# Sample Lesson

**Lesson 4: How Our Muscles Know When to Move**

**Teacher Background Information**

**My Science Notebook**

**Mi Libreta de Apuntes de Ciencias**

**Assessments**

**Teacher Masters**

**Visual Pack**

**Student Reference Book**

**ExploraGear**

**I Wonder Circle**

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**Module Components**

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**Science Companion Unique Features**

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Any text in blue is a link. Clicking blue text will take you to another page of the sample.

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Science Companion
The Teacher Lesson Manual engages and guides teachers to implement hands-on science lessons with their students. Lesson by lesson, students develop strong process skills and in-depth understanding of specific concepts.

The book brings teachers up to speed for the science content through “Teacher Background Information” and in-context lesson notes. Teachers can feel comfortable with leading the class—whether they have a long history of teaching science or not.

Each Teacher Lesson Manual focuses on a set of Big Ideas for a science topic. Each lesson focuses on a Big Idea. Groups of lessons (called clusters) develop a Big Idea through a series of different experiences and discussions.

Lessons Follow a Consistent Sequence

- **Engage** – In this section of a lesson, the teacher introduces the topic. The goal is to briefly generate interest, activate prior knowledge, or link the day’s activities to what has come before.

- **Explore** – This is often (but not always) a hands-on exploration conducted in small groups. Students record their work in their Science Notebooks. Collaboration with peers is encouraged. Key materials are provided in the ExploraGear kit.

- **Reflect and Discuss** – In this important section, the teacher and students discuss what they observed, share ideas and data, and reflect on the day’s activities. This portion of the lesson brings the class back to the Big Idea.

You’ll find that while the lesson format is very consistent, students explore science content and the process of “doing science” in a large variety of ways.

You’ll also find that students LOVE the mix of active, hands-on, minds-on science.
Lessons at a Glance

Science Content: Big Ideas

The Human Body in Motion Unit concentrates on the following Big Ideas. Along with the scientific Habits of Mind discussed on pages 6–7, these concepts are reinforced throughout the unit. The lessons in which each Big Idea is introduced or is a major focus are indicated in parentheses.

Lessons

• To move, many parts of our bodies must work together.
  (Lessons 1–5, 8–10, 12)

• Muscles move our skeletons by pulling on bones that meet at joints. (Lessons 2–3)

• Nerves carry signals to our muscles to move parts of our body.
  (Lessons 4–5)

• Bones are made of unique cells important to movement.
  (Lesson 6)

• To produce energy and function properly, all cells need a constant supply of oxygen, nutrients, and water. (Lesson 6)

• Muscles are made of unique cells important to movement.
  (Lesson 7)

• To produce the energy needed for movement, muscle cells need a constant supply of oxygen, nutrients, and water.
  (Lesson 7–10)

• The human body is made up of many different types of cells. Each type of cell has unique characteristics for performing a specific “job.” (Lesson 11)

Skill Building Activities

• Paying attention to the way a particular book is laid out can assist reading comprehension. (Skill Building Activity “Reading Science Books”)

• Observation is a powerful tool for learning about something. Detailed and accurate descriptions of your observations help you communicate them to others. (Skill Building Activity “Observing and Describing”)

• Scientists plan and design fair tests so they can determine how the one variable being changed affects the results of an experiment. (Skill Building Activity “Designing a Fair Test”)
# Unit Summary

## Cluster 1: Mechanics of Movement  
*(Lessons 2–5)*

<table>
<thead>
<tr>
<th>Overview</th>
<th>The class focuses on three systems most directly involved in moving the body—the skeletal, muscular, and nervous systems. Students learn that muscles move at joints and that the design of these joints affects the ways various bones can move. They construct arm models to discover how the muscles that move the body often work in pairs. They discover that the nervous system controls the muscles that move the body.</th>
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</thead>
</table>
| **Science Content** | • To move, many parts of our bodies must work together.  
• Muscles move our skeletons by pulling on bones that meet at joints  
• Nerves carry signals to move parts of the body. |
| **Science Center** | • Use reference books to identify and label x-ray images of joints.  
• Create a "Joint" wall displaying pictures of joint-like connections found in everyday life.  
• Collect small items featuring joint-like connections.  
• Display the skeletal, muscular, and nervous system posters.  
• Provide reference books on the skeletal, muscular, and nervous systems.  
• Modify and refine limb models. |
| **Family Links** | • Identify ways to maintain our joints and keep them healthy throughout our lives.  
• Demonstrate and explain their limb models to three friends or family members.  
• Track how many times particular reflexes occur in one evening. |
| **Further Science Explorations** | • Revise a spiritual lyric using actual bone names.  
• Learn about scientists, doctors, and other professionals who deal with bones and muscles.  
• Use chicken wings to demonstrate the concept of antagonistic muscles.  
• Learn first aid guidelines for sprains and strains.  
• Explore the knee-jerk reflex and other common reflexes.  
• Discover how the nervous system controls body temperature.  
• Create a class cookbook with high-calcium recipes and have a calcium food feast.  
• Discover how muscle fatigue affects handwriting.  
• Research diseases of the joints, bones, muscles, and nervous system. |
| **Cross-Curricular Extensions** | **Language Arts**: Interview and report on someone suffering from arthritis. Relate the terms “antagonistic muscles” and “antagonist.” Read about people afflicted with conditions of the nervous system.  
**Mathematics**: Calculate the number of times an average person blinks each day.  
**Social Studies**: Present a report on the "Bone and Joint Decade." Locate the Achilles tendon and then read stories about the Trojan War featuring the Greek warrior Achilles.  
**Art**: Draw proportionally correct figures of the human body. |
### Cluster 2: Body Basics (Lessons 6–7, 11)

Students learn how the human body is “put together” or organized. They learn about the needs of cells, specifically bone cells and muscle cells, and gain an understanding of the structure of bones.

- The human body is made of many different types of cells.
- Bones and muscles are made of unique cells important for movement.
- To produce energy needed for movement and to function properly, all cells need a constant supply of oxygen, nutrients, and water.
- Each type of cell has unique characteristics for performing a specific job.

- Create a “Calcium” collage with pictures of foods that are high in calcium.
- Look for cookbooks featuring calcium-rich recipes.
- Provide books on the muscular system, fitness, and athletes.
- Use reference books to identify and label images of cells posted in the Science Center

- Use a nutritive value chart to identify foods that are high in calcium.
- Compare cells to the building parts of a familiar construction toy.

**Language Arts:** Write reports on famous athletes, their training, and accomplishments. Read select pages from *Cells Are Us* and *Enjoy Your Cells.*

**Mathematics:** Make calculations of data from Lesson 7’s exploration on muscle fatigue. Calculate how many years it would take to count to 50 trillion—the approximate number of cells in the human body. Calculate how many average-sized human cells would span the diameter of a pencil eraser.

**Social Studies:** Research discoveries relevant to cells during the Age of Enlightenment.

### Cluster 3: Supporting Active Muscle Cells (Lessons 1, 8–10, 12)

Students learn how three systems—the circulatory, respiratory, and digestive systems—support their muscles and bones. The circulatory system delivers oxygen and nutrient-rich blood that muscle cells need and carries away their waste. The respiratory system delivers oxygen to the blood and removes carbon dioxide waste from the blood. The digestive system takes in food, digests it, and passes its nutrients into the blood.

- To produce energy needed for movement, our muscle cells need a constant supply of oxygen, nutrients, and water.

- Create a pictorial “Human Body in Motion” wall.
- Look through books that cover the circulatory, respiratory, and digestive systems.
- Display the circulatory, respiratory, and digestive system posters.
- Contribute thoughts and discoveries recorded in journals to create a class book.

- Identify some conditions of the respiratory system that make it difficult to exercise.

- Determine the amount of time it takes the heart to return to a normal resting heart rate after exercising.
- Use a cardboard tube to listen to a partner’s heart beat.
- Investigate disease of the circulatory, respiratory, and digestive systems
- Create a lung model.
- Use index cards smeared with petroleum jelly to discover why it is important for our airways to filter the air we breathe.
- See how CPR and other first aid techniques are performed.

**Language Arts:** Create a “Motion” word bank. Create imagined diary entries of an individual engaged in a feat of endurance. Think of common terms or phrases that include the word *heart.* Create a newsletter on healthy eating. Write a descriptive essay on a memorable meal.

**Mathematics:** Make calculations of the data collected from Lesson 8’s exploration on heart rates. Calculate how many times our hearts beat and how many breaths we take in an hour, a day, a week, a month, a year, and 50 years.

**Social Studies:** Research the history of the first heart transplant, blood transfusion, artificial heart, and pacemaker. Learn about Dr. Charles Drew—the man who developed the concept of the blood bank. Research the history of underwater diving.

**Art:** Depict the human body in motion. View famous works of art that show the human body in motion.

**Music:** Demonstrate how controlled breathing is important for singing.

### Cross-Curricular Extensions

**Human Body in Motion | Unit Summary**
Lesson 4

How Our Muscles Know When to Move

A QUICK LOOK

Big Idea
To move, many parts of our bodies must work together. Nerves carry signals to our muscles to move parts of our body.

Overview
Students learn how the nervous system supports movement. They develop and test strategies using different senses to catch a ruler between their fingers. They think about how the brain receives information from the senses, makes decisions based on this information, and sends messages to muscles to bring about an appropriate response.

Process Skills
- Communicating
- Observing
- Describing
- Recording

Key Notes
For more information about the science content in this lesson, see the “Controlling Muscles” section of the Teacher Background Information on pages 254–261.
Standards and Benchmarks

As the students use different senses to help them catch a dropped ruler, they gain exposure to the Human Organism Benchmark 6C (Basic Functions): “The brain gets signals from all parts of the body telling what is going on there. The brain also sends signals to parts of the body to influence what they do.”

This lesson also supports Life Science Standard C (Structure and Function in Living Systems) as children focus on the nervous system: “The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.”

Lesson Goal

Discover that the senses, brain, and other parts of the nervous system work together to signal muscles to move.

Assessment Options

- Listen to the students during the synthesizing discussion and review the last question on page 16 of their science notebook. Do they recognize that the nerves carry signals to the muscles to move their bodies? Use criterion C of Rubric 2 to record their understanding.

- You might also consider having the students respond to the following scenario in the journal section of their science notebooks: “Jonathon was standing on the blacktop at school when he noticed a ball rolling straight toward him. He moved over to the side so the ball wouldn’t hit him. Explain how Jonathon’s feet received the instructions to move out of the way.”

- This lesson also provides the students with another opportunity to make detailed and accurate descriptions. Review their science notebook entries on pages 14–15 to see whether their skills are progressing. You can use the Observing and Describing checklist to record your observations.

Rubric 2: Mechanics of Movement

Checklist: Observing and Describing

Criteria:

A. Observations, descriptions and drawings are accurate; they reflect actual properties of objects.

B. Observations, descriptions, and drawings incorporate details.

C. Uses multiple perspectives and scales when making observations.
Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExploraGear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rulers</td>
<td>1 per pair</td>
<td>To test reaction times.</td>
</tr>
<tr>
<td>Classroom Supplies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ball, small and soft</td>
<td>1</td>
<td>For introductory discussion.</td>
</tr>
<tr>
<td>Curriculum Items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poster “The Nervous System and Movement”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Body in Motion Science Notebook, pages 13–16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Body in Motion Student Reference Book, pages 17–23 and 25–26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubric 2: Mechanics of Movement (optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checklist: Observing and Describing (optional)</td>
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Preparation

- Arrange the classroom so that pairs of students can work comfortably at desks or tables throughout the room. During the exploration, one student will be sitting at a desk or table while their partner stands and drops a ruler through their fingers.

- Locate books and other reference materials about the nervous system for the Science Center that students can use independently. See the Science Library and Web Links section on pages 42–47 for suggestions.

- Place the nervous system poster in the Science Center.

Using the Student Reference Book

After completing the lesson, assign pages 17–23 of the student reference book to reinforce how the senses, brain, and other parts of the nervous system work together to signal muscles to move.
Vocabulary

**brain** ................. The command center of the nervous system. Our brains receive information through our body’s nerves, make decisions based on this information, and then send out signals to certain body parts to follow instructions.

**nerve** ................. A thin, wire-like body part that carries information.

**nervous system** .... The organ system that includes the brain, spinal cord, sensory organs, and nerves.

**reaction** .............. A response to a change in the environment.

**sensory organ** ....... A body part associated with the senses (such as the eyes, ears, tongue, skin, and nose) that sends information about the external environment to the brain.

**spinal cord** ............ A bundle of nerves that extends from the brain down along the back. The spinal cord carries information from our brains to all parts of our body and from our body parts back to our brains.

Teaching the Lesson

Engage

**Introductory Discussion**

1. Assign students a familiar exercise they can perform briefly, such as jumping jacks. Afterwards, discuss how their muscles “knew” what to do. Guide the discussion to reach the conclusion that their muscles get the directions to move from their brains—they thought about how they wanted their bodies to move and their brains made it happen!

2. Toss a ball around the classroom. Let students practice catching it and tossing it to others. As they do this, have them think about the muscles they use to catch the ball. How do their muscles “know” when to respond to the thrown ball? What else besides the brain is involved? *(Students should recognize that their senses—primarily sight—helped them catch the ball.)*
3. Reflect on the two activities. Which one involved a reaction to something external (in the room around them)? (Tossing the ball.) Discuss further the concept of a “reaction” and the role played by the brain, senses, and muscles:
   - What is a reaction? (It’s the way we respond to something.)
   - What parts of our body help us react? (Our sensory organs prompt reactions.)
   - What are our five senses? (They include sight, hearing, touch, taste, and smell.)
   - Where does the information picked up by the senses go? (It goes to the brain.)
   - What are examples of information that senses might send to the brain?
   - How would the brain respond to this information? What muscles would be activated in the response?

4. Show the class the poster of the nervous system. Point out the main parts of the nervous system (brain, spinal cord, nerves, and sensory organs). Trace the path of information for several reactions (such as hearing a knock at the door or seeing an angry dog, etc.) to reinforce the basic sequence of events involved. Afterwards, challenge several students to trace the path of a reaction of their choosing. The path of information includes this sequence:
   - Various senses are used to pick up information from the environment.
   - Sensory organs send this information through nerves to the brain.
   - The brain makes a decision based on the information it received.
   - The brain sends directions through nerves back to various muscles to react.

5. Tell the students that today they will see firsthand how their bodies react with the help of their senses.
Explore

All Senses Go

The students demonstrate how they can catch a dropped ruler using just one of the following senses at a time: sight, hearing, or touch.

1. Divide the class into pairs at desks or tables and give each pair of students a ruler.

2. Refer the students to pages 13–16 of their science notebooks. As a class, review the directions before beginning the experiment. Consider using two students to demonstrate a possible setup for dropping and catching the ruler as illustrated in the following graphic.

3. Tell students to start exploring how they can react to a dropped ruler using a specific sense. Circulate around the room as students conduct their explorations. If students have trouble imagining strategies, guide them through the process with the following suggestions:

   - **Sense of sight:** The partner catching the ruler keeps their eyes open and does not touch the ruler until their partner drops it. The partner dropping the ruler does not speak.

   - **Sense of hearing:** The partner catching the ruler closes their eyes. The partner dropping the ruler gives a verbal signal when they release the ruler.

   - **Sense of touch:** The partner catching the ruler closes their eyes. The partner dropping the ruler doesn’t speak but touches the partner on the arm at the same moment they drop the ruler.
Reflect and Discuss

Sharing

1. Give the sets of partners time to share their strategies and demonstrate them to the class.

2. Let volunteers explain how they caught the ruler using a specific strategy by tracing the pathway on the nervous system poster. (First, I saw the ruler drop, then my eyes sent a message to my brain through nerves, then my brain sent a message through nerves to my hand muscles, then my muscles moved my bones, and my bones caused my fingers to close around the ruler.)

Ongoing Learning

Science Center

- Provide a variety of books containing information on the nervous system for students who are interested in learning more.

- Encourage the students to write questions they have about the nervous system on self-sticking notes and place them on the nervous system poster. Review the questions periodically to see if any can be answered as they progress through the nervous system lessons.

Big Idea

To move, many parts of our bodies must work together. Nerves carry signals to our muscles to move parts of our body.

Materials: Books on the nervous system, nervous system poster, self-sticking notes
Extending the Lesson

Further Science Explorations

Researching Nervous System Diseases

Have children research diseases of the nervous system, particularly those that involve neuromuscular function such as amyotrophic lateral sclerosis (Lou Gehrig’s disease), Parkinson’s disease, polio, multiple sclerosis, muscular dystrophy, and cerebral palsy. Several of these diseases are described on pages 25–26 of the student reference book.

Exploring the Distribution of Nerves

Use a bobby pin or unfolded paper clip shaped into a “U” to demonstrate on a volunteer how there are more sensory receptors—the part of nerve cells involved in sensory perception—in one’s fingers than higher up the arm. This type of test, also known as a two-point discrimination test, determines whether a region being tested is well enough supplied with sensory receptors to feel both points of a bobby pin or paper clip. Students will find that certain regions, such as their fingertips, have a rich supply of sensory receptors (so both points can be felt), while others, such as their upper arm, are poorly supplied (meaning only one point can be felt.)

1. Ask for a student volunteer. Instruct the student to look away, or blindfold the student.

2. Spread the tips of the bobby pin or paper clip far apart (approximately 1 cm) and randomly alternate between touching with one or two points. Begin at the student’s middle finger and slowly move up the hand and then arm. Repeat the procedure with the tips spread a half-centimeter apart.

3. Have the student tell the class how many tips he or she feels. The class should keep track of the number of mistakes the student makes at each part of the arm.
4. Introduce the class to sensory receptors—special nerve cells that are concentrated in areas that are sensitive to touch, pressure, temperature, and pain such as the fingers, tongue, and lips.

5. Promote a discussion about the demonstration:
   - Why was it easier for the student to feel two distinct tips when they were placed on the finger and more difficult as they moved up the arm? *(There are more sensory receptors in the fingertips than the upper arm.)*
   - Why is it advantageous to have more sensory receptors in our fingers? *(We rely on our hands to provide us with a wealth of information about the external environment. Having a large number of sensory receptors in our fingers makes them more sensitive to outside stimuli and enables the nervous system to detect even the slightest touch.)*

**Language Arts Extension**

Read about people afflicted with conditions of the nervous system such as Franklin Delano Roosevelt, Lou Gehrig, Stephen W. Hawking, Helen Keller, and Christopher Reeves.
Planning Ahead

For Lesson 5

During the exploration, students gently toss paper balls at their partner’s face, while their partner protects his or her eyes with an overhead transparency sheet. If you are concerned about classroom management during this activity, you could arrange for parent volunteers to observe and assist.

For Lesson 6

• You need clean, cooked chicken bones for the sensory observation. Refer to the Teacher Directions “Preparing Chicken Bones” on page 124 of Lesson 6 for detailed instructions and preparation time requirements.

• You also need to obtain beef soup bones from the grocery store or butcher for the exploration. See the Preparation section on page 118 for more information.
Teacher Background Information

This section provides detailed descriptions of the structure of the human body, the mechanics of movement, and the systems of the body involved in movement. This material is intended to give you background information you may need as you teach the unit; however, it is not necessary to master or present all the content offered. The Key Note section of each lesson indicates which portion to review prior to teaching the lesson. A quick read-through before teaching the unit—to get the big picture—followed by more focused readings before each lesson should help you guide the children in their discoveries about how their bodies move.

Introduction

To move, many parts of our bodies must work together. This overarching concept, or “big idea,” is the thread that weaves through the Human Body in Motion Unit. Explorations of the muscular, skeletal, circulatory, respiratory, digestive, and nervous systems reveal the vital role played by each system in bringing about movement and highlight the interconnectedness of the body’s systems. Some of these systems are directly involved in the mechanics of movement; others support or control the cells, tissues, and organs of these systems. Regardless of their function, all parts are essential and depend on each other. An understanding of how movement occurs in the human body leads to an understanding of how the body operates in general—with every part playing a role to ensure that we cannot only move, but also think, feel, heal, stay warm, keep cool, bear children, fight disease, grow, and do nearly everything else we need to do to survive and thrive.
Controlling Muscles

Nervous System

Skeletal muscles do not contract on their own to move the body’s bones—they require input from the nervous system. The nervous system is the incredibly complex system that makes much of the communication between body parts possible. The nervous system includes the brain, spinal cord, and a huge network of nerves that extend throughout the body. It controls the body’s skeletal muscles, smooth muscles, and many of its glands (tissues that secrete substances such as hormones and enzymes), controlling almost every aspect of life: balance, posture, smell, taste, sight, touch, hearing, heart rate, blood pressure, breathing rate, body temperature, urination, defecation, hormone release, thoughts, memory, hunger, thirst, and more. This unit focuses on aspects of the nervous system directly involved in movement of the human body.

The Brain

The brain is the body’s “command central.” It receives information sent through the body’s nerve network, makes decisions based on this information, and sends instructions out to the specific body parts that will carry them out. Despite its formidable role, the brain of an average adult weighs only 1300–1400 grams (about 3 pounds). It is composed of nervous tissue and is protected by the skull.

The brain receives information from both internal and external sources. The five senses—sight, smell, hearing, touch, and taste—are its major source of information about the external world. The brain also receives information about the internal environment from a variety of sensors, monitoring such things as blood pressure, carbon dioxide levels in the blood, body temperature, and the position of bones and joints.
The brain takes input from all of these sources and makes “decisions” based on it. For example, the brain may receive information from the senses of an approaching danger, make a decision to move the body from harm’s way, and send signals out to the skeletal muscles that will carry out this decision.

**Nerves**

Like all parts of the nervous system, the brain communicates through special cells known as neurons. Neurons can be thought of as “wire-like” cells—electrical signals called nerve impulses can travel through them. Neurons vary in length, with some less than a millimeter long, and others reaching over a meter in length.

Neurons have tentacle-like extensions at both ends, allowing them to make thousands of connections with other cells. The extensions of nerve cells don’t actually touch connecting cells, but are close
enough so that chemicals called **neurotransmitters** can travel across the small gap between them—known as a **synapse**—to keep the “message” going. Nerve impulses (signals) travel in only one direction through a neuron, with one end of the neuron receiving signals, while the other end transmits them.

Like the wires in a telephone cable, neurons are bundled together into thin, cable-like **nerves**. These nerves form a virtual “communication network” within the body. Messages are transmitted within nerves from one neuron to the next until a final destination is reached. Transmissions happen quickly, at speeds ranging from 0.5 meters per second to 120 meters per second (268 miles per hour).

Three types of neurons construct the body’s nerves:

- **Sensory neurons**—Carry information from the senses to the **central nervous system** (brain and spinal cord).

- **Motor neurons**—Bring information from the central nervous system to the muscles (and glands). When muscles receive signals from motor nerves they contract. When these signals are no longer present, muscles relax and lengthen.

- **Association neurons**—Found only in the spinal cord and brain, often connecting sensory neurons to motor neurons. Association neurons are also known as connector neurons or interneurons.
The Spinal Cord

The **spinal cord** is the “main highway” to and from the brain. Nerves leading to the brain, as well as nerves leading away from the brain, meet and are bundled together there in one large, rope-like “cord.”
It is very important to protect the nerves that make up the spinal cord since information to the brain travels through them, and they are the conduit for carrying out the brain's decisions. Fortunately, the spinal cord is protected by a part of the skeleton known as the **vertebral column** (also known as the spinal column). The vertebral column is composed of thirty-three rings of bone called **vertebrae** that surround and protect the spinal cord. **Gliding joints** between most of the vertebrae make it possible to move the back. Protection of the spinal cord is limited, though; serious accidents and infections can sever, bruise, or compress the spinal cord, often leading to partial or complete paralysis.

**Reaction Time**

Reaction time is the time it takes to react or respond to something. In Lesson 4, students test their **reaction time** and experience firsthand the communication relay occurring in their bodies—from sensory nerves to their brains, from their brains to motor nerves, and, finally, from their motor nerves to their muscles. Reacting to a ruler being dropped unannounced between their fingers requires the following sequence:

1. A student's senses detect the ruler being dropped.
2. The senses send a message through sensory nerves to their brain letting them know that the ruler has dropped.
3. Their brain makes the decision to grab the ruler.
4. The brain sends a message through motor nerves to the muscles of their hand "telling" them to pull on the bones involved in grabbing.
5. Their bones move to grab the ruler.
Reaction time is critical for survival since it facilitates quick responses to danger—for example, swerving on a bike to avoid hitting something. It is also helpful in fast-paced activities such as athletics—blocking a kick or scoring a goal, for example. Alcohol, sleep deprivation, and certain drugs can decrease reaction times, making it hard to respond quickly to dangerous situations.

**Reflexes**

Sometimes information from the senses reaches the spinal cord and causes an almost instantaneous response in specific muscles. The brain is not involved in these responses—the message travels straight from the senses to the spinal cord and back out to the muscles. This happens, for example, if you accidentally place your hand on a hot stove. You quickly remove your hand from the stove before your brain is even aware of what has happened. At other times, such as when you blink reflexively, a part of the brain is actually involved, though this part, called the brain stem, is not under conscious control. These automatic responses, typically thought of as protective in nature, are called reflexes. Since a reflex does not require a conscious decision by the brain, it can happen more quickly. Speed is crucial, since the longer your hand remains on the stove, the more likely it is that your skin cells will be damaged or burned.

The following are some common reflexes that students may wonder about. They explore two of these reflexes, the pupillary reflex and the blink reflex, in Lesson 5.

- **Sneezing reflex**—The spasmodic expulsion of air from the nose that occurs when irritants and allergens need to be cleared from the nasal air passages. The sneezing reflex keeps airways free of potentially harmful foreign material.

- **Coughing reflex**—The spasmodic expulsion of air from the mouth that occurs when irritants or excessive mucus in airways needs to be expelled. The coughing reflex also keeps airways free of potentially harmful foreign material.

- **Shivering reflex**—The uncontrollable shaking of the body that occurs in response to cold (and fear). Shivering helps warm up the body. In order to shiver, skeletal muscles must contract. Contraction requires energy, and energy production releases heat. The heat that is released warms up the body.
• **Blink reflex**—The automatic, rapid closure of the eyelids that occurs to protect the eyes. We blink constantly—about 12 times a minute—to spread lubricating tears over our eyes. We also blink when there is an irritant in the eye, or when we detect something heading directly toward our face. In Lesson 5, students work in pairs to trigger a blink reflex in each other.

![Blink reflex](image)

• **Pupillary reflex**—The change in pupil size that occurs as the level of light changes. The size of our pupils decreases as the level of light increases, and increases as the level of light decreases. The pupil is the eye’s aperture; it controls the amount of light that can enter the eye. The pupillary reflex keeps out excessive light that could damage the eye.

• **Yawning reflex**—The wide-mouthed intake of air that occurs when sensors in the brain detect too much carbon dioxide in the blood. A yawn makes the muscles of the mouth and throat contract and forces the mouth wide open, allowing carbon dioxide to be expelled and a large amount of oxygen-rich air to be taken in.

• **Startle reflex**—The automatic flinch or jerk that occurs in response to a sudden loud noise. The startle reflex mobilizes individuals to protect themselves from serious blows or impacts to the body.

• **Knee-jerk reflex**—The automatic kick of the leg that occurs when a person is tapped (usually by a doctor’s hammer) just below their knee cap. The knee-jerk reflex is a muscle stretch reflex that makes it possible to automatically adjust one’s standing position without having to think about it.
The Science Notebook is a student’s ongoing record of his or her work as a scientist. Each Science Companion module for grades 1-6 has a Student Science Notebook tailored for that module.

Student Science Notebooks are age-appropriate. Notebooks for younger grades contain minimal text and opportunities to draw instead of write, so all students can participate and shine as scientists. For older grades, Student Science Notebooks utilize students’ developing skills: they contain procedures for students to follow, and provide support for controlling variables as students develop their own experiments—all leading to increased independence.

All the Student Science Notebooks develop literacy and support mathematics skills. Students apply these disciplines in the highly motivating process of doing science.
Hello Scientist,

Welcome to the Human Body in Motion unit. This notebook is your place to record discoveries about the human body and how it moves. Like all scientists, you will wonder, think, try, observe, record, and discover. As you do so, it is important to keep a record of your work. Your questions, investigations, answers, and reflections can then be shared and returned to at any time.

We know much about science, but there is much more to be learned. Your contributions start here.

Enjoy, take pride in, and share your discoveries—science depends on scientists like you!
**All Senses Go**

**Introduction**

**Purpose:** Develop and test different strategies that use only one sense at a time—sight, hearing, or touch—to catch a dropped ruler.

**Materials:** One ruler

**Procedure:**
1. Focus on only one sense at a time.
2. Write down your strategies for catching the ruler and then test it on both yourself and your partner.
3. Have one partner drop the ruler while the other partner catches it using any strategy you decided to try. The only rule is that the “catching” partner can’t touch the ruler until it is dropped.
4. Change your strategy if you are having problems with your first idea. Make sure you describe the changes in the strategies areas on pages 14—15.
All Senses Go

Strategies

**Sense of Sight:** Use the space below to explain or draw how you and your partner used only the sense of sight to catch the ruler.

**Sense of Hearing:** Use the space below to explain or draw how you and your partner used only the sense of hearing to catch the ruler.
All Senses Go

Strategies

**Sense of Touch:** Use the space below to explain or draw how you and your partner used only the sense of touch to catch the ruler.
All Senses Go

Analysis: Making Sense of the Observations

1. Was it more difficult to catch the ruler using one of the senses as compared to the other? Explain.

2. How could you use only the sense of smell to catch the ruler? The sense of taste?

3. Explain how your senses, nerves, brain, and muscles in your fingers helped you catch the ruler for one of the senses explored. Use pages 17–23 of your student reference book to help you.
Human Body in Motion Journal
Hola Científico,

Bienvenido a la unidad del Cuerpo Humano en Movimiento. Ésta libreta es el lugar donde escribirás los descubrimientos del cuerpo humano y cómo se mueve. Como todos los científicos, tendrás curiosidad por saber, pensarás, observarás, documentarás, y descubrirás. Al hacer eso, es importante guardar las anotaciones de tu trabajo. Tus preguntas, investigaciones, respuestas, y reflexiones podrán ser compartidas y revisadas en cualquier tiempo.

Nosotros sabemos mucho sobre la ciencia, pero aún hay mucho más que aprender. Tus contribuciones empiezan aquí.

Disfruta, orgullécete, y comparte tus descubrimientos—la ciencia depende de científicos como tú!

Hola Científico
Todos Los Sentidos Van

Introducción

**Objective**: Desarrollar y probar estrategias diferentes que usan solamente un sentido a la vez, la vista, el oído, y el tacto para agarrar una regla que se cae.

**Materiales**: Una regla

**Procedimiento**:  
1. Enfócate en un solo sentido a la vez.

2. Escribe tus estrategias para agarrar la regla y después haz la prueba contigo y con tu compañero.

3. Haz que uno de tus compañeros tiren la regla mientras el otro la agarra usando cualquier estrategia que decidiste probar. La única regla es que la persona que le toca agarrar la regla no podrá hacerlo hasta que la regla ya haya sido tirada en el aire.

Todos Los Sentidos Van

Estrategias

**Sentido de la Vista:** Usa el espacio que está abajo para explicar o dibujar cómo tu y tu compañero usaron solo el sentido de la vista para agarrar la regla.

**Sentido de Oído:** Usa el espacio que está abajo para explicar o dibujar cómo tu y tu compañero usaron solo el sentido del oído para agarrar la regla.
Todos Los Sentidos Van

Estrategias

**Sentido del Tacto:** Usa el espacio que está abajo para explicar o dibujar cómo tu y tu compañero usaron solo el sentido del tacto para agarrar la regla.
Todos Los Sentidos Van

Análisis: Interpretando de las Observaciones

1. ¿Fue más difícil agarrar la regla usando uno de los sentidos comparado con los otros? Explica.

2. ¿Cómo pudiste usar solo el sentido de olfato para agarrar la regla? ¿El sentido del gusto?

3. Explica cómo tus sentidos, nervios, cerebro, y músculos en tus dedos te ayudan agarrar la regla con uno de los sentidos explorados. Usa las páginas 17-23 de tu libro referencias para ayudarte.
Diario
Cuerpo Humano en Movimiento
Science Companion supplies a variety of tools to assess children “in-the-act” of doing science, as well as evaluate their understanding and proficiency as they finish clusters of lessons.

**In the Teacher Lesson Manual:**
- Big Ideas and lesson goals are clearly outlined on each lesson’s Quick Look pages.
- Assessment Options in each lesson suggest where pre-assessment and formative assessment can occur in the context of a lesson.

**In the Assessment Book:**
- **Rubrics** are supplied to score understanding of science content. The criteria in each rubric are derived from a module’s Big Ideas and lesson goals.
- **Opportunities Overviews** show where each criteria can be evaluated during pre-assessment, formative assessment and summative assessment.
- **Checklists and Self-Assessments** list criteria that are related to science process skills.
- **Performance Tasks** are used for summative assessment to evaluate students’ understanding of Big Ideas and lesson goals. The Assessment Book supplies evaluation guidelines and blank masters for each Performance Task.
- **Quick Checks**—another summative assessment tool—employ a multiple-choice format.

**The Science Notebook Teacher Guide:**
A final assessment tool is the Science Notebook Teacher Guide. This teacher edition of the Student Science Notebook is annotated to help teachers know what to expect in from children in their Student Science Notebooks.
## Rubric 2: Mechanics of Movement

<table>
<thead>
<tr>
<th></th>
<th>Criterion A</th>
<th>Criterion B</th>
<th>Criterion C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4 - Exceeds Expectations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knows content beyond the level presented in the lessons.</td>
<td>A skeleton moves at its joints. There are different kinds of joints in the human body.</td>
<td>Muscles move the bones they are attached to by pulling on them.</td>
<td>Nerves carry signals to the muscles to move our bones.</td>
</tr>
<tr>
<td><strong>3 - Secure (Meets Expectations)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knows content at the level presented in the lessons and does not exhibit misconceptions.</td>
<td>Recognizes that a skeleton moves at its joints and that there are different types of joints in the human body.</td>
<td>Recognizes that muscles move bones by pulling on them and work in pairs to move limb bones.</td>
<td>Recognizes nerves carry signals to the muscles to move bones either through a reflex or an intentional reaction.</td>
</tr>
<tr>
<td><strong>2 - Developing (Approaches Expectations)</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Shows an increasing competency with lesson content.</td>
<td>Understands that a skeleton moves at its joints, but does not recognize that there are different types of joints in the human body.</td>
<td>Has an incomplete understanding of how muscles move bones.</td>
<td>Has an incomplete understanding of how nerves carry signals to the muscles to move bones.</td>
</tr>
<tr>
<td><strong>1 - Beginning</strong></td>
<td>Does not understand that a skeleton moves at its joints or that there are different kinds of joints in the human body.</td>
<td>Does not understand that muscles move bones by pulling on them.</td>
<td>Does not understand that nerves carry signals to the muscles to move bones.</td>
</tr>
</tbody>
</table>
Opportunities Overview: Mechanics of Movement

This table highlights opportunities to assess the criteria on Rubric 2: Mechanics of Movement. It does not include every assessment opportunity; feel free to select or devise other ways to assess various criteria.

<table>
<thead>
<tr>
<th>Criterion A (Lesson 2)</th>
<th>Criterion B (Lesson 3)</th>
<th>Criterion C (Lessons 4 and 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre and Formative Opportunities</strong></td>
<td><strong>Performance Tasks</strong></td>
<td><strong>Summative Opportunities</strong></td>
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<tr>
<td>Lesson 2:</td>
<td>Lesson 3:</td>
<td>Lesson 4:</td>
</tr>
<tr>
<td>- Journal writing</td>
<td>- Introductory discussion</td>
<td>- Sharing discussion</td>
</tr>
<tr>
<td>- Introductory discussion</td>
<td>- Reflective discussions</td>
<td>- Science notebook page 16</td>
</tr>
<tr>
<td>- Sharing discussion</td>
<td>- Science notebook pages 9-12</td>
<td>Lesson 5:</td>
</tr>
<tr>
<td>- Science notebook page 7</td>
<td></td>
<td>- Journal writing</td>
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<tr>
<td></td>
<td></td>
<td>- Sensory observation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Synthesizing discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Science notebook page 18</td>
</tr>
</tbody>
</table>

**Performance Tasks**

- **Mechanics of Movement Cluster**
  - A Trip to the Natural History Museum, page 32
  - The Soccer game, page 35
- **Unit Assessment**
  - Working Together, pages 39-40

**Summative Opportunities**

- **Mechanics of Movement Cluster**
  - A Trip to the Natural History Museum, page 32
  - The Soccer game, page 35
- **Unit Assessment**
  - Working Together, pages 39-40

**Quick Check Items**

- **Mechanics of Movement Cluster**
  - Pages 44 45: items 1 4
- **Mechanics of Movement Cluster**
  - Page 45: item 5
- **Mechanics of Movement Cluster**
  - Pages 45-46: items 6 9

Opportunities Overviews show where ongoing and summative assessment can occur for each criteria.
Checklist: Observing and Describing
Teacher Assessment
(Lessons 1, 3 4, and 6)

Determine whether the following skills are evident as the student makes observations and descriptions. You might assign one point for each criterion that the student demonstrates. You can add specific observations or comments in the space below each criterion.

Name  Date

Criteria:

A. Observations, descriptions and drawings are accurate; they reflect actual properties or events.

B. Observations, descriptions, and drawings incorporate details.

C. Uses multiple perspectives and senses when making observations.
Self-Assessment: Observing and Describing

Think about your observations, descriptions and scientific drawings. Answer the following questions.

1. Do you make careful observations?

   Always   Sometimes   Seldom

2. How much detail do you include in your observations, drawings or descriptions?

   A lot of detail   Some detail   Very little detail

   Give some examples of when you included details in your observations:

3. Do you use more than one sense when you make observations?

   Always   Sometimes   Seldom

   Give some examples of when you used different senses in your observations:
On Your Mark, Get Set, Go!
Mechanics of Movement Cluster (Lessons 2-5)

Teacher Note:
Use this assessment after teaching Lesson 4.

Look carefully at the picture and notice that the numbers show the steps that need to happen for the girl to start running the race. Describe what happens at each step.

Step 1: How are the ears involved?

The ears hear the person saying, “On your mark, get set, GO!”

Step 2: How are the nerves between the ears and the brain involved?

The nerves carry the signal from the ear to the brain.

Step 3: How is the brain involved?

The brain receives the signal from the ears and makes a decision about what to do.

Step 4: How are the nerves between the brain and the leg muscles involved?

The nerves carry the directions from the brain to the leg muscles.

Step 5: How are the muscles involved?

The muscles receive the information from the brain and pull on the bones causing the girl to start the race.
4. (Lesson 2) Which type of joint allows you to move it in all directions?
   a. pivot joint
   b. ball and socket joint
   c. hinge joint

5. (Lesson 3) True or False? If false, rewrite the statement to make it true.
   a. When muscle cells contract, they lengthen. **false**
      
      *When muscles cells contract, they shorten.*

   b. The muscles of your long bones work in pairs (two at a time) to move your limbs. **true**

   c. Muscles can push bones. **false**
      
      *Muscles pull bones.*

6. (Lesson 4) How do you catch a falling ruler? Number the steps from 1 to 5 in the order they occur.

   My muscles move my bones. 4
   My eyes see the ruler drop. 1
   My brain sends a message through my nerves to my hand muscles. 3
   My eyes send a message through my nerves to my brain. 2
   The bones in my fingers close around the ruler. 5
7. (Lesson 4) List your five senses:

- taste
- touch
- sight
- hearing
- smell

8. (Lesson 5) Label the following movements as a reflex or an intentional reaction:

- shivering           reflex
- catching a ruler    intentional reaction
- blinking            reflex
- answering a phone   intentional reaction

9. (Lesson 5) Sneezing is a reflex because:

a. You decide when you want to sneeze.

b. It happens without you having to think about it.

c. You can stop a sneeze if you choose to.
The eyes see the soccer ball approaching.

The brain rapidly “fires” out a set of messages. The first message travels through nerves that extend through the spinal cord and out to the muscles that bend the leg. The muscles contract and the leg bends.

The eyes send a message through the optical nerve to the brain letting it know that the soccer ball is yours.

The second message goes out to the muscles that straighten the leg. These muscles now contract and the leg straightens—sending the ball flying towards the goal!

Where Nerve Cells and Muscle Cells Meet

The end of a nerve cell (the branched structure) is sending the message to contract to a group of muscle cells.
The Student Reference Books provide another avenue for students to explore science content. Topics are directly related to each module’s Big Ideas.

Reading the books, students can verify and extend what they’ve learned through hands-on exploration. Rich graphics in each book help students extend classroom experiences into real-world contexts.

In addition, the books contain color-coded sections about the history of science and technology. Sections such as “People Doing Science” tell about pivotal scientists of the past, and also describe work that different kinds of scientists conduct in the present. “Technology and Inventions” sections explore the ways that advances in technology have led to new scientific exploration as tools improved, and how scientific discoveries have been applied by human technology.

The spirit of inquiry.
An invitation into curiosity.
The tools for success.

ScienceCompanion

www.sciencecompanion.com
How Your Nervous System Works

You see a mouth-watering chocolate chip cookie. It smells so good! How do you control the muscles of your hands and arms so that you can grab that cookie and get it to your mouth? How do you get your jaw to move so you can devour it? To grab a cookie and eat it—or make any other movement—you need your nervous system.

The nervous system includes the **brain**, **spinal cord**, and a huge network of **nerves** that extend throughout your body.
Your Brain—Command Central

Your brain is the control center for your body. It gets information (sent through your nerves) about what’s going on inside and outside your body. It uses this information to make decisions that keep your body running as it should.

Once it makes a decision, your brain sends out instructions to the body parts that will carry it out. Remember the cookie? You see it. Your brain gets information about its yummy smell. Your brain also gets information that you’re hungry. So your brain sends out instructions to the muscles in your arm and hand so you can grab it!

Your Senses—Providing Information

Your brain gets most of its information from your five senses: sight, smell, hearing, touch, and taste. For example, the first information your brain receives about that freshly baked cookie might be about its smell or the way it looks. Later, if you’re lucky, your brain might get information about how it tastes.
Each of your senses gives you important information. For example:

- Your sense of **sight** might let you see that a car is approaching so you can get out of the way. Or it might guide you as you use a tweezers to pull out a splinter.
- Your sense of **smell** helps you recognize when something is burning.
- Through your sense of **hearing**, you know when a fire alarm is ringing or a baby is crying.
- Your sense of **touch** lets you know when bathwater is hot or when a bug is crawling up your leg!
- And your sense of **taste** lets you enjoy your favorite meal.

**Your Nerves—Sending the Messages**

A network of nerves goes from your brain to all parts of your body. Information travels all over that network, from your senses to your brain and back to your body parts, including your muscles. Your nerves send messages to and from your brain at incredibly fast speeds. Once your brain decides what to do, it sends messages back to your muscles through your nerves.

This network is constantly sending messages to keep you safe and healthy and get you where you want to go.

---

**Human Body Facts**

- Humans tend to depend most on our sense of sight. For many animals, their sense of smell is more important than their sense of sight.
- With your sense of smell, you can tell the difference between thousands of different odors.
- Pain is your body’s way of protecting itself, through your sense of touch. When you feel pain, you get the message to stop doing something that hurts.
Your spinal cord—the main pathway
messages travel on

Your spinal cord is the main pathway to and from your brain. Nerves going to the brain, and nerves going away from the brain, are part of it. Nerves from your arms, legs, and other parts of your body send messages through it. All the nerves that meet here are bundled together as one large, rope-like “cord” that goes up and down your back inside your spine.

If the nerves that make up the spinal cord are severely damaged, your brain cannot receive or send information. Fortunately, your spinal cord is protected by a part of your skeleton known as the vertebral column, or spinal column. This protection is limited, though. Diving accidents and serious falls, among other things, can damage the spinal cord. When someone injures their spinal cord, they can become partly or completely paralyzed, meaning they cannot move certain parts of their body. The muscles of the arms and legs are fine but, without the message to “move” from the brain, they can’t move the body’s limbs.

How do all the parts of your nervous system work together?

What does the brain do with the information it receives about a cookie? That part depends on a lot of different things. Are you hungry? Have you eaten dinner yet? Is it the last cookie? Is the cookie yours or does it belong to someone else? Your brain considers all this information.

If you decide to eat the cookie, your brain sends out messages down the spinal cord to the muscles of your arm and hand.
These messages “tell” the muscles to contract. This moves the bones in your arm so you can grab the cookie and put it in your mouth. Yum!

Think About It!

Look at the spinal cord in this picture. What parts of your body would you be unable to move if your spinal cord was damaged at the neck? What if it was cut below the chest?
Reaction Time

In science class you tested your reaction time—the time it takes for you to react to something. You saw how your senses, brain, and muscles all worked together to help you catch a ruler that was dropped between your fingers.

Here’s what took place between the time the ruler was dropped and the time you caught it:

1. Your eyes saw the ruler being dropped.

2. They sent a message to your brain. Then your brain made a decision to grab the ruler.

3. Your brain sent a message to your hand muscles, through your nerves, “telling” them to contract and pull on your bones.

4. Your bones moved to grab the ruler.
Having quick reaction times can keep you safe from harm. For example, reacting quickly can help you avoid hitting something by swerving (turning sharply) on your bike.

Quick reaction times can also help you when you play sports. Have you ever moved quickly to stop someone from making a goal, caught a ball someone threw suddenly, or blocked a kick?

**Health Connection**
Alcohol, certain drugs, and lack of sleep can increase reaction times, so it takes longer to respond to dangerous situations. In some cases, this can be a matter of life and death—when someone is driving a car, for instance.
Moving Without Thinking About It—Reflexes

Sometimes information from your senses reaches the spinal cord and causes an almost instant response in your muscles—before you even know what has happened. These messages don't go to your brain. They travel straight from your senses to your spinal cord and back out to your muscles.

**Human Body Fact**

Babies can’t make many controlled movements, but they have lots of reflexes. For example, if you touch a baby’s cheek, they will automatically turn their head to the side. Scientists believe they do this to search for food. These reflexes disappear as babies grow and are able to control their movements.

These automatic responses—called reflexes—protect your body from harm. For example, if you touch a hot stove, you’re likely to remove your hand before your brain is even aware of what has happened. Since the response happens without a decision by the brain, it can happen very quickly. Speed is important, since the longer your hand remains on the stove, the more likely your skin is to be burned.

**Think About It!**

Did you know that the size of your pupils gets smaller when the amount of light in a room increases? Why do you think this happens? Is this something you think about or does it happen automatically?
Diseases and Other Problems of the Nervous System

Many people have diseases and conditions that affect their nerves and muscles. Think about how much harder it might be to do some of your daily activities if you had one of these diseases.

**Muscular dystrophy** is a group of inherited (passed on from your parents) diseases. Over time, this disease weakens a person’s voluntary muscles—the muscles you can control. In one form of muscular dystrophy called Duchenne’s muscular dystrophy, people don’t have enough of a substance that muscles need (called dystrophin). Sometimes they don’t have any dystrophin at all in their body. Without it, a person’s muscles become weaker and weaker. First, the muscles in the arms, legs, and trunk weaken. Later, a person’s heart and “breathing” muscles are affected. Duchenne’s muscular dystrophy, or DMD, begins in young children (usually boys) ages two to six. It is rare for someone with DMD to survive beyond their early 30s.

**ALS (Lou Gehrig’s Disease)** is a disease that weakens a person’s muscles until they no longer work. ALS slowly damages the nerves that control muscles. Over time, as the nerves are destroyed, the muscles they control become weaker and weaker. Eventually, the muscles become paralyzed, making it impossible to walk, talk, swallow, and eventually breathe. People with ALS usually only live three to five years after they find out they have it. In most cases, the cause of ALS is unknown.

**Parkinson’s disease** is a brain disorder that leads to uncontrolled shaking and other movement problems. It occurs when the part of the brain involved in voluntary movement—movements you control—doesn’t work properly. Normally, this part of the brain produces a substance called dopamine that helps
your muscles move smoothly. People who don’t have dopamine can have tremors (shaking), stiffness, poor balance, and a shuffling walk. This makes it hard to do daily activities such as eating, writing, and talking. People don’t usually get Parkinson’s disease until they are at least 65 years old.

**Cerebral palsy** is a chronic (life-long) condition that occurs when the parts of an infant’s brain that control movement are permanently damaged, either before or soon after birth. Children with cerebral palsy are often unable to sit, stand, walk, talk, write, eat, or play like other children.

**People Doing Science**

**Stephen Hawking** is a scientist who has studied many things. He is best known for his theories (ideas) about how the universe began. He has been called the most brilliant scientist since Albert Einstein.

Hawking has lived with ALS for over thirty years. He cannot move much of his body and cannot even speak (his vocal cords were damaged in an operation). In fact, he can only use two fingers in his right hand. Still, he has written a best-selling book and gives sold-out lectures. How does he do it? He “talks” through a computer “communicator” on his wheelchair. He presses a switch to choose words from lists and make sentences. Then the computer turns these words into speech, so Hawking can give lectures, share his research, and “talk” with his family and friends.
ExploraGear® Items

The ExploraGear® provides all of the hard-to-find, hands-on materials needed to effectively implement a Science Companion module. This kit of non-consumable and consumable items is your go-to place for the tools needed to teach inquiry science. The authors of Science Companion carefully developed the curriculum so that the ExploraGear® items are not overwhelming and unfamiliar, but filled with the most essential, high quality items needed to engage students in a rich, interactive, inquiry science experience.
Science Companion uses the “I Wonder” Circle to help students reflect on how they (and other scientists!) do science.

I Wonder: notice, ask questions, state problems
I Think: consider, gather information, predict
I Try: experiment, model, test ideas, repeat
I Observe: watch, examine, measure
I Record: record data, organize, describe, classify, graph, draw
I Discover: look for patterns, interpret, reflect, conclude, communicate discoveries
What’s in Science Companion?

For the Teacher

- Teacher Masters
- Assessment
- Student Notebook
- Transparencies and Posters
- I Wonder Circle® Poster in English & Spanish

For the Classroom

- Great Classroom Support
- Reference Materials
  - Teacher Reference Materials
  - Lesson 0
- Visual Aids
- Teacher Guide
- Teacher Lesson Manual
- Assessment Book

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I Discover...

What’s in Science Companion?

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Student Science Notebook
English & Spanish

Great Curriculum Support

Student Reference Book
(Levels 4-6)

ExploraGear® Kit

Trade Books
(Levels K-3)

Curriculum now available in print and digital!

ScienceCompanion

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Collecting and Examining Life
From collecting animal tracks to dissecting flowers, children deepen their understanding of what makes something alive as well as exploring the similarities and differences among living things.

Rainbows, Color, and Light
Through experiments with prisms, mirrors, bubbles, water, sunlight, and flashlights, children bring rainbow effects into their classroom and onto the playground. They also mix colors to observe that colored light produces different results than mixing pigmented paints, dough, or water.

Solids, Liquids, and Gases
While deciding what makes a solid a solid, watching water disappear from an open cup, or comparing various liquids, children find the value in asking questions and probing the world around them for meaningful answers.

Motion
Through activities that engage children’s bodies and minds, children move their own bodies in various ways to learn about motion, as well as build ramps, roll toy cars, drop and crash marbles, slide pennies and shoes, and even fly paper airplanes.

Life Cycles
From watching a pea sprout to feeding apples to butterflies, children closely study four organisms, including humans, to observe the remarkable growth and change that living things experience during their life spans.

Early Science Explorations
From making a collage of the leaves and seeds they find to constructing a lever from rocks and wood, children are introduced to the wonders of science and scientific exploration. Contains 7 studies in one book: Growing and Changing; Class Pet; Collections from Nature; Constructions; Dirt, Sand and Water; Sky and Weather; and My Body.

Weather
One day students learn to use a thermometer to record temperature, another day they measure rainfall or investigate the nature of ice. Throughout the year, students use their senses as well as scientific tools to discover that weather is a dynamic part of nature.

Magnets
From testing what sort of everyday objects are attracted to magnets to comparing the strength of different magnets, children deepen their observation skills while learning about the nature of magnets.

Rocks
One day children examine fossils, another day they might test minerals. As children collect, examine, describe, and experiment with rocks, minerals and fossils, they hone their observation skills and begin to unravel the puzzle of what rocks are and how they are formed.

Soils
From closely observing soil components and their properties to discovering the importance of earthworms, children use their senses of sight, smell, and touch to explore the wonders of soil.
Habitats
From going on a nature walk to dissecting owl pellets, children are asked to think about how organisms (plants, animals, fungi, and microscopic living things) survive in the places they live, and how they interact with other living things.

Electrical Circuits
Whether exploring static charges, figuring out how to get a light bulb to light, or testing the conductivity of everyday objects, students experience firsthand the excitement of electricity and scientific discovery.

Nature's Recyclers
By watching composting worms create soil, to modeling the nutrient cycle, students have the opportunity to investigate the organisms that carry out the process of decomposition and recycle nutrients in an ecosystem.

Earth's Changing Surface
From building river models that explore erosion and deposition to touring the school grounds looking for evidence of the earth's changing surface, students use hands-on investigations to discover the dynamic nature of the earth's surface.

Human Body in Motion
By modeling how muscles move bones, testing reflexes, and measuring the effects of exercise on breathing and heart rate, students begin to appreciate the interactions between body parts and recognize the importance of protecting them by making healthy choices.

Force and Motion
By demonstrating and explaining ways that forces cause actions and reactions, as well as gaining a deeper understanding of basic forces such as friction and gravity, students discover the many ways that forces affect the motion of objects around them.

Science Skill Builders
With 21 lessons spanning the breadth and depth of science skills, students develop a core understanding of using tools in science, scientific testing, observation skills, and the importance of analysis and conclusions.

Light
Whether watching light "bend" a pencil in water or building a periscope, the combination of hands-on, multi-sensory learning enables children to understand what light is, how it behaves, and why it makes sight possible.

Our Solar System
One day children chart the moon's cycles, another day they might make a scale model of our solar system. By observing the world around them, they address questions such as "Why are there seasons?" and "Why does the moon appear to change shape?"

Watery Earth
Whether following a drop of water through the water cycle, measuring their own water usage, or exploring how filters clean dirty water, students are encouraged to use what they learn to have a positive impact on water resources.

Matter
With challenges like exploring what they can learn about an unknown substance called "Whatzit," students experience the excitement of scientific discovery and gain an appreciation of the scientific method used by professional scientists.

Energy
Whether testing the efficiency of light bulbs, exploring heat conduction, or designing an imaginary invention demonstrating the transfer of energy, students discover that energy is at the root of all change occurring in the world around them.

Design Projects

The design project series was developed to support compatible modules by allowing students to design and/or build animal homes, tools, machines, and designs of their own creation. Taking between 4-6 sessions, the projects strengthen skills and ideas about choosing materials, using tools, working with the limitations of materials, solving problems, and overall project design.
<table>
<thead>
<tr>
<th>Program Features</th>
<th>FOSS</th>
<th>Science Companion</th>
<th>STC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepares students to do inquiry-based science</td>
<td>✓</td>
<td>Lesson O introduces students to the scientific method through the “I Wonder” Circle</td>
<td></td>
</tr>
<tr>
<td>Hardback, colorful, content-rich student reference materials for upper elementary students</td>
<td>✓</td>
<td>Student Reference Books</td>
<td></td>
</tr>
<tr>
<td>Bound student science notebooks to foster student literacy and reading skills</td>
<td>✓</td>
<td>The original Student Science Notebooks</td>
<td></td>
</tr>
<tr>
<td>Parallels in instructional design to Everyday Mathematics®</td>
<td>✓</td>
<td>Developed by the creators of Everyday Mathematics®</td>
<td></td>
</tr>
<tr>
<td>Variety of assessment strategies</td>
<td>✓</td>
<td>Teacher-friendly formative and summative assessment strategies</td>
<td>✓</td>
</tr>
<tr>
<td>A variety of pilot options to fit the interests and needs of districts</td>
<td>✓</td>
<td>Several no-cost pilot options, including an innovative online pilot program</td>
<td></td>
</tr>
<tr>
<td>Correlations to local and state science standards</td>
<td>✓</td>
<td>Correlated to state standards with customized local standard correlations available upon request</td>
<td></td>
</tr>
<tr>
<td>Teacher must gather minimal teacher supplied items</td>
<td>✓</td>
<td>ExploraGear and Supplemental Classroom Supplies available</td>
<td>✓</td>
</tr>
<tr>
<td>Early Childhood activity-based modules available</td>
<td>✓</td>
<td>Modules developed specifically for PreK-K available</td>
<td></td>
</tr>
<tr>
<td>Unique content offered to meet standards</td>
<td>✓</td>
<td>Light and Rainbows, Color, and Light modules available</td>
<td></td>
</tr>
<tr>
<td>Children develop science habits of mind in addition to content knowledge</td>
<td>✓</td>
<td>“I Wonder” Circle integrates modules as tool for student reflection</td>
<td></td>
</tr>
<tr>
<td>Engaging activities nourish children’s curiosity</td>
<td>✓</td>
<td>Engaging, hands-on activities focused on Big Ideas</td>
<td>✓</td>
</tr>
<tr>
<td>Supports teachers in reaching Big Ideas</td>
<td>✓</td>
<td>Reflective Discussions help children integrate their experience and build science knowledge</td>
<td></td>
</tr>
<tr>
<td>Full curriculum available digitally</td>
<td>✓</td>
<td>Hyperlinked teacher materials (iTLM’s) &amp; digital student materials build affordable access</td>
<td></td>
</tr>
</tbody>
</table>

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