Anatomy of the head and neck

Optometry Technology Department

First Level First Program

Prepared by

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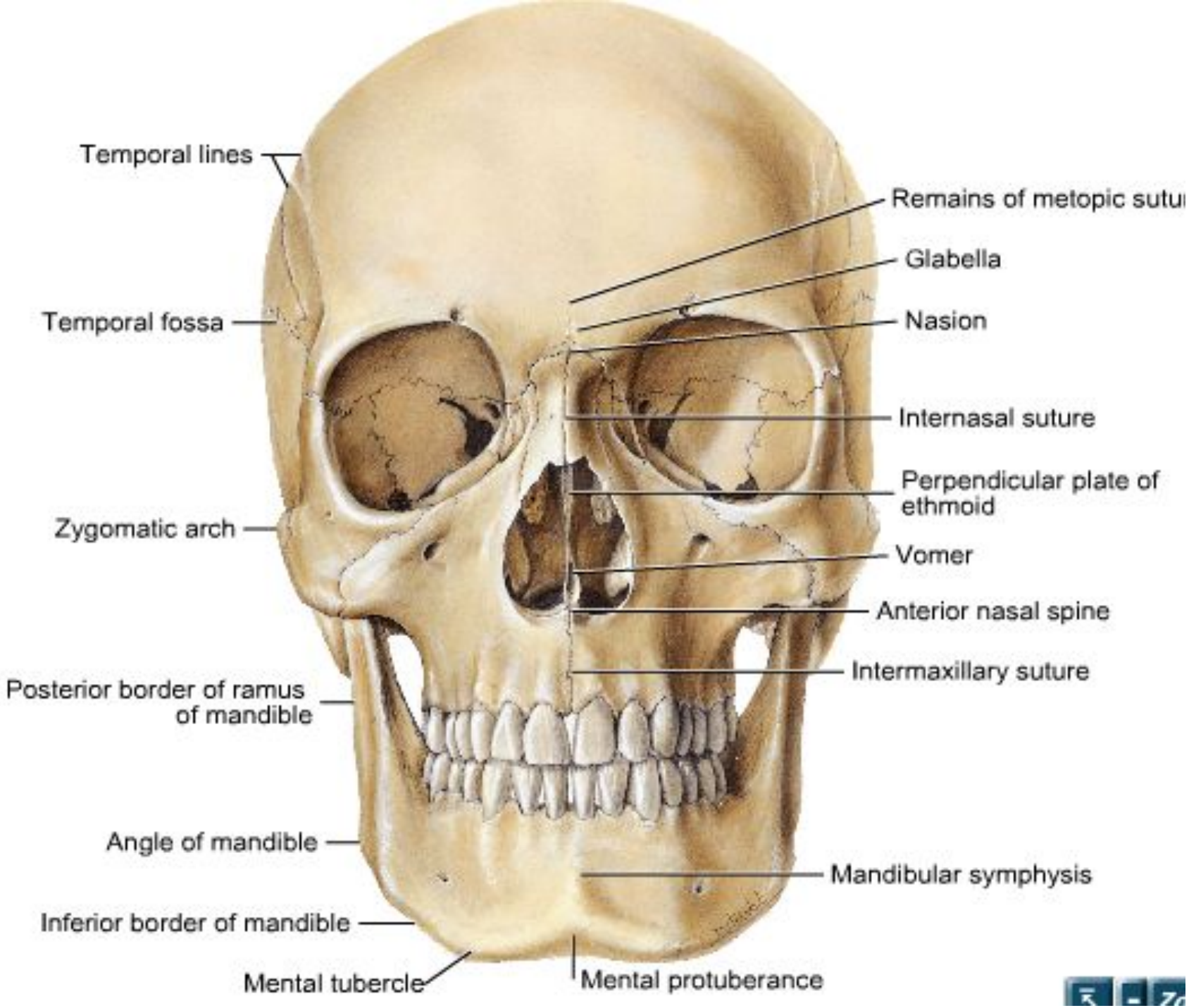
The Skull

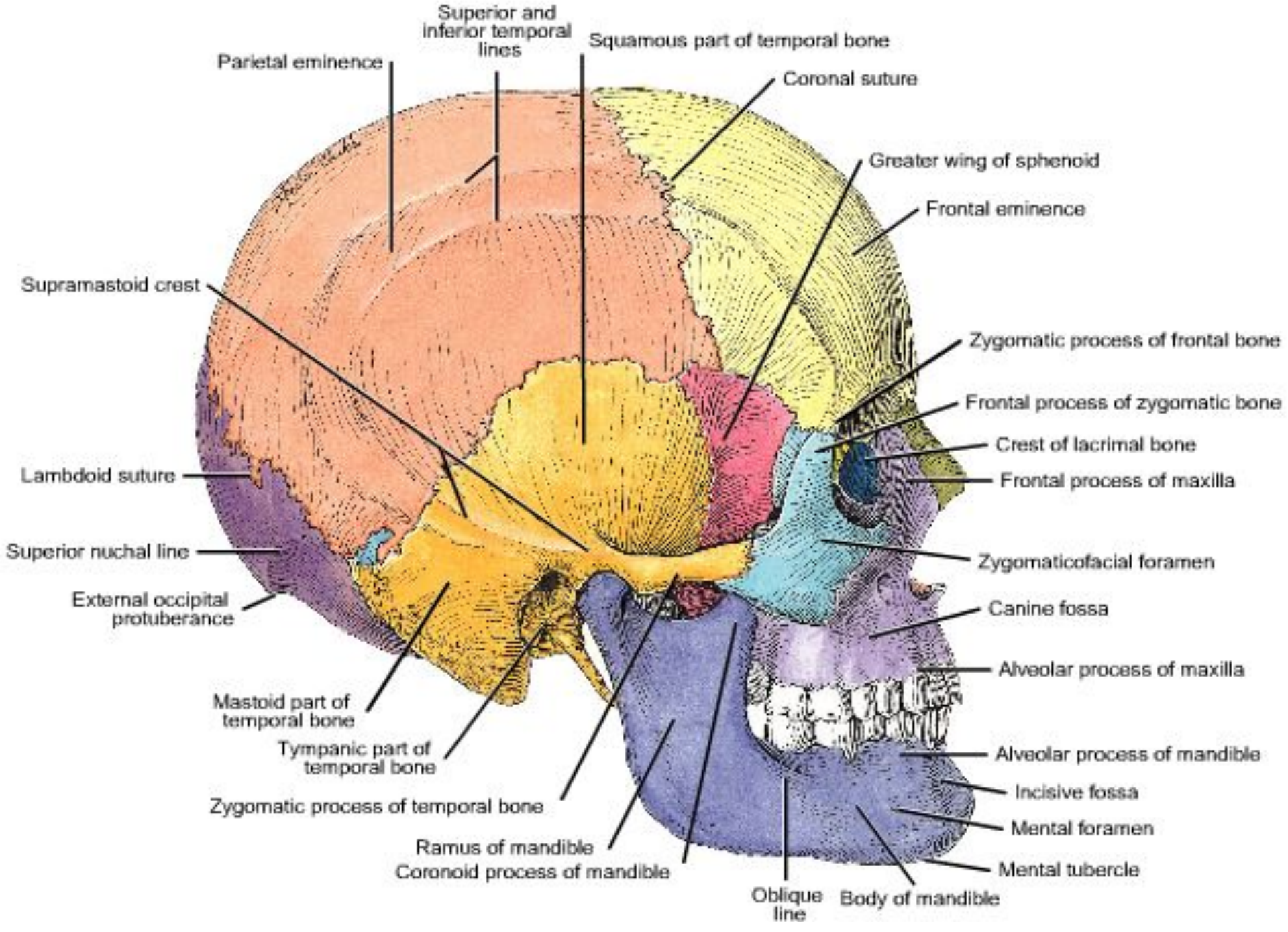
- **Skull: skeleton of head , formed of 22 bones , 6 single & 8 paired**
- **Single : lie in midline are ;**
- **frontal , ethmoid , vomer , sphenoid , occipital & mandible**
- **Paired : lie on sides are;**
- **zygomatic , maxilla , nasal , palatine , lacrimal , palatine , parietal & temporal**
- **The two inferior concha lie in lateral walls of nose ,are separate bones**
- **All bones are joint together by immmobile synostosis joints(sutures) except the mandible (TMJ) which is mobile forming a single skeleton**

- **Parts of skull:** 2 parts
- **Neurocranium :** (brain box) provides a protective case for brain & meninges is formed of flat bones(parietal ,frontal ,occipital temporal & sphenoid
- **Viscerocranium** : facial skeleton ,forms sockets for eye balls (orbit) ,surround oral & nasal cavities formed of remaining bones
- **Orbitomeatal plane**: inferior margin of orbit & superior margin of external acoustic maeatus lie in same plane in anatomical position of skull (Frankfort horizontal plane)

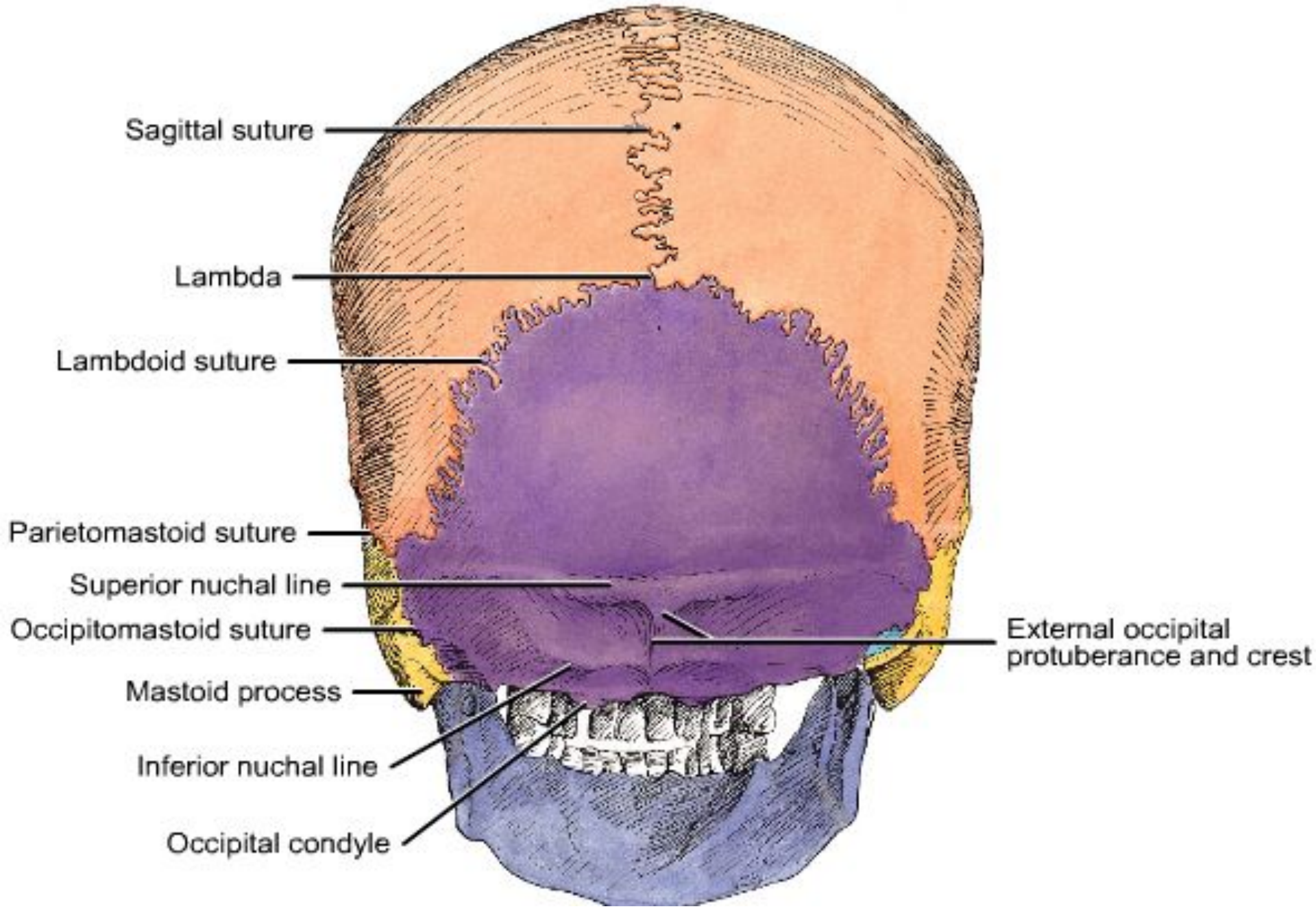
- **Features of skull: is described as it seen from all aspects as: roof ,floor front ,sides , back & inferior aspect known as Norma**
- **Norma frontalis : anterior aspect of skull**
- **formed by frontal , zygomatic bones , enclose orbits ,nasal region , maxillae & mandible.**
- **Features: glabella , nasion , supraorbital margin , superciliary arch**
- **Foramina : supraorbital , infraorbital , zygomaticofacial , mental**
- **Apertures: orbit , nasal ,**
- **Alveoalr arches carrying teeth**


Temporal lines
Temporal fossa
Zygomatic arch
Posterior border of ramus of mandible
Angle of mandible
Inferior border of mandible
Mental tubercle
Remains of metopic sutu
Glabella
Nasion
Internasal suture
Perpendicular plate of ethmoid
Vomer
Anterior nasal spine
Intermaxillary suture
Mandibular symphysis
Mental protuberance

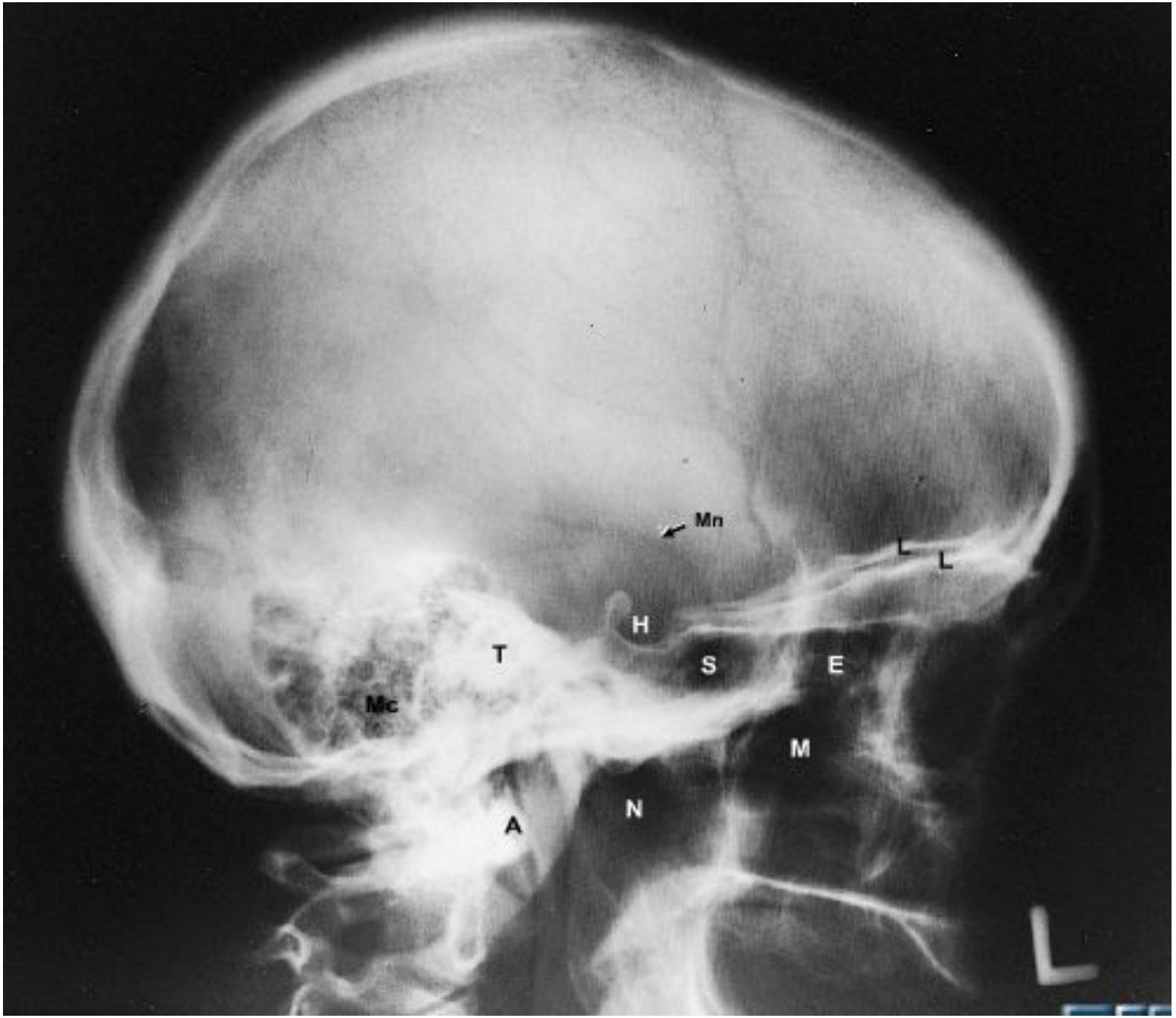
- **Norma lateralis : lateral view of skull**
- **Temporal fossa; temporal lines**
- **External acoustic meatus**
- **Zygomatic arch**
- **Infratemporal fossa**
- **Pterion:**
- **Mastoid process , styloid process**
- **Asterion**


Superior and inferior temporal lines
Squamous part of temporal bone
Parietal eminence
Coronal suture
Greater wing of sphenoid
Frontal eminence
Supramastoid crest
Zygomatic process of frontal bone
Frontal process of zygomatic bone
Crest of lacrimal bone
Lambdoid suture
Frontal process of maxilla
Superior nuchal line
Zygomaticofacial foramen
External occipital protuberance
Canine fossa
Alveolar process of maxilla
Mastoid part of temporal bone
Tympanic part of temporal bone
Alveolar process of mandible
Zygomatic process of temporal bone
Incisive fossa
Ramus of mandible
Mental foramen
Coronoid process of mandible
Mental tubercle
Oblique line
Body of mandible

- **Norma occipitalis : posterior aspect of skull**
- **occipit is ovoid in outline is formed by occipital , mastoid temporal & part of parietals**
- **Features: External occipital protuberance(Inion)**
- **External occipital crest**
- **Superior nuchal line**
- **Lambda**
- **Foramen magnum**
- **Mastoid emissary foramen**


Sagittal suture
Lambda
Lambdoid suture
Parietomastoid suture
Superior nuchal line
Occipitomastoid suture
Mastoid process
Inferior nuchal line
Occipital condyle
External occipital protuberance and crest

- **Norma verticalis : calvaria: sup aspect**
- **Formed of frontal ,two parietals**
- **Features: parietal eminences , sagittal suture , coronal suture ,lambdoid suture**
- **Bregma , vertex (highest point)**
- **Parietal emissary foramen**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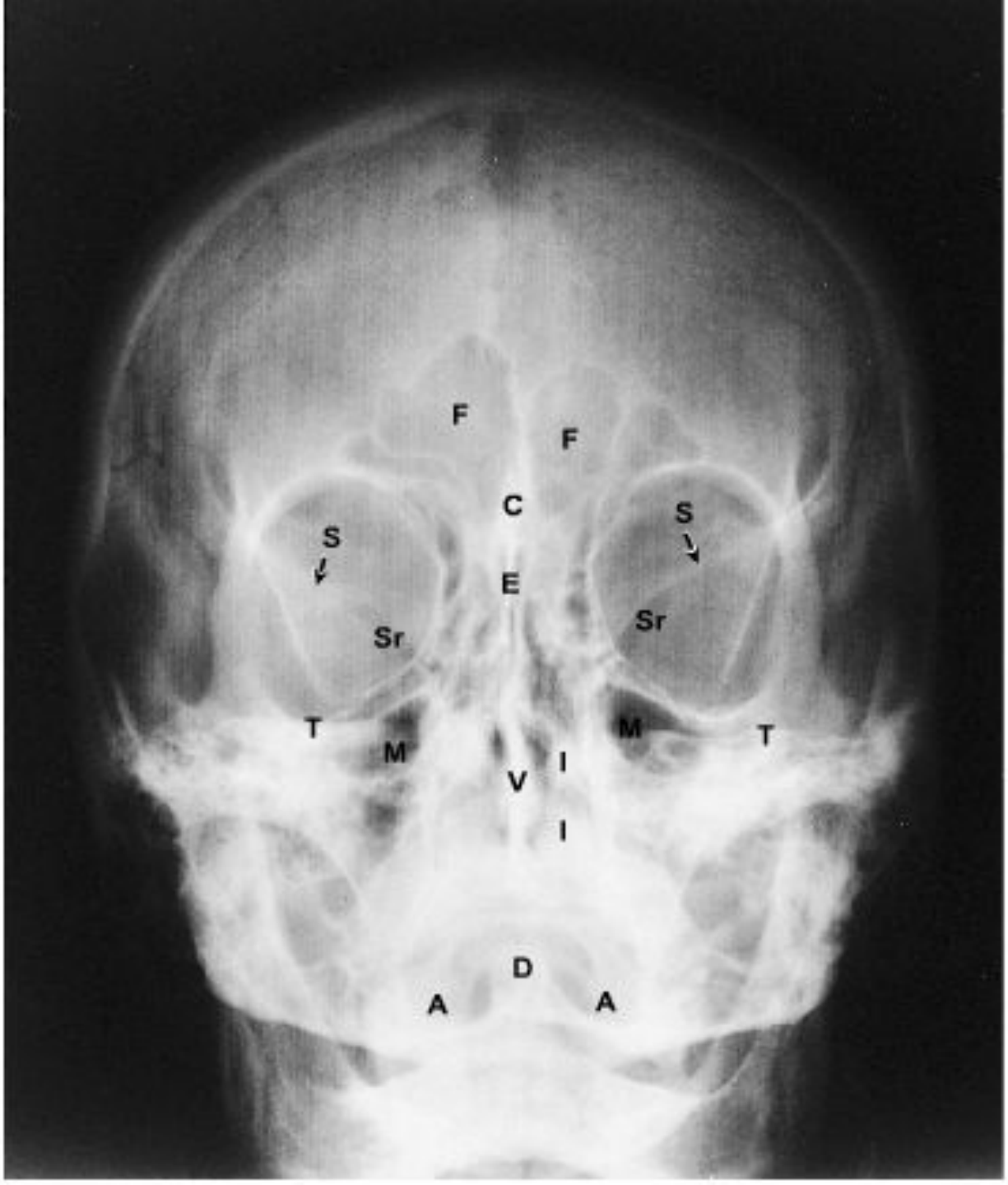
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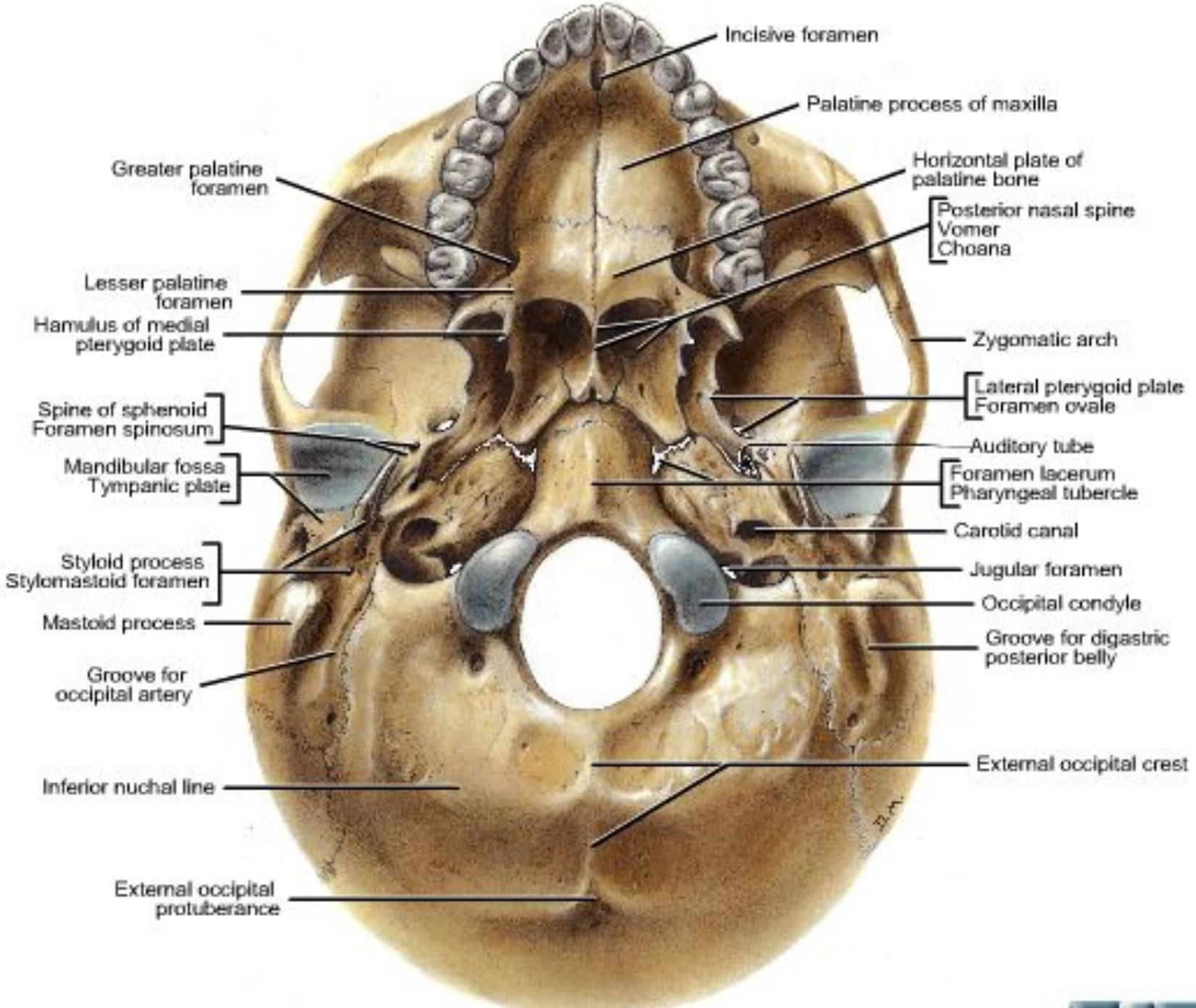
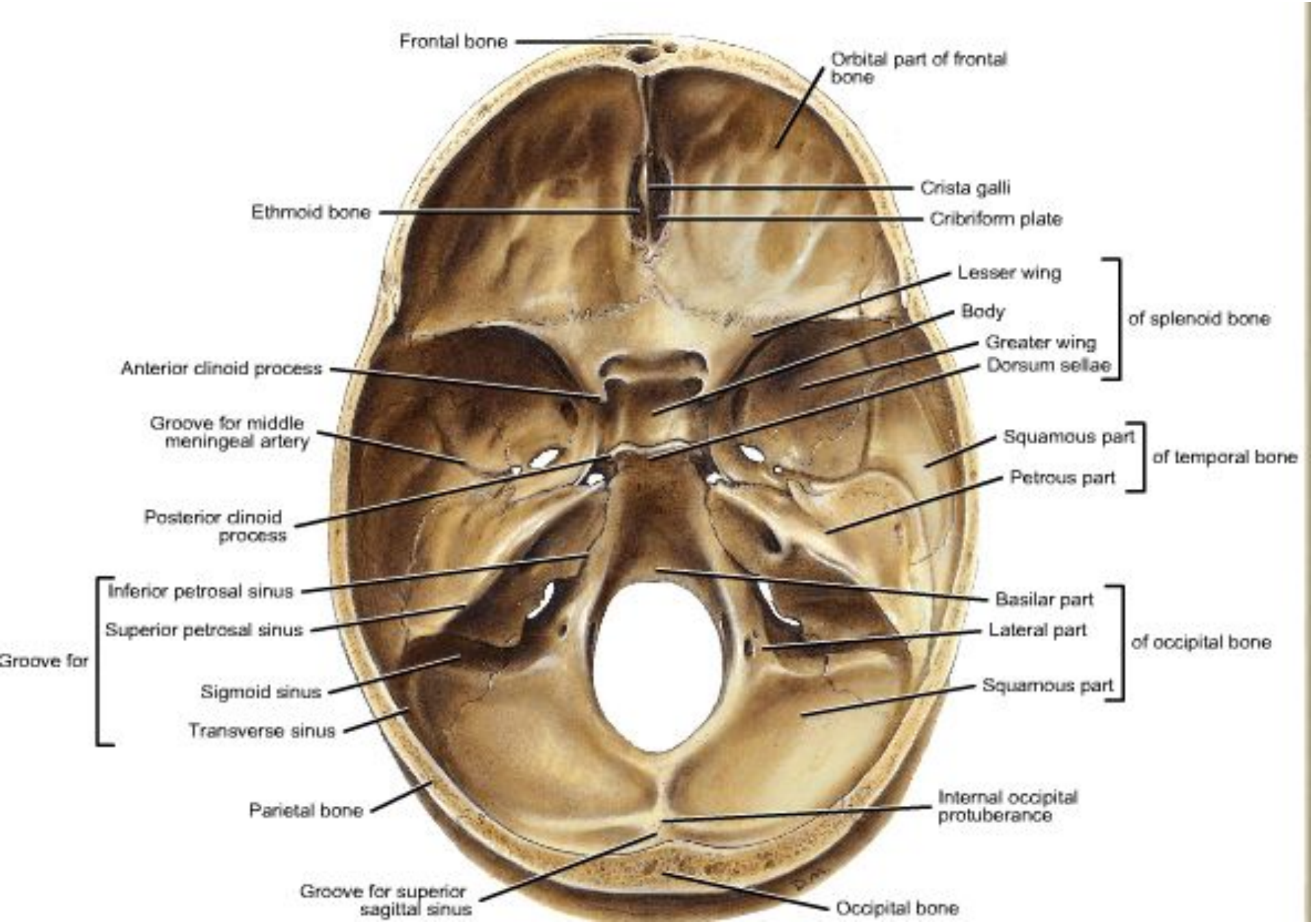
- **Norma basalis:** base of skull
- Bones from ant to post are
- Maxilla , palatine , vomer , sphenoid , basal occipit , squamous temporal , petros temporal & occcipital bones
- **Features :** superior alveolar arch
- Hard palate ,posterior nasal spine ,posterior nasal apertures (choanae)
- Sphenoid bone: body , greater ,lesser wings & pterygoid process , pterygoid plates & fossa , spine of sphenoid
- Mandibular fossa for TMJ
- Occipital condyles
- Mastoid process , styloid process


Incisive foramen
Palatine process of maxilla
Greater palatine foramen
Horizontal plate of palatine bone
Posterior nasal spine
Vomer
Choana
Lesser palatine foramen
Hamulus of medial pterygoid plate
Zygomatic arch
Lateral pterygoid plate
Foramen ovale
Spine of sphenoid
Foramen spinosum
Auditory tube
Mandibular fossa
Tympanic plate
Foramen lacerum
Pharyngeal tubercle
Carotid canal
Styloid process
Stylomastoid foramen
Jugular foramen
Occipital condyle
Mastoid process
Groove for digastric posterior belly
Groove for occipital artery
External occipital crest
Inferior nuchal line
External occipital protuberance

- **Foramina:**
- incisive , greater & lesser palatine
- Ovale , spinosum in greater wing of sphenoid
- Carotid canal in petrous temporal
- Lacerum ,
- Carotid canal in petrous temporal
- Stylomastoid foramen
- Condyler canal
- Hypoglassal canal
- Foramen magnum

- **Cranial cavity : interior of skull : is formed of 3 large distinct depressions :cranial foasse**
- **anterior , middle , posterior ,they form floor of cranial cavity ,lying at highest to lowest level repsectively , it lodges the brain & covering meninges ,blood vessels**
- **Anterior cranial fossa: formed of orbital part of frontal bone ,lesser wing of sphenoid & cribriform plate of ethmoid bone**
- **Features: frontal crest , foramen caecum**
- **Crista gali ,**
- **Foramina in cribriform plate transmit olfactory nerve (1st cranial nerve) to nose**

- **Middle cranial fossa:** butter-fly shaped , formed by : sella turcica in middle , two large ,deep depressions on each side
- Sella turcica: formed of tuberculum sellae , hypophyseal fossa & dorsum sellae
- 4 clinoid processes , anterior surface of petrous temporal
- **Foramina:** optic canal , superior orbital fissure , foramen rotendum , ovale , spinosum .
- Foramen lacerum , carotid canal .
- Hiatus for greater & lesser petrosal nerves


Frontal bone
Orbital part of frontal bone
Crista galli
Ethmoid bone
Cribriform plate
Lesser wing
Body
Greater wing
Dorsum sellae
of splenoid bone
Anterior clinoid process
Groove for middle meningeal artery
Squamous part
Petrous part
of temporal bone
Posterior clinoid process
Inferior petrosal sinus
Superior petrosal sinus
Groove for
Sigmoid sinus
Transverse sinus
Basilar part
Lateral part
Squamous part
of occipital bone
Parietal bone
Internal occipital protuberance
Groove for superior sagittal sinus
Occipital bone

- **Posterior cranial fossa:** deepest ,largest , lodges hind brain
- Formed of petrous ,mastoid parts of temporal & occipital (basal & squmous parts)
- **Features:** internal occipital protuberence
- internal occipital crest
- Transverse & sigmoid grooves for corresponding venous sinuses
- **Foramina:** magnum , internal acoustic meatus , jugular foramen , hypoglossal canal , mastoid emissary foramen , condyler canal

- **The cranial cavity lodges the brain ,**
- **From brain 12 pairs of cranial nerves emerge & leave cavity through foramina in base of skull in addition to blood vessels supplying brain & meninges as follows:**
- **Foramina in anterior fossa**
- **1-Caecum closed , 1% emissary vein**
- **2-Cribriform f olfactory nerve fibers**
- **3-Ant & post ant & post ethmoidal**
- **ethmoidal nerves & vessels**

Middle cranial fossa;

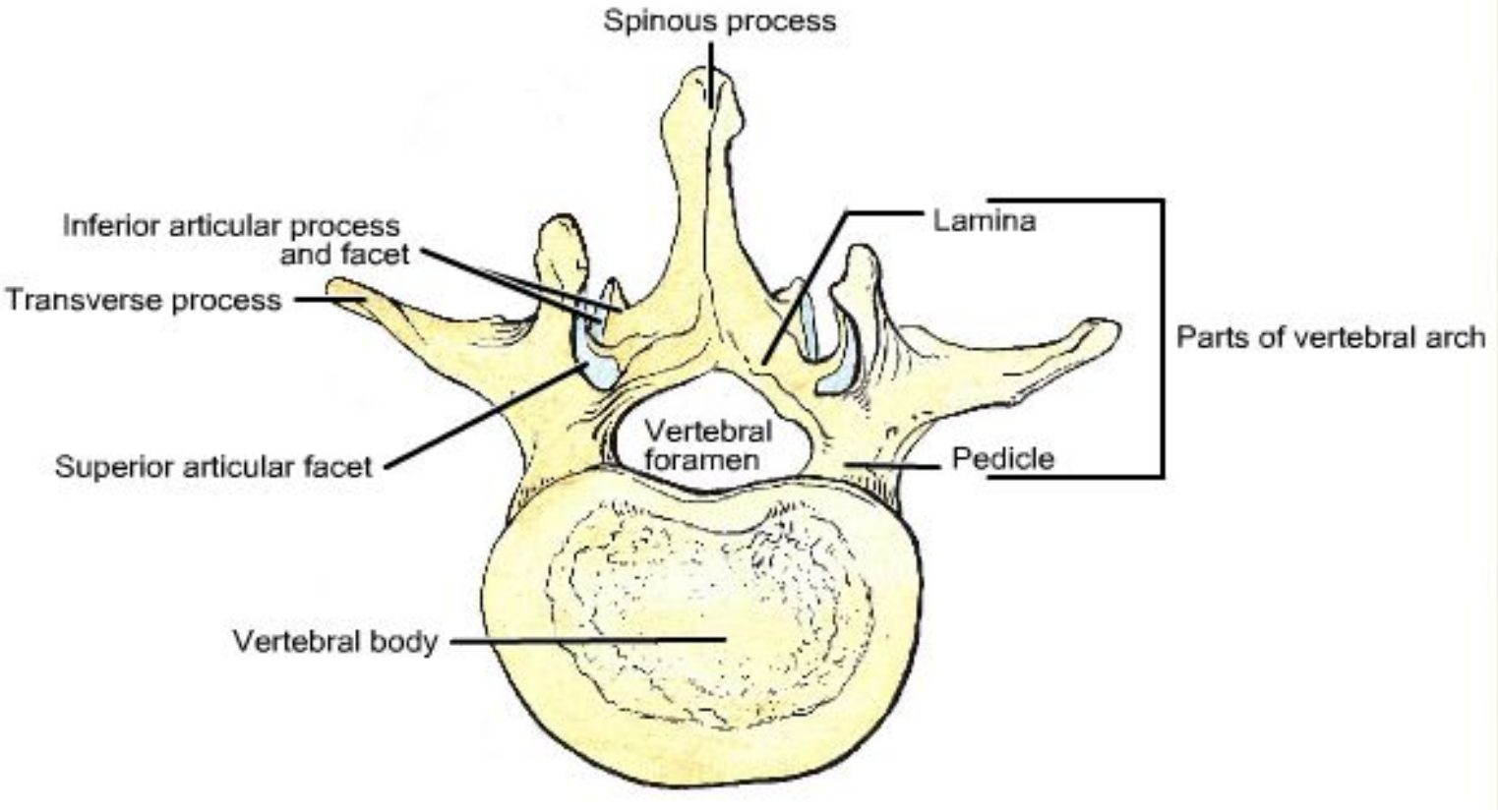
- **Optic** optic nerve , ophthalmic art.
- **Sup orbital fissure** ophthalmic veins ,
- ophthalmic nerve
- III , IV , VI & sympath-
- etic nerves
- **F. rotendum** maxillary nerve
- **F. ovale** mandibular nerve , ac
- cessary meningeal A.
- **F. spinosum** middle meningeal A.&
- V. , meningeal branch
- of mandibular nerve
- **F. lacerum** emissary veins
- **Groove for greater petrosal nerve**

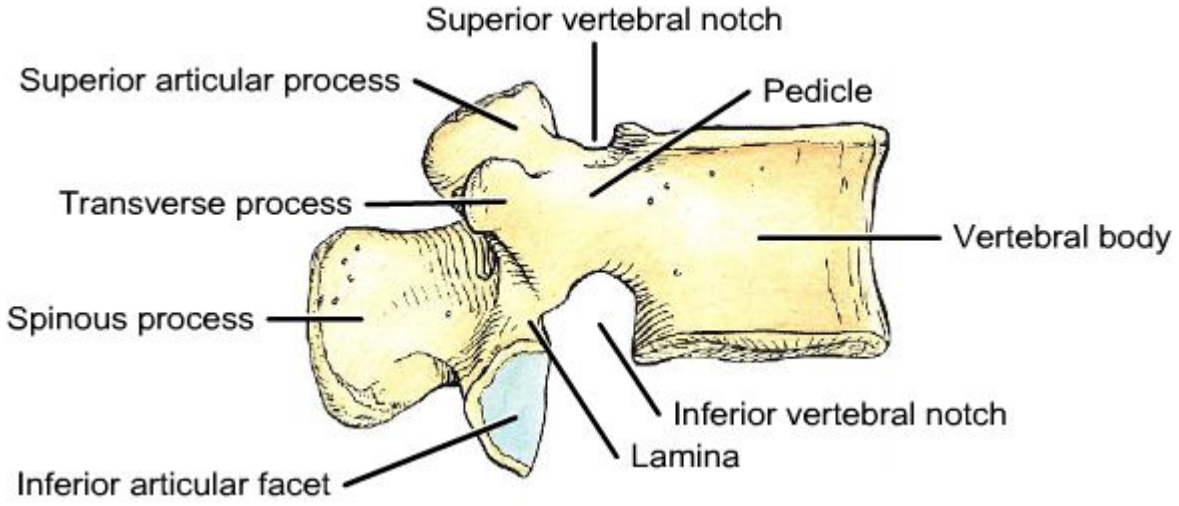
- **Posterior cranial fossa:**
- **Internal acoustic meratus** VII & VIII nerves
- **Jugular** IX , X , XI nerves
- internal jugular vein , men
- ingeal branch of ascendin
- g pharyngeal &occipital A.
- **Hypoglossal** XII n
- **Condyler** emissary vein
- **Mastoid** emissary vein , meningea
- branch of occipital A.
- **Magnum** medulla , meninges , vertebral A
- spinal root of XI n. ant & post
- spinal arteries

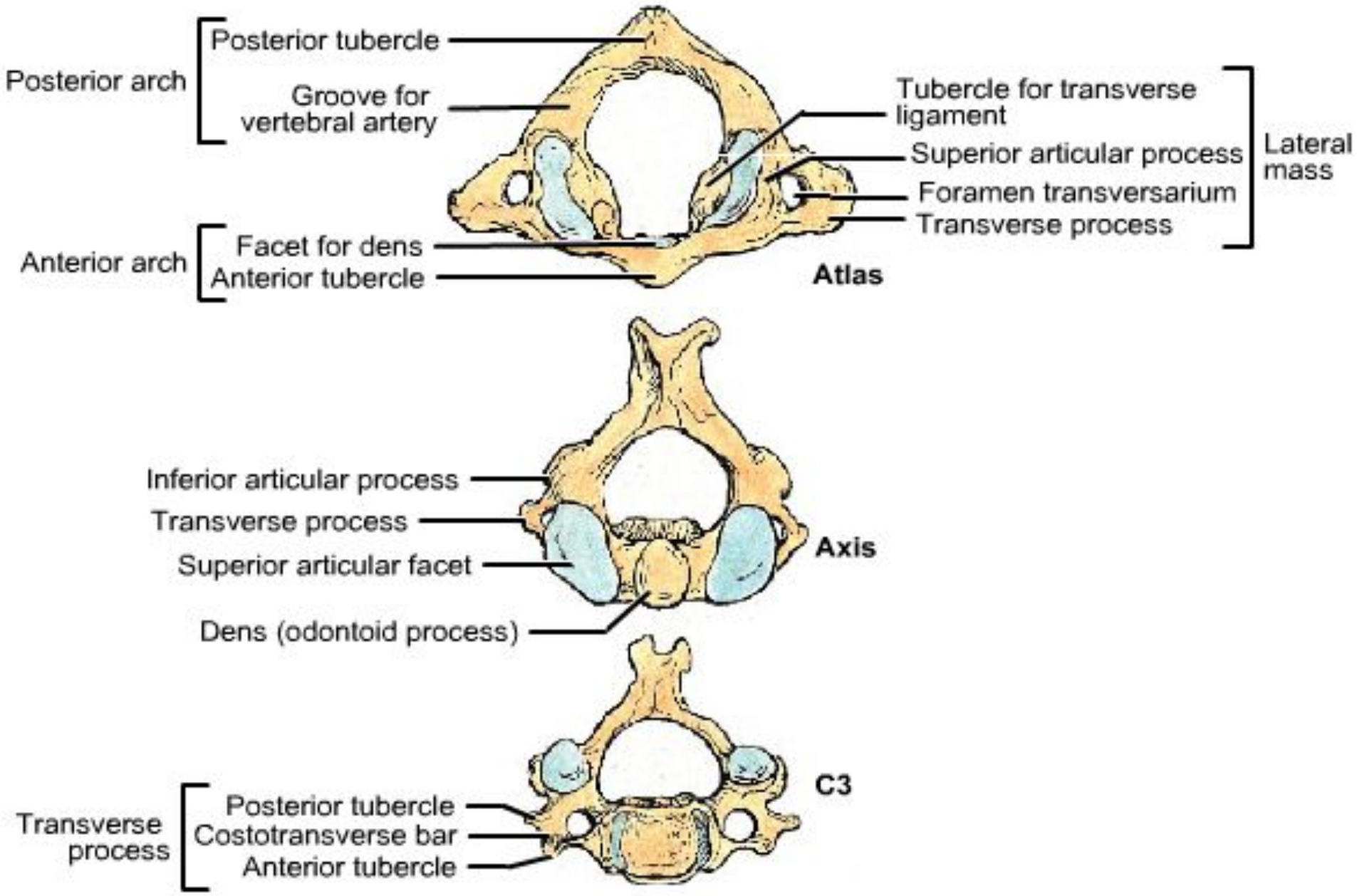
Cervical vertebrae

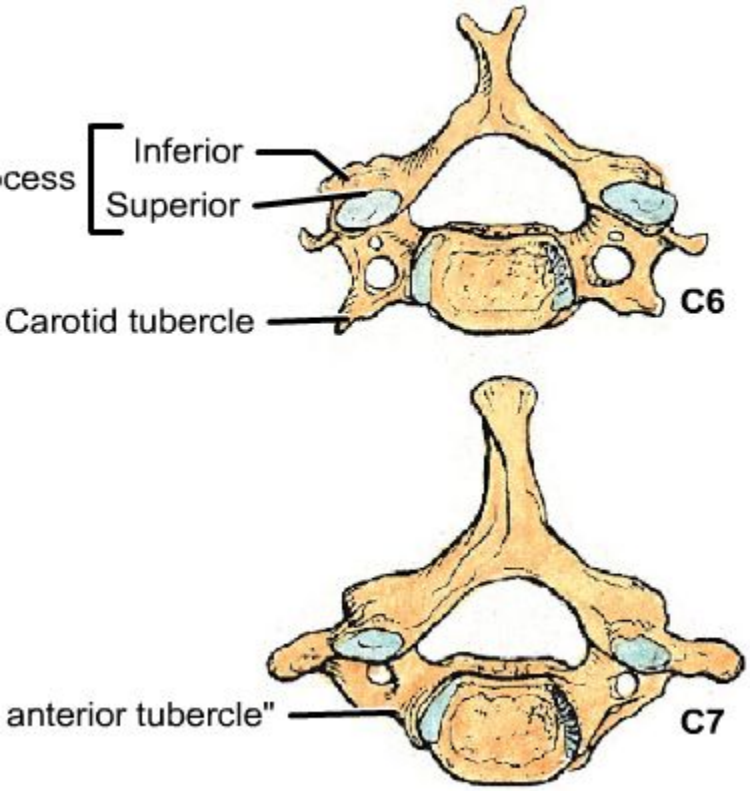
CERVICAL VERTEBRAE

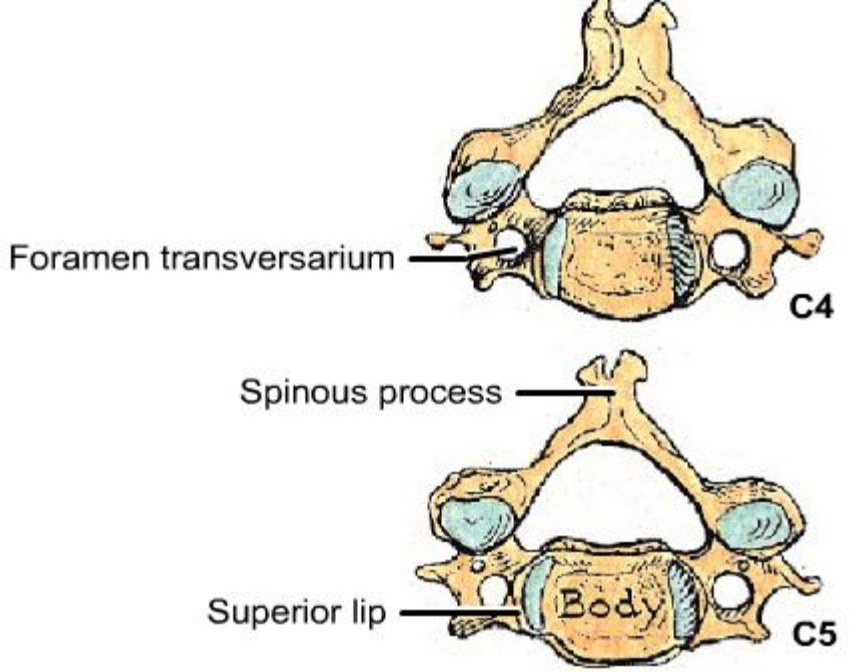
- Form skeleton of neck , are seven in number , form cervical part of vertebral columnwhich enclose spinal cord & covering meninges
- Structure of vertebra: an irregular bone formed of : centrum(body) : is large anterior mass, vertebral(neural) arch: is formed of two pedicles & two laminae which attach to body & each other to complete the vertebral foramen
- 7 processes : 3 paired; superior & inferior articular , transverse & one single spinous process
- Typical vertebrae vary in different regions

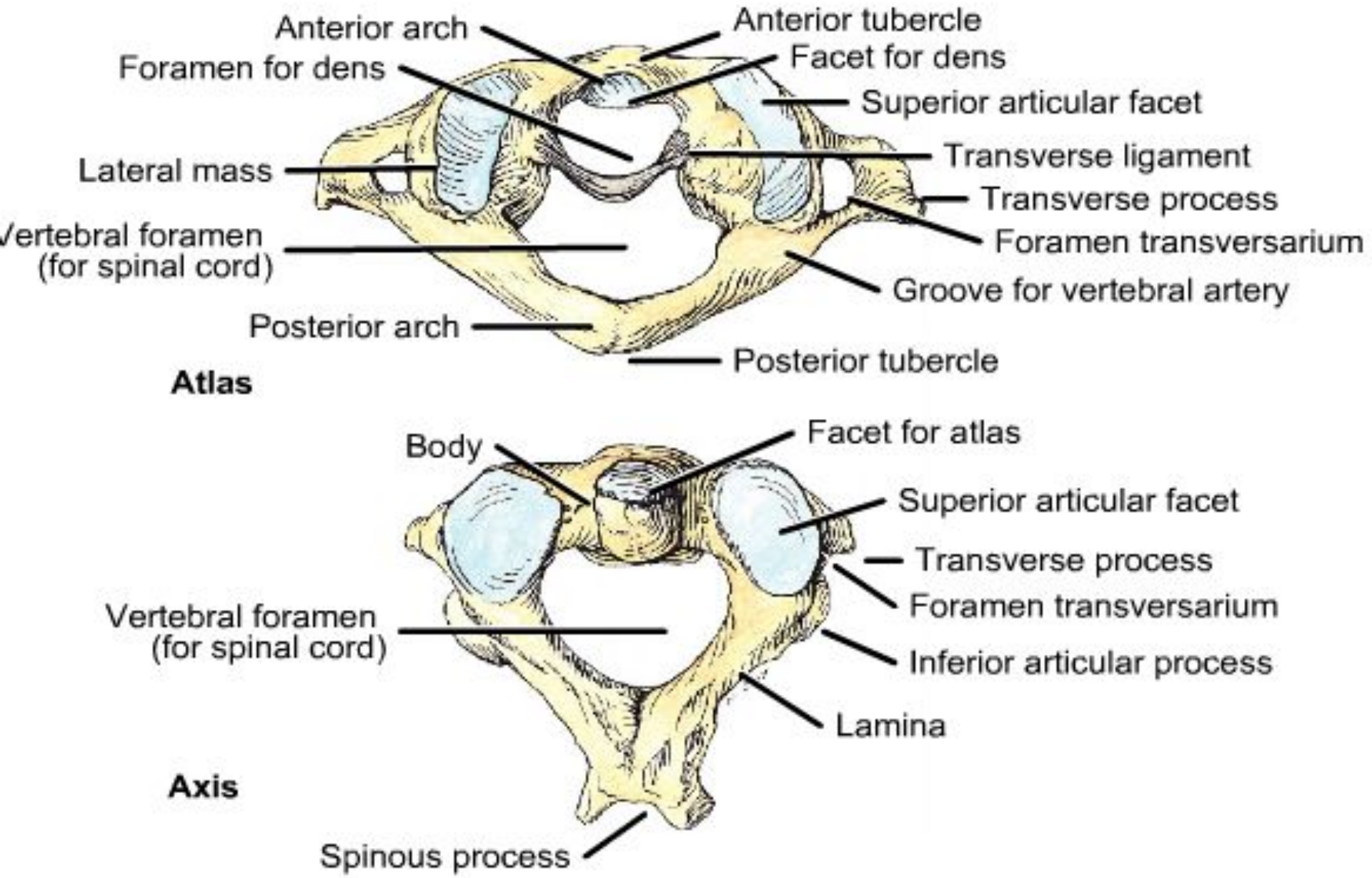

Spinous process
Inferior articular process and facet
Transverse process
Lamina
Parts of vertebral arch
Vertebral foramen
Superior articular facet
Pedicle
Vertebral body


Superior vertebral notch
Superior articular process
Pedicle
Transverse process
Vertebral body
Spinous process
Inferior vertebral notch
Lamina
Inferior articular facet


Posterior arch
Posterior tubercle
Groove for vertebral artery
Anterior arch
Facet for dens
Anterior tubercle
Tubercle for transverse ligament
Superior articular process
Foramen transversarium
Transverse process
Lateral mass
Atlas
Inferior articular process
Transverse process
Superior articular facet
Dens (odontoid process)
Axis
Transverse process
Posterior tubercle
Costotransverse bar
Anterior tubercle
C3


cess
Inferior
Superior
Carotid tubercle
C6
anterior tubercle"
C7


Foramen transversarium
C4
Spinous process
Body
Superior lip
C5


Anterior arch
Anterior tubercle
Foramen for dens
Facet for dens
Superior articular facet
Lateral mass
Transverse ligament
Transverse process
Vertebral foramen
(for spinal cord)
Foramen transversarium
Groove for vertebral artery
Posterior arch
Posterior tubercle
Atlas
Body
Facet for atlas
Superior articular facet
Transverse process
Vertebral foramen
(for spinal cord)
Foramen transversarium
Inferior articular process
Lamina
Axis
Spinous process

- Typical cervical vertebrae: C3,4,5,6 has following characters:
- Body: small , wider from side to side , superior surface concave & inferior surface convex
- Vertebral foramen: large , triangular
- Transverse process: contain foramina transversarium which transmits vertebral artery , vein & accompanying sympathetic plexus
- Articular processes: sup facets directed superoposteriorly , inf facets directed inferoanteriorly
- Spinous process: short & bifid

- **Atypical cervical vertebrae:**
- **C1,2 & 7**

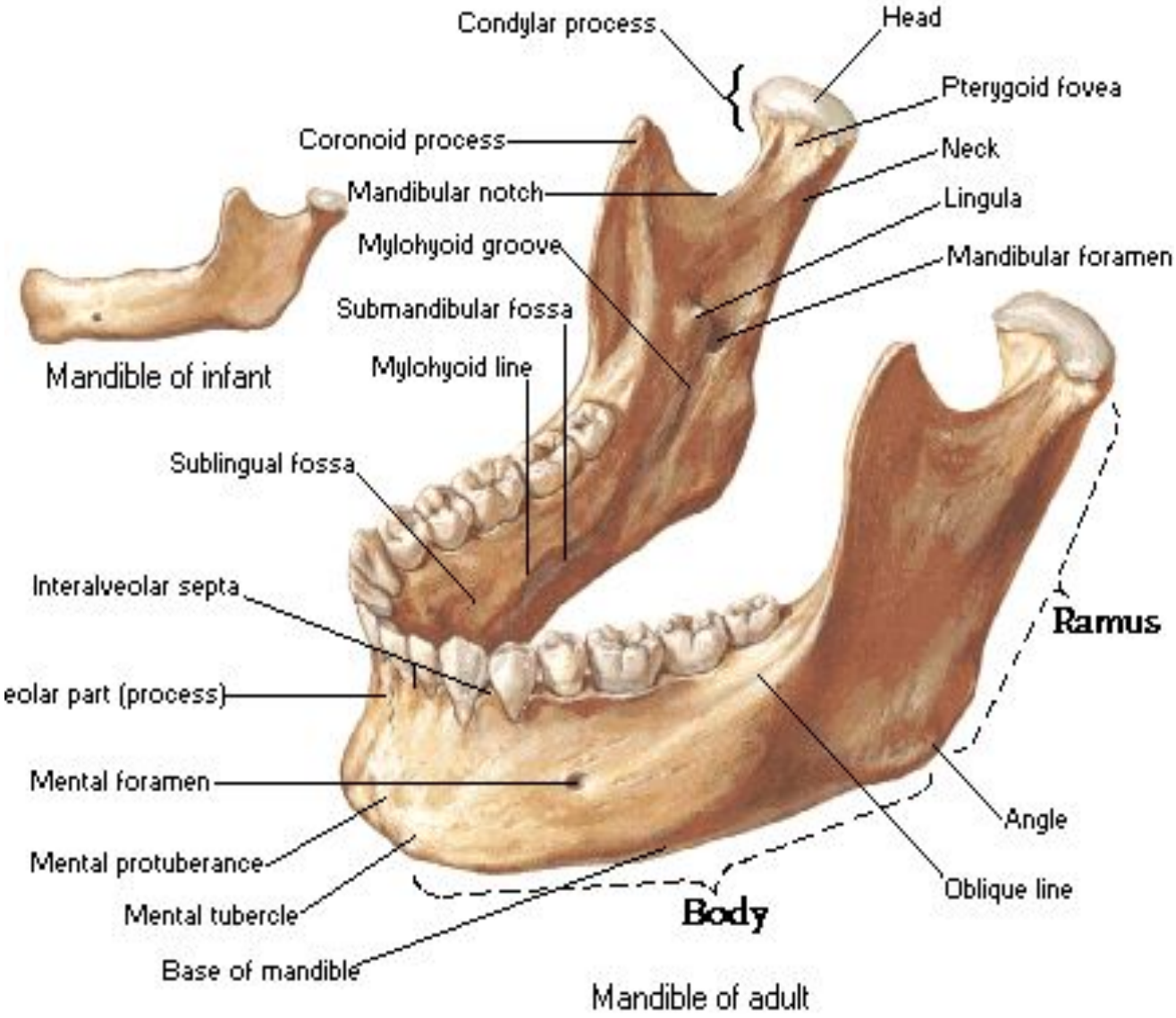
- **C1: Atlas : no body , is ring like ,kidney shaped bone lacking spinous process . Consist of 2 lateral masses connected by ant & post arches**
- **Sup articular process articulate with occipital condyles(holds skull)atlantooccipital joint**

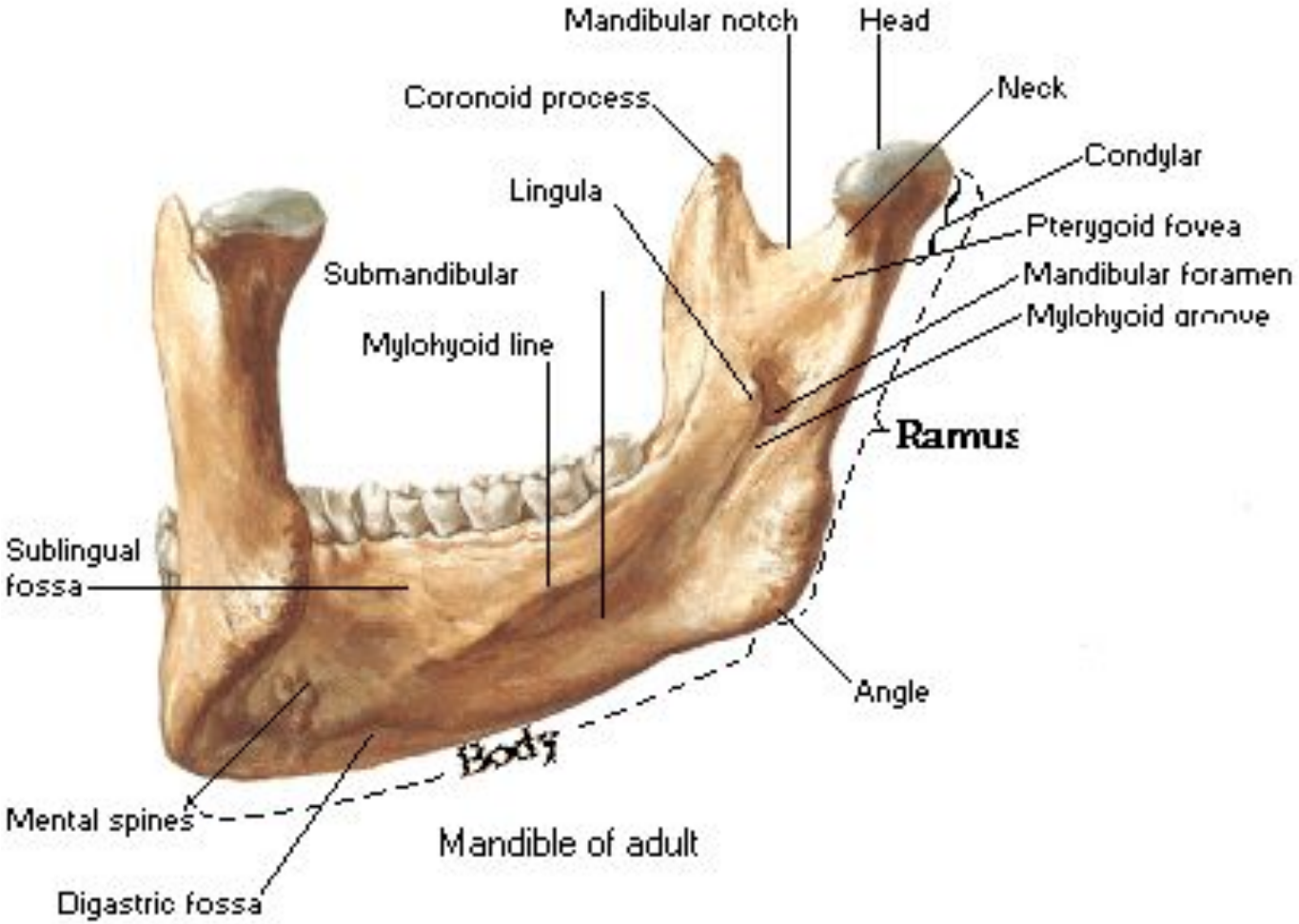
- **C2; Axis ; is typical except has a peg like dens(odontoid process)which projects superiorly from body , articulates with atlas (atlantoaxial joint) head & atlas rotates on axis dens.**

- **The Mandible:** single bone formed of two fused halves united at symphysis menti
- Each half is formed of
- Ramus & body
- Ramus : flat rectangular with borders & two surfaces
- Features: head & neck , coronoid process ,mandibular notch Lingula , mandibular foramen . Myelohyoid line & groove
- Body :lower alveolar arch , submandibular & sublingual fossae, mental foramen , inferior alveolar canal & meylohyoid line & groove
- Genial tubercles

- **Nerve in direct contact : masseteric , inferior alveolar , mental , lingual**
- **Vessels in direct contact : masseteric , inferior alveolar , mental , facial & lingual branch of inferior alveolar**
- **Muscles attached: all muscles of mastication , anterior belly of digastric , meylohyoid , geniohyoid & genioglossus**
- **Age changes :**

Mandible


Condylar process
Head
Pterygoid fovea
Coronoid process
Neck
Mandibular notch
Lingula
Mylohyoid groove
Mandibular foramen
Submandibular fossa
Mylohyoid line
Mandible of infant
Sublingual fossa
Interalveolar septa
Ramus
eolar part (process)
Mental foramen
Angle
Mental protuberance
Mental tubercle
Oblique line
Body
Base of mandible
Mandible of adult



Mandible of adult

- **The Mandible**
- **Accessory foramina: may be present for passage of branches of facial ,myelohyoid ,buccal & other nerves for supply of teeth ,these may be significant in dental blocking techniques**

Blood vessels of head and neck:

The head and neck receives the majority of its blood supply through the carotid and vertebral arteries.

The Carotid Arteries:

The right common carotid artery arises from a bifurcation of the brachiocephalic trunk (the right subclavian artery is the other branch). This bifurcation occurs roughly at the level of the right sternoclavicular joint.

The left common carotid artery branches directly from the arch of aorta. The left and right common carotid arteries ascend up the neck, lateral to the trachea and the oesophagus. They do not give off any branches in the neck.

At the level of the superior margin of the thyroid cartilage (C4), the carotid arteries split into the external and internal carotid arteries. This bifurcation occurs in an anatomical area known as the carotid triangle.

The common carotid and internal carotid are slightly dilated here, this area is known as the carotid sinus, and is important in detecting and regulating blood pressure.

-

-The external carotid artery supplies the areas of the head and neck external to the cranium. After arising from the common carotid artery, it travels up the neck, passing posteriorly to the mandibular neck and anteriorly to the lobule of the ear.

The artery ends within the parotid gland by dividing into the superficial temporal artery and the maxillary artery. It gives rise to six branches in total:

Superior thyroid artery

Lingual artery

Facial artery

Ascending pharyngeal artery

Occipital artery

Posterior auricular artery

The facial, maxillary and superficial temporal arteries are the major branches of note. The maxillary artery supplies the deep structures of the face, while the facial and superficial temporal arteries generally supply superficial areas of the face.

-The internal carotid arteries do not supply any structures in the neck, entering the cranial cavity via the carotid canal in the petrous part of the temporal bone. Within the cranial cavity, the internal carotid artery supplies:

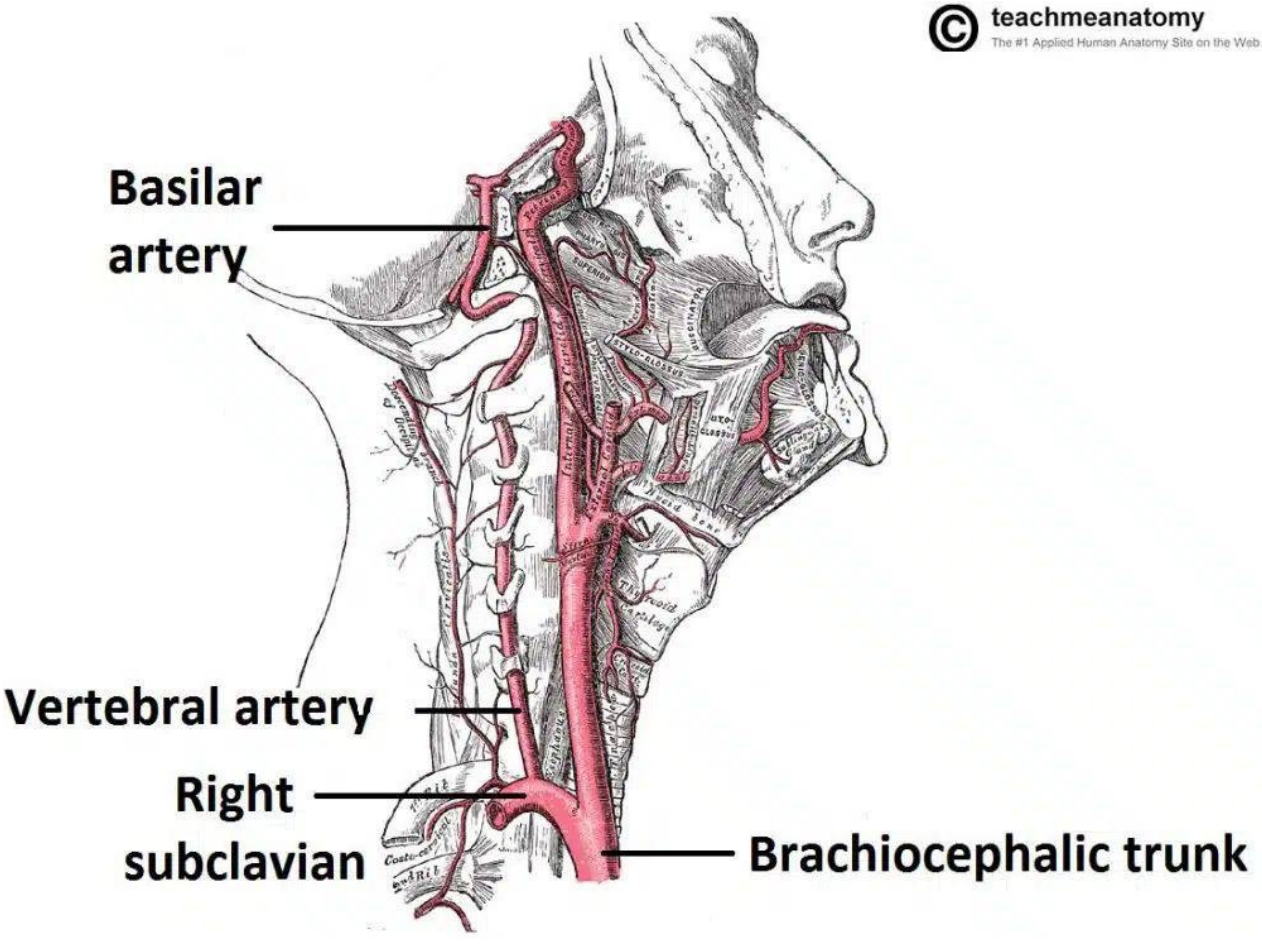
The brain

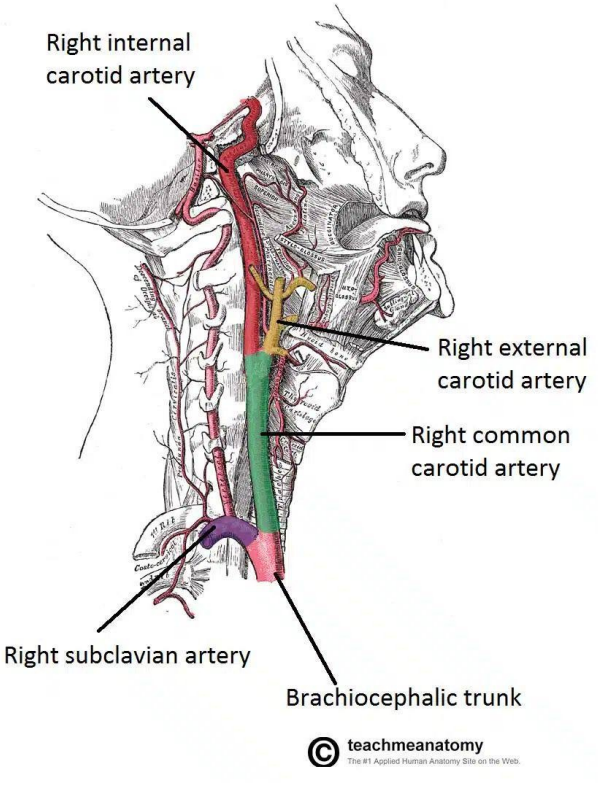
Eyes

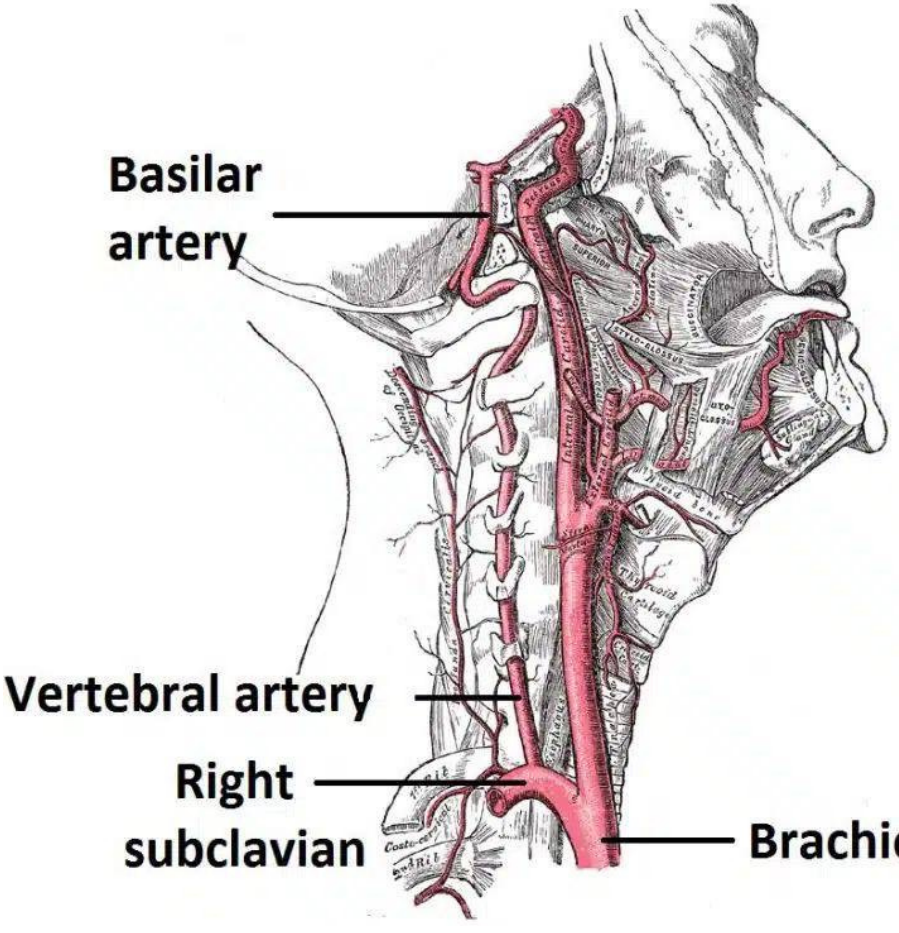
Forehead

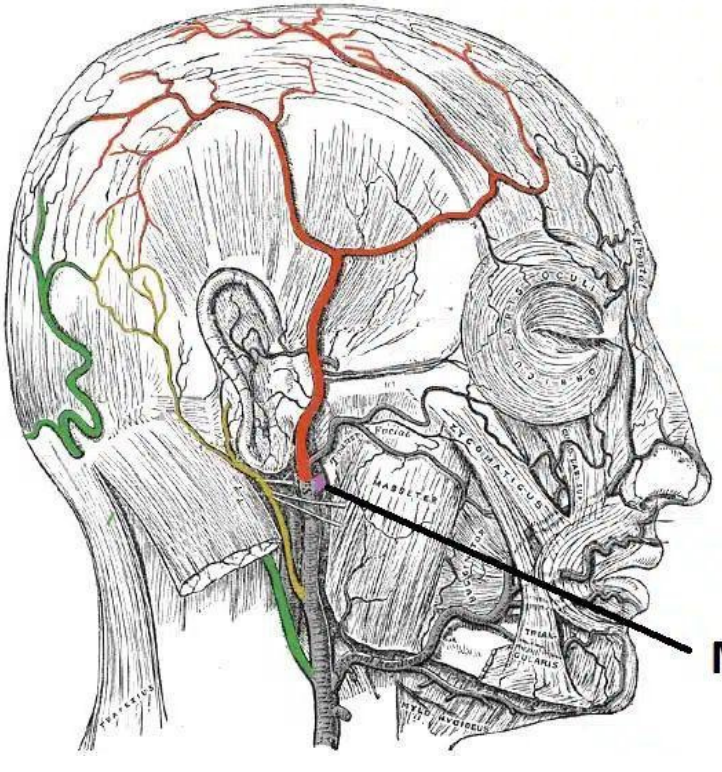
-The vertebral arteries are paired vessels which arise from subclavian arteries, just medial to the anterior scalenes. They ascend the posterior aspect of the neck, passing through holes in the transverse processes of the cervical vertebrae (known as foramen transversarium).

The vertebral arteries enter the cranium via the foramen magnum and converge to form the basilar artery – which continues to supply the brain. The vertebral arteries do not supply any branches to the neck or other extra-cranial structures



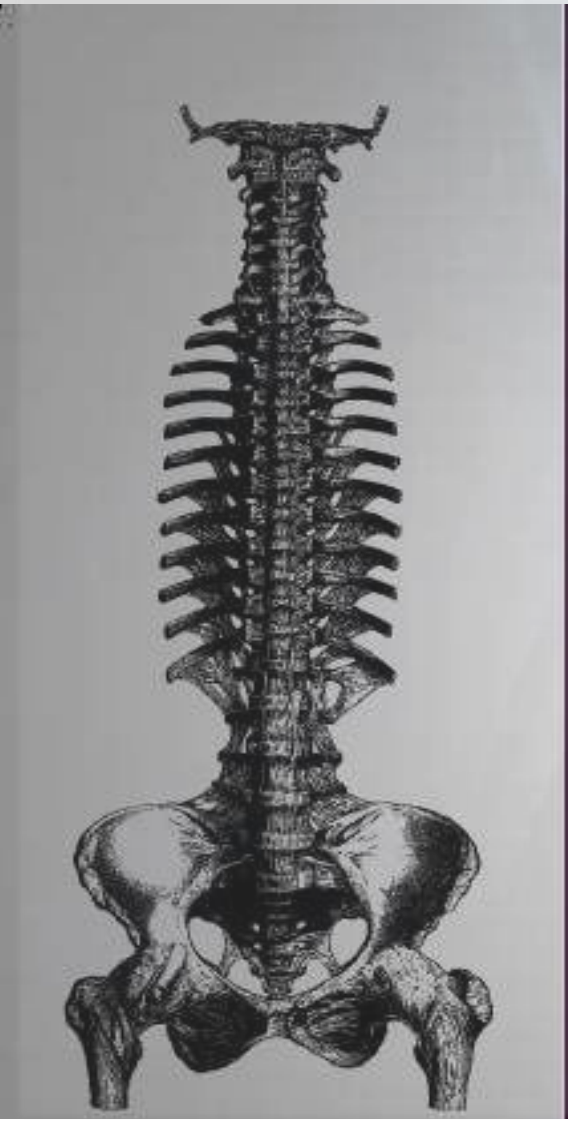


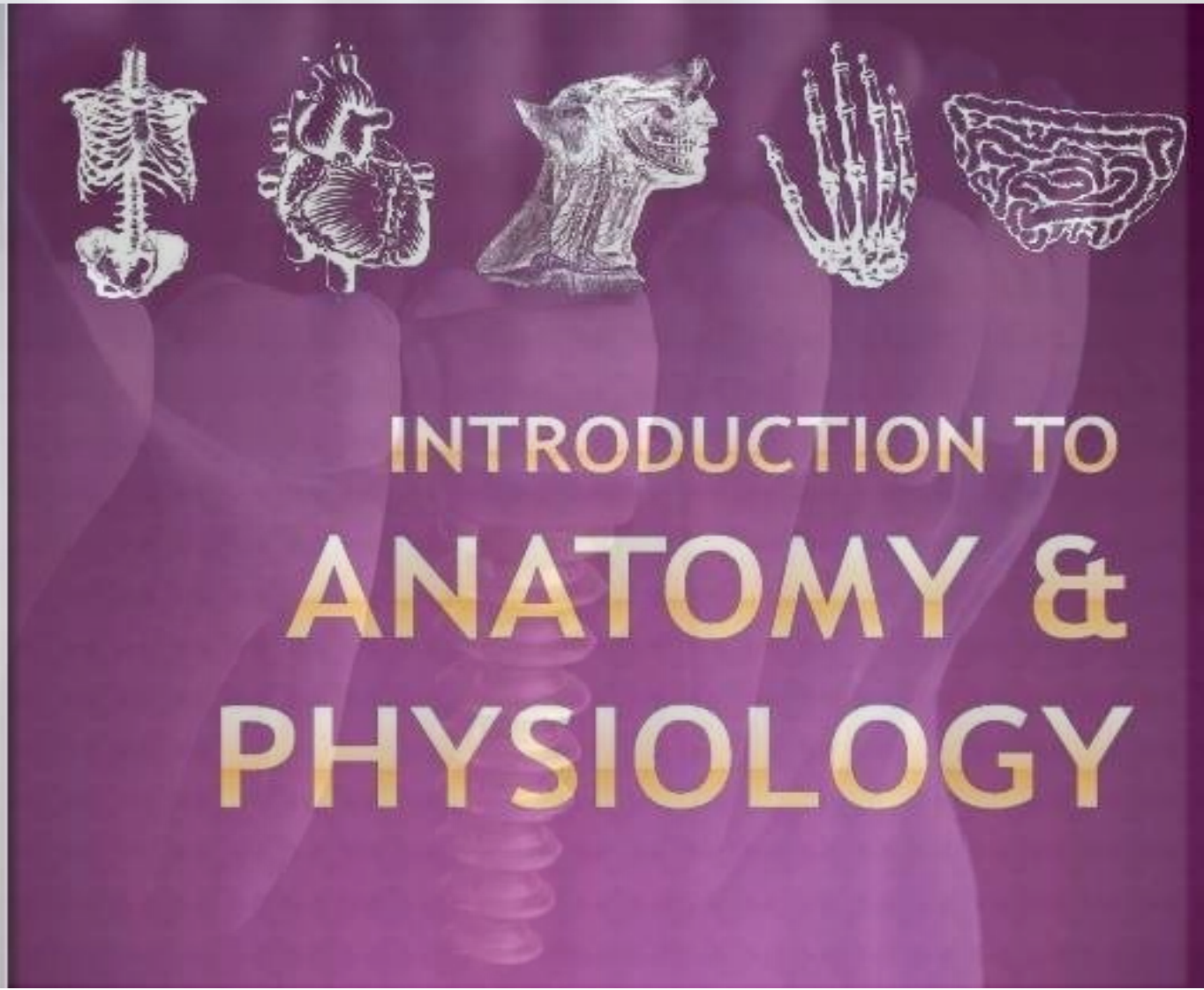




Lecture 3

Anatomical Medical Terminology





INTRODUCTION

Anatomy

- Studies of the body parts and their relationships.

Macroscopic (Gross) Anatomy

- Study of large body structure.
  (e.g: heart, lungs, kidneys... etc.)
- can be further divided into:

1. Regional Anatomy
   - all structures in one particular region.

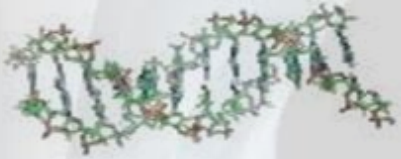
2. Systemic Anatomy
   - system by system

3. Surface Anatomy
   - study of internal body structures

Microscopic Anatomy

- Very small structures that cannot be seen with naked eyes.

1. Cytology
   - Study of body cells



2. Histology
   - Study of body tissues

Developmental Anatomy

- Structural changes to the body throughout lifespan.

1. Embryology

- Development which occur before birth

INTRODUCTION

Physiology

- **Study of the body function**
  - **System Physiology**
    - study of body system's function

  - **Comparative Physiology**
    - study of various characteristics of living organisms

  - **Medical Physiology**
    - study of physiological dysfunction and diseases

MEDICAL TERMINOLOGY

LESSON 1

STRUCTURAL LEVEL OF A BODY

Chemical
Combination of **atoms** to **form molecules**

Cell
Basic living units; have common characteristics, differ in structure and function

Tissue
A **group of cells with similar structure and function**: epithelial, connective, muscle, nervous

Organ
Two or more tissues work together perform one or more common function: eye, skin, stomach, heart.

Organ System
A group of organs of a common function:
Skeletal, Muscular, Nervous, Endocrine, Cardiovascular, lymphatic, respiratory, digestive.

SYSTEM OF THE BODY

- **Integumentary System**
  - External cover of the body (skin)
  - Protects deeper tissues from injury
  - Site of cutaneous, receptors, sweat and oil glands.

- **Skeletal System**
  - Bones
  - Protects and supports body organs

SYSTEM OF THE BODY

- **Muscular System**
  - muscles
  - produce body movement

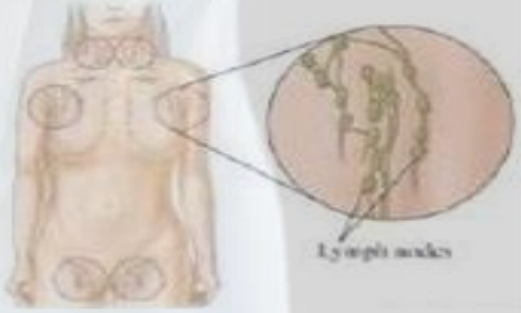
- **Nervous System**
  - consist of brain, sensory receptor, nerves, spinal cord
  - control homeostasis by stimulating particular muscles contraction and glands secretion

SYSTEM OF THE BODY

- **Endocrine System**
  - Hormones secretion to regulate body processes.

- **Cardiovascular System**
  - Transport blood to the body

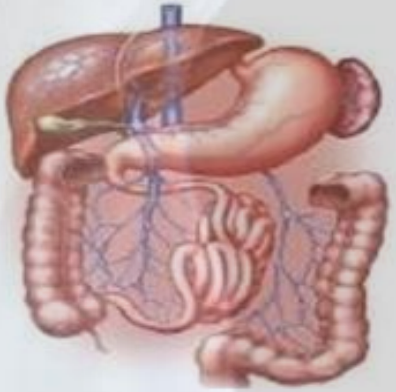
- **Lymphatic/Immune System**
  - Protect the body by attacking foreign substances entering body system



SYSTEM OF THE BODY

- **Respiratory System**
  - supply blood with oxygen and removing carbon dioxide.

- **Digestive System**
  - break down the food for absorption
  - indigestible food will be removed as feces



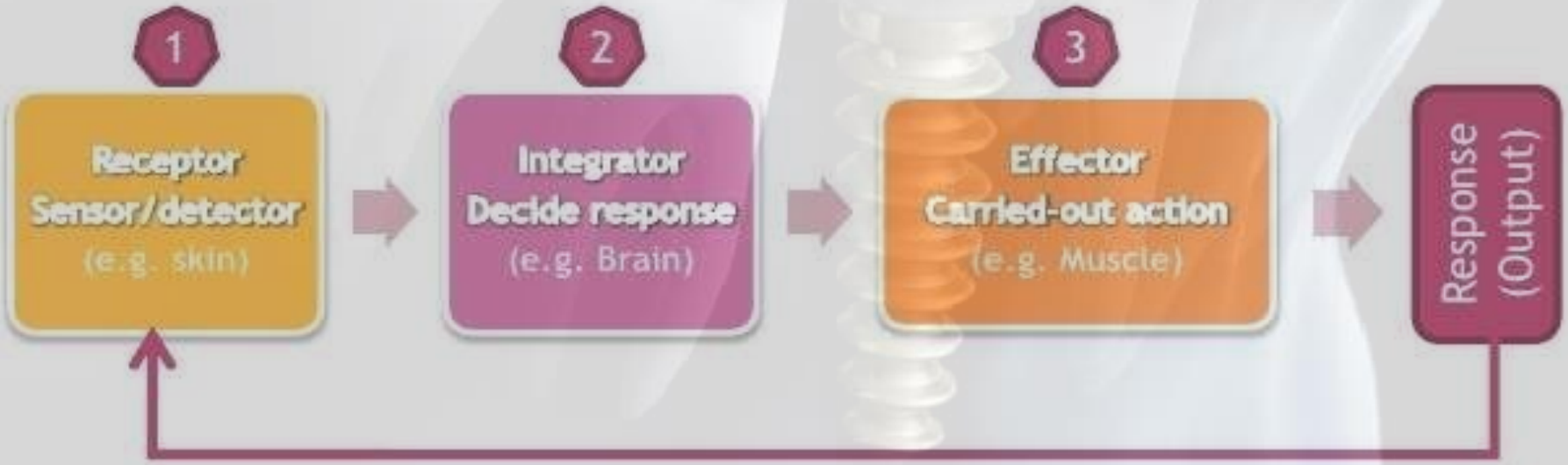
SYSTEM OF THE BODY

- **Urinary System**
  - regulation of water, electrolytes and acid-base balance in the body.

- **Reproductive System**
  - production of babies

HOMEOSTASIS

- Body's ability to maintain relatively stable internal conditions although the external environment keep changing...
- 3 components:-



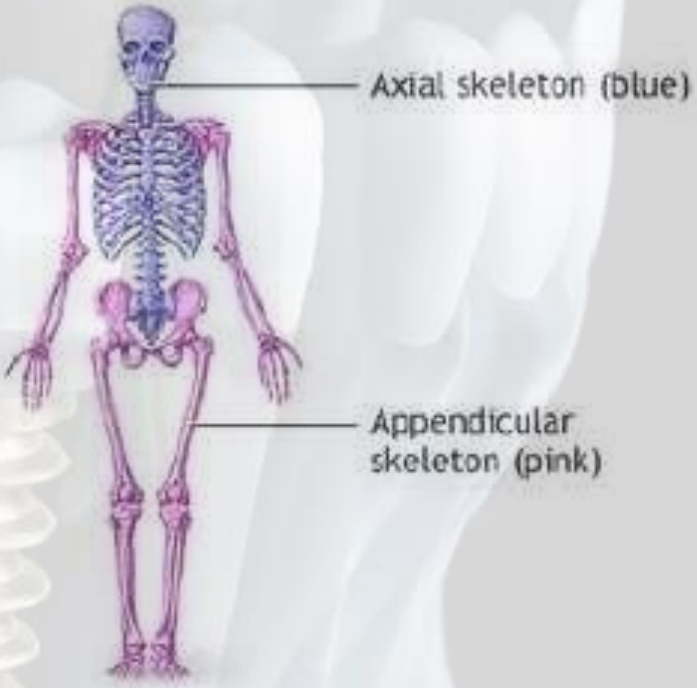
DIRECTIONAL TERMS

- Explain and locate precisely where the body structure and it's relation to another.

TERM	DEFINITION
Superior (cranial)	Toward head end, above
Inferior (caudal)	Away head end, below
Anterior (ventral)	Front of the body
Posterior (dorsal)	Behind the body
Medial	Midline of the body, inner
Lateral	Away from midline, outer
Intermediate	Between medial and lateral
Proximal	Close to body origin
Distal	Away from body origin
Superficial (external)	Toward body surface
Deep (internal)	Away body surface

REGIONAL TERMS

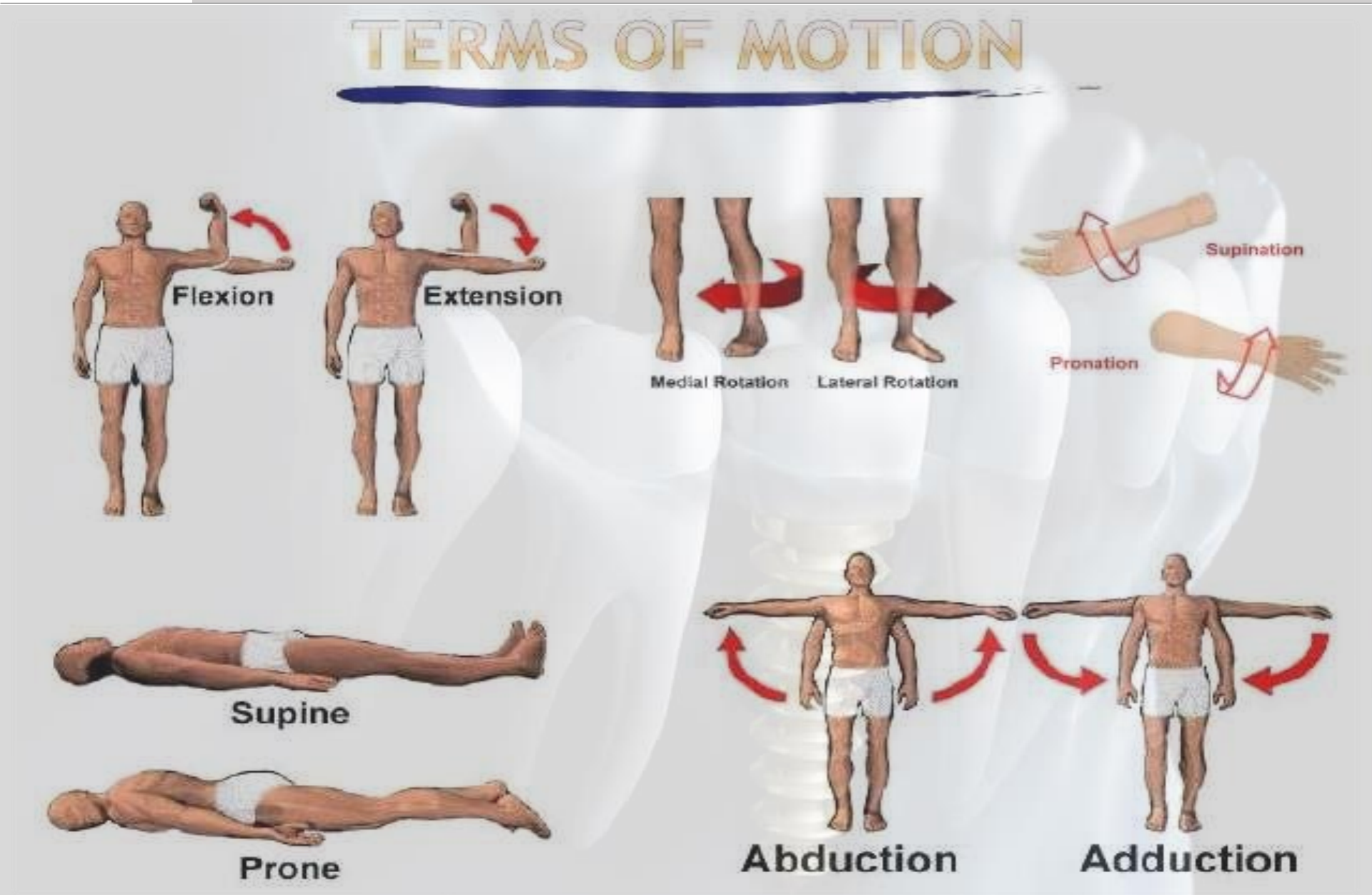
- **Axial Region**
  - axis of our body
  - comprise of three parts:
    head, neck and trunk



- **Perpendicular Region**
  - limbs, or appendages
  - body parts that attached to the axis.

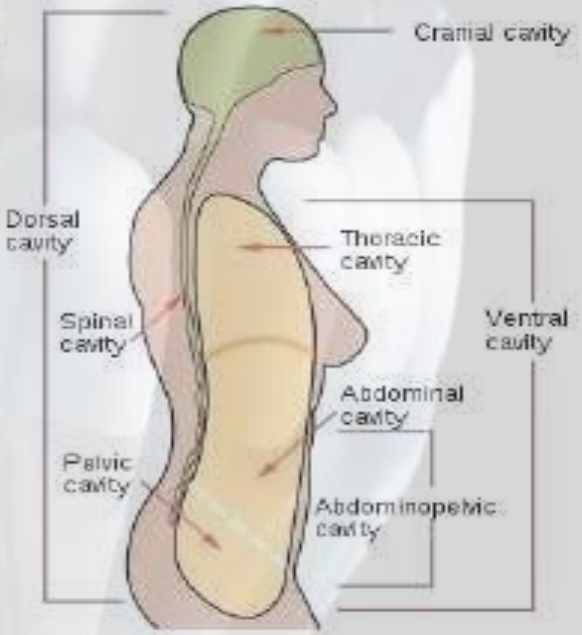
MEDICAL TERMINOLOGY

LESSON 1



BODY CAVITY

- **Dorsal Cavity** – protects nervous system
  - two subdivisions:-
    1. Cranial Cavity – brain
    2. Spinal Cavity – spinal cord



- **Ventral Cavity** – houses visceral organs
  - two subdivisions:-
    1. Thoracic Cavity – pleural (lungs), mediastinum (heart, esophagus, trachea, etc…)
    2. Abdominopelvic cavity – abdominal (stomach, intestines, spleen, liver, etc…), pelvic (bladder, reproductive system, rectum)

Human Anatomy

Lecture 4 **Assist. Prof. Dr. Dalya Basil**

Nervous System

The nervous system can be divided into the central and peripheral nervous system.

The nervous system is involved in most body functions, such as:

1- Sensory input

2- Integration

3- Motor output

Central Nervous System

The central nervous system (CNS) consists of the brain and the spinal cord.

The brain is located within the skull. It is one of the largest organs in the body, that coordinates most body activities.

Cerebrum is the largest section of the brain, it is located in the upper portion of the brain and is the area that processes thoughts, judgment, memory, problem solving, and language. The outer layer of the cerebrum is the cerebral cortex, which is composed of folds of gray matter.

The cerebrum is subdivided into the left and right halves called cerebral hemispheres. Each hemisphere has 4 lobes.

Frontal lobe, Parietal lobe, Occipital lobe, and Temporal lobe.

Cerebellum is the second largest portion of the brain, located beneath the posterior part of the cerebrum. The cerebellum aids in coordinating voluntary body movements and maintaining balance and equilibrium.

Brain stem

- Midbrain—acts as a pathway for impulses to be conducted between the brain and the spinal cord.
- Pons — means bridge—connects the cerebellum to the rest of the brain.
- Medulla oblongata—most inferior positioned portion of the brain; it connects the brain to the spinal cord.

Spinal Cord: The spinal cord is located within the vertebral canal, it connects to the brain at the level of foramen magnum and extend inferiorly in the vertebral canal to level L1-L2 of the vertebral column. It is considerably shorter than the vertebral column because it doesn't grow as rapidly as the vertebral column during development.

The spinal cord gives rise to 31 pairs of spinal nerves, which exit the vertebral column through intervertebral and sacral foramina.

The spinal cord is not uniform in diameter throughout its length. The cervical enlargement, in the inferior cervical region is where spinal nerves supplying the upper limbs arise. The lumbosacral enlargement in the inferior thoracic, lumber, and superior sacral regions is the site where spinal nerves supplying the lower limbs arise.

Immediately inferior to the lumbar enlargement, the spinal cord tapers to form a conelike region called the **conus medullaris.** Its tip is the inferior end of the spinal cord and extends to the level of the second lumbar vertebra.

The conus medullaris and the numerous nerves extending inferiorly from it, within the vertebral canal, resemble a horse's tail and are therefore called the **cauda equina.**

Meninges of the spinal cord

- Dura mater: outermost layer; continuous with epineurium of the spinal nerves
- Arachnoid mater: thin and wispy
- Pia mater: bound tightly to surface

Peripheral Nervous System

The peripheral nervous system (PNS) is external to the CNS. It consists of sensory receptors and nerves.

Sensory receptors are the endings of nerve cells or specialized cells that detect temperature, pain, touch, pressure, light, sound, odors, and other stimuli.

Sensory receptors are located in the skin, muscles, joints, internal organs, and specialized sensory organs such as the eyes and ears.

The PNS is divided into two divisions:

1- The sensory (afferent) division transmits signals to the CNS from sensory receptors.

2- The motor (efferent) division transmits signals from the CNS to effector organs, such as muscles and glands.

Neurons

Neurons are specific type of the cells of nervous system which receiving and transmit signals to other neurons or to effector organs.

Each neuron consists of a cell body, and two types of processes dendrites, and axons.

Types of neurons:

Neurons are classified according to their function or structure. The structural classification is based on the number of processes that extend from the neuron cell body.

The three major categories of neurons are:

1- Multipolar neurons: have many dendrites and a single axon. Most of the neurons within CNS and motor neurons are multipolar.

2- Bipolar neurons: have two processes one dendrite and one axon. Bipolar neurons are located in some sensory organs such as in the retina of the eye and in the nasal cavity.

3- Unipolar neurons: have a single process extending from the cell body.

Nerves:

A nerve is a bundle of axons and their sheathes. Twelve pairs of cranial nerves originate from the brain, and 31 pairs of spinal nerves originate from the spinal cord. Nerves transmit electrical signals

Cranial Nerves

- **I Olfactory nerve –** sensory for smell
- **II Optic nerve –** sensory for vision
- **III Oculomotor nerve –** motor fibers to eye muscles
- **IV Trochlear –** motor fiber to eye muscles
- **V Trigeminal nerve –** sensory for the face; motor fibers to chewing muscles
- **VI Abducens nerve –** motor fibers to eye muscles
- **VII Facial nerve –** sensory for taste; motor fibers to the face
- **VIII Vestibulocochlear nerve –**sensory for balance and hearing
- **IX Glossopharyngeal nerve –** sensory for taste; motor fibers to the pharynx
- **X Vagus nerves –** sensory and motor fibers for pharynx, larynx, and viscera
- **XI Accessory nerve –** motor fibers to neck and upper back
- **XII Hypoglossal nerve –** motor fibers to tongue

Spinal Nerves

Cervical spinal nerves, Thoracic spinal nerves, Lumber spinal nerves, Sacral spinal cords.

Brain anatomy

Dr.Fawzi Hammadi

What is the brain?

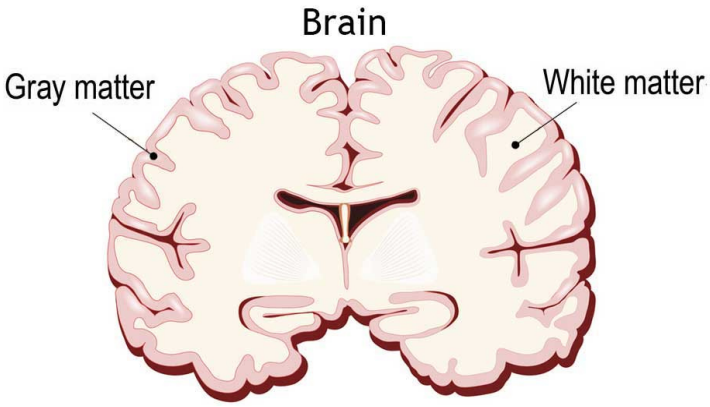
The brain is a complex organ that controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger and every process that regulates our body. Together, the brain and spinal cord that extends from it make up the central nervous system, or CNS.

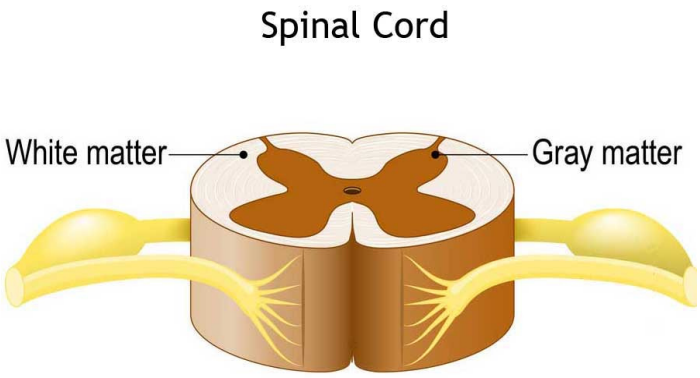
What is the brain made of?

Weighing about 3 pounds in the average adult, the brain is about 60% fat. The remaining 40% is a combination of water, protein, carbohydrates and salts. The brain itself is a not a muscle. It contains blood vessels and nerves, including neurons and glial cells.

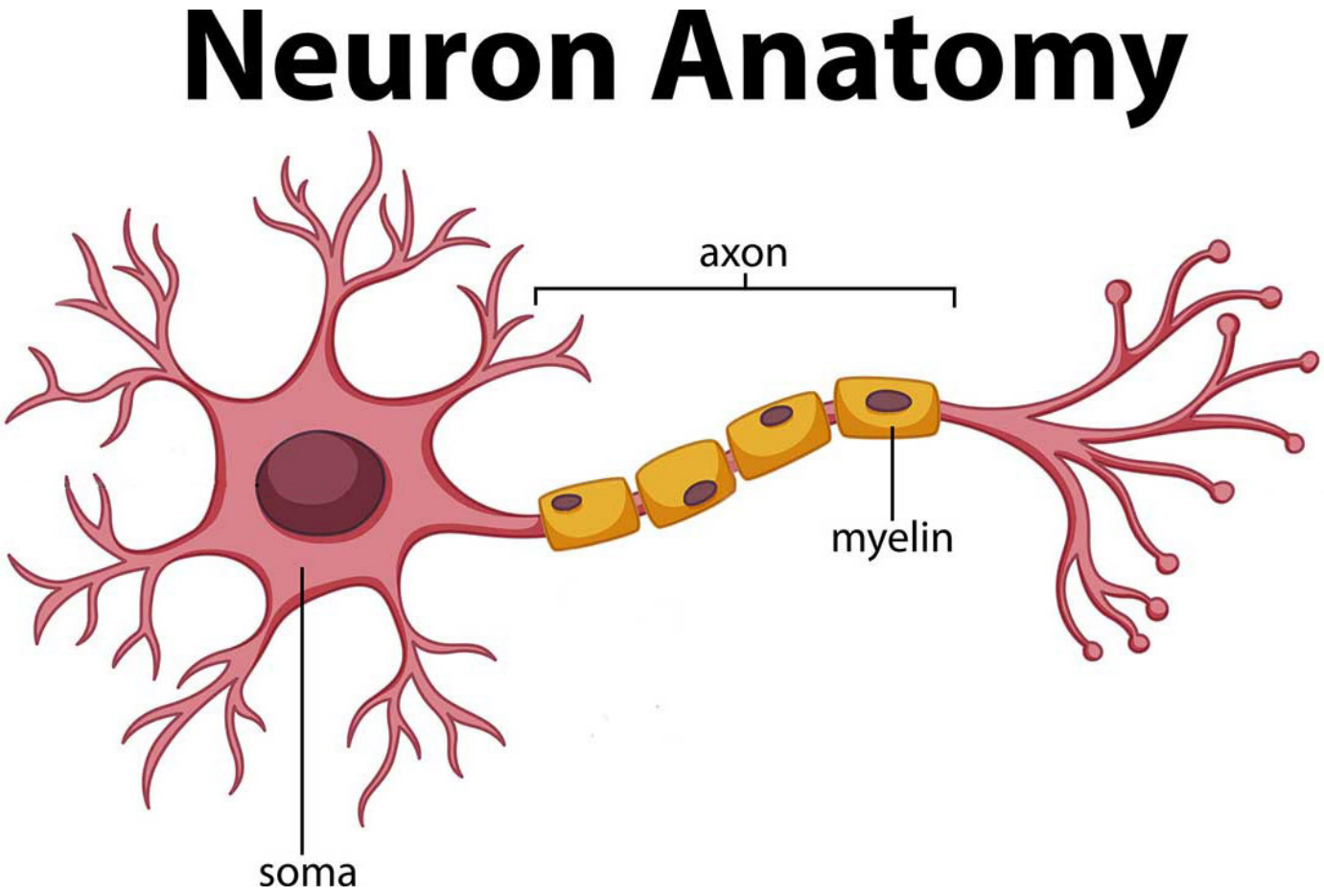
What is the gray matter and white matter?

Gray and white matter are two different regions of the central nervous system. In the brain, gray matter refers to the darker, outer portion, while white matter describes the lighter, inner section underneath. In the spinal cord, this order is reversed: The white matter is on the outside, and the gray matter sits within.





Gray matter is primarily composed of neuron somas (the round central cell bodies), and white matter is mostly made of axons (the long stems that connects neurons together) wrapped in myelin (a protective coating). The different composition of neuron parts is why the two appear as separate shades on certain scans.



Each region serves a different role. Gray matter is primarily responsible for processing and interpreting information, while white matter transmits that information to other parts of the nervous system.

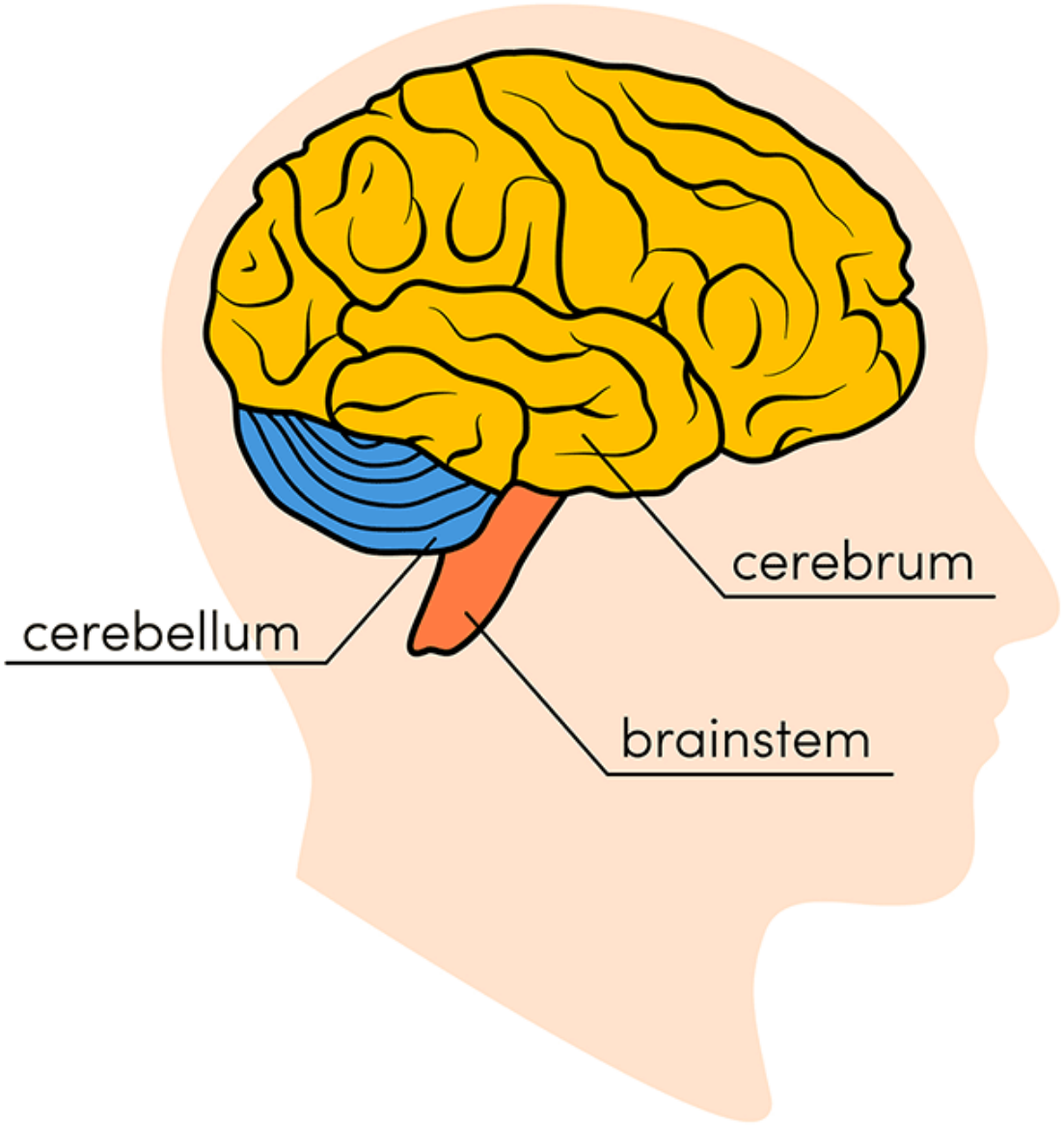
How does the brain work?

The brain sends and receives chemical and electrical signals throughout the body. Different signals control different processes, and your brain interprets each. Some make you feel tired, for example, while others make you feel pain.

Some messages are kept within the brain, while others are relayed through the spine and across the body's vast network of nerves to distant extremities. To do this, the central nervous system relies on billions of neurons (nerve cells).

Main Parts of the Brain and Their Functions

At a high level, the brain can be divided into the cerebrum, brainstem and cerebellum.



Cerebrum

The cerebrum (front of brain) comprises gray matter (the cerebral cortex) and white matter at its center. The largest part of the brain, the cerebrum initiates and coordinates movement and regulates temperature. Other areas of the cerebrum enable speech, judgment, thinking and reasoning, problem-solving, emotions and learning. Other functions relate to vision, hearing, touch and other senses.

Cerebral Cortex

Cortex is Latin for “bark,” and describes the outer gray matter covering of the cerebrum. The cortex has a large surface area due to its folds, and comprises about half of the brain’s weight.

The cerebral cortex is divided into two halves, or hemispheres. It is covered with ridges (gyri) and folds (sulci). The two halves join at a large, deep sulcus (the interhemispheric fissure, AKA the medial longitudinal fissure) that runs from the front of the head to the back. The right hemisphere controls the left side of the body, and the left half controls the right side of the body. The two halves communicate with one another through a large, C-shaped structure of white matter and nerve pathways called the corpus callosum. The corpus callosum is in the center of the cerebrum.

Brainstem

The brainstem (middle of brain) connects the cerebrum with the spinal cord. The brainstem includes the midbrain, the pons and the medulla.

Midbrain. The midbrain (or mesencephalon) is a very complex structure with a range of different neuron clusters (nuclei and colliculi), neural pathways and other structures. These features facilitate various functions, from hearing and movement to calculating responses and environmental changes. The midbrain also contains the substantia nigra, an area affected by Parkinson’s disease that is rich in dopamine neurons and part of the basal ganglia, which enables movement and coordination.

Pons. The pons is the origin for four of the 12 cranial nerves, which enable a range of activities such as tear production, chewing, blinking, focusing vision, balance, hearing and facial expression. Named for the Latin word for “bridge,” the pons is the connection between the midbrain and the medulla.

Medulla. At the bottom of the brainstem, the medulla is where the brain meets the spinal cord. The medulla is essential to survival. Functions of the medulla regulate many bodily activities, including heart rhythm, breathing, blood flow, and oxygen and carbon dioxide levels. The medulla produces reflexive activities such as sneezing, vomiting, coughing and swallowing.

The **spinal cord** extends from the bottom of the medulla and through a large opening in the bottom of the skull. Supported by the vertebrae, the spinal cord carries messages to and from the brain and the rest of the body.

Cerebellum

The cerebellum (“little brain”) is a fist-sized portion of the brain located at the back of the head, below the temporal and occipital lobes and above the brainstem. Like the cerebral cortex, it has two hemispheres. The outer portion contains neurons, and the inner area

communicates with the cerebral cortex. Its function is to coordinate voluntary muscle movements and to maintain posture, balance and equilibrium. New studies are exploring the cerebellum's roles in thought, emotions and social behavior, as well as its possible involvement in addiction, autism and schizophrenia.

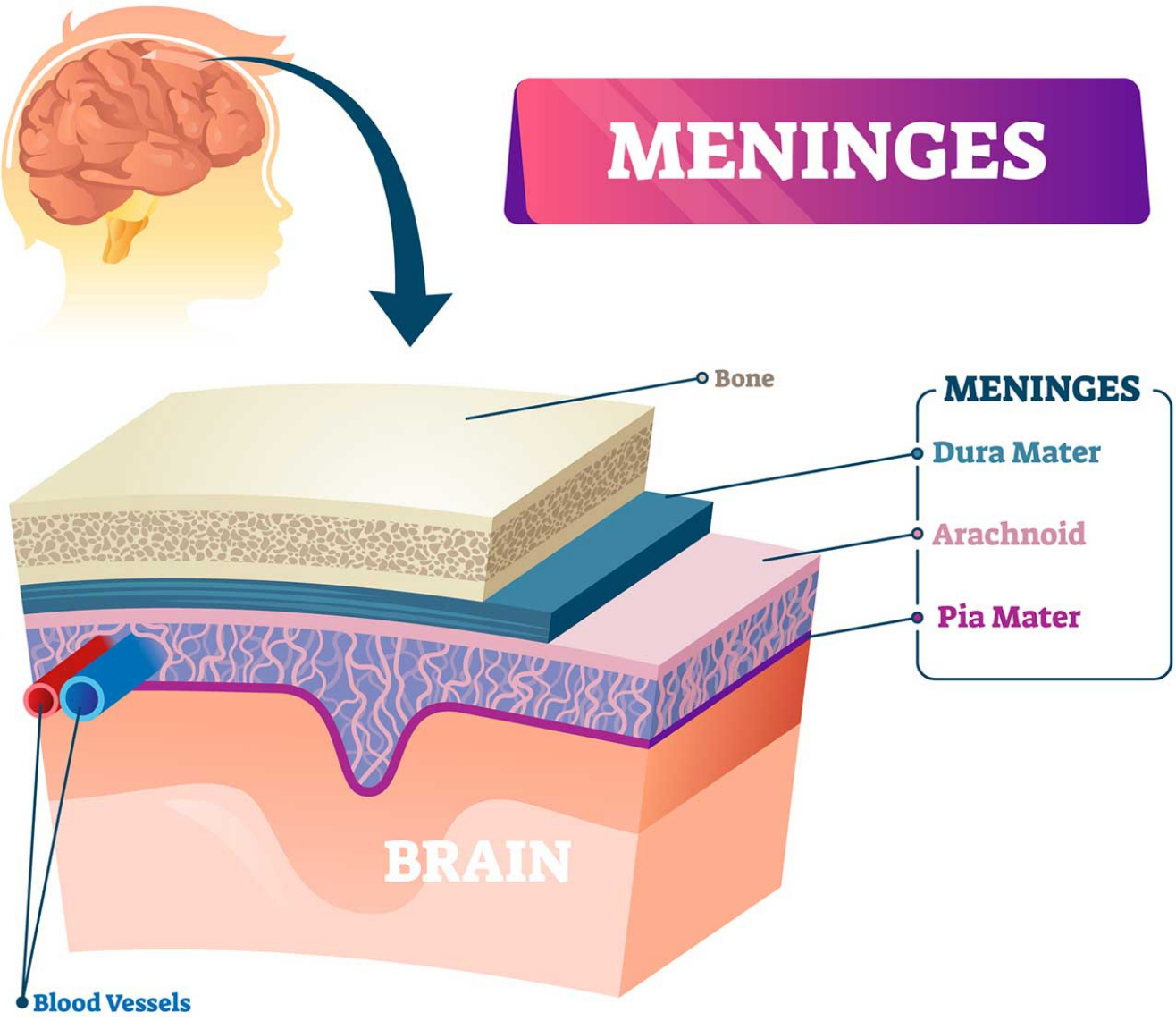
Brain Coverings: Meninges

Three layers of protective covering called **meninges** surround the brain and the spinal cord.

The outermost layer, the **dura mater**, is thick and tough. It includes two layers: The periosteal layer of the dura mater lines the inner dome of the skull (cranium) and the meningeal layer is below that. Spaces between the layers allow for the passage of veins and arteries that supply blood flow to the brain.

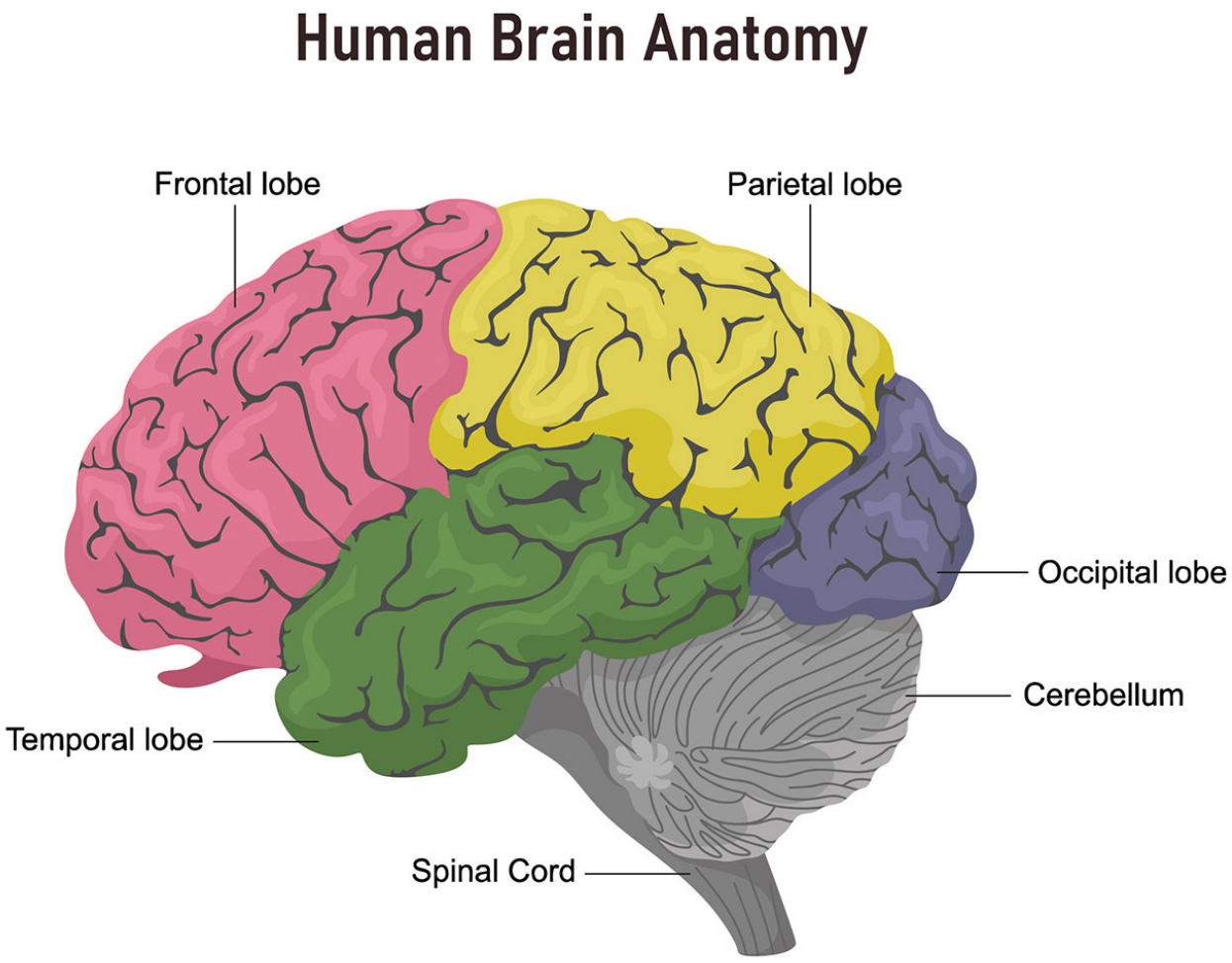
The **arachnoid** mater is a thin, weblike layer of connective tissue that does not contain nerves or blood vessels. Below the arachnoid mater is the cerebrospinal fluid, or CSF. This fluid cushions the entire central nervous system (brain and spinal cord) and continually circulates around these structures to remove impurities.

The **pia mater** is a thin membrane that hugs the surface of the brain and follows its contours. The pia mater is rich with veins and arteries.



Lobes of the Brain and What They Control

Each brain hemisphere (parts of the cerebrum) has four sections, called lobes: frontal, parietal, temporal and occipital. Each lobe controls specific functions.



Frontal lobe. The largest lobe of the brain, located in the front of the head, the frontal lobe is involved in personality characteristics, decision-making and movement. Recognition of smell usually involves parts of the frontal lobe. The frontal lobe contains Broca's area, which is associated with speech ability.

Parietal lobe. The middle part of the brain, the parietal lobe helps a person identify objects and understand spatial relationships (where one's body is compared with objects around the person). The parietal lobe is also involved in interpreting pain and touch in the body. The parietal lobe houses Wernicke's area, which helps the brain understand spoken language.

Occipital lobe. The occipital lobe is the back part of the brain that is involved with vision.

Temporal lobe. The sides of the brain, temporal lobes are involved in short-term memory, speech, musical rhythm and some degree of smell recognition.

Deeper Structures Within the Brain

Pituitary Gland

Sometimes called the “master gland,” the pituitary gland is a pea-sized structure found deep in the brain behind the bridge of the nose. The pituitary gland governs the function of other glands in the body, regulating the flow of hormones from the thyroid, adrenals, ovaries and testicles. It receives chemical signals from the hypothalamus through its stalk and blood supply.

Hypothalamus

The hypothalamus is located above the pituitary gland and sends it chemical messages that control its function. It regulates body temperature, synchronizes sleep patterns, controls hunger and thirst and also plays a role in some aspects of memory and emotion.

Amygdala

Small, almond-shaped structures, an amygdala is located under each half (hemisphere) of the brain. Included in the limbic system, the amygdalae regulate emotion and memory and are associated with the brain’s reward system, stress, and the “fight or flight” response when someone perceives a threat.

Hippocampus

A curved seahorse-shaped organ on the underside of each temporal lobe, the hippocampus is part of a larger structure called the hippocampal formation. It supports memory, learning, navigation and perception of space. It receives information from the cerebral cortex and may play a role in Alzheimer’s disease.

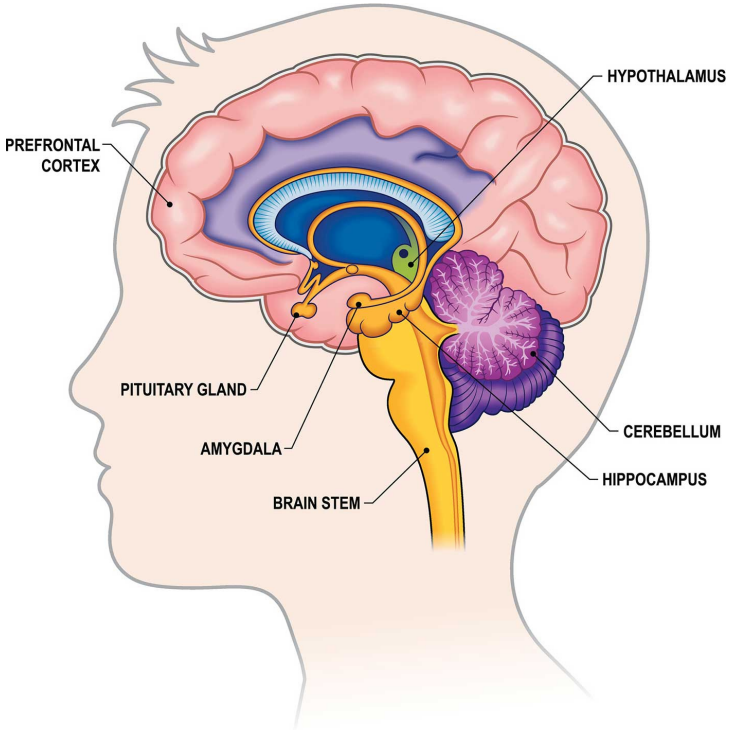
Pineal Gland

The pineal gland is located deep in the brain and attached by a stalk to the top of the third ventricle. The pineal gland responds to light and dark and secretes melatonin, which regulates circadian rhythms and the sleep-wake cycle.

Ventricles and Cerebrospinal Fluid

Deep in the brain are four open areas with passageways between them. They also open into the central spinal canal and the area beneath arachnoid layer of the meninges.

The ventricles manufacture **cerebrospinal fluid**, or CSF, a watery fluid that circulates in and around the ventricles and the spinal cord, and between the meninges. CSF surrounds and cushions the spinal cord and brain, washes out waste and impurities, and delivers nutrients.



Blood Supply to the Brain

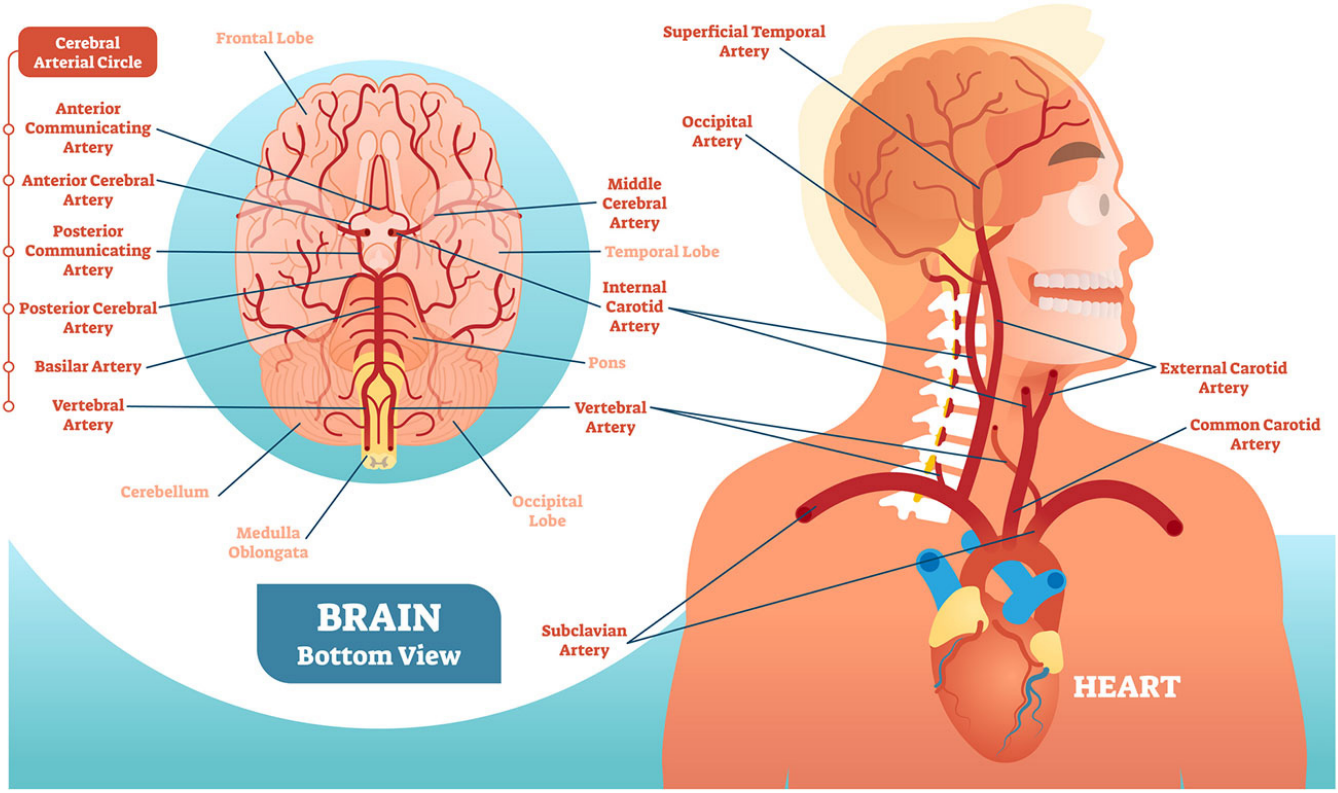
Two sets of blood vessels supply blood and oxygen to the brain: the **vertebral arteries** and the **carotid arteries.**

The external carotid arteries extend up the sides of your neck, and are where you can feel your pulse when you touch the area with your fingertips. The internal carotid arteries branch into the skull and circulate blood to the front part of the brain.

The vertebral arteries follow the spinal column into the skull, where they join together at the brainstem and form the **basilar artery**, which supplies blood to the rear portions of the brain.

The **circle of Willis**, a loop of blood vessels near the bottom of the brain that connects major arteries, circulates blood from the front of the brain to the back and helps the arterial systems communicate with one another.

BRAIN CIRCULATORY SYSTEM



Anatomy of face

Dr.Fawzi Hammadi

The human face is the most anterior portion of the human head. It refers to the area that extends from the superior margin of the forehead to the chin, and from one ear to another.

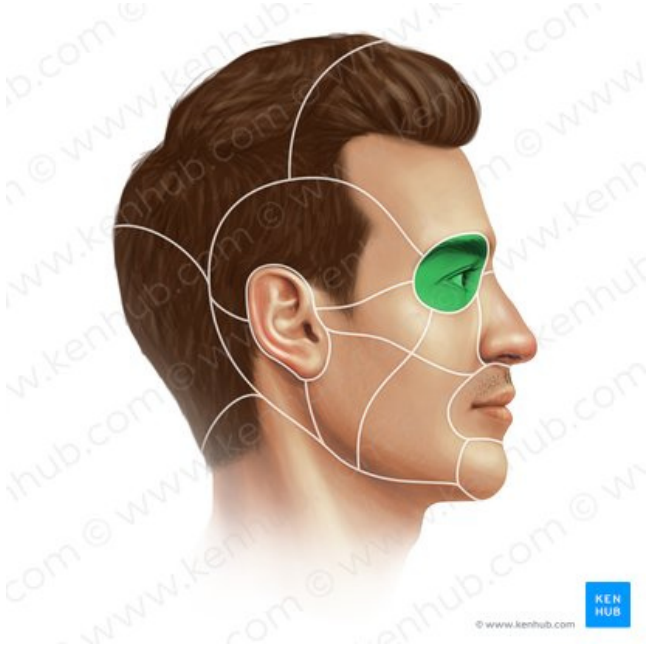
The basic shape of the human face is determined by the underlying facial skeleton (i.e. viscerocranium), the facial muscles and the amount of subcutaneous tissue present.

The face plays an important role in communication and the expression of emotions and mood. In addition, the basic shape and other features of the face provide our external identity.

Regions of face

The human face can be divided into three main parts the superior part of the face, middle part of the face, and the inferior part of the face.

Superior part of face



Frontal region

Regio frontalis

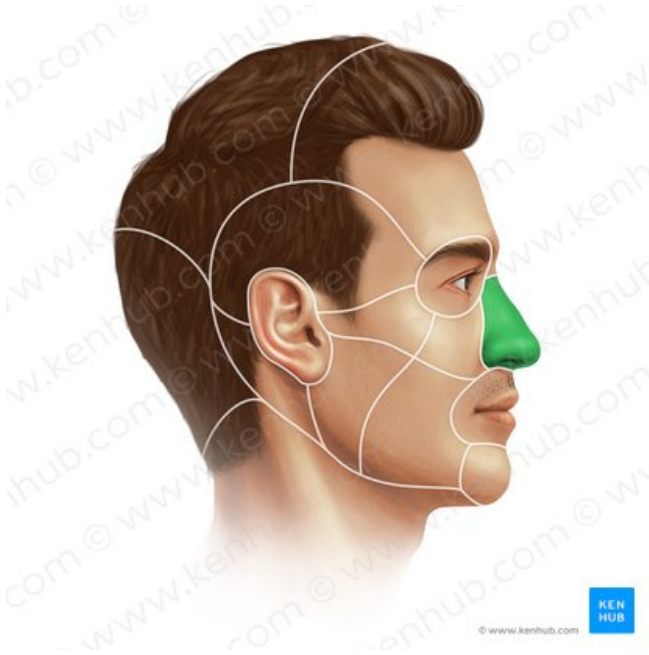
The superior part of the human face extends from the hairline to the inferior margin of the orbit. The lateral margins of this portion extend to the temporal region. The superior part of the face

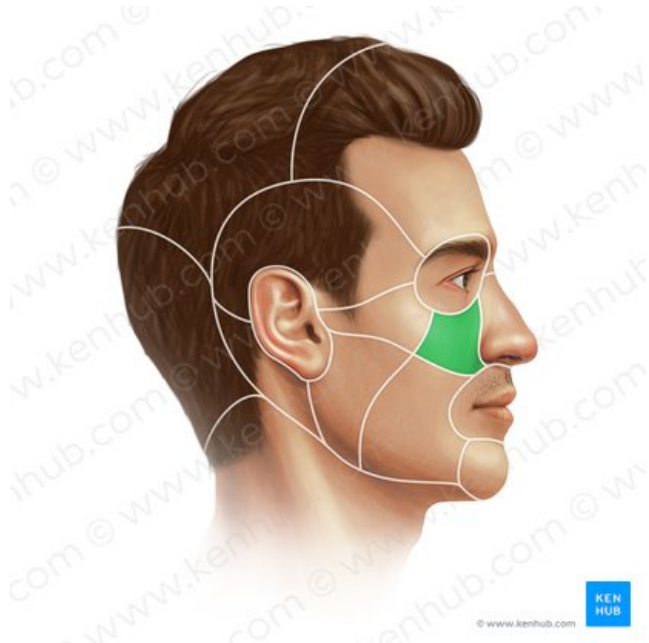
can be divided into three separate regions including the frontal, orbital and temporal regions.

These regions are characterized by the following:

- The frontal region, also known as the forehead, is the most superior region of the face that spreads from the hairline to the eyebrows. It is composed mainly of the frontal bone and the overlying muscles including the procerus, occipitofrontalis, depressor supercilii and corrugator supercillii muscles. The muscles are covered by several fat pads (central, middle and lateral) and skin.
- The orbital region contains the eyes and orbits. Eyes are paired spherically-shaped organs situated in the orbits. The orbits are composed of several cranial bones including the frontal bone superiorly, nasal bone medially, maxilla inferomedially and the zygomatic bone inferolaterally. Each eyeball is cushioned by superior, inferior, and lateral fat pads. The orbit is surrounded by a single muscle known as the orbicularis oculi muscle, while the eyes are enveloped and covered by the eyelids which function to protect the eyes from external factors. The orbicularis oculi muscle closes the eyelids on contraction while the levator palpebrae muscle opens the eyelids. The edges of the eyelids are lined with eyelashes.
- The temporal region is composed of the frontal, sphenoid and temporal bones. It is covered mainly by the temporalis muscle and overlying skin.

Middle part of face





Nasal region

Regio nasalis

The middle part of the face region extends from the lower eyelid superiorly to the superior margin of the upper lip inferiorly. This portion of the face is marked by four regions including the nasal, infraorbital, zygomatic and auricular regions.

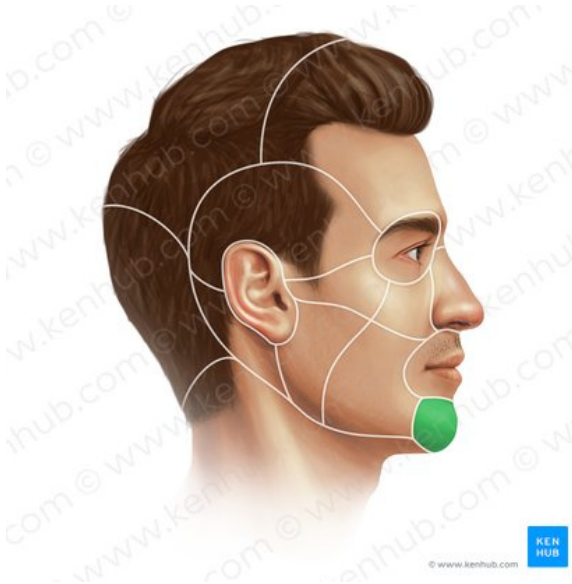
- The nasal region is located in the central portion of the human face and, as its name suggests, it features the nose. The nose is the central pyramid-shaped structure, situated in the midline. The base of the nose is formed mainly by the nasal bone and covered by the nasalis muscle. The apex of the nose ends inferiorly in a rounded ‘tip’. The area between the base and apex is the dorsum of the nose which is formed by nasal cartilage. Superficially, the dorsum of the nose is covered by fat pads and skin.
- The infraorbital region overlies the maxilla, while the zygomatic regions overlie the zygomatic bone. These regions are located lateral to the nose and mark the superior portion of the cheek. The cheek is a prominence that overlies the zygomatic arch and is comprised of muscles and fat. The zygomatic arch is composed of two bones (zygomatic and maxilla). The muscular layer of the cheeks contains several muscles that include the masseter, levator labii superioris alaeque nasi, levator labii superioris, zygomaticus minor, zygomaticus major, risorius, levator anguli oris and buccinator muscles. The muscles of the cheeks are covered by fat pads and overlying skin.

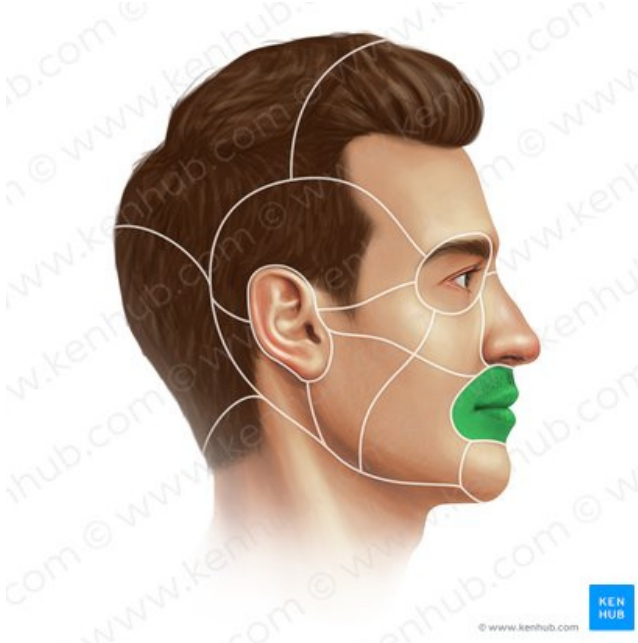
The auricular region is the most lateral region of the face. It contains the external ear (auricle). The internal structure of the auricle is made from cartilage and covered by skin. The ears are surrounded by three auricular muscles (anterior, posterior, and superior).

Take a closer look at the regions of the face in the study unit below!

Regions of the head and neck

Inferior part of face





Mental region

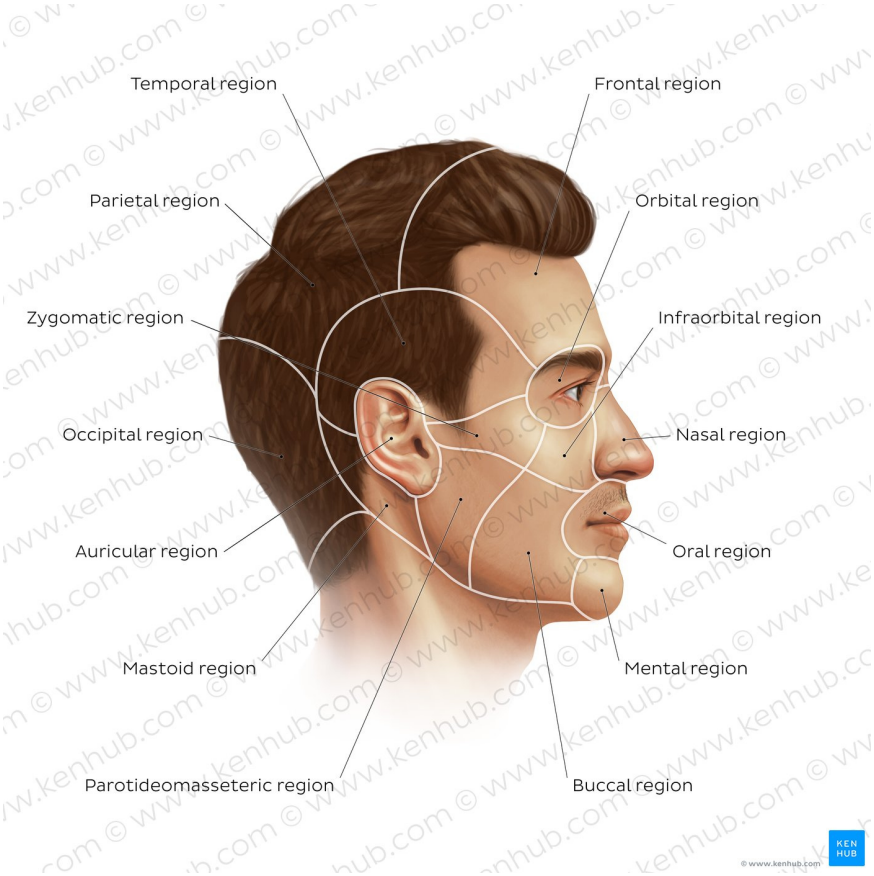
Regio mentalis

The inferior part of the face is bordered superiorly by the superior margin of the upper lip and inferiorly by the inferior border of the chin. The lateral borders of the inferior part of the face are formed by the angles of the mandible on each side. This part can be divided into oral, mental, buccal and parotideomasseteric regions.

- The oral region surrounds the lips, the most prominent structures in the inferior part of the face. They are divided into two parts: the upper lip and lower lip. The upper lip is associated with the maxilla, while the lower lip, with the mandible. The lips are surrounded mainly by the orbicularis oris muscle which functions in altering the shape of the lips when we speak or eat. The other muscles that facilitate the movements of lips are

the risorius, mentalis, depressor labii inferioris, and depressor anguli oris muscles. The movements of the lips allow for actions such as speech, eating, and kissing.

- The mental region is located inferior to the mouth. It features the chin, a central structure that overlies mental protuberance of the mandible.
- The buccal region is located just inferior to the infraorbital and zygomatic region, and comprises the inferior portion of the cheek. It mainly refers to the area marked by the buccinator muscle. The inferior border of the buccal region is the jawline, formed by the inferior border of the mandible.
- The parotideomasseteric region is located lateral to the buccal region. This region is named after the underlying parotid gland and masseter muscle.



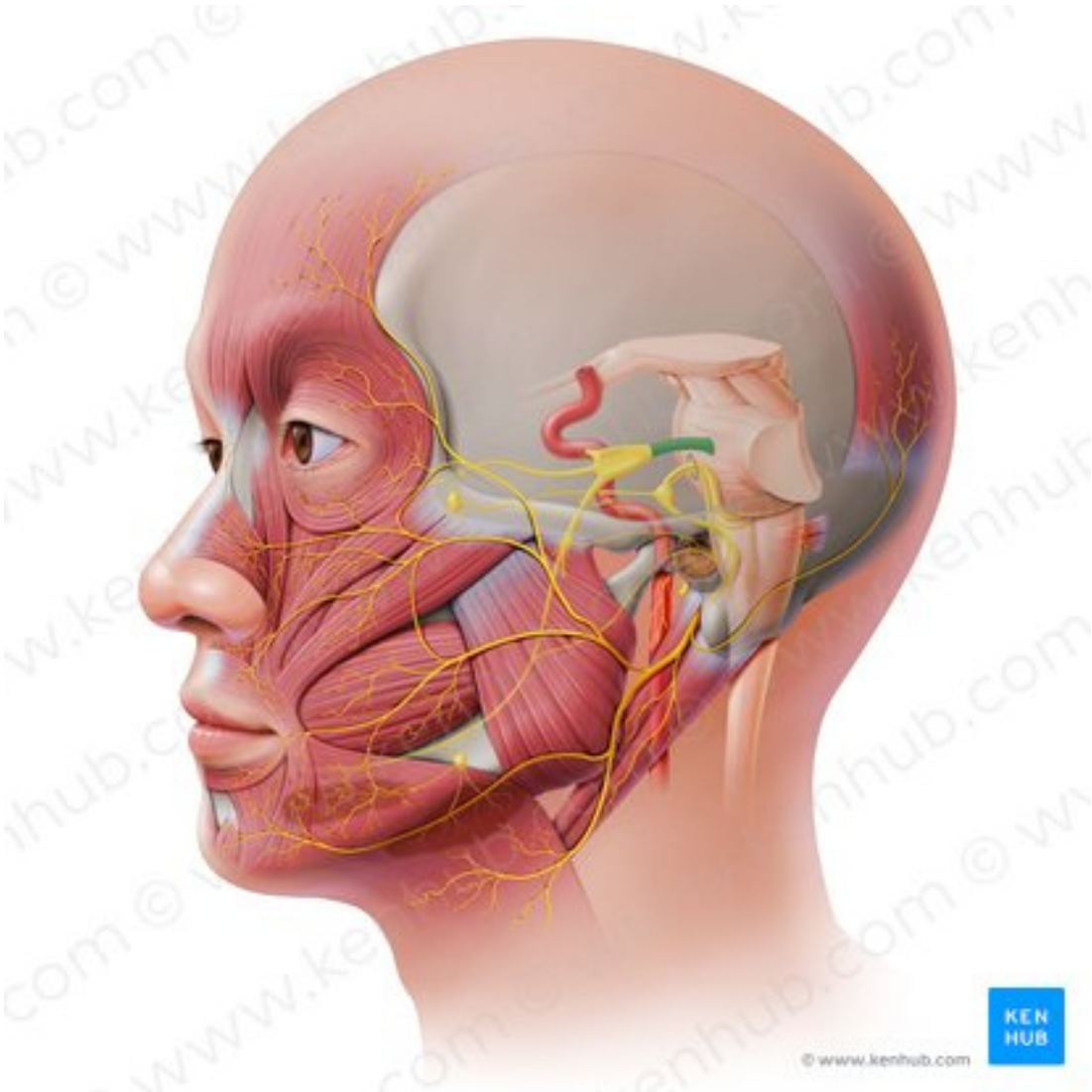
Regions of the face

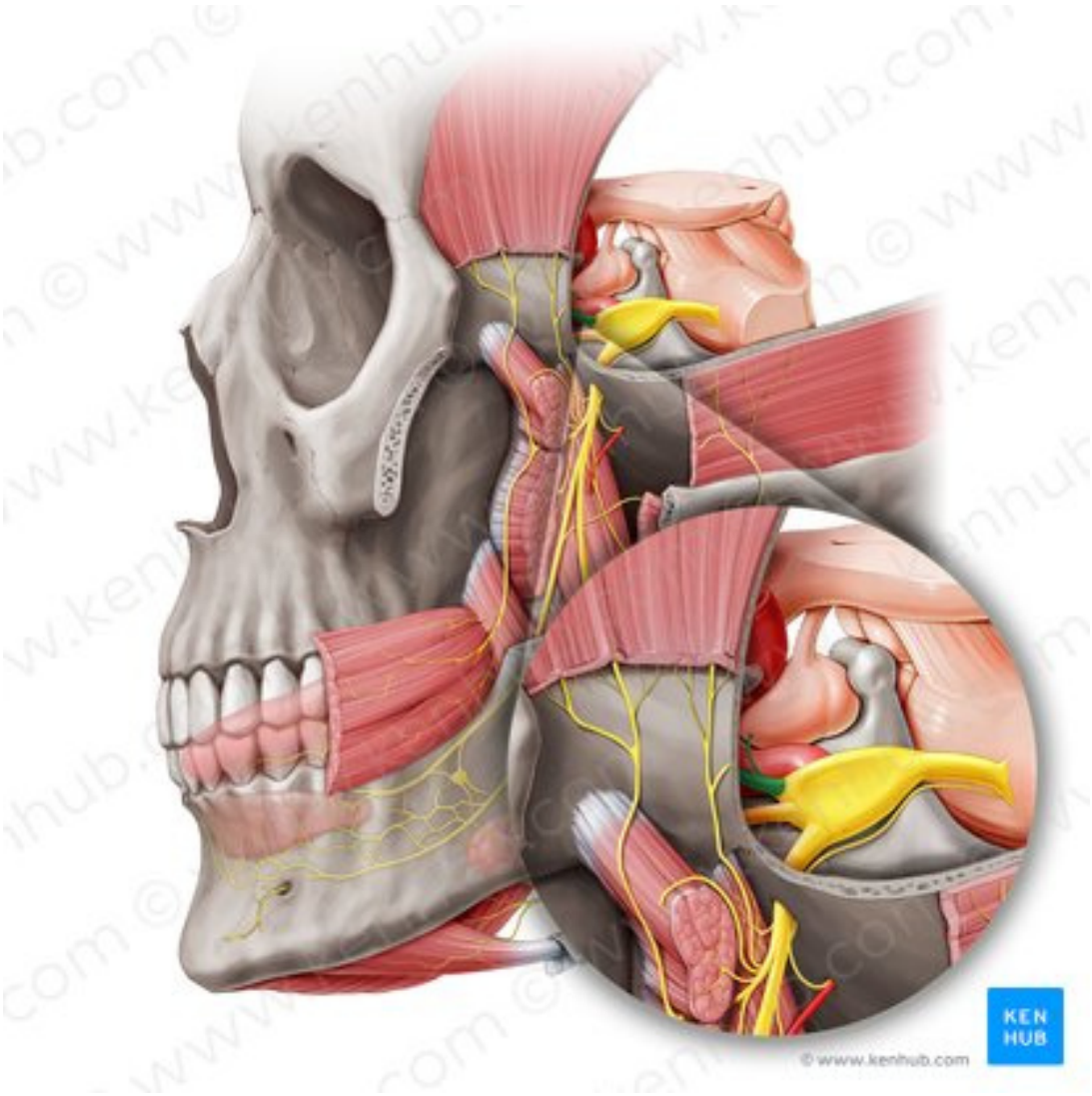
The orbital region contains the organs, bones and soft tissue of the orbit. Inferior to this is the infraorbital region, overlying the maxilla, and the zygomatic region, named after the zygomatic bone (commonly referred to as the cheek bone). The nasal region contains the bone, cartilage and other tissues of the nose, while the oral region below contains the structures of the oral cavity. The buccal region is named after the latin term 'bucca', which refers to the cheek (largely comprised by the buccinator muscle), while parotidomasseteric region is named after the underlying parotid gland and masseter muscle. The inferior-most region of the face is the mental region, demarcating the chin (Latin = mentus).

Test your knowledge on the regions of the head and face with this quiz.

Borders and contents of the regions of the head and neck (18 structures).

Innervation





Trigeminal nerve

Nervus trigeminus

> The three divisions of the trigeminal nerve (CN V) are responsible for the somatic sensation of the entire face according to the three embryological origins.

The ophthalmic nerve (CN V1) which comes from the frontonasal prominence supplies the anterior scalp, forehead, and nasal dorsum.

Deriving from the maxillary prominence the maxillary nerve (CN V2) provides mainly the anterior cheek, the lateral face, the upper lip, the side of the nose, and the lower eyelid.

The mandibular nerve (CN V3) originates from the mandibular prominence and supplies the lower lip,chin, and posterior cheek.

Blood supply

Facial artery

Arteria facialis

The face is richly perfused by a subdermal plexus formed mainly by musculocutaneous arteries coming from the superficial temporal and facial arteries. The facial artery

branches off the external carotid artery, winds around the inferior border of the mandible and ascends along the side of the nose. The superficial temporal artery similarly arises from the external carotid artery and gives off numerous branches which supply different parts of the face including the transverse facial artery and the middle temporal artery.

The venous blood of the face drains from the subdermal plexus to the deep venous plexus via communicating veins.

Bones of the face

Nasal bone

Os nasale

> The facial skeleton is also known as the viscerocranium. It is composed of fourteen bones, six paired and two unpaired bones.

The bones of the viscerocranium include:

- Two nasal bones
- Two maxillae
- Two inferior nasal conchae
- Two palatine bones
- Two zygomatic bones
- Two lacrimal bones
- Mandible
- Vomer

The main function of these bones is to give shape to the human face and to protect the internal structures. In addition, these bones provide openings for the passage of neurovascular structures and bony features for the attachment of facial muscles.

Muscles of face

Levator labii superioris muscle

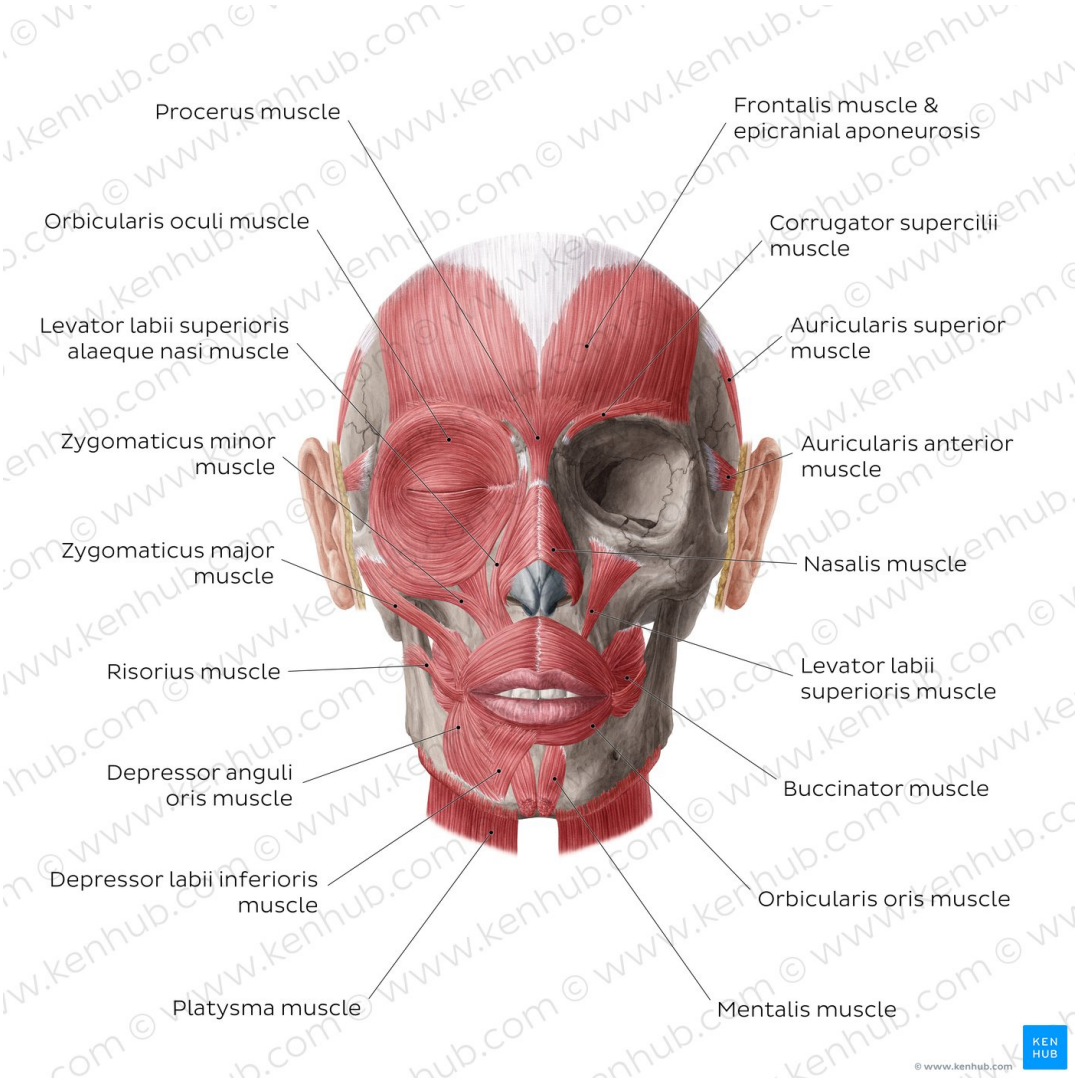
Musculus levator labii superioris

The facial muscles are also known as the muscles of the facial expression or the mimetic muscles. These muscles are a group of approximately 20 superficial skeletal muscles of the face and scalp divided into five different groups according to their location and function. These groups include:

- Buccolabial (oral) group: Levator labii superioris, levator labii superioris alaeque nasi, risorius, levator anguli oris, zygomaticus major, zygomaticus minor, depressor labii

inferioris, depressor anguli oris, mentalis, orbicularis oris and buccinator muscles.
- Nasal group: Nasalis and procerus muscles.
- Orbital group: Orbicularis oculi and corrugator supercilii muscles.
- Epicranial group: Occipitofrontalis and platysma muscles.
- Auricular group: Auricularis anterior, auricularis superior, auricularis posterior muscles.

All facial muscles originate from the bony and fibrous structures of the skull and insert into the skin. The prime function of the facial muscles is to provide a wide range of facial expressions which is important for expressing emotions and mood (e.g. smiling, grinning, frowning). In addition, these muscles help in opening and closing the mouth and eyes, and thus protect the delicate structures of the face.



Muscles of facial expression

The largest group consisting of 11 muscles is the buccolabial group. This group is in charge of the shape and movements of the mouth and lips. The next group is the nasal group which consists of 2 muscles (nasalis and procerus muscles). The orbital group consists of 3 muscles (orbicularis oculi, corrugator supercilii, depressor supercilii muscles) which are responsible for opening and closing the eyes and moving the eyebrows. The auricular group is a group of 3 fan-shaped muscles (auricularis anterior, auricularis posterior and auricularis superior

muscles) that move the ear lobe/auricle to a certain extent. The last group is the epicranial group (scalp and neck group) which includes 2 wide and flat muscles (occipitofrontalis and platysma muscles).