer

Materials in Alphabetical Order

Acorn

Aluminum foil

Aluminum pie pan

Aluminum roasting pans

Apple core

Apples

Balloons

Barometer (optional)

Basketball

Batteries, D cell

Bead, large

Birdseed

Birdseed, pinecones, peanut butter, etc.

Bowls of equal size

Bucket

Cardboard

Carpet scraps

Coins

Coconut oil, sunscreen, or lotion

Colored beads

Compass

Container with lid, mesh wire, or other structure

Craft stick

Cream of tartar

Cup

Dowel or stick

Egg, hard-boiled, cooled and peeled

Electric hair dryer

Electrical wire

Flashlight

Flashlight light bulb

Flexible wire (string or yarn can also be used)

Flour

Food coloring

Fruits and candies of your choice

Glass bowl or baking dish

Glasses of various sizes

Golf ball

Grapefruit

Grass or grain seeds

Ground pepper

Hole punch

Ice cubes

Index cards or sturdy art paper

Jell-O

Jug, gallon or quart

Laser pointer

Lemon

Lettuce leaf

Liquid dishwashing soap

Liquid hand soap

Magazines

Magnifying glasses

Marble

Marker

Match

Metal pie pan

Microscope and slides (optional)

Mirrors

Modeling clay

Nail, copper

Nail, zinc

Nail or screwdriver

Newspapers

Oil

Onion

Orange peel

Paints and brush

Paper, white

Paper clips

Paper towel

Pencil

Ping-pong ball

Pipe cleaners (optional)

Plastic bag, small

Plastic bottle with a cap, clear

Plastic bottle, clear, 1 liter

Plastic drinking straw, clear

Plastic food wrap

Plastic gallon jug, with lid

Plastic ruler

Plastic ziplock bags

Plate (not metal)

Pond water

Poster board or large piece of paper

Pushpin

Rain gauge (or cup and ruler)

Red food coloring

Rice, uncooked

Rubber band

Rubbing alcohol

Ruler

Salt

Sand

Saucepan

Scissors or utility knife

Screen or cheesecloth

Sewing needle

Shallow dish or planter

Shovel

Small glass bottle

Soccer ball

Sock

Softball

Soil

Spoon, metal

Spoon, plastic

Spoon, wooden

String

String or thread

Stuffing (cotton balls, batting, or sock)

Tape

Tape or staples

Thermometer

Thermometer, outdoor

Timer

Twigs or branches

Vegetable oil

Walnut

Wide-mouth glass bottle

Wood

Worms (optional)

Yarn