



## **NSBRI TAP Classroom Activity**

Title: **SHIFTY EYES**

Grade Level: 5-8

Content Area: Space/Life Science

National Science Content Standards:

Unifying Concepts and Processes (Grades 5-8)

- Models

Standard C. Life Science (Grades 5-8)

- Structure and function in living systems
- Regulation and behavior
- Diversity and adaptations of organisms

Behavioral Objectives:

- The student knows the relationship between structure and function in living systems.
- The student knows the meaning of the term special orientation and how it relates to the human body.

Lesson Objective:

- In this lesson the students will experience the changes in visual-motor performance that astronauts experience during space flight and see how success can be achieved at performing a simple task through repeated practice.

Time:

- Two 45 minute class periods; One 90 minute block period

Materials:

1. Safety goggles–1 per group
2. Page size plastic magnifier lens sheet– 1 sheet per two sets of goggles (available at WalMart)
3. Elmer's Glue
4. Scissors
5. Foam balls, Nerf balls, or Whiffle balls (balls should be greater than 10 cm in diameter)

**This lesson was developed by participants and staff of the Teacher Academy Project at Texas A&M University with support from the National Space Biomedical Research Institute through NASA NCC 9-58.**

Procedure:

*Pre-activity Preparation*

Construct the altered reality goggle by cutting the magnifier lens sheet with scissors to fit the goggle shape. Glue sheet into goggles by placing a small amount of glue carefully around the edges of the magnifier lens so that glue is not smeared on the lens area itself.

*Activity*

- 1) In pairs, the student not wearing goggles stands 6 meters away from his/her partner and tosses the ball to the partner who is wearing the altered reality goggles.
- 2) The student with the goggles tries to catch the ball tossed to him or her.
- 3) Repeat toss and catch activity for two minutes and record the number of catches versus tosses.
- 4) Partners then switch positions and repeat.
- 5) Switch partners again and repeat the exercise this time for 4 minutes and record catches versus tosses.
- 6) Partners should again switch positions and repeat.
- 7) Each group reports its data to the class and records information on the board. Look for trends that would lead you to believe that spatial adaptation has occurred as a result of repeated practice.

	Number of times the ball is tossed	Number of times the ball is caught
Partner 1 2 min		
Partner 2 2 min		
Partner 1 4 min		
Partner 2 4 min		

Extensions :

- An additional lesson can be performed from the website:  
<http://www.mssm.edu/defyinggravity/balance.htm>  
Click on the Lesson link and it will take you to a lesson titled, “Balance your Life in Microgravity”. In this lesson the student explores the relationship between the eyes and how neural signals are interpreted.
- To show accuracy you may have the students toss numbered bean bags at a target with goggles on and then with them off to show how much perceptions can change and how practice with this skewed perception can lead to more accuracy.

Resources:

White, R.J. & Lujan, B.F. (1994). *Human Physiology in Space*, NASA Life and Biomedical Sciences and Applications Division.

Available online at: <http://www.nsbri.org/HumanPhysSpace/>

*The Brain In Space* NASA Life Sciences Division, Washington DC.

Available online at: <http://spacelink.nasa.gov/products/The.Brain.in.Space/>

Background Information:

\*Note: It may be necessary for the teacher to research new terms before relating this lesson to younger students.

Several types of receptors acting in combination can produce very complex sensory experiences. We may find a particular food palatable or unpalatable, for example, not only because of how it tastes and smells, but also because of how it appeals to the eye. When you look out the window of a stationary train and see another train pull away, your eyes might suggest that you are moving until other receptors in your body inform you that you're not. We may simultaneously experience sensations of touch, pressure, heat and pain in lifting a pot from the stove. In fact, to take just one step forward, we first need to know the positions and **spatial relationship** of the parts of our body.

The term "spatial" here refers to "the space that a body or object occupies" and does not refer to "space flight." The fact is that no matter where we find ourselves - on Earth, Mars or orbiting somewhere in outer space - there will always be "space" around us and it is the job of our vestibular system, brain, eyes, muscles, and our touch receptors to judge our position in space at all times. This not only includes a general awareness of position, but it also includes how the different parts of our body are positioned relative to other parts of the body. Even further, these organs help us develop and maintain the awareness of our own body in relation to the pull of gravity.

Vestibular information received by the brain is altered in microgravity conditions. These variations are due to changes in signals sent to the brain from the semi-circular canals and the otolith organs. In space the weightless environment provides a different stimulus to the otolith organs, and the resulting signals no longer correspond with the visual and other sensory signals sent to the brain. This signal conflict causes disorientation. That is, your brain has difficulty making sense of the fact that, although you see the floor and the ceiling, there is no other sense realism connected to the concept of "up" and "down". The touch and balance mechanisms are completely confusing the brain. You don't realize how quickly you'll bounce back from something that you touch because there is nothing to anchor your position. Immediately upon experiencing weightlessness, you feel as though you are simply a floating set of eyeballs, not even knowing where your limbs are because they have no weight associated with them to give your brain clues about their whereabouts! The complete collection of environmental and physical data that your brain is trying to comprehend does not make sense.

The practical aspects of neurovestibular research in space include the prediction, prevention, and treatment of space motion sickness; the reduction of risk in an emergency egress (escape) in the event of an accident; and the long-term issues of human adaptation to very long duration flights en route to Mars. The underlying research questions deal with the fundamental role of gravity in the development of specialized sensory organs, the neural connections that are associated with the vestibular systems under altered environmental conditions, and the levels of the brain at which these reversible adaptive processes take place.

By wearing altered reality goggles students will practice catching a foam ball tossed at them, without relying on correct visual sensory input. This demonstrates altered spatial orientation. In space flight this altered orientation is much more subtle. It is necessary for astronauts to perform realistic practice of mission objectives here on earth. This practice may be performed for up to three years prior to a mission allowing the astronauts' reaction to daily events on orbit to become second nature.

**Student Assessment (Student Copy)**

Title: **SHIFTY EYES**

1. What does the term spatial refer to?
2. What physical cues does an astronaut lose in space?
3. In the experiment you performed with the altered reality goggles you impaired your visual cues. What did you do to adapt to this situation?
4. Did you find in your experiment that your frequency in catching the ball increased or decreased with practice? Explain why.
5. Explain why an astronaut has to train to perform simple Earth tasks in microgravity conditions?
6. Why is it important to the astronaut's safety to understand these altered spatial inputs?

**Student Assessment**

Title: **SHIFTY EYES**

1. What does the term spatial refer to?

Ans: The space that an object, in this case our bodies, occupies.

2. What physical cues does an astronaut lose in space?

Ans: When in microgravity they lose the feeling of gravity pulling on their body along with the lack of pressure associated with having the floor pushing against them. Your eyes say you falling; however, the pressure receptors in your body tell you that you are not.

3. In the experiment you performed with the altered reality goggles you impaired your visual cues. What did you do to adapt to this situation?

4. Did you find in your experiment that your frequency in catching the ball increased or decreased with practice? Explain why.

5. Explain why an astronaut has to train to perform simple Earth tasks in microgravity conditions?

Ans: Due to altered spatial orientation the astronaut if after having practiced repeatedly the basic requirements of their job they will be mechanical or deliberate in performing the same task in space.

6. Why is it important to the astronaut's safety to understand these altered spatial inputs?

Ans: Prediction, prevention, and treatment of space motion sickness; the reduction of risk in an emergency egress (escape) in the event of an accident; and the long-term issues of human adaptation to very long duration flights en route to Mars.