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Synthetic Materials—Plastic

Think about things around you that are made of plastic. Water bottles, plastic bags, sports equipment, and maybe even your chair can be made of plastic. Plastic is found in computers and cell phones, cars and airplanes, clothing and shoes, and toothbrushes and pens. There are more products made from plastic than any other material.

We know that everything comes from natural resources. So, what natural resource is used to make plastic? Most plastic is made from **fossil fuels**, which are the remains of ancient plants and animals. We have to dig very deep to get fossil fuels out of the ground where they have been buried for millions of years.

How do fossil fuels become plastic? They are heated and mixed with other things to cause a **chemical reaction**. In a chemical reaction, **molecules** are broken apart and rearranged. This means plastic is a **synthetic**, or human-made, material. Depending on the chemicals used, plastics can be hard or soft, stretchy or stiff, clear or cloudy.

One of the properties that makes plastic useful is that it lasts a long time. But this also makes plastic a problem. Natural materials, like paper and leftover food, will **decompose**, or break down, over time. Plastics will not! It can take from 400 to 1,000 years for plastic to decompose.

Think about it: If George Washington and the Founding Fathers had been drinking water from plastic bottles when they signed the Declaration of Independence, their bottles would still be around today.

1. What is a *chemical reaction*?
   - **a.** It occurs when molecules break apart and are rearranged.
   - **b.** It is a way to make natural resources.
   - **c.** It is something that lasts a long time.
2. What are some things you use every day that are made of plastic?

   _____ _____ _____
3. What are some problems caused by plastics lasting a long time?

   _____

   _____

   _____

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Non-Contact Forces

What happens when you kick a ball? Your foot puts **force** on the ball, making the ball move. This is called a **contact force** because your foot makes contact with, or touches, the ball.

What happens when you jump up into the air? You fall back down to the ground. You can't see anything pushing you down—there is no contact force. So what force makes you come back down? A **non-contact force**!

Non-contact forces push or pull on objects without touching them. There are many kinds of contact forces, but there are not very many non-contact forces. Here are two types of non-contact forces:

Gravitational Force

When you jump up, **gravitational force** is the force that brings you back down to the ground. Gravitational force, or as we call it, **gravity,** is an invisible force that pulls objects together. We feel Earth's gravitational force pulling down on us and on everything around us all the time.

Electromagnetic Force

Electromagnetic force is all around us—and in us! It's what holds **atoms** together. Atoms are what everything is made of, so electromagnetic force holds everything together! We can see electromagnetic force working in electricity and magnets. Depending on what the atoms are doing, this electromagnetic force can **repel** (push) or **attract** (pull). It can make your hair stand up, it can make a magnet work, or it can store information in a computer. Electromagnetic forces can even cause lightning!

1. A *non-contact* force can _____.

- **a.** pull on things
- **b.** push things
- **c.** act on objects without touching them
- **d.** all of the above

2. _____ forces pull objects together.

3. _____ forces can push or pull.

4. How is a *contact force* different from a *non-contact force*?

_____

_____

_____

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Mechanical Waves

Try this: Press your ear to your desk and tap gently on the desk. Can you hear the sound through the desk? The sound energy is carried by **mechanical waves** traveling through the solid matter of the desk.

Mechanical waves can only travel through a **medium**, or some sort of matter. They cannot travel through empty space. The energy in a mechanical wave travels when the particles in matter bump into one another. One particle passes energy to the next, which passes it to the next, and so on. It is similar to dominoes falling in a line. Each domino bumps into the next. The energy is transferred along the line.

The particles in a mechanical wave don't always move side to side like dominoes. Particles can move in different ways depending on the kind of mechanical wave it is and the medium. They can move up and down, side to side, or in circles. Particles can move closer together (contract) and farther apart (expand).

Remember, in a wave, the particles of matter move a little bit and end up back where they started. It's the *energy* that moves from place to place.

Mechanical waves include waves on the surface of water, sound waves, and seismic waves that travel along the ground in an earthquake. Mechanical waves can travel through gases, liquids, or solids, such as when you heard sound waves traveling through your desk.

1. In a *wave*, the _____ moves along from one place to another.
   a. energy **b.** matter **c.** medium
2. *Mechanical waves* can only travel through _____.
3. Name the three states of matter that mechanical waves can travel through.

_____ _____ _____

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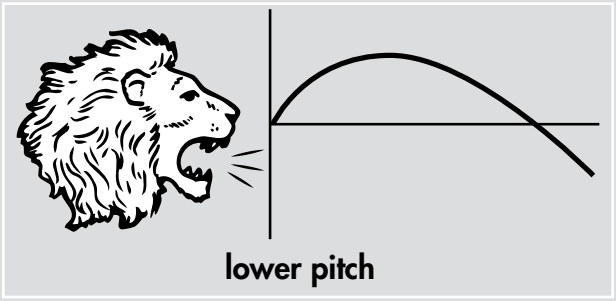
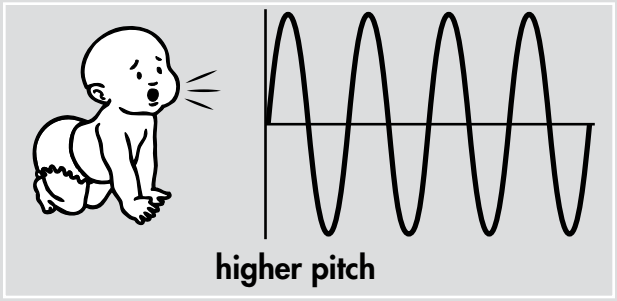
Sound Waves and Light Waves

Sound Waves

The wavelength and frequency of sound waves tell us about the **pitch** of the sound. Sound waves that have a short wavelength and a high frequency, like a whistle or a crying baby, have a high pitch. Sound waves that have a long wavelength and a low frequency, like the rumble of thunder or the roar of a lion, have a low pitch.



lower pitch

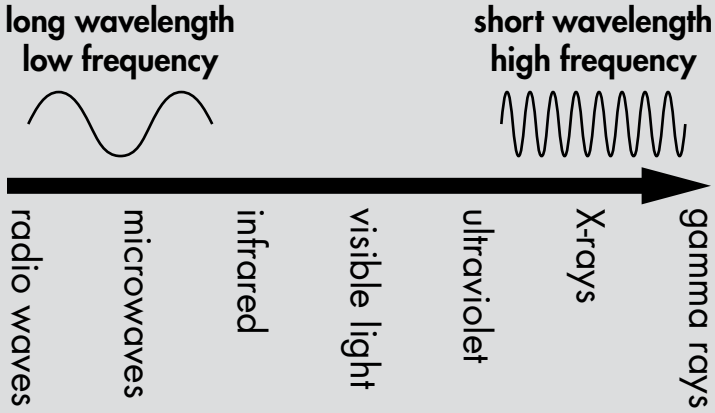


higher pitch

Light Waves

The wavelength and frequency of a light wave tells us what kind of wave it is.

- Radio waves have very long wavelengths and low frequencies.
- X-rays have very short wavelengths and high frequencies.
- The wavelengths of light that we can see lie somewhere in the middle.



1. Which sound has a low *pitch* and a low *frequency*?
   a. a whistle **b.** thunder **c.** a crying baby
2. Why does the sound of thunder have a low pitch?

   _____
3. Which light waves have the lowest frequency?

   _____
4. What is the difference between *pitch* and *volume*?

   _____ is the loudness or quietness of a sound.

   _____ is the highness or lowness of a sound.
5. What does the wavelength and wave frequency of a light wave tell us?

   _____

   _____

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Change in Ecosystems

Ecosystems are changing all the time. A **driver** is an event or process that causes change in an ecosystem.

Natural disasters, such as fires, hurricanes, and volcanic eruptions, drive ecosystems. These events can kill many organisms. The abiotic factors in an ecosystem can change, too. The most dramatic example is when lava from a volcanic eruption covers the land. It destroys or covers everything that was there before. The entire area becomes a field of rock. Over time, new species will populate the lava field. A new ecosystem will arise.

Invasive species are organisms in an ecosystem that don't belong there. They can reproduce quickly and spread aggressively. They kill or crowd out **native** species. Invasive species sometimes enter an ecosystem naturally, but often, humans bring them in. The fast-growing kudzu vine was brought to the southern United States from Japan as a way to control erosion. Kudzu vines can grow a foot each day in many directions. They quickly smother native plants and trees.

Pollution from human activity can get into the air, water, and soil of an ecosystem. As plants and animals use these resources, the pollution affects them as well. Jellyfish are sea turtles' natural prey. Discarded plastic bags floating in the ocean can look just like jellyfish to a hungry turtle. A sea turtle can die from eating just one plastic bag.

Resource use is when humans gather resources from the environment. We use them to grow food, build cities, and travel in vehicles. Sometimes, to get these resources, we drive change in ecosystems. We cut down trees to get wood and to clear land for farming. Forest ecosystems change completely when these trees are removed, and most of the forest species cannot live there anymore. For example, the orangutans in Borneo are critically endangered because the forests they live in are being cut down.

1. Which *driver* of ecosystem change is not caused by humans?
   a. invasive species **b.** pollution **c.** natural disaster

2. A _____ is an event or _____ that causes change in an ecosystem.

3. Name one *driver* and explain how it can change an ecosystem.

_____

_____