Good Vibes

Evelyn Glennie is a world-famous percussionist who appears in concert halls around world. She plays 60 instruments ranging from snare drums to marimba and timpani. She plays with classical orchestras, jazz bands, and pop stars. And she plays ... *barefoot*.

It's not a fashion statement. She performs without shoes so she that she can feel the music. Feeling the music is vital to her because she can't hear it. Glennie is deaf.

After she went deaf at age 12, Glennie taught herself to feel music. Her teacher would play the timpani, and she would put her hands on the wall so she could feel the vibrations from the instrument. She learned how to identify different notes by how she felt them. "The low sounds I feel mainly in my legs and feet," she says, "and high sounds might be particular places on my face, neck, and chest."

All music—in fact, all sound—is created when something is made to vibrate. When you hit a drumhead with a stick, it vibrates. When you pluck a guitar string, it vibrates. When you talk or sing, your vocal cords vibrate. Those vibrations create a disturbance in the air that is known as a sound wave.

So there are two ways we experience sound—with our ears, and with our bodies. Glennie says they're just different ways of hearing. When she performs, she "hears" the music with her body. Being barefoot allows her to feel the vibrations from her instruments much better than if she had shoes on. "And it's just more comfortable," she adds with a laugh.

The title of Glennie's autobiography is *Good Vibrations*. That says it all.

Photo: James Wilson/© Evelyn Glennie

Sound in Space

The battles in sci-fi movies are loud! But would a real space battle sound that noisy? Would you hear an enemy starship explode when you hit it with a shot from your laser turboblaster?

No. The battle would be silent. That's because there's no air in space. Space is empty—a vacuum—and sound can't travel through a vacuum. Without a medium such as air, sound has no way of getting from the source of the sound to your ear. So the tagline for the *Alien* movie had it right: In space, no one can hear you scream.

Illustration: blaster219

Bang a drum and the drumhead vibrates. Those vibrations disturb the surrounding air and get the molecules all agitated. They bump against each other and pass the vibration along from molecule to molecule. That produces a sound wave that travels to your ears, causing your eardrums to vibrate. Your brain interprets those vibrations as sound.

Sound waves don't only travel through gases such as air. They also go through liquids and solids. That's why you can hear the drummer next door, even though there's a thick wall between you.

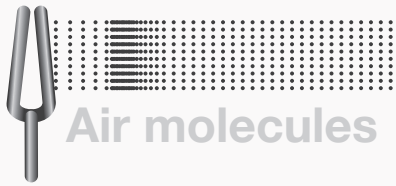
Seeing Sound

Sound waves are invisible. But here's a way to "see" sound as it travels from a source to your ear.

Musicians use a tuning fork to tune their instruments. It's a metal tool with a handle and two prongs. When you tap a tuning fork, it produces a single clear note. This illustration shows what happens to the nearby air molecules.

The tuning fork is still, and so are the air molecules around it.

When you tap the fork, it vibrates. As the prongs divide, they push nearby air molecules away.



As the prongs come together, they pull the air molecules back.

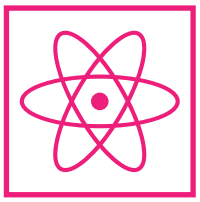
The molecules moving back and forth collide with the molecules next to them, causing them to vibrate. And those molecules bump into the ones next to them. That series of vibrations traveling through the air produces a sound wave.

Sound waves travel away from the tuning fork to your ear. But the air molecules don't actually travel all the way from the fork to your ear. Sound waves aren't like a breeze. Each single molecule only moves a small distance, passing the energy on to the molecule next to it.

Photo: D. Sniegowski

Types of Energy

Energy makes plants grow, lights our cities, powers our computers, cooks our food, plays our music. It's everywhere, and it takes many different forms.



Atomic Energy is produced when atoms are split. Nuclear power plants produce a tremendous amount of energy this way.

Chemical Energy is a form of potential energy that is stored in such things as food and gasoline.

Electrical Energy is produced by electrons moving through a substance. It lights our homes, runs motors, and makes our TVs, phones, and computers work.

Heat Energy is the movement of the atoms and molecules within substances. As the atoms and molecules move and collide faster, the substance heats up.

Light Energy is a form of radiation that travels as electromagnetic waves. These waves can carry energy through space and matter.

Mechanical Energy (kinetic energy) is moving energy. All moving objects produce mechanical energy.

Sound Energy is produced when an object vibrates. Sound waves travel out in all directions through a medium such as air, water, or wood.

Illustrations (top to bottom): The Noun Project; 3 Ryan Oksenhorn, from The Noun Project; 5 Boris Ruether, from The Noun Project
Photos (top to bottom): U.S. Nuclear Regulatory Commission; Pamela Graham; Dereks Key; Andreas; Alba Campus; Hindrik Sijens; Herbert Ponting

How much popcorn do Americans eat every year?

17 billion quarts. That's an average of 55 quart buckets for every person in the country. Since some people eat no popcorn, others are eating a lot more than that!

How high can a popcorn kernel fly when it pops?

Up to three feet!

What makes popcorn pop?

Each kernel contains a bit of moisture. As the kernel is heated, this water turns to steam. The kernel's shell is hard, which means the steam can't escape. That creates pressure inside the kernel. The pressure builds up until the kernel finally explodes and turns inside out. A popped kernel can be 40 times bigger than an unpopped one.

How many ways are there to cook popcorn?

Two, basically. One way is to apply heat directly. That's what happens when you pop corn in a pot or a Jiffy Pop pan on the stove, or use a hot-air popper. In those cases, heat is transferred from the source—an electric coil, flames, hot air—to the kernels. But most people cook popcorn in a microwave. And that doesn't involve applying heat.

What? How can you cook something without applying heat?

A microwave oven isn't hot when you open it because there's no heat source in it. Instead, it sends out electromagnetic waves (called microwaves) that penetrate food. That energy is absorbed by water molecules in the food and "excites" them—it gets them moving really fast. The movement causes friction, and friction produces heat (just like when you rub your hands together). As the water heats up, it turns into steam. The steam cooks the kernels and turns them into the fluffy white puffballs Americans love to eat.

Photos (top to bottom): 1 Erwin Soo; 3 Renee Comet

In the Old West, hunters searching for buffalo would sometimes get off their horses and put an ear to the ground. They were listening for the sounds of a herd in the distance. But why would putting an ear to the ground be better than listening for sounds carried through the air?

The answer is all about molecules.

Picture a closely packed line of people, and someone in the back gives the next person a push. That person bumps the person in front of them, who bumps the next person, and so on all the way down the line. In the same way, a vibrating object gets molecules in matter (such as dirt or air) to "push" against each other. That's how sound travels from one place to another.

But sound travels through different substances at different speeds. For instance, sound travels through the ground faster than it does through air. Why? Because the molecules of a solid are packed closer together than the molecules of a gas. Molecules in the ground are closer together than molecules are in the air, so they bump into each other more easily.

Since sound waves travel through the ground faster than they do through air, the hunter who put his ear to the ground would hear an approaching buffalo herd sooner than he would have if he'd stayed on his horse.

Photo: Marc St. Gil, The U.S. National Archives