Puffy Head, Bird Leg

Adapted from NASA's Get a Leg Up Activity
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Get_a_Leg_Up_Activity.html

Objectives

Students will:

- Learn how an astronaut's body will change and adapt as a result of living in a reduced gravity environment.
- Compare and evaluate how the presence and absence of gravity affects fluid distribution in the body.
- Simulate the fluid shift felt by astronauts while preparing for flight and upon entering space.
- Collect data by measuring the circumference of the leg, neck and head before and during the simulation.
- Use data to explain the changes observed in the circumference of the leg, neck and head.
- Develop a conclusion based upon the results of this simulation using individual and class data.

Suggested Grade Level

6th-12th

Subject Areas

Science

Timeline

120 minutes

Standards

- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

21st Century Essential Skills

- Collaboration and Teamwork
- Critical thinking

Background

"When astronauts are in space, they experience the phenomenon known as "Puffy-Head, Bird-Legs" Syndrome. The astronauts feel a sensation of sinus stuffiness and develop puffiness in the face. On Earth, gravity affects the distribution of fluids by pulling the various body fluids down toward the feet. In space, the constant free-fall motion of the International Space Station around the Earth creates an environment virtually absent of gravity. With this

virtual absence of gravity, body fluids redistribute upwards towards the chest and the head. This perceived increase in fluid volume in the upper part of the body causes multiples physiologic changes in the kidneys and associated fluid-regulating hormones in the cardio-vascular system and in the red blood system. The body begins to compensate for this perceived increase in fluids, until it adapts to the new environment. Scientists have gathered data over time and measurements have been taken before, during, and after space flight to show that the legs do change their shape during space flight. Astronauts with larger leg circumference show a larger decrease in leg volume than astronauts with smaller legs. This change in shape makes sense because increased muscle requires more fluid and blood flow to feed that muscle. The more blood and fluid there are in one area, the more there is to move. The reported sensations in the head and the measured changes in the legs support the hypothesis that fluids in the body shift upwards during space flight."

Vocabulary

Gravity, fluid shift, cardiovascular system

Materials

- Tape measure (1 per pair)
- Washable (non-toxic) marker pen (1 per pair)
- A desk chair (1 per pair)
- Watch with a second hand or stopwatch (1 per pair)
- Puffy Head, Bird Legs worksheet (1 per student)

Lesson

1. Establish the hypothesis that states, "A head-down tilt orientation to the human body will induce physical characteristics that indicate a shift of fluids toward the upper part of the body."
2. Measure the circumference of the head, neck, and mid-calf of several students while they are standing.
3. Carefully mark the placement of the tape measure with the marker pen.
4. Record the results of the initial measurements.
5. Lay each student down on the floor and elevate his or her legs onto the seat of the desk chair.

6. The student should be in a head-down position.
7. Ask the student to describe the sensations felt, especially in the head and the upper body.

8. After the student has been lying down for five minutes, measure the circumference of the calf, neck, and the head in the exact same place as before. DO NOT have the students stand up!!
9. Record the measurement.
10. Ask the student to describe the sensations felt, after five minutes, especially in the head and the upper body.
11. After the student has been lying down for ten minutes, measure the circumference of the head, neck, and calf in the exact same place as before.
12. Record the measurement.
13. Discuss.
    - What happened to the circumference of your leg after you had your feet up on the wall?
    - Why do you think this change happened?
    - How is this result similar to what the astronaut's experience?
    - What happened to your legs after you resumed some physical activity?
    - What can astronauts do to overcome Puffy-Head, Bird-Leg Syndrome?

	Standing	After 5 minutes	After 10 minutes	After 15 minutes
Circumference of HEAD (cm)				
Circumference of NECK (cm)				
Circumference of CALF (cm)				

Extensions

- Learn more about the effects of space on the human body. Go to the NASA web site and search for information about what happens to the astronauts in a microgravity environment. Find out what the astronauts do to compensate for these effects.
- Create a storyboard to record observations. You can use electronic devices to document effects of microgravity, or have students write their findings on paper to share with the class.

Resources

"Human Physiology in Space" A Curriculum Supplement for Secondary Schools. By Barbara F. Lujan and Ronald J. White

Dunbar, B. (2012, February 01). Get a Leg Up Activity. Retrieved from http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Get_a_Leg_Up_Activity.html

Mars, K. (2016, March 30). The Human Body in Space. Retrieved from https://www.nasa.gov/hrp/bodyinspace

Puffy Head, Bird Legs

Materials

Tape measure
Washable (non-toxic) marker pen
A desk chair
Watch with a second hand or stopwatch

Procedure

14. Measure the circumference of the head, neck, and mid-calf of several students while they are standing.
15. Carefully mark the placement of the tape measure with the marker pen.
16. Record the results of the initial measurements.
17. Lay each student down on the floor and elevate his or her legs onto the seat of the desk chair.
18. The student should be in a head down position.
19. Ask the student to describe the sensations felt, especially in the head and the upper body.
20. After the student has been lying down for five minutes, measure the circumference of the calf, neck, and the head in the exact same place as before. **DO NOT** have the students stand up!!
21. Record the measurement.
22. Ask the student to describe the sensations felt, after five minutes, especially in the head and the upper body.
23. After the student has been lying down for ten minutes, measure the circumference of the head, neck, and calf in the exact same place as before.
24. Record the measurement.

	Standing	After 5 minutes	After 10 minutes	After 15 minutes
Circumference of **HEAD** (cm)				
Circumference of **NECK** (cm)				
Circumference of **CALF** (cm)				