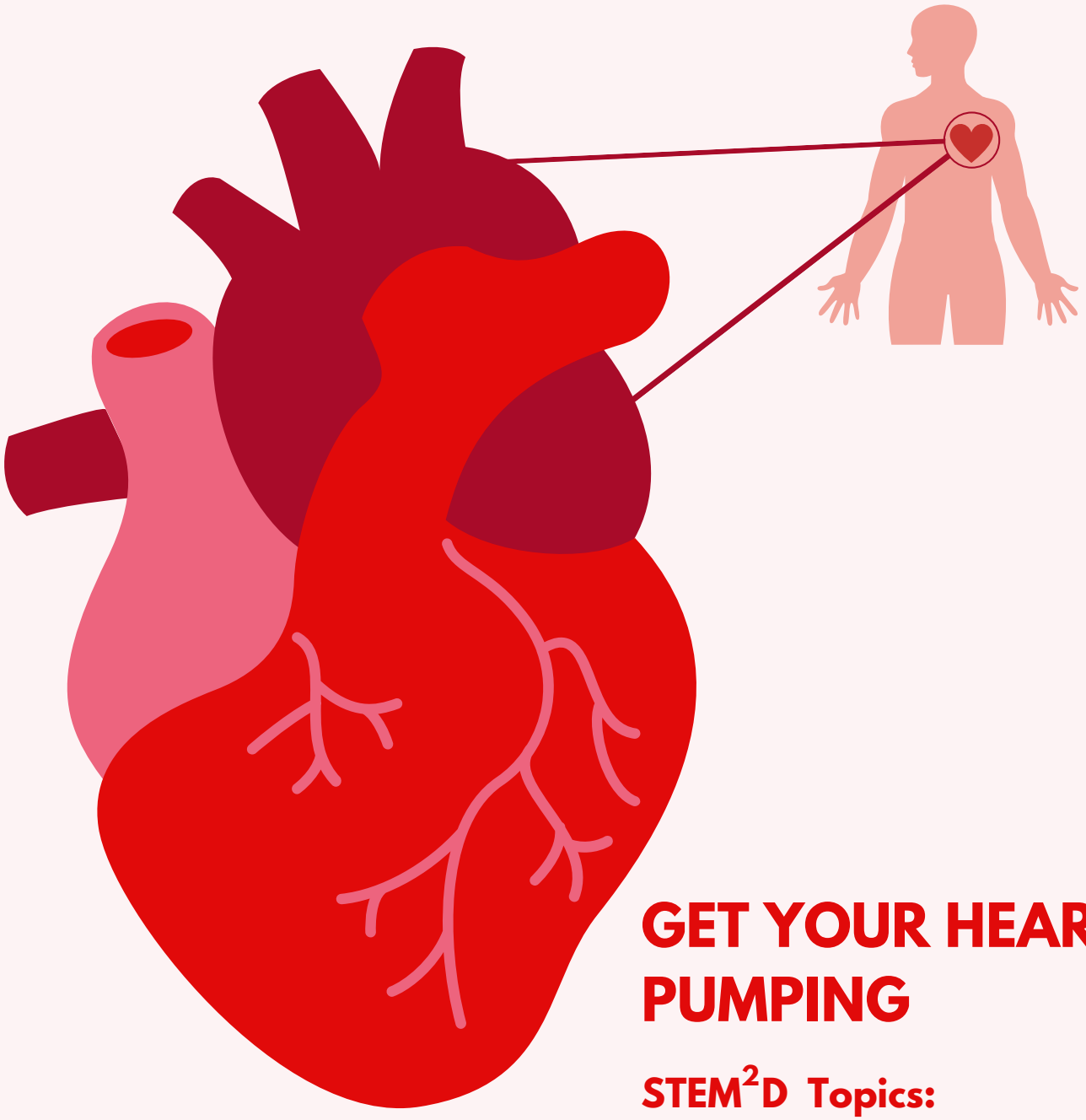
IGNITE ACTIVITY



GET YOUR HEART PUMPING

STEM^{2}D Topics:
SCIENCE & ENGINEERING

Target Population:
Students, ages 8-14

GET YOUR HEART PUMPING is part of the Student Activities Series developed by FHI 360 for Johnson & Johnson's WiSTEM^{2}D initiative (**W**inning in **S**cience, **T**echnology, **E**ngineering, **M**ath, **M**anufacturing, and **D**esign). The series features interactive and fun, hands-on activities for youth.

GET YOUR HEART PUMPING

STEM^{2}D Topic: Science & Engineering
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ACTIVITY DESCRIPTION

The heart is a driving force responsible for pumping blood throughout the body. If disease or injury weakens the heart, the body's organs will not receive enough blood to function properly. Having a healthy heart is crucial for living a long and healthy life! In this hands-on activity, students will learn about the different parts of the heart and how blood flows through the body, and will create a model that mimics the heart pumping blood to other organs.

ESTIMATED TIME

This session typically takes **10 to 15 minutes** to complete.

STUDENT DISCOVERIES

Students will:

- Learn how STEM^{2}D – science, technology, engineering, mathematics, manufacturing, and design – subjects are connected to the healthcare industry.
- Build important STEM^{2}D skills, such as exploring problems, communication, and collaboration.
- Consider STEM^{2}D concepts including the way the heart functions and healthcare connections to various STEM^{2}D fields.
- Have fun experiencing STEM^{2}D!

STEM^{2}D Skills

- Exploring Problems
- Communication
- Collaboration
- Attention to Detail
- Adaptability

GETTING READY

Materials:

- Pre-Activity Checklist
- Tell My Story Form, *optional*
- Activity materials, 1 set of the following items per group:
  - 1 Balloon
  - Red food coloring
  - 1 Toothpick
  - Scissors
  - 2 Clear jars or cups
  - 2 Flexible straws
  - Tape
  - Water

Estimated Cost:

Activity leaders can expect to incur $20 in materials costs per 15 students.

ACTIVITY LEADER PREPARATION

1. Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth, as it provides important background knowledge about STEM²D, strategies for engaging students, and tips for working with groups of students.
2. See the **STEM²D Student Activities Overview** for additional information.
3. Review the **Pre-Activity Checklist** (at the end of this document) for details and specific steps for planning, preparing, and implementing this activity.
4. If you have limited access to supplies or time scheduled with students is shorter than 10 minutes, consider providing a volunteer demonstration of how to build a working heart model to the entire group.

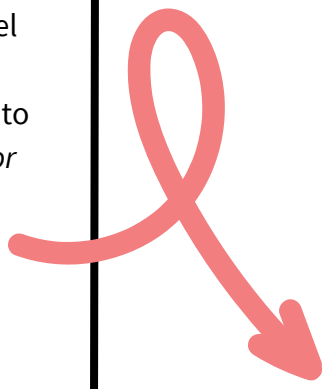
STEP-BY-STEP INSTRUCTIONS

1. **Welcome & Introductions (3 minutes)**
   - Greet the students as they arrive.
   - Tell the students your name, title, and organization/company.
   - Explain why you love STEM²D, and how your work is connected to various STEM²D areas.

Engaging Students

- Circulate and answer questions during the building process.
- Check frequently for understanding by asking open-ended, topic-specific, or process questions.
- Encourage students to ask questions to gain deeper understanding.

2. **Learning Activity: Get Your Heart Pumping (10 minutes)**
   - Explain that today students will build a heart pump model to demonstrate how the heart pumps blood through the body. Show the students the materials they will be using to create the heart pump model. *See Pre-Activity Checklist for more details.* Ask:
     - Which of the 11 human body systems does the heart belong to?
     - What is the primary responsibility of the heart?
     - What are the main parts of the heart?
     - How does blood flow through the heart and body?
     - Why is it crucial to keep the heart and circulatory system healthy?
   - Consider playing the following video that walks the students step-by-step through the construction of the heart pump model. Pause the video after each step to allow students time to perform each task within their group.
     - bit.ly/STEM2Dheartpump
   - If you do not have access to technology during this session, walk students through the steps of building the heart pump model.
     - Cut off the neck of your balloon. Make sure to keep both balloon parts.
     - Fill one jar halfway with water, then add 4 drops of red food coloring to represent blood.
     - Take the wider part of the balloon and stretch it over the top of the jar until it lays flat.
     - Use the toothpick to carefully create two small holes 1 inch apart into the balloon. The holes should be very small to prevent air from escaping.
     - Insert a straw into each of the holes created by the toothpick.
     - Cover the opening of one straw with the neck of the balloon previously cut in step 1. Tape the neck of the balloon to the straw opening to create a tight seal at the end of the straw.
     - Place your second jar next to the opening of the straw that has not been sealed. This jar will catch the blood as it is pumped from the heart.



Helpful Hints

- The heart belongs to the circulatory or cardiovascular system.
- The heart is responsible for pumping blood and oxygen throughout the body and transporting waste products like carbon dioxide back to the lungs to be removed.
- The main parts of the heart into the atria, ventricles, and the tricuspid, pulmonary, mitral, and aortic valves.
- The normal path of blood follows the following pattern: body - heart - lungs - heart - body.
- A strong heart reduces the risk of heart attacks and other cardiovascular issues. A healthy circulatory system lowers the risk of heart disease, which is the leading cause of death worldwide.

- Place one or two fingers in the middle of the balloon between the two straws and press down repeatedly mimicking the rate at which a heart typically pumps. The action of poking your finger into the balloon imitates the muscles in your heart contracting, resulting in blood being pushed out of your heart and into your arteries.
- Explain what is happening inside the model.
  - This is a very simplified model of the heart to illustrate how the heart pumps blood through the body.
  - The act of pushing down on the balloon increases the pressure inside the cup, which forces the colored liquid to escape into the unsealed straw. If the pressure is great enough, the colored liquid will exit the straw into the empty cup.
  - The sealed straw represents the path the blood took to enter the heart chamber, which is why the colored liquid does not reenter the sealed straw.
  - Essentially, the contraction squeezes the chambers of the heart, forcing the blood out of the heart chambers in a single direction and into the arteries where it then circulates through the body.

3. Student Reflection (2 minutes)

- Wrap up the activity by asking the following reflection questions:
  - Why is the heart considered the hardest-working muscle in the body?
  - What can you do to keep your heart healthy?
  - How did your understanding of the heart change today?
- Ask students to consider what kind of careers people with an interest/degree in this area would have. Examples include:
  - Heart Specific Careers: Cardiologist, Cardiovascular Surgeon, Cardiac Nurse, Electrophysiologist, Echocardiographer, Cardiovascular Technician
  - Engineering: Biomedical Engineer, Orthotist, Prosthetist
  - Arts: Medical Illustrator
  - Education & Rehabilitation: Clinical Exercise Physiologist, Cardiac Rehabilitation Specialist, Genetic Counselor, Health Educator

STEM²D Connections

- *Biology (Life Sciences):* understanding the structure and function of the heart.
- *Biochemistry:* studying how the heart utilizes energy sources like glucose and fatty acids, to contract and pump blood.
- *Physiology:* analyzing heart rate, blood pressure, cardiac output, and other physiological parameters.
- *Biomedical Engineering:* developing, and using techniques like echocardiography, MRI, and CT scans to visualize the heart's structure and function.
- *Math and Statistics:* creating mathematical models to simulate blood flow, pressure, and heart behavior.
- *Physics:* investigating blood flow patterns with the heart and blood vessels.

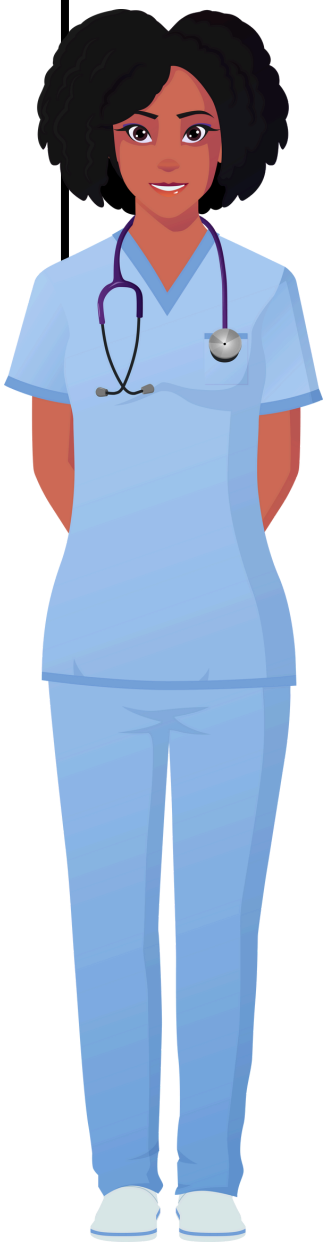
- Thank students for joining you today and encourage them to continue exploring careers in STEM²D.
  - Direct students to the Exploring Nursing Pathways eBook to learn more about careers in healthcare.
    - https://www.stem2d.org/navigating-nursing
  - Encourage students to take the STEM Career quiz and explore how a career in STEM²D can help to shape their future.
    - https://www.stem2d.org/stem2d-at-home

EXTENDED LEARNING

You can extend student learning by having students (or teams):

- **Watch** the following video that illustrates how blood moves through the heart and body.
  - The Human Body: The Heart | Educational Videos For Kids (youtube.com)
- **Explain** what blood pressure is and why it is important. How is it measured, and what do the numbers mean?
  - What is Blood Pressure (youtube.com)
- **Experiment** with different health conditions.
  - What would happen if there was an obstacle in the straws that blocked blood flow?
  - How would the circulatory system be affected if there was a small puncture in the balloon?
- **Encourage** students to explore how to find their pulse and the impact exercise has on your pulse and heart.
- **Watch** a demonstration of five hands-on challenges focused on heart health with a group of students ages 9-12. Share the link with students and encourage them to try some of the activities from the video on their own.
  - Women in STEM²D: Let's Learn about Heart Health

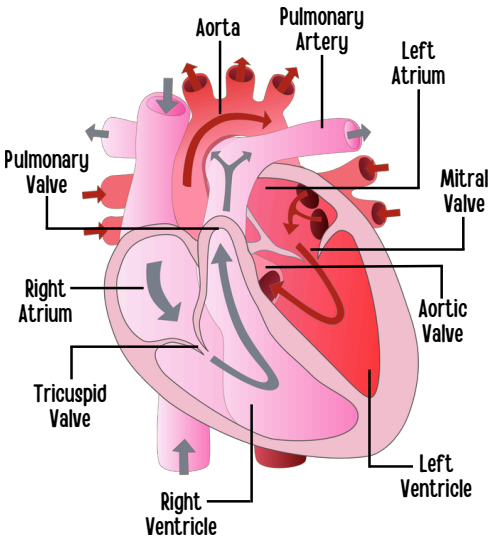
  If time permits, consider watching the *Ask a Nurse: How Does the Heart Work?* WiSTEM²D information session that includes the additional activities above and explores the heart and circulatory system with a panel of nurses .
  - Ask a Nurse: How Does the Heart Work?



KEY WORDS

- **Aorta:** A large artery carrying oxygen-rich blood to the entire body. The aorta is the largest blood vessel in the body.
- **Aortic Valve:** A valve that connects the left side of the heart with the aorta. The aortic valve acts as a gateway between the left ventricle and the aorta.
- **Circulatory System:** Also known as the cardiovascular system, this body system is crucial to healthy organs, muscles, and tissues. The circulatory system is comprised of the heart, blood vessels, and blood.
- **Heart:** Main organ in the cardiovascular system that pumps blood through the body.
- **Left Atrium:** A chamber of the heart located at the back left side of the heart and serves as a holding chamber as it receives oxygenated blood returning from the lungs.
- **Left Ventricle:** A chamber of the heart located in the bottom left portion of the heart. The left ventricle is responsible for delivering oxygenated blood to the body for circulation.
- **Mitral Valve:** A valve located between the left atrium and the left ventricle whose primary responsibility is to ensure blood flows from the left atrium into the left ventricle.
- **Pulmonary Artery:** An artery that carries deoxygenated blood from the right side of the heart to the lungs.
- **Pulmonary Valve:** A valve located between the right ventricle and pulmonary artery that ensures that deoxygenated blood from the right ventricle flows into the pulmonary artery.
- **Right Atrium:** A chamber of the heart located at the upper right side of the heart, whose primary role is to collect deoxygenated blood from various parts of the body.
- **Right Ventricle:** A chamber of the heart located in the lower right portion of the heart. The right ventricle is responsible for pumping oxygen-depleted blood to the lungs.
- **Tricuspid Valve:** A valve located between the right ventricle and right atrium whose primary function is to open and close to ensure the deoxygenated blood flows from the right ventricle to the right atrium.

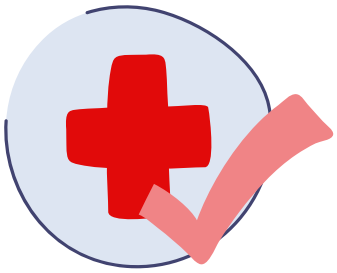
Parts of the Heart



RESOURCES AND REFERENCES

Activity concepts and real-life connections adapted from:

- Home Science Tools, How to Make a Heart Pump Science Project https://www.homesciencetools.com/article/how-to-make-a-heart-pump-science-project/
- Team Cartwright, Easy Heart Pump Model: Cardiovascular STEM for kids https://team-cartwright.com/heart-pump-model/
- Teach Engineering, Clearing a Path to the Heart https://www.teachengineering.org/activities/view/cub_biomed_lesson03_activity1
- TeacherTube, Marshmallow Cardiogram https://www.teachertube.com/videos/measure-your-pulse-with-a-toothpick-and-marshmallow-454883
- My Cleveland Clinic, Blood Flow Through the Heart https://my.clevelandclinic.org/health/articles/17060-how-does-the-blood-flow-through-your-heart
- Heart.org, How the Healthy Heart Works How the Healthy Heart Works | American Heart Association



PRE-ACTIVITY CHECKLIST

GET YOUR HEART PUMPING

*The following checklist helps activity leaders plan and prepare to conduct the **Get Your Heart Pumping** activity with students.*

DID YOU . . .

- ☐ Read Spark WiSTEM^{2}D? This is essential reading for all volunteers interested in working with youth. It defines the STEM^{2}D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students.
- ☐ Visit the event venue (optional) and/or finalize logistics with the organizer? Ask:
  - ☐ What is the date, time, and location of the event?
  - ☐ How will the room be arranged? Do I have access to tables? How big are they?
  - ☐ How many students do you expect? How will the students be organized/participate in the event? Knowing this will help you determine the quantity of materials to purchase.
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity? Did you:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? *(optional)*
- ☐ Obtain the required materials? See the Materials and Estimated Materials Costs sections.
- ☐ Set up the site appropriately for the activity?
- ☐ Practice your presentation? *Make sure you can explain the concepts to students, if needed, and that you know the correct answers.*
- ☐ Bring a camera, if desired, to take photographs?
- ☐ Obtain and collect permission slips and photo release forms for conducting the activity, if applicable?
- ☐ Have fun!

TELL MY STORY FORM

This form will help activity leaders and other volunteers prepare to talk about their STEM²D interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people will get out of this activity?

_____

_____

FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood when you first had your "spark" or "interest" in STEM²D.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges, and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in university that helped or interested you most? _____

_____

How did you know you wanted to pursue a STEM²D career? _____

_____

What was your postsecondary path, including the institution you attended and your degree? If you switched disciplines, make sure you explain why. _____

_____

_____

What does your current position entail? Be sure to include how you use STEM²D during a typical work day. _____

_____

_____