

STEAM Subject: Engineering
Lab: Build Your Own Stethoscope

Grades: 4-8

Learning Objective:

Students will build their own stethoscopes and explore bioengineering inventions and careers.

ENGAGE:

Ask students the following questions:

1. What are the different types of engineers that you know about? *Examples: civil, mechanical, aerospace, computer, software, electrical, chemical, and more!*
2. What is the name for the engineer that builds medical devices, such as the stethoscope? *A bioengineer!*
3. What is a **stethoscope** used for? *A medical device used for listening to the action of a human or animal's heart and breathing.*



EXPLORE:

The activity is to build your own stethoscope out of only three materials. Then, you can listen to your own heart and breathing, and someone else's!

Materials needed:

- Aquarium tubing or any type of flexible tubing you may have
- Two 1.25" PVC pipe (90-degree elbows) – any size may work
- Duct tape
- Rubber bands (optional)

Directions:

1. Cut enough aquarium tubing to reach from your ear to your heart or someone else's heart.
2. Place one side of the tubing into one PVC pipe elbow and place the other side into the other PVC pipe elbow.
3. Using the duct tape, wrap it around the pipe and the tubing on both ends.
4. Make sure that the tape seals all the openings, and that there are no holes. Secure with a rubber band if necessary.



After making your stethoscope, now test it out! Listen to your heartbeat when you are at rest, and then try listening to it after you run (in place or around the room) for 30 seconds. Is your heartbeat faster and louder after you have run around? Yes, it probably is!

Challenge: Count how many beats you can hear in one minute as you listen to your heart. Then try it on someone else!

EXPLAIN:

There are two different STEM topics that we will discuss that relate to this activity: biology and engineering. We will focus mainly on the engineering side of things but there may be a few biology terms that we will learn.

When someone is sick or hurting, they usually go to a doctor or a nurse to make them feel better. However, these doctors and nurses get help from people called **bioengineers**. These engineers work together to create machines, devices, and other technologies that are used in hospitals by doctors and nurses. For bioengineers, it is important for them to learn about the human body and engineering because they must know both to create the best equipment for hospitals.

Here are some examples of **medical devices** that bioengineers have created:

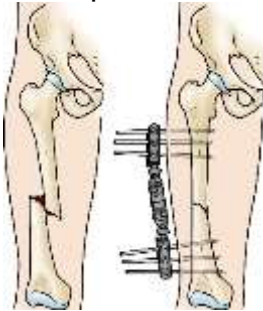
- X-rays, MRI's, and ultrasounds that take pictures of the inside of your body, so doctors know what is going on in your body



- Artificial limbs for those who have lost arms or legs



- Metal pins that hold bones and muscles in place when they are damaged



- Pacemakers that go inside the heart when someone's heart does not beat correctly

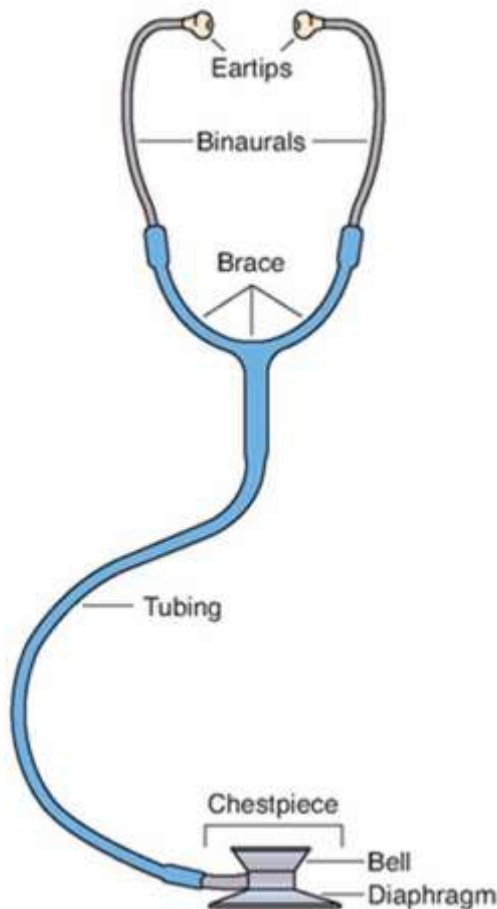


- Hearing aids for people who have trouble with their hearing



How does a stethoscope work?

While it is mostly used for detecting heart and breathing sounds, it can also be crucial in detecting abnormalities in the digestive system and blood sounds.



This image shows the different parts of a stethoscope. One of the most important parts is the **chest piece**, which is made of two parts: the bell and the diaphragm. This is the part that touches the patient, capturing the sound.

The **diaphragm** is a flat, metal disk that excels in capturing the higher-pitch range of sounds, which includes normal breathing sounds and heartbeats. The **bell** is a hollow, bell-shaped piece of metal with a tiny hole on top. This part is better at picking up low-pitched sounds, such as heart murmurs, which is not a good sound to hear! Next time you go to the doctor, notice how they will use both sides of the chest piece to listen to your heart.

Another part of the stethoscope is the **tubing**. The sounds picked up travel through a single tube, until they split up into two channels so that the listener can hear the sound in both ears.

The **ear tips** are the last main part of the stethoscope. They are made of soft rubber, which is for comfort but also to create a seal

that help block out all the surrounding noise. This is to help the doctor hear the sounds accurately.

It is known that a person more than two feet away from a patient's chest can hear the heart sounds louder than a person who does not have a stethoscope and whose ear is right next to the patient's chest. That is how powerful a stethoscope is!

EVALUATE:

Come up with a list of bioengineering companies in San Diego. These are companies that design and build medical devices. You can find these companies by searching online. Once you find a few companies, research what type of medical devices they create. Try to make a list of five different companies!