GET A LEG UP

Student Section Student Name _____

Lesson Objective

This lesson simulates the fluid shift felt by astronauts upon entering space.

During this lesson, you will

- gather data by measuring the circumference of the leg before and during the simulation.
- use data to explain the changes observed in the circumference of the leg.
- develop a conclusion based upon the results of this simulation.
- compare individual results to class results looking for patterns.

Problem

On Earth, how can I simulate the fluid shift felt by astronauts when they enter space?

Observation

While on Earth, gravity causes most of the body's fluids to be distributed below the heart. In contrast, living in space with less gravity allows fluids in the body to spread equally throughout the body.

When astronauts first travel into space, they feel as if they have a cold and their faces look puffy. Many astronauts talk about not feeling thirsty because of this fluid shift. The body records this shift as an increase in blood volume. The body takes care of this fluid shift by eliminating what it thinks are extra fluids as it would normally – that's right – through the kidneys -- resulting in visits to the restroom. Once this "extra fluid" is flushed from the body, astronauts adjust to space and usually feel fine.

Puffy faces and chicken legs are short-term changes that astronauts feel. Within three days of returning to Earth, the fluid level of the astronauts return to normal, and the body is "back to normal."

In this experiment, you will mimic this fluid shift felt in space by staying in a reclined position for a certain amount of time. You will record the effect this position has on your body's fluid distribution.

Use the first column of this KWL chart to organize your observations about how the heart pumps blood through your body.

Brainstorm with your group what you want to know about the fluid shift that happens in space, then list in the second column of this KWL chart.

KNOW	WANT TO KNOW	LEARNED

Hypothesis

Based on your observations, answer the "problem question" with your best guess. (On Earth, how can I simulate the fluid shift felt by astronauts when they enter space?) Your hypothesis should be written as a statement.

My hypothesis: _____

Materials

Per group

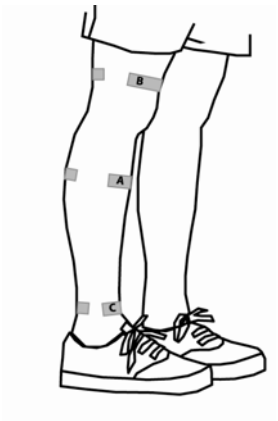
- metric measuring tape or string and metric ruler
- washable marker or masking tape

Safety

Review your classroom and lab safety rules.

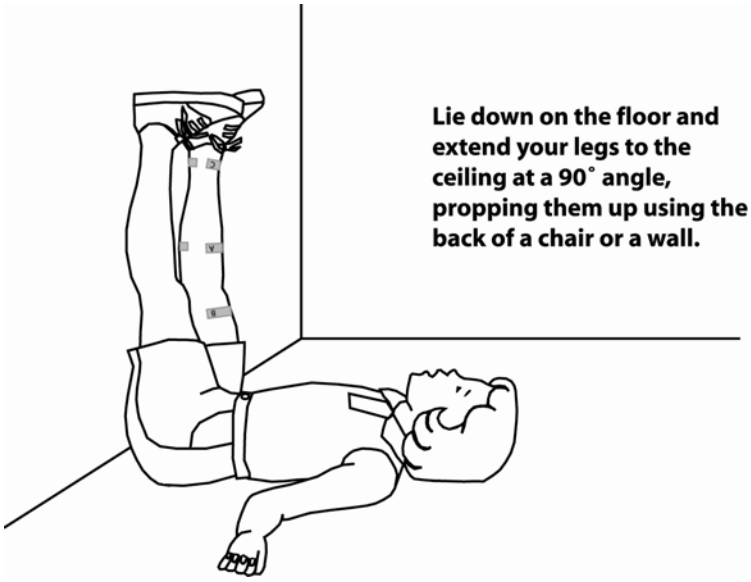
Test Procedure

1. Try to be relaxed and stand for 10 minutes. While standing, do the following:
    - With a partner, identify three places to measure on your bare leg. Make sure one of the places measured is the calf.
    - Your partner should use a washable marker or small pieces of masking tape to mark the places to be measured on the front and back of your leg. Label these as A, B, C. (See diagram.)
    - Identify these places to measure on the Leg Circumference Data Sheet.
    - Your partner should measure the distance around your leg at each of the three places. This distance is the circumference. Note: Be sure to pull the tape measure or string firmly around the leg, but not so tight that there are "dents" in the skin.
    - Record all data on the Leg Circumference Data Sheet. Double check your measurements.



Label the places you will measure as A, B, and C.

2. Predict what will happen to the circumference of your leg if you lie down for 10 minutes. Record your prediction on the Leg Circumference Data Sheet.
3. Lie down on the floor, and place your data sheet, measuring instrument and pencil close to you. Extend your legs to the ceiling at a 90° angle. Keep both legs raised for 10 minutes, propping them up using the back of a chair or a wall. (See diagram below.)



Your partner should remain standing for these 10 minutes.

While your partner is standing, they should identify three places on their own leg to measure, as in step 1 above. If your partner needs additional help, they may ask another person who is also standing for assistance.

4. After 10 minutes, do not stand up. Your partner should remain standing and measure the circumference of all three places on the leg again. Note: Be sure to pull the tape measure or string firmly around the leg, but not so tight that there are “dents” in the skin.
5. Collect and record all data on the Leg Circumference Data Sheet. Double check your measurements.
6. Repeat steps 2-5 for your partner.
7. After taking all measurements, study the data and draw conclusions by answering the questions following the Leg Circumference Data Sheet.

Record Data

Leg Circumference Data Sheet

Measurement Location	My measurement standing (cm)	My prediction Will my leg become smaller? larger? remain the same?	My measurement reclined (cm)
A calf			
B			
C			

Study Data

1. What happened to the circumference of the leg after it was raised for 10 minutes? Why do you think this happened?

2. Compare your results with what might happen to astronauts when they are in a reduced gravity environment.

3. Explain why we call what astronauts look like in space, the puffy face, and chicken leg syndrome. Did you get chicken legs during this activity?

4. How do you think the fluid shift you experienced might affect other parts of your body?

5. Does this data support your hypothesis? Why or why not?

6. How do your results compare to your partner's results? To the class results?

7. Based on your findings, what would you suggest to NASA researchers about helping astronauts overcome the fluid shift while in space?

Conclusion

- Update the LEARNED column in your KWL chart.
- Restate your hypothesis and explain what happened during testing.