Unit 1 Muscles Move our Bodies

Write a letter to a friend. Run fast to catch the bus for school. Stand up and stretch after watching too much TV. What's the connection between these actions? They all use our bones and muscles!

The bones and muscles which help us move are called "locomotive organs." Bones form the structure of our body. They support our body, too. They also protect important organs like our heart, lungs, and brain.

Muscles surround the bones. They extend and flex to make the body move. Let's see how muscles work to move bones.

Step 1. Flatten two straight straws using a pencil. Push a paper fastener through one end of each straw.

Step 2. Put a bendy straw into a plastic bag. Tie the opening of the bag to the straw so no air can get out.

Step 3. Tape both sides of the bag to both straws, front and back. You can tape a drawing of a hand to the front straw.

Step 4. Blow air into the plastic bag through the bendy straw. What happens?

When you blew air, the plastic bag swelled up. It got thicker and shorter, and it made the front straw lift up. This is how arms move.

Our muscles are connected to our bones. When the muscles in our arms flex, they get thicker and bend our arms. When our muscles extend, they get flatter and straighten our arms again.

Thanks to our bones and muscles moving together, we are able to move. Without them, we wouldn't be able to do simple things, like turn the pages of this book!

Unit 2 Amazing Bones

Jessie was playing soccer with her little brother Pete when he fell and hurt himself.

“Ow!” He held onto his leg.

“Are you okay?” asked Jessie.

“I think so,” said Pete bravely. He wanted to keep playing, but Jessie wanted to make sure his bones weren’t hurt.

“What are bones?” asked Pete.

“Bones are hard substances inside our bodies. They help us walk and run. They protect our organs.”

“Do all bones look the same?”

“No, they don’t. Your skull is round. It protects your brain. Your ribs are curved like a banana. They protect your heart and lungs. Your spine looks like a long stick of bamboo. It helps you stand up and lie down.”

“Wow, I have so many bones,” said Pete.

“You do. You have over 200! Now, you might have hurt your leg bone. We should go to the orthopedic doctor to check. That’s a bone doctor.”

Pete had an x-ray. The orthopedic doctor said Pete had a crack in his leg bone and recommended lots of calcium.

Pete drank milk and thought about his amazing bones.

Unit 3 Light Energy

Sunlight is very important to our world.

We know that plants need sunlight to grow. How do they do it? Plants convert light energy into chemical energy. This chemical energy makes the plants big and strong.

Solar batteries convert light energy into electric energy. They make electrical things work.

Let's see how light energy is converted into electric energy.

Step 1. Tear or cut a thin piece of paper into long pieces. Attach it to the blades of a propeller using double-sided tape.

Step 2. Connect a solar battery to a motor with wires and crocodile clips.

Step 3. Put the propeller on the axis of the motor.

Step 4. Place the solar battery facing the sun.

What did you see? You saw the propeller turn.

How did it work? Light from the sun shone on the battery. The battery converted this light energy into electric energy.

The electric energy from the battery powered the motor. The electric energy became kinetic energy when the propeller turned.

So, light energy turns into electric energy. Then electric energy turns into kinetic energy.

We can't see the energy change forms because it happens so quickly.

Unit 4 Roller Coaster Cars

Mike went to an amusement park with his dad. They had fun on some small rides. They sat down to eat some lunch. Mike heard some happy screams. He turned and saw a huge roller coaster.

“Dad, look at that!” he shouted.

The cars on the roller coaster came flying down a hill and went up another.

“How do the roller coaster cars go so fast?” Mike asked. “Do they have an engine like a bus?”

“No, they don’t. The track pulls the cars up a big hill. As they go up, they create potential energy. Then they go down the other side. Gravity pulls them downward. The potential energy becomes kinetic energy. This energy pulls the cars fast around the track.” “Wow, that’s amazing!”

“Yes, potential energy gets converted to kinetic energy all the time. When you drop a ball, it has potential energy. As it hits the ground, that is turned into kinetic energy, and it bounces up. So, would you like to ride the roller coaster?”

“Maybe not, Dad. Let’s just go on the merry-go-round again!”

Unit 5 Our Hearts Pump Blood

We breathe air into our lungs. Our lungs extract oxygen.

We swallow food. The stomach breaks it down and our intestines turn it into nutrients.

We need oxygen and nutrients to live. They need to move around our body. Blood delivers nutrients and oxygen to all cells in the body.

The heart pumps blood through the body. If the heart stops, the body can't get the oxygen and nutrients it needs.

The heart and blood vessels are called "circulatory organs." Let's see how they work.

Step 1. Prepare a hand pump and pipe, a big bucket of water, and some red ink.

Step 2. Put the pipe in the water and squeeze it quickly. Check the speed and amount of flowing water.

Step 3. Now, check the speed and amount of flowing water when you press the pump slowly.

In the experiment, the pump is the heart. The pipe is a blood vessel, and the red water is blood.

When the heart beats fast, blood flows fast. More blood can move around the body. When the heart beats slowly, blood flows slowly. Only a small amount of blood can move.

Look after your heart. A healthy heart moves faster.

It moves blood from the heart all through the body and back again. Blood keeps flowing round and round.

Your blood is flowing as you read this!

Unit 6 Blood Moves All Around

Oh, no! Alex accidentally cuts himself with his scissors.

Mom comes and puts a bandage on the wound. As she treats it, Alex asks where blood comes from.

“Blood comes from the heart. It moves all around inside your body.”

“Even my fingers and toes?”

“Everywhere! There’s blood under the skin all over your body. Blood contains essential nutrients and oxygen. The heart is a powerful pump that moves blood around inside the body through our blood vessels.”

“Are all blood vessels the same?”

“No, there are three kinds of blood vessels: arteries, veins, and capillaries. Arteries push blood away from the heart. Veins bring blood back to the heart. Capillaries connect the two. They are very small and carry blood to the tips of your fingers. You cut a capillary on your finger, so it bled.”

“My blood vessels must be very long!” says Alex.

“You have 120,000 km of blood vessels in your body!” says Mom.

“Now, let’s look after your heart with a tasty salad for lunch.”

Unit 7 Making Magnetic Fields

We know how electric currents work. We know how magnets work.

Did you know that electric currents can make magnets move?

It's true! Electricity creates magnetism. Let's take a look.

Step 1. Make an electronical circuit using a battery, wires, and a switch.

Step 2. Put the compass under one of the wires. Make sure the wire is parallel to the needle of the compass.

Step 3. Press the switch. See the needle move.

Step 4. Now, put the battery the other way around. Put the wire parallel to the needle like before.

Step 5. Press the switch. See which way the needle moves now.

How did the electric current move the needle of the compass?

Compasses use magnets to work. Earth's poles are like giant magnets. The needle of a compass is a small magnet. The south pole of the compass needle points toward Earth's north pole. When we pressed the switch, the electric current created a magnetic field. The wire was now magnetic. Electricity always flows from positive to negative.

The needle of the compass pointed toward the flow of electricity in the wire. We turned off the switch. The wire wasn't magnetic anymore. The needle pointed north again.

We then moved the battery the other way around. We moved the direction of the electrical flow.

The needle of the compass pointed in the new direction.

Add more batteries in a serial connection or put the wires and compass closer. The movement of the needle will be bigger.

Unit 8 Earth is a Magnet

Bella went camping with her family. She went to get wood with her dad. They saw a squirrel in the trees. They followed it for a while but soon realized they were lost.

“Dad? Where are we?”

“Don’t worry, Bella. We’ve been walking south. The campsite is to our north. We can use a compass to get back.”

Following the compass north, they soon found their campsite. Mom started a fire with the wood.

“Wow, this tiny compass really knows the way. How does it work?”

“Good question, Bella!” said Dad. “You learned about magnets in school, didn’t you?”

“Yes! The same poles repel, and opposite poles are attracted to each other.”

“Correct! Earth is like an enormous magnet. It has a north and south pole. The needle of a compass is a tiny magnet.”

“Let me guess. The south pole of the magnet points to the north pole of Earth. That’s why compasses always point north!”

“That’s right!” said Dad. “Explorers used compasses to travel around the world.”

Unit 9 Bacteria vs. Fungi

Bacteria and fungi are living things that are all around us. You probably have yogurt, made by bacteria, and mushrooms, a type of fungi, in your fridge at home.

Yogurt is made from milk. Bacteria in the milk create lactic acid. They turn the liquid milk into thick yogurt.

Mushrooms are a type of fungi. Of course, we know we can eat some kinds of mushrooms!

Mold is another type of fungi. Like bacteria, mold can make new foods. This process of making new foods is called fermentation.

Milk turns to yogurt because of fermentation. Other fermented foods include kimchi, cheese, and soy sauce.

While bacteria are very small, fungi grow large enough to see with our bare eyes.

Let's make our own mold and watch it grow.

Step 1. Spray a little water on a slice of bread.

Step 2. Put the bread in a zipper bag and seal it.

Step 3. Put the zipper bag in a warm and humid place.

Step 4. Observe the mold over about 7 to 10 days. Leave the bread inside the bag and don’t forget to wash your hands properly afterward.

Fungi need somewhere warm and humid to grow.

They can’t get nutrients alone, so they get them from other things. These things can include animals or plants. It can include old food like the bread we used. Now you know why old fruit gets moldy if you leave it too long!

Some bacteria can produce their own nutrients. Unlike fungi, bacteria are made of only a single cell.

Unit 10 Strange Smells

Dad is back from playing tennis. But... what's that smell?

Mark says, "Dad, your feet smell bad! Is it because of athlete's foot?"

Dad looks embarrassed. He goes to wash.

Mom explains, "Bacteria make feet smell bad, and fungi cause athlete's foot."

"Oh," says Mark, "are bacteria and fungi different?"

"They are. Bacteria and fungi are both very small, and they do a lot of work. Both of them can make food go bad and sometimes cause illnesses."

"Bacteria and fungi are very scary, aren't they?" asks Mark.

"They're not all bad. Because of their hard work, rotten food, dead animals, and dead plants become nutrients. Mold and mushrooms are both types of fungi."

"Wow, mushrooms are tasty and cool."

"Yes, they are! Bacteria and mold both cause fermentation as well. This helps make the bread and soybean paste you and Dad like so much. Bacteria in the yogurt you have in the morning strengthen your body!" explains Mom.

"Wow! They do so many things! It would be a whole different world if they didn't exist."

Unit 11 62 Degrees in the Morning?

It's a very hot summer morning.

You decide to check the latest weather conditions on some weather sites.

Wait, this can't be right. Is it really 62 degrees in the morning, and 80 degrees in the afternoon? Oh, is it 86 degrees on Thursday?

How can the temperature be this high? That's far too hot!

Well, it's quite simple. There's no need to worry at all.

There are two common ways to measure temperature: Celsius and Fahrenheit.

What's the difference between them?

Step 1. Find a weather chart which describes the degrees with Fahrenheit.

Step 2. Find Celsius degrees using a formula changing Fahrenheit to Celsius. First, subtract 32 from the Fahrenheit temperature.

Step 3. Next, multiply the result by 5/9.

(Fahrenheit degrees – 32) x 5/9 = Celsius degrees

You can always change Fahrenheit into Celsius with this formula.

Let's take an example. One weather site says it's 62°F in the morning.

First, subtract 32, which is the freezing point of Fahrenheit temperature, from 62. That gives us 30.

Next, multiply the result by 5/9. That's 50/3.

The result of that is about 16.7, which means that 62°F is 16.7°C.

That's not very hot, is it? Why don't you try to turn more Fahrenheit temperatures into Celsius?

Try some different numbers. What Fahrenheit temperature is 25°C?

Unit 12 Different Temperatures

Emma goes on a trip to the U.S. with her family. After a day of fun, they come back to their accommodations. Dad watches the weather forecast on television.

Wait, it will be 77 degrees tomorrow!

“Dad, how can it be so hot?” asks Emma.

“Don’t worry, Emma. That’s the temperature in Fahrenheit. 77°F is 25°C.”

“What’s the difference, Dad?”

“Fahrenheit measures temperature a bit differently. 0°F is the freezing point of salt water.”

“Why salt water?”

“Because that was the coldest thing a human could make at that time. 32°F is the freezing point of pure water. 212°F is the boiling point of water.”

“Then what is Celsius?” asks Emma.

“Another scientist proposed Celsius temperature in 1742. It adopted the unit of °C. He set the freezing point of water as 0°C and the boiling point of water as 100°C. Except for the U.S. and a few other countries, most places in the world use Celsius.”

Why don’t you find an American weather forecast and see what degrees look like in Fahrenheit?

Unit 13 The Wonder of Rainbows

Refraction and reflection are two ways of moving light.

Look at a bird with binoculars. It looks close even though it's far away. That's because of refraction. Binoculars bend and focus the light.

The birds fly over a lake. You can see them in the water. The light bounces off the water and is reflected.

Let's look at reflection and refraction at the same time. We will make our own rainbow!

Step 1. Fill a transparent glass with water. Put the mirror in the water at an angle.

Step 2. Place the glass near a window so the sun can shine on the mirror.

Step 3. Check the reflection on the wall. Control the angle of the glass to make a rainbow on the wall.

How did this work?

The sunlight was refracted as it entered the water. It slowed down and changed direction. Then the light hit the mirror. It was reflected. It bounced off the mirror and came back. As it left the water, it was refracted again.

Light is made of many colors. We usually see it as only white. When the light hit the mirror and left the water, the light was split up into different colors. We saw a rainbow.

In nature, we only see rainbows when the sun shines after it rains. There are water droplets in the air. Light is refracted and reflected like in the experiment.

Aren't rainbows amazing?

Unit 14 All the Colors of the Rainbow

Noah and his mom are caught in a heavy shower on the way to town. They run inside a cafe. They order some hot chocolate. It soon stops raining, and the sun comes out.

“Wow, Mom, look at that! It’s a rainbow! Let’s go and find the end. I want to touch the rainbow.”

Mom laughs. “You can’t touch a rainbow, Noah. Rainbows are made of light.”

“Oh, I think we learned about it in school. Is it because of light reflection?”

“Yes, and light refraction. Because it rained, there are still raindrops in the air. The sun shines on the drops. When the light enters the drops, it is refracted.”

“It bends!”

“That’s right. It then hits the back of the water drop and is reflected.”

“It bounces back!”

“Correct. As it leaves the drop, it is refracted again.”

“So the light is refracted twice and reflected once? All inside a tiny raindrop?” asks Noah.

“Yep. As it exits the droplet, the light is split into many wavelengths.”

“And the wavelengths are all different colors?”

“That’s right! All the colors of the rainbow.”

Unit 15 Creating Organs and Limbs

Your body consists of many organs all working together. It is like a wonderful and complicated machine.

However, they don't always work properly. Hearing can become very bad. Hearts stop working properly. Limbs can be lost in an accident.

What can people do? They might be able to get an artificial organ to do the work of their real organs.

Doctors can give you an artificial limb. It might be an arm with fingers that can really move.

Doctors can replace a damaged heart with an artificial one. They can replace your inner ear so you can hear better.

Artificial organ producers design and make artificial organs. They look at our real organs and try to copy them. They make them from plastics and metals. They test them over and over.

There is still a lot of work to do, though. Artificial organs are not as good as real ones. They are often very expensive. They don't look the same. There are also some organs that humans cannot yet create. But artificial organ producers keep trying.

They do all they can to help people who need artificial organs and limbs.

Unit 16 Online Doctors

You start to feel sick. You don't know what's wrong. You need to speak to a doctor. But the doctor's office is too far away. Or maybe there's a bad storm outside.

How can you speak to a doctor? You can try telemedicine. Telemedicine allows people to speak to their doctor without leaving the house. You may have used video software for school or to speak with family. But you can use it with your doctor, too.

Talk to an online doctor on the computer or the phone.

The doctor can check your medical records. They can see what's wrong with you. They can prescribe medicine and tell you what to do next.

Not everyone likes online doctors, however. Some people prefer to see doctors face-to-face. Others think online doctors could miss something important.

However, it can help many people. Disabled people or people in the countryside might prefer online doctors. People can even speak to an online doctor from another country. Telemedicine can make many lives easier.

Online doctors can change people's lives.