IT'S A SECRET!

Loo}p~~p~ YR^^
Wp¢pw zq Otqqtn¡w ¥E ?
R}lop]lyrpE V8=

ZaP]aTP b

In this activity, students explore how sound waves travel through various materials. They will build a sound transmission device capable of transmitting a secret message.

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]plw8 bz}wo ^ntpynp _z{tn~E

- An exploration of how sound waves travel
- An exploration of how sound waves travel through different media

Zmupn t¢p

Students will gain an understanding of how sound waves travel through different media by building a sound transmission device.

Xl p}tlw~ Yppopoqz}^ ¡opy Ln t¢t ¥

Materials Needed for Sound Transmission Device

- string
- wire clothes hangers
- spool of thin-gauge copper wire (or other thin wire)
- paper cups
- scissors
- pen/pencil (for poking holes in the paper cups
- wire clippers

YR^^ _s}pp8Otxpy~tzy~

^ntpynp lyo Pyrtypp}tyr [}ln tnp~	Ot~nt{wtyl}¥ Nz}p Topl~	N}z~~n¡ tyr Nzynp{ ~
Nzy~ }¡n tyr P¤{wlyl tzy~ lyo Op~trytyr ^zw¡ tzy~ • Use tools and materials provided to design a device that solves a specific problem.	**[^4 CE Information Technologies and Instrumentation** • People also use a variety of devices to communicate (send and receive information) over long distances.	**Influence of Engineering, Technology, and Science, on Society and the Natural World** • People depend on various technologies in their lives; human life would be very different without technology.

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^_P[^+QZ] *IT'S A SECRET!*

_plnsp}+[}p{l}l tzy+

Straighten out the wire hangers that you will be using for the activity ahead of time. Then, using the scissors and wire clippers, prepare several lengths of string and copper wire that are the same length as the unfolded hangers.

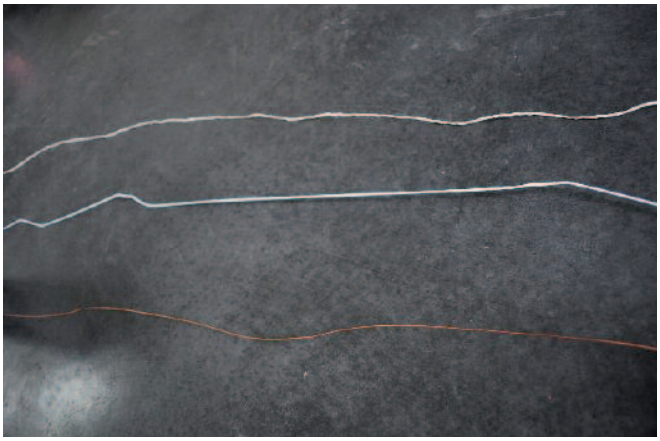
Depending on the level of the class, you may wish to build a sample transmission line out of each material before the activity so that students have a model for their transmission lines.

<9 **b l}x8¡{+Ln t¢t ¥£** Have students tap lightly on their desks with their fingernails or a pencil and listen to the sounds they hear. Then, have them lower their ears to the desk and tap again. Ask students how the sound changed when they put their ears to their desks. Students should note that the sound seemed louder. Have students think about why this might happen.

Next, ask students to think about times when they have heard sounds through materials other than air. Prompt them to think about sounds they have heard underwater, or through the walls of their homes. Tell students that in this activity, they will use the idea that sound travels through different materials to build a device that will successfully transmit secret messages from one person to another.

=9 Show students the materials they will be working with for this activity. Hold up a ball of string, a coil of copper wire, and a (folded) coat hanger. Explain to students that they will be using these materials to create to create transmission lines for sound. Each transmission line provides a path for the sound to travel along.

+Divide students into teams of three to five,then distribute the prepared materials and Student Handouts. Allow students to observe the properties of each material by touching, bending, tapping, and listening to each material. Then, have students guess which material will make the best transmission line. Each team should select one material to use to make transmission lines. Encourage teams to pick different materials then neighboring groups so that there are a variety of transmission lines.



^_P[^+QZ] *IT'S A SECRET!*

>9 Begin assembling the transmission lines.

Have students construct their sound transmission lines by attaching a paper cup to each end of the string or wire. Instruct students to use caution when working with the wire (hangers or copper wire), as the wire can be sharp. To create wire transmission lines, students can poke each end of the wire through the bottom of the paper cup and then bend the end of the wire so that the wire is secured to the inside of the cup. To create the string transmission line, students can poke a hole through the bottom of the paper cups (using a pen or pencil). Then, they can insert each end of the string through the holes and tie the string into a thick knot to secure it in place.

?9 Allow students time to experiment with their transmission devices.

Have each group try talking into the cups of their transmission line to see the sound transmits through the device. Give them a few minutes to make any needed changes to their devices based on their observations.

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@9 Develop a secret message to send along the transmission line.

Instruct each group to develop a secret message. The message should be short, no more than a sentence. Remind students to keep their message appropriate for the classroom. Instruct students to work quietly so that other groups cannot overhear them. Then tell students that one member of the group will send the message over the transmission line to a person from another group.

A9 Test the transmission lines with the secret message.

Have two groups come to the front of the class and exchange their secret messages over their transmission lines. While they are doing so, the rest of the class should listen carefully to see if they can "intercept" the message. Then, have the next two groups come up. Continue in this manner until all groups have attempted to send their secret messages. Ask each group if they were able to receive the other group's message. Then ask the class as a whole whether they were able to "intercept" any of the messages.

B9 b}l{8`{+Ln t¢t ¥E+After all groups have sent their secret messages, bring the class back together to discuss the activity. Have students think about why they were able to hear sound that traveled through a solid piece of material but they couldn't hear that same sound through the air. Explain when you make a sound, tiny particles in matter start to vibrate, and bump into other particles. This movement transmits the sound. To help students visualize this concept, have them think about a crowded room of people. Each person represents a particle. If a person on one side of the room stumbles and accidentally pushes the person next to him or her, that person will then bump into the next person, who will bump into the next person, and so on, until the person on the far side of the room eventually feels the push. Sound travels in a similar way. When a person talks into the paper cup on one side of the sound transmission line, the particles in the wire or string to vibrate and bump into each other. The sound then travels along the wire or string until it reaches the other end, where the other person hears it.

Remind students that the particles in solid materials are packed together very tightly, like the people in a crowded room. However, the particles in the air are much farther apart from each other. This is like a room with only a few people in it. If a person on one end of the room is pushed, that person might bump into the next person, but the strength of the initial push will be much weaker each time the push is transferred, because the people have so far to travel before they bump into each other.

It's a Secret! P¤ py~tzy+Ln t¢t tp~

Challenge students to develop simple experiments to test how sound travels though different mediums. For example, students can test how the sound from simple musical instruments, such as wooden blocks, changes when they are placed underwater. Is the sound still audible? Have students try testing several sounds, and observing what happens to the sound.

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b s l t~ ~z ¡ yoJ

We hear sounds all around us all the time. Sound is one form of energy. It is produced when something makes particles around us vibrate. For example, when we speak, our vocal cords make the air in front of our mouths vibrate. When we clap our hands together, it makes the air around our hands vibrate. Our ears can recognize differences in these vibrations. This allows us to hear many different kinds of sounds.

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Like light, sound is a kind of energy that travels in waves. When a sound is created, the vibrating object makes the particles around it vibrate. These particles bump into nearby particles which then bump into other particles, and so on. This process allows the sound to be transmitted. One way to think about sound transmission is to imagine a line of small springs hanging next to one another in the air. If you tap a spring on one end, it will start to vibrate, causing the next spring in the line to vibrate, and so on.

b s¥ oz ~z ¡ yo £ l ¢p~ } l ¢pw mp p} s}z ¡ r s np} lty ¥ {p~ zq x potlJ

Sound can travel through solids, liquids, and gases. If you were to place your ear on a table and someone taps the opposite side of the table, you would be able to hear the tap more clearly than you would through the air. This happens because the particles in solid objects are packed closely together. This lets them transmit the vibration very quickly and without much energy loss. The particles in gases are much farther apart. When a sound causes a particle to move through air, it must travel a greater distance before it hits another particle. This makes it lose more energy as it travels. The result is that the sound can't travel as far.hysical weathering is a process that breaks rocks down from large to small pieces. It can happen as a result of wind, gravity, water, ice, or other natural forces. Erosion is the process by which the weathered particles are carried away from their source. Other types of physical weathering might result from the freeze-thaw cycle. Water within a rock expands and contracts, causing the rock to crack. If a plant seed embeds itself in this crack, it may begin to grow. This will force the rock to split and allows more weathering to occur. You can often see this kind of weathering in sidewalks.

b s l t~ nsp x tn l w £ p l sp}ty rJ

Chemical weathering occurs when water that contains chemicals washes over rock. Chemical reactions take place at the molecular level. The individual mineral grains within the rock react chemically with molecules in the water. Over time, the chemical makeup of the rock changes. Acid rain is a common source of chemical weathering.

Vp¥ azn l m ¡ w l }¥

~z ¡ yo vibrations that travel through a medium

} l y~ x t~~tzy the action of something moving from one place to another

{ l } tnwp a small piece of matter

wt x p~ zyp a sedimentary rock usually formed in warm shallow seas from the shells of sea creatures

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PLNSP]+SLYOZ`

What material did your group use for the transmission line?
[Sample answer: Our group used string for our transmission line.]

Draw a picture of your completed transmission line. Label each material.
[Images will vary, but should contain labels denoting the material and the paper cups.]

With your group, decide on a short secret message. Write it below.
[Answers will vary.]

Was your team successful in sending your secret message?
[Sample answer: Yes, we are able to send our message to the other team.]

Was it easier to hear the messages through the transmission line, or through the air when you were sitting at your desk?
[Sample answer: It was easier to hear the messages through the transmission line.]

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Date:

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