Waves Traveling the Universe

Scene: Flash to Bang

While at their school's overnight camp, ***Denzel****,* ***Riley****, and* ***Jordan*** *are wading in a pond. The sky has grown dark.*

Jordan: Looks like rain.

Riley: Yeah, you can tell it's pouring already, way over those hills.

Denzel: Ooh! Can we go swimming in the rain? I've never done that!

Jordan: No way, not in a thunderstorm. Lightning can kill you.

Denzel: Is this a thunderstorm? We didn't have any where I grew up.

Riley: Oh, right. The California desert.

Denzel: Sort of. I was on the coast. Thunderstorms are really rare there. I never saw lightning until I moved here.

Jordan: Whoa! Did you see that flash?

Denzel: Oh, man, did I just miss it?

Jordan: Wait for it....

Riley: [*mumbling*] two Mississippi three Mississippi four Mississippi five Mississippi six...

Denzel: What does Mississippi have to do with anything? We were talking about California.

Riley: [*mumbling, a little louder*] ...15 Mississippi 16 Mississippi 17 Mississippi...

Jordan: I think that Riley is counting seconds.

Riley: [*mumbling, even louder*] ...20 Mississippi 21 Mississippi 22 Mississippi...

Jordan: Every "Mississippi" is another second. We should have used a stopwatch instead.

Riley: 32...Mississippi...

The thunder roars, "BOOM!"

Riley That must have been really loud right under the thunderclap, given how loud it is here, just about ... six and a half miles away.

Denzel: How do you figure?

Riley: You just count the seconds. Sound travels a mile every 5 seconds, so you divide the number of seconds by 5 to get the miles. In this case, 32 divided by 5....

Denzel: Ah, I get it. That's 6.4.

Riley: Yeah, like I said. About six and a half miles away.

Jordan: When I was a kid, the summer camp counselors called counting the seconds "flash-to-bang."

Denzel: Ha! "Flashtobang" would be a good superhero name.

Jordan: Well, it can save your life, for sure. At camp we had to seek shelter whenever we counted any less than 30 seconds from flash to bang.

Riley: Hmm. We were pretty close to 30.

Jordan: If you said Mississippi a little slower, we might have only gotten 29. If lightning strikes again, let's use my stopwatch, and leave Mississippi out of this. I've got it ready.

Denzel: Ooh! There's another flash of lightning! Go!

The three friends huddle around the phone.

Riley: [every five seconds] One mile... Two miles... Three miles...

The thunder roars a second time, louder, "BOOM!"

(continued...)

Waves Traveling the Universe

Scene: Flash to Bang

Riley: Whoa, just 18 seconds this time. It's getting closer. Grab your shoes. Let's head inside the concert barn.

Denzel: I don't get it. Why do we start counting when we see the lightning? Shouldn't we add the time that it takes for the light of the lightning flash to get to us?

Riley: It would be such a small number.

Jordan: Riley's right. Light travels at a million miles a second or so, am I right?

Riley: Not quite. It travels that far in about six seconds. Any place on Earth, though, is less than a tenth of a second away, when you travel at the speed of light.

Jordan: Denzel, traveling at the speed of light should be the superpower of your superhero, Flashtobang.

Denzel: Good idea! One thing I do know about light and sound is that they are both made up of waves. Why is sound so much slower than light?

Jordan: Hmm. That's a good question. Maybe they're different kinds of waves. Sound travels by moving molecules around, doesn't it? The speed of sounds must have something to do with how fast molecules bump into each other.

Denzel: But doesn't light from the lightning travel through the same air that the sound of a thunderclap does?

Jordan: Yeah... on the other hand, light can get transmitted without needing air or anything else to travel through, right, Riley?

Riley: Yup! Light can even travel through the vacuum of space, but sound waves can't. We can see stars billions and billions of light years away, but thank goodness we can't hear them! I bet they would roar!

Denzel: If sound waves can't travel through space, then how do radio telescopes work? Aren't they listening for sounds from extraterrestrial civilizations, from the far reaches the universe?

Riley: Radio waves are another kind of wave, more like light waves.

Jordan: That's confusing. Radios make sound. Aren't radios making sound waves?

Riley: Yes and no. Radios turn the waves into signals they send to their speakers, and speakers make sound. A radio receives radio waves that were transmitted from a radio station. Radio waves can be kilometers long!

Denzel: I guess those huge radio waves make the floor shake when we crank up the volume on the speakers.

Riley: Actually, the radio waves keep on going through the floor and out the door. It's the sound waves that make matter move. Speakers have parts that move in and out to make waves. The louder the volume, the more they move to make the sound louder. They aren't sound waves, though. Light waves and radio waves are part of the electromagnetic spectrum.

Denzel: Electromagnetic? That sounds dangerous.

Riley: Some electromagnetic waves are dangerous, especially out in space. The earth and its atmosphere and magnetosphere protects us from most electromagnetic waves—they are everywhere.

Jordan: Everywhere? I don't see anything...

Riley: Um... You don't see anything? Jordan, the only reason you can see ANYTHING is because of light waves!

The sky lights up with a crack of lightning that lights up the room at the same time that the thunder roars, the third, loudest "BOOM!"

Jordan: Whoa! We don't need my stopwatch to tell us where that storm is!

Denzel: [*looking a little jittery*] Yup. The floor's not the only thing shaking now!

Comprehension Questions

Why did the friends start counting when they saw the flash of lightning? How did they account for the time it took the light to get to them?

At the speed of light, what's the maximum amount of time it takes to get between any two points on Earth?

What is something light and sound have in common?

What can't sound waves do in the vacuum of space, that light waves can?

Are radio waves more like light waves or sound waves?