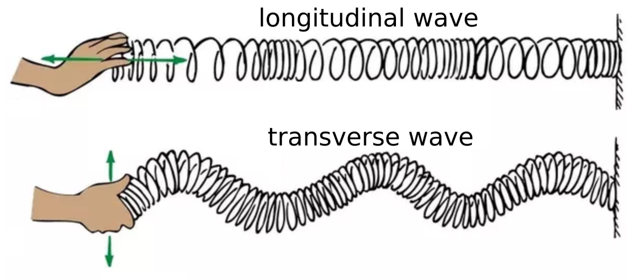
Standing Waves and Sound

- Waves are vibrations (jiggles) that move through a material
- **Frequency:** how often a piece of material in the wave moves back and forth.
- Waves can be **longitudinal** (back-and-forth motion) or **transverse** (up-and-down motion).



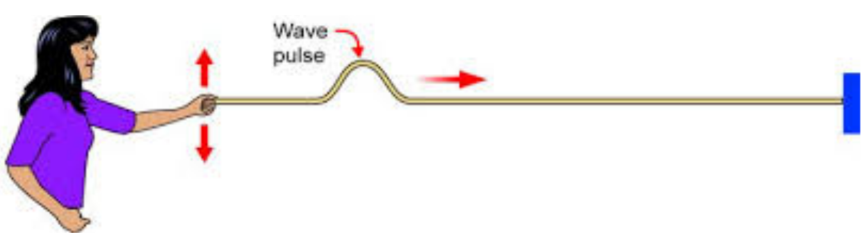
- When a wave is caught in between walls, it will bounce back and forth to create a **standing wave**, but only if its frequency is just right!
- **Sound** is a longitudinal wave that moves through air and other materials. In a sound wave the molecules jiggle back and forth, getting closer together and further apart.

Work with a partner!
Take turns being the "wall" (hold end steady) and the slinky mover.

Making Waves with a Slinky

1. Each of you should hold one end of the slinky. Stand far enough apart that the slinky is stretched.

2. Try making a **transverse wave pulse** by having one partner move a slinky end up and down while the other holds their end fixed.



What happens to the wave pulse when it reaches the fixed end of the slinky? Does it return upside down or the same way up?

Try moving the end up and down <u>faster</u>:

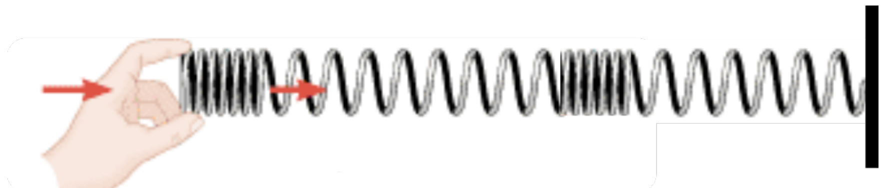
Does the wave pulse get narrower or wider?

Does the wave pulse reach the other partner noticeably faster?

3. Without moving further apart, pull the slinky tighter, so it is more stretched (scrunch up some of the slinky in your hand). Make a transverse wave pulse again.

Does the wave pulse reach the end faster or slower if the slinky is more stretched?

4. Try making a **longitudinal wave pulse** by folding some of the slinky into your hand and then letting go.



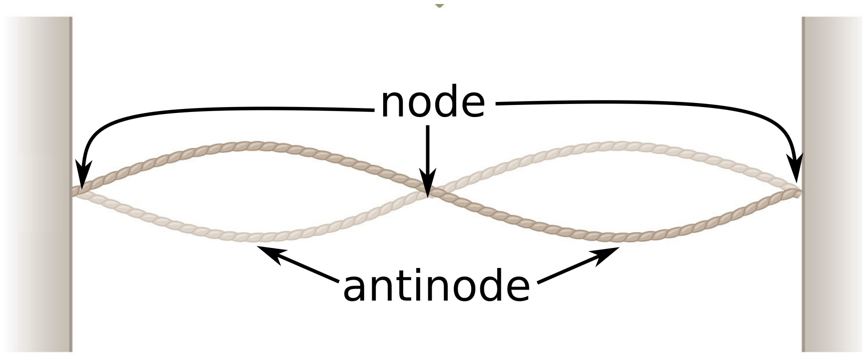
Slinky Standing Waves

1. Have one partner make a **transverse wave** by shaking the slinky end up and down with an even rhythm, while the other partner holds their end fixed.

2. Try shaking with different **frequencies** (faster or slower). Do not shake very hard – make small movements of your hand.

Can you find a frequency such that small movements of your hand make a large wave in the slinky?

This wave will look like it is standing still, with some parts of the slinky (the anti-nodes) moving a lot while others (the nodes) barely move. The special frequency you're shaking with is called a **resonant frequency** of your slinky.



How many anti-nodes does your standing wave have?

3. Can you find other frequencies that make different numbers of anti-nodes?

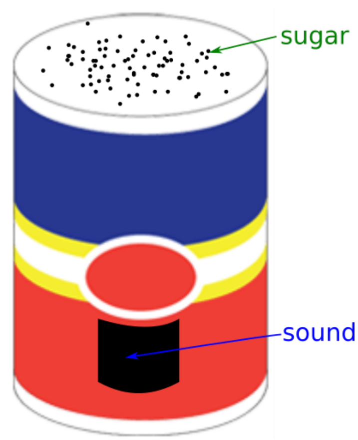
How many anti-nodes were you able to make?

4. If you pull the slinky tighter, do you have to shake with a higher or lower frequency to make a standing wave with one node in the middle?

When a string instrument (violin or guitar) makes a note, the string vibrates and makes a standing wave with certain resonant frequencies. The frequency of the vibrating string determines the frequency of the sound produced. We hear this as different pitches (high and low).

"Seeing" Sound

1. Cut a square hole (about 2" across) in the side of a cylindrical oatmeal container (about 2" from the bottom).



2. Sprinkle some sugar on the lid of the container.

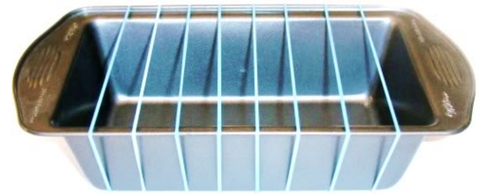
3. One partner should hum into the hole on the side, while the other observes the sugar on the lid. Try humming at different pitches (low vs high sounds). Then trade places.

What did the sugar do?

Was humming at some pitches more effective than others?

Sound is a wave – a vibration that travels through the air. Sounds are made by vibrating objects (your lips when humming, or the string of a guitar) which push air back and forth. When sound waves hit the lid, they make it vibrate in turn, making the sugar dance. If the frequency of the humming is just right to set up a standing wave in the container, the sound is amplified (becomes louder).

Rubber Band Guitars



1. Put several rubber bands of different thicknesses onto your box or can or cup so that the rubber band is stretched across the open end of the container.

2. Pluck the different rubber bands.

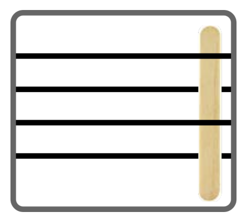
Do the thinner bands make a higher or lower pitched sound?

3. Based on what you learned with the slinky, make a prediction:

If you pull a rubber band tighter do you expect it to make a higher or lower pitch?

Try the experiment. Was your prediction correct?

This is how violin and guitar strings are tuned: by changing the tension!



4. Try inserting a craft stick through the bands towards one end of the container. This lets you make the strings shorter.

Do the shorter strings make higher or lower pitched sound?