Hearing and Equilibrium

Hearing, like vision, is considered to be one of the *special senses.* Hearing, the ability to detect a range of sound **frequencies** (pitches) and **intensities,** is only one of the senses mediated by the ear apparatus. Two types of **equilibrium** are also mediated by ear receptors. One type, **static equilibrium,** allows you to determine your position relative to a center of gravity. In other words, it tells you whether you are right-side-up, upside-down, or something in between. Your sense of **kinetic (dynamic) equilibrium** gives information regarding the speed and direction of your body's motion.

This exercise challenges you to perform tests that demonstrate the basic functions of hearing and equilibrium.

Before you begin

❑ Read Chapter 15 in your textbook.

❑ Set your learning goals. When you finish this exercise, you should be able to
- ❑ demonstrate some clinical screening tests for hearing and equilibrium

❑ Prepare your materials:
- ❑ tuning fork (256 Hz)
- ❑ swimmer's earplugs (optional)
- ❑ chalkboard and chalk
- ❑ bright desk lamp
- ❑ metric ruler (30 to 100 cm)
- ❑ watch or clock
- ❑ swivel chair

❑ Read the directions and safety tips for this exercise **carefully** before starting any procedure.

A. Hearing tests

Conduction impairment refers to a blocking of sound waves as they are conducted through the external and middle ear to the sensory areas of the inner ear (the *conduction pathway*). **Nerve impairment** implies insensitivity to sound because of inherited or acquired nerve damage. The two hearing tests described are often used in clinical settings to screen patients with suspected hearing impairments.

❑ 1 Conduct the **Rinne test** (Figure 29-1) on a subject:
- ❑ Strike a tuning fork on the base of your palm and place the handle against the subject's mastoid process.
- ❑ When the subject no longer hears the tuning fork's hum, quickly move the prongs to the opening of the external auditory meatus (but do not touch it).
- ❑ Normally, a hum will be heard again. If not, a conductive impairment is suspected. Repeat on the other side of the head. You may want to try simulating conductive impairment in a normal subject by using swimmer's earplugs.

❑ 2 Conduct the **Weber test** on a subject:
- ❑ Strike a tuning fork on the base of your palm and place the handle against the middle of the forehead.
- ❑ Ask the subject on which, if any, side the sound seems louder.
- ❑ A conduction problem is indicated on a side that is noticeably louder than the other. Again, you may want to simulate a conduction impairment by having the subject wear one earplug.

B. Equilibrium tests

❑ 1 The **Romberg test** demonstrates a subject's ability to use information sensed by the utricle and saccule alone, without any help from the sense of vision.

> **SAFETY FIRST!**
> If an equilibrium impairment exists, the Romberg test may result in the subject toppling over! One or two people should stand ready to catch the subject if necessary.

- ❑ Position the subject standing near a chalkboard or other vertical writing surface, facing away from the board.
- ❑ Use a desk lamp or other light source to cast a shadow of the subject onto the chalkboard.
- ❑ Have the subject stand with feet together and eyes open for 2 minutes.
- ❑ Mark the farthest edges of the subject's shadow as it sways.
- ❑ After 2 minutes, measure the longest distance of sway.
- ❑ Repeat with the subject's eyes closed.
- ❑ Repeat with the subject facing perpendicular to the board.
- ❑ Results showing excessive sway, almost to the point of falling, indicate an equilibrium problem.

❑ 2 The **Barany test** evaluates the function of the semicircular canals. Be sure to record your results in Lab Report 29 as you proceed.

SAFETY FIRST!

Hold onto the chair tightly and surround the subject so that no one topples over and becomes injured. Students prone to motion sickness or related problems should not participate in this activity.

- ❑ Have your lab partner sit in a rotating chair with eyes closed and head tilted 30 degrees forward.
- ❑ Rotate the chair in one direction for about 10 seconds.
- ❑ When you stop the rotation, look into your lab partner's eyes. The side-to-side movement that should be apparent is called *nystagmus*. Side-to-side nystagmus is evidence that the lateral semicircular canals are being stimulated by the rotation.
- ❑ Allowing time for rest, repeat the demonstration with your lab partner's head tilted toward one side about 90 degrees. This stimulates the superior canals, causing up-and-down nystagmus.
- ❑ Allowing time for rest, repeat the demonstration with your lab partner's head tilted as far forward as possible. This arrangement stimulates the posterior canals maximally, producing rotary nystagmus.

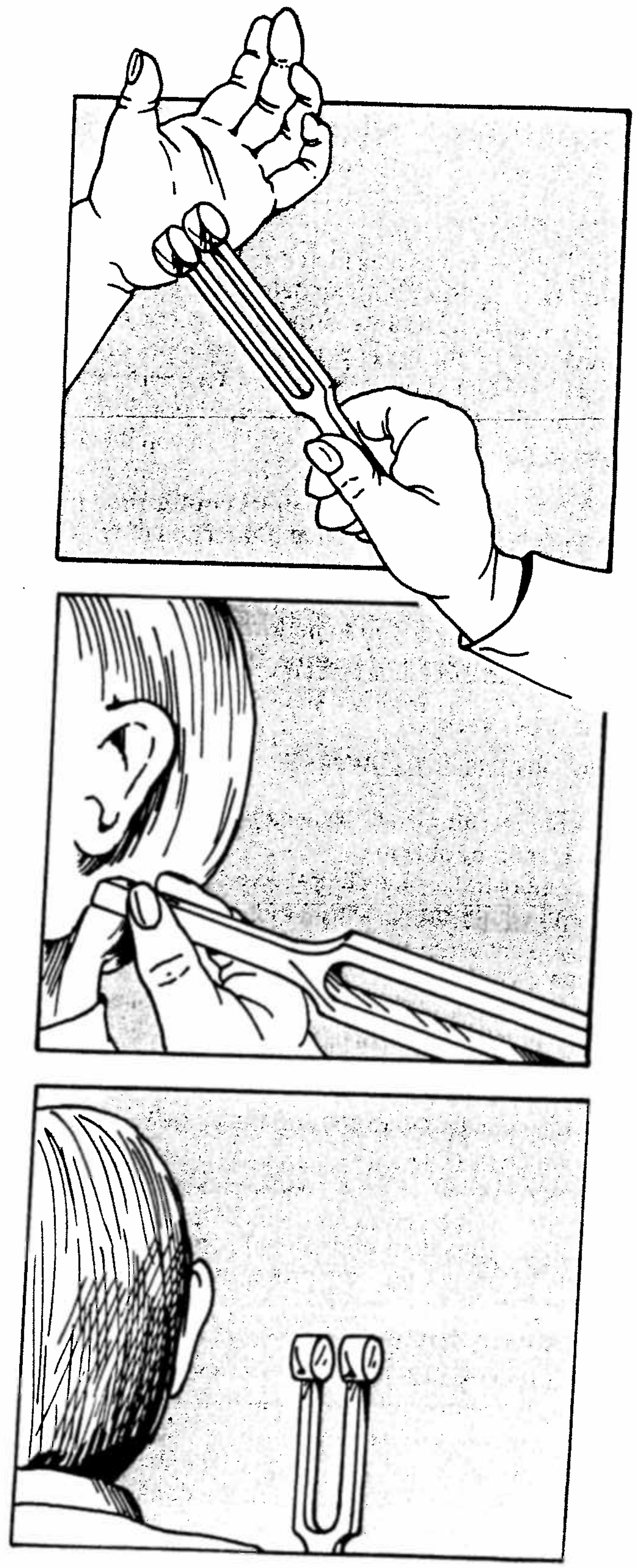


Figure 29-1 Using tuning fork for Rinne test.

Name:______________________ Date:__________ Section:______

LAB REPORT 29

Hearing and Equilibrium

Hearing tests

Test	Normal	Impaired	Normal	Impaired
Rinne test (normal)	❑	❑	❑	❑
Rinne test (simulated impairment)	❑	❑	❑	❑
Weber test (normal)	❑	❑	❑	❑
Weber test (simulated impairment)	❑	❑	❑	❑

Explain the difference in results between the normal hearing tests and the hearing tests performed with a simulated impairment.

Romberg test

Observations:

Result: ❑ normal ❑ impaired

Barany test

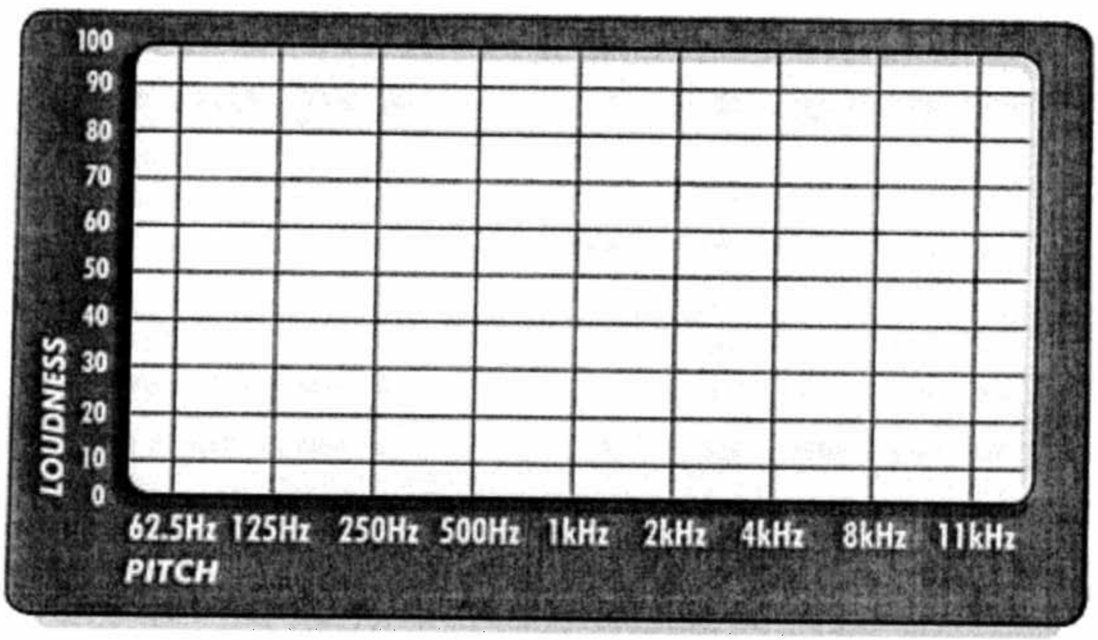
Position	Observations	Explanation
Head forward 30 degrees		
Head to side 90 degrees		
Head full forward		

Explain how the results of the Barany test relate to the function of the semicircular canals.

Hearing Response

Name______________________________ Date______________________

Frequency (Hz)	62.5	125	250	500	1,000	2,000	4,000	8,000	11,000
Loudness Value on y-axis									



Discussion Questions

1. At what frequencies is your hearing most sensitive? Circle these frequencies on your graph.

2. As we get older or are repeatedly exposed to loud sounds, we tend to lose hearing at higher frequencies. How might the hearing-response curve change for an individual with high-pitched hearing loss?