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QUESTION: Discuss the physiology of balance.

Balance refers to an individual’s ability to maintain their line of gravity within their Base of support (BOS). It can also be described as the ability to maintain equilibrium, where equilibrium can be defined as any condition in which all acting forces are cancelled by each other resulting in a stable balanced system. The balance portion of the inner ear can be subdivided into areas that detect angular motion (pitch, yaw and roll) and areas that detect linear motion (front-to-back, side-to-side, and up-and-down). There are balance organs on both sides of the head and these work together to provide accurate information for the purpose of static and dynamic balance. They are arranged in functional pairs and you will learn about these shortly. Before you do you will learn about the hair cell. This is the basic unit of all the neuroepithelia within the membranous labyrinth.

The vestibular system is the sensory apparatus of the inner ear that helps the body maintain its postural equilibrium. The information furnished by the vestibular system is also essential for coordinating the position of the head and the movement of the eyes. There are two sets of end organs in the inner ear, or labyrinth: the semicircular canals, which respond to rotational movements (angular acceleration); and the utricle and saccule within the vestibule, which respond to changes in the position of the head with respect to gravity (linear acceleration). The information these organs deliver is proprioceptive in character, dealing with events within the body itself, rather than exteroceptive, dealing with events outside the body, as in the case of the responses of the cochlea to sound. Functionally these organs are closely related to the cerebellum and to the reflex centers of the spinal cord and brainstem that govern the movements of the eyes, neck, and limbs.

Although the vestibular organs and the cochlea are derived embryologically from the same formation, the otic vesicle, their association in the inner ear seems to be a matter more of convenience than of necessity. From both the developmental and the structural point of view, the kinship of the vestibular organs with the lateral line system of the fish is readily apparent. The lateral line system is made up of a series of small sense organs located in the skin of the head and along the sides of the body of fishes. Each organ contains a crista, sensory hair cells, and a cupula, as found in the ampullae of the semicircular ducts. The cristae respond to waterborne vibrations and to pressure changes.