THE FRANKLIN INSTITUTE

Be a **Health Scientist!**

Be a Cardiologist

Educator Guide

Big Question: How can cardiologists help blood flow through a clogged artery?

GSK Science in the Summer™

In collaboration with GSK

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Be a Health Scientist! Big Ideas

These are the themes you'll find running through all five *Be a Health Scientist!* activities.

Health Science is all about finding ways to keep people healthy and helping them get better when they are sick.

- *What are some ways people can stay healthy?*
- *How can we learn more about the spread of germs and diseases?*
- *What are some ways to help people get better when they are sick?*

The human body is complex. There are many parts that work together to protect us from sickness and work to keep us healthy. When those parts are unable to do their job, health scientists can help in a variety of ways:

- *Finding the cause of the problem through tests and identifying ways to fix it.*
- *Using specially designed equipment to help our body work.*
- *Making sure our body has what it needs to stay healthy.*

Core Four Strategies

Use the Core Four Strategies as you guide your learners through this activity.

- **Ask questions** to spark curiosity and encourage new ideas
- **Encourage scientific thinking** with chances to observe, make predictions, and test ideas
- **Cultivate rich dialogue** with chances to talk together, share ideas, and use science words
- **Make connections** between learners' experiences, science careers, and this activity

Ask Questions

Encourage Scientific Thinking

Cultivate Rich Dialogue

Make Connections

Be a Cardiologist

Big Question: ***How can cardiologists help blood flow through a clogged artery?***

MATERIALS:

Per pair of learners:

- Length of plastic tubing, ½" x 12"
- Modeling clay, a ball ½" wide, or about the size of a dime
- Dowel or chopstick
- Building materials, such as:
  - Straws
  - Paper clips
  - Pipe cleaners
  - Rubber bands
  - Skewers
  - Tape

Per class:

- Pitchers (4–6)
- Turkey basters (4–6)
- Water
- Additional lengths of plastic tubing for demonstration (2)

Prepare

1. Pre-make one "blocked artery" model. Make a ball of modeling clay about ½" wide (about the same width as the opening of the tube). Use a dowel to push the clay about halfway down the tube to create a blockage. Test the blockage by adding some water to the tube with a turkey baster. It does not need to stop the water completely but should cause it to significantly back up and slow down.
2. Set aside one empty tube and the blocked artery model for demonstration.
3. Create a materials station with the building materials in an accessible location.
4. Set up "blood flow" testing stations with one empty pitcher, one pitcher full of water, and two turkey basters.

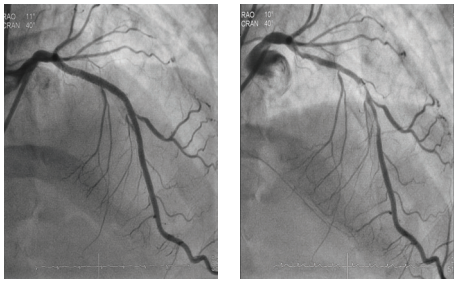
Engage (~10min)

1. Introduce the cardiologist career by showing the group the career card and asking questions to encourage students to think about what a cardiologist might do:
   - *What do you notice about this picture? What do you think this person is doing?*
   - *What does the name "cardiologist" make you think of? What do you think a cardiologist might do or study?*
2. Explain that a cardiologist is a doctor that takes care of the heart and blood vessels. They can treat problems related to those parts of the body and help keep you from getting heart diseases.
   - *What do your heart and blood vessels do for you? Why is it important to keep them healthy?*
   - *Have you heard of any problems or diseases people can have with their hearts?*

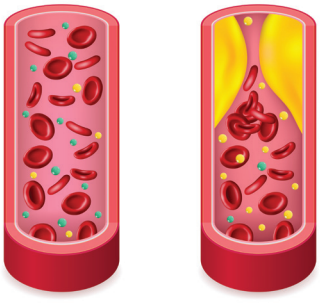
3. Introduce the storyline like this:
   - We are a team of cardiologists. Another doctor has asked us for help with a patient who is having trouble with their heart.
   - The doctor thinks the patient may have a problem with how the blood is flowing through their **arteries**—the blood vessels that carry blood from the heart out to the body.
     - *How do you think that might affect the patient?*
   - **Our job is to figure out the problem and see if we can find a way to help the patient's blood flow more easily again.**

Explore (~40min)

Part 1: Research and Modeling



1. Explain that we have an image from inside the patient's body that will help us learn what is wrong. Invite learners to look at the patient's artery images on page 9 of their lab notebook.
   - *What do you notice about the difference between the first image and the second image?*
   - *What do you think this could mean for blood flow?*
2. Invite learners to look at the illustrations of clogged and unclogged arteries on page 10 of their lab notebook and compare them to the patient's images.
   - *What do you notice?*
   - *Which picture looks the most like our patient's artery? How would this affect blood flow?*



3. Show the group your pre-made "clogged artery" and the clear "unclogged artery." Explain that this is a **model** that will help us learn about the problem and experiment to find solutions—without hurting the patient!
   - *What do you notice about the clogged artery in this model?*
   - *How do you think this model could help us solve our*

patient's problem?

4. Explain that they will start by creating a model and testing it to observe how a blockage can affect blood flow.
5. Divide the group into pairs. Give each pair 1 flexible tube, 1 small ball of modeling clay, and 1 dowel or chopstick. Invite pairs to create a "clogged artery" with the clay like the one you modeled.
6. Encourage pairs to test the "blood" flow in their artery models at the testing stations:
   - Hold the artery model upright above the empty pitcher.
   - Fill the turkey baster with water from the full pitcher.
   - Empty the water from the turkey baster into the top end of the artery model.
   - Observe how fast or slowly the water flows through the tube.
   - (Optional) Test the unclogged model (from the demonstration) the same way and compare it to the clogged model.

Part 2: Tool Creation

1. Explain that each team must now design a tool to clear the clog and help blood flow better through the artery.
   - *What are some ways we could help the blood flow better?*
   - *Could we remove the clog completely? Or just flatten it to make more space for the blood to flow?*
   - *What kinds of tools could help us do that?*
2. Encourage pairs to look at the available building materials and sketch a plan in their lab notebooks on page 11.
   - *Do you plan to flatten or remove the blockage? What tools will you use?*
   - *What tests can you use to measure the success of your tool?*
   - *What if your design doesn't work as planned?*
3. Once teams have a clear plan, invite them to a materials station to select materials and begin building their designs. As they build, encourage them to test often and re-design like engineers.
   - *What parts of your design are working well, and what parts could work better?*
   - *Which materials work best for getting to where the clog is?*
   - *Which materials work best for flattening or removing the clog?*
4. When teams feel that they have successfully improved their blocked artery, invite them to test it again at the testing station.
   - *How did water flow before you used your tool?*
   - *How did water flow after you used your tool?*
   - *Do you think your tool would be successful in helping our patient's blood flow more easily?*
   - *Is there anything else you would like to try to help the blood flow even better?*

Extend

1. Invite teams to try whichever method they did not try first (flatten or remove) and design and test a second tool for that purpose.
   - *Will your first tool work for the second method?*

- *What changes could you make that would help it work better for that method?*

2. Real arteries are longer, more flexible, and less sturdy than our plastic model. Tools for clearing blockages need to reach and clear the clog without poking or damaging the sides of the artery. Challenge teams to reconsider their tool based on this information and redesign their tool to better real-life conditions::
   - *What parts of your tool might be too stiff to wind through a long artery?*
   - *What materials in your tool might be too hard or sharp and damage the artery?*
   - *How can you redesign your tool to avoid those problems?*

Reflect (~10min)

1. Gather the whole group together. Invite learners to reflect on the process they went through testing ways to remove the blockage.
   - *What solutions did we find for clearing the blockage? How are our tools similar or different?*
   - *What was the most difficult thing about clearing the blockage?*
   - *What techniques should we recommend for clearing the clog in our patient's artery?*
2. Discuss the planning process:
   - *What did you think about when designing tools to remove the blockage?*
   - *What did you try that didn't work?*
   - *What other materials that we didn't provide do you think would have helped in your tool design?*
3. Encourage the group to reflect on how they were like a cardiologist during the activity. Refer to the career card and the science skills stickers:
   - *What are some of the things we did today as cardiologists?*
   - *How did we think like scientists? What science skills did we use?*
   - *What did you do today that made you feel like a scientist?*
4. Allow time for learners to draw or write their reflections on page 11 of their lab notebooks. Invite them to choose a science skills sticker that reflects a skill they used and add it to their notebooks.

Background

- The **cardiovascular system—the heart and blood vessels—helps deliver oxygen and nutrients throughout the body** to help keep all the parts working as they should. The heart is a pump that keeps the blood flowing, and blood vessels are like pipes or tubes that the blood moves through to get around the body. There are about 60,000 miles of blood vessels in the human body—that's enough to go around the world twice!
- The human body has three main types of blood vessels:
  - **Arteries** carry blood away from the heart out to the body
  - **Veins** carry blood from the body back toward the heart
  - **Capillaries** are tiny blood vessels that deliver blood into organs and tissues
- Veins and arteries work together like the two sides of a highway, helping things travel quickly over long distances. Capillaries are like the small local roads that reach all the separate neighborhoods and houses.
- **Plaque** is a build-up of fat and waste products that can gather on the walls of arteries. **This narrows the opening of the artery, making it harder for blood to flow** and putting extra stress on the heart as it pumps harder to push past the clog. If the clog blocks enough of the blood flow, it can stop organs and tissues from getting the oxygen and nutrients they need and cause permanent damage.
- **Cardiologists use different techniques to improve blood flow in clogged arteries.** The most common method is to inflate a tiny balloon to flatten the blockage and then add a **stent**—something like a tiny wire fence—to prop open the artery. Another method is to break up and remove the plaque using tiny blades or a laser.

Acknowledgments

Authors: Tiffany Allen, Rachel Castro-Diephouse

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Sponsor: This program is made possible with the generous support of GSK and the contributions of their dedicated team.

Host Organizations: Thank you to the many organizations who host and support GSK Science in the Summer™ programs across the country. GSK Science in the Summer™ reaches thousands of children each summer thanks to your ongoing commitment and invaluable contributions.

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Be a Cardiologist Quick Guide

EDUCATORS DO:	EDUCATORS ASK:	LEARNERS DO:
ENGAGE		
Introduce Career • Use career card • Ask discussion questions • Explain what cardiologists do	*What do you notice about this picture?* *What do you think this person is doing?* *What do you think a cardiologist might do or study?*	• Make observations about the image • Make connections to their own experience • Share their ideas
Introduce Story • We are a team of cardiologists at a hospital and we have a patient having trouble with blood flow in their arteries • We need to find the problem and come up with a solution	*What do your heart and blood vessels do for you? Why is it important to keep them healthy?* *Have you heard of any problems or diseases people can have with their hearts?* *How could the blood flow problem be affecting our patient?*	• Imagine being a cardiologist • Discuss why it is important to identify and fix problems with our heart
EXPLORE		
Part 1: Research & Modeling • Show learners radiology images of clogged arteries • Demonstrate artery model • Distribute model materials	*What do you notice about the difference between the first image and the second image?* *What do you think this could mean for blood flow?* *How do you think this model could help us solve our patient's problem?*	• Look at artery images and make observations • Identify problems on medical images • Build and test an artery model

***Quick Guide continues on the following page.*

Be a Cardiologist Quick Guide

EDUCATORS DO:	EDUCATORS ASK:	LEARNERS DO:
Part 2: Tool Creation • Encourage pairs to plan, design, and test a tool for clearing the model artery	*What materials will you use to create your tool design?* *What tests can you use to measure the success of your tool?* *What if your design doesn't work as planned?*	• Design a tool to clear the model artery • Build, test, and redesign • Test the function of the repaired artery
REFLECT		
Share Group Results	*What solutions did we find for clearing the blockage?* *What techniques should we recommend for improving our patient's blood flow?* *What did you try that didn't work?*	• Share results • Draw conclusions • Reflect on the design process
Make Career Connections	*What did you do today that made you feel like a cardiologist?* *How did we think like scientists?* *What science skills did we use?*	• Use skills stickers • Draw/write reflections

Notes