Name ____ Date ___________ Period ________

Lab: Making a Model Eardrum

CONCEPTUAL PHYSICS: SOUND WAVES

Background: Sound is the transfer of energy in the form of waves through a substance, or ***medium***, such as air, water, or a flexible solid. You can picture sound waves as a series of nudges that cause particles in a medium to bump into one another in successive collisions. Sound can also travel between different media, which is why you can hear loud music coming from a room with the door closed.

Speakers produce sound waves by vibrating back and forth, compressing or "pushing" air particles. When you hear music coming from a speaker, you are actually "feeling" the sensation of air particles vibrating against your eardrum as the speaker's sound waves are transferred through the air. Those vibrations are transmitted to your inner ear, where they are converted into information that your brain interprets as a sound. You can distinguish different sounds based on sound waves' duration, ***wavelength***, wave height (***amplitude***) and rate (**frequency**).

Purpose: In this experiment, you will be able to visualize sound vibrations from speakers by building a portable eardrum model.

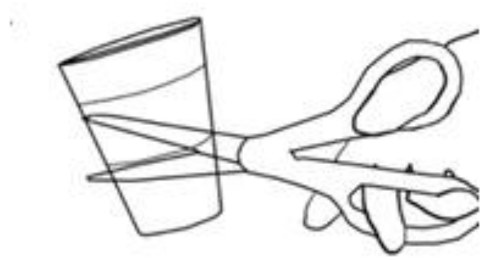
Materials:

- Plastic soda bottle or rigid plastic cup
- Rubber band
- Balloon or plastic wrap
- Sugar, salt, dry ground coffee, flour, cornmeal or other sand-like substance
- Scissors
- Smart phone or small speakers
- *Optional - free tone generating app that produces tones of known frequency

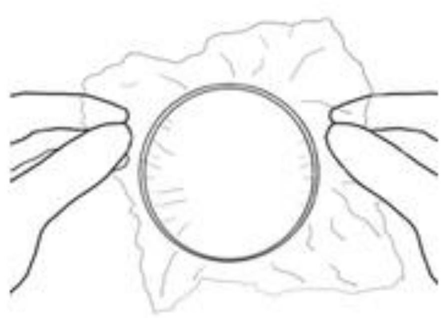
Procedure:

Part I: Making a model eardrum:

1. Cut a 5 centimeter-wide ring out of a plastic bottle or cup.



2. Stretch a balloon, some plastic wrap, or a plastic bag over one end of the ring, and secure it tightly with a rubber band. Pull the surface taut by tugging gently on the sides.

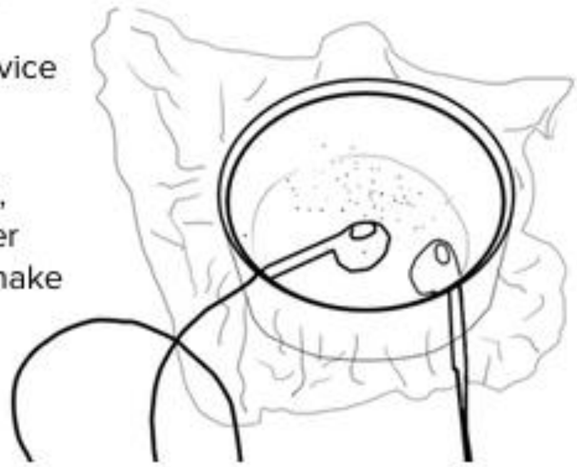


Taken from: http://www.sciencefriday.com/blogs/04/18/2014/make-a-model-eardrum-to-detect-sound-waves.html

3. Sprinkle a tiny bit of salt (or one of the listed alternatives) on top of the stretched plastic. Your eardrum model is ready!

4. Hold your model eardrum over the top of any small speakers, mobile phone, or headphones while the device is playing loud music.

5. Carefully observe the salt crystals, and describe what you see. Try other types of music and observe which make the salt vibrate the most.



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Part II: Extension – find the natural frequencies of your model. The frequency of sound is the number of wave cycles that are transmitted per second and is measured in a unit called "***Hertz***" (Hz). Most systems—like your eardrum model—have a tendency to vibrate more easily and with greater amplitude at certain frequencies than at others. These are called ***natural frequencies***, and they're determined by various properties of the system, such as its rigidity, size, and mass. When the frequency of sound waves precisely matches the natural frequency of a system, the maximum possible amplitude of vibration is achieved. This phenomenon is called ***resonance.*** .How many natural frequencies does your eardrum model have? Use the procedure below to find out.

1. Download a free tone-generating app to your smartphone. Make sure that you choose an app that allows you to select the frequency of the tone that it generates.

2. Position your model eardrum so that the plastic almost touches the phone's speakers. Use the app to play different sound frequencies loudly while carefully observing the grains of salt on the surface.

3. Record which frequencies cause the surface to resonate. The salt on the surface will vibrate more at these frequencies. These are the natural frequencies of your model eardrum. They're unique to your model based on its size, flexibility, and stretchiness.

4. Try switching out your balloon for plastic wrap or a plastic baggie, and see how it changes the natural frequencies of your model.

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<u>OBSERVATIONS</u>

PART 1:

PART II:

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