

**Lesson Objective(s):**

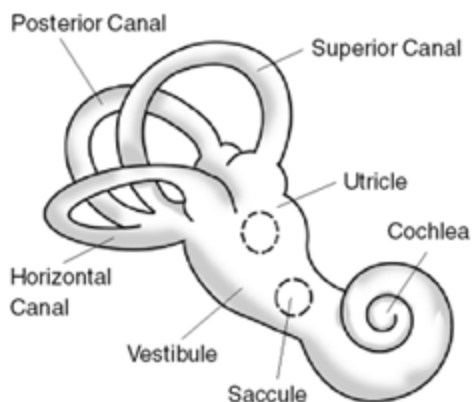
1. Describe the processes at work in the vestibular system when the human body responds to circular motion.
2. Describe the role of the vestibular system when the human body responds to circular motion.
3. Design and conduct an experiment to learn more about how the vestibular system is affected.

**Balance: The Ears Have It<sup>1</sup>**

The **vestibular system** within the inner ear detects the position and movement of the head. The chief purpose of the vestibular system is to keep the body balanced at all times whether you're running, doing a cartwheel, or just standing still. The vestibular system interacts with the eyes and skeleton to maintain the body's position. The brain receives, interprets, and processes the information from these systems to control our balance.

An organ in our inner ear, the **labyrinth**, is an important part of the vestibular system.

Three structures of the labyrinth, the **semicircular canals**, let us know when we are moving in a circle. The three semicircular canals are fluid-filled. Motion of the fluid tells us if we are moving. The semicircular canals and the visual and skeletal systems have specific functions that help keep a person balanced.

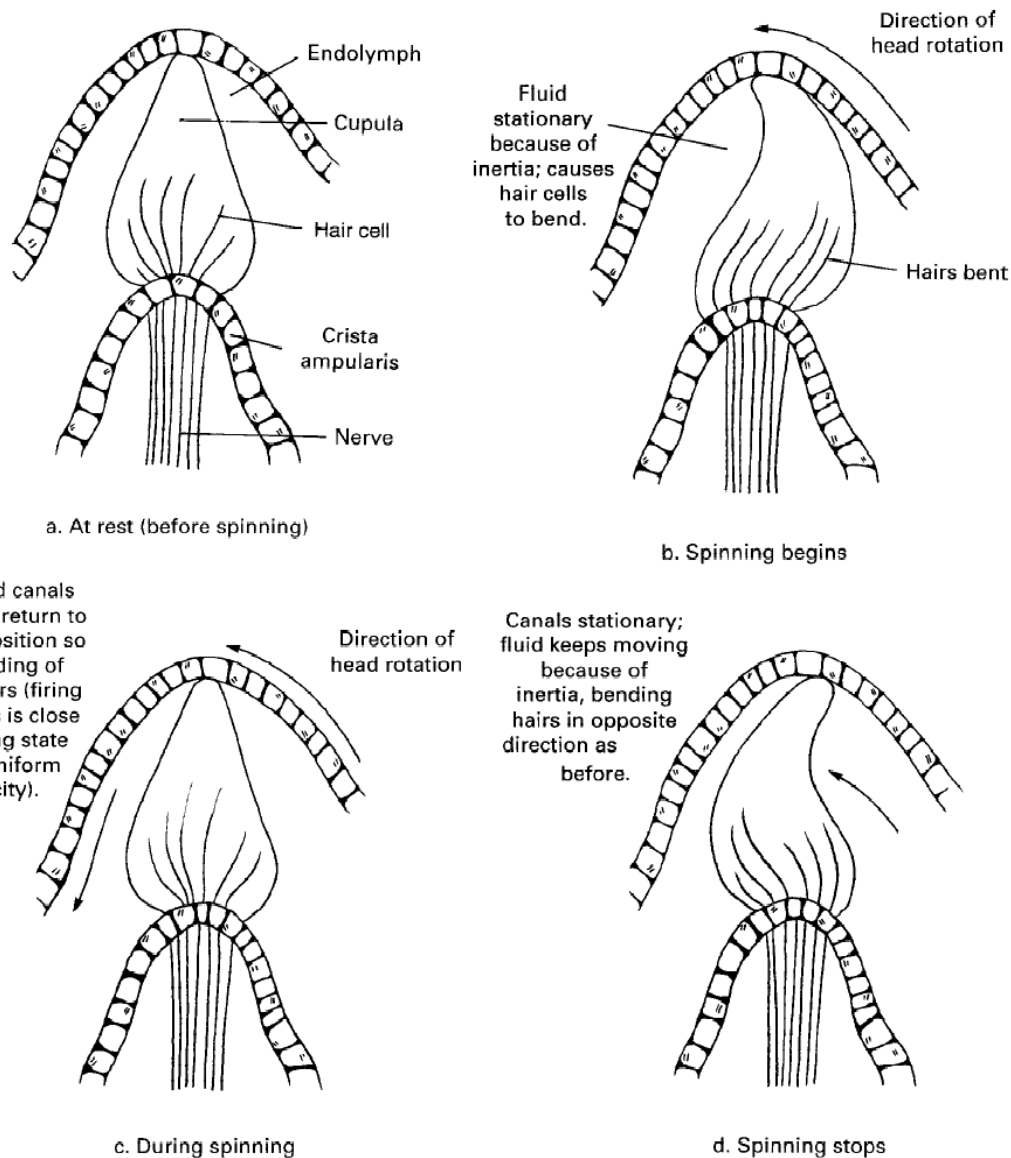


The **vestibule** is the region of the inner ear where the semicircular canals come together, close to the cochlea (the hearing organ). The vestibular system works with the visual system to keep objects in focus when the head is moving.

image from <http://www.everydayergonomics.org/agingergonomics/innerear.php>

**How Does the Balance System Work?**

Movement of fluid in the semicircular canals signals the brain about the direction and speed of rotation of the head--for example, whether you are nodding your head up and down or looking from right to left. Each semicircular canal has a bulbed end, or enlarged portion, that contains tiny hairs. Rotation of the head makes the fluid move, which in turn causes the top portion of the hairs to move.



**Figure 2: Motion of the hairs in the semicircular canals before, during, and after spinning**  
 image from NABT's Neuroscience Laboratory Activities Manual: What Else Do Ears Do? pg 40

The balance system works with the eyes, muscles, and joints to maintain orientation or balance. Let's see how this works:

**Student Activity: What is Nystagmus?**

1. Divide up into groups of four.
2. Obtain an office chair or some other chair that spins around.
3. Pick one person to be the one who gets spun, two others to be the spinners, and one person to observe and record what happens.
4. Have the spinners stand behind the chair and the observer stand a little ways in front,

while the spun person sits in the chair. *Don't start spinning yet.*

5. Have the spun person close his/her eyes (**and keep them closed**) and keep his/her arms down at their sides for the whole spinning time.
6. Both spinners should start spinning the chair at a medium speed, taking care that the spun person doesn't fall out.
7. After 5-10 whole spins, the spinners should stop the chair when the spun person is *facing* the observer.
8. Have the spun person OPEN HIS/HER EYES IMMEDIATELY.
9. The observer should record eye movement of the spun person's eyes.

What do you see?

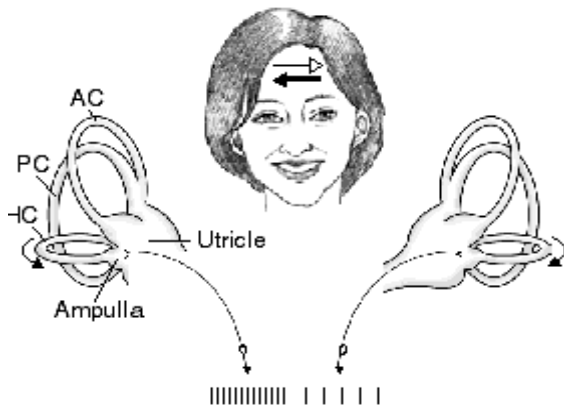
What are 3 **variables** (things you can change) that might change the results?

- 1.
- 2.
- 3.

In some activities, like ice-skating, the participants spin around and around all the time. Do you think the same thing that happened above happens to them? Explain why or why not.

What just happened?

Well, visual signals are sent to the brain about the body's position in relation to its surroundings. These signals are processed by the brain, and compared to information from the vestibular and the skeletal systems. An example of interaction between the visual and vestibular systems is called **nystagmus**.



**Figure 3: Nystagmus.**

The person is spinning to her left.

In the figure thin straight arrows give the direction of slow movement; thick straight arrows give the direction of fast movement; curved arrows give direction of fluid flow in the semicircular canals.

AC--anterior, PC--posterior, HC--horizontal canal

image from [http://www.hearct.com/balance\\_southbury\\_connecticut.php](http://www.hearct.com/balance_southbury_connecticut.php)

**Nystagmus** is an involuntary rhythmic eye movement that occurs when a person is spun around and then suddenly stops. When a person stops spinning suddenly, the body stops moving but the fluid in the semicircular canals keeps spinning for a little while. Because the sense of balance is based on the movement of this fluid, the brain thinks the person is still spinning and continues to move the eyes to keep up with the spin.

<sup>i</sup> This document adapted with permission from *Neuroscience Laboratory and Classroom Activities* (1996): What Else do Ears do? pp. 37-58 -- a publication developed by the National Association of Biology Teachers and Society for Neuroscience, with funding from the National Institutes of Health. Additional background derived from *Balance Disorders*: NIH Publication No. 00-4374, January 2000, retrieved 3 July 2003 from the National Institute on Deafness and Other Communication Disorders website: [http://www.nidcd.nih.gov/health/balance/balance\\_disorders.asp](http://www.nidcd.nih.gov/health/balance/balance_disorders.asp)

1. Draw and label and/or write a description of the processes at work in the vestibular system when the human body responds to circular motion.

2. Draw and label and/or write a description of the role of the vestibular system when the human body responds to circular motion.