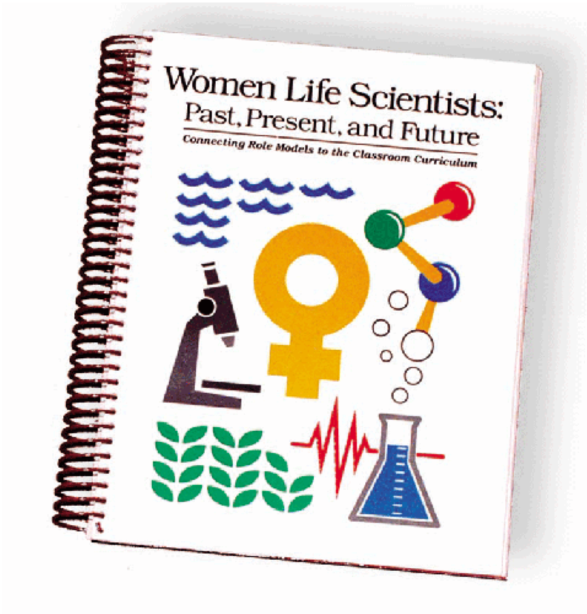

Joyce J. Jones

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Copies of the activities from *Women Life Scientists: Past, Present, and Future* can be found at http://www.the-aps.org/education/k12curric/index.asp. To purchase bound copies, visit the APS store at http://www.the-aps.org/cgi-bin/ecom/productcatalog/Product_catalog.htm.

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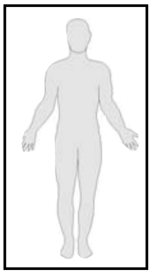


Joyce J. Jones
Physiologist

Unit developed by
Marsha Lakes Matyas and Andrea S. Jackson
The American Physiological Society

Who is Joyce J. Jones?

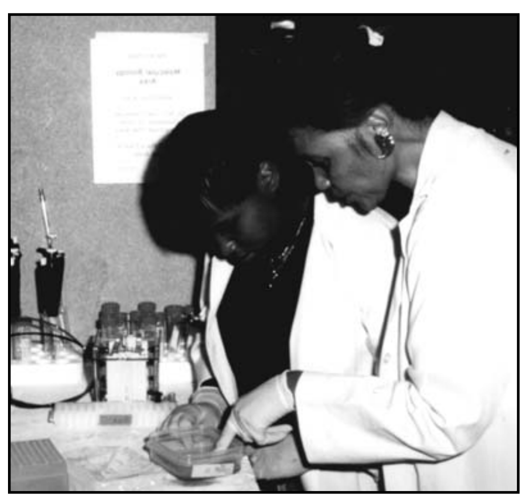
Dr. Joyce J. Jones is a research scientist in the Physiology Department and the Dalton Cardiovascular Research Center at the University of Missouri-Columbia. In conjunction with her research, Dr. Jones spends part of her time mentoring high school and undergraduate students.

Joyce was born in Mississippi but grew up in Chicago, Illinois. She started to think that she might like to be a scientist when she was in the fourth grade. She loved to explore the natural world, and she wanted to find the answers to many of nature's questions. Unfortunately, none of her teachers and peers supported her; they ridiculed her instead for being interested in science. She was told that "girls don't do science."

As a young girl, Joyce became very ill and her family did not think she would live to grow up. At the time, doctors did not have any specific answers about her illness. Joyce's family sent her to live at her grandfather's home in Mississippi where she would be more comfortable. Her grandfather was a very influential person in Joyce's life. He taught her important lessons about the value of helping others and tutored her while she stayed with him. He was part Cherokee Indian, and he worked as a veterinarian and medicine man. Indian and African-American people were often not admitted into hospitals in those days, so he made medicines from herbs for them when they became sick. Even though he did not have a degree, he was very well respected by his friends and the community, who called him "Mr. Buddy Red." While with her grandfather, Joyce gradually began to recover and thrive, and she returned to Chicago after a year in Mississippi.

When Joyce returned from her grandfather's home, she started school again and a test indicated that she was a gifted student. As a result, she entered a special gifted student program in the seventh grade. She had a good teacher who supported her interest in science, and she began to put together what she learned from nature with the chemistry and physics she learned in class.

How did Dr. Jones become a research scientist?

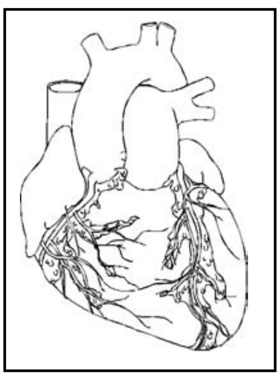


Joyce traveled a long road to her current career. She was always thrilled by learning new things, and her mother and grandfather encouraged her to have a vision of what she wanted to do, and to work hard toward it. However, she was often discouraged by other people.

In high school, she worked in physicians' offices and thought that perhaps she would become a physician herself. But the people she worked with encouraged her to be a nurse instead. When Joyce began college at Chicago State University as a biology major, she attended classes year-round because she enjoyed it so much. She took children from her church and community on field trips to museums to show them how exciting it was to learn new things. However, Joyce's college counselors did not share her enthusiasm about becoming a scientist or doctor; they mistakenly felt that she should limit her career options because she was African-American and female. They told her that she was smart, but that the best career for her would be as a teacher. So she set aside her dream and took education classes along with her science courses. After receiving her undergraduate degree, Joyce taught students in a gifted children program at a Catholic elementary school.

When Joyce continued her graduate studies at the University of Illinois at Chicago, she met an African-American Ph.D. for the first time. With his sponsorship, she studied cell and developmental biology and received a Master's degree in 1974. After attaining her Masters degree, Joyce taught middle and high school students in the Chicago public school system. She was a talented instructor who taught science by incorporating many multicultural aspects into her lessons. She was also determined to encourage her students to follow their dreams. After many years, though, she realized that she had not been taking her own advice. So she decided to finally pursue her dream of becoming a research scientist. She then entered a Ph.D. program at the University of Missouri-Columbia, and she became Dr. Joyce J. Jones in 1993. Her dream had finally come true.

What kind of research does Dr. Jones do?



Dr. Jones does research in the field of cardiovascular physiology. She studies how the cardiovascular system functions during *pathological*, or disease-causing, conditions such as *endotoxic* (circulatory) *shock*. Endotoxic shock, or ETS, affects people of all ages, often those who have just had surgery. It can occur very quickly, within 48 hours of surgery, and it is impossible to know ahead of time who will be affected. ETS is the leading cause of death in surgical intensive care units today, causing more than 100,000 deaths annually.

When bacteria invade the circulatory system and produce a toxin that is released into the circulatory system, ETS occurs. The toxin, called *endotoxin*, disrupts the cardiovascular system, causing heart failure and low blood pressure. Consequently, oxygen and nutrients are not distributed properly to the heart and other organs. After surgery, people are usually given antibiotics to prevent infection. But occasionally an infection is already present. This is what causes ETS in certain people. Bacteria are already in their system, the antibiotics kill the bacteria, and the toxin inside is released into the circulatory system.

Most people are able to recover from infection because of important cardiovascular reflexes that maintain blood pressure. However, during certain infections, such as *sepsis*, the cardiovascular reflexes of some individuals do not respond properly and this results in a sudden drop in blood pressure (*hypotension*), which may lead to septic or endotoxic shock.

Why do bacteria create toxins? When bacteria encounter bad growing conditions, such as dry areas or lack of food, the toxin helps them to survive by killing off other bacteria that compete with them for food or water. The endotoxin created is actually a type of sugar called a *lipopolysaccharide*.

How is Dr. Jones studying this problem?

Dr. Jones is studying the specific biochemical and molecular mechanisms that result in ETS. In particular, she is doing research on the *hyporesponsiveness*, or low response, of the cardiovascular system. For example, Dr. Jones wanted to find out the difference between normal cardiovascular function versus hyporesponsiveness caused by an endotoxin. So, she decided to track the differences between changes in the heart muscle and blood vessels of normal and endotoxin-treated tissue. She placed pieces of smooth muscle from blood vessels and heart muscle (obtained from guinea pigs) in a machine to measure their contraction (tightening) and relaxation responses.

Within four hours Dr. Jones could see differences between the two tissues. She found that the tissue treated with endotoxin lost its tone and did not relax or contract properly, a problem that could lead to heart failure and, ultimately, death. Through her research, Dr. Jones hopes to find a way to know ahead of time who will be affected by ETS and to learn how to prevent ETS from happening. She also hopes to identify the mechanisms involved in the poor response of the heart and blood vessels and thereby improve treatment of this disease.

What is important to Dr. Jones?

Dr. Jones feels it is very important to try to enjoy life and learn as much as possible, partly because of her childhood illness. Due to the influence of her mother and grandfather, it is satisfying for her to help and teach others through her research. At work, Dr. Jones tries to balance her research and teaching responsibilities. Outside of work, she is very close to her family and enjoys traveling. She has a teenage son, L. Alex, who is in high school.

Dr. Jones speaks from plenty of experience when she offers the following advice to students, “Give some thought to your future. Decide what you want to do. Before you make a commitment to it, talk to someone who does that as their work. You are committing to a career and a lifestyle. If it fits you, you’ll have a realistic outlook. Then go for it!”

Did You Know...?

Human blood travels 60,000 miles per day on its journey through the arteries, arterioles, and capillaries and back through the venules and veins.

(From the Access Excellence website: http://www.gene.com/ae/.)

SUGGESTIONS FOR TEACHERS

ACTIVITY #1: Arteries and Plaque
ACTIVITY #2: Are All Fats Alike?
ACTIVITY #3: Clot Buster!

Purpose
To demonstrate the effects of plaque build-up on the work required by the heart.

Objectives
1) To become familiar with the concepts of pressure and flow and how they relate to the work done by the heart.
2) To gain skills in inquiry processes, especially experimental design, data collection, data analysis, and development of conclusions.

Materials
For each group of three to four students
- 4 syringes (40-60 ml, no needles)
- 3 pieces of aquarium or Tygon tubing, each 24 in (60 cm) long
- red food coloring
- access to cold and hot water
- pan for water (or sink with a stopper)
- margarine
- butter
- vegetable shortening
- various cooking oils
- stop watch or clock
- spring scale
- 250-ml beakers
- hot plate or microwave
- string
- scissors
- millimeter ruler

Before You Begin
1) Cut tubing into 24-inch (60 cm) lengths. Make sure there is a tight fit between tubing and syringes. If not, use an adapter. Tubing should have at least a 1/4-inch (6 mm) opening.
2) Call local hospitals, clinics, and medical labs — they often have syringes that have never been used for patients but, because they have been exposed to air and are no longer sterile, must be thrown away. They will often save them for you. Some facilities are willing to donate a supply of syringes for your use. Similarly, contact science departments at colleges or universities in your area. They can purchase Tygon tubing for you at a much lower cost.
3) Students can melt butter, margarine, or shortening individually in 250-ml beakers OR you can have a setup at the front of the room with larger beakers of warmed fats. Try a warming tray, such as one used for appetizers at buffet tables, to keep fats warm after you melt them. The water used to mix with the fats should be very hot.
4) Students should have something to which they can hook or tie the spring. This could be the base of a vacuum or gas jet, a sturdy ring stand, or a drawer pull.
5) Spring scales are commonly used in elementary physics activities; if you do not have them in your life sciences supplies, see if you can borrow them from the physics instructor.
6) Set up a demonstration of the equipment so students can compare their setup before beginning. You may also want to demonstrate how to draw the plunger outward with a steady, slow, constant pressure.
7) Divide students into teams of three to four. Each team receives copies of the materials.
8) All teams should do *Activity #1*. You may want to divide the class so that half of the class continues with *Activity #2* and the other half does *Activity #3*. The students can share their results when the activities are complete.

Safety Considerations
- Students should wear lab aprons to protect their clothing and should wear appropriate eye protection.
- Exercise caution when melting fats. Fats should be melted slowly and should not be allowed to come to a boil. Watch carefully

that fats do not reach smoking temperature. If students will be melting fats at their individual stations, provide instructions on how to respond to a grease fire before beginning the class; be sure to emphasize that students should NOT pour water into very hot or burning fats.

Questions to Ask

- Why should the same person serve as the Pressure Controller for each experiment?
- What is happening inside the tubing as the fat and water pass through? What do you see happening at the point where the tubing rests in the pan of cold water?
- How do you think plaque build-up might affect the heart? Why?
- What would happen to the "blood" supply at the far end of the tube if the tube became completely blocked with plaque or with a blood clot?
- How big a blood clot would be needed to block a "clogged" artery versus an artery with no plaque?
- Why are we using room temperature water in the pan instead of body temperature water? (Note: this serves to speed up a process that, in living mammals, may take many years).
- Why do you think diet can be important in reducing a person's risk of heart disease?

Ideas for Assessment

- Ask student groups to report on *Activity #2* and *Activity #3*.
- Ask students to select one of the risk factors for heart disease. As individuals or groups, they can gather information from the library, Internet, local American Heart Association office, or an interview with a physician. They should discuss with the class why the risk factor affects the function of the heart and what the current recommendations are from physicians on how to minimize one's risk.

Where to Go From Here

- Ask students to write down everything they eat for two days. Then students can do an assessment of how "heart-healthy" their diet was for that period and make suggestions for improvements.

References and Resources

Martich, G. D., Boujoukos, A. J., & Siffredini, A. F. (1993). Response of man to endotoxin. *Immunobiology, 187*, p. 403-416.

Stone, R. (April 15, 1994). Search for sepsis drugs goes on despite past failures. *Science, 264*, p. 365-367.

✓ *About the activities:*

Activities adapted from *Saturated Versus Unsaturated Fats* by Jeff Beiswinger, Jefferson Junior High School, Columbia, MO, developed during an American Heart Association (Missouri Affiliate) Cardiovascular Experiment Workshop for Science Teachers, January 7, 1995.

✓ *For science supplies:*

Carolina Biological Supply Company, 2700 York Road, Burlington, NC 27215, (800) 334-5551.

Fisher Scientific, Educational Division, 485 South Frontage Road, Burr Ridge, IL 60521, (800) 955-1177.

Flinn Scientific, P.O. Box 219, Batavia, IL 60510, (630) 761-8518.

WARD'S, 5100 West Henrietta Road, P.O. Box 92912, Rochester, NY 14692-9012, (800) 962-2660.

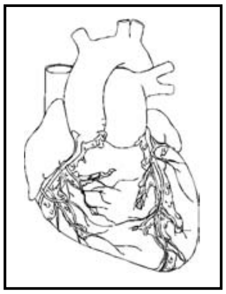
✓ *On current research:*

For an excellent review of current research on and treatment of cardiovascular disease, see articles in the issue, *Science, 272*, May 3, 1996.

✓ *Photo credit:*

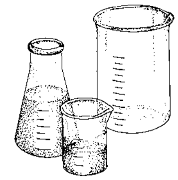
Photos on pages 37, 39, 40, and 41 courtesy of Joyce J. Jones, University of Missouri-Columbia, Columbia, MO.

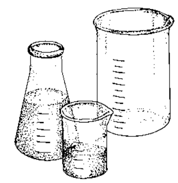
ACTIVITY #1: Arteries and Plaque



You've undoubtedly heard that eating a lot of fat in your diet can "clog your arteries." But what does that mean? And are all fats bad for you?

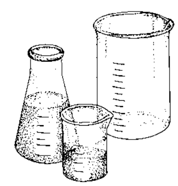
In this activity, we'll build a model artery and heart pump and find out what happens to the heart when the artery becomes "clogged."





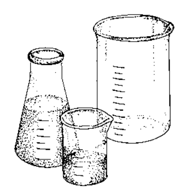
You will work in teams of three to four to do this activity. Divide the following jobs among your group:

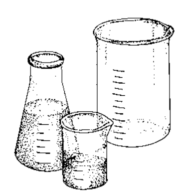
- **Timer**
- **Technical Engineer** (If there are only three persons in your group, everyone should help with this job).
- **Pressure Controller**
- **Recorder**



Make sure that all equipment and materials are ready. Gather the following:

- 4 syringes (no needles)
- 3 pieces of aquarium tubing, each 24 in. (60 cm) long
- red food coloring
- room temperature water and very hot water
- margarine, butter, or vegetable shortening
- stop watch or clock
- spring scale
- 2 beakers (250 ml each)
- hot plate or microwave
- string
- scissors
- millimeter ruler
- dish detergent or other liquid soap





Now, follow this procedure:

1. Fill the tub or sink with room temperature water.

2. Cut two pieces of string to 6- to 8-inch lengths. Tie a loop in one end of each string. Tie the other end to the plungers of the syringes.

3. Prepare a solution of very hot tap water and food coloring. To 100 ml of water, add 5-8 drops of food coloring.

4. Draw 16 ml of colored hot water into one of the syringes. Hook the loop on the string to the hook on the spring. Use string to connect the other hook on the spring to something solid, such as a water pipe, gas jet, or ring stand rod. Connect the tubing to both syringes, and lay the middle of the tubing in the pan. The ***Technical Engineer*** should check the Diagram, "Setting Up Your Equipment," on page 46 to make sure that the equipment is assembled correctly.

5. The **Pressure Controller** should pull on the plunger of the empty syringe with steady, slow pressure. The **Timer** should start the timer when the **Pressure Controller** starts pulling the plunger. The **Recorder** should record the maximum amount of force used (as measured very roughly by the pull on the spring) to pull the fluid through the tube.

6. When the first syringe is empty (or nearly empty), record the amount of time used. Then turn the syringe/tubing assembly around, hook the other syringe to the spring, and repeat the experiment. Record the amount of force used during the second trial.

7. In a beaker, melt the butter or shortening. Do NOT bring to a boil; just melt the solid.

8. Drain the water out of the syringes and tubing.

9. Repeat *steps 4*, *5*, and *6*, using 8 ml of melted butter or shortening and 8 ml of hot water mixed in the syringe. The same person should serve as the **Pressure Controller** for each trial.

10. Record your results in the "Data Table" on page 46.

11. Each member of the team should then try pulling the water/fat mixture through the tube.

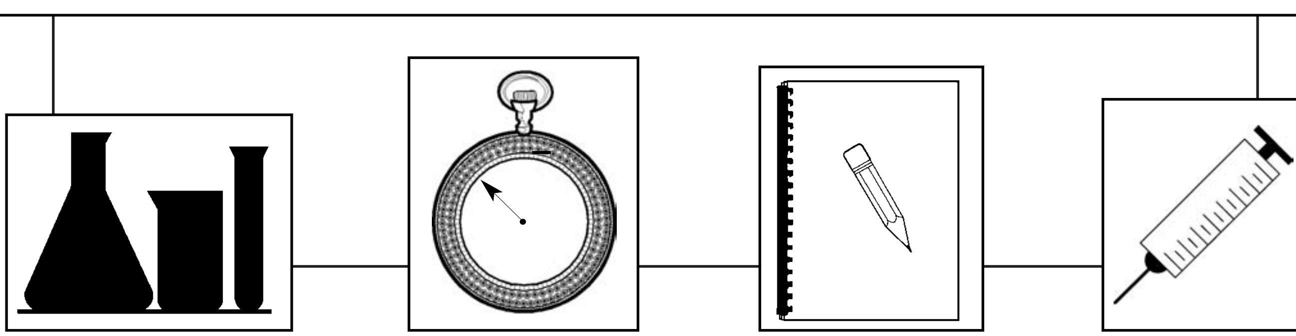
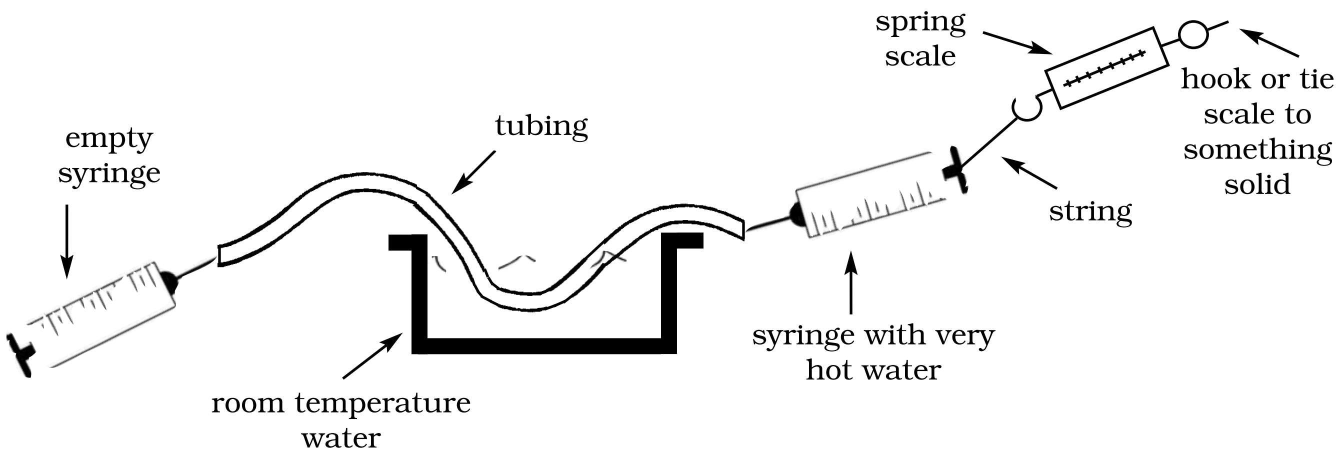


Diagram:
Setting Up Your Equipment



Data Table

Trial number	"Blood plasma" (hot water)		Saturated fat (butter or shortening mixed with hot water)	
	Time needed to move the fluid (seconds)	**Maximum force**	**Time needed to move the fluid (seconds)**	**Maximum force**
1				
2				
Average				

Now, answer the following questions:

1. Did you see or feel any difference in the pressure needed to pull the plain water versus water/butter mixture through the tubing?

2. What happened to the butter/shortening as it passed through the tubing?

3. How is this similar to fatty plaque being deposited along the walls of arteries? How is it different?

ACTIVITY #2: Are All Fats Alike?

Design and carry out an experiment to show that different types of fats can have different effects on the pressure inside the walls of the "artery" in our model system.

ACTIVITY #3: Clot Buster!

Design and carry out an experiment to show how a "clot-buster drug" could reduce the pressure and increase the flow of blood in our model system.