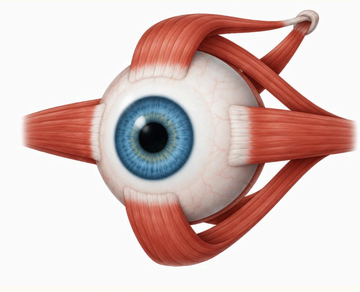
Posture · Movement · Balance · Stability

Depends on how the brain answers two questions...

Where am I in my environment?

Where is the environment in relation to me?

Visual system



Eyeball with the six extraocular muscles

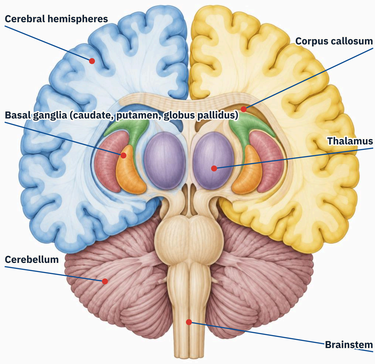
VISUAL SYSTEM

- Retina → optic nerve (II) → chiasm → optic tract → lateral geniculate nucleus → visual cortex
- Optic flow, fixation and environmental references support orientation
- Saccades shift fixation; smooth pursuit follows moving targets; vergence aligns both eyes

Eye muscle	Cranial nerve	Actions
Medial rectus	III	Adduction
Lateral rectus	VI	Abduction
Superior rectus	III	Elevation, adduction, intorsion
Inferior rectus	III	Depression, adduction, extorsion
Superior oblique	IV	Intorsion, depression, abduction
Inferior oblique	III	Extorsion, elevation, abduction

Muscle actions vary with gaze position. Coordinated gaze involves nuclei III, IV and VI and the medial longitudinal fasciculus, not a simple left/right brain rule.

Central integration



Brain, coronal section: hemispheres, deep nuclei, cerebellum and brainstem

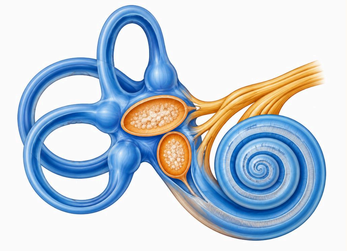
CENTRAL INTEGRATION

- Brainstem and spinal circuits: rapid postural responses
- Cerebellum: prediction, calibration and error correction
- Thalamus and cortex: perception, attention and task-dependent control
- Basal ganglia: selection and scaling of movement
- Corpus callosum: exchange between the hemispheres

SENSORIMOTOR LOOP

1. Sensory receptors
2. Afferent nerves and pathways
3. Spinal, brainstem and brain networks
4. Descending motor pathways
5. Muscles and joint mechanics
6. Movement → new sensory feedback

Auditory and vestibular system



Inner ear: cochlea and vestibular apparatus

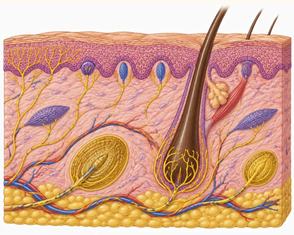
VESTIBULAR SYSTEM

- Semicircular canals: angular head acceleration
- Utricle and saccule: linear acceleration and orientation relative to gravity
- Vestibular nerve (VIII) → vestibular nuclei and cerebellum
- Vestibulo-ocular reflex stabilizes gaze during head movement; vestibulospinal pathways contribute to posture

INNER EAR LANDMARKS

- Cochlea: hearing; semicircular canals, utricle and saccule: vestibular sensing
- Auditory cues can aid environmental awareness; they are not a substitute for vestibular input

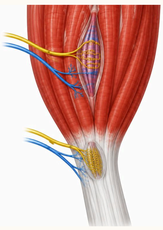
Somatosensory system



Skin cross-section: epidermis, dermis and sensory receptors



Vertebral column — front and side views



Muscle spindle and Golgi tendon organ

SKIN RECEPTORS

- Free nerve endings — pain, heat and cold
- Merkel disks — sustained light touch
- Meissner corpuscles — light touch and flutter
- Pacinian corpuscles — deep pressure and vibration
- Ruffini endings — skin stretch
- Root hair plexus — hair movement
- Krause end bulbs — touch

MUSCLE AND TENDON SENSORS

- Extrafusal fibers — the working muscle fibers
- Intrafusal fibers — inside the muscle spindle
- Muscle spindle — senses muscle length and its changes
- Golgi tendon organ — senses tendon tension
- Tendon — connects muscle to bone
- Gamma motor neurons from the CNS — set spindle sensitivity
- Sensory (afferent) neurons — carry signals to the CNS

SOMATOSENSORY SYSTEM

- Muscle spindles: muscle length and rate of change (Ia / II afferents)
- Golgi tendon organs: muscle–tendon tension (Ib afferents)
- Cutaneous receptors: contact, pressure, vibration and skin stretch; joint receptors add position signals
- Dorsal-column pathways support conscious position sense; spinocerebellar pathways carry feedback to cerebellum

Posture · Movement · Balance · Stability



Axial skeleton and antigravity musculature

POSTURE

- Orientation and alignment of body segments relative to gravity and the task
- Axial and proximal muscles provide a changing support framework
- Brainstem, spinal, cortical and cerebellar networks all contribute

MOVEMENT

- Goal selection → motor planning → descending commands → feedback
- Basal ganglia contribute to selection and scaling; cerebellum to timing and adaptation
- Anticipatory postural adjustments prepare the body before voluntary movement

BALANCE

- Control of body mass relative to gravity and the support surface
- Vision, vestibular and somatosensory inputs are reweighted as conditions change
- Ankle, hip and stepping strategies help restore equilibrium

STABILITY

- Ability to resist or recover from a disturbance during stance or movement
- Joint control combines passive tissues, muscle force and neural coordination
- Dynamic tasks may require a new step or grasp to enlarge the support base

STANCE AND GAIT

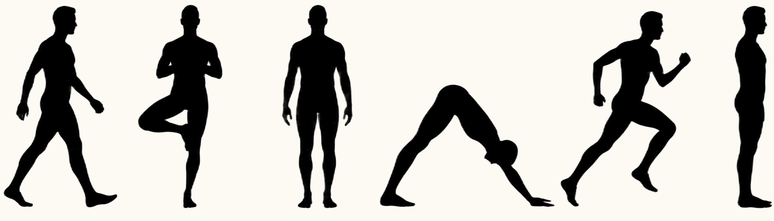
- Alignment, support width, sway, transfers, gait symmetry and turning
- Romberg findings reflect sensory contributions; they do not identify one structure alone

COORDINATION AND GAZE

- Finger-to-nose, heel-to-shin and alternating movement tasks
- Fixation, saccades, pursuit, nystagmus and head-motion symptoms

INTERPRETATION AND SAFETY

- Combine history, neurological examination and appropriate vestibular testing
- Balance testing requires fall precautions and qualified supervision



Posture, movement, balance and stability in everyday life