FUNCTIONING HEART MODEL

Teacher Background:

- Small groups of 3-4
- Duration: one 45–50-minute class
- Setting: indoors

Pre-stem activities:

- Listening to your Heart:
    - Using a stopwatch (phone/laptop), count your heartbeat for 10 seconds.
    - Now, determine your heartbeat per minute.
    - Review the handout "Heart Rate Record" and complete the activities such as running on the spot or meditating and record their heart rates depending on the activities.
- Blood flow through the body:
    - Review the handout "Blood flow direction" and ask questions if needed.
    - Blood flows through the heart in one direction only. The main function of our heart valves is to ensure that our blood travels in one direction only.

Rationale/Objectives:

The heart works like the engine for our body pumping blood constantly to keep our organs functioning. In this activity, we will build a functioning heart model out of household items. Our heart health is central to overall good health. If we encourage students to embrace a healthy lifestyle at a young age, the hope is that they will continue these good practices forever.

Method:

Heart rate is affected by many things. It varies by person, but also each person experiences variations in their heart rate every day. Many things can affect heart rate including age, health, activity, caffeine, sugar and more. In our heart model we are exploring how blood flows in one direction through the heart chambers. We have four chambers in our heart, the right and left atrium, and right and left ventricle. Blood will flow in only one direction – into the heart, to the lungs to be oxygenated, back into the heart, then back out into the body. The four valves of our heart are important for ensuring this one-way blood flow.

Materials:

- 3 x Pop bottles (710 mL) with caps, labels removed.
- 4 x Bendy straws
- 3 Cups of water
- Food colouring
- Tape
- Clay or playdough
- Sharp object for making holes in the caps (we suggest scissors)

The Activity (Directions):

1. You will need 2 bottle caps for this experiment. In the first cap “drill” two holes that are the same size. You want the holes to be just big enough for the straws to slide through. In the second cap “drill” one hole that is straw sized. The second should be smaller.
2. In a pitcher, mix your water and food colouring to create your “red blood”. The exact amount of water is not important.
3. Take two straws, stretch, and bend them to create a 90-degree angle. Slide one straw into the other straw (pinch one to make it smaller so it slides in), then tape up. Repeat with the second set of straws.
4. Place your three bottles on the table. Fill the first two with your water to about 80% full. Leave the third one empty.
5. On the first bottle place the cap with one straw hole and one small hole. On the middle bottle place the cap with two straw holes. Leave the third bottle without a cap.
6. Carefully slide the straws through the bottle caps. Place clay or play dough around the straw bases on the middle bottle to make an airtight seal with the bottle cap. You are now ready to put your heart model to work!
7. In this simple model the first bottle is the atrium of the heart, the second bottle is the ventricle, and the third bottle represents either the lungs or body. Our fingers function as the valves of the heart.
8. To make your heart model work, squeeze the middle bottle only. Start by pinching the straw between the atrium and ventricle bottle. Squeeze the middle bottle and watch your “blood” squirt out into the body.
9. Keeping the middle bottle “squeezed” move your fingers and pinch the straw between the ventricle and body. Now release the middle bottle and watch your blood move from the atrium into the ventricle.
10. Repeat, repeat, repeat to pump blood from the atrium, into the ventricle then out to the body!
11. Once your blood in the atrium gets too low, you can take blood from the “body” and add it back into the atrium. Then start again.

Possible extensions & variations:

- You may decide to provide less instructions to students but give them the necessary materials. This would require students to get more creative with the project, while also problem solving how to create a functioning heart model with only the materials provided.
- In-depth lesson on examining how blood flows.

Skills for Success:

- Collaboration, Communication, Problem Solving

Related career: Nursing

Reflection:

- In our heart model we are exploring how blood flows in one direction through the heart chambers. We have four chambers in our heart, the right and left atrium, and right and left ventricle. Blood will flow in only one direction – into the heart, to the lungs to be oxygenated, back into the heart, then back out into the body. The four valves of our heart are important for ensuring this one-way blood flow. Watch carefully as you do the work of the valves as you pinch the straws. **What happens to the liquid in the straws?**
- We have 4 heart valves. The Tricuspid and Mitral are located between the atrium and ventricle. The Aortic and Pulmonary valves control blood flow out of the ventricles into the arteries. **When you pinch the straw between the first two bottles what is happening?** (You are mimicking the Tricuspid or Mitral valves.) **When you pinch the second straw what is happening?** (You are mimicking the Aortic or Pulmonary valves.)