Keeping the Flow

AIM

To investigate the effect of diet on cardiovascular function and the development of cardiovascular disease.

SCIENTIFIC PROCESSES

- **question, experiment, construct knowledge, apply**

OBJECTIVES

Students will be able to:

- **explain how cardiovascular disease disrupts the function of the cardiovascular system;**
- **explain how diet affects cardiovascular health;**
- **state ways in which they plan to maintain cardiovascular health.**

OVERVIEW

In this lesson, students continue to learn more about the cardiovascular system. The lesson begins with the class sharing its triumphs and challenges in meeting the food and physical-activity goals. This is followed by a review of the Lesson 14 homework reading. Use the homework reading and notes to guide student discussion in this lesson. Next, students work in pairs to investigate the effect that clogged blood vessels have on the flow of blood in the human body. Through a class discussion, students discover how cardiovascular disease develops over time and learn about ways to maintain a healthy cardiovascular system. The lesson closes with a discussion of the homework reading and an assignment to interview family members to find out about diet-related health conditions they might have.

MATERIALS

For the teacher:
- Homework questions for Lessons 15 and 16 (p. 250)
- ***Go with the Flow*** experiment sheet
- Red food coloring
- (Optional) cornstarch
- (Optional) stove, microwave, or other heat source
- 3-inch piece of 3/4-inch clear plastic (PVC) tubing
- 2 tablespoons of yellow play dough

For each pair of students:
- (Optional) ***Go with the Flow*** experiment sheet
- 2 3-inch pieces of 3/4-inch clear plastic (PVC) tubing
- 2 tablespoons of yellow play dough (p. 281)
- 1 cup of cornstarch "blood" (p. 282) or red-tinted water
- 1 small plastic bowl
- Pencil
- Paper towel
- Newspapers or other surface covering

For each student:
- ***The* C3 *Journey*** (pp. 251–274)
- **Type 2 Diabetes** student reading (p. 237)
- Notes from Lesson 14 homework
- ***Interviewing My Family*** activity sheet
- (Optional) ***Homework Notes*** activity sheet (p. 275)
- LiFE Log

PROCEDURE

Before You Begin:

- Review the ***Go with the Flow*** experiment sheet. Gather materials. Make one clogged blood vessel as a sample for students and make the cornstarch "blood" (p. 282). Alternatively, you may wish to simply tint some water red for "blood."
- (Optional) If you decide to have students work in pairs, make copies of the ***Go with the Flow*** experiment sheet for each student pair.
- Remind students to bring in their notes from the **Healthy Hearts** homework assignment. Have the homework questions available for discussion.
- Review the ***Interviewing My Family*** activity sheet, the **Type 2 Diabetes** student reading, and the homework questions. Make copies of the activity sheet and student reading for each student. If you plan to distribute copies of the ***Homework Notes*** activity sheet, make enough to distribute one to each student. Alternatively, students can take notes in their LiFE Logs.
- If you have not already done so, post the Module Question and Unit 4 Question at the front of the classroom.

MODULE QUESTION

How can we use scientific evidence to help us maintain energy balance?

UNIT QUESTION

Why are healthy food and activity choices important for our bodies?

APPLYING TO LIFE

1. Discuss The *C3* Tracker

Have students take out their copies of ***The* C3 *Journey*** and turn to **The *C3* Tracker** (p. 268). Check to make sure that they are making entries on the tracker. If they are not, you may wish to give them a few minutes to work on it. However, encourage students to make their entries at the time they are attempting to reach their goal. Engage students in a discussion of how their work is going. Invite volunteers to share their experiences with the class. Acknowledge students' successes. Brainstorm as a class different ways to overcome challenges. If students need a reminder as to why the *C3* food and activity goals are important, refer to pages 255–260 in ***The* C3 *Journey***. Draw this discussion to a close.

THEORIZING

2. Review Module and Unit Questions

Remind students of the Module and Unit questions and explain that in this lesson, they are going to learn about how diet affects the cardiovascular system.

3. Discuss Homework

Have students take out their notes from the **Healthy Hearts** homework assignment. Engage them in a discussion of the reading. Use the homework questions to guide the discussion. *What happens when the heart has to pump hard to push blood through clogged blood vessels? What is cholesterol? Why are healthy food choices important for a healthy heart?*

EXPERIMENTING

4. Compare Blood Flow

Remind students of the simulation they read about in **Healthy Hearts.** *What did Dr. Floyd*

want Christian to simulate? Explain that the students will do this same simulation in class. Tell them that they will compare two models of blood vessels: one that is very clogged with fat and cholesterol and has developed a lot of plaque, and one that is not clogged with plaque. Show students the sample clogged blood vessel that you made. Explain that this is what the clogged blood vessel should look like. Follow the procedure on the ***Go with the Flow*** experiment sheet.

THEORIZING

5. Review Clogged Vessels

Use the questions on the ***Go with the Flow*** experiment sheet to lead a class discussion. Encourage students to refer to their homework notes from the **Healthy Hearts** reading. *What have we already learned about the cardiovascular system?* (The blood carries digested nutrients from food to all the cells in the body.) *What happens if there are clogged blood vessels?* (It will make it more difficult to deliver the oxygen and nutrients the body needs.) *The body still needs to have blood flow, so what will happen?* (The heart will have to pump harder to get the blood through. Blood going through clogged vessels causes increased pressure within the blood vessels, or high blood pressure.) *What happens if the coronary artery becomes completely clogged?* (This causes a heart attack.)

6. Discuss Diet and Cardiovascular Disease

Engage students in a discussion of how diet affects the function of the cardiovascular system. Have them think about what they observed in the ***Go with the Flow*** experiment and what they have learned in the **Healthy Hearts** reading. *Why do blood vessels get clogged with plaque? What can be done to keep them from getting clogged? How does diet affect the function of the cardiovascular system? What can happen if you eat a diet rich in animal fat? What can happen if you don't get enough exercise? What can you do to reduce the risk of cardiovascular disease?*

Explain that it takes a long time for blood vessels to become clogged with plaque. Emphasize that eating a hamburger one day does not result in blood vessels covered in fat the next day. *Do you think young people can have clogged blood vessels?* (Fat accumulates in blood vessels with age. However, this does not mean that young people cannot have clogged blood vessels.) *If you have clogged blood vessels, can you do anything to change the situation? Think about what you have learned about eating and physical activity — do you think you can improve the health of your heart and circulatory system? What can you do?* (I can change my eating and activity habits to be more "heart friendly.")

7. Review Homework Reading

Distribute one copy of the **Type 2 Diabetes** student reading to each student. Tell students that for their homework reading and in the next lesson, they will be learning about Type 2 diabetes. Post the homework questions for the reading on the board. Have students copy them onto the ***Homework Notes*** activity sheet or into their LiFE Logs. Remind them to bring their notes to the next class.

SEARCHING

8. Discuss Family Interview

Distribute one copy of the ***Interviewing My Family*** activity sheet to each student. Point out that Type 2 diabetes is often associated with a cluster of factors, including abdominal obesity, high blood pressure, high blood glucose levels, high LDL cholesterol, high blood triglycerides, and low HDL cholesterol. Tell students that they will be surveying their family members to find out if they have any of these conditions. Remind students to bring the completed activity sheet to the next class.

Go with the Flow

In this experiment, students compare the flow of "blood" in clogged and unclogged model blood vessels.

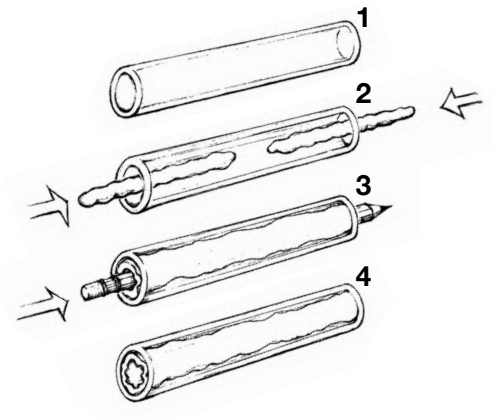
Setup

1. Gather materials.
2. Make simple "blood" by mixing red food coloring with water. If you wish to have thicker "blood," follow the ***Cornstarch "Blood"*** recipe (p. 282).
3. Cover work surfaces with newspaper or other covering so any "blood" that might spill will not stain.

Procedure

1. Have students work in pairs.
2. Give each pair of students two plastic tubes. Tell them that these tubes represent blood vessels.
3. Distribute the yellow play dough to each student pair. Tell them that this play dough represents plaque, which comes from the fat and cholesterol in the foods we eat.
4. Have them set aside one plastic tube. Tell them that this represents a blood vessel that has not been clogged with plaque.
5. Have them use the second plastic tube to make a blood vessel that is clogged with a lot of plaque and only has a small opening for blood to flow through. Demonstrate how to do this. Use your hand to roll the play dough into two long, thin logs. Make them slightly smaller in diameter than the plastic tube. Stuff one log into each end of the tube. Stick a pencil through the middle of the play dough in the tube so that there is a small opening from one end to the other.

Steps for making a plaque-filled blood vessel:



1) Take one of the clear tubes.

2) Roll the play dough into two logs thin enough to insert into the tube. Stuff one log into each end of the tube so it is filled with play dough.

3) Use a pencil to make a narrow hole all the way through the tube. Twist the pencil to help it pass through the play dough.

4) Remove the pencil. Now the tube models a plaque-filled blood vessel

6. After the student pairs have made the plaque-filled blood vessel, distribute the "blood" — a cup to each pair.
7. Instruct the pairs to have one student hold the unclogged blood vessel over the plastic bowl. Tell the other student to pour the "blood" through the blood vessel as quickly as possible. Have the partner holding the blood vessel count the seconds it takes for the blood to flow through. Tell them to record the time in their LiFE Logs.
8. Have students pour the "blood" back into the cup. Students should now switch roles. This time, have one hold the clogged blood vessel over the plastic bowl. Have the other pour the blood through while the partner holding the blood vessel counts out the seconds. Tell them to record the time in their LiFE Logs.
9. After they have completed this experiment, have them clean the play dough out of the clogged blood vessel by pushing a paper towel through the tube with a pencil.

Questions

1. *What did you observe when the blood flowed through the unclogged blood vessel?*
2. *What did you observe when the blood flowed through the clogged blood vessel?*
3. *Did you observe any differences in the way the blood flowed through the two different blood vessels? Describe what you observed.*
4. *What do you think would happen if your heart had to pump blood through very clogged blood vessels?*

Name Date

Interviewing My Family

Ask five adults in your family who are over the age of 21 if they have any of the conditions listed below. Place a check beside all the conditions they say they have. The adults in your family could include parents, grandparents, aunts, uncles, or cousins. If you are not able to talk to five adults, you can also ask younger family members.

FAMILY HISTORY

Name	Condition
	❑ None ❑ High blood sugar ❑ High blood cholesterol or triglycerides ❑ High blood pressure ❑ Low good cholesterol (HDL*) ❑ Fat in the stomach area (abdominal obesity)
	❑ None ❑ High blood sugar ❑ High blood cholesterol or triglycerides ❑ High blood pressure ❑ Low good cholesterol (HDL*) ❑ Fat in the stomach area (abdominal obesity)
	❑ None ❑ High blood sugar ❑ High blood cholesterol or triglycerides ❑ High blood pressure ❑ Low good cholesterol (HDL*) ❑ Fat in the stomach area (abdominal obesity)
	❑ None ❑ High blood sugar ❑ High blood cholesterol or triglycerides ❑ High blood pressure ❑ Low good cholesterol (HDL*) ❑ Fat in the stomach area (abdominal obesity)
	❑ None ❑ High blood sugar ❑ High blood cholesterol or triglycerides ❑ High blood pressure ❑ Low good cholesterol (HDL*) ❑ Fat in the stomach area (abdominal obesity)

*HDL=High-density lipoprotein

pump faster to get the oxygen and nutrients to our cells. We also have to breathe faster during exercise so that our bodies can take in more oxygen and we can release, or breathe out, more carbon dioxide. Getting into shape isn't always easy, but it's good for your heart to get a workout every now and then. Some days on the court feel easier than others, don't they?" asked Dr. Floyd.

"I guess you're right. The more I play, the easier it gets," replied Calvin.

"And that's your heart getting stronger. That's good!" said Dr. Floyd. "Exercise that challenges us helps us improve our fitness. Do you know what I mean by fitness?"

"Well, I'm strong," replied Calvin. "We do sit-ups and push-ups in gym, and my backpack is really heavy. It's kind of like lifting weights to carry it."

"And I'm very flexible," added Carol. "I do lots of stretches and bends in dance."

"**Strength** and **flexibility** are two components of fitness," said Dr. Floyd. "The third is **endurance,** which is the ability to do something for a long period of time without getting tired. Some exercise experts say that raising our **heart rate** for 30 to 60 minutes at least four times a week can improve endurance. Dancing, climbing stairs, running, and swimming are great for raising your heart rate. Because they require lots of oxygen, we call them **aerobic activities.**"

"That's a lot of time to spend exercising," remarked Carol. "I have lots of other things to do, so it's not easy to do all that exercise just so I can be fit."

"I understand. You've got very busy schedules. But what if I tell you that there are other benefits to fitness? Being fit improves our moods, helps us sleep better, and reduces the risk of Type 2 diabetes. Being fit also increases our energy out, which helps us maintain energy balance."

"You've convinced me," said Calvin. "Let's take the stairs today, Carol, and get our heart rates up."

"Thanks for meeting with me today, Calvin and Carol," said Dr. Floyd. "See you next time."

LESSON 15:
Healthy Hearts

Calvin and Carol knocked on Dr. Floyd's office door and walked in. "Hi, Dr. Floyd. Ms. Lee said you wanted to meet with us today. What's up?" asked Calvin.

"Where's Christian?" inquired Carol. "Ms. Lee said he'd be joining us, too. Are we going to work with models?"

"So many questions," laughed Dr. Floyd. "You certainly are curious — and yes, Christian will be joining us. He just had to

go back to his lab and pick up some materials. Last time we met, we discussed why physical activity is important for our bodies. Today, we're going to investigate why healthy food choices are important."

Just then Christian pushed open the door. His hands were full of plastic tubing and a box of other materials. "Let me help you," said Calvin. He took the box and peered inside. "What's all this for? Is this play dough? Hmm, red food coloring, a bowl… Are we going to make something out of play dough?"

"Slow down, Calvin," chuckled Dr. Floyd. "Give Christian a chance to get set up here. Christian and I have been meeting and discussing how to design a simulation that will help you have some hands-on experience with the flow of blood through the human body."

"Awesome," said Calvin. "I'm ready!"

"I don't know," remarked Carol. "It sounds pretty messy. Where's my lab coat? Should we put on gloves and a mask if we're working with blood?"

"Here are your lab coats and safety glasses, but we're not working with real blood, Carol, it's fake blood," said Christian. "We're going to compare two models of blood vessels. One is very clogged with fat and cholesterol. As a result, you can see how the plaque has built up. The other model is a blood vessel that isn't clogged with plaque. Here's a printout that describes the setup for you, and here are your materials."

Christian handed them two pieces of plastic tubing 3 inches long and 3/4 inch wide. "This yellow play dough represents the plaque. Put one piece of tubing aside. It represents the blood vessel without plaque. Now, here's a piece of play dough for each of you. Roll it out into a long, skinny piece, skinny enough that it can fit into the ends of the tube."

Calvin and Carol used their hands to roll out the play dough. "Now what do we do?" asked Carol.

"Stuff one roll into each end of this tube. Now push a pencil all the way through the middle of the play dough so there is a small opening that runs the length of the tube," instructed Christian. He checked their model. "Excellent, now we'll get the blood."

Dr. Floyd handed Christian a container with a red liquid in it.

"Yuck," exclaimed Carol. "How did you make that?"

"I started with some 'simple' blood — just water and food coloring. But I wanted to give it a consistency that's similar to real blood, so I added some cornstarch. What do you think?" asked Dr. Floyd.

"Looks like blood to me," said Calvin. "I'm convinced."

"Okay, then," said Christian. "Let's take the unclogged blood vessel and pour a cup of blood through it as fast as possible. Remember to record your observations in your notebook."

Calvin picked up the empty tube and Carol poured the "blood" through it into the bowl.

"Now can we try the clogged blood vessel?" asked Carol as they finished writing. "Can I hold it over the bowl this time?"

"Okay, then I'll pour the blood," added Calvin. "Whoa, what a difference! The blood flows a lot faster through the unclogged

blood vessel than the clogged one!"

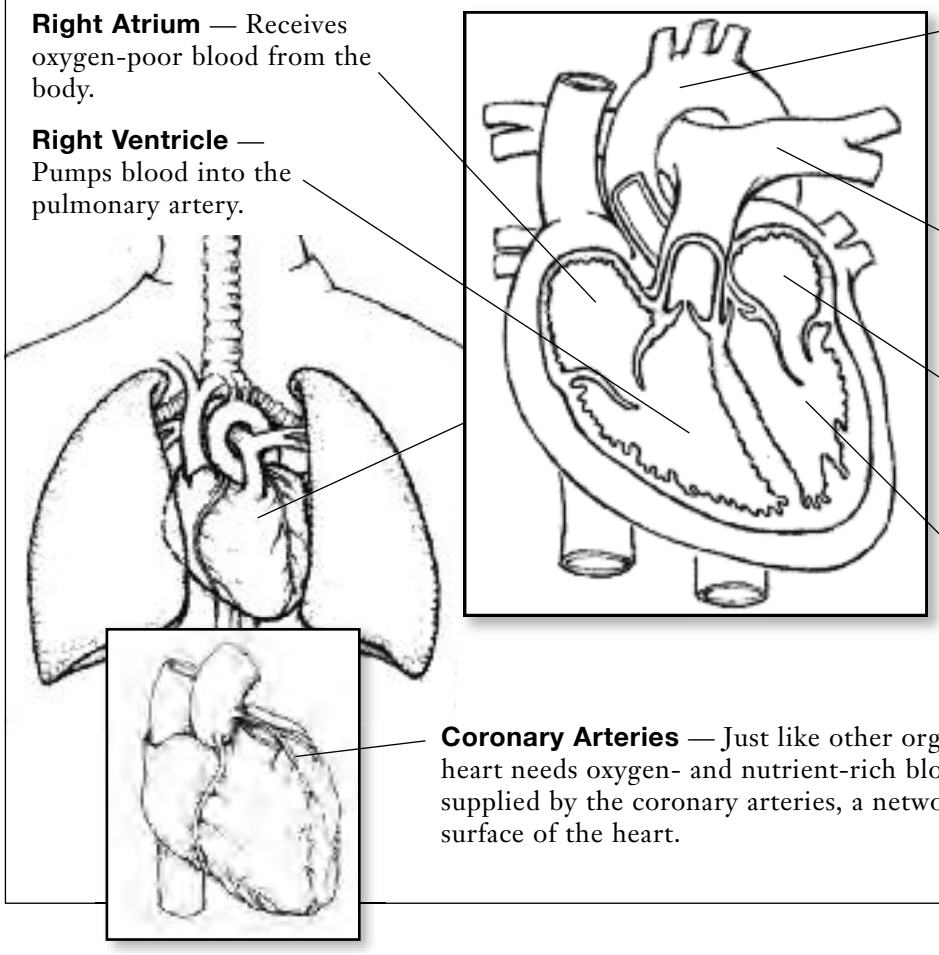
"Good observation, Calvin," commented Dr. Floyd. "Now, what do you think would happen if your heart had to pump blood through very clogged blood vessels? Do you think this would be a problem?"

"For sure it would be a problem, Dr. Floyd," Carol exclaimed. "The clogged vessels would make it harder to get the oxygen and nutrients that our bodies need."

"And blood still has to get to all parts of our body, even if the vessels are clogged. Probably the heart would have to pump harder to get the blood through," observed Calvin.

"You're both right," said Dr. Floyd. "When the heart pumps harder to push the blood through the clogged vessels, it causes increased pressure inside the blood vessels, which causes high **blood pressure**. If you'll look at this diagram of a heart, you'll see there are blood vessels that supply the heart with the oxygen and nutrients that it needs to keep beating. If the coronary artery, which is the major blood vessel that 'feeds' the heart,

The heart is located between the lungs.The right and left sides of the heart do different jobs. Both are important. The right atrium receives oxygen-poor blood from the body and the right ventricle pumps it to the lungs, where it gets oxygen and gets rid of waste—carbon dioxide. The left atrium receives oxygen-rich blood from the lungs, and the left ventricle pumps this blood into a network of vessels that provide every cell of the body with oxygen and nutrients. Blood also carries waste away from cells.



Right Atrium — Receives oxygen-poor blood from the body.

Right Ventricle — Pumps blood into the pulmonary artery.

Aorta — The main artery of the body. It carries oxygen-rich blood to all parts of the body.

Pulmonary Artery — Carries oxygen-poor blood to the lungs.

Left Atrium — Receives oxygen-rich blood from the lungs.

Left Ventricle — Pumps blood into the aorta.

Coronary Arteries — Just like other organs in the body, the heart needs oxygen- and nutrient-rich blood. This blood is supplied by the coronary arteries, a network of arteries on the surface of the heart.

gets completely clogged, it causes a heart attack."

"My grandfather had a heart attack, but I never understood what that meant. I remember when he got better, he had to be on a diet and stop eating fried foods. He was grumpy, but my grandmother told him he had to do it. Now I understand why," said Calvin.

"I'm glad your grandfather is okay," said Dr. Floyd. "Your observations about his diet lead into our next topic, eating for a healthy heart. Let's summarize what we've learned about fatty foods. Cholesterol is a soft, fatty substance that's found in your body's cells. Your body makes some cholesterol and gets some from food."

Calvin and Carol wrote furiously in their notebooks, trying to keep up with Dr. Floyd. Carol stopped and asked, "Do eggs have cholesterol?"

"Yes, eggs and other foods that come from animals, such as whole milk, eggs, meats, cheese, and butter all have cholesterol and **saturated fat**."

"Everything I love," sighed Calvin. "So, I'm guessing that foods with lots of cholesterol and saturated fats are not good for you, right? So what can we eat for a healthy heart?"

Ms. Lopez walked in just at that moment. "Why, Calvin, there are lots of foods that you can eat. You can eat foods that come from plants. They are naturally high in nutrients that our bodies need and they are low in fat. Can you name a few?"

"I can," said Carol. "I am eating more fruits and vegetables as my food goal. Many of the vegetables I'm eating, like green beans and carrots, I'm harvesting from my grandmother's garden!"

"Excellent," noted Ms. Lopez. "What about you, Calvin, anything to add to the list?"

"My grandmother made my grandfather oatmeal for breakfast, and he ate whole-wheat bread. She also fixed dishes made from beans. Now that I think of it, all of those come from plants, too," observed Calvin.

"Right you are," exclaimed Ms. Lopez. "This seems like a perfect place to end this session. But before you go, let's head down to my office and take a look at how you're doing with your goals."

Calvin and Carol gathered up their backpacks. "Thanks, Dr. Floyd, thanks, Christian. The simulation worked great!"

LESSON 16:
Type 2 Diabetes

"Ms. Lopez," Calvin called out, "You said that today we'd meet with an endo… um, endocrinologist and Christian. But what's an endocrinologist?"

"Glad you asked, Calvin," said Ms. Lopez. "I'll let Dr. Shapiro tell you for himself. Calvin and Carol, let me introduce you to Dr. Eli Shapiro."

"Glad to meet you both. An endocrinologist is a doctor who is specially trained to study the endocrine system. The endocrine system is your body's system of glands, so endocrinologists diagnose and treat diseases that affect your glands." Dr. Shapiro looked at Calvin and Carol's blank faces. He paused for a moment and continued, "Glands are organs in the body that make **hormones**. Different kinds of hormones control metabolism, reproduction, growth, and