Tap into Learning

Volume 4, Number 1

Spigot

Science Magazine

for Kids and Classrooms ®

In this Issue:

*What is Sound? *Sound Effects
*Sound-making Devices *Sound vs. Hearing
*and much more!

Our Mission

The mission of Spigot Science Magazine is to help children understand how and why the world works and to inspire young minds to be curious and thoughtful stewards of the world that will be theirs one day.

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From the Publishers

Dear Readers,

Sound plays a very important part in our lives. It surrounds us and helps us understand our world. It helps us communicate with others.

In this issue, we look at sound from many points of view. We start with what sound is and how it is made with waves or digits. (p. 4-7).

We also explore how animals make and use sounds. (p. 8-9) We even show how sound is used to make ice cream! (p. 10)

Many sounds affect us. For example, the sound of hello can make us feel welcome. (p. 12) Ancient sounds are being discovered today by Peruvian archeologists. (p. 13)

Sound is about more than pretty notes. It's about pitch and volume. (p. 14-15) It's also about activities that are fun, like a play filled with sound effects or words like "meow," that sound like the sounds they make. (p. 16-17)

The recorded sounds we hear today on our MP3 players have a long history. They have been developing since 1835. (p. 20-21)

Not everyone can hear well. Some people need hearing aids, while others need cochlear implants. We all need to protect our hearing. (p. 23-24)

As musicians know, music is all about vibrations. Just how are these vibrations made on horns, strings, and other instruments? (p. 25)

We complete our issue with some great books that will help you learn a whole lot more about sound.

We wish you happy reading, happy doing, and happy sounds.

Pondering,

Valeria Girandola, Publisher and Editor-in-Chief
David Cochran, Publisher and Chief Learning Officer

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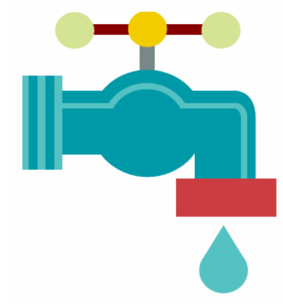
Spigot



Sound

Connections Across the Curriculum

In this Issue

Science Connection

Geography Connection

Math Connection

Language Arts Connection

Look for **BOLD** words throughout Spigot. These are vocabulary words you should learn. If you don't know them, look them up online or in a dictionary.

Social Studies Connection

Health Connection

Arts Connection

Library Connection

Next Issue

When you see a picture of Ponder in Spigot, you'll know it's time to think or try something.

Sound All Around

Sound. We hear it; we make it; we feel it; and we use it. Sound is an important part of our lives. We hear sounds almost constantly – talking, TV, rustling leaves, and rumbling trucks. We make sound by talking, singing, playing music, and tapping on a desk. We feel the vibration of sound when thunder claps or music plays loudly. We use sound when we have ultrasound body scans or locate objects with underwater **sonar**.

What is Sound?

Sound is a type of energy just as heat and light are. It occurs when molecules move and vibrate. In air, the molecules move, causing them to compress and expand. This creates waves that vibrate at different rates called **frequencies**. **Pitch** describes the frequency of the sounds we hear. We hear things that vibrate fast as high-pitch sounds. We hear slower vibrations as lower sounds. The sound starts when the molecules first vibrate. For example, when someone claps his hands, the sound wave travels through the air to our ears where we hear it.

Hz = vibrations per second

The measurement unit for sound waves is called **Hertz** (Symbol: Hz). The higher the Hz, the faster the molecules are vibrating and the higher the frequency. A higher pitch is like a violin. If a sound has a low Hz, it means that that the molecules are moving slower. A lower pitch is like a cello or a double bass instrument.

Dogs and cats can hear at higher frequencies than we do. That's why they will sometimes hear things that we can't hear. Learn more about animal hearing on pages 8-9.

Causing Sound

We can make sounds by causing things to vibrate. For example, we can tap lightly on a keyboard or even vibrate the vocal chords in our throats to make noise. Of course, some noises are more pleasant than others. We like a beautiful melody, but if someone scratches fingernails on a hard surface, it might make us **cringe**.

There are some sounds we don't hear at all.

We hear many sounds at high and low frequencies, but there are some sounds we don't hear at all. These sounds are out of our sound range. An example is the **ultrasound** used mainly in the medical field for taking pictures of the human body without x-rays. We can't hear ultrasounds because they are at a very high frequency – at least 20,000 Hz. When technicians take an ultrasound picture, the sound enters the body and reflects back when it strikes an organ such as the heart. The reflection is captured and special technology creates a picture of the heart.

Some vibrations are so strong that we not only hear them, but we also feel them. Sometimes car sound systems have the volume turned way up. We not only hear the thumping beat, but if we are close enough, we can actually feel it too. Similarly, a very

Sound All Around continued

close clap of thunder will make us vibrate along with the air around us.

Unfortunately, not all people can hear the vibrations that enter their ears. Some people have damage to the parts of the ear that capture sound. When this happens, they have reduced hearing. In severe cases, their world is silent. These people are said to be hard of hearing or deaf. Learn how some deaf people are hearing thanks to **cochlear** implants by reading *Wired for Sound* on page 23.

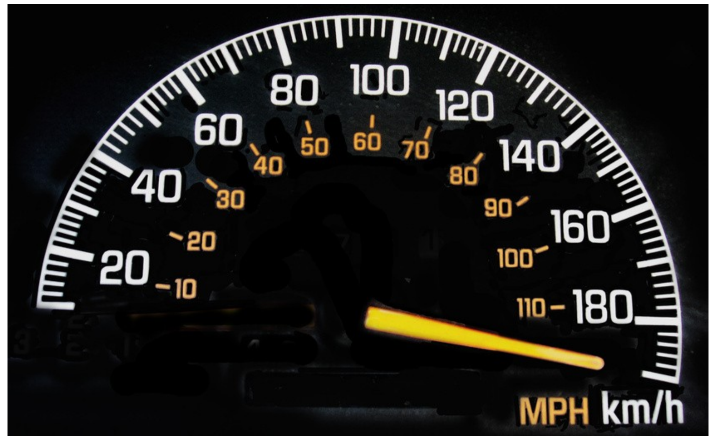
Because sound is such an important part of our lives, it is important to learn how sound is made, how we hear, and what we can do to protect our ears from damage.

Activities

1. Pay very close attention to where you hear sounds for 15 minutes. List every sound you hear and tell what makes the sound. Compare your notes with someone else.
   - Which sounds haven't you thought about before?
   - How do you think sound affects us?
2. Go to Lindsay's Wheel of Acoustics at www.physics.byu.edu/research/acoustics/what_is_acoustics.aspx

   Choose two fields of Acoustics, research them. Then compare and contrast them in a Venn diagram graphic organizer.

Sound Travels



Speed of Sound

Sound travels at about 344 meters per second or 770 miles per hour. But this speed varies depending on what the sound is traveling through. Most of the sound we hear travels through the air. The warmer the temperature, the faster sound travels. Our brains are not sensitive enough to tell the difference between sound traveling at 771 mph or 766 mph. These sounds would reach us only fractions of a second apart.

We hear lots of sounds. Some are close and some are far away. We hear close sounds like a bus stopping right in front of us almost as soon as the sound is made. If a sound is made several miles away, and it is loud enough, it may take four seconds to reach us.

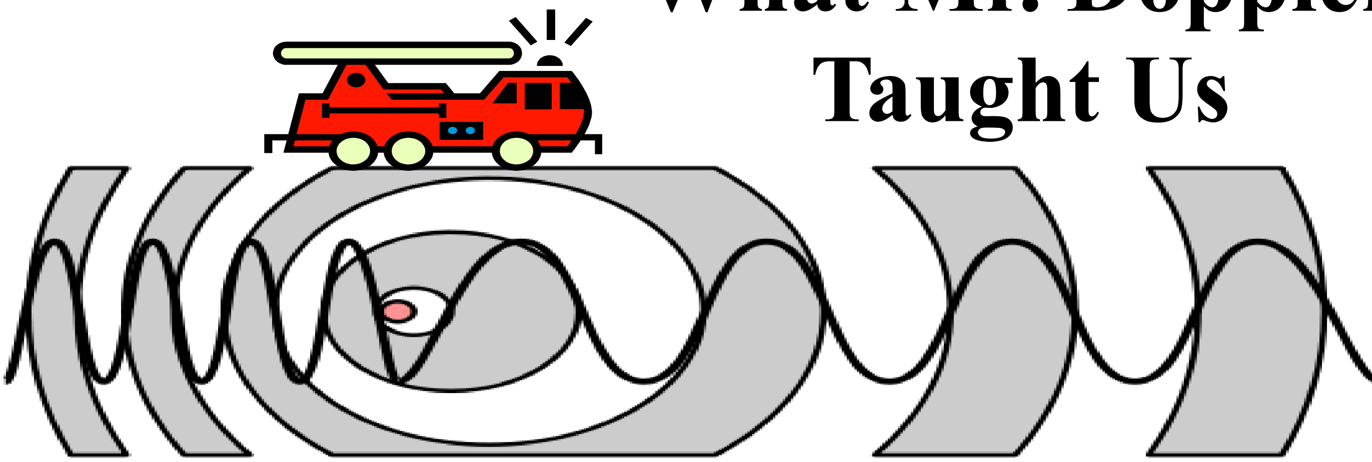
Light Is Faster than Sound

Light travels a lot faster than sound. It travels at 300,000 meters per second or 671 million miles per hour. That's over 87,000 times faster! This is why we see lightning before we hear thunder. Both light and sound energy are coming from the same thundercloud, but their speed through air is quite different. We see lightning almost instantly, but we hear the sound seconds later.

Ponder

Humans can move in airplanes and rockets at the speed of sound or faster. What would happen if we could move at the speed of light?

What Mr. Doppler Taught Us



You're standing on the sidewalk facing the street. A fire truck with its siren blaring is coming from your left side. Its sound has a high pitch. It passes you and continues to your right side. The farther away it gets, the lower the pitch of the sound becomes. Hmmm? Why would the same sound on one side of you have a change in pitch as it goes past you?

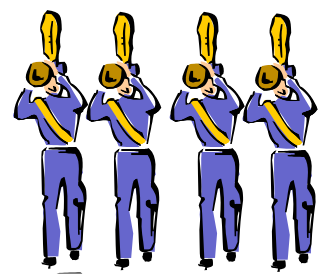
Austrian physicist Christian Doppler wondered the same thing. In 1842, he predicted that the same sound would change as it moved toward and away from a person. Dutch scientist Christoph Ballot tested Doppler's hypothesis in 1845. Ballot stood next to a railroad track and listened as a rail car full of musicians approached. Their music had a high pitch as the rail car approached. After the car passed and went away from him, the music had a much lower pitch .

Sound Frequencies Change

He and Doppler suggested that this change in sound happens because the frequency of sound waves changes as they move toward and away from us. When the sound is coming toward us, the waves are compressed and have a higher pitch. As the waves move past us, they stretch out and have a lower frequency, a lower-sounding pitch. Doppler realized that the musicians didn't change their pitch; it was the movement of the sound waves through the air that made the change.

This change in sound waves has become known as the **Doppler Effect**. It isn't just sound that behaves this way. Scientists have applied the Doppler Effect to all waves including light waves and ocean waves. They use it to figure out how planets move in relation to each other. They also use it in **electrocardiograms** that measure electrical activity in our hearts over time.

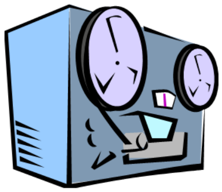
Next time you hear an ambulance or fire truck coming. Notice how the pitch gets lower after it passes you. You can impress your friends by saying, "Hey, we just witnessed the Doppler Effect." Be sure to explain to your friends what the Doppler Effect is.



Activity

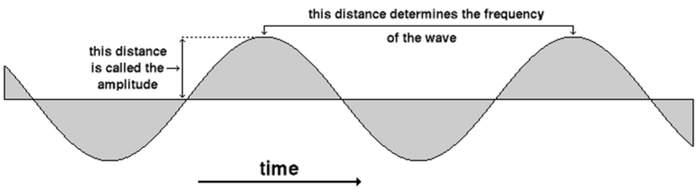
Test the Doppler Effect by repeating Ballot's experiment.

- Have someone take a horn or other musical instrument outside.
- Have the musicians move far away from you, but be sure you can hear the instrument.
- Have the musician walk toward and away from you at an even pace while playing the same note on the instrument.
- Pay close attention to the changes in the sound as the musician approaches, passes, and goes away from you.
- Write in your own words what the Doppler Effect is.



Two Kinds of Sound: Analog and Digital

Recorded sound fills our lives. It is hard to go anywhere without hearing it. We hear it in stores, the elevator, in our music players, everywhere. The sound we hear can be one of the two types of recorded sound — **analog** or **digital**. While we can hardly tell the difference, these sounds are made in different ways — in waves or with numbers.



Graham Mitchell
http://grahammitchell.com/writings/vorbis_intro.html
Analog sound wave

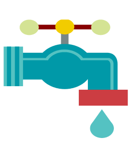
Analog Sound

When we make analog sounds, we set up vibrations. These vibrations are waves of energy that go from the sound source outward. They travel in waves like rippling water. These natural waves are continuous from the beginning of the sound until the end.

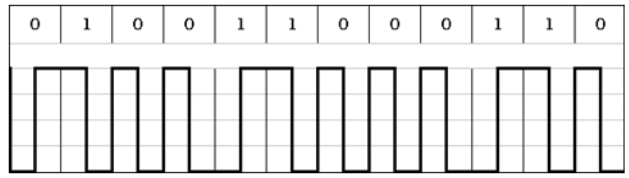
The diagram of a sound wave above has its ups and downs. The closer together the waves are, the greater the frequency. This means that the pitch will be high. When waves are spread out, the pitch is low.

The height of the wave, its **amplitude**, shows how loud the noise is. The higher the wave is above the line, the louder the volume is.

In analog sound recordings, the sound energy is transferred to electrical energy and saved on a magnetic medium like a tape recorder. We do not use tape recorders much anymore because acoustical scientists have found ways to make digital sounds. Until about 30 years ago, most recorded sound was in the form of analog sound waves.



SpigotFact: You can hear analog sounds on tape recordings and records. You can hear digital sounds on CDs and MP3s.



Wikipedia Commons
Digital code

Digital Sound

Digital sounds are stored as numbers rather than waves. Each sound pitch and volume has a certain **binary** number assigned to it. Binary code is written using ones and zeros. On a digital sound player like a CD or MP3 player, the numbers are called up in order and the right pitch and volume are played.

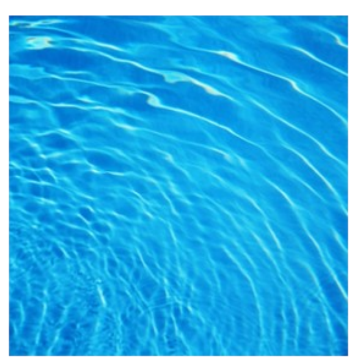
Some people prefer sounds that are recorded on analog devices. They think it is a purer sound that is more pleasant to their ears. Others prefer digital sounds because they can be stored in very small computer files. You can fit many songs in an MP3 player, for example.

In recorded sound, digital sounds are a lot more common than analog sounds these days. The world has gone digital and so has its sound.

Activity

Make a chart to compare how analog and digital sound are similar and different.

Why do you think digital sounds are so popular today?



Ponder

Look at this picture of ripples in the water.

Is it more like digital or analog sound? Why?

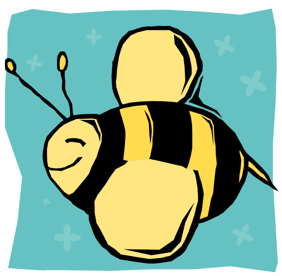
The Sound Feelers

by Sandie Lee

Have you ever heard thunder rumble so loudly you could actually feel it? If so, you've experienced what many creatures use as a means of hearing.

Not all animals and insects have normal ears or a normal way of listening to the world around them. Bats, bees, and snakes, for example, are a few critters that rely on sound-waves to hunt, **navigate,** and avoid dangerous situations.

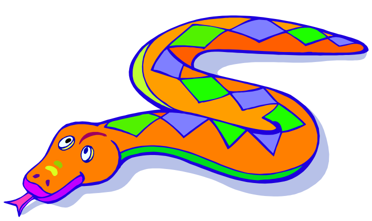
Bee-Vibe



Do you know that bees have ears? Their hearing organ is called the **Tympanum** (tim-pa-num). This small organ has a hole with a thin **membrane** stretched across it, like a drum. It's located in the bee's tiny **abdomen** and is considered the bee's main ear. As the bee moves its back-end up and down, this organ is able to "hear" **vibrations** in the air.

The bee's feet and **antennae** also help them hear. They're so sensitive they can pick up the smallest vibration around them. This *bee-vibe* helps keep them safe from **predators.**

Stereo Sound Snake



Even though snakes don't have outer ears, they do have fully developed inner ears.
The **cochlea** (kok-lee-uh*),* a small bone filled with fluid, helps the snake to hear by gathering in sound. Bones and muscles in the snake's lower jaw also connect to the inner ear. And just like the bee, this specially designed ear can pick up vibrations from the ground.

Unlike other animals, the snake can unhinge its jaw one side at a time. This is thought to allow the snake to hear in stereo sound.

Bat Mega-Phone

Bats use **echolocation** to navigate the night skies. This is a type of **sonar**. The Leaf-Nosed Bat, as its name suggests, has a leaf-shaped structure in its nose that acts like a mega-phone. When the bat wants to locate something, it emits short "shouts" (10-15 per second). It then listens for the echo-information coming back. The echolocation pulse only lasts a few thousandths of a second. However, the bat's brain and ears are so highly tuned they can interpret the brief silences between calls. This allows them to hunt, locate roosting **crevices**, and avoid bumping into things.

Sandie Lee lives in Ontario, Canada. Visit her website at: http://imagination-cafe.com

Activities

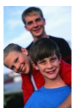
1. Do an Internet search for the term *echolocation*. See if you can find other animals that use echoes to locate prey.
2. Search in the library or online to find out how dolphins use sound.
3. Go to http://www.ypte.org.uk/environmental/communication-in-animals/19 . You will find information on the ways that animals communicate. Go to Section 2, Sound. Read about how animals use sound to communicate. Make a list of animals and the way they communicate. Discuss your list with others. Tell why you think animals use sound in the way they do.

Science Connection

Animals Don't Hear Alike

By S. V. Richard

Have you ever wondered if humans and animals hear and process sound the same way? Do some species have a hearing advantage over others? There are many differences between hearing in humans and as listed in the sections below.



Humans

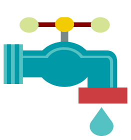
It is a **complex** process for human beings to translate sound into signals the brain will understand. Sound must travel through the external ear into the middle ear. Once sound hits the ear drum, it causes vibrations to pass through three tiny bones. The vibrations cause pressure waves in the cochlea that eventually signal hair cells in the organ of Corti to generate sound through **auditory** nerves. The range of sound that humans can hear is limited when compared with other animals.

Dogs

Dogs, for example, have an excellent sense of hearing compared to human beings. They are able to hear sounds at a much higher and lower frequency than humans, even with their floppy ears. This makes them much more sensitive to sound than humans. Loud sounds, such as popping fire crackers, might actually be painful for a dog to hear.

Cats

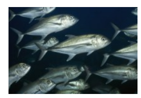
Cats also have better hearing than humans, but they can hear much higher frequencies than dogs. A cat's **external** ear is designed to pull sound into their ear canal. A cat is a better hunter because it is able to hear higher frequencies. For example, a cat is able to hear a mouse in the near distance that a human might not otherwise notice.



SpigotFact: The blue whale makes a deep rumbling sound (188dB) that can be heard 800 kilometers or 500 miles away.

Birds

Birds don't have external ears like human beings, cats, and dogs. Most birds have ear holes hidden behind their feathers so they can fly without it affecting their hearing. This design reduces the wind noise. Birds hear shorter notes than humans, so what we hear as one sound, a bird might hear as several notes within that one sound.



Fish

Fish do not have ears outside their bodies like humans. As sound travels through the water, the vibrations pass right through the fish. Tiny stones, called **otoliths**, in their nerve hair tell the fish there is a nearby sound. They then know how to move toward or away from the sound.

The way species hear varies greatly. Each species' ear and method of hearing is **adapted** to how they function in their environment. Being able to hear within their environment is very important to animals' survival.

S. V. Richard is the author of several children's stories and workbooks. Visit her website at www.diskuspublishing.com/sarahrichard.html

Activities

1. Choose a different animal than has been discussed in this article. Use the library and/or Internet to find out how the animal hears. Draw a picture to illustrate this, and in 100 words or less describe how the animal hears.
2. Look at the SpigotFact in the first column. Search books on sound such as we have in the Library Connection on page 26. When you see an interesting fact, write it in your own words in just one sentence per fact. Share your facts with others.

Cool Sounds

You scream.
I scream.
We all scream
For ice cream.

Now here's a use for sound that you probably would never dream of – to chill ice cream! That's right, two Penn State scientists, working with Ben and Jerry's ice cream company, have developed a sonic refrigerator, an ice cream cooler that uses sound to keep it cold. Matt Poese and Steve Garratt of the Applied Research Laboratory at Penn State University have developed a way to use very loud sounds (173 **decibels** – an airplane engine is less that 150 decibels) to chill the refrigerator.

Metal plates are placed in certain positions in a tube and very loud sound waves are pumped in. Some plates get hot and some get cold from the noise. A heat exchanger is placed at each end of the tube to remove the heat and leave the tube very cold. The result is a cool temperature to chill ice cream.

You would think the very loud sound would keep people away. But because of the gases inside the refrigerator, the sound is not heard outside it. That's good, because the sound is ten times louder than a rock concert. Such a loud noise could permanently damage our ears.

This is an experimental field called **acoustical refrigeration.** You won't find these refrigerators at an appliance store just yet, but who knows — maybe someday sound may be cooling your food at home.

Echoes

Sound Bounces

When you dribble a basketball, it bounces back to you each time it hits the floor. Sound operates the same way. It travels outward from its source until it hits something. It then bounces and the sound returns to where it came from. The sound reflects from a surface much as light reflects from a mirror.

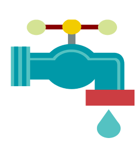
These sound bounces are called echoes. You can hear them in many places, but particularly in enclosed areas like caves, caverns, and canyons. As we can see from other articles in this issue. Echoes are used by animals such as bats and dolphins to locate food. Echoes are also used to take pictures of our hearts and other body parts by bouncing back sound rays and converting them into pictures.

Activity

Get a large wide-mouth jar or pot. Yell into it and listen for the echoes!

V. Girandola

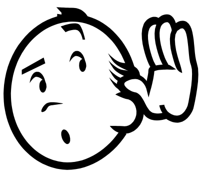
Star listens to her iPod while thinking about Nipper, the RCA mascot in the picture next to her.



SpigotFact: Nipper became famous as the Radio Corporation of America (RCA) dog. Nipper lived from 1884-1895, but his picture has appeared on RCA and other products ever since.

Think Like a Scientist

Have you ever thought about how you think? Have you ever wondered how we can look at something that's confusing and make sense out of it? Scientists do this all the time. Learning how scientists think can help us become better thinkers. The scientific inquiry process is an important part of discovering and learning how the world works. When reading Spigot*, look for opportunities to* ***Think Like a Scientist.***



Part of thinking like a scientist is learning to listen like a scientist. Sounds are all around us. They are invisible vibrating waves caught by our ear and sent to our brain. In our brain, these invisible sound waves make sense. They bring us marvelous information that we can't see, touch, feel, or taste. Sounds are magical, musical wisps of monumental meaning.

Our **sonic** environment is rich with information. Learning to listen well takes time and a lot of practice. By observing with our ears, we can fine-tune our sense of sound and learn much more about the world we live in.

Listen Like a Scientist

To listen like a scientist, we should know what we are listening for. First of all, we are listening to find out where the sound is coming from. In which direction should we turn our head to hear better? With words, we are listening for meaning in the vowel and consonant sounds. But what does the speaker's tone of voice tell us? In music we learn to recognize repeating patterns of sounds with **harmony**, **pitch,** and **rhythm**. In nature, we learn to tell a robin's song from a cardinal's song. Is the bird just singing or is it distressed because we are too close to its nest?

The field of science called **Acoustics** deals with the production, control, transmission, reception and effects of sound. The four broad fields of study include earth sciences, engineering, life sciences, and the arts.

See Lindsay's Wheel of Acoustics at: www.physics.byu.edu/research/acoustics/what_is_acoustics.aspx

Right now astronomers at SETI, the Search for Extra-Terrestrial Intelligence, are focusing radio telescopes on the skies, waiting and listening for sounds of other life in the universe.

Cosmologists are tuning in to the vibrations of space-time, listening for gravity waves to chart the chirps, pops, beats, and murmurs making a new map of the heavens. And underneath the Earth, microphones are listening for sounds of moving soil, forecasting landslides. Scientists are applying underwater acoustics to probe the mid-ocean ridges where molten rock is pushing up from below.

Biologists are listening to the **vocalizations** of blue whales and are able to trace and study the movement and communication of many other creatures throughout the oceans.

Observe carefully the sounds of your environment, the sounds of voices all around you, and listen to music. You will be thinking like a scientist.

Activities

1. List four reasons why scientists use sound in their explorations.
2. Start a listening journal.
3. Observe and record 10 sounds that you hear throughout the day. What is the meaning of each sound?
4. Listen to different bird songs. Choose one that lives in your area. Learn the sound. See if you can find and identify the same bird by its song outside. www.birdjam.com/birdsong.php?id=1

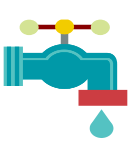
THE SOUNDS OF HELLO

Language is very complicated. Different cultures all around the world use different sounds and **symbols** to mean the same thing. One thing that each of the over 6,000 languages in the world has is its own words to greet someone — how to say hello. Depending on where you live, how you greet someone may be understood worldwide or by just people in your own culture.

Even people in the over 100 countries where English is spoken have different ways of saying things or pronouncing words. When you are greeted by someone in Australia, it will sound quite different from the way you might be greeted by someone in a southern state in the USA, even though they are both speaking English. In Australia, the greeter might say "G'day" meaning "good day." In a southern state, you might be greeted with "Hi y'all" which is short for "hi you all."

If you are in the South Pacific Ocean visiting the Fiji Islands, "hello" would be "bula" in Fijian. In German, it might be "guten Tag" or "hallo." In one of the four main dialects in China, Cantonese, you would hear "Néih hóu."

The sounds we hear from cultures may be quite different, but the meanings are very similar. This is why taking time to learn a world language is helpful in understanding others and learning to get along well with people who are from a different culture.



SpigotFact: There are over 165 languages spoken in the United States today.

Activities

1. Learn how many other cultures greet each other by going to http://users.elite.net/runner/jennifers/. Practice greeting someone in some of the more than 800 languages on this site. Listen to how different the sounds are.

2. On a map of the world, write a greeting or other phrase such as "thank you" or "goodbye" and draw an arrow to the country that uses the phrase. Use the site listed in #1 above to find phrases from different countries.

   A free printable world map is available at http://img510.imageshack.us/i/worldmapgq1.png/ and other sites on the Internet. You may need an atlas to help you locate the countries.

Ponder

Adz, Wikipedia Commons

Hello Airlines

Why do you think this airline named itself Hello? How does the sound of hello make you feel?

Ancient Conch Instruments Found

If you played in a band in Peru 3,000 years ago, its sounds would have been quite different from a band today. First, there would have been no trumpets, saxophones, or tubas. Second, you most likely would have made your own instrument out of a **conch shell**.

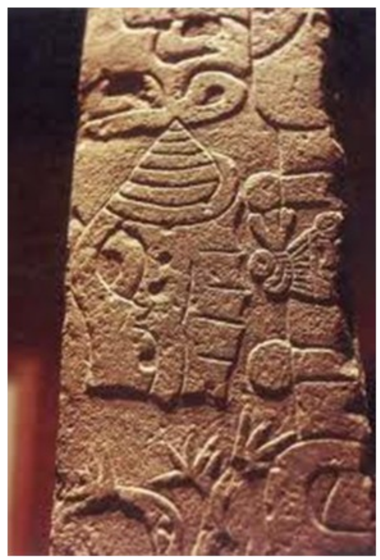
According to Science News (11/19/10), archaeologists in Chavín de Huántar, Peru, have found a religious ceremonial chamber with 20 trumpet-like shells called **pututus** that were part of an ancient band. The scientific name for the conches that were found is *Strombus galeatus*. The shells were once the homes of large sea snails that live in the South Pacific Ocean.

manandmollusc.net

Strombus galeatus, the conch used in the Peruvian ban

Conch shells make a haunting, droning sound. Some people have described their sound as being like the low roar of an animal like a lion. To make the shell into a horn, musicians cut a hole in one end so that air can be blown through it. Today, some people add a mouthpiece to change the sound. They also carved designs on the shells for the gods they worshipped.

Conches are still used today to make music. There are conch bands all over the world. Many conch musicians feel that the strange sounds they make are as beautiful as the sounds of any other horns.



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Carved conch shell with design for the gods the Peruvians worshipped

Do You Know?

Do you know that conches are vegetarians?

They eat at the bottom of the food chain. Their favorite food is algae.

Do you know what eats conches?

Mainly humans! Rays, starfish, and octopuses also like to dine on conches.

Activity

Do you know that you can make music with vegetables? You can make a cauliflower conch by drilling a hole in it and putting in a mouthpiece. That's not all! You can make a carrot kazoo, radish clarinet, and melon drum. Check it out at http://www.growingsounds.sound101.org/cauliflower_conch.html and make some music with natural instruments.

The Sounds of Music

Algont
Wikpedia Commons
An octave on the piano

What is music? Think a minute. Which of these answers would you choose?

Music is sound that is pleasant.
Music makes me feel good.
Music is something that I can create.
Music happens when I sing.

While all these answers could be true, the scientific answer is that music is an art form like dancing or painting, but uses sounds organized into patterns of pitch and rhythm. People compose music with sounds of different pitches. They use sound to express ideas and feelings. The sounds of music are pressure waves traveling through air. Musical instruments like a piano, violin, a trumpet, or a guitar make these waves. When we strike a piano key or slide a bow across a violin, we call that playing. The human voice also makes music. We call that singing.

Sound waves are caused when sound energy vibrates the air around it. The different tones or pitches happen when the distance between the sound waves changes. When the distance is longer, it means that the waves are farther apart and the sounds are lower. When the distances are closer together, the sounds are higher.

On a music scale, each note has its own vibration rate or frequency. This rate is measured in units called Hertz (Hz). Think of Hertz as the number of times something vibrates in one second. If there are many Hertz, it means that the air is vibrating fast and the waves are closer together. Higher Hz = higher pitch sounds. Lower Hz = lower pitch sounds. Here is an example of how the Hz changes going up the scale from middle C on a piano.

	Note	Frequency (Hz)
1 octave up	C	524
	B	495
	A	440
	G	392
	F	349
	E	330
	D	294
Start here	Middle C	262

Activities

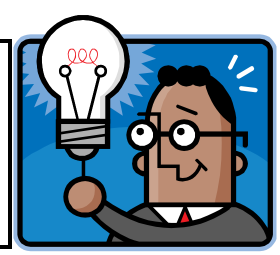
The melody of *Mary Had a Little Lamb* is written in letter notation like this:

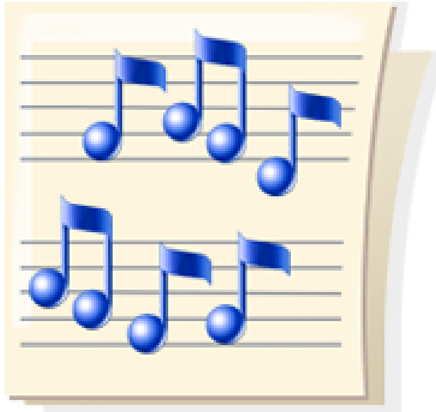
E D C D E E E
D D D E G G
E D C D E E E
E D D E D C

1. Use the table above to write the same song in vibration frequency notation (Hz). For example, the first note would be 330.
2. Write another song in vibration frequency. See if your classmates can guess the song.
3. In your own words, tell why a higher Hz number means that there is a higher pitch sound.
4. Write for ten minutes in your journal your thoughts about what music means to you. Give some examples about which sounds you like and how music makes you feel.

Music Helps Your Brain

Some scientists think that music helps our brains function better. So go practice your piano. You'll get smarter!





Measuring Music

When we hear a sound, we might think it is loud or soft, high pitched or low. We can't tell its exact measurement. This is because measuring sound levels of pitch and volume exactly requires special instruments. To our ears, a sound could be too loud, or not loud enough and the pitch just right, or a little off. However, the **amplitude** (volume) and frequency of sound energy are measurable in units called **decibels** and **hertz**.

Amplitude is a measure of the height or intensity of the sound wave, the loudness. This is the force of the sound pressure hitting our ears. The unit of measure of loudness is called the decibel (dB). It is named in honor of Alexander Graham Bell who invented, among many other things, the telephone.

Noise	Decibels
Loudest possible noise	194
Jet engine	140
Train whistle	90
Normal talk	60-70
Library talk	30
Silence	0

Decibels are measured in units of 10. Deci means 10. Every unit of 10 is 10 times louder than the unit below it. Here are some examples of sounds at different levels. Sound starts to be painful at about 125 dB, and it can do serious damage to our ears if it is at 140 dB for very long.

The unit for measuring the frequency of a sound is the hertz (Hz) named after the German physicist Heinrich Hertz. (See more about frequency on page 4.)

You might have heard the "tuning up" sounds of instruments in an orchestra before a concert. The conductor will sound the concert pitch, usually the A above middle C, which is measured at 440Hz. Each instrument is then adjusted to match that sound so that all instruments are playing "in tune." Otherwise, out of tune instruments playing together produce **dissonance**, a combination of sounds that is very displeasing to the ears.

The conductor also controls the loudness and softness of the music in the orchestra. He uses his baton and his hand movements to signify greater or lesser volume. The musical notation for loudness and softness is written on the music sheets for the players. The symbol for loudness is f, which means "forte." The symbol for softness is p, which means "piano."

There is a lot more to pitch and volume than we realize. We can measure it, and we can tell musicians when to increase or decrease through symbols and signals.

Activity

1. Sound the note A above middle C on a piano or pitch pipe. This is a sound that is 440 Hz. If you don't have a way to make this sound, go to http://www.seventhstring.com/tuningfork/tuningfork.html where you can hear all the pitches on a piano keyboard and see the Hz for each note.

Use your voice to match the tone and hold it. Do this with several different pitches. Put your fingers on your vocal chords as you do this to feel the vibrations in your throat. Notice how your throat adjusts the sound vibrations to change the pitch levels.

How does your throat feel as the pitch gets higher? How does it feel as the pitch gets lower?

2. Figure out your comfortable sound range using the website in #1 above. What is the highest and lowest pitch you can reach? What is the Hz of these pitches? The difference between your highest and lowest Hz is your comfortable sound range.

A Sound Effects Story

By David Cochran

Many years ago, before television, radio was the way people were entertained in their homes. Shows were done live because the tape recorder had not been invented. The actors had sound assistants to make sound effects to go along with the show. Since the listeners could not see what was happening, the actor's voices and the sound effects had to tell the story.

Children sat around the radio listening to stories coming alive over the radio. The only pictures of what was going on in the story were created by their own imagination. The scary tale below is a short story with sound effects. Gather the materials for the sound effects and assign people to do them. Pick a narrator and present it for your listeners just like the radio folks did in the 1930s and 40s. Listeners: close your eyes as you listen to the story. Use your imagination to make up your own pictures.

Narration	Sound Effect	To Make the Sound Effect
This is a very scary tale.	Ghostly sounds	Voice – soft "oooing" sounds
It was a dark and stormy night.	Wind, rain	Voice - a swooshing sound
The shutters were banging against the side of the house.	Wood swinging and hitting another piece of wood	Two boards, books, or notebooks
Thunder rumbled in the distance.	Thunder	Wave a metal sheet back and forth
I was scared.	Ghostly noises	Make ghost noises
The thunder got closer and a large crack of lightning struck outside the window.	Thunder, lightning crack	Wave a metal sheet back and forth Smack a ruler on a hard surface for the lightning
The lights went out.	Gasp, "Oh no"	Make with voice
I heard a voice, but I couldn't understand what it was saying.	Muffled talking	Talk into a pillow
The voice grew louder.	Louder but still muffled voice	Talk louder into a jar or pot
I could hear it coming closer.	Gasp	Make with voice
And closer	Shriek in fear	Make with voice
Slowly the door to my bedroom opened.	Creaking sound	Make a sound like a creaking door
I covered my head with my pillow and screamed.	Muffled scream	Scream into a pillow
"Are you all right?"	Mother's voice	Make with voice
I cough and sputter, "Mom?"	My voice, very scared	Make with voice
"Yes, dear, are you OK?"	Mother's voice,	Make with voice
"Oh, sure, I'm fine."	My voice, shaky	Make with voice
A loud clap of thunder explodes outside my window.	Thunder	Wave a metal sheet back and forth
I leap out of bed and run to my mother's side.	Footsteps	Paper cups on a desktop
"Of course, you're fine," my mother says.	Mother talks with a bit of laughter in her voice.	Make with voice
I crawl into mother's bed for the night.	Footsteps	Paper cups on a desktop

Sound Words

Onomatopoeia

Many words sound just like the sound they describe. The word "meow" sounds just like the sound a cat makes. Car horns often sound like "beep-beep." There is even a word for the web shooter that Spiderman uses — "thwip."

A word describes a sound, it is called **onomatopoeia** (on-o-mat-o-peea).

Here are a few examples:

- Hiccup — a hiccup
- Vroom — a car engine revving
- Zap — electricity arcing
- Tick tock — a mechanical clock
- Pop — a cork coming out of a bottle
- Sizzle — sound of bacon frying

Many animal sounds have become common words. For example, the noise a dog makes – woof – is onomatopoeia. These sounds are not just in English. Here is how "woof woof" sounds in other languages:

Chinese (Cantonese) *wou wou*
Croatian *vau-vau*
Finnish *hau-hau*

We use sound words all the time without thinking about where they came from. As you listen to others talk, be aware of the words that are based on a sound. You will become an onomatopoeia expert!

Activities

1. Go to http://www.writtensound.com. This site is filled with sound words. Click through the index to find a topic of interest. Make a list of your favorite sound words and share it with others.

2. Write a short story or script that includes at least 10 sound words.

This is perhaps the most famous onomatopoetic poem. Maybe it should be the official poem of our magazine!

Onomatopoeia
by
Eve Merriam
(1916-1992)

The rusty spigot
sputters,
utters
a splutter,
spatters a smattering of drops,
gashes wider;
slash
splatters
scatters
spurts
finally stops sputtering
and plash!
gushes rushes splashes
clear water dashes.

Learn more about Eve Merriam and her poetry at http://www.freewebs.com/poetry-project/

More Sound Activities

1. Try making up your own short story and adding your own sound effects using your voice or props.
2. Make a podcast. This is an audio recording of your story. There are many recorded sound effects on the Internet. One site where you can find thousands of sounds is http://soundbible.com/free-sound-effects-1.html.

Write a short script, then add sounds that you download. You can use a sound editing program like Audacity (http://audacity.sourceforge.net/)to record your narration and add the sound effects. Once recorded, you can put it on a web site or play it for others.

In Their Words

Here are some quotes about sound. Have you heard them before?

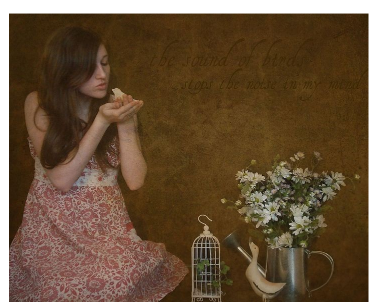
"The hills are alive with the sound of music."
~Lyricist Oscar Hammerstein II
Play/movie: The Sound of Music

"Everybody should have his personal sounds to listen for – sounds that will make him exhilarated and alive or quiet and calm…One of the greatest sounds of them all – and to me it is a sound – is utter, complete silence."
~Andre Kostelanetz

"The empty vessel makes the loudest sound."
~William Shakespeare

Peter Morgan, Wikipedia Commons
Indonesian bowl

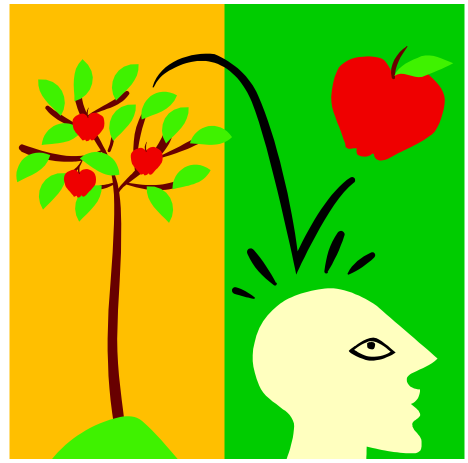
"Music is what feelings sound like."
~Author Unknown



Wikipedia Commons
Sound of birds

Discussion

Pick one of the sound quotes and tell in your own words what it means. Share your meaning with others and see if they have different ideas about it.



Drop It

A Word Game You Can Play Anywhere

Drop It First read the word clue. Guess the word. Read the Drop It clue. Guess the shorter word. Do both words make sense? Example: A four-letter word meaning to get bigger. Drop it and it means something you do with an oar. Answer: **GROW**, **ROW**
Take turns finding the answers and then make up some of your own.

Word Clues	First Word	Drop It Clue	Shorter word
1. A four-letter word meaning what you do with your ears		Drop it and it means a body part.	
2 A four-letter word meaning to read through something quickly		Drop it and it is a metal container.	
3. A five-letter word meaning the vibration rate, or frequency, of a musical sound		Drop it and it is something you scratch.	
4. A six-letter word meaning the opposite of faster.		Drop it and it means the opposite of higher.	
5. A four-letter word meaning the sound of two hands hitting together		Drop it and it is something you get when you sit down.	
6. A six-letter word meaning to go on a journey from place to place		Drop it and it means a tangle.	
7. A five-letter word meaning what you think with		Drop it and it is a form of precipitation.	
8. A six-letter word meaning someone who plays a game or an instrument		Drop it and it is a single thickness in a pile of thicknesses.	
9. A five-letter word meaning to copy a figure by outlining it		Drop it and it means a running contest.	
10. A five-letter word meaning to gain new information		Drop it and it means to work for money.	

Answers on p. 28

Takkk, Wikipedia Commons
Victrola

Sound Devices through the Years

Humans have been making sounds for as long as they have been on Earth. In addition to making noises with their voices, early humans made sounds with instruments such as drums and horns. It was not until the1800s that humans learned how to store sound and transport it from one location to another. From then on, the sound device inventions kept coming and coming. Today we have ways of making, recording, and sending sound to all parts of Earth that would flabbergast our early ancestors.

No invention is a final product when it is first created. The dates listed here are important for each of the inventions, but they are not the exact dates of their creation. Here are just some of the sound devices that have changed our lives over the past 175 years.

Telegraph – 1835

Samuel Morse discovered a way to send electrical signals over wires. The telegraph used Morse code that changed dots and dashes to signals to send to a receiver.

Telephone – 1874

Tomasz Sienicki
Wikipedia Commons
Early telephones did not have dials . You had to tell the operator whom you were caling.

Elisha Gray and Alexander Graham Bell invented the telephone at the same time. Bell patented his telephone first. He gets most of the credit for the invention.

Phonograph - 1877

Thomas Edison with an early version of the phonograph.

In 1877, Thomas Edison found a way to cut grooves into a cylinder with tin foil around it. The grooves matched the sound waves that were spoken. "Mary Had a Little Lamb" were the first words recorded on his phonograph.

Radio – 1888

Heinrich Hertz was the first to discover and produce radio waves. He is the same person for whom the measure of frequency was named. Radio became popular after 1920, when station KDKA in Pittsburgh broadcast the first licensed radio program.

Talkies - Movies with Recorded Sound - 1926

Poster from the first "talkie," in 1928

Sound Devices through the Years, continued

Until the late 1920's, the only sound in movies was from a live piano player who accompanied the pictures on the screen. In 1926, Warner Brothers and Western Electric recorded piano playing and sound effects on a disc that was played with the movie. The next year the voices and songs were recorded, and *The Jazz Singer*, the first "talkie," played in theaters in early 1928.

Records - 1930

Fredrik Tersmeden

To make this portable record player from the 1930s work, you had to crank the handle. It played at a turntable speed of 78 rpm (revolutions per minute).

Edison's invention changed from cylinders to flat vinyl records. RCA (Radio Corporation of America) developed a way to produce flat discs that had the sound waves etched in its grooves. A needle would pass through the grooves and play the sound over a speaker.

Ponder

How do you think sound and pictures will be transmitted in 2050?

Magnetic Tape Recorder – 1930's

Toki-ho, Wikipedia Commons

An open reel audio tape recorder

Tapes that used magnetism to record sound were developed in Germany. In the early 1960s, tapes became easier to use when they were put into small cartridges called cassettes. They gradually replaced records for storing sound.

Internet – 1969

The Internet was developed many years before it became popular. In 1969, the military worked with universities to develop a communication system that would not completely crash in case of a nuclear attack. It became a major commercial communication form in the late 1990s. Today, many feel that it has completely changed the way we live and communicate.

Cell Phones -1973

The earliest mobile phones were invented in the 1920s.

Through the years, police departments and others used mobile phones using radio signals to communicate wirelessly.

Today, cell phones work by sending digital signals to cell towers. The first call from a cell phone was made in 1973. By 1983, the first cellular network was set up in Illinois.

Compact Disc (CD) – 1979

Electronic companies Phillips and Sony combined efforts to produce the first Compact Disc - Digital Audio. They used technology from the unsuccessful laser disc to store sounds on a disc digitally. From this invention, the CD – ROM disc was invented to store data of all types for computers.

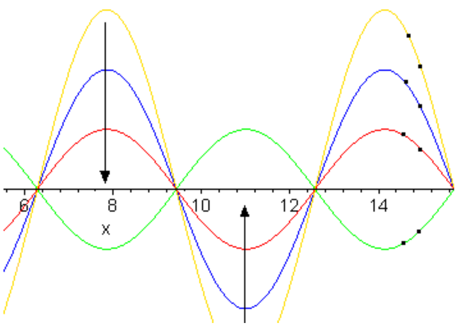
MP3 – 1998

MP3 is a way of compressing sound so that it can fit into a small file to be stored in small MP3 players such as an iPod. MP3 means "MPEG-1 Audio Layer 3" which refers to the Motion Picture Expert Group that sets standards for compressing and sending sound.

Activity

Explore an invention in more detail. Working with a team or by yourself, pick one of these inventions.

- Brainstorm questions you have about the invention and its inventor(s).
- Do research in the library or on the Internet to answer your questions.
- Using your favorite medium (writing, drawing, singing, dancing, video, audio, etc.) share your questions and answers about the invention.



Star of David, Wikipedia Commons

Sound wave

Scientists Are People Too

To see, we must open our eyes. To touch, we reach out with our hands. To smell, we sniff the air. To taste, we put something in our mouth. But to hear, we don't do anything. The idea that sound is carried by waves most likely came about a long time ago by observing water waves. Sound comes to our ears momentarily and then it goes just as quickly.

How are sounds made? How do people hear? Here are some scientists who attempted to answer these questions through the **physics of acoustics.** They observed, experimented, and came up with inventions that have led to today's **technological** world of sound.

Hooke

Robert Hooke (1635 – 1702) is regarded as the most **influential** and **experimental** scientist of the 17th century. This is strange because even with his many inventions and discoveries, he is relatively unknown.

A **chronology** of his work is at: www.rod.beavon.clara.net/chronolo.htm

Through his study of sound, Hooke discovered that sound waves could be "seen" by putting flour on a glass plate and pulling a violin bow across the edge of the glass. The sound of the bow on the glass made the glass vibrate and the flour move into patterns of the sound waves. He invented the first ear trumpet to aid people who were hard of hearing. His findings on sound have influenced other scientists on through the next two centuries — including Thomas Edison's first recording of the human voice in 1877.

Chladni

Ernst Chladni (1756 - 1827) was a German physicist and musician. He continued on with Hooke's work on "seeing sound" waves. Chladni's diagrams of sound wave patterns in sand, caused by vibrations of a violin bow, showed that sound can move physical matter. His diagrams, called Chladni Figures, so intrigued Napoleon, the Emperor of France, that he ordered a command court performance. He then announced a prize to anyone who could explain how this worked.

Germaine

Sophie Germaine (1776 – 1831), a French mathematician, was studying mathematics in secret. Math was not considered a ladylike thing to do. However, she came up with the explanation of how the Chladni Figures worked — how sound moved matter. She received Napoleon's gold medal for her explanation of this phenomenon. Hers was the only entry.

Edison

Thomas Edison (1847 – 1931) was a major American inventor credited with creating the modern world of technology including the light bulb. In addition to his many inventions, Edison re-worked Hooke's experiments with the ear trumpet and invented the megaphone. Now the human voice could be heard two miles away. In 1877, he made the first sound recording of the human voice on his phonograph. Edison's work with sound was a large part of his 1,368 patented inventions.

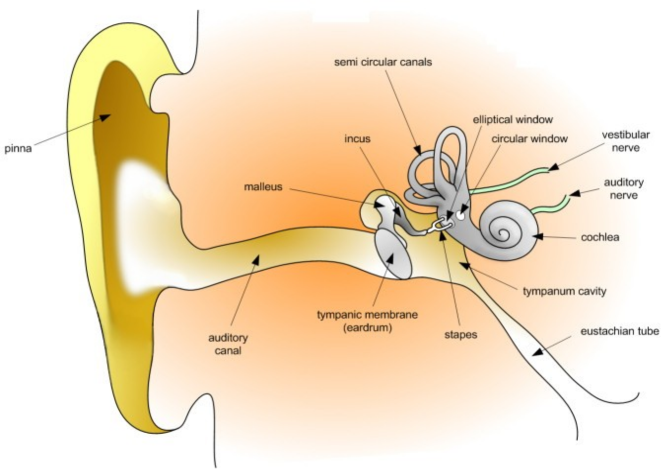
Activities

1. Use resources in the library or Internet to find out more about one of these scientists.
2. For an amazing listing of Edison's major inventions, go to www.thomasedison.com/Inventions.htm Choose one of his inventions, research more about it, and present your findings to your class. Tell why you chose it and why it is important.

Wired for Sound

By Randi Lynn Mrvos

People without the sense of sound live in a world of complete silence. For people who can hear, that is hard to imagine. What would it be like without hearing laughter, music, or friends talking with you? Suppose you couldn't even use the telephone? When you close your eyes, and you don't see anything, you can sense what it's like to be blind. But you can't really close your ears. Even the best ear plugs can't completely shut out sound.



dpickard, Wickipedia Commons

Human ear

How Do We Hear Sound?

Let's say you ring a bell. The outer ear funnels the sound waves through the ear canal and to the eardrum. When the sound waves strike the eardrum, they cause **vibrations.** The vibrations pass to the small bones of the middle ear. These bones, the **ossicles,** amplify the sound vibrations. The vibrations travel to the inner ear, which contains the **cochlea,** the sensory organ of hearing.

Along the length of the cochlea are cells topped with bundles of hair-like tubes. These hair bundles move in response to the vibrations. Movement of the bundles sets off **nerve impulses**. The impulses pass through the auditory nerve and on to the brain. Then the brain interprets the signals as sound.

Cochlear Implant

Scientists have come up with a technology that brings sound vibrations to the hearing nerves in the inner ear. It's called a **cochlear implant**. Most hearing loss results from damage to the hair cells inside the cochlea. A cochlear implant bypasses the damaged hair cells and then stimulates the auditory nerve with electrical energy.

A surgeon implants the device next to the skull, behind the ear and under the skin. The device holds delicate **electrodes** which are threaded into the cochlea. The cochlear implant also contains a computer chip, an antenna, and a magnet, which keeps the **transmitter** in place.

The external parts of the implant consist of a microphone, a **speech processor**, and a transmitter. The microphone picks up sounds and sends them to the speech processor. The speech processor changes sound into electrical signals. The signals are sent to a transmitter worn on the head just behind the ear. Like radio waves, the signals travel from the transmitter through the skin to the antenna. When the electrodes pick up the signals, they stimulate the auditory nerve.

Turning On the Sound

About one month after surgery, the implant is turned on. The amount of electricity sent to the electrodes is "mapped" by an **audiologist**, a professional who evaluates and treats people with hearing loss. She makes sure that the sound is not too loud or too soft. For children who are born deaf, a cochlear implant enables them to learn to talk. Other children use the device with sign language to help them to communicate. Many cochlear implant recipients would recommend it to others with hearing loss. They find it easier to converse with friends, to enjoy school, and to participate in sports. Hearing can improve their lives.

The author wishes to thank Nancy Young (Medical Director, Audiology & Cochlear Implant Programs, Northwestern University's Feinberg School of Medicine) and Annelle Hodges (Associate Professor and Director, Cochlear Implant Program at the University of Miami) for their expertise.

Activities

Try some of these sound activities:

- http://www.suite101.com/content/listening-to-nature-activities-for-all-ages-a107818
- http://faculty.washington.edu/chudler/chhearing.html

Sound Can Be Dangerous to Your Health

Have you ever been watching television in a room with several people when someone says, “Turn that sound up. I can’t hear it.” So you turn it up.

Then another person says, “Hey! That’s way too loud. It’s making my ears hurt?” So you turn it down.

We are really very different from each other when it comes to how much loud sound we can stand before it starts to hurt our ears. At loudness levels of around 125 decibels, sound not only causes pain, but it can also lead to ringing in the ears, called tinnitus. If we experience loud sounds for a long time, it can even cause hearing loss.

To protect workers, the government has established a noise standard that is the law for all workplaces in the United States. The standard states that the loudest continuous noise level at work must not be more than 90 decibels over an eight-hour period.

Loud noises also come from places that we have little control over. If it is on TV, we can turn the volume down, but if we live near a highway or visit an airport, we may experience loud noises that we can’t turn down. The loud noises produced by machines are often called noise pollution. While there are laws to try to control these noises, not everything can be covered by laws.

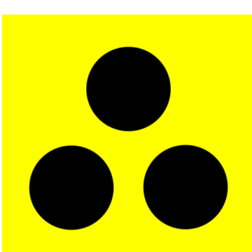
So what can we do if we are in a noisy situation we can’t control and our ears hurt? The natural thing to do is cover our ears with our hands. Babies do this to protect their ears. Another thing we can do is to walk away from the noise. The farther we get, the less the volume will be. If we know we are going to be close to a loud noise like a riding lawn mower or tractor, we can plan ahead and wear ear protection like noise-reducing earphones.

Perhaps the best thing we can do is to stay away from extremely loud noise situations. We have to protect our gift of hearing because we have only one set of ears. We need them to last a lifetime.

To Understand

1. How many decibels is a loud noise?
2. Name three ways loud noises are produced.
3. Name three things you can do if a noise is too loud for you.
4. How is the government trying to protect your hearing?
5. What else do you think should be done to reduce noise pollution?

Ponder



This is the universal symbol for deafness. When you see it, it means that there is someone nearby who cannot hear.

How should you act when you see this symbol?

Years before there were battery-powered hearing aids, people used hearing horns. The sound would be captured at the wide end and be channeled through a narrow tube to the ear. These horns helped direct the sound to the ear and reduce interfering noises.

Madame de Meuron with a hearing horn

Making Music

It's all about vibrations.

Have you ever wondered how music is made? It's all about the vibrations.

Brass

Lestat (Jan Mehlich)
Wikipedia Commons
A trumpeter plays a solo.

Brass instruments – vibrations are made by the player's lips blowing air through a shaped mouthpiece.

Strings

Strings – vibrations are made when the bow is drawn across the tightly stretched string and then sound resonates inside the hollow box of the instrument's body.

Roland Frisch
Wikipedia Commons
Guitarist Wallis Bird

Woodwinds

Woodwinds – vibrations are made when air is blown across the reed causing it to vibrate against the mouthpiece.

Wikipedia Commons
Clarinetists

Keyboards

AgnesHeinrich Böll Stiftung
Wikipedia Commons
Agnes Krumwiede am Klavier plays the piano.

Keyboards – vibrations are made by hammers striking strings of different lengths.

Percussion

Tom Pich, Wikipedia Commons
Percussionist Candido Camero

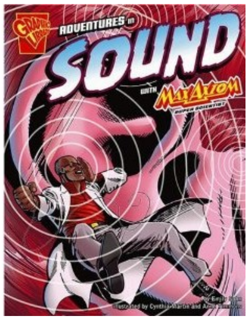
Percussion instruments – vibrations are made by striking, shaking, or scraping the instrument.

Activities

1. Go to: www.dsokids.com
2. Click on LISTEN to hear the different sounds that musical instruments make.
3. Click on ACTIVITIES AT HOME. Make your own musical instrument.

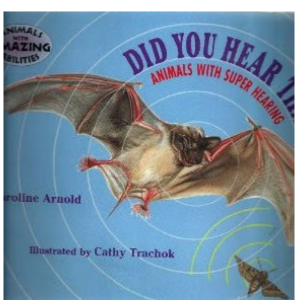
Sound Book Reviews

By Dr. Patricia Richwine



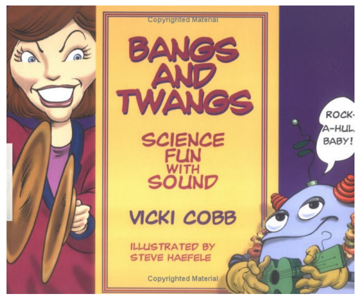
Adventures in Sound with Max Axiom, Super Scientist by Emily Sohn, 2007, Capstone Press

Are you ready? Super scientist, Max Axiom, is about to take you on a journey. He's going to learn about the sounds that are all around him and all around you. Max checks out *sonar*, *infrasound*, and *ultrasound*. He travels into space and under the ocean. Max shrinks himself to go inside a human ear. Use the code in this book to access sound-related FactHound web sites. This graphic science book is awesome!



Did You Hear That? Animals with Super Hearing by Caroline Arnold, 2001, Charlesbridge.

Did you hear that? If it was a bat, an elephant, or a whale you probably didn't hear anything. Bats use high-pitched sounds and echoes as a radar system to find directions and food. This is called *echolocation*. Elephants talk to one another in low, rumbling vibrations; too low for humans to hear. These are *infrasounds*. Humpback whales can also use very low sounds to communicate more than one hundred miles in the ocean. Find out how other animals and insects use ultrasounds and infrasounds that we can't hear.

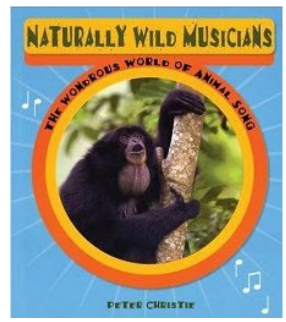


Bangs and Twangs: Science Fun with Sound by Vicki Cobb, 2000, Millbrook Press

Start with sounds you can make with your body. Move on to those you can make with things around your house. Try banging pots or gently tapping glasses. Find a rubber band, stretch it, and then pluck it like a guitar string. There are lots of ways you can make a screecher, which makes a screeching sound when you blow on it. Try a straw, a piece of paper, or a gum wrapper. Make your own bat-like super ears with paper cups. You can even send your voice through a walkie-talkie made with dental floss.

Cool Special Effects: How to Stage Your Very Own Show by Karen Latchana Kenney, 2010, ABDO Publishing.

Lights, camera, action! If you're going to produce a show, you'll need sound effects. It's easy to make the sounds of a crackling fire, thunder, boiling water or even a cricket with a few items from your home. You might also want to use recorded sound effects or music for certain scenes. You can be the sound designer and decide where sounds will enhance your production. Learn about lighting, special effects, and get scenery tips too.



Naturally Wild Musicians; The Wondrous World of Animal Song by Peter Christie, 2007, Annick Press

Animal songs are different from everyday animal calls. These songs are used to find a mate or to fight off a bully. Instead of singing, some animals, like the cricket, play tunes as if they are playing a fiddle. Deer, fish, insects, and even a tortoise use songs and tunes to attract mates. Walruses, birds, toads, and geckos have been known to use their songs to drive away enemies and competitors. Some animals, like bats and dolphins, use their songs to attract food. The silver perch has learned to stay quiet when the bottlenose dolphin is searching for food. Think about how you use your voice when you're looking for something to eat.

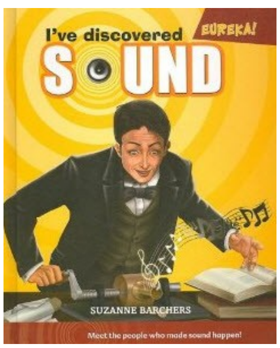
Continued on page 27

Library Connection

Sound Book Reviews, continued

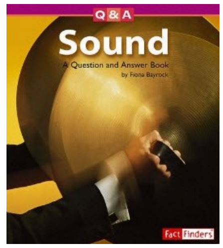
The Ear: Learning How We Hear by Josepha Sherman, 2002, The Rosen Publishing Group

The ear is much more than meets the eye. Most of the workings of the ear are inside the human head. The canals and nerves are complex and intricate. Not only do ears let us hear, they also help our balance. The ears allow you to stand and walk. If you are good at sports, you might thank your ears. If you like rock concerts and loud music, you may harm your ears and eventually need a hearing aid. That's what happened to former president Bill Clinton. Do some research to find out how hearing aids correct hearing loss.



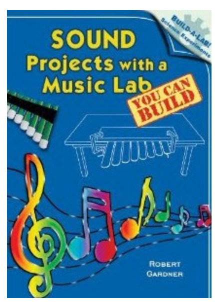
I've Discovered Sound by Suzanne Barchers, 2009, Marshall Cavendish

You are about to meet some amazing scientists. First, there's Alfonso Corti who, in the late 1800s, discovered the tiny hairs in the inner ear which vibrate to send messages to the brain. This part of the ear is called the organ of Corti. Also read about the scientists who invented stethoscopes, telephones, phonographs, radios, and what is known as SONAR. Best of all, you can make your own models and try some of the experiments that led to these great discoveries.



Sound: A Question and Answer Book by Fiona Bayrock, 2006, Capstone Press

Maybe you've wanted some answers to your own questions about sound. Would you like to know "How do ears work?" or "Why can't sound waves travel through outer space?" Maybe you just want to know "How can I make music sound better in my bedroom?" Learn some basics about sound, try the hands-on activity, and then think of more questions you have about sound. Use the FactHound Internet site code in this book to help you find your answers.



Sound Projects with a Music Lab You Can Build by Robert Gardner, 2008, Enslow Publishers

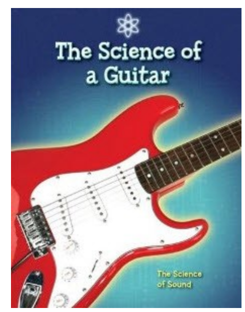
Whether you are entering a science fair competition or just want to make music, this book is for you. Start with the science of sound. Then move on to science and music. Learn about sound *frequency* and *pitch*. Find out how sound travels in solids and liquids.

Make a model to demonstrate *resonance*. Before you know it, you'll be creating your own string, wind, and percussion instruments.

Check out the list of science supply companies for special materials you might need.

Sounds Interesting: The Science of Acoustics by Dr. David Darling, 1991, Macmillan

The vibrations of sound are a form of energy. Make your own vibrations using a slinky and a broom handle. Use cardboard tubes to bounce sound off a wall. Try blindfolding a friend and have others form a circle around that person. See if the blindfolded person can identify the source of sounds she hears. Open an umbrella and use it to catch animal sounds and then record what you hear. Some of the experiments in this book can be developed into science fair projects.

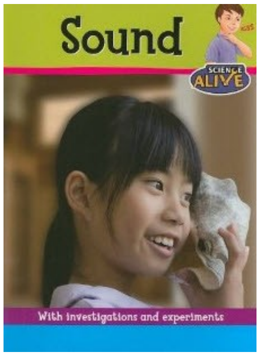


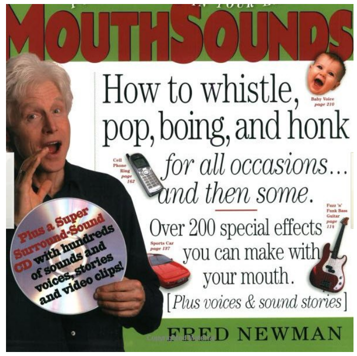
The Science of a Guitar by Anna Claybourne, 2009, Gareth Stevens

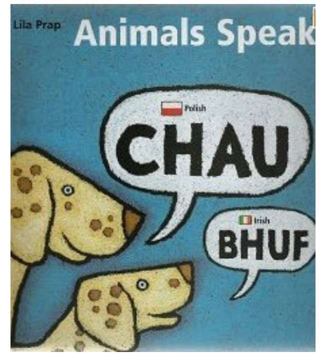
Instruments similar to guitars have been played for thousands of years. The strings are important but so is the size and shape of the box portion of a guitar or other stringed instruments such as the piano. The box part of an electric guitar is solid instead of hollow as in acoustic guitars. Banjos have a round-shaped body. Violins and cellos are played with bows instead of being plucked like a guitar. Find out more by doing some research about famous musicians and about valuable musical instruments like the Stradivarius violins.

Continued on page 28

Sound Book Reviews, continued







Sound by Terry Jennings, 2009, Black Rabbit Books

Can you actually see sound? Well, you can see sound vibrations traveling through air with a simple experiment. Did you know that there's no sound in space? That's because there's no solid, liquid, or gas for sound waves to travel through. How do astronauts communicate? What sound waves can clean coins? Ultrasound is the answer. Where's the special box in your body that makes sound? Put your hand on your throat and feel your voice box at work when you make sounds.

MouthSounds: How to whistle, hop, boing and honk for all occasions... and then some by Frederick R. Newman, 2004, Workman Publishing

We can whisper or yell. We can sing and talk. It's amazing the sounds a human mouth can make. With practice, we can make lots of sounds. Have you ever tried to make the sounds of a cow or a pig? What about a frog or a lion? Can you whistle? Maybe you can make the sound of a car or a train or a helicopter. You might even be able to make some rude noises but those might be better practiced in private!

Animals Speak by Lila Prap, 2006, North-South Books

Did you ever wonder what your cat or dog is saying to you? If you live in the United States, you may think you hear 'meow" or "woof, woof." What do you hear if you and your pets live in other parts of the world? What do farm animals around the world sound like? In the US a duck says "quack, quack" but if you live in Denmark, it says "rap, rap." Get out your globe and travel around the world to 41 countries to learn how to talk to 14 different animals. That's quite a trip!

Listen Up!

Listening is very important in every job, but there are some jobs that are using new ways to listen. In these Exploratorium interviews, you will hear how a wildlife tracker, acoustic navigator, instrument builder, car mechanic, and others use new technology to do their jobs.

http://www.exploratorium.edu/listen/online_watch.php

Answers to Drop It, p. 19

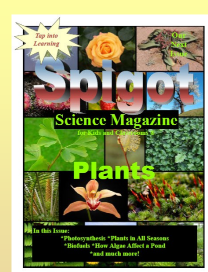
1. hear, ear
2. scan, can
3. pitch, itch
4. slower, lower
5. clap, lap
6. travel, ravel
7. brain, rain
8. player, layer
9. trace, race
10. learn, earn

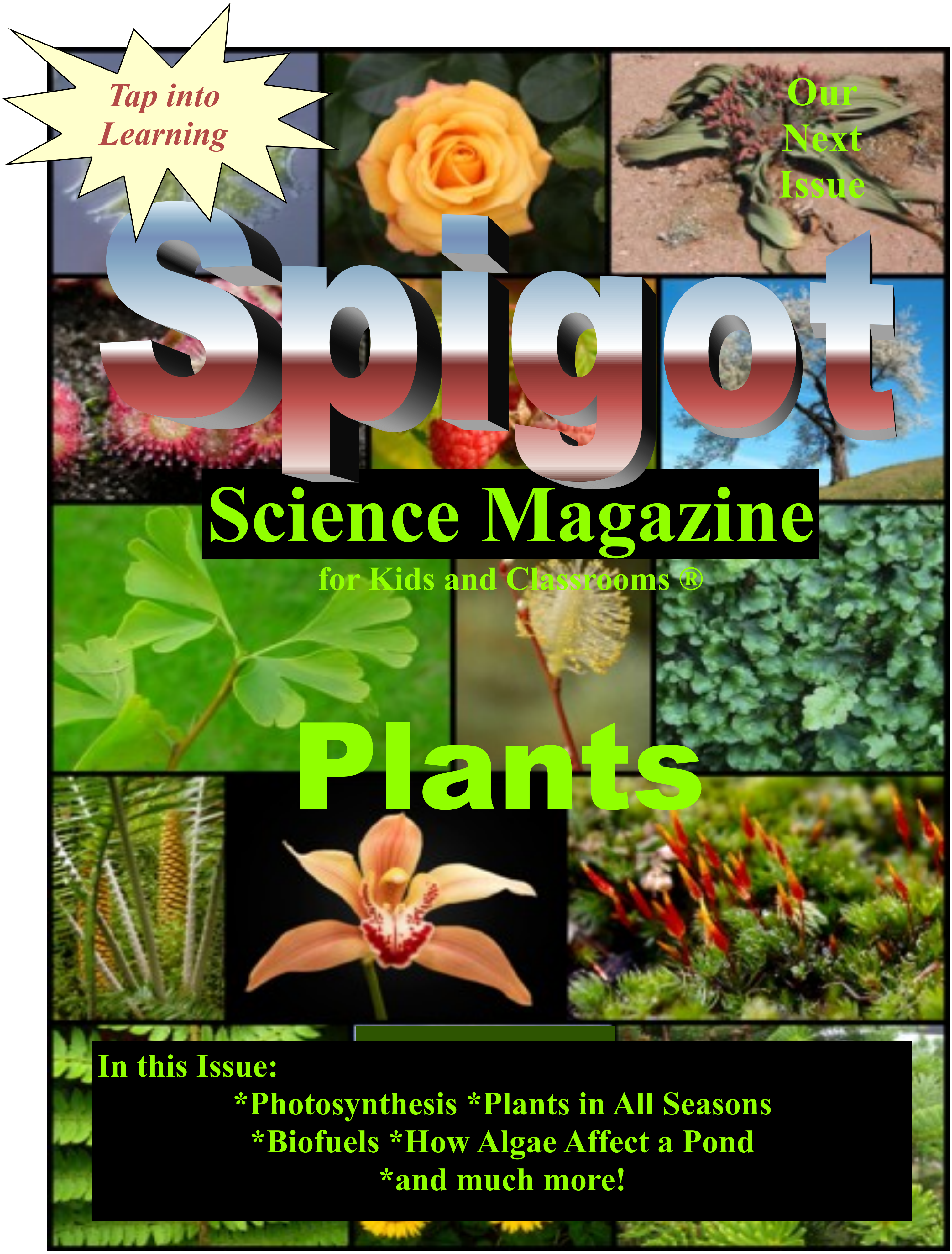
Future Spigot Issues

Plants — Spring 2011

Oceans — Summer 2011

Motion — Fall 2011

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In this Issue:
*Photosynthesis *Plants in All Seasons
*Biofuels *How Algae Affect a Pond
*and much more!