READY, SET, FLOW!

LOGISTICS

- **Big Idea:** Blood Pressure
- **Type of Activity:** Assessing atherosclerosis / clogged arteries
- **Length of Activity:** 5 minutes
- **Group Size:** 2
- **Space Needed:** One table, covered with a towel (Water will spill during this activity!)
- **Special Space Considerations:** The floor may get wet. If someone is hosting you, ask if it is okay to do the activity, and if you can use red food coloring.
- **Grades:** Third Grade – Adult
  Small children will not understand the concept of artery, clogged artery, or atherosclerosis. This will be more of a physics game, understanding how clogging a tube can affect force and pressure. For more sophisticated students, it can help explain high blood pressure.

PREPARATION:

Set-Up

1. Fill the tub or big bowl with water and add food coloring to make it look like blood.
2. Make sure there are two turkey basters: one clear, and one clogged with hot glue.
3. Place the two cups labeled “Brain” on the table.
4. Place the pound of fat model on the table (from the main outreach tub).
5. Place the clogged artery model on the table.

Core Concepts:

The turkey baster (heart) race is a great way to illustrate how hard the heart has to work when arteries get clogged. See the National Science Standards section to better understand the science connections to the activity, as well as what different age groups are capable of understanding.

1. When arteries get clogged:
   a. The heart has to work harder to deliver blood around the body.
   b. Blood cannot deliver oxygen to other organs as quickly and easily as when they are clear.
   c. Pressure on the inside of the artery increases.

2. (Related concept) Blood pressure will increase when atherosclerotic plaque builds up in the arteries.

Safety Note:

Small children are tempted to grab the tub to look inside, and subsequently spill water on themselves. Guard the tub carefully.
Special Supplies: If you are trying to re-create the existing activity.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Approx. cost per unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey basters</td>
<td>2</td>
<td>$15.00</td>
<td>Grocery Store</td>
</tr>
<tr>
<td>Hot glue</td>
<td>1</td>
<td>$5 for hot glue gun,  $1 for hot glue</td>
<td>Hardware Store: Carefully pour hot glue down the inside of one turkey baster. Be careful to not clog it entirely. Pour a little at a time and test it, until it feels difficult to squeeze, but still permits the flow of water.</td>
</tr>
</tbody>
</table>

Easy To Obtain Supplies:

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Approx. cost per unit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large bowl</td>
<td>1</td>
<td>$3.00</td>
<td>Grocery Store</td>
</tr>
<tr>
<td>Water</td>
<td>Fill the bowl</td>
<td>$0</td>
<td>Faucet</td>
</tr>
<tr>
<td>Red food coloring</td>
<td>1</td>
<td>$3.00 / box of 4</td>
<td>Grocery Store</td>
</tr>
<tr>
<td>Picture of Circulatory System</td>
<td>1</td>
<td>$0</td>
<td>Printing Resource, end of packet</td>
</tr>
<tr>
<td>Cups</td>
<td>2</td>
<td>$1</td>
<td>Write “Brain” on the side</td>
</tr>
</tbody>
</table>

PERFORMING THE ACTIVITY

Activity Outline:

Hook
1. Want to play some blood races?

Engage *(This question can be printed from the Printing Resources section.)*
1. How does a clogged artery challenge the heart?
Questions
(Introduction) We have two artificial hearts here (squeezy part), each with arteries attached to them (tubes). Your job is to see which heart can pump blood the fastest from the body (big bowl) to the brain (small cups).
1. Which heart do you predict will work the fastest?
2. How did you figure that out?

Explore
1. Demonstrate how to use the turkey baster.
2. Hand each person a turkey baster.
3. Let them know that the baster will work better if it is not touching the bottom, but sucks up "blood" from the middle of the bowl.
4. Which worked the fastest? Why?
5. Which one did you have to squeeze with more pressure?
6. Do you know what causes our arteries to get clogged like that?
   (eating fatty foods, foods high in refined sugar, and not exercising)
7. Depending on their interest, show them the model of the circulatory system, the clogged artery, the model of the heart, or the pound of fat. When discussing the pound of fat, try to use positive language. Instead of "Look how much we gain when we gain one pound," say, "When you lose one pound, you have a lot to be proud of!"

Evaluate
1. When you go home, what are some things you can do to help prevent making your heart work so hard? (go out and play, eat vegetables and fruits, etc.) Try to focus on the positive, fun things that they can do!
2. What happens to your heart if your arteries get clogged? What does it have to do? (work harder)

Adaptations
• **For Smaller Children:** They will not understand the concept of the arteries or clogging, but they’re probably familiar with where their heart is, and that it beats. Focus on enjoying the races, and talking about which was easier or harder, and why. The concept of force and pressure is applicable to many areas of science.
• **For Groups In Physical Activity Programs:** Discuss how physical activity helps keep our arteries clear.
• **For Older, More Sophisticated Participants:** Discuss the impact that fat and carbohydrates have on the health: too many can cause buildup of plaque in the arteries, leading to high blood pressure, stroke, and heart attacks.

The concept of blood pressure is a little easier to understand with this activity. The heart has to pump with
more force, because the pressure inside of the artery increases when it is filled with plaque.

**Learning Links**

- They or their family members may have some form of heart disease.
- If they enjoy this activity, they may want to explore a career in nursing or become a doctor.
- Next time they get their blood pressure taken, they can know that the doctor is seeing how hard the heart has to work.

**BACKGROUND**

**Background Science**

One strain on the heart can happen when we eat a diet high in cholesterol (which comes from eating food from animals, such as meat and eggs), or refined sugar (found in foods such as candy, white bread, pasta and rice). Eating too much cholesterol and/or refined sugar is thought to lead to atherosclerosis: a build up of plaque in the inner lining of the blood vessel wall. Plaque consists of low density lipoproteins that stimulate an immune response in the vessel wall, resulting in inflammation of the artery. This plaque narrows the passageway of the blood vessel, and makes it harder for blood to pass through. For most people, the internal diameter of our blood vessels decreases as we grow older. When the passageway is narrower, the rate of blood flow lowers. This slowing of the flow of blood is known as resistance to flow. (Example: A car crash on the highway slows the traffic flow. The car crash causes resistance to flow.)

A smaller diameter impedes the flow of blood through the blood vessel and causes pressure to build up inside of it. This can contribute to high blood pressure; the heart needs to work harder to deliver blood through the narrow openings in the obstructed blood vessels. This additional pressure on the inside of the vessels can result in damage to their lining, bursting of the blood vessels, or blockage of the blood vessels.
High Blood Pressure

High blood pressure (otherwise known as “hypertension”) is called the “silent killer” because it has no symptoms that you can hear, feel or see. High blood pressure occurs in 1 in 4 adults in the USA: this is more than 50 million American adults. High blood pressure can put you at the risk of the following:

- **Stroke (commonly called “brain attack”):** A weakened blood vessel can cause bleeding in the brain. Atherosclerosis can result in a blood clot. Either of these conditions can result in loss of oxygenated blood to an area in the brain. Without oxygen, the brain cells will die.

- **Impaired Vision:** Blood vessels in the eye can eventually burst or bleed. This may blur your vision and can result in blindness.

- **Hardening of the Arteries (called atherosclerosis):** As people get older, arteries throughout the body “harden” due to the build up of plaque. This can result in a blood clot that can block blood vessels. Also, the heart has to work harder to get blood to go through these stiffer arteries and blood pressure goes up.

- **Heart Attack (Myocardial Infarction):** Coronary arteries bring oxygen-rich blood to the heart muscle. If these arteries become blocked, the cells of that part of the heart muscle will not get oxygen. This will damage the heart muscle, causing chest pain (known as “angina”).

- **Heart Failure:** This is a serious condition in which the heart muscle becomes so damaged that it is unable to pump enough blood to supply the body’s needs.

- **Kidney Damage:** The kidneys filter blood to rid the body of wastes. As blood vessels to the kidneys become hardened, the kidneys filter less fluid, and waste builds up in the blood. The kidneys may fail altogether. Medical treatment (dialysis) or kidney transplant may be needed.

Lifestyle choices can help prevent high blood pressure. Factors such as diet, level of physical activity and stress affect blood pressure.

**Find Out More**

- **Youth Take Heart**
  http://www.youthtakeheart.org

- **Blood Pressure IQ Test**
  http://www.americanheart.org/presenter.jhtml?identifier=3021399

- **Prevent and Control America’s High Blood Pressure: Mission Possible**

- **Lowering Your Blood Pressure with DASH**
Body Story – Heart Attack Video
http://school.discoveryeducation.com/ontv/videoclips/humanbody1.html

Video - Atherosclerosis

Heart Attack/Stroke Warning Signs
http://www.americanheart.org/presenter.jhtml?identifier=3053

3D Heart Video and Animation
http://www.hhmi.org/biointeractive/cardiovascular/animations.html

American Heart Association
http://www.americanheart.org/presenter.jhtml?identifier=1200000

National Standards

Position and Motion of Objects

Kindergarten - Fourth Grade
The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.

Fifth Grade - Eighth Grade
An object that is not being subjected to a force will continue to move at a constant speed and in a straight line. If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object’s motion.

Translation: By narrowing the tube of the turkey baster, it creates an unbalanced force. The water has to push harder against the walls of the tube, and this does two things: 1) It lessens the efficiency with which water can leave the tube, and 2) The bulb of the turkey baster has to push with more force.

Personal Health

Kindergarten - Fourth Grade

- Safety and security are basic needs of humans. Safety involves freedom from danger, risk, or injury.
- Individuals have some responsibility for their own health. Students should engage in personal care—dental hygiene, cleanliness, and exercise—that will maintain and improve health.

Fifth Grade - Eighth Grade

- Regular exercise is important to the maintenance and improvement of health. The benefits of physical fitness include maintaining healthy weight, having energy and strength for routine activities, good muscle tone, bone strength, strong heart/lung systems, and improved mental health. Personal exercise, especially developing cardiovascular endurance, is the foundation of physical fitness.
- The study of science-related personal and societal challenges is an important endeavor for science education at the middle level. By middle school, students begin to realize that illness can be caused by various factors, such as microorganisms, genetic predispositions, malfunctioning of organs and organ-systems, health habits, and environmental conditions. Students in grades 5-8 tend to focus on physical more than mental health. They associate
health with food and fitness more than with other factors such as safety and substance use. One very important issue for teachers in grades 5-8 is overcoming students’ perceptions that most factors related to health are beyond their control. Students often have the vocabulary for many aspects of health, but they often do not understand the science related to the terminology. Developing a scientific understanding of health is a focus of this standard.

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How Does High Blood Pressure Damage the Arteries?

- High Blood Pressure damages the lining of the arteries, allowing plaque to form. As this plaque builds up, the blood vessels become narrow and stiff. This is called atherosclerosis.
- The walls of the blood vessels weaken, causing them to balloon out and possibly rupture. This is called an aneurysm.

How can Artery Damage Cause Problems in Other Body Systems?

When vessels that feed the cells of different organs become blocked by a blood clot caused by atherosclerosis, or when the vessel ruptures, the cells die, because they don’t get the oxygen and nutrients they need.

What Causes High Pressure?

High pressure is caused by two things:

High resistance & High force (or push)

- The wall of the pop can provide high resistance.
- The liquid escapes through the weakest part.
- The blood escapes through the weakest part. (Aneurysm)
- Plaque in the artery provides high resistance. (Atherosclerosis)
- The heart has to push with more force when there is high resistance. Many things, including atherosclerosis, cause high blood pressure.
How does a clogged artery challenge the heart?