Lesson: “What would happen if you screamed in outer space?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! When you go swimming, have you ever tried to talk underwater? Like this little boy here. Listen. Now, if you haven't tried this before, you can hear it is possible to talk underwater. It sounds a little garbled. But some sounds, like the sound of two solid things hitting each other, sound really loud and clear underwater. Now check this out. This is a construction worker using a jackhammer underwater. Listen. You hear how well you can hear that? It turns out sounds can even travel really long distances when they're underwater. Scientists invented underwater microphones for listening to what sounds might be found in the ocean. And when they did that, they heard sounds like these. Do you know what that is? This is the sound of whales calling to each other. In fact, scientists realized that each type or species of whale has their own special sound that they make in order to talk to each other. These are the sounds of humpback whales that you're hearing. But a different kind of whale, pilot whales, sound like this. Ready? Sound travels so well through the water that whales are able to communicate or talk to each other across hundreds of miles of ocean. Now, it might have come as a surprise to you that sound travels through water like this. But sound can go through lots of different materials. If you've played with a paper cup telephone, you know that sound goes right through the string, too. As you talk, you can feel that you're creating vibrations in your throat, which travels to the paper cup, and then from there, you can actually feel the vibrations in the string. And then the person

on the other side, if they touch the bottom of their paper cup, they can feel the vibrations from your throat all the way on their end. The vibrations go from one place to the other. It's the same thing in the case of a whale making sounds in the water. The whale creates vibrations from its voice-producing organs in its head, and it sends those vibrations out into the water. The water itself vibrates slightly when a whale makes sound. What about when you're talking to your friends in a room? I mean, you know you can feel the vibrations in your throat where you're making this sound. But are vibrations really traveling outwards from your throat to your friends' ears? If they are, it's not like there's water or string that can carry those vibrations. So are there vibrations going through the air when we're talking? It doesn't seem like it. We don't feel any vibrations in the air when people are talking to us. But it could be that they're very small vibrations, though. So how could we find out? Do you think there are vibrations in the air when we talk to each other? Could you think of a way to find out?

ACTIVITY INTRODUCTION VIDEO

Today you're going to do two short activities. For the first activity, you're going to be using a balloon as a sound detector. We'll do that now. I'll show you what to do, step by step.

ACTIVITY PART 1 STEP 1

Find a partner. Decide who will be the Big Noise and who will be the Hum Feeler. Don't worry, you'll change jobs later. Click the arrow on the right when you're ready to move to the next step.

ACTIVITY PART 1 STEP 2

Get your supplies. Each group needs these.

ACTIVITY PART 1 STEP 3

Big Noise: stretch the balloon and blow it up. The bigger, the better. You'll tie it in the next step, so just hold it closed when you're done.

ACTIVITY PART 1 STEP 4

Hum Feeler: twist the balloon's neck, like this. Then fold it over, like this. Big Noise: clamp the clip on the fold. Now, your balloon is tied.

ACTIVITY PART 1 STEP 5

Hum Feeler: hold the balloon in front of you. Big Noise: try saying OHHHH in a low voice. Hum Feeler: what do you feel?

ACTIVITY PART 1 STEP 6

Switch jobs and try it again. Big Noise: say OHHHH in a very low voice. Hum Feeler: what do you feel?

ACTIVITY PART 1 STEP 7

Discuss these questions as a group.

ACTIVITY PART 1 STEP 8

You have two minutes to try some more experiments. You could try holding the balloon different distances. Or making different sounds, like humming or whistling. Pay attention to what you feel in the balloon when you make a change.

ACTIVITY PART 1 STEP 9

Put the balloons away, then watch the next video.

EXPLORATION VIDEO 2

When you make a sound, you create vibrations in your throat. Those vibrations travel out of your mouth and reach the balloon, making it vibrate too, even if the balloon is a few feet away. So sound vibrations do travel through the air. In fact, your ears work similar to this balloon. Inside your ear is a little part made of thin material, just like the thinness of a balloon. It's called your eardrum. When someone or something makes a sound, the vibrations from that sound go through the air, into your ear, and then make the ear drum vibrate, just like a drum vibrates when you hit it. Whenever your eardrum vibrates, that sends a message to your brain, letting you know you're hearing a sound. Now, you might wonder: if sound vibrations are in the air all around you, why can't you feel the air shaking or see the air vibrations, even? Like, as someone talks to you, or if someone plays music, could you notice someone's hair vibrating back and forth? Well, maybe the vibrations are just too small to notice. Maybe if we made the sounds louder, then we'd notice something. So let's see. This person is going to hold a balloon over a speaker with really loud music coming out of the speaker. It's going to be just like the experiment you tried, but with louder sound. Now, I've turned the sound off so that you can just

see what happens. Ready? Here we go. You see that? The entire balloon jiggles back and forth. So you can really see the vibrations. Let's see if it gets even louder. Here's a birthday balloon in someone's car when someone is blasting the radio. Now this time I've kept the sound on, but not so loud that it hurts your ears. You would not want to be in this car without ear protection. You can really see those vibrations, can't you? Well, what happens if the sound gets even louder? Could the vibrations be big enough to—you know where I'm going with this, right? Keep an eye on this windshield. Watch as these people—who, by the way, really ought to be wearing ear protection—experiment with the vibrations from the really loud speakers in the back of their car. And here's a close-up of the speakers. Watch what happens. That windshield is a goner. And here's one more time. This time, this person is wearing ear protection, and they've got an old car where they're going to see if they can deliberately make that windshield shatter as quickly as possible. Ready? Watch. So, the vibrations from the speakers are traveling through the air and are actually making the windshield vibrate back and forth? Really? How is that possible? I realize you couldn't see inside this car, but I'm telling you there's no big gust of wind going from the speaker to the windshield. All you can see is the speaker going back and forth and the windshield cracking and moving. Now, one way to figure out what's going on is to make a model that shows something that you can't see using things that you can see. So, in a minute, you're going to do an activity. You're going to make a model that uses people to show how sound travels from a car's speaker—this person will act as the speaker—through the air—these people represent little sections of the air—over to a windshield and break the windshield. Now in this activity, different people will play different parts of the problem you're trying to figure out. If you're in a classroom, your classmates can play the parts. If you're at home, get members of your family to help out. I'll show you how to do this, step by step.

ACTIVITY PART 2 STEP 1

Choose someone to be the car's Speaker and someone to be the car's Windshield. Have them tape a label on their shirt, like this.

ACTIVITY PART 2 STEP 2

Choose people to be the Air Blobs. We used four Air Blobs, but you can use more or fewer. Give them labels to wear, like this.

ACTIVITY PART 2 STEP 3

Speaker, Windshield, and Air Blobs—get some chairs and sit in a line, like this. The Speaker should sit on the far left, and the Windshield on the far right. Air Blobs, sit in between.

ACTIVITY PART 2 STEP 4

Speaker: wobble back and forth in your chair like the video below. Then discuss this as a group.

ACTIVITY PART 2 STEP 5

Here's our idea. Speaker: wobble back and forth, and push on the first Air Blob. Air Blobs: pass the wobble along until it reaches Windshield. Give it a try.

ACTIVITY PART 2 STEP 6

Discuss as a group.

WRAP-UP VIDEO

When you make a sound, you really are making vibrations go across a distance. Now, in the case of talking into a string, or in the case of making a sound underwater, you know that there's some stuff, or material, that the sound is vibrating. The sound vibrates the string, or the sound vibrates the water. But when we're just talking to each other in a room, we don't think of sound vibrating anything. We forget the fact that there is a material around us all the time—air. So what would happen to sound if there were no air? If there were nothing, just emptiness? We could totally find out if only we could find a place without air. Can you think of a place where we could do that? Maybe you're thinking of outer space. There's no air in outer space, so we could do the experiment there. It's just a little hard to get there. Luckily, there's a device right here on earth that can create the same condition as outer space. It's this: a device called a vacuum pump. If that makes you think of one of these, that's actually not too far off. This is a vacuum cleaner. That uses suction to get dirt off your floor. Well, a vacuum pump is just stronger than that. Instead of sucking up dirt, a vacuum pump can be used to suck the air out of a container. So let's try it out. This vacuum pump is hooked up to underneath this little table, so that it will suck all the air out of this space. If you put a bottle in here with a little hole drilled in the top so that air can escape, watch what happens when you turn the vacuum pump on. Ready? The vacuum pump sucked all the air out of the bottle, leaving it completely empty. That's actually what the word vacuum means. It comes from the Latin word for empty. So by turning the vacuum pump on, inside this jar we've created the same condition as outer space, where there's no air. So what if we made a sound inside the jar and took out the air? What would happen? This is a bell. You hear that? Right now there's air all around it, so let's take it all out. First, we'll turn on the bell, and then we'll put it inside a jar. Then we'll turn on the vacuum pump, and it will start to

suck out all the air. OK, it's sucking out all the air, so listen. What happens as it does that? You hear that? There's no air left inside now. The bell is still ringing. It's not broken. But you can't hear any sound at all. You just hear the sound of the vacuum pump. So if we put the air back in, what do you think will happen? Now the air is coming back in. You hear that? And the sound is back. So you can hear a sound through air, but you can't hear sound in empty space. Why do you think that is? Why can't you hear sound in empty space? Well, if we think again of the idea that sound is a vibration, you can make sense of this. Because in order for there to be a vibration, there has to be some thing, some material or stuff, which is being vibrated. A string can vibrate, water can vibrate, even air can vibrate. But empty space? If we remove the air, then there's no way for sound to travel, because there's no material to vibrate. Sound is a vibration. If there's no material, there will be no sound. Keep that in mind next time you watch a movie when you hear a spaceship blowing up. You know, like this. Really it should sound more like this. Silent. It's not nearly as exciting as in the movies. Stay curious, and see your next Mystery!