Snapback!
Exploring Elasticity Lab
Student Activity Page 3B

Activity Introduction:
Have you ever been snapped by a rubber band? If so, you know something about *elasticity*. Elasticity is very important in allowing your blood vessels to function properly. Think of your blood vessels as elastic tubes through which blood moves, taking food and oxygen to all parts of your body. When these blood vessels lose their elasticity, they cannot do their job and your body suffers. In this lab, you will have a chance to learn more about elasticity and its importance in keeping your heart and blood vessels healthy. You will work in a group of 3-4 students to explore the properties of elastic tubes.

Statement of Problem: The question being investigated in this lab is to determine how a force applied to an elastic body affects the length and circumference as the elastic body stretches.

Activity Background:
A material that can resist stretching and return to its original size and shape when a force is applied and then removed is *elastic*. An object is more elastic if it returns more exactly to its original size and shape. For example, think of a ponytail holder and a guitar string. The guitar string resists stretching and returns to its original length even after continual usage. A ponytail holder will lose its shape much faster under continual usage and is thus less elastic than the guitar string. Using a spring as an example of an elastic object, a weight hanging on the end of the spring as shown in *Figure 1, Spring Elasticity*, applies a *stress* to the spring. When the weight pulls on the spring, the spring will pull back in an attempt to resist stretching, but will lengthen to some degree under the stress of the weight. The stretch of an elastic object due to an applied force is called *strain*. A property the spring is that twice as much must be applied to stretch the spring twice as far (See *Figure 1, Spring Elasticity*). The same principle applies to other elastic bodies such as the tubes used in this activity.

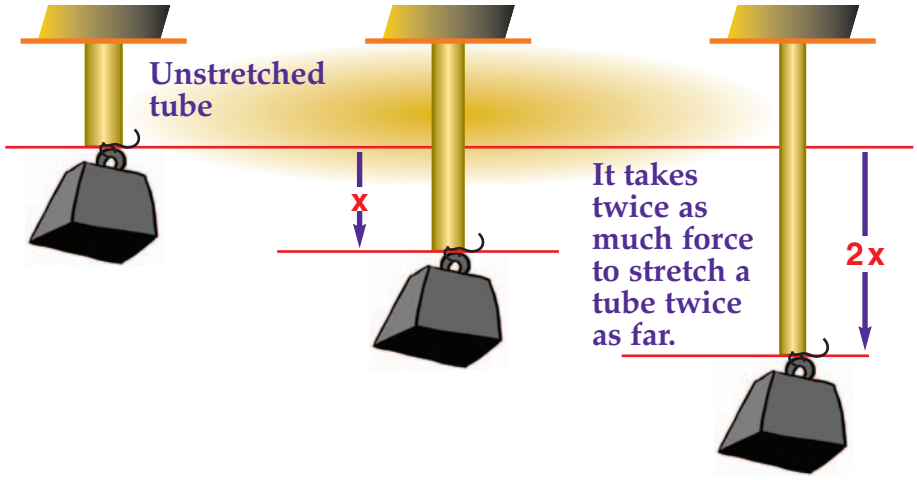
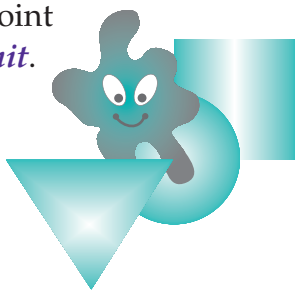
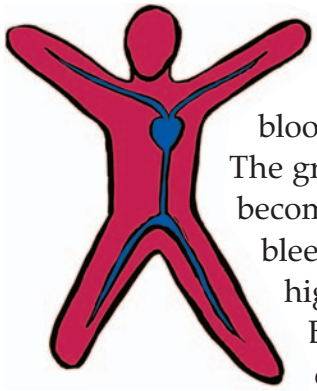


Figure 1 Spring Elasticity

Elastic materials obey Hooke's Law, which you will describe in this lab. The point at which elastic materials do not obey ***Hooke's Law*** is known as the ***elastic limit***. When the elastic limit of a material is ***not exceeded***, the material will go back to its original length when the weight (stress) is removed, but if too much weight is added, the material will stretch without going back to its original length when the weight is removed. If a very large weight is hanging on an elastic object, the object will get longer and longer until it breaks.



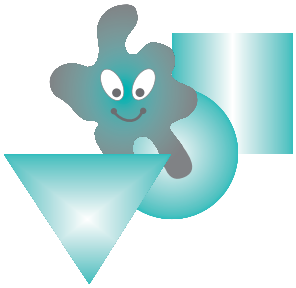
How does ***elasticity*** relate to the human body? The cardiovascular system consists of the heart and blood vessels (arteries, veins, and capillaries) and elasticity is an important property that allows our blood vessels to function properly. Arteries receive blood that is pumped away from the heart under pressure – this stretches arterial walls. Elastic fibers in arterial walls ensure that the vessel returns to its original shape. Arterial Elasticity keeps pressure on the blood inside, smoothing out the flow of the blood even when the heart relaxes; this pressure keeps the blood moving. Elastic recoil keeps blood moving though the capillaries – without it, the heart would have to work much harder. The elastic properties of arteries change with age and with disease. ***Arteriosclerosis*** is a disease in which arteries lose elasticity as their walls became stiff and inflexible; often as a result of high blood pressure exerting excess force against arterial walls. ***Atherosclerosis*** is a disease that begins with inflammation and causes arteries to become blocked. Atherosclerosis used to be considered an old person's disease; however, it ***begins in childhood*** and progresses through young adulthood to cause coronary heart disease (CHD). Fatty streaks and lesions have been found in youth as early as ***15 years of age***.



It is important to understand the elastic behavior of arteries in terms of force and motion. In an elastic tube, such as an artery, the blood inside exerts a force by pushing against the walls to create a stress. The greater the force on artery walls, the less elastic and more stiff they become. If an artery wall goes beyond its elastic limit, a rupture may cause bleeding which can result in irreparable damage or death. Maintaining higher elasticity in the arteries is necessary for managing vascular health. Blood vessel elasticity can be maintained by eating a low-fat, healthy diet, exercising, maintaining a healthy body weight, and keeping blood pressure within a healthy range. Learning about the elastic properties will help you to make positive changes that can affect your health.

Hypothesis: After reading the background and thinking about the problem being investigated in this lab, write your hypothesis to predict how ***an applied force*** might affect the ***stretch of an elastic body***. Write your hypothesis in the correct space on your **Student Data Page**. (Remember, we are looking for a change in length and circumference as measures of elasticity in the tubes.)

Activity Materials: (per group)



- Ring stand
- Clamp
- Spring scale (compatible with range of weights)
- metric measuring tape
- (1) 10 cm and (1) 15 cm stretchy rubber tube with the same inside and outside circumference, labeled A and B
- (2) 15 cm stretchy rubber tubes with different sized inside and outside circumferences, labeled C and D
- Set of weights (100 gram increments)
- Safety goggles
- 1 set of task cards per group

Activity Instructions: Your group will explore the properties of elastic tubes. Read each instruction and check off when completed.

SAFETY REMINDER: This lab involves adding weights to elastic tubes; because they will stretch and spring back, you must wear safety goggles to protect your eyes. Also, avoid stretching and releasing the tubes as this could cause the weights to hit you or someone in the class, causing injury.

❒ 1. Observe the setup of the experimental apparatus (Figure 2, Lab Set-Up). An elastic tube will hang vertically from a fixed point. **Note:** The tubes have clips already attached as per instructions in the teacher page.

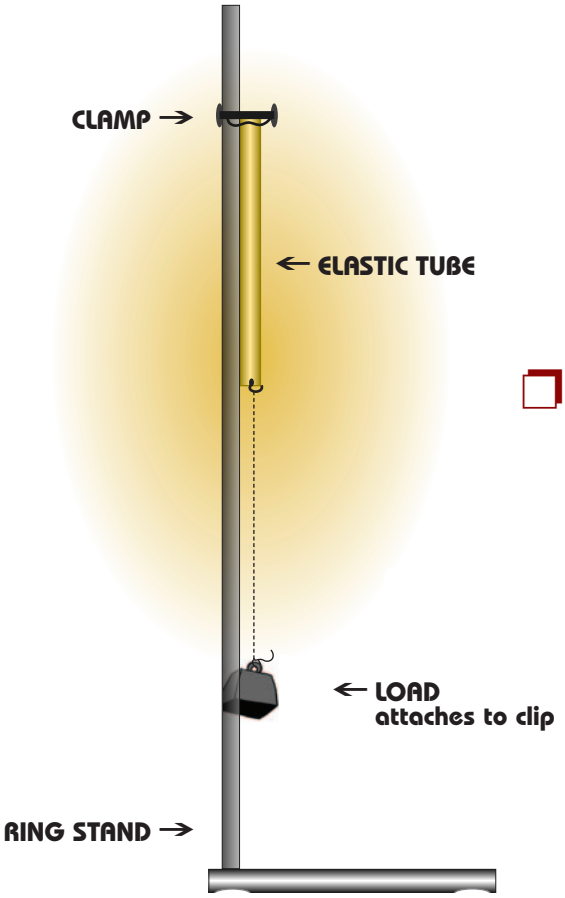
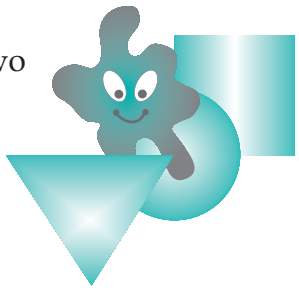


Figure 2 Lab Set-UP

❒ 2. Locate the tubes that are labeled A, B, C, and D. Measure the outside circumference of Tube A. Record the measurement for the circumference in Data Table 1.

3. Using the ruler, measure length of tube A (not including clips). Record the measurement in ***Data Table 1*** on your ***Student Data Page***. These two measurements are the ***starting length and circumference*** for tube A.



4. Hang Tube A on the ring stand and add a 100 gram weight onto the clip. Measure the length of the stretched tube in centimeters. The amount of stretch in the tube is calculated by subtracting the starting length (cm) from the stretched length (cm). **Note:** Do not add more than 1000 grams to the spring scale as this will break the scale.

Amount of Stretch = Stretch length – Starting length

5. Repeat step 4 until the tube does not stretch any more or until you have added ten 100 gram weights to the tube.

6. Record your data in ***Data Table 1*** on your ***Student Data Page***.

7. Repeat steps 1 – 6, using tubes B, C, and D. *Always begin by measuring the unloaded (0 grams) length of the tube*. Record your data for Tube B in ***Data Table 2*** on your ***Student Data Page***.

8. Repeat step 7 with tubes C and D, adding the 100 gram weights, one at a time. You will record the data for Tube C in ***Data Table 3*** on your ***Student Data Page***. Data on Tube D will be recorded in ***Data Table 4***. Put away all tubes when you finish this step.

9. Using the data on tube length, create a line graph that shows the relationship between the pull of the weights (stress) and stretch (strain). Make a separate line on your graph for each tube. When you finish the graph, use 4 map pencils to make each line a different color. Make a legend at the bottom of your graph to indicate which tube is represented by each color.

10. Repeat step 9 to make a second line graph of the change in tube circumference with each weight for each tube. Be sure to color code each line and create a legend for your graph.

11. Put away all equipment and setup the lab for the next group.

12. Complete the ***Processing Out*** questions on your ***Student Data Page***.