

# Introduction to Gross Anatomy; the Back

September 10, 2015

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Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture, you should be able to describe and/or define:

## Muscles

- trapezius
- latissimus dorsi
- rhomboid major and minor
- levator scapulae

intrinsic muscles



deep

extrinsic muscles



superficial    intermediate

## Bones

- scapula
  - o spine
  - o acromion
  - o superior and inferior angles
  - o superior, lateral and medial borders

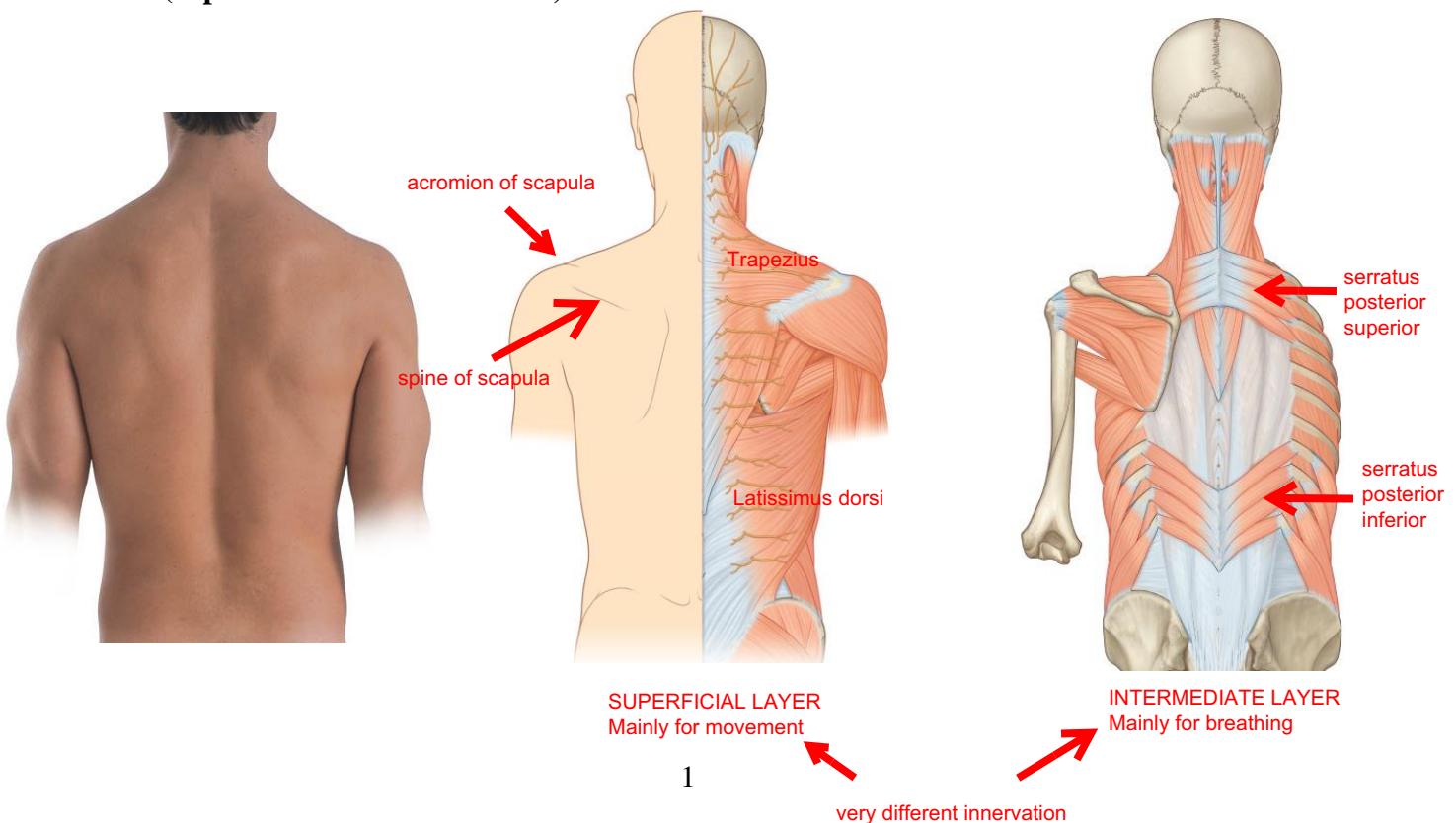
## Nerves

- Accessory nerve (cranial nerve XI (CN XI))

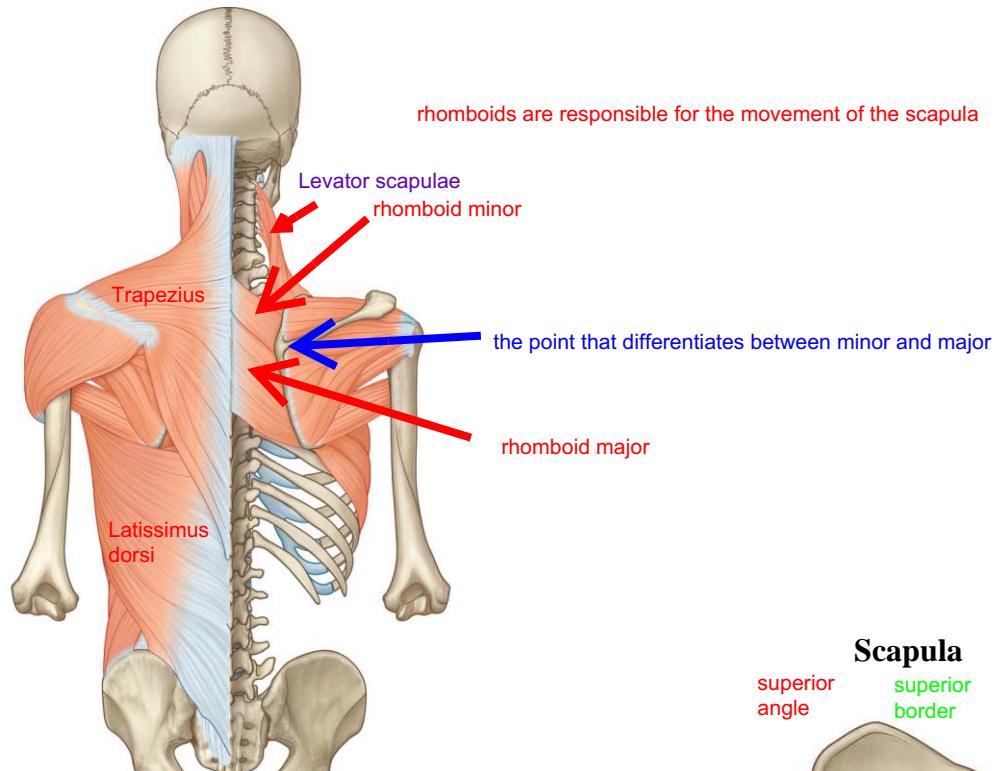
## Indicate the vertebral regions of the body

Extrinsic muscles are involved with movements of the upper limbs and thoracic wall. This is in contrast to deep muscles which support and move the vertebral column and participate in moving the head.

## Extrinsic (superficial and intermediate) muscles

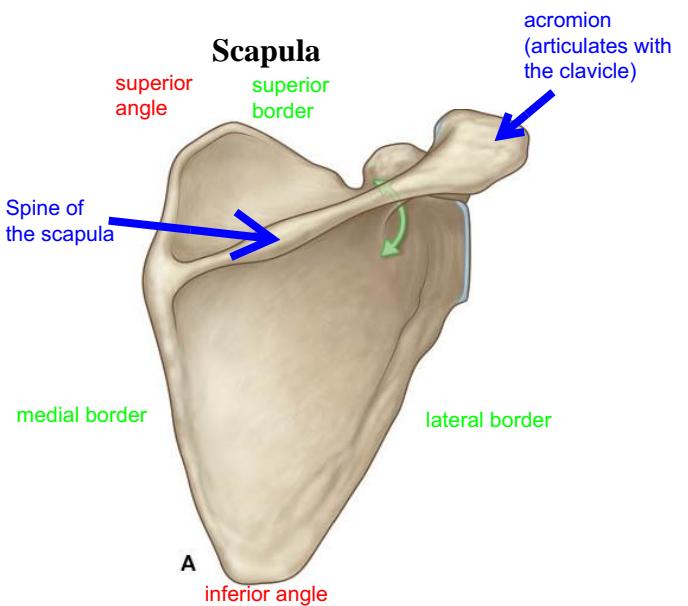
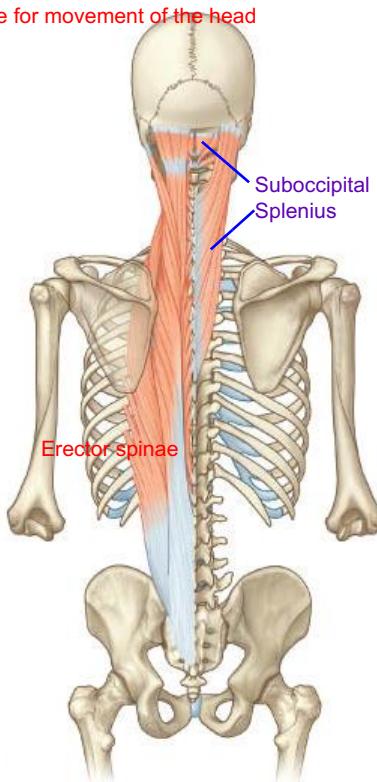


### Superficial layer in more detail



### Deep back muscles

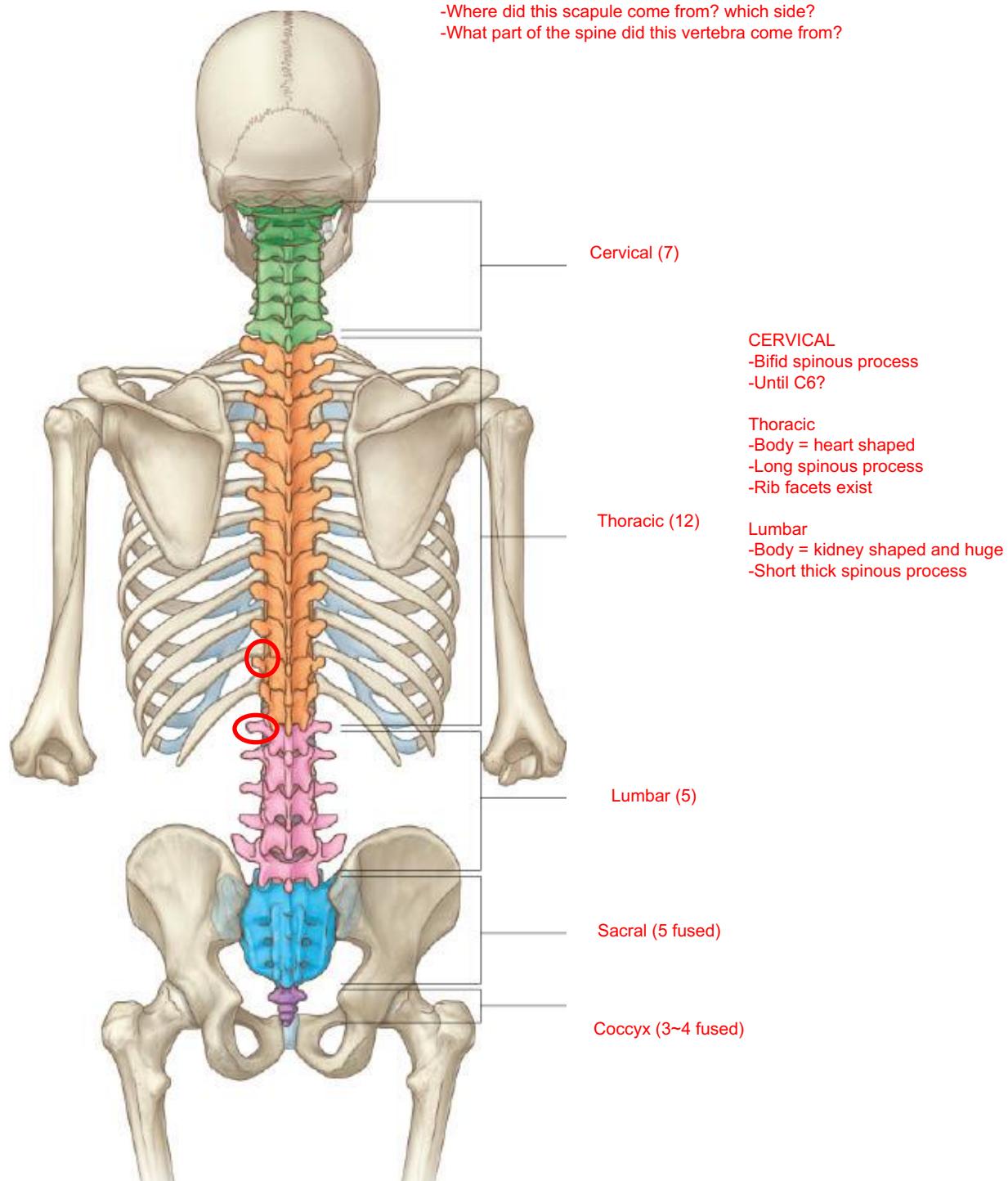
responsible for movement of the head



## Vertebral regions

Example lab exam questions:

- Where did this scapula come from? which side?
- What part of the spine did this vertebra come from?



Cervical (7)

CERVICAL

- Bifid spinous process
- Until C6?

Thoracic (12)

Thoracic

- Body = heart shaped
- Long spinous process
- Rib facets exist

Lumbar

- Body = kidney shaped and huge
- Short thick spinous process

Lumbar (5)

Sacral (5 fused)

Coccyx (3~4 fused)

# Introduction to the Nervous System and Spinal Nerves

September 17, 2015  
Dr. Paweł Kindler

STRUCTURALLY, the nervous system is organized into CNS and PNS  
FUNCTIONALLY, the nervous system is organized into somatic and visceral

Following the lecture, you should be able to describe, define and/or identify:

- Subdivisions of the nervous system and their general functions
- Embryonic origins of motor and sensory neurons
- Major components of a spinal nerve at a single level of the spinal cord
- A dermatome vs. myotome
- Numbering of spinal nerves in relation to vertebrae
- Spinal cord and meninges

**NERVOUS SYSTEM:** The SOMATIC part (skin and skeletal muscles, concerned with external environment) +  
The VISCELAR part (organ systems, smooth muscles and glands, concerned with internal

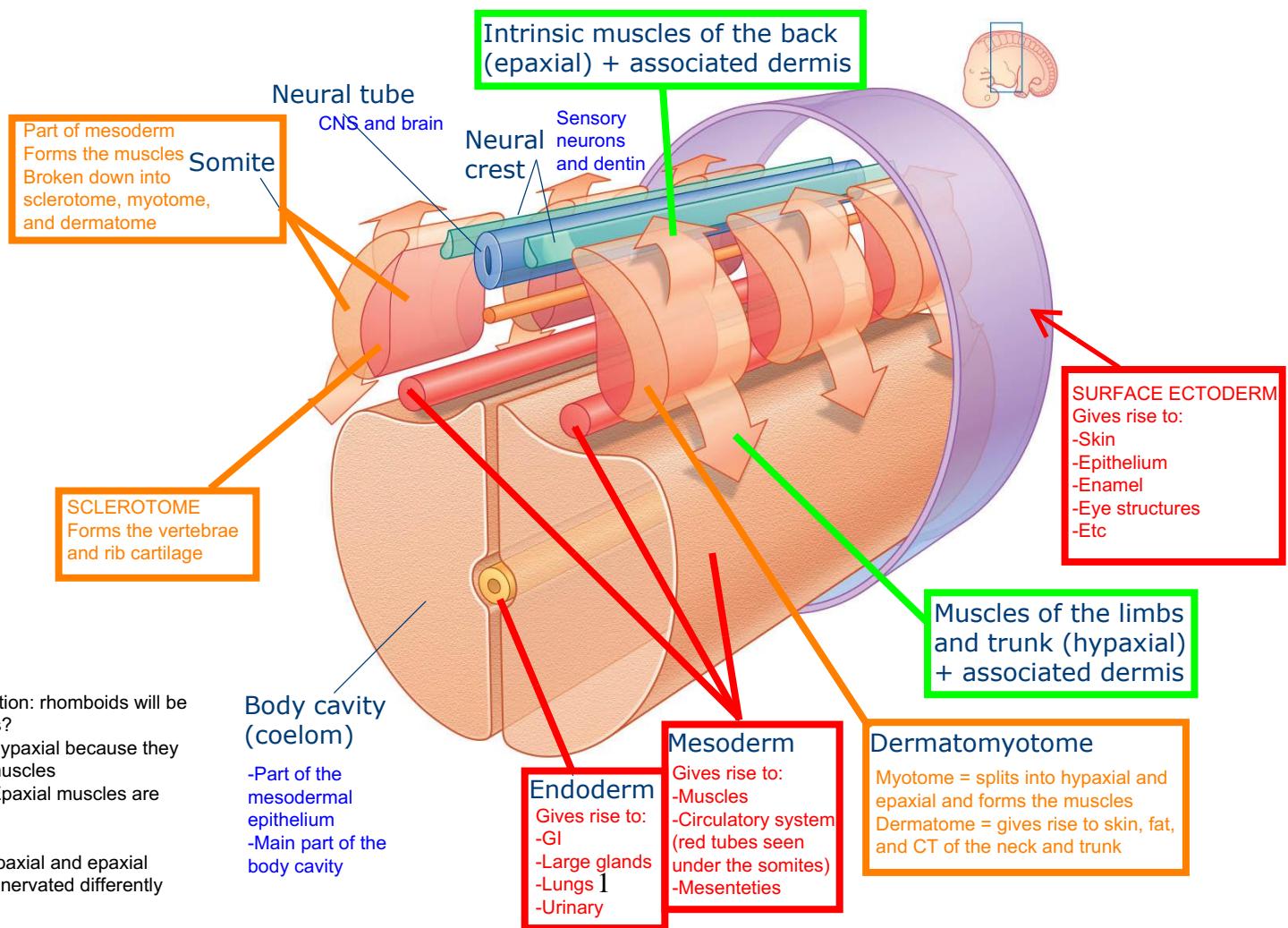
**Somatic Nervous System:** Somatic sensory nerves touch, temperature, proprioception

- Carry conscious sensations from the periphery to the CNS +

Somatic motor nerves

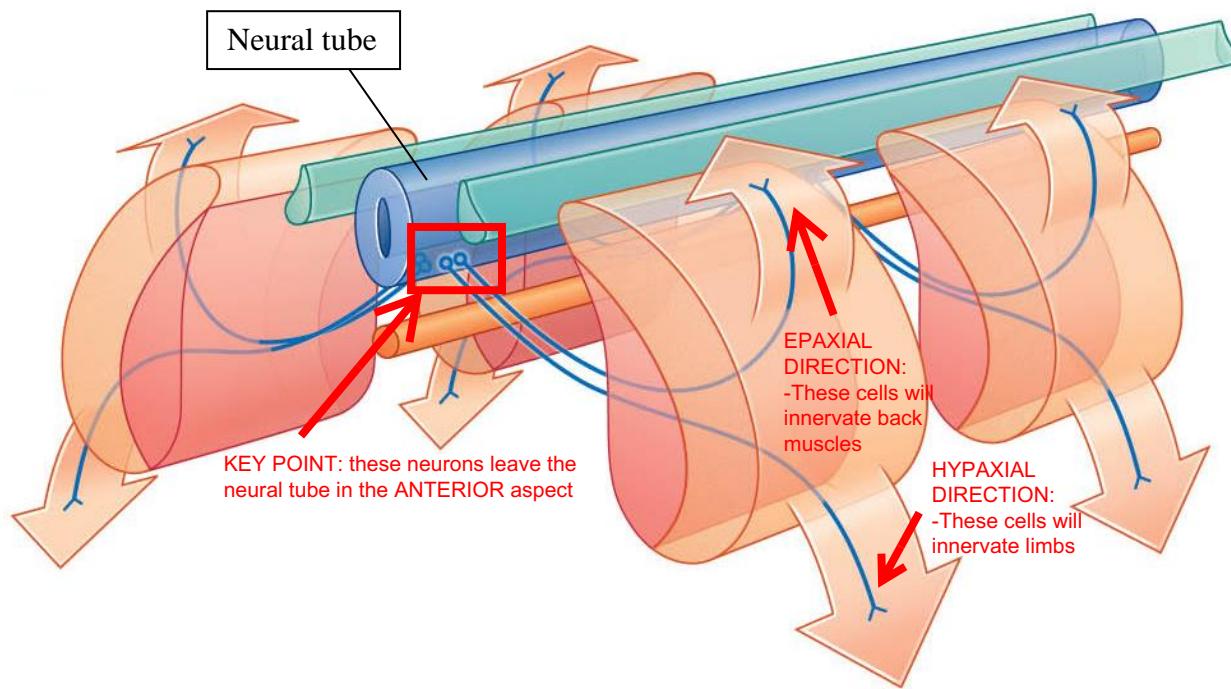
- Innervate voluntary muscles

## Embryonic differentiation of somites



this is how muscles become innervated during development

## Embryonic development of somatic motor neurons

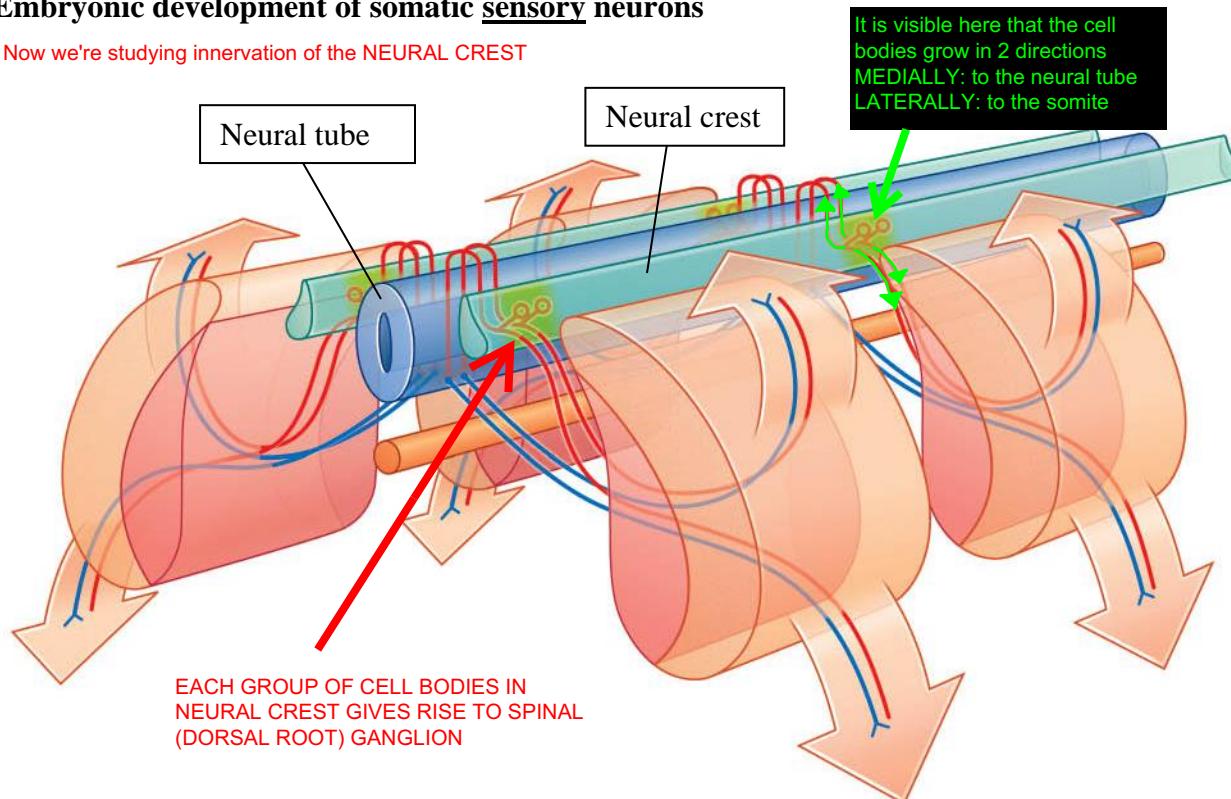


Motor neurons grew laterally and started in the neural tube

Sensory neurons grow laterally AND MEDIALLY and start in the neural crest

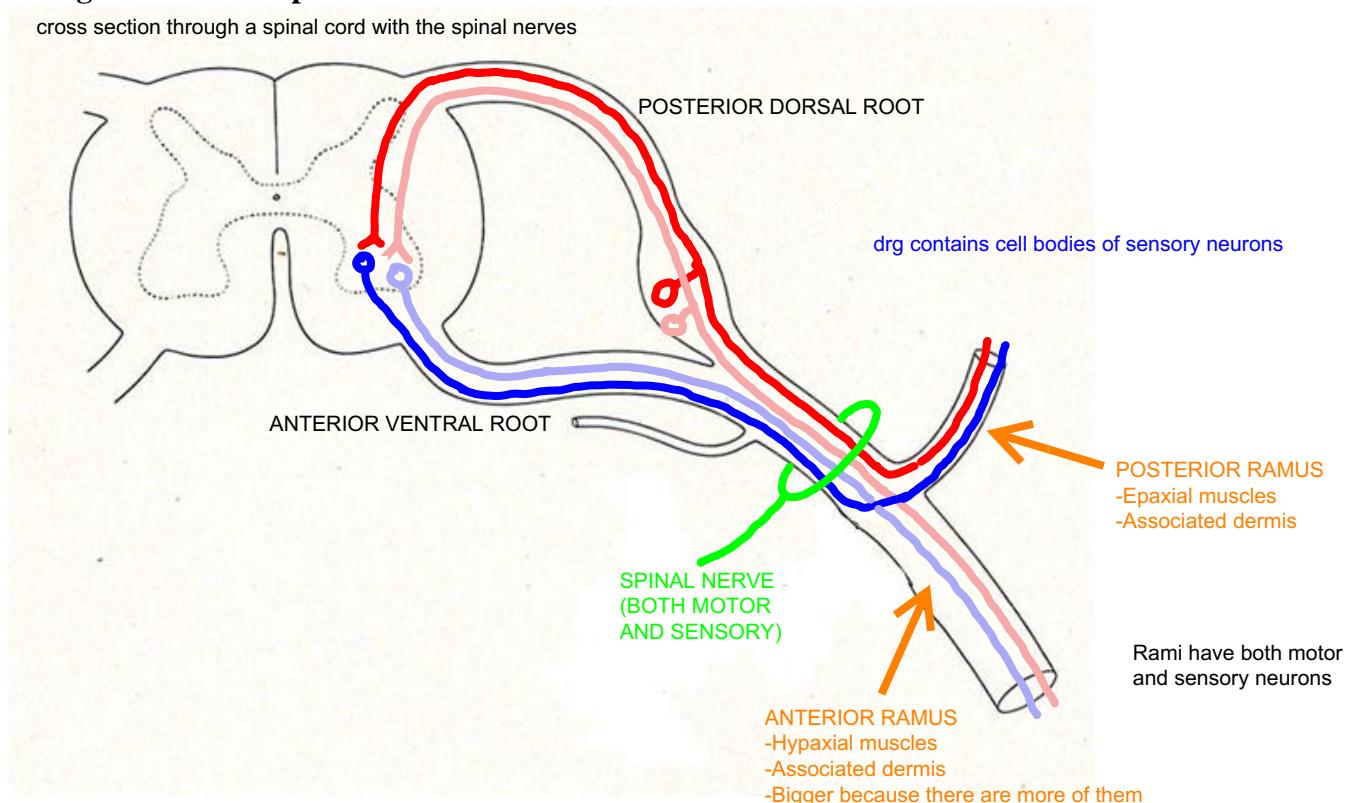
## Embryonic development of somatic sensory neurons

Now we're studying innervation of the NEURAL CREST



## A single level of the spinal cord

cross section through a spinal cord with the spinal nerves



## Terminology can be confusing...

Somatic sensory neurons (temperature, pain, touch and proprioception from periphery → CNS)

Or...

Somatic sensory afferents

Or...

General somatic afferents (GSAs)

---

Somatic motor fibers (CNS → skeletal muscles)

Or...

Somatic motor efferents

Or...

General somatic efferents (GSEs)

## Dermatome vs. myotome

ss = somatic sensory

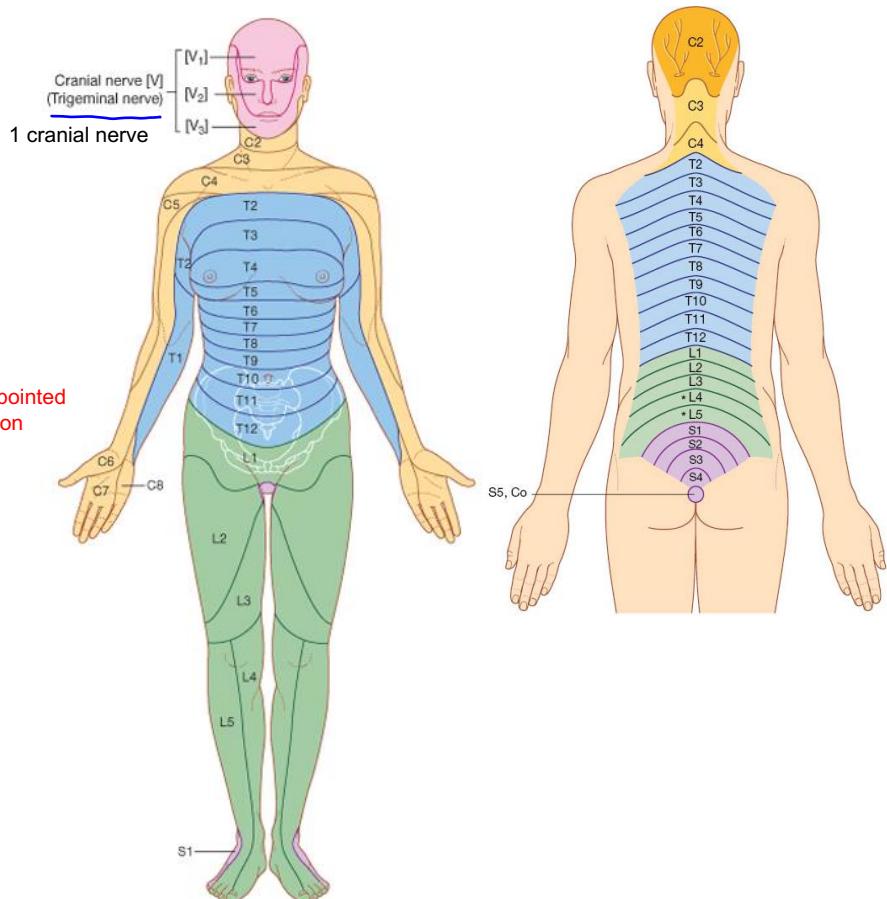
Each spinal nerve carries SS information from a specific area of skin or a **DERMATOME**

**(Dermatome:** an area of skin supplied by a single spinal cord level)

Important because problems in the spinal cord can be pinpointed to the exact level based on how patients perceive stimuli on various areas of the skin

**Myotome:** a portion of a skeletal muscle innervated by a single spinal cord level

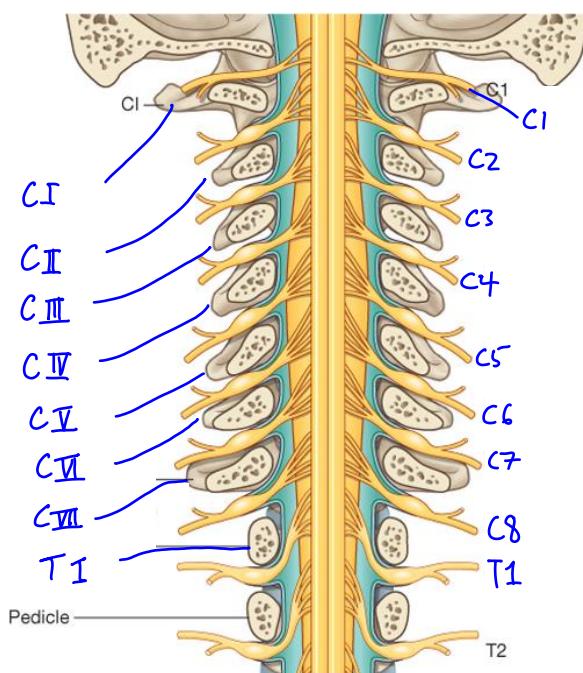
Less significant



VERTEBRA SIDE

SPINAL NERVE SIDE

## Numbering of spinal nerves

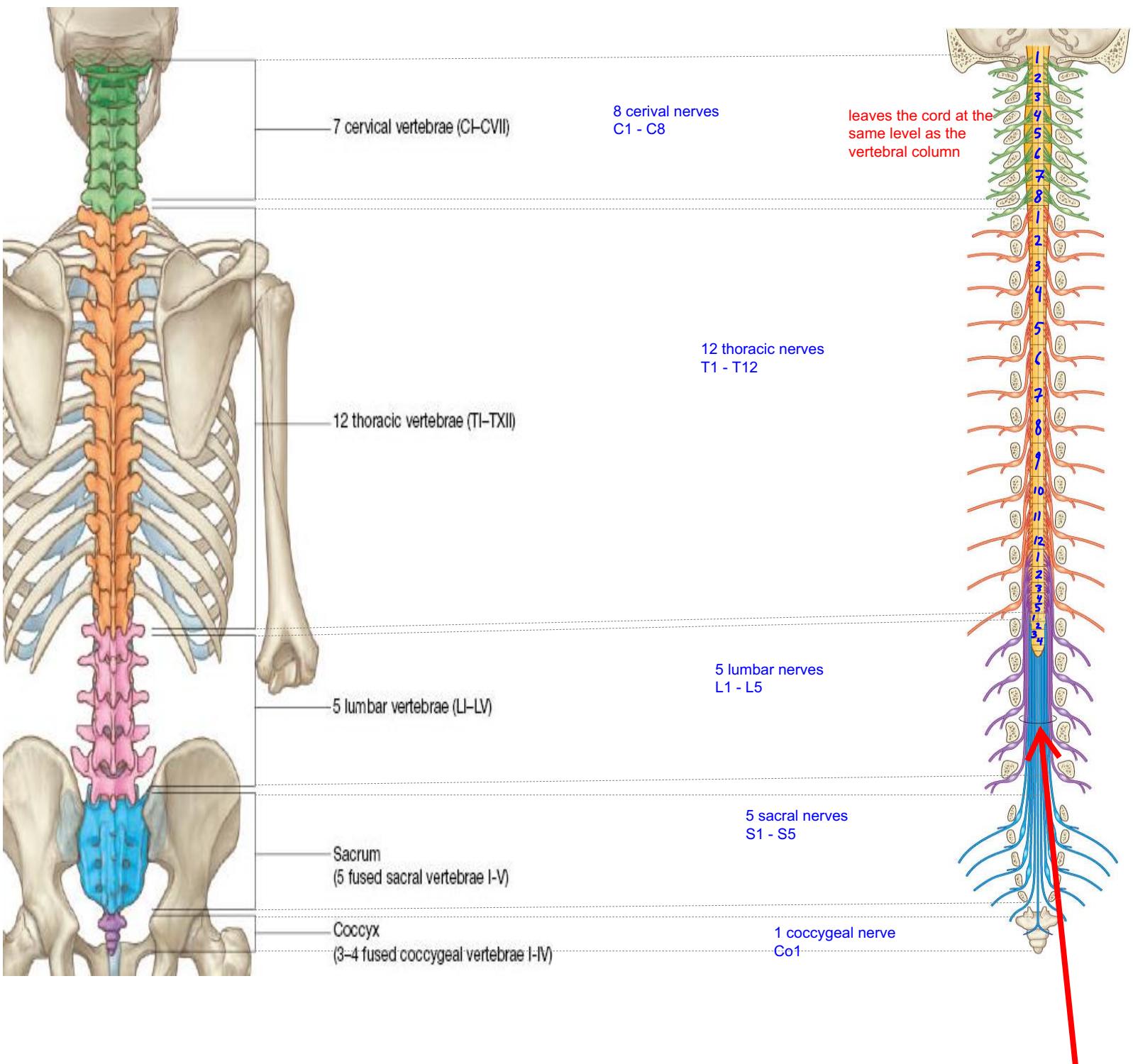


Cervical nerves are ABOVE its equivalent vertebra

However, cervical nerve goes up to C8, which shifts all the nerves down

So when we are in the thoracic region, the nerve is below its equivalent vertebra

## Relationship between vertebral regions, spinal nerves and spinal cord



The spinal cord is shorter than the vertebral column

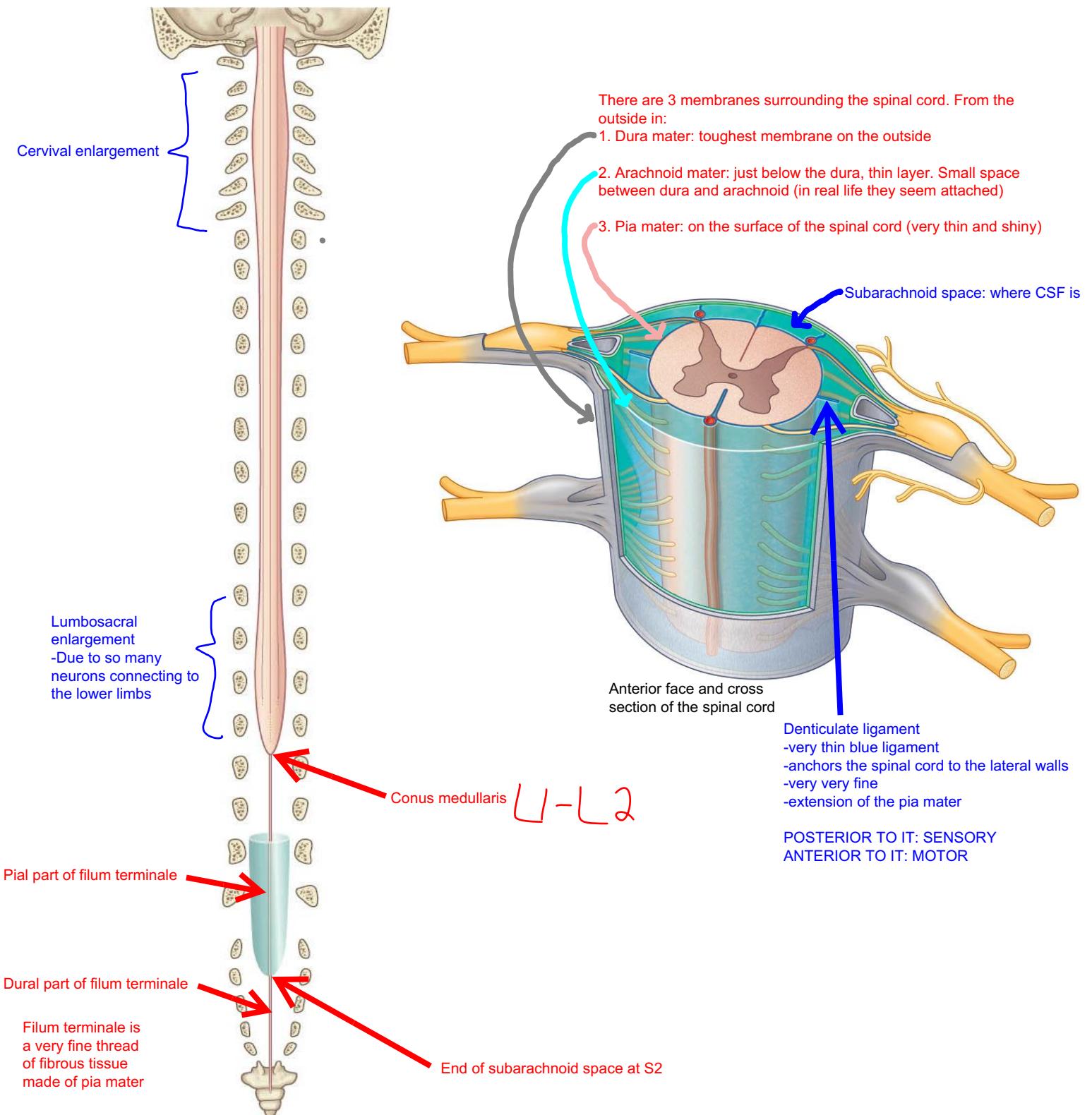
- Reason: spinal cord stops growing during embryonic development much sooner than the vertebral column
- Stops at L1 or L2 (some people are L3)
- All you will see inferior to this is a bundle of nerves called the cauda equina

cauda equina

When you are doing a lumbar puncture:

- you don't want the needle to enter into the spinal cord space
- Make sure it is below L4 to assure you are not in the cord

## Spinal cord and meninges



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# DMD Anatomy: The Visceral Nervous System

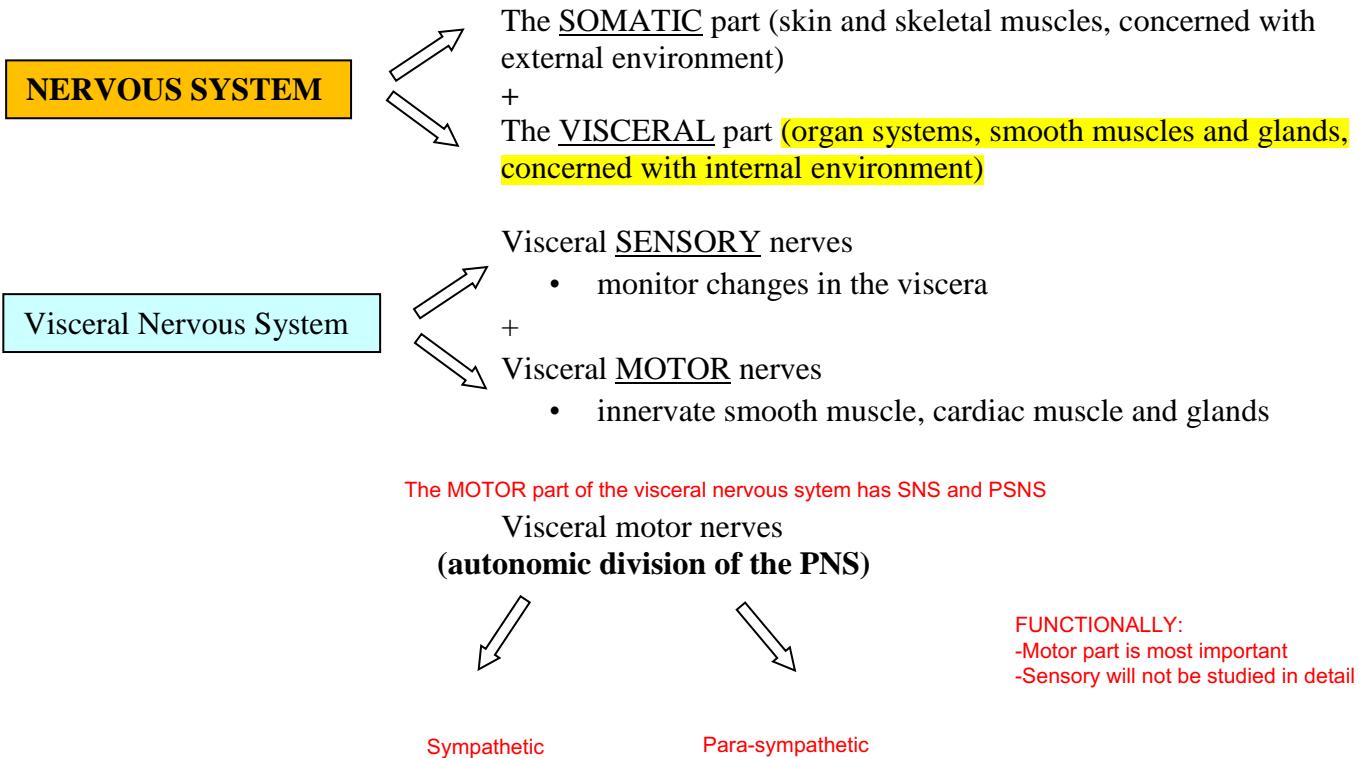
October 1, 2015

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Following the lecture, you should be able to describe and/or define:

- Subdivisions of the visceral NS
- The term “autonomic nervous system”
- The terms “sympathetic” and “parasympathetic” and indicate with which regions of the CNS these elements are associated
- Preganglionic vs. postganglionic neurons
- The basic arrangement of visceral motor and visceral sensory pathways as they relate to a typical spinal nerve and to the spinal cord
- The anatomical and functional features that characterize the visceral motor component of the nervous system
- Sympathetic trunk, its relationship with the spinal cord and its role in distributing autonomies to the periphery
- Splanchnic nerves and their role in distributing autonomies to viscera
- The concepts of paravertebral and prevertebral autonomic plexuses
- Parasympathetic innervation



## Embryonic development of **sensory** and **motor** visceral neurons

**VISCERAL SENSORY:** Just like somatic, it originates in the neural crest. The neuron grows LATERALLY and MEDIALLY  
Innervates: Gut

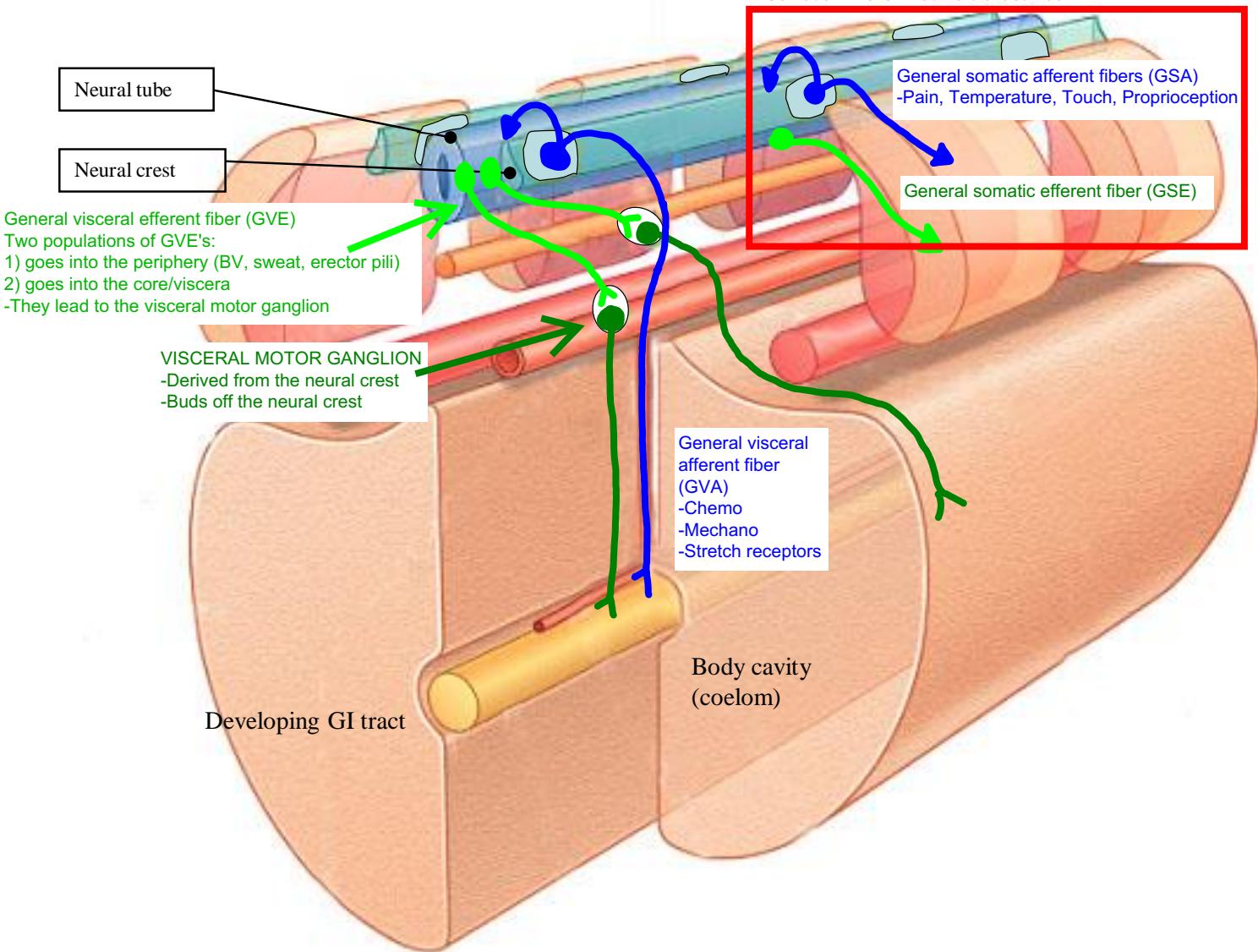
**VISCERAL MOTOR:** Just like somatic, it originates in the neural tube. However, it is a little more lateral on the tube  
Innervates: Blood vessels, sweat glands, erector pili muscles

One key difference:

- Somatic motor neurons requires only a 1 cell connection (i.e. from CNS to toe muscle is 1 neuron)
- Visceral motor neurons requires a TWO cell connection (1 PREGANGLIONIC and 1 POSTGANGLIONIC)

Ganglion = collection of cell bodies OUTSIDE the CNS  
Nucleus = collection of cell bodies INSIDE the CNS

Somatic. This is what we did last week



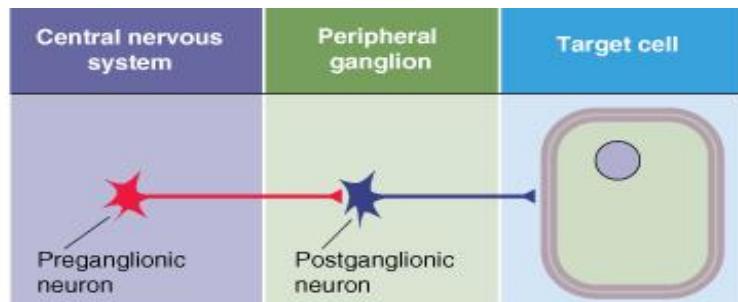
## Preganglionic vs. postganglionic neurons

### Preganglionic

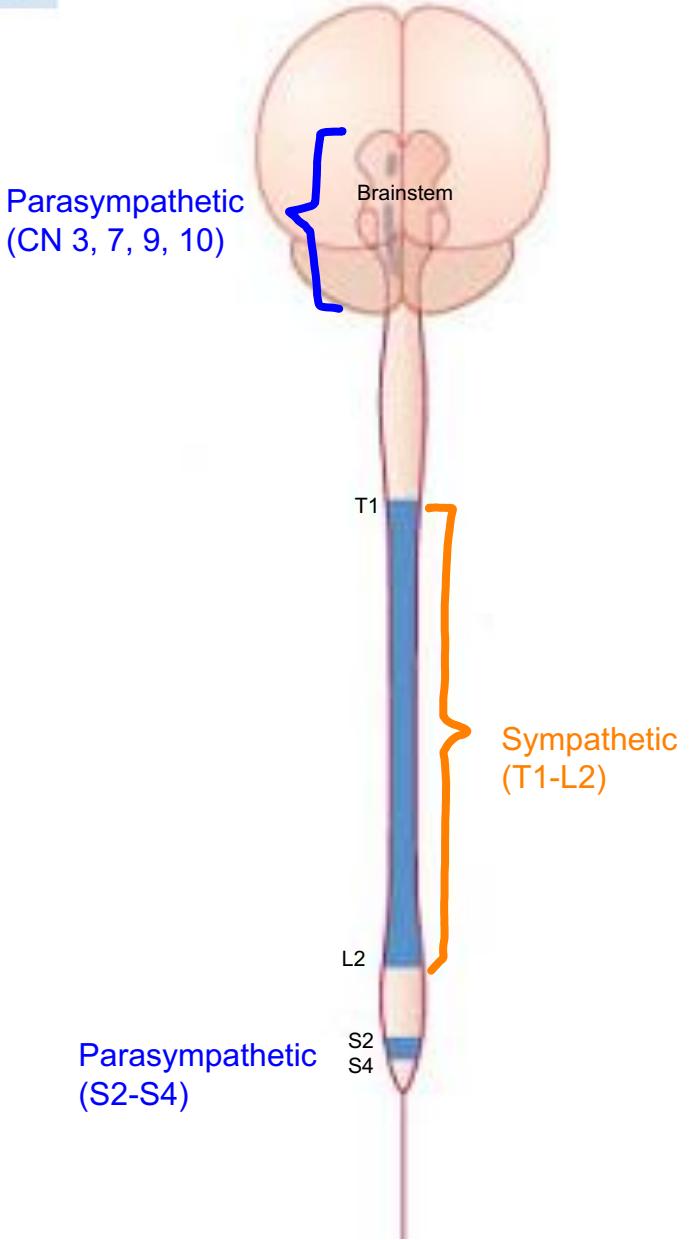
- Key feature: cell body is in the CNS
- From the NEURAL TUBE

### Postganglionic (the ones that start from the visceral motor ganglia)

- Key feature: cell body is in the peripheral ganglion
- From the NEURAL CREST



**Visceral motor and sensory fibers do not enter and leave the CNS at all levels**



## Sympathetic division TO THE PERIPHERY

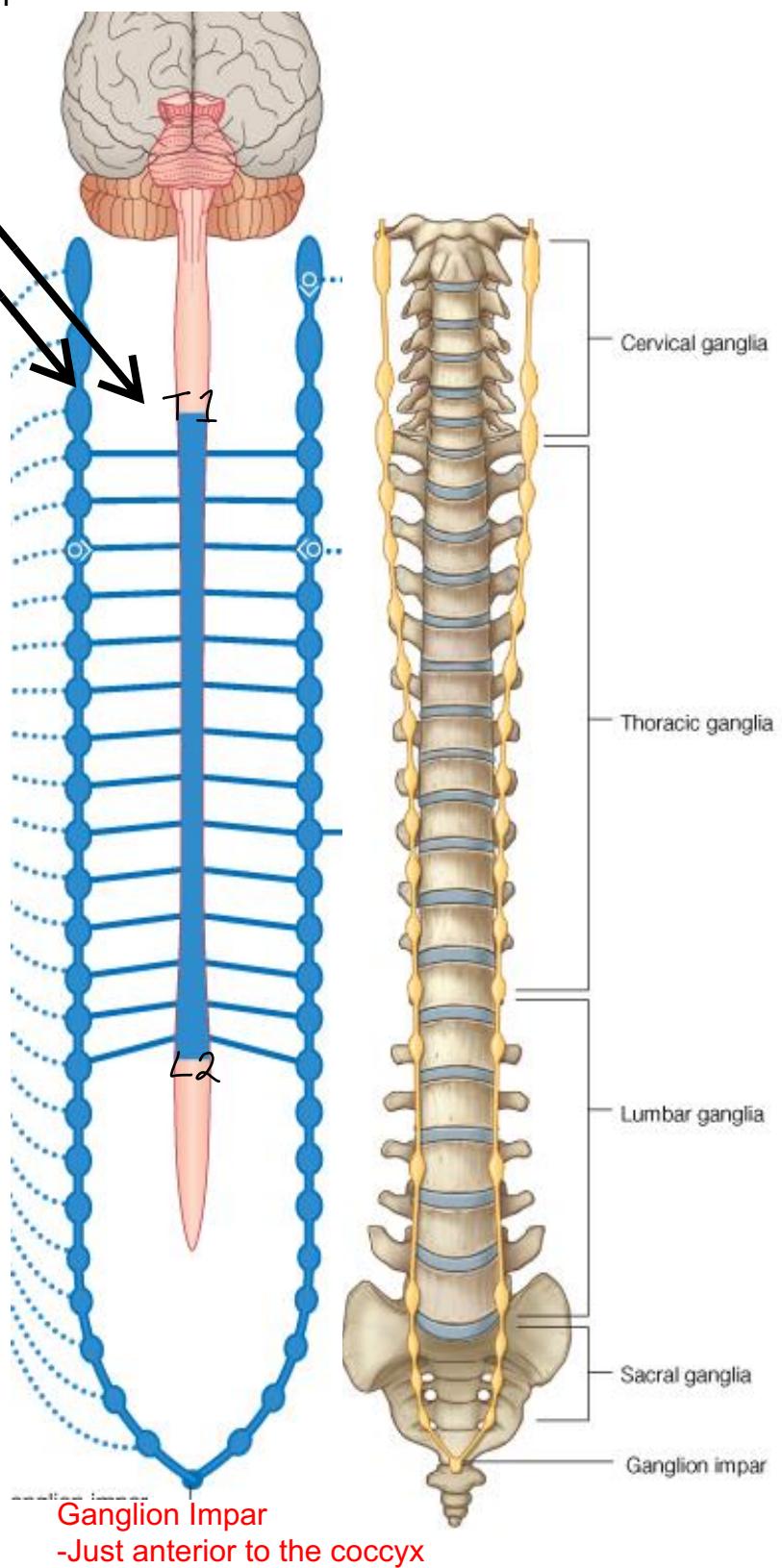
1. T1-L2 visceral motor fibers
2. Paravertebral sympathetic trunk:
  - Is located on each side of the vertebral column
  - From the base of the skull to the coccyx

**-AKA paravertebral plexus**

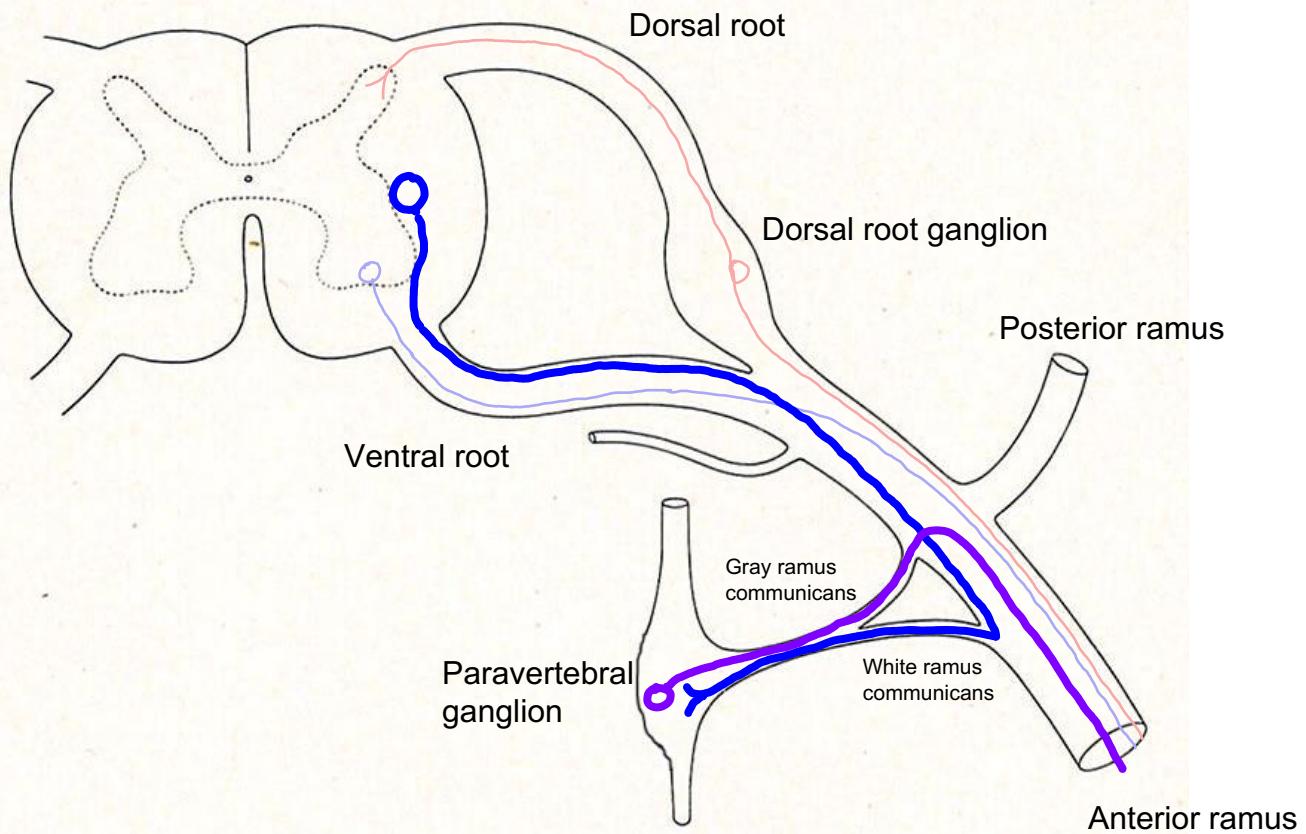
Each trunk:

  - Is a series of paravertebral ganglia
  - Allows for the distribution of sympathetic innervation to the periphery

**Not to the organs!**



## Single level of the spinal cord (T1 to L2)



Why white vs gray?

- Neurons covered with lipids which allows AP's to propagate much faster
- Pre = myelinated
- Post = unmyelinated

**White rami communicantes:** associated with [Anterior rami of spinal nerves T1-L2](#)

**Gray rami communicantes:** associated with [Anterior rami of all spinal nerves](#)

Myelinated preganglionic fiber → **white** ramus communicans → synapses within ganglion → nonmyelinated postganglionic fiber → **gray** ramus communicans → anterior (or posterior) ramus

Question: preganglionic sympathetic fibers connect the following:

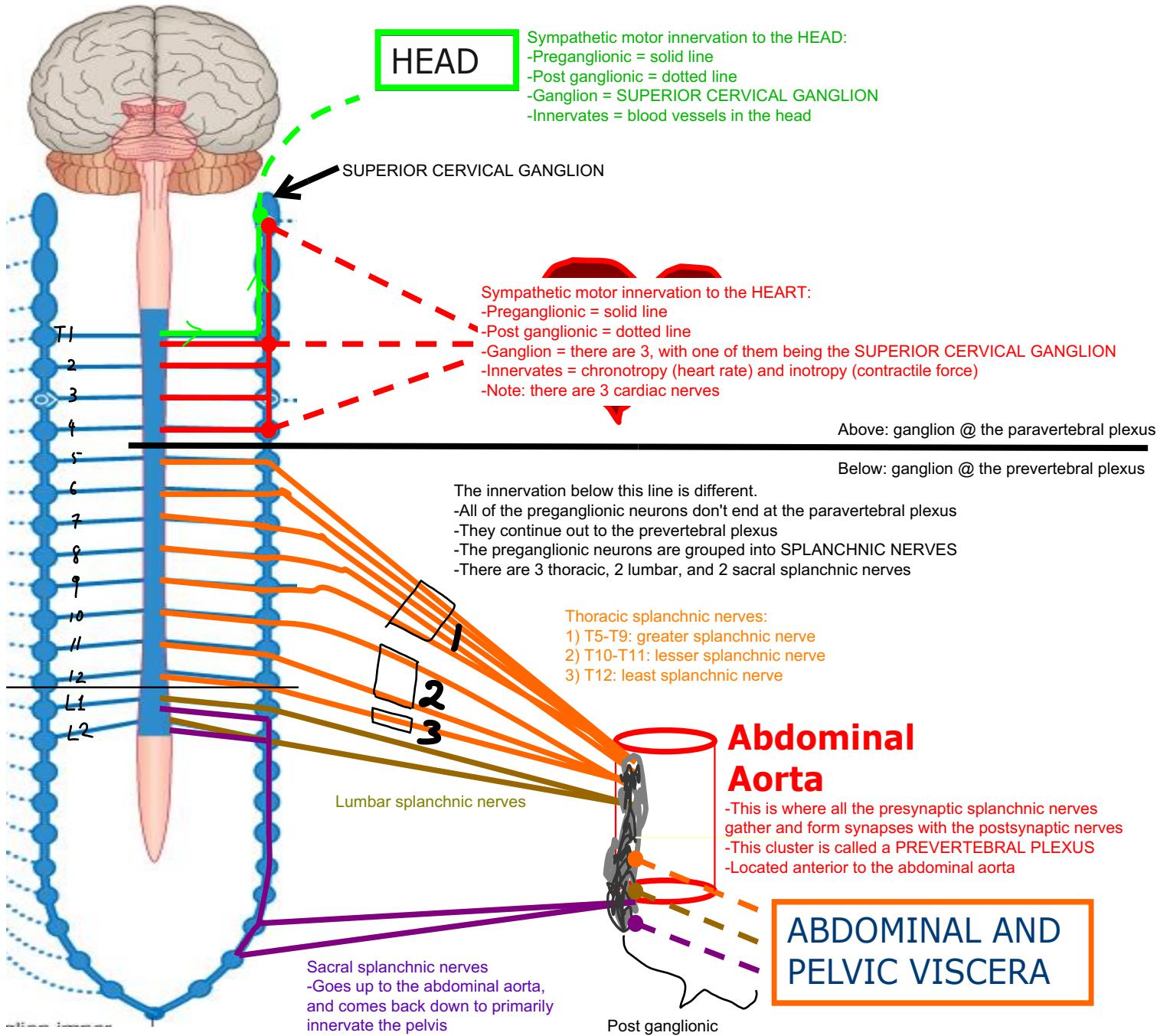
- A) spinal cord with target structures
- B) a paravertebral ganglion with target structures
- C) spinal cord with a paravertebral ganglion
- C

Sympathetic fibers innervating targets in the periphery are:

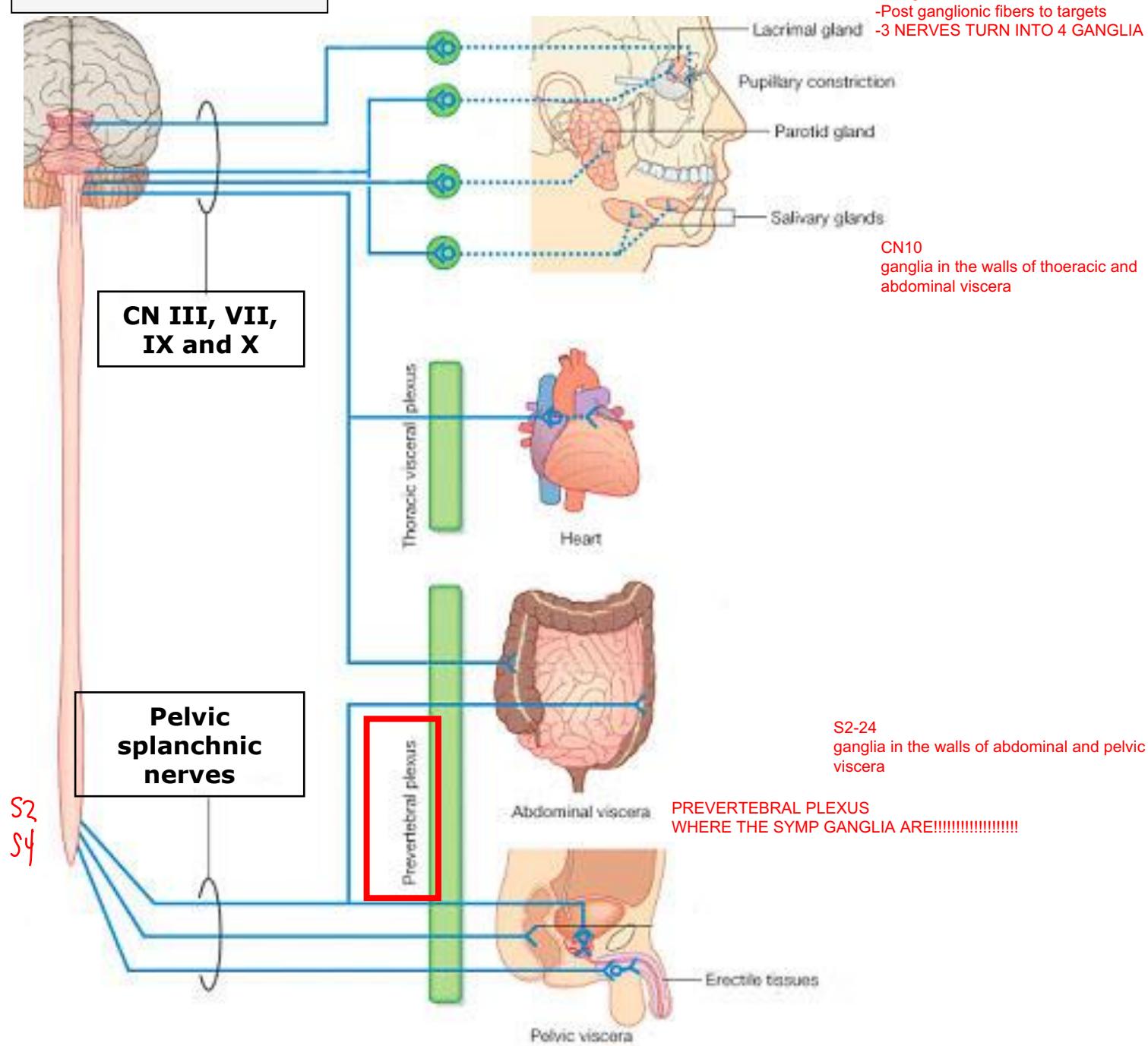
- A) preganglionic
- B) Postganglionic
- B

## Sympathetic innervation of organs and viscera

Sympathetic motor innervation to the viscera is MUCH different from sympathetic motor innervation to the periphery



## Parasympathetic division



Preganglionic parasympathetic fibers in CN III, VII and IX → one of four parasympathetic ganglia in the head → postganglionic fibers → target tissues in the head and neck

Preganglionic parasympathetic fibers in CN X → thoracic and most abdominal viscera → form synapses with postganglionic neurons in the walls of target organs

Preganglionic parasympathetic fibers in **pelvic splanchnic** nerves (NOT sacral splanchnic nerves!) → prevertebral plexus → along blood vessels to inferior abdominal and pelvic viscera → form synapses with postganglionic neurons in the walls of target organs

# DMD Anatomy

## Abdomen (1): Anterior Abdominal Wall and Inguinal Region. General Organization of the Peritoneum and Viscera

October 8, 2015

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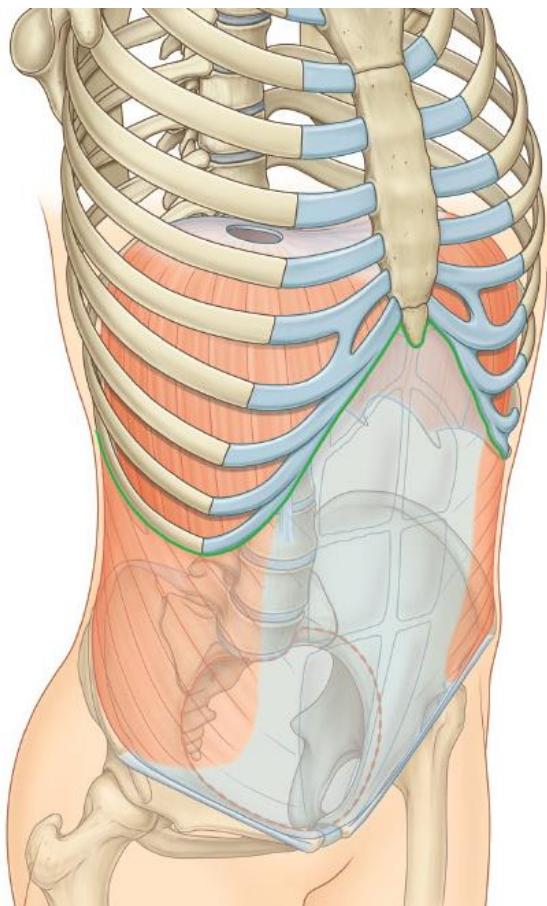
MD Undergraduate Program

LSC 1545

Following the lecture you should be able to identify, define and /or describe:

- Layers and muscles of the abdominal wall
- Structures associated with the inguinal region (groin)
- Types of inguinal hernias
- Peritoneum and peritoneal cavity
- Omenta, mesenteries and ligaments
- Intraperitoneal vs. retroperitoneal organs
- Major abdominal viscera

### Abdomen



Location of the abdomen:

- SUPERIOR to the pelvic inlet
- INFERIOR to the diaphragm

Functions:

- Breathing, coughing, vomiting
- Increases intra-abdominal pressure for micturition, defecation, and parturition

Layers:  
 -PET  
 -SCARPA  
 -CAMPERS

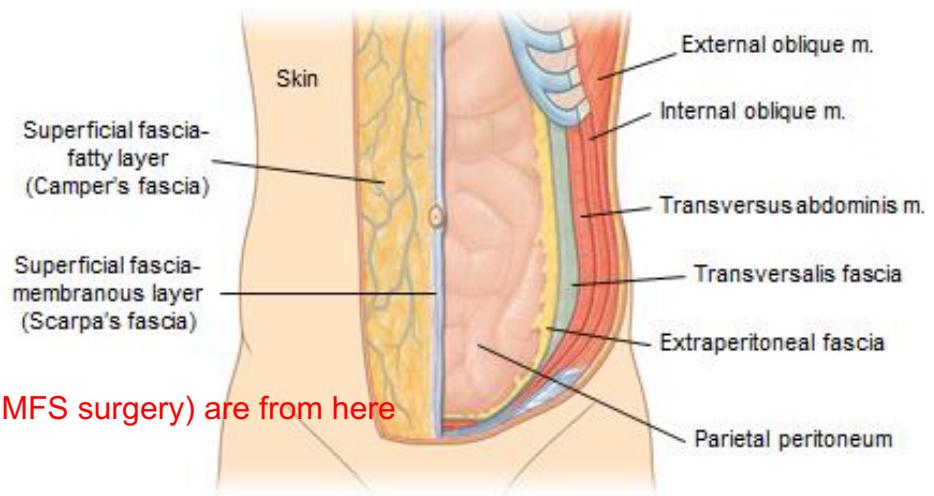
## Abdominal wall: layers

Broken down into 2 further layers

1. Fatty layer = CAMPER's fascia
2. Membranous layer = SCARPA's fascia

### Camper's fascia

- Body stores fat here
- Autologous abdominal fat grafts (used in OMFS surgery) are from here
- Don't have to worry about rejection
- Non carcinogenic and safe
- Acquired from minimally invasive procedures
- Limits heterotrophic calcification (development of bone in places where it should not grow. This is a problem in TMJ surgeries)



*Note: Autologous abdominal fat grafts are clinically significant in maxillofacial procedures for trauma, cosmetic and temporomandibular joint (TMJ) reconstruction.*

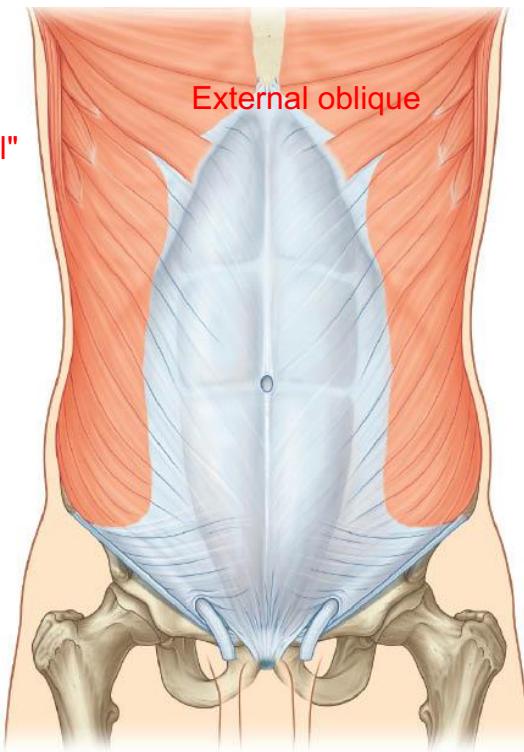
## Anterolateral muscles

### 3 flat muscles:

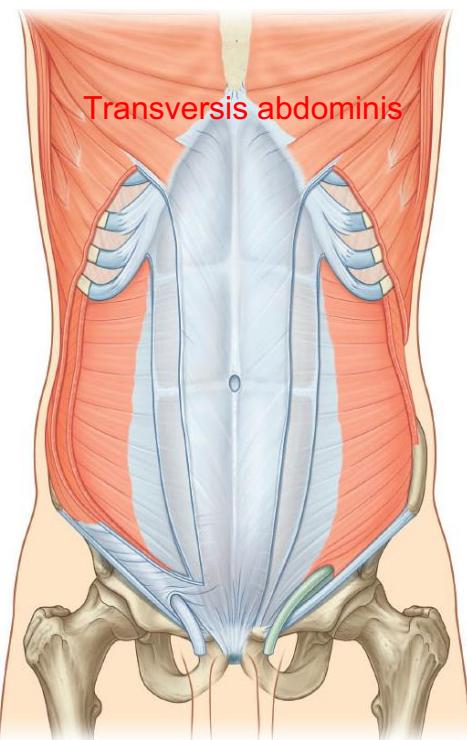
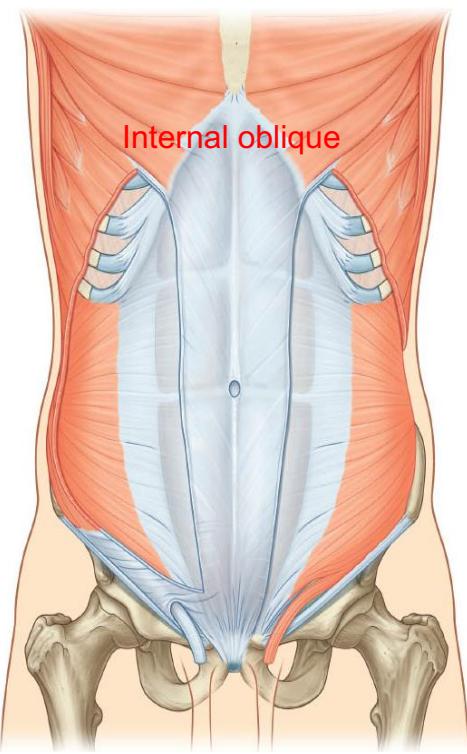
- External oblique "hands in pocket"
- Internal oblique "90 degrees to external"
- Transversus abdominis Parallel to floor

### 2 vertical muscles:

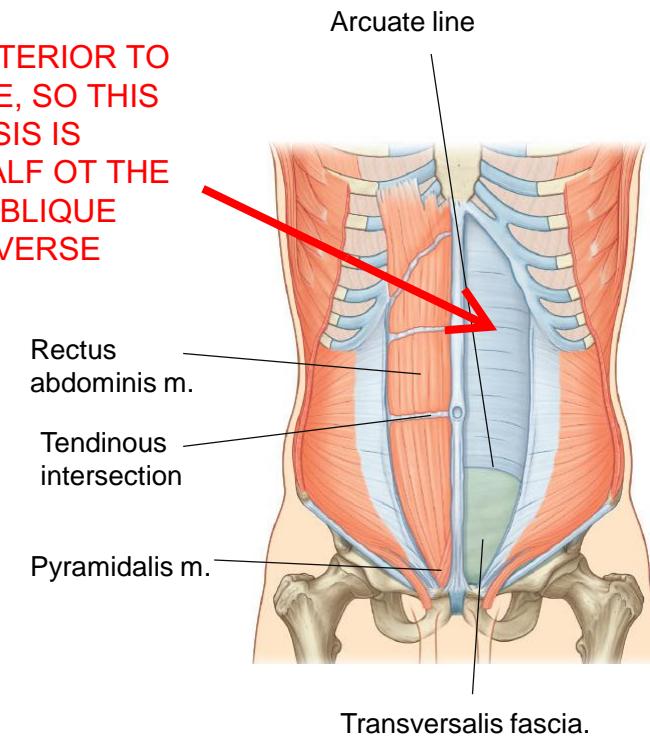
- Rectus abdominis
- Pyramidalis



## Anterolateral muscles – cont.

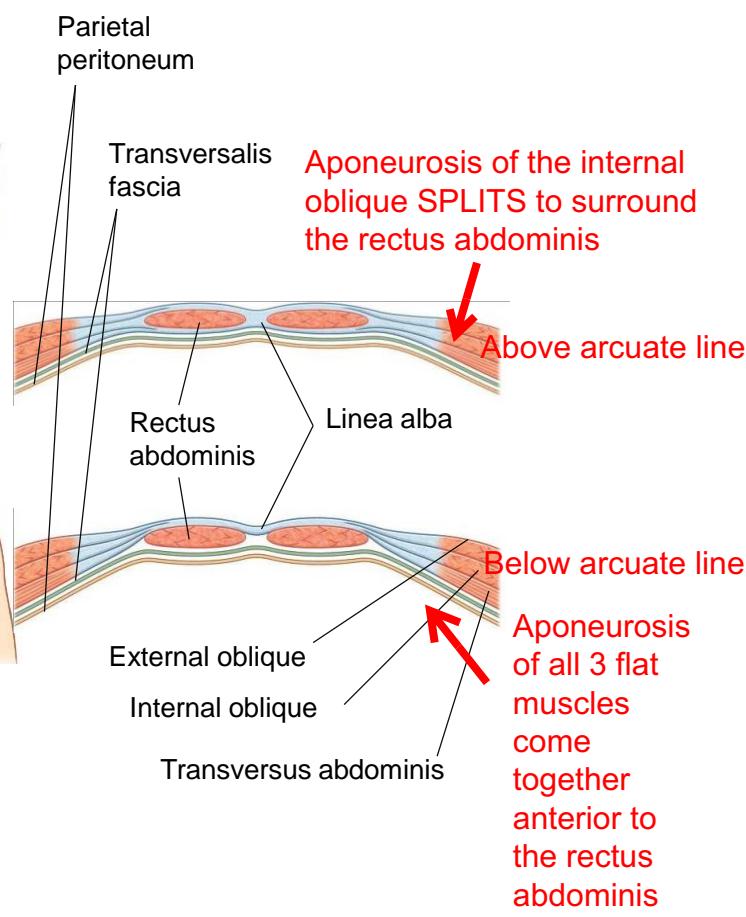


**Vertical muscles: rectus abdominis**



THIS IS POSTERIOR TO THE MUSCLE, SO THIS APONEUROSIS IS MADE OF HALF OF THE INTERNAL OBLIQUE AND TRANSVERSE ABDOMINUS

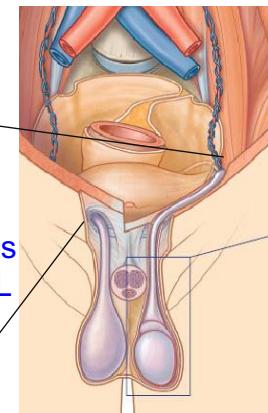
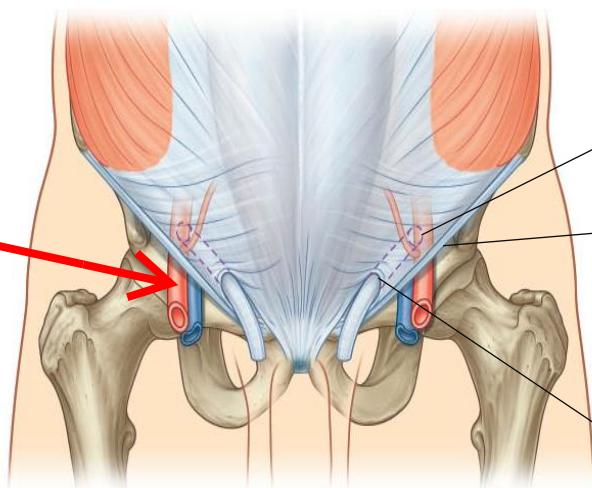
**Rectus sheath:**



Formed in the TRANSVERSALIS FASCIA (Remember PET layer under skin)  
 -Men: spermatic cord (vas def, testicular artery, veins, nerves, lymphatics)  
 -Women: round ligament of uterus (BV, nerves, lymphatics)

### Inguinal region (groin)

Note: the canal is lateral to epigastric vessels

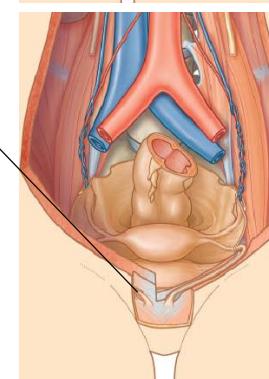


Deep inguinal ring  
 Between these 2 rings = INGUINAL CANAL  
 Superficial inguinal ring

Aponeurosis of the EXTERNAL OBLIQUE MUSCLE

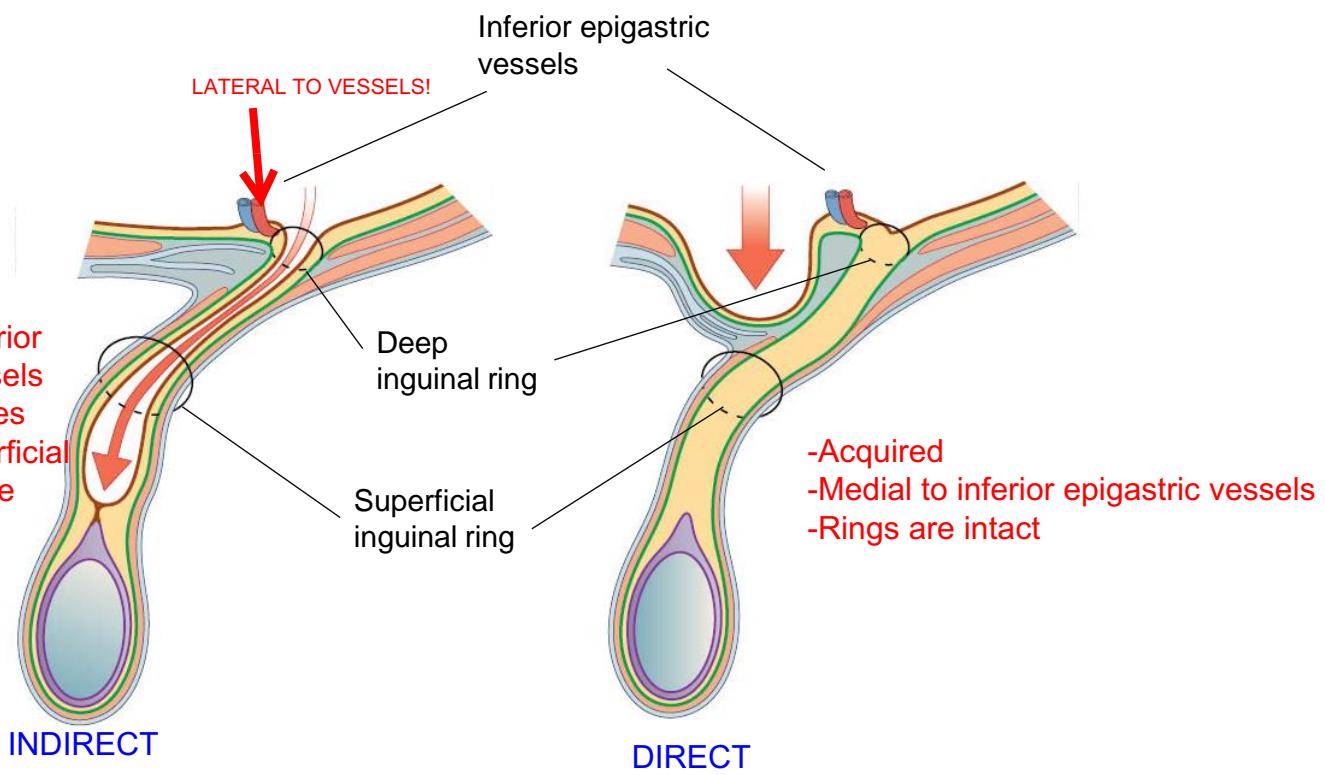
#### Inguinal ligament:

- Most inferior part of the abdominal muscle
- Border between abdomen and thigh
- Goes all the way down to the inguinal region and folds on itself



### Inguinal hernias: indirect vs. direct

Part of the small intestine ends up in the scrotum



- Congenital
- Lateral to inferior epigastric vessels
- Small intestines enter the superficial ring through the canal

- Acquired
- Medial to inferior epigastric vessels
- Rings are intact

Parietal peritoneum and visceral peritoneum  
-Continuous

Peritoneal cavity

lesser omentum

PARIETAL PERITONEUM

VISCELAR PERITONEUM

Liver

Lesser sac  
(Omental bursa)

Stomach

Pancreas

Duodenum

Transverse colon

Transverse mesocolon

Small intestine

Peritoneal cavity

-Further divided into:

- Greater sac (intestines and down to pelvis)
- Lesser sac (below liver, behind stomach, anterior to pancreas)
- Lesser sac is hypothetical (hard to find)

Greater omentum

-Apron like structure

-High in fat

-Covers abdominal viscera

Mesentery

-Associated with jejunum and ileum of small intestine

Greater sac

Bladder

Rectum

## Peritoneal cavity

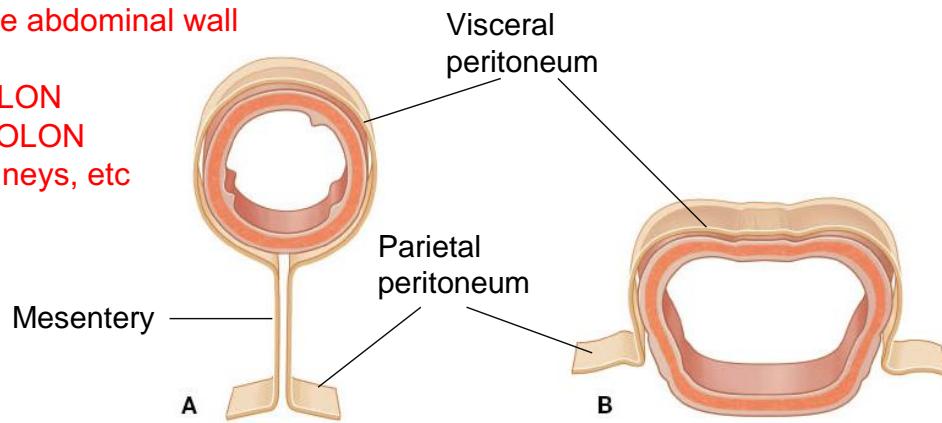
All organs in development are intraperitoneal. With folds and twists, some organs end up being **SECONDARY** retroperitoneal

## Abdominal viscera:

Can be suspended in the peritoneal cavity by mesenteries (folds of peritoneum); are referred to as **INTRAPERITONEAL**

Can be outside the peritoneal cavity, with only one surface or part of one surface covered by peritoneum; are referred to as **RETROPERITONEAL**

- Embedded into the abdominal wall
- DUODENUM
- ASCENDING COLON
- DESCENDING COLON
- and pancreas, kidneys, etc



## Omentum vs. mesentery vs. ligament

They are all folds of peritoneum, but differ slightly

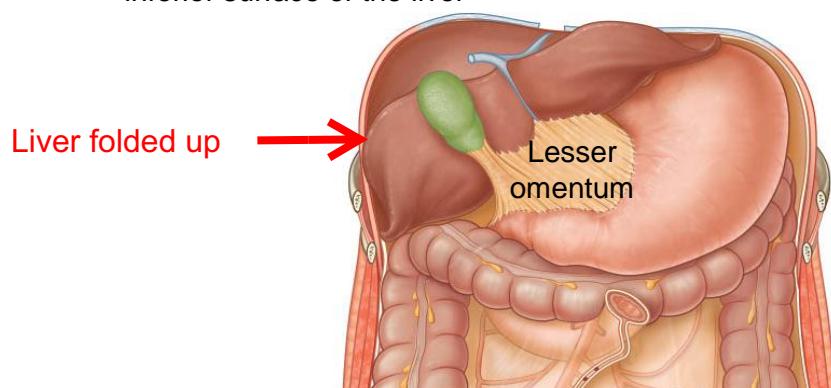
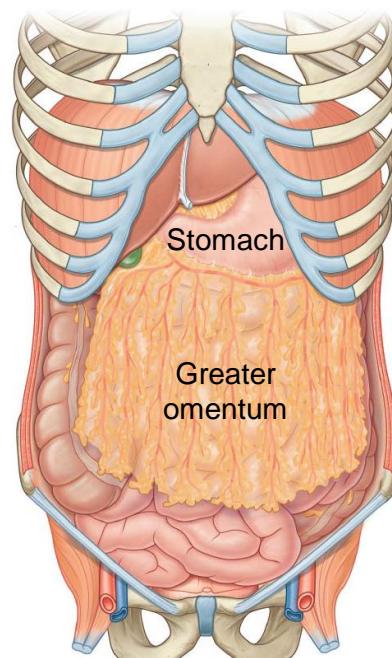
### Folds of peritoneum

Connect organs to each other or to the abdominal wall

**Omenta** (consist of two layers of peritoneum)

Greater omentum: apron-like, attaches to the greater curvature of the stomach and the first part of the duodenum

Lesser omentum: extends from the lesser curvature of the stomach and the first part of the duodenum to inferior surface of the liver



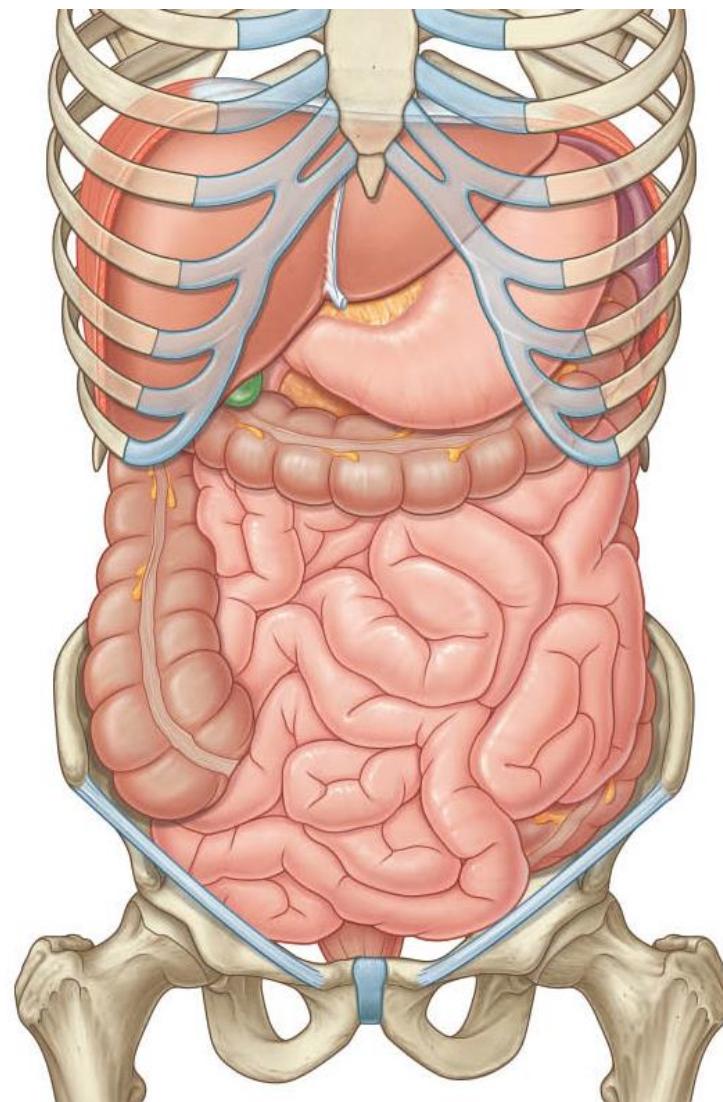
## Mesenteries

- Parietal folds that attach viscera to the posterior abdominal wall
- Peritoneal
- Include
  1. Mesentery (associated with jejunum and ileum of the small intestine)
  2. Transverse mesocolon (transverse colon)
  3. Sigmoid mesocolon (sigmoid colon)
  4. Mesoappendix (appendix)

## Peritoneal ligaments

- Consist of two layers of peritoneum that usually connect two organs to each other
- Important examples include hepatogastric and hepatoduodenal ligaments

## Major abdominal viscera



# Abdomen (2): Foregut, Midgut and Hindgut: Organs and Vessels

October 15, 2015

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MD Undergraduate Program

LSC 1545

Following the lecture you should be able to identify, define and /or describe:

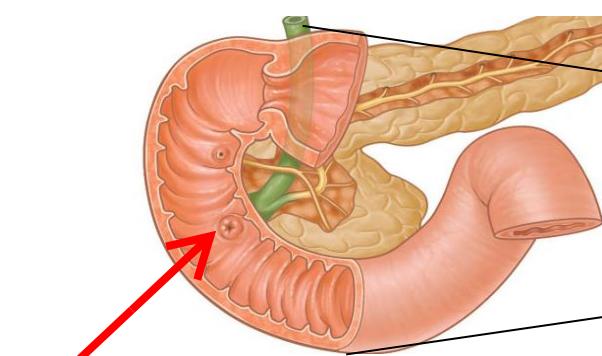
- Components of each of the divisions of the gastrointestinal tract
- Primary arterial supplies and their major branches
- Venous drainage of the gastrointestinal tract
- Autonomic innervation of the abdominal portion of the gastrointestinal tract

## Divisions of gastrointestinal tract

EACH "GUT" has its own arterial supply and innervation

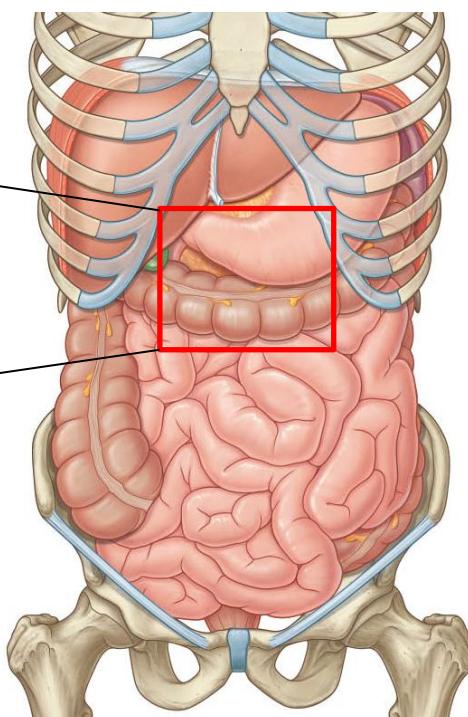
		Foregut	Midgut	Hindgut
Components		Abdominal esophagus, stomach, duodenum (superior to major papilla), liver, pancreas, gallbladder, spleen	Duodenum (inferior to major papilla), jejunum, ileum, cecum, appendix, ascending colon, proximal two-thirds of transverse colon	Distal one-third of transverse colon, descending colon, sigmoid colon, rectum, upper part of anal canal
Primary arterial supply		Celiac trunk	Superior mesenteric artery	Inferior mesenteric artery
Innervation	Sympathetic	Greater splanchnic nerve T5-T9	Greater and lesser splanchnic nerves T5-T11	Least and lumbar splanchnic nerves T11-L2
	Parasympathetic	Vagus CN10	Vagus CN10	Pelvic splanchnic nerves (S2,3,4)

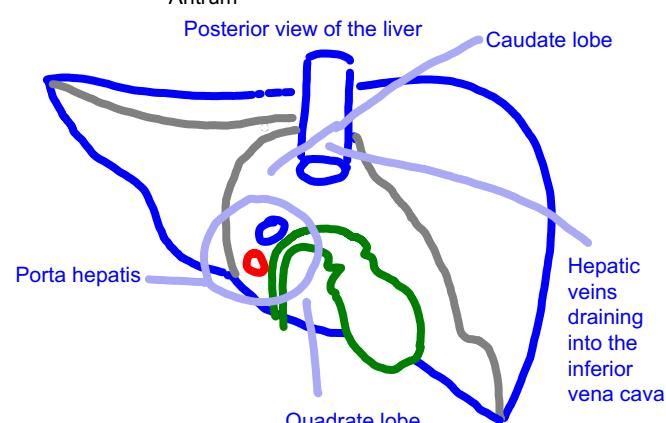
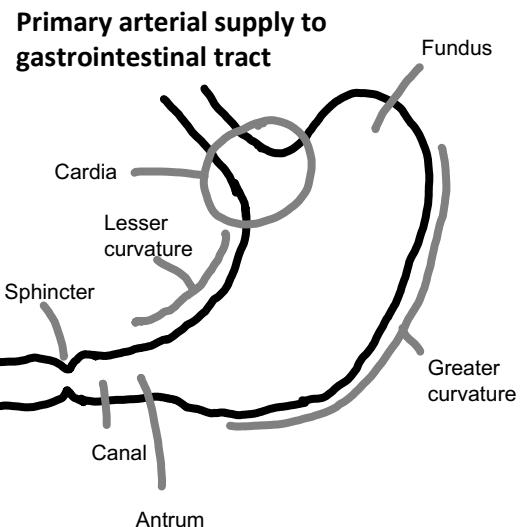
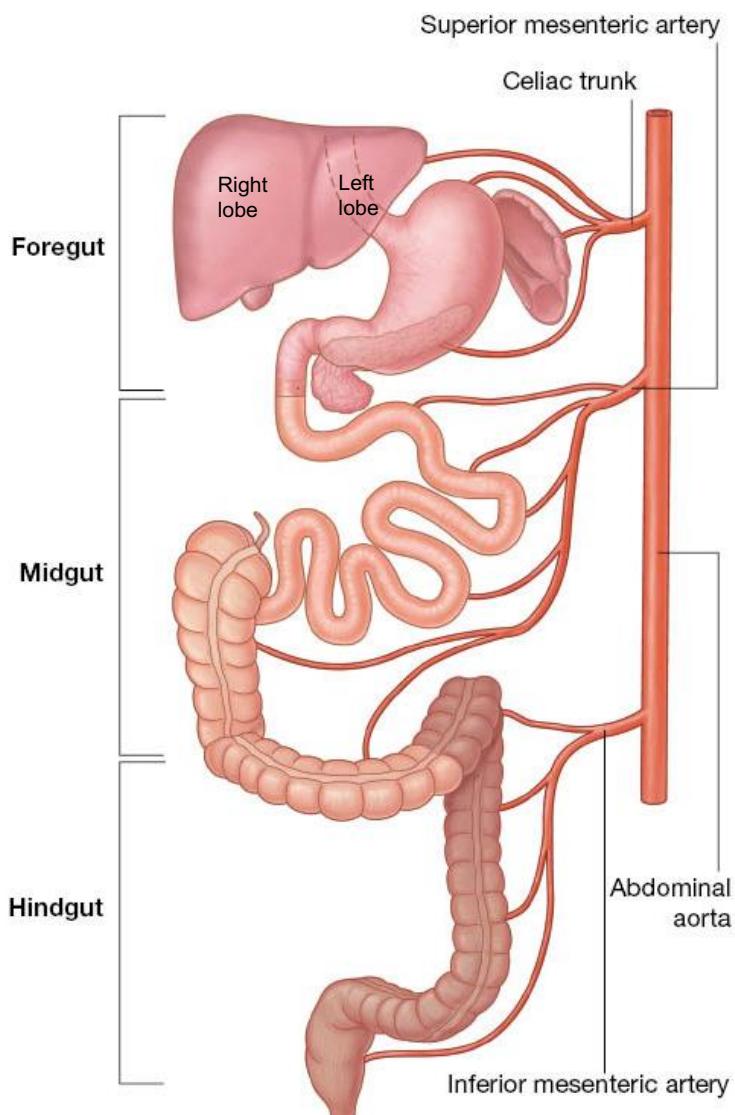
## Duodenum



Major duodenal papilla

-Secretions from gallbladder and pancreas come out  
-Transition from fore to midgut





### Distribution of the celiac trunk

Left and right hepatic arteries

Hepatic artery proper

Gastroduodenal artery

Right gastric artery

Left gastro-omental artery

Right gastro-omental artery

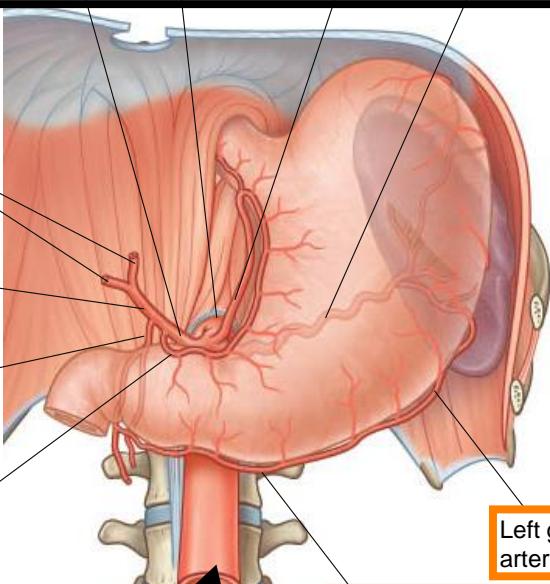
Celiac trunk is short.

It almost immediately branches into 3 arteries:

1) Left gastric artery  
-Supplies the lesser curvature of the stomach

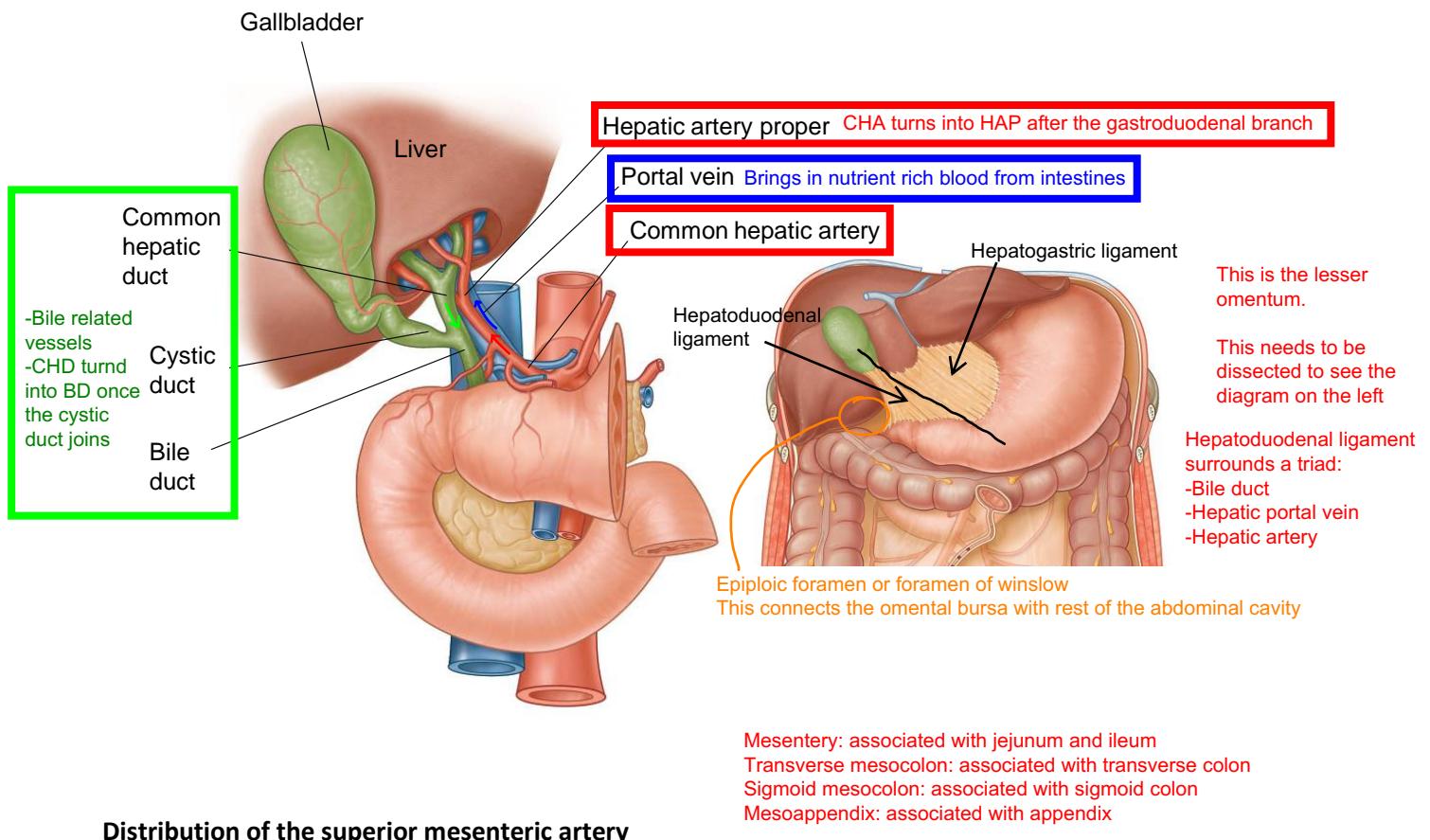
2) Splenic artery  
-Supplies the spleen  
-Has 1 branch: Right/left GASTRO-OMENTAL ARTERY

3) Common hepatic artery - has 2 branches  
A) Right gastric artery (anastomizes with left gastric artery)  
B) Gastroduodenal artery (anastomizes with right/left gastro-omental artery)  
-After these 2 branches, it is now called the HEPATIC ARTERY PROPER  
-The Hepatic artery proper divides to left/right hepatic arteries

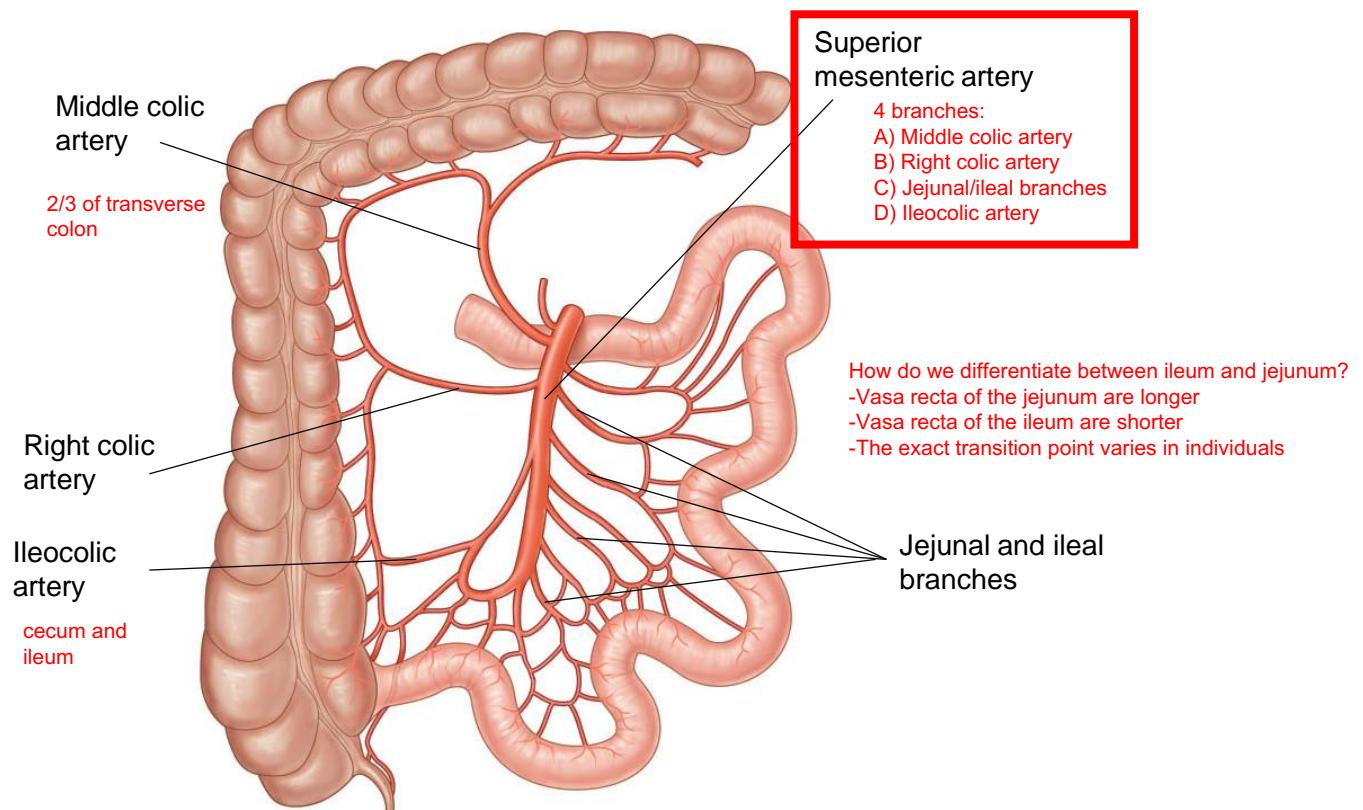


Abdominal aorta is retroperitoneal  
-When you open the abd cavity, it's not very visible  
-Embedded behind peritoneum

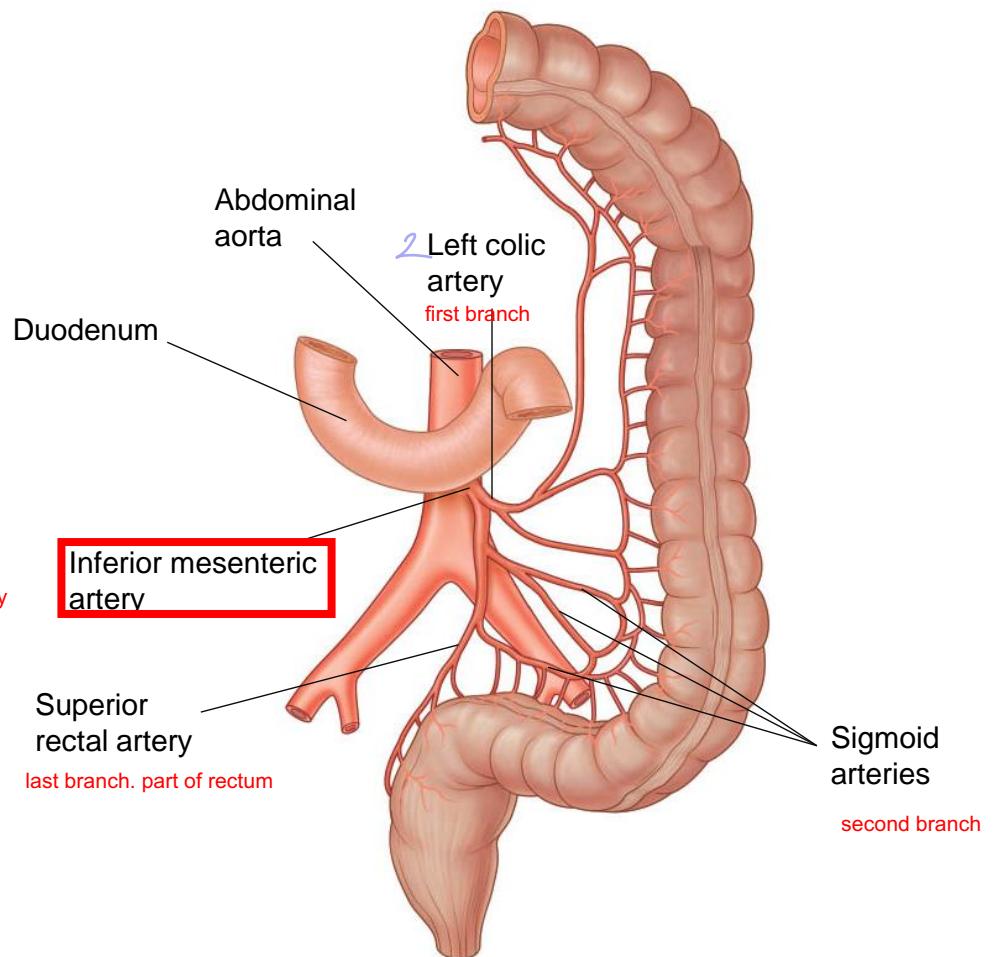
## The hepatoduodenal ligament and its content



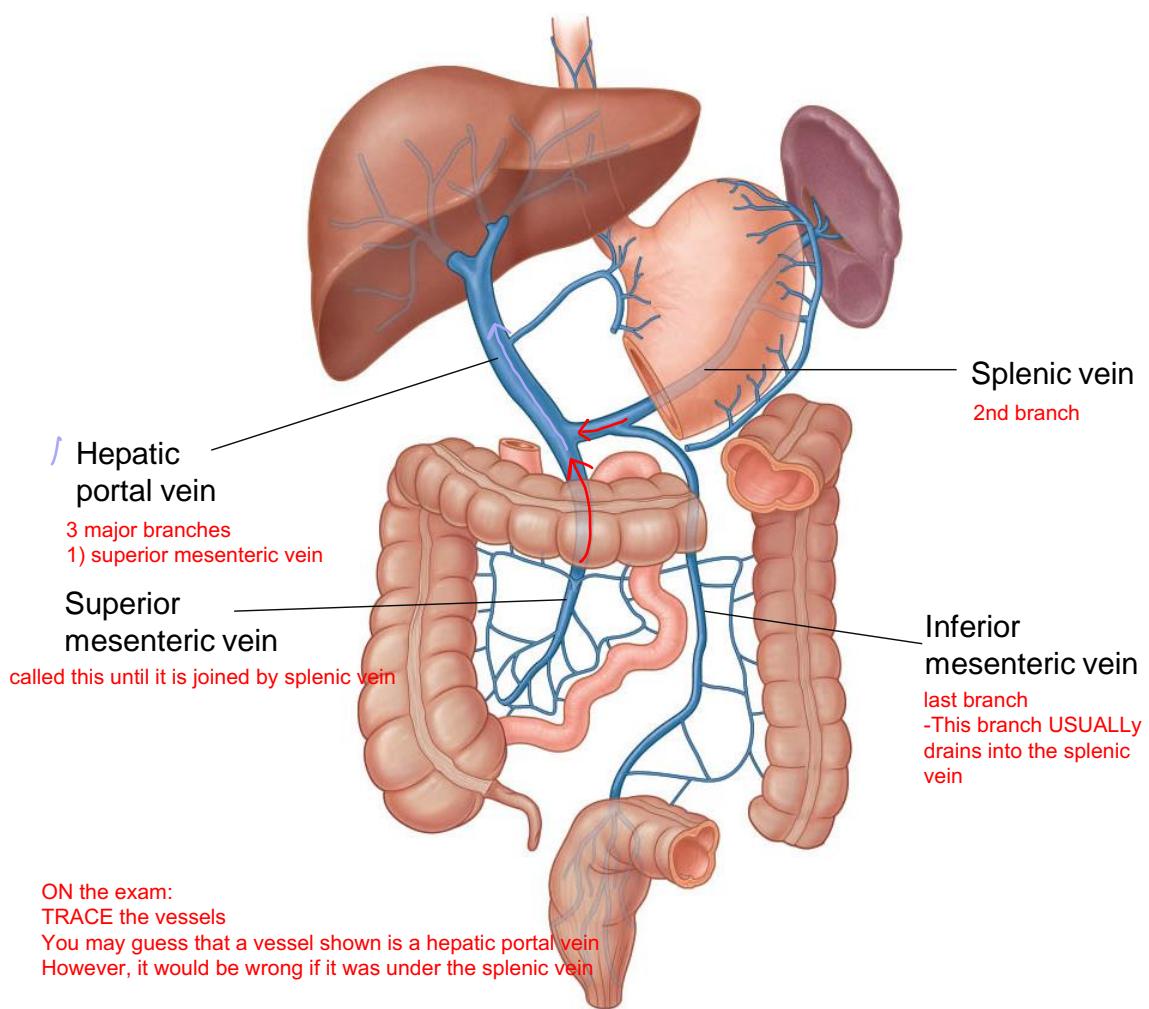
## Distribution of the superior mesenteric artery



**Distribution of the superior mesenteric artery**



**Venous drainage of the GI tract**

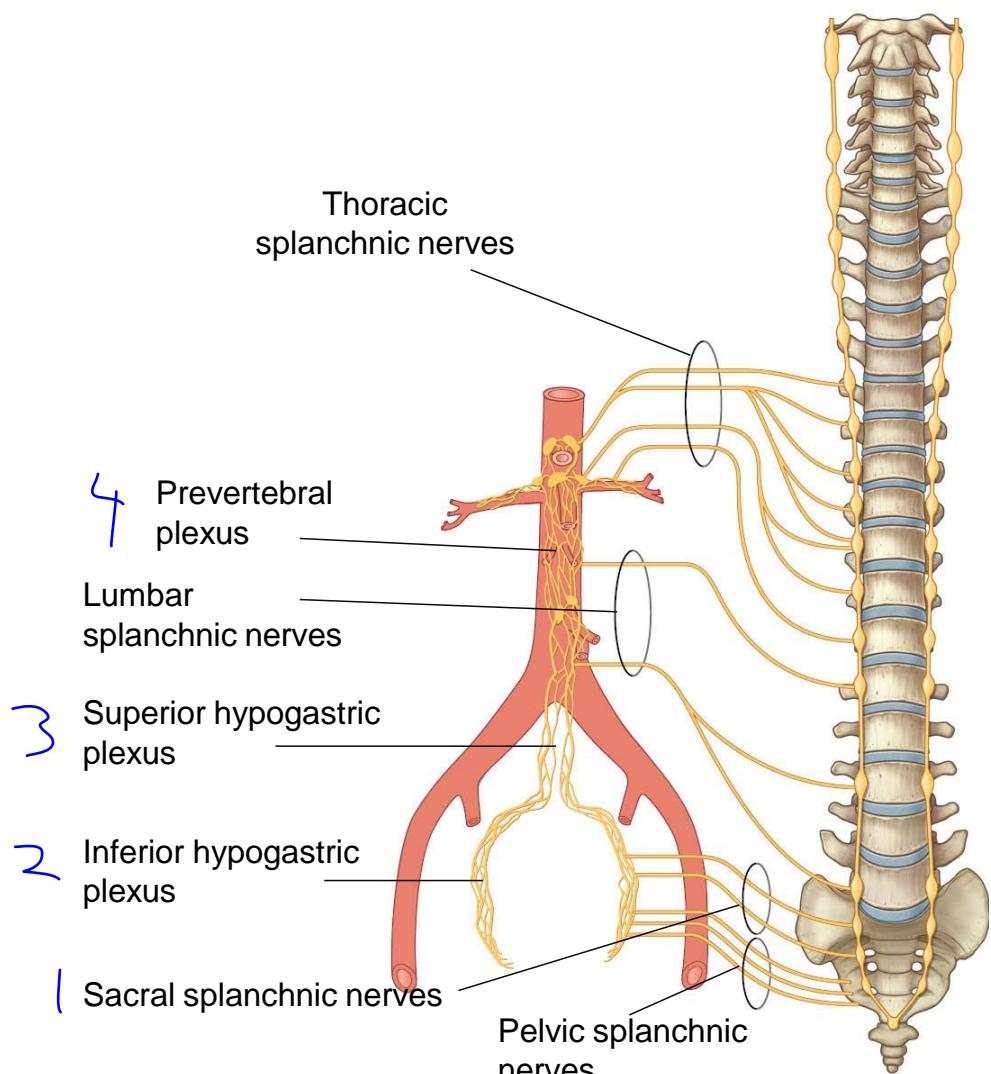


Q: pelvic splanchnic nerves innervate:  
splenic flexure of transverse colon  
sigmoid colon

### Innervation of abdominal viscera

Pelvic splanchnic nerve has to innervate all the way up to the transverse colon.

To be able to reach all the way up there, the nerves form an inferior hypogastric plexus and travel superiorly to the superior hypogastric plexus. It keeps going up until it innervates the transverse colon



**Damage to inferior hypogastric plexus will affect PSYMP innervation of sigmoid colon**

### The enteric system

The GI has its own nervous system  
Called the enteric system

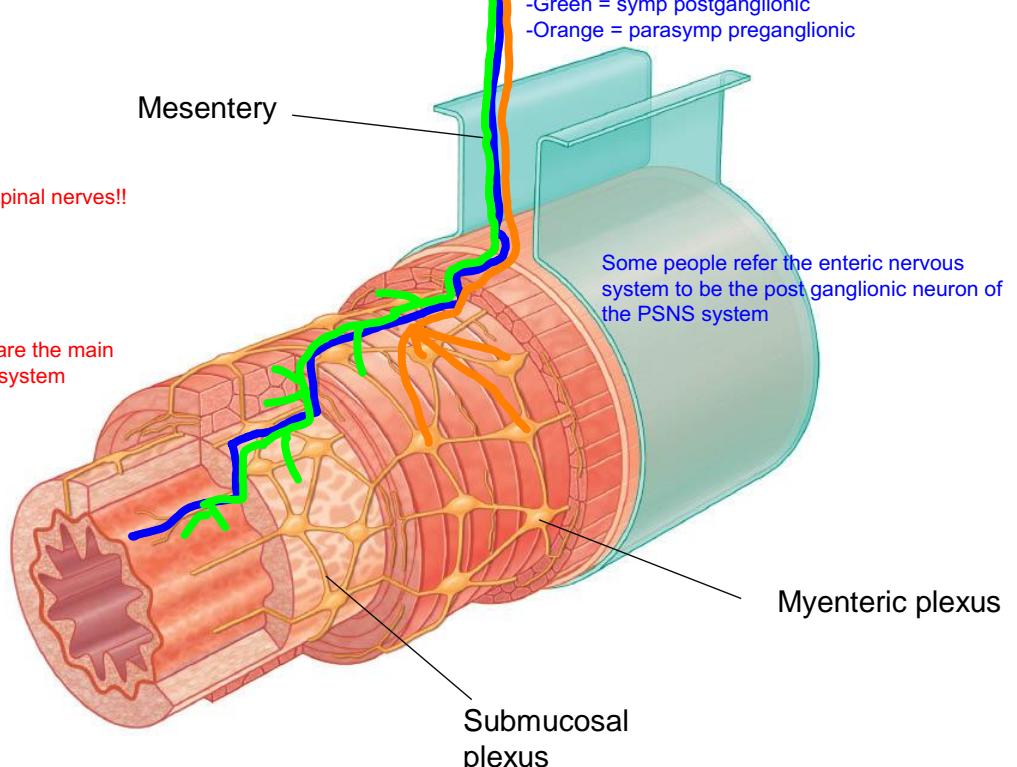
Thought to have more nerves than the spinal nerves!!

Divided into 2 main plexuses

- 1) Submucosal plexus
- 2) Myenteric plexus (between muscles)

It is self controlled, but SNS and PSNS are the main regulators of the activity of this nervous system

How do enteric and autonomic interact??  
 -Say this is a blood vessel  
 -The branches of the ANS will follow vessels  
 -Green = symp postganglionic  
 -Orange = parasymp preganglionic



# Abdomen (3): Posterior Abdominal Wall and Viscera

October 22, 2015

Dr. Paweł Kindler

Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture you should be able to identify, define and /or describe:

- Bones and muscles of the posterior abdominal wall
- Viscera:
  - Kidneys and associated vasculature
  - Ureters
  - Adrenal (suprarenal) glands
  - Abdominal aorta and major branches
  - Inferior vena cava and major branches
- Lumbar plexus

## Posterior abdominal region

Posterior to the abdominal part of the GI tract, the spleen and the pancreas

Bounded by bones and muscles

Bones:

- Lumbar vertebrae
- Upper margin of the sacrum
- Iliac crest and fossa of each ilium
- Ribs XI and XII

Muscles

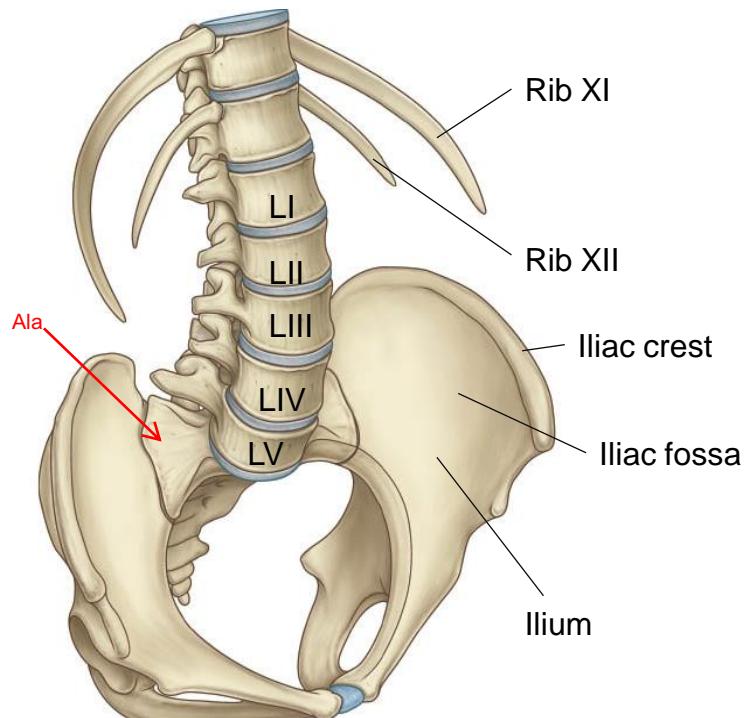
- Diaphragm
- Psoas major and minor
- Quadratus lumborum
- Iliacus

Viscera:

- Kidneys and associated vasculature
- Ureters
- Adrenal (suprarenal) glands
- Abdominal aorta and major branches
- Inferior vena cava and major branches

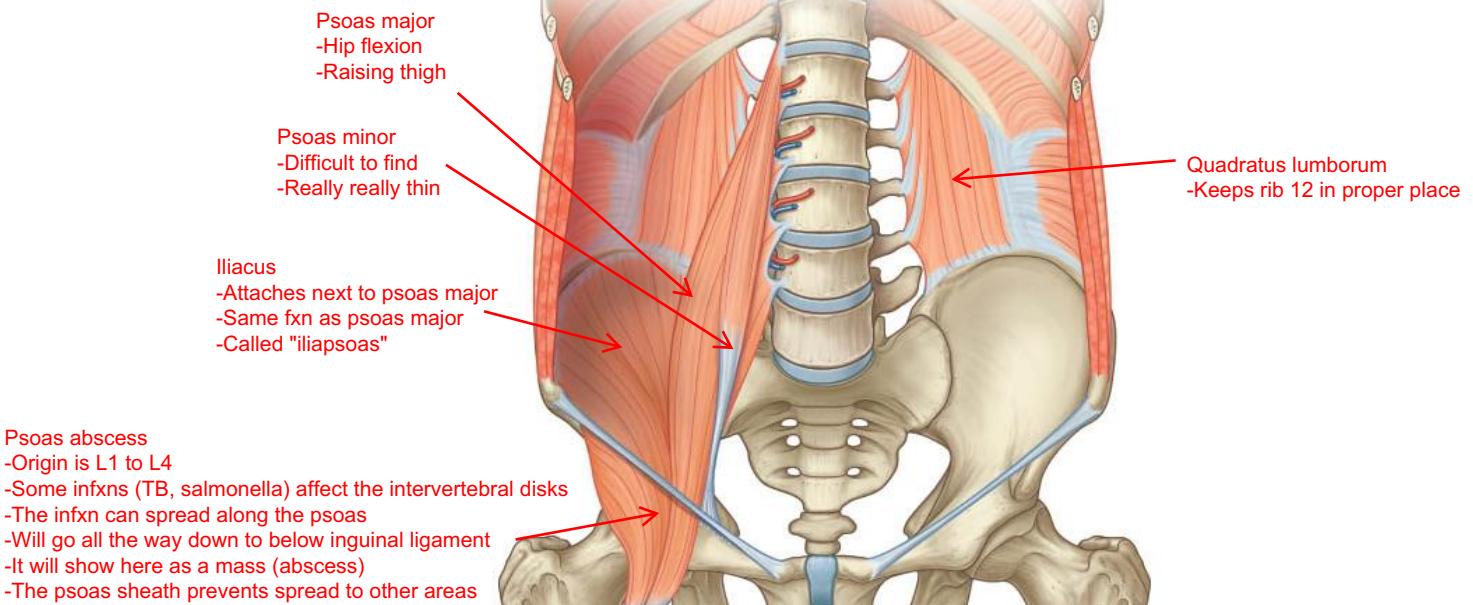
Prevertebral plexus

Lumbar plexus



Iliac crest is a common source of bone grafts

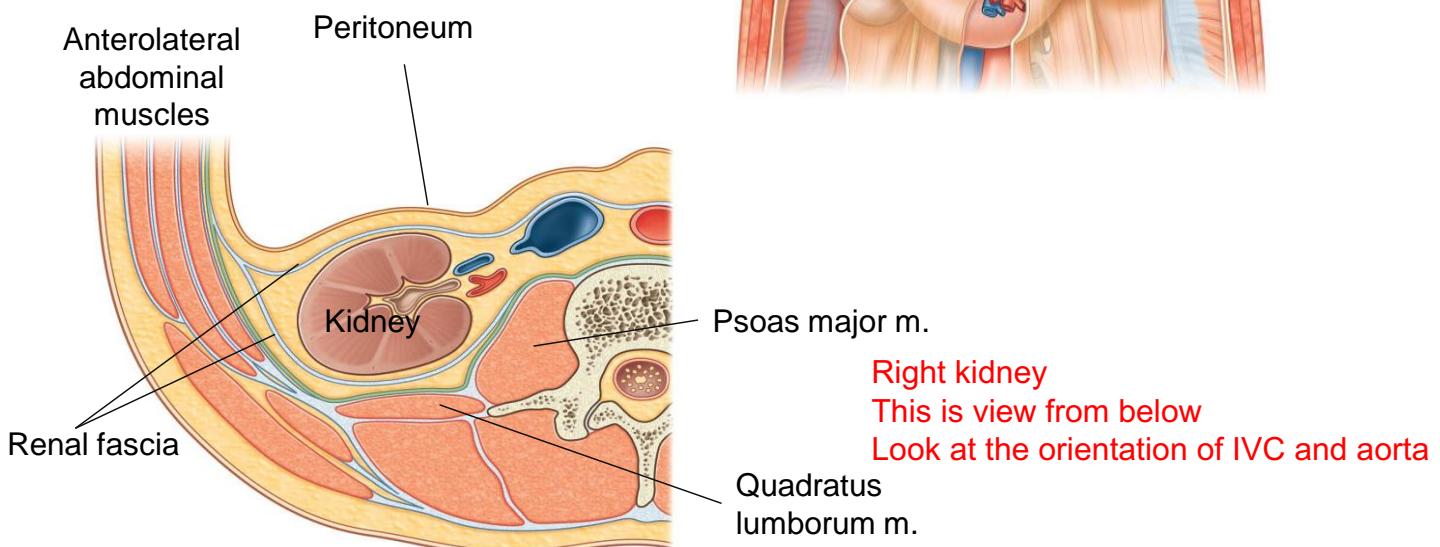
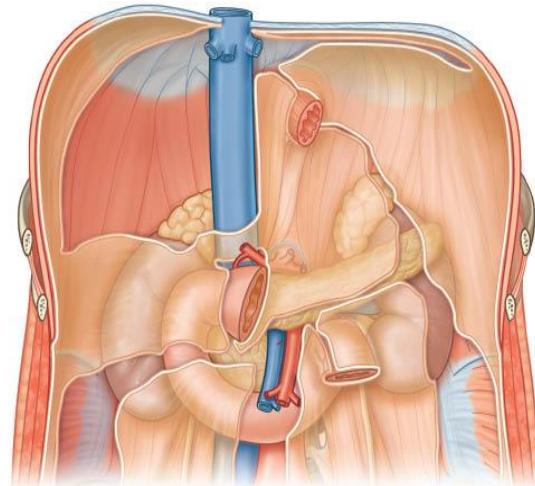
## Muscles



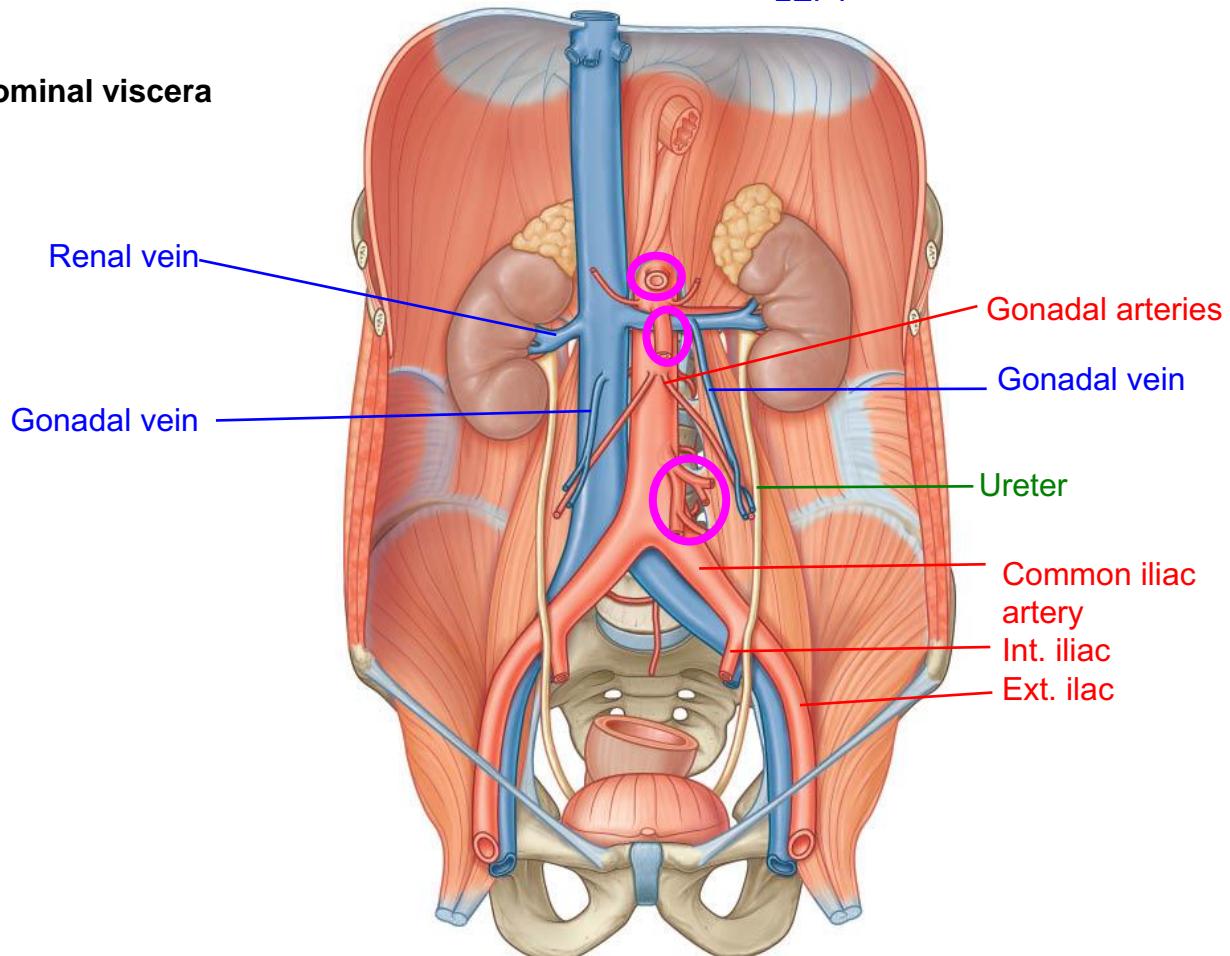
## Viscera: kidneys

IVC is retroperitoneal. It is not SECONDARILY RETROPERITONEAL.

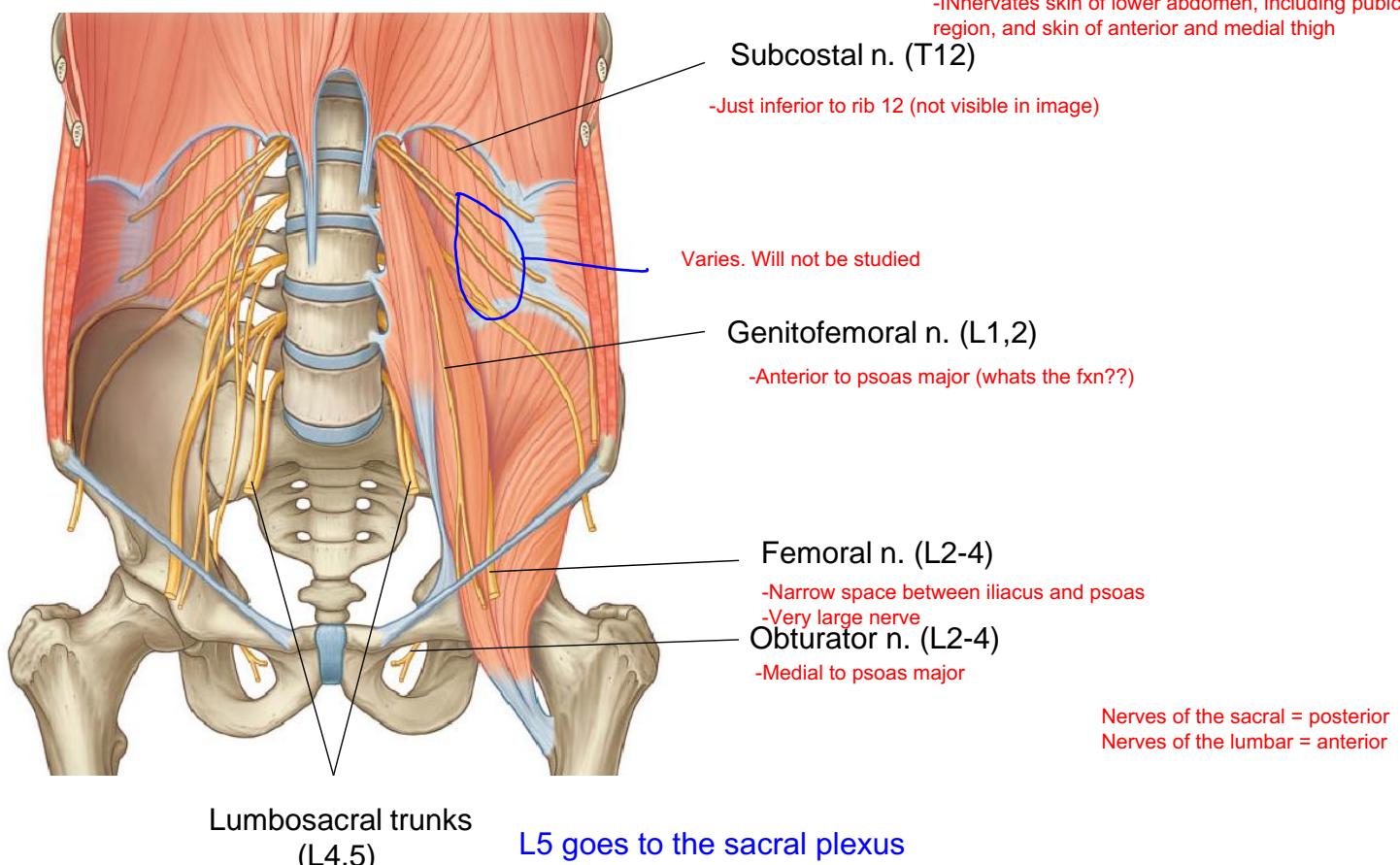
2ndary retroperitoneal = starts off intraperitoneal but becomes retro. I.E. GI tract



## Posterior abdominal viscera



## Lumbar plexus in the posterior abdominal region



# Head and Neck (1): Overview of the Skull

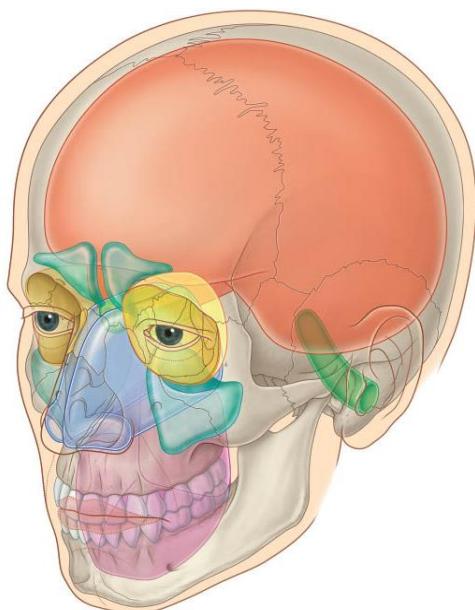
October 29, 2015

Dr. Paweł Kindler  
Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture you should be able to identify, define and /or describe:

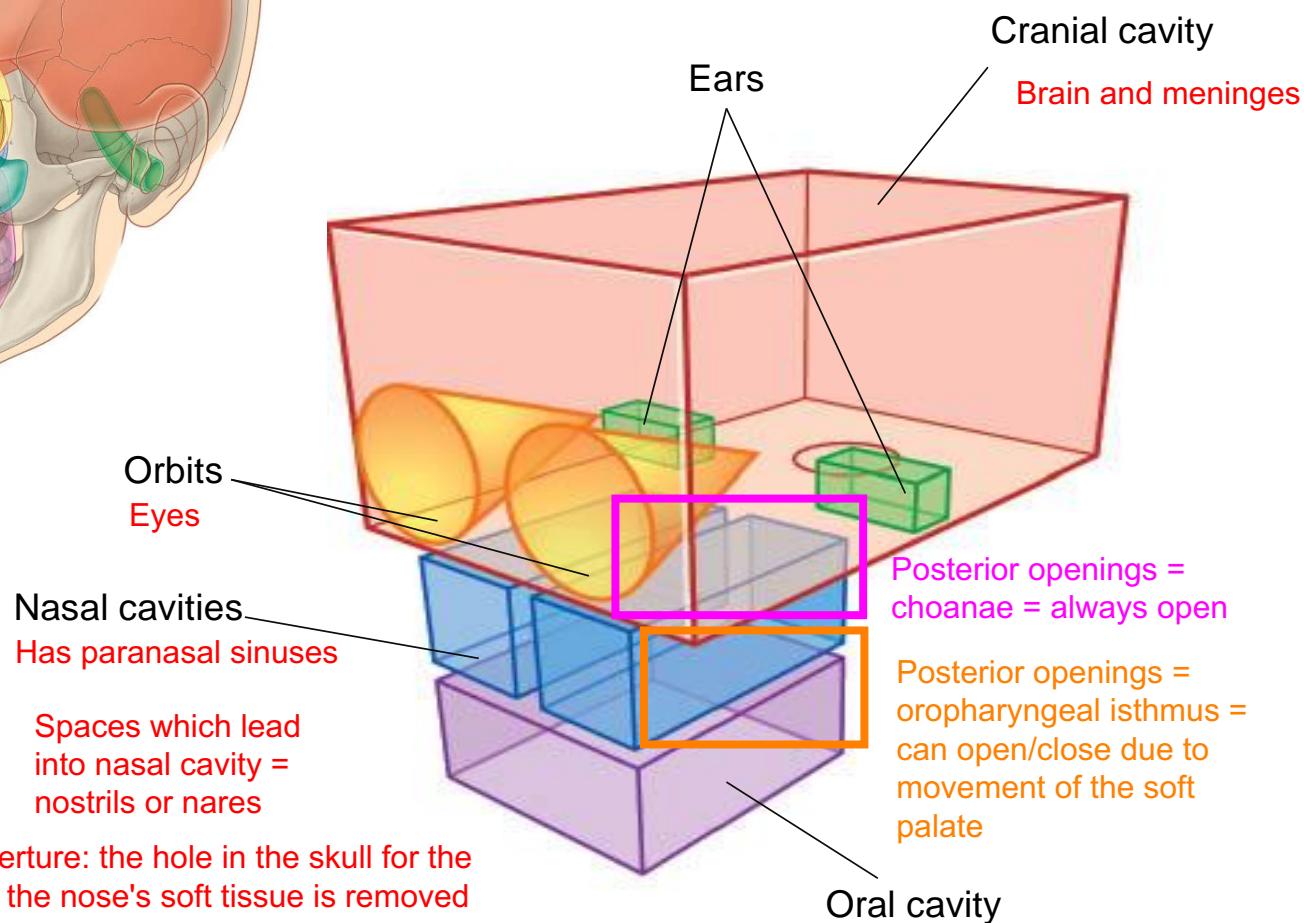
- Major compartments of the head
- The cranium and its subdivisions
- Bones, and their features, included in the:
  - Anterior, lateral and posterior views of the skull
  - Inferior view of the skull
  - Floor of cranial cavity

## Major compartments of the head



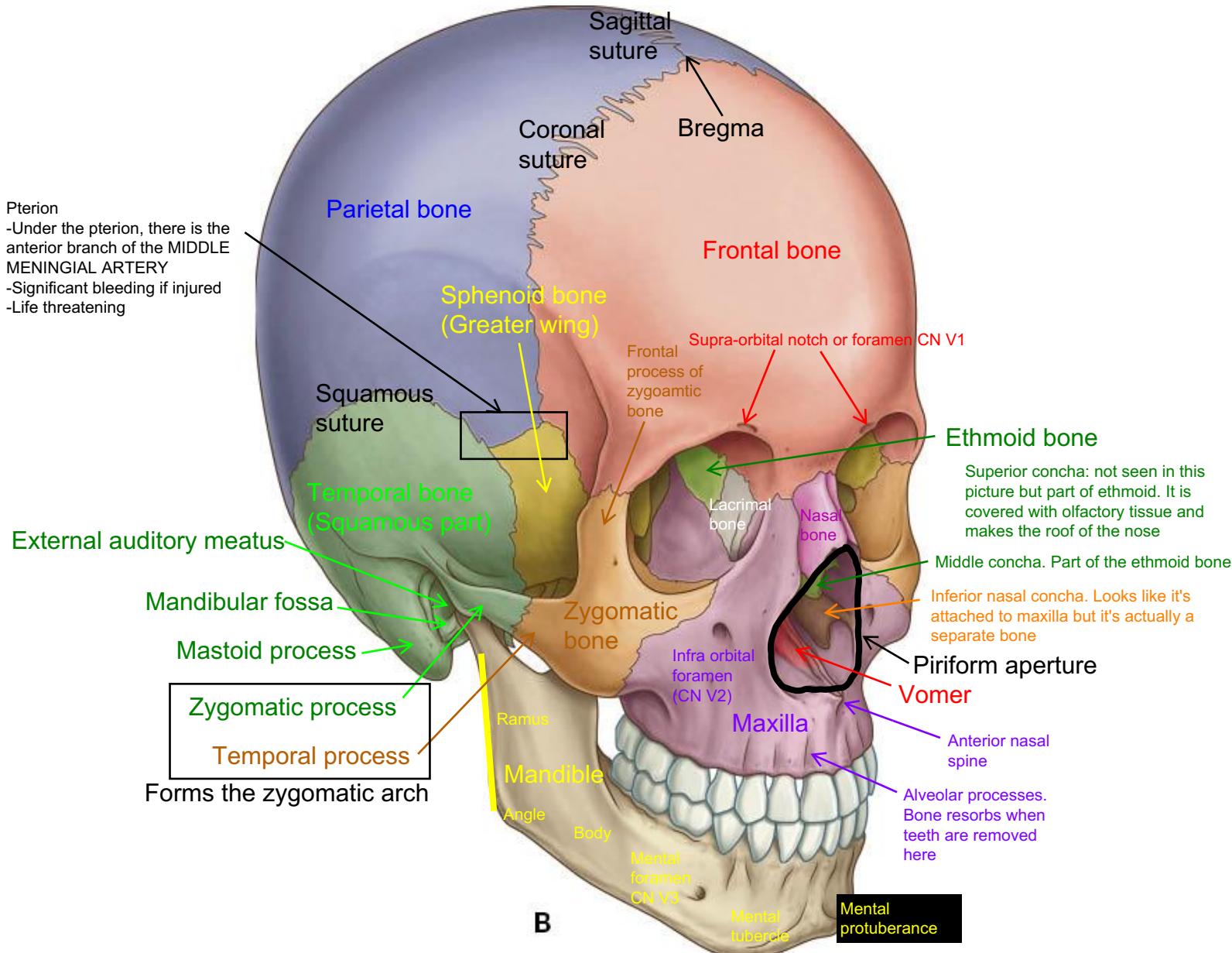
Space between the eyelids = palpebral fissures  
"You have very beautiful palpebral fissures" - Kindler

Space between the lips = oral fissure



- Bones of the skull form the cranium. Cranium is divided into 3 areas:
  - 1) Calvaria (covers and protects brain)
  - 2) Viscerocranum (facial/anterior skeleton)
  - 3) Floor of cranial cavity (not seen here)
- Mandible is part of the viscerocranum (due to embryonic origin)

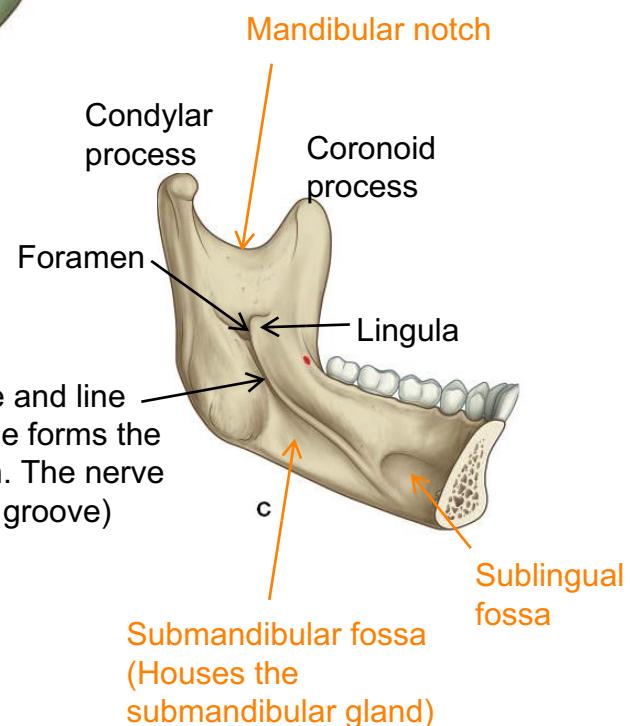
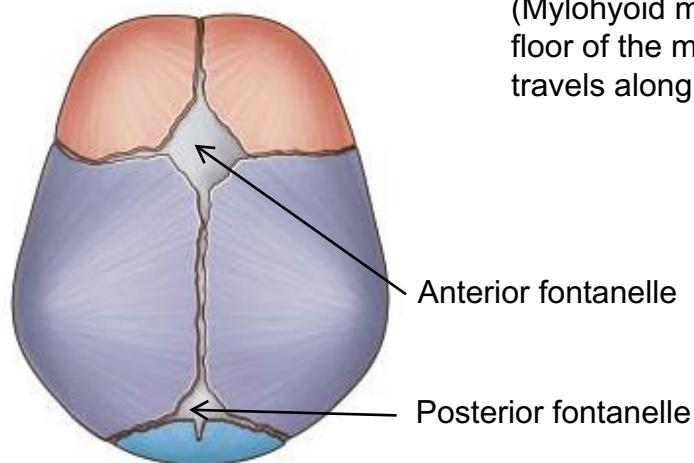
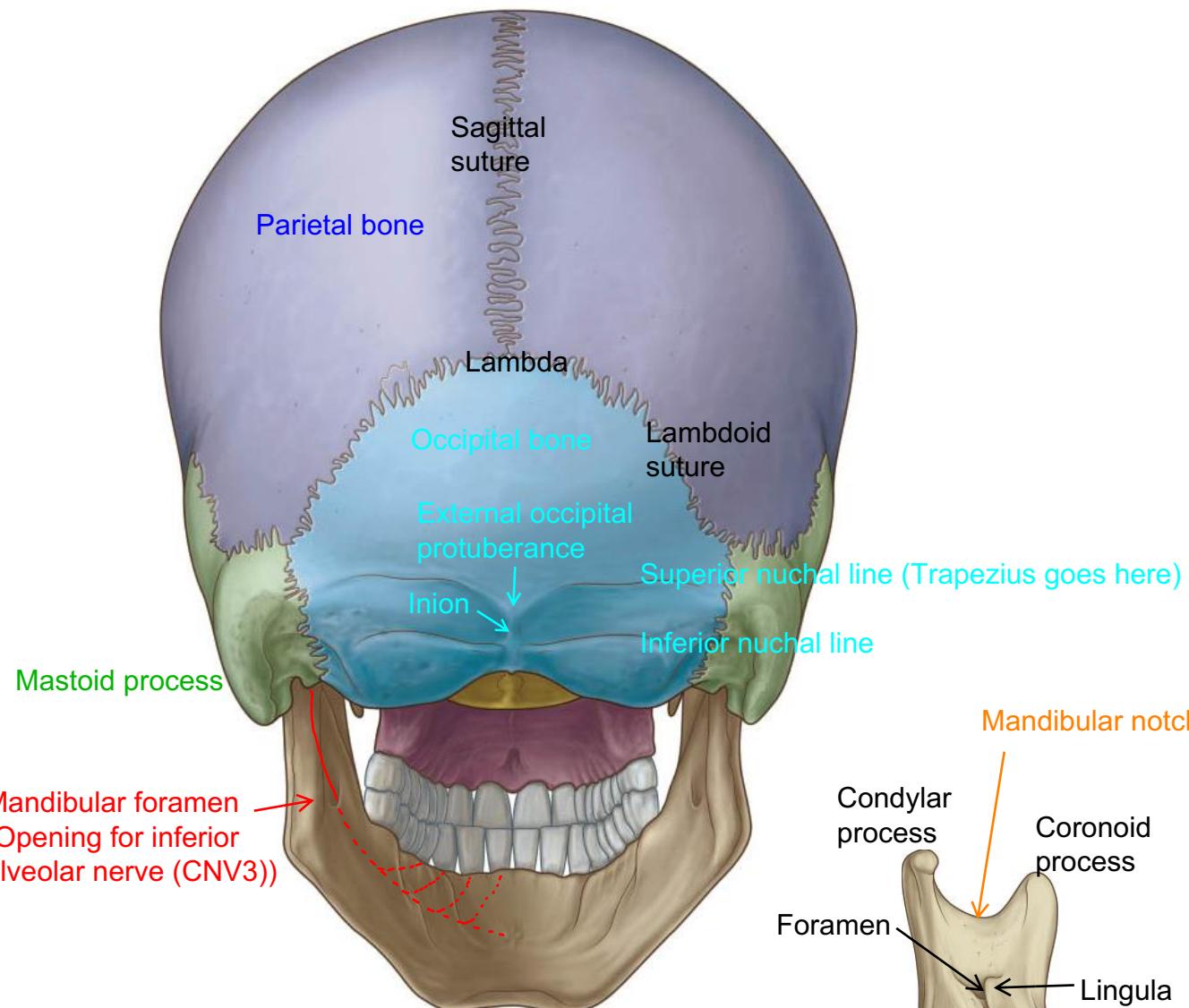
### Anterolateral view of the skull



TMJ = mandibular process + condylar process

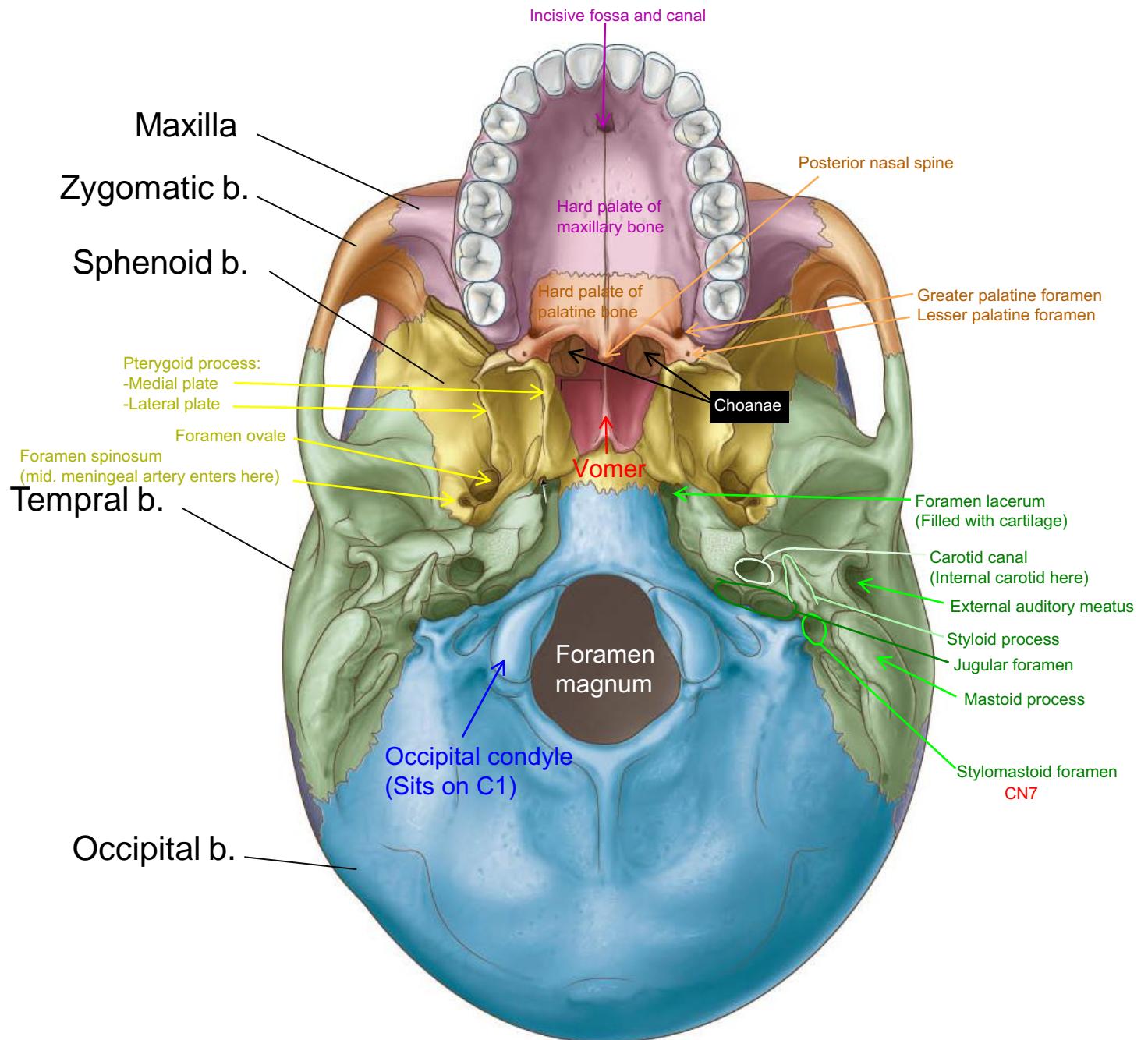
Inferior and middle concha make shelves which increase surface area --> adds moisture and stuff to air

## Posterior view of the skull

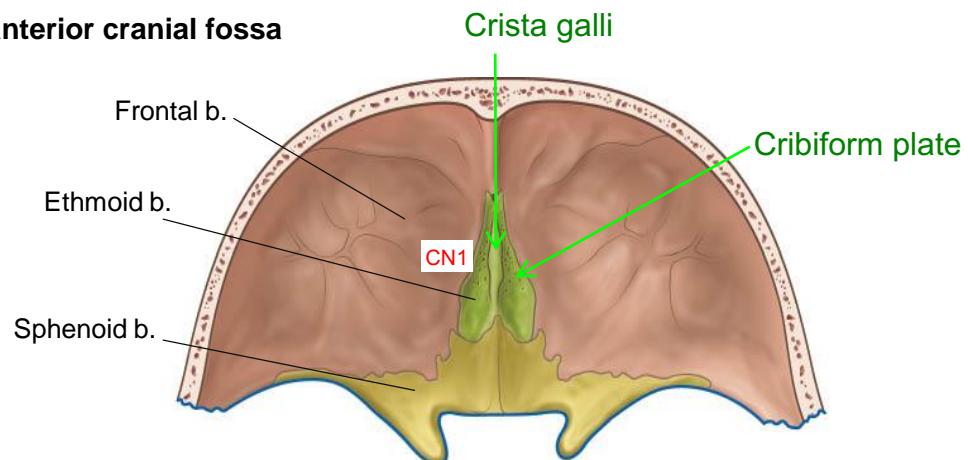
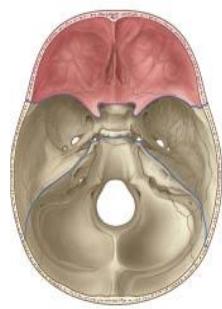


Newborn baby - bones aren't fused yet so handle with care

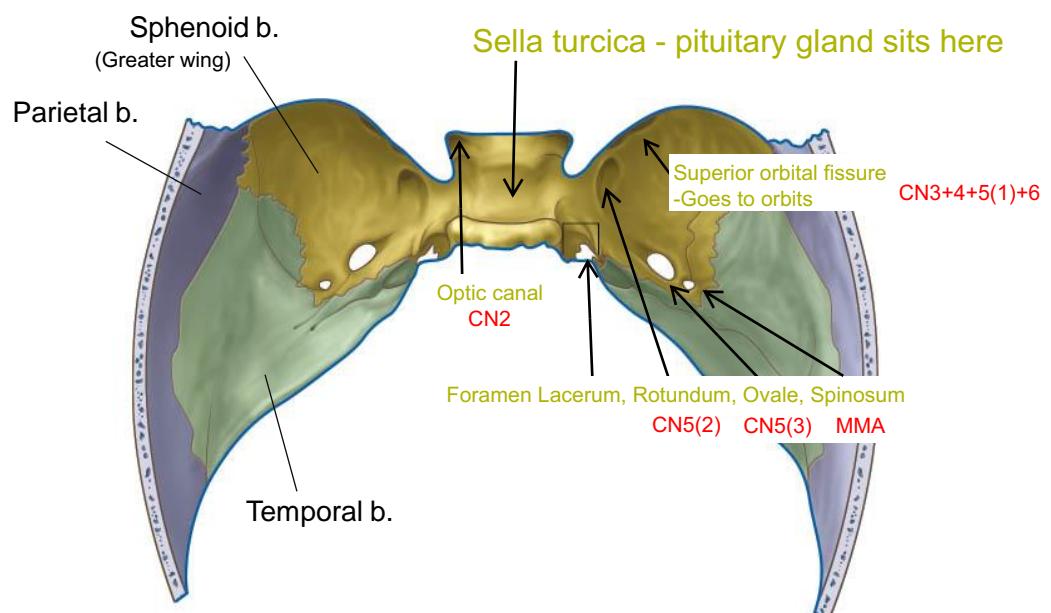
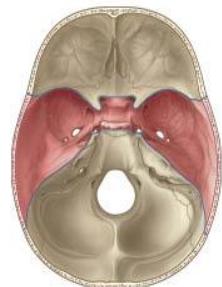
## Inferior view of the skull



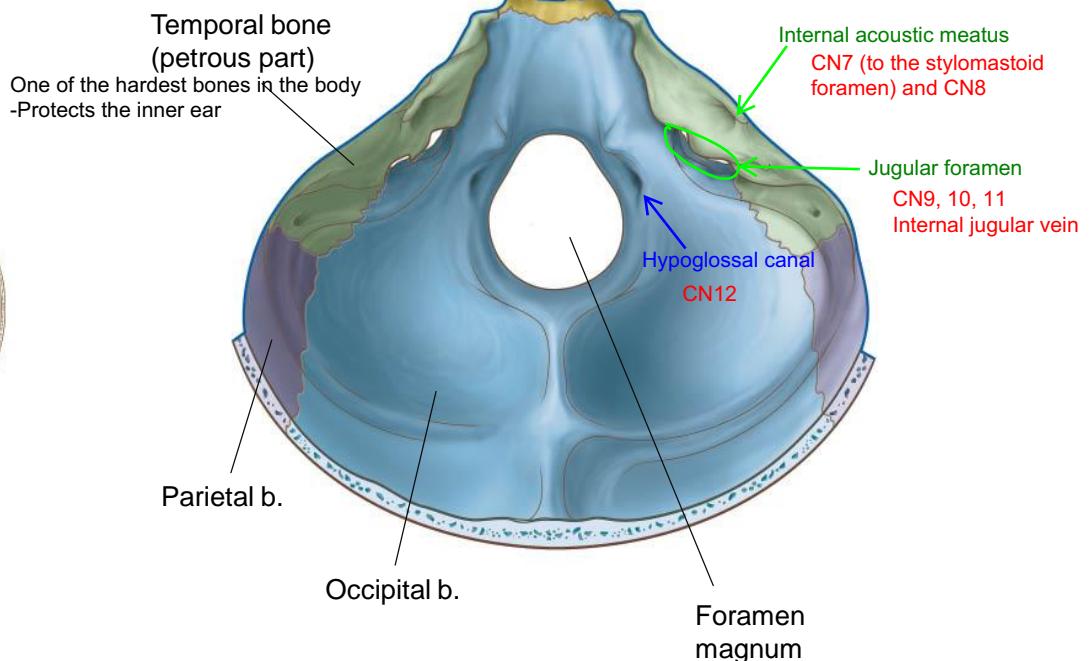
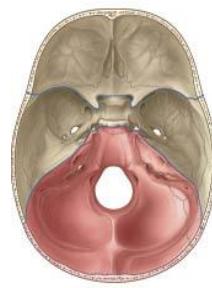
### Floor of cranial cavity: anterior cranial fossa



### Middle cranial fossa



### Posterior cranial fossa



# Head and Neck (2): Introduction to Cranial Nerves; Muscles of Facial Expression; Sensory Innervation of the Face; Introduction to Parasympathetic Innervation of the Head

November 5, 2015

Dr. Paweł Kindler  
CPS & MDUP  
LSC 1545

Skinny sluts make money but my brother says big bitches make more  
OOOTTAFAVGVAH

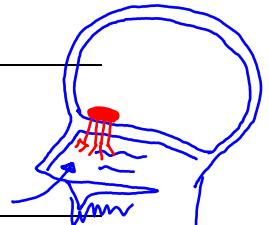
Following the lecture you should be able to identify, define and /or describe:

- Cranial nerves and their general functions
- Muscles of facial expression and their innervation
- Sensory innervation of the face
- Basic principles of parasympathetic innervation of the head

ALL CRANIAL NERVES EXCEPT 1 ORIGINATE FROM THE BRAIN

## Introduction to cranial nerves and their functions

<b>Olfactory (I)</b> <i>S</i>	<ul style="list-style-type: none"><li>• smell<ul style="list-style-type: none"><li>-Many small nerves which go through the cribriform plate</li><li>-Olfactory bulb = all the smell nerves gather here and go to the brain</li></ul></li></ul>
<b>Optic (II)</b> <i>S</i>	<ul style="list-style-type: none"><li>• vision<ul style="list-style-type: none"><li>-Exits through optic canal</li></ul></li></ul>
<b>Oculomotor (III)</b> <i>M</i>	<ul style="list-style-type: none"><li>• motor to most extra-ocular muscles (move eyeball) <i>Supplies 5/7 extra-ocular muscles</i></li><li>• parasympathetic (pupillary constriction, accommodation of lens) <i>Remember, CN 3, 7, 9, 10 are PSYMP. this is one of them</i></li></ul>
<b>Trochlear (IV)</b> <i>M</i>	<ul style="list-style-type: none"><li>• motor to one extra-ocular muscle<ul style="list-style-type: none"><li><i>1/7</i></li></ul></li></ul>
<b>Trigeminal (V)</b> Has 3 divisions: V <sub>1</sub> ophthalmic (exits cranial cavity through <i>superior orbital fissure</i> ) <i>B</i> V <sub>2</sub> maxillary (exits cranial cavity through <i>foramen rotundum</i> ) V <sub>3</sub> mandibular (exits cranial cavity through <i>foramen ovale</i> )	<ul style="list-style-type: none"><li>• sensory from most of head, including <b>ALL TEETH</b></li><li>• <b>motor to muscles of mastication</b></li></ul> <p>Also exits through the supraorbital foramen</p>



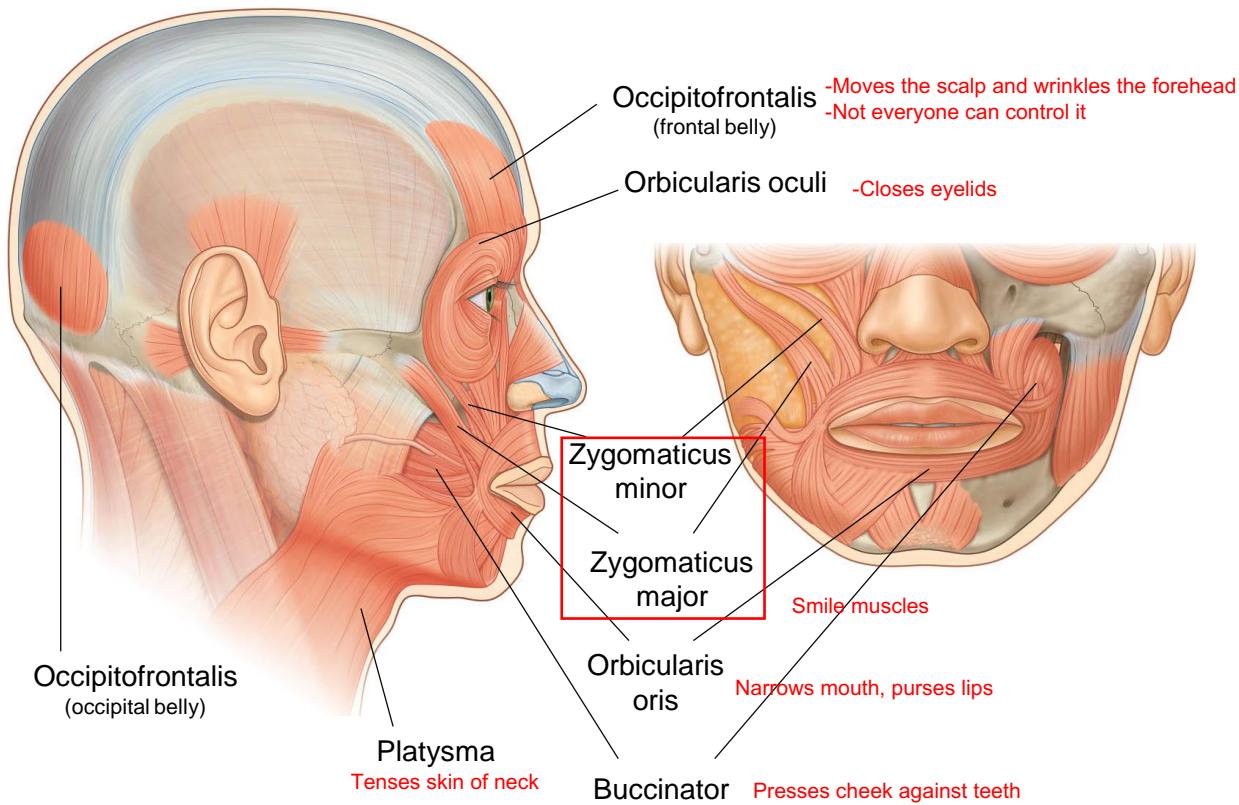
<b>M</b>	<b>Abducent (VI)</b>	<ul style="list-style-type: none"> <li>• Exits cranial cavity through <i>superior orbital fissure</i></li> </ul>	<ul style="list-style-type: none"> <li>• motor to one extra-ocular muscle</li> </ul> <p style="text-align: center;">1/7</p>
<b>B</b>	<b>Facial (VII)</b>	<ul style="list-style-type: none"> <li>• Exits cranial cavity through <i>internal auditory meatus</i> and <i>stylomastoid foramen</i></li> </ul>	<ul style="list-style-type: none"> <li>• motor to muscles of facial expression</li> <li>• taste from <i>anterior 2/3 of tongue</i></li> <li>• parasympathetic (<i>lacrimal gland, submandibular and sublingual salivary glands</i>) <small>floor of mouth glands and tears in eyes</small></li> </ul>
<b>S</b>	<b>Vestibulocochlear (VIII)</b>	<ul style="list-style-type: none"> <li>• Exits cranial cavity through <i>internal auditory meatus</i></li> </ul>	<ul style="list-style-type: none"> <li>• hearing and balance</li> </ul>
<b>B</b>	<b>Glossopharyngeal (IX)</b>	<ul style="list-style-type: none"> <li>• Exits cranial cavity through <i>jugular foramen</i></li> </ul>	<ul style="list-style-type: none"> <li>• motor to one muscle of pharynx</li> <li>• taste from <i>posterior 1/3 of tongue</i></li> <li>• visceral sensory from carotid body and sinus</li> <li>• parasympathetic (<i>parotid salivary gland</i>)</li> </ul>
<b>B</b>	<b>Vagus (X)</b>	<ul style="list-style-type: none"> <li>• Exits cranial cavity through <i>jugular foramen</i></li> </ul>	<ul style="list-style-type: none"> <li>• motor to soft palate, pharynx and larynx</li> <li>• visceral sensory from most cervical, thoracic and abdominal viscera</li> <li>• parasympathetic (most cervical, thoracic and abdominal viscera) <small>None to the head!</small></li> </ul>
<b>H</b>	<b>Accessory (XI)</b>	<ul style="list-style-type: none"> <li>• Unusual – arrives from C1-C5 rather than brain</li> <li>• Exits cranial cavity through <i>jugular foramen</i></li> </ul>	<ul style="list-style-type: none"> <li>• motor to sternocleidomastoid and trapezius muscles</li> </ul> <p style="text-align: center;"><small>This is the one that doesn't start at brain&gt;</small></p>
<b>M</b>	<b>Hypoglossal (XII)</b>	<ul style="list-style-type: none"> <li>• Exits cranial cavity through <i>hypoglossal canal</i></li> </ul>	<ul style="list-style-type: none"> <li>• motor to all intrinsic and most extrinsic muscles of tongue</li> </ul>

### Muscles of facial expression

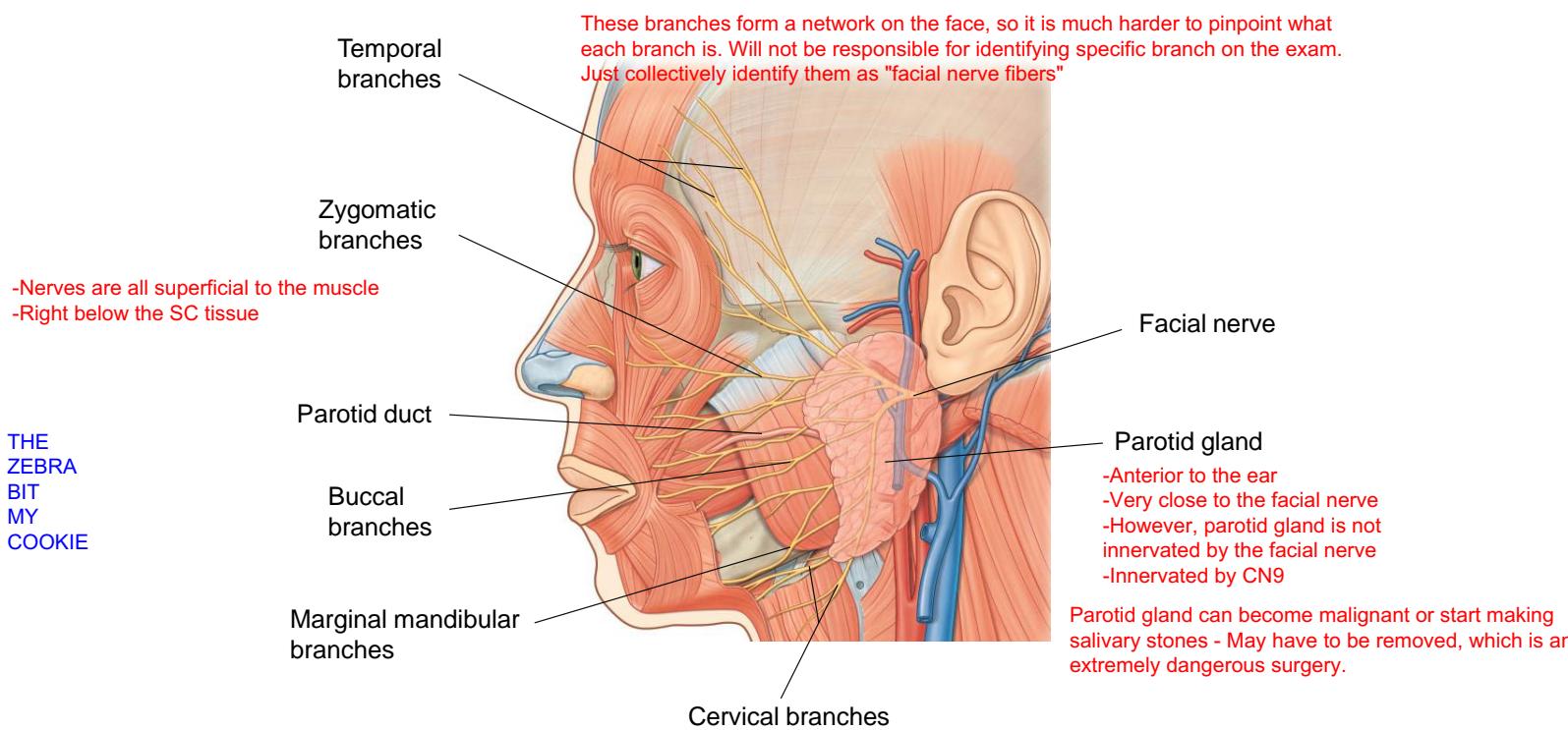
Humans use facial expressions to convey emotions. In clinical contexts, important information about a patient's health can be generated by observing patient's face.

Muscles of the face are located in the superficial fascia, originate from bone or fascia and insert into the skin of the face. All are innervated by the facial nerve (CN VII)

- All are innervated by CN7 (facial)
- Extremely superficial because some insert at the skin (which is why they convey emotion)



### Facial nerve on the face and parotid gland



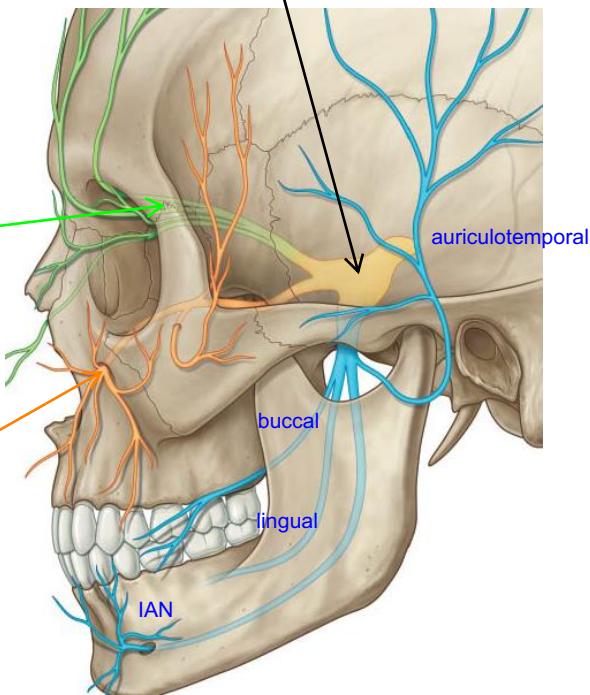
## Sensory innervation of the face

It is provided by the trigeminal nerve (V).

Before leaving the middle cranial fossa, the trigeminal nerve divides into 3 divisions:

**Ophthalmic (V1), Maxillary (V2) and Mandibular (V3)**

- Trigeminal nerve ganglion
- Still in the middle cranial cavity
- Cell bodies of all the sensory nerves are here, bringing it to the face
- Analogous to dorsal root ganglion



### Ophthalmic (V1)

Exits the skull through the superior orbital fissure and enters the orbit.

One of its branches exits through the supra-orbital foramen as the **supra-orbital nerve** to innervate upper eyelid, forehead and scalp.

Branches of CNV supply the scalp anterior to the vertex (topmost point of cranium)



Posterior to the vertex, sensory innervation of scalp is C2 and C3

NOT CN2/3

### Maxillary (V2)

Exits the skull through the foramen rotundum and enters the inferior orbital fissure.

Continues forward in the infra-orbital canal and exits through the infra-orbital foramen as the **infra-orbital nerve** to innervate lower eyelid, cheek, side of the nose and upper lip.

### Mandibular V3

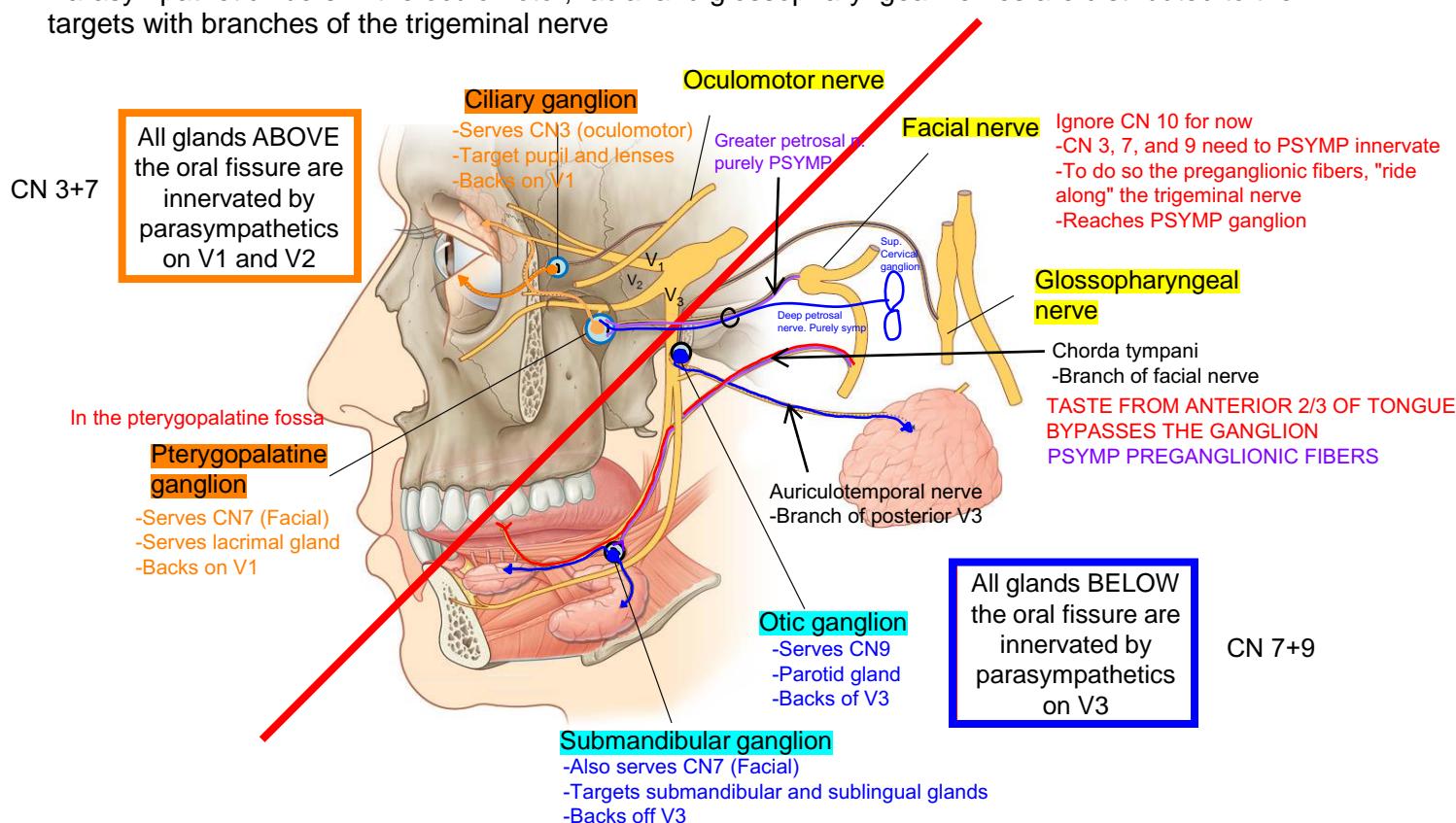
Exits the skull through the foramen ovale.

Its branches include the **inferior alveolar nerve** which enters the mandibular foramen, travels through bone within the mandibular canal and exits through the mental foramen as the **mental nerve** to innervate the lower lip and chin, and the **auriculotemporal nerve** to innervate the temple.

## Parasympathetic innervation of the head

3, 7, 9, 10

Parasympathetic fibers in the oculomotor, facial and glossopharyngeal nerves are distributed to their targets with branches of the trigeminal nerve



# Head and Neck (3): Temporal and Infratemporal Fossae; TMJ and Its Movements, Muscles of Mastication

November 12, 2015

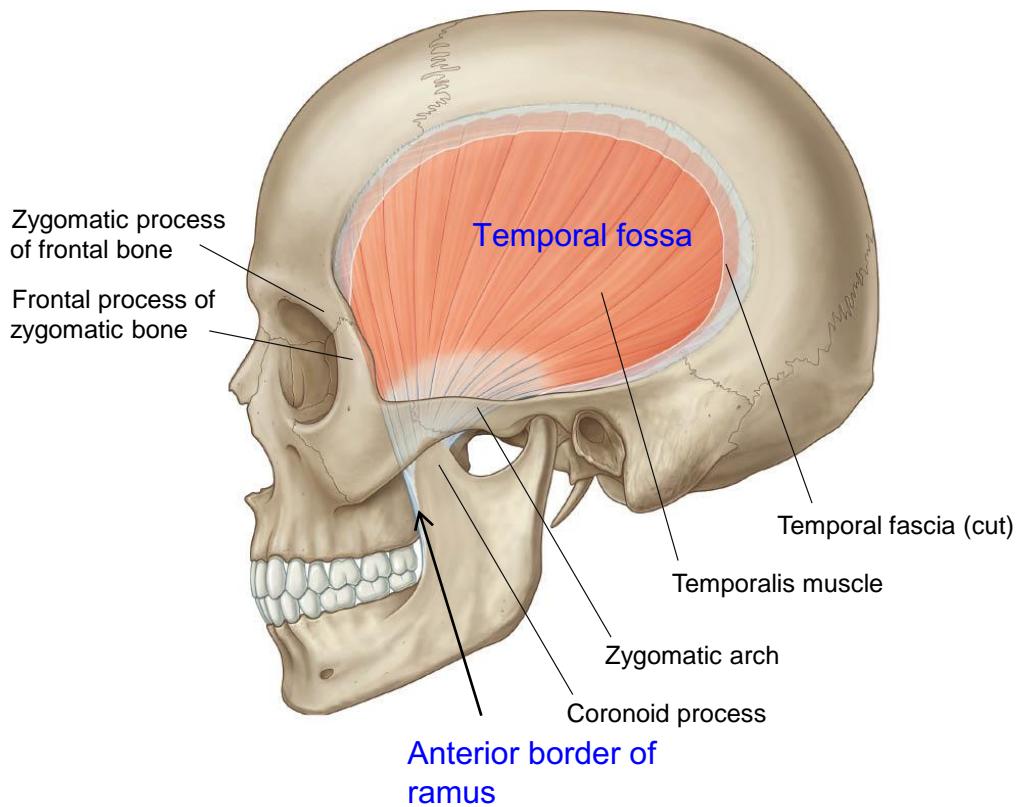
Dr. Paweł Kindler  
Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture you should be able to identify, define and /or describe:

- Temporal fossa:
  - location
  - contents
- Infratemporal fossa:
  - skeletal framework
  - contents
    - mandibular nerve (V3) and main branches
    - maxillary artery and main branches
- TMJ and its movements
- Muscles of mastication
  - temporalis
  - masseter
  - medial and lateral pterygoids

## Temporal fossa

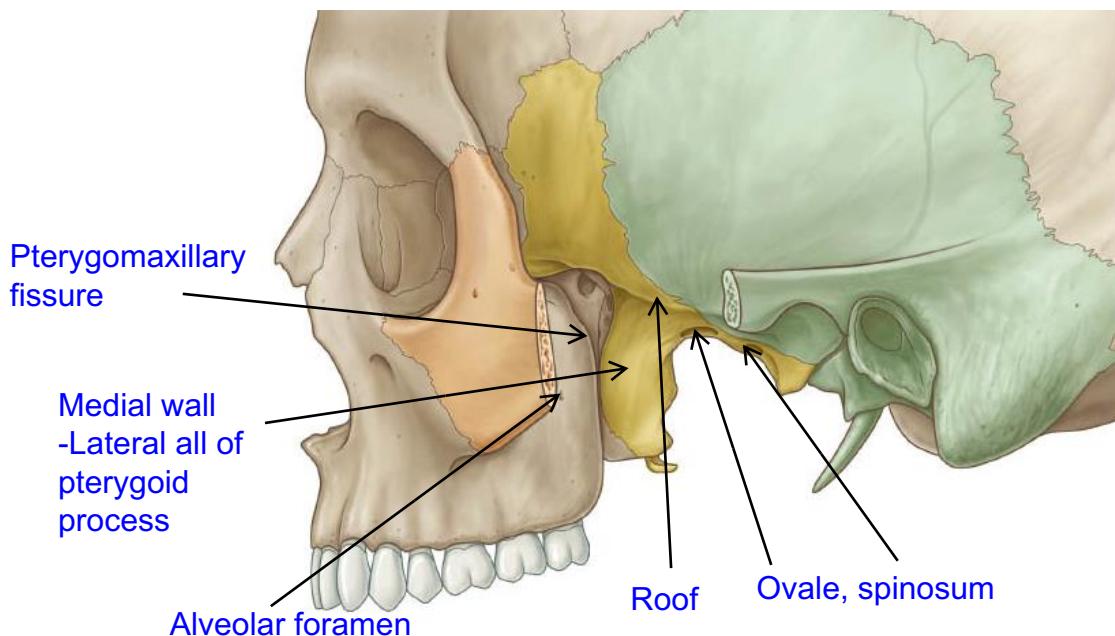
- Located above the zygomatic arch, covers the lateral surface of the skull
- Major structure is the temporalis muscle which inserts on the coronoid process of the mandible
- Limited by temporalis fascia overlying the temporalis muscle
- Anterior margin is marked by zygomatic process of frontal and frontal process of zygomatic bones
- Communicates with the infratemporal fossa below through the gap between the zygomatic arch and temporal and sphenoid bones.



- Zygomatic arch and mandible removed
- Medial to the mandible
- Main bridge between cranium and infratemporal fossa = ovale

### Infratemporal fossa

- Located inferiorly to temporal fossa
  - The roof: the inferior surfaces of the greater wing of sphenoid and temporal bones; contains foramen spinosum and foramen ovale
  - The lateral wall: the medial surface of the ramus of mandible; contains the opening of mandibular canal
  - The medial wall: the lateral wall of pterygoid process of sphenoid, contains pterygomaxillary fissure
  - The anterior wall: the posterior surface of maxilla; contains alveolar foramen and inferior orbital fissure



- Contents of infratemporal fossa include:
  - Mandibular nerve (V3)
  - Maxillary artery
  - Medial and lateral pterygoid muscles
  - Sphenomandibular ligament

### Mandibular nerve (V3)

- Both sensory and motor

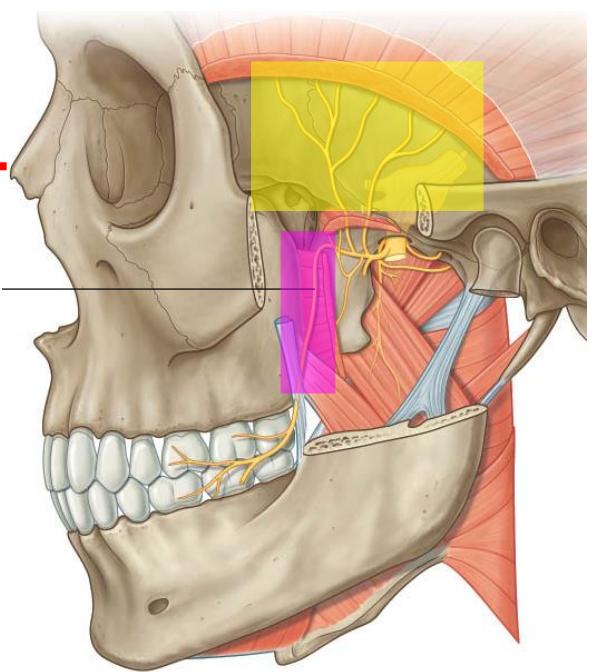
- Anterior trunk includes:

**Motor**    o small motor branches to muscles of mastication

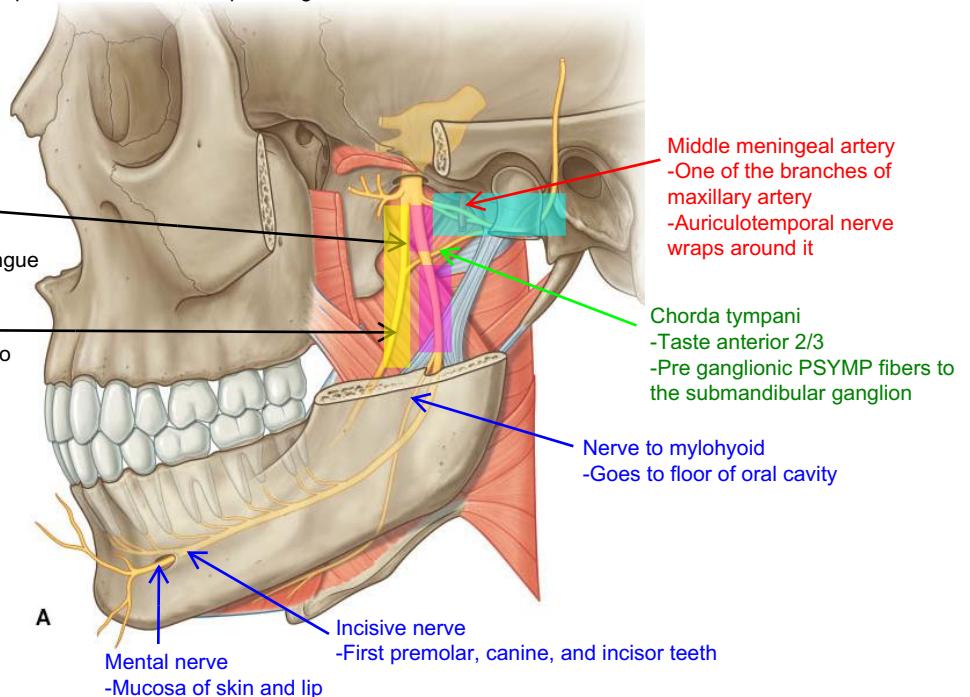
Buccal nerve

Temporalis,  
masseter,  
pterygoids

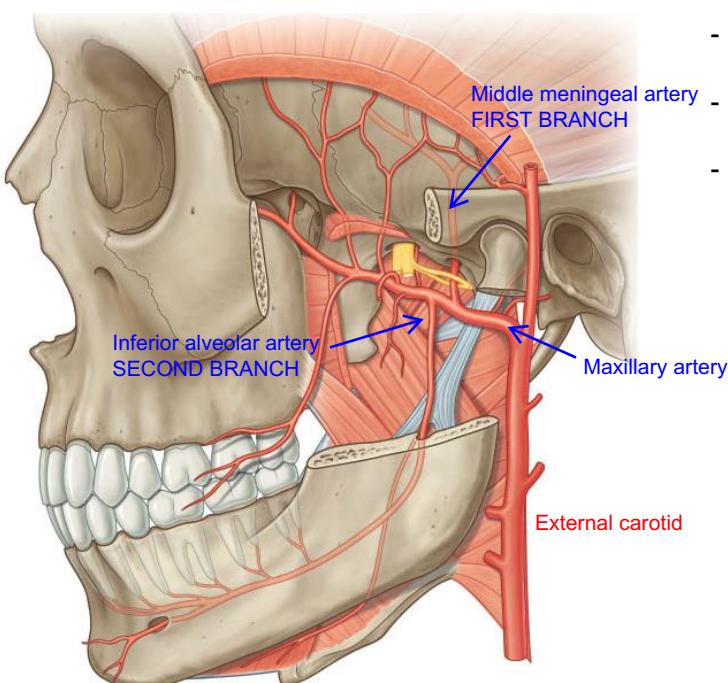
**Sensory**    o buccal n.: sensory to the cheek (both skin and oral mucosa) and buccal gingivae of lower molars



- Posterior trunk includes:
  - o **lingual n.**: sensory to anterior 2/3 of tongue, oral mucosa on the floor of mouth and lingual gingivae of lower teeth
  - o **inferior alveolar n.**: enters mandibular canal through mandibular foramen to provide sensory innervation to all lower teeth and associated gingivae
    - ✓ Exits the mandible through mental foramen as mental nerve to supply mucosa and skin of the lower lip
  - o **auriculotemporal n.**: sensory to skin of the temple  
Also carries CN9's parasympathetic fibers into the parotid gland



### Maxillary artery

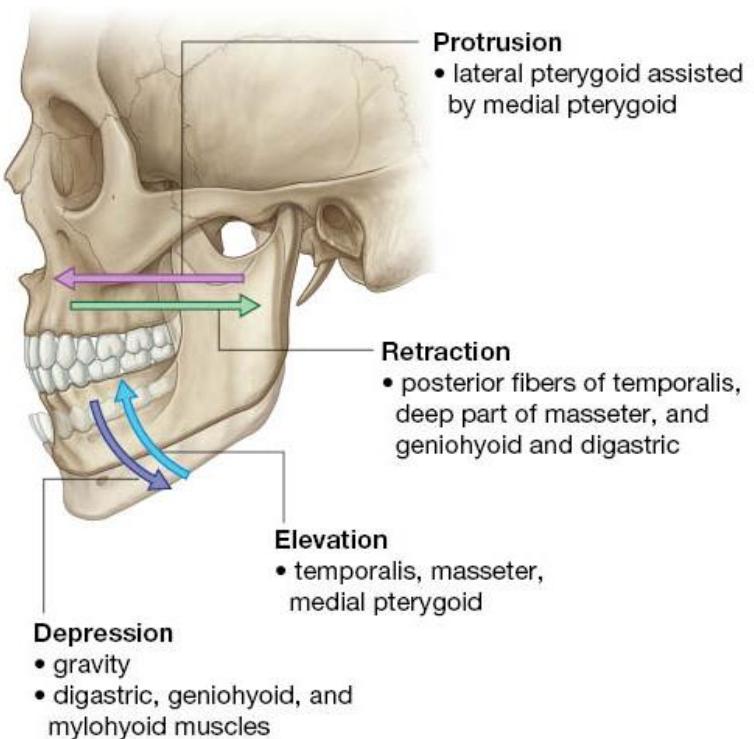
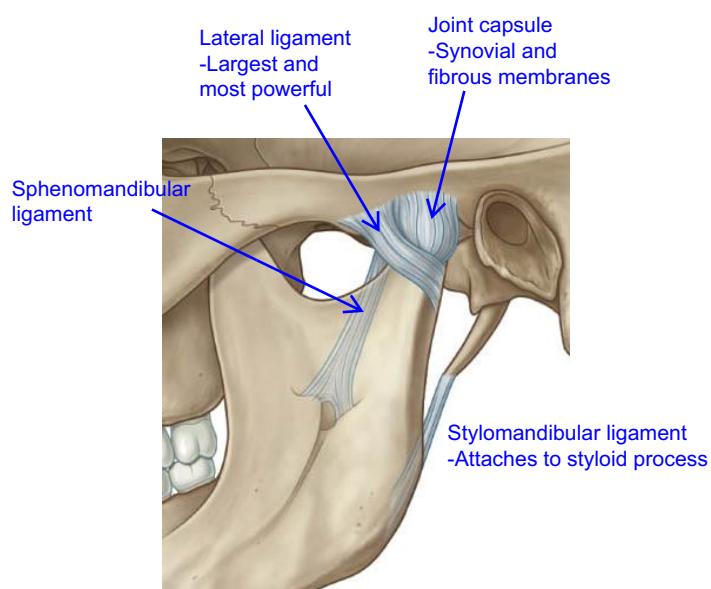
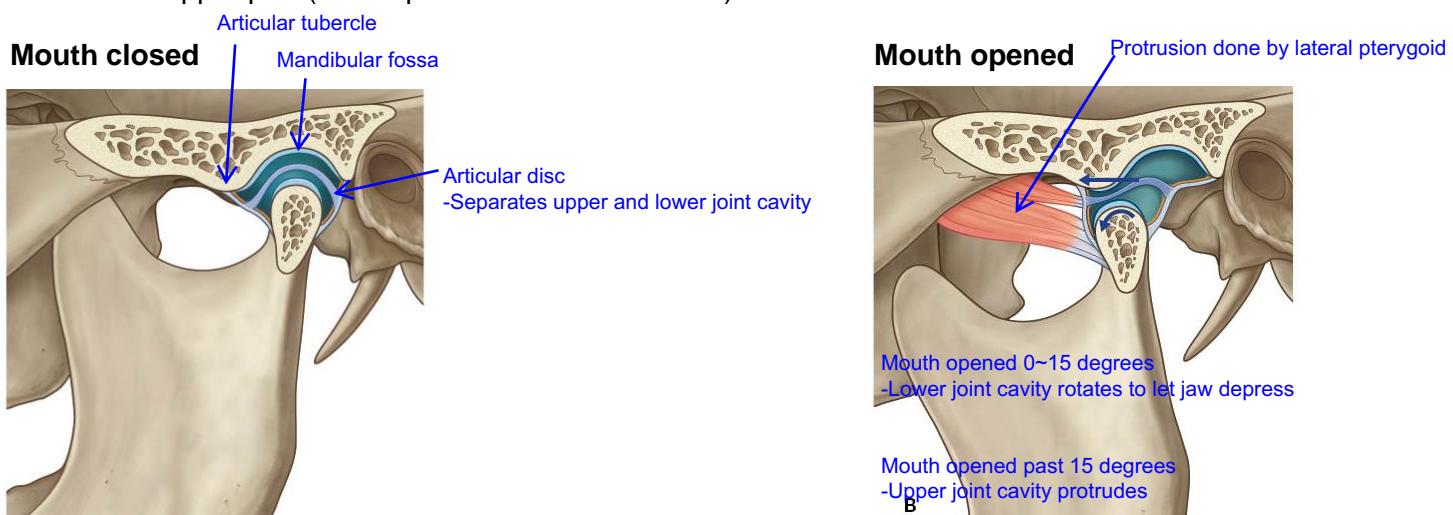


- Internal carotid runs straight into the brain  
The big artery we see here is the external carotid
- The largest branch of external carotid artery
- A major blood supply for all teeth
- Branches within the infratemporal fossa:
  - o middle meningeal a.
  - o inferior alveolar a. (follows inferior alveolar n. to supply all lower teeth)

On top of all of this, there is a PTERYGOID VENOUS PLEXUS. Messing up anesthetics and putting it in this plexus will cause lots of problems

## Temporomandibular joint and its movements

- Allows movements of the jaw (opening, closing, side-to-side)
- Synovial, between the head of ~~mandible~~ and the ~~articular~~ fossa and ~~tubercle~~ of the temporal bone  
 Synovial type of joint      Condylar process      Mandibular      Articular tubercle
- Covered by fibrocartilage  
 Covered by fibrocartilage, as opposed to hyaline cartilage which is usually what's used
- Divided by articular disc into two parts:
  - The lower part (allows depression and elevation)
  - The upper part (allows protrusion and retraction)

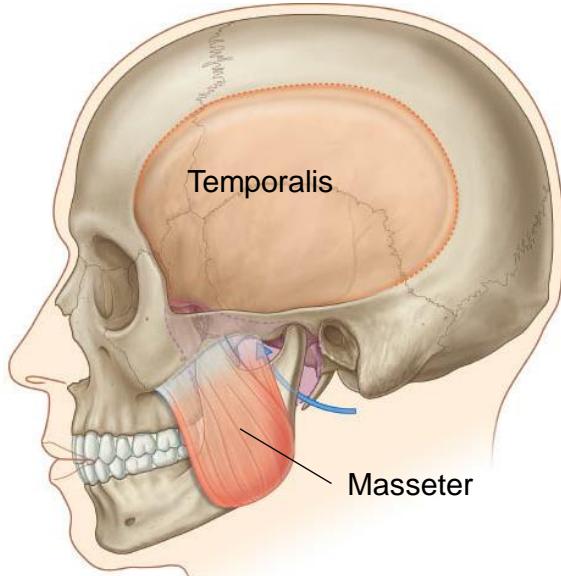


Know these 4 muscles including points of origin and insertion

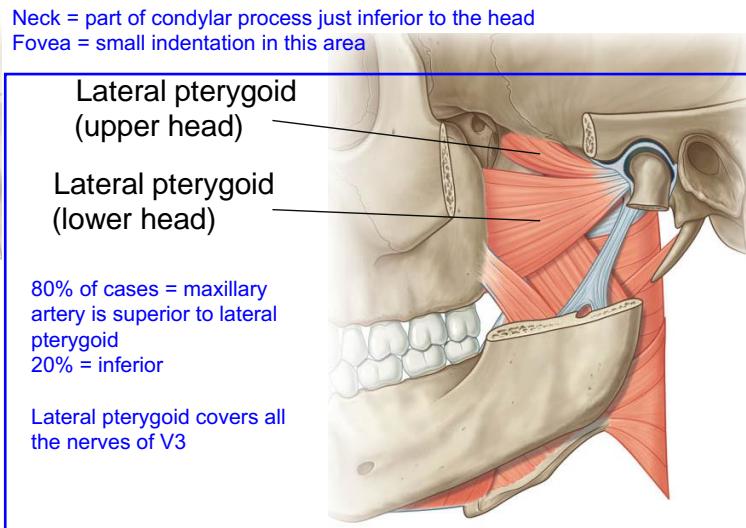
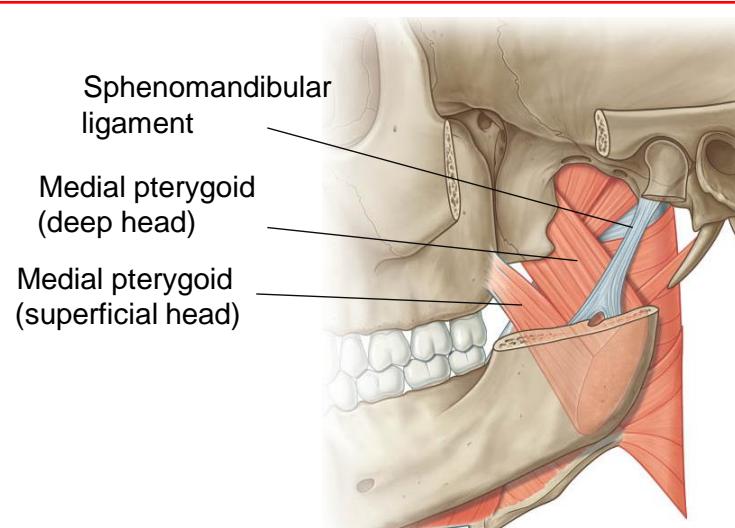
### Muscles of mastication

- Move TMJ to allow opening and closing of the mouth and chewing or side-to-side movements of the lower jaw.

Muscle	Origin	Insertion	Innervation	Function in movement of mandible
Temporalis	Temporal fossa and fascia	Coronoid process <b>medial side of CP</b> and anterior margin of ramus of mandible	Mandibular nerve (V3)	Elevation and retraction
Masseter	Zygomatic arch	Lateral surface of ramus of mandible	Mandibular nerve V3	Elevation



Muscle	Origin	Insertion	Innervation	Function in movement of mandible
Medial pterygoid	<u>Deep head</u> : medial surface of lateral plate of pterygoid process <u>Superficial head</u> : maxilla and palatine bone	Medial surface of angle of mandible	Mandibular nerve V3	Elevation and side-to-side movements
Lateral pterygoid	<u>Upper head</u> : greater wing of sphenoid bone <u>Lower head</u> : lateral surface of lateral plate of pterygoid process	Articular disc of TMJ and <u>pterygoid fovea on neck of mandible</u>	Mandibular nerve V3	Protrusion and side-to-side movements



# Head and Neck (4): Pterygopalatine Fossa and Maxillary Nerve (V2); Submandibular Region

November 19, 2015

Dr. Paweł Kindler

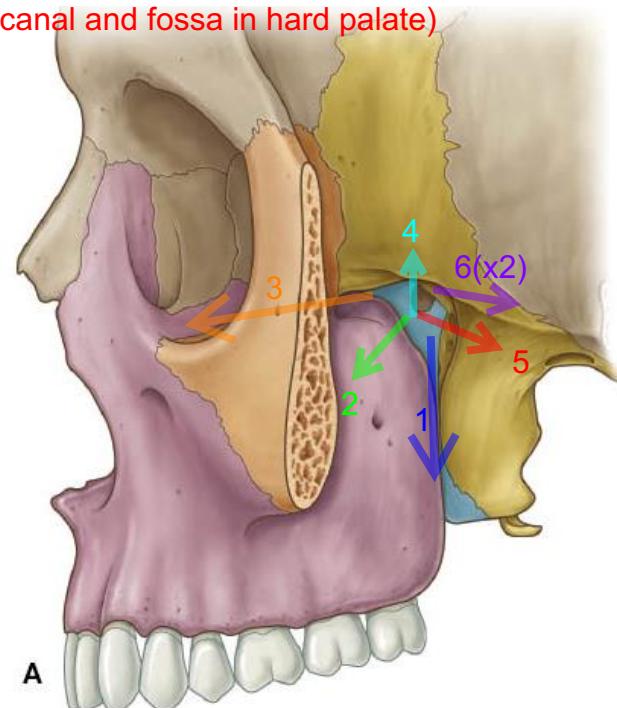
Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture you should be able to identify, define and /or describe:

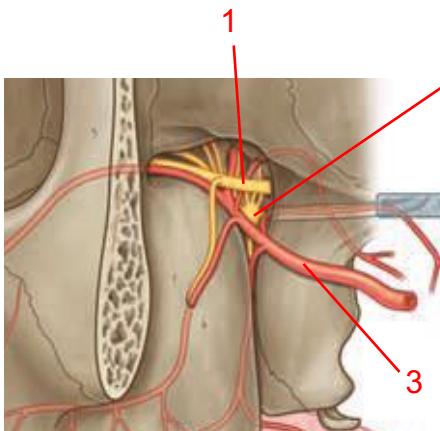
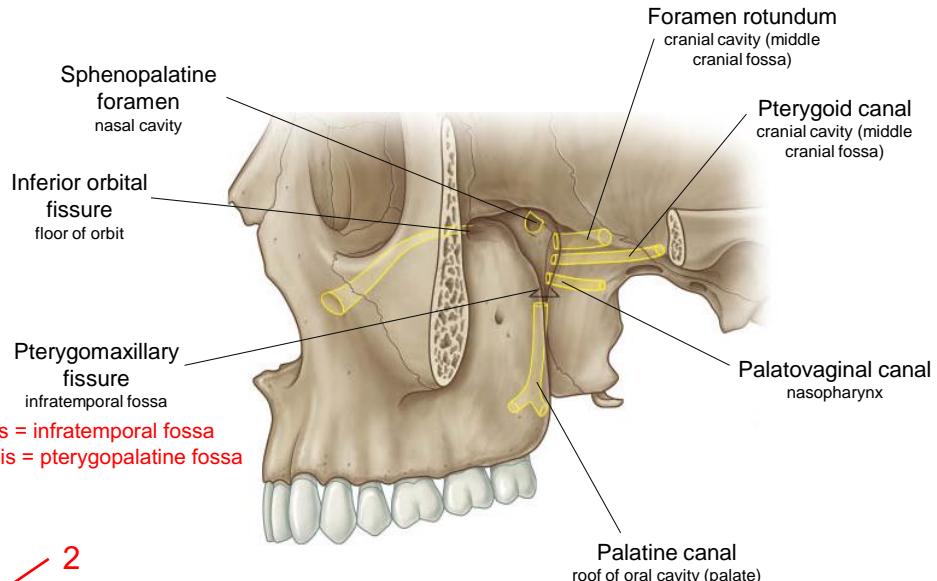
- Bony framework and gateways of pterygopalatine fossa
- Maxillary nerve (V2) and its major branches
- Pterygopalatine ganglion
- Maxillary artery and its major branches
- Boundaries and contents of submandibular region (triangle)

## Pterygopalatine fossa

- Pterygopalatine fossa is small in size but strategically located as it communicates with:
  1. Roof of the oral cavity (hard palate)
  2. Infratemporal fossa (lateral)
  3. Floor of the orbit
  4. Lateral wall of nasal cavity (targeting incisive canal and fossa in hard palate)
  5. Nasopharynx
  6. Middle cranial fossa (2 ways:
- Skeletal framework:
  - Posterior wall and roof
    - sphenoid bone
    - foramen rotundum
    - anterior opening of the pterygoid canal
    - palatovaginal canal
  - Medial wall
    - palatine bone
    - sphenopalatine foramen
  - Anterior wall
    - posterior surface of maxilla
    - inferior orbital fissure



## Gateways



### Contents of pterygopalatine fossa include:

1. Maxillary nerve (V2) (purely sensory) and its branches
2. Pterygopalatine ganglion **Largest psymp ganglion in the head**
3. Maxillary artery and its branches

## Maxillary nerve (V2)

**Course:** Trigeminal ganglion in middle cranial fossa > foramen rotundum > pterygopalatine fossa > inferior orbital fissure and canal > emerges from infraorbital foramen as infraorbital nerve

### Branches of V2: Purely sensory

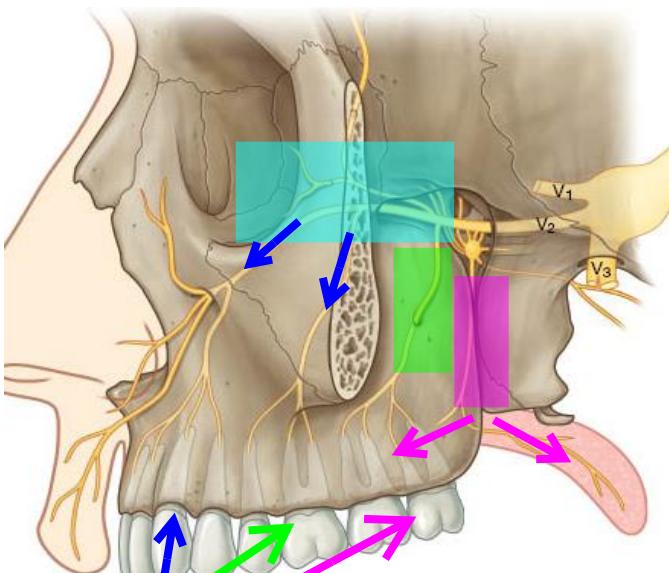
1. Palatine nerves (from the pterygopalatine ganglion) → **palatine canal** → exit through greater and lesser palatine foramina as **greater palatine nerves** to innervate hard palate and lingual gingiva of molars and premolars, and as **lesser palatine nerves** to supply soft palate.

2. Posterior superior alveolar n. → pterygomaxillary fissure → infratemporal fossa → **alveolar foramen** → to innervate molar teeth and corresponding buccal gingiva

3. Infra-orbital n. + zygomatic n. and orbital branches → **inferior orbital fissure**

Infra-orbital n. enters infra-orbital canal where it gives origin to the **middle and anterior superior alveolar nerves** to innervate the remaining upper teeth and corresponding buccal gingiva.

Focus mainly on infraorbital nerve



Posterior, middle, and anterior alveolar nerves form the SUPERIOR DENTAL PLEXUS

Infra-orbital n. ultimately exits through infra-orbital foramen to innervate structures discussed last week.

4. Nasal n. → sphenopalatine foramen → lateral wall of the nasal cavity → exits through the incisive canal and fossa in the hard palate as **nasopalatine nerve** to innervate gingiva associated with incisor and canine teeth  
 WHEN IT EXITS INCISIVE FOSSA, IT IS CALLED NASOPALATINE NERVE

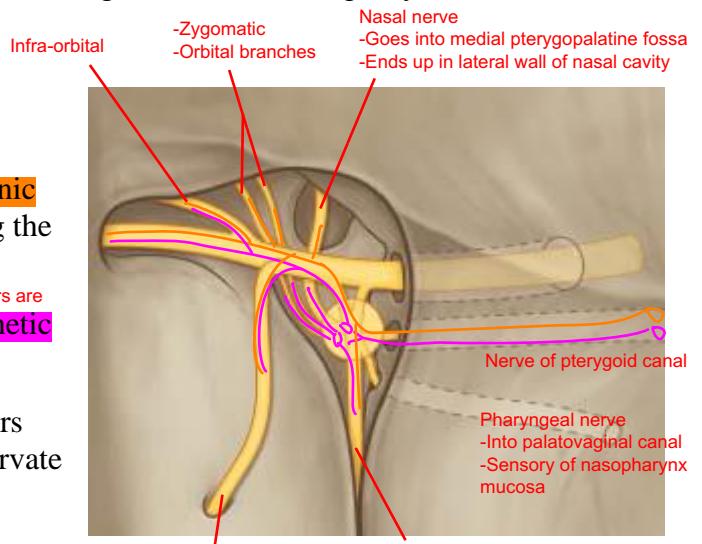
5. Pharyngeal n. (from the pterygopalatine ganglion) → palatovaginal canal → nasopharynx

### Pterygopalatine ganglion

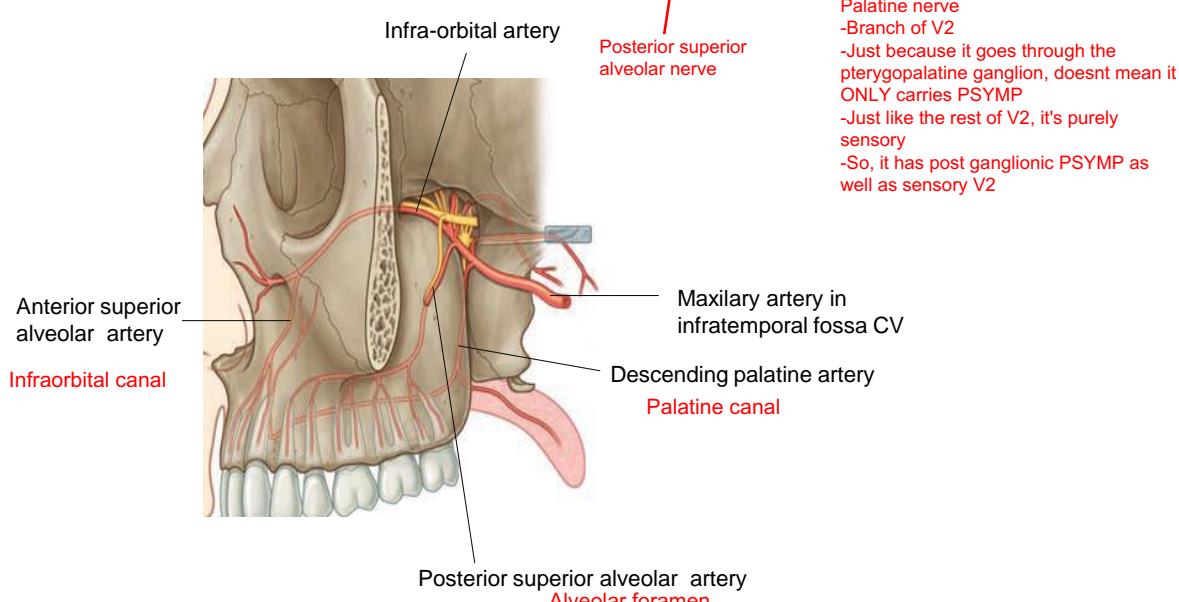
- The largest parasympathetic ganglion in the head
- Receives preganglionic parasympathetic fibers (from facial nerve via **greater petrosal n.**) and **postganglionic sympathetic fibers** (via **deep petrosal n.**), all forming the **nerve of pterygoid canal**

Why postganglionic symp? Because superior cervical ganglion is where preganglionic symp fibers are

- Formed by **cell bodies of postganglionic parasympathetic neurons**
- Postganglionic parasympathetic and sympathetic fibers leave the ganglion by **joining branches of V2** to innervate **all glands above the oral fissure (including lacrimal gland)** and mainly blood vessels, respectively.



### Maxillary artery



### Submandibular region (triangle)

#### Boundaries:

- Inferior border of mandible superiorly
- Anterior and posterior bellies of digastric muscle inferiorly

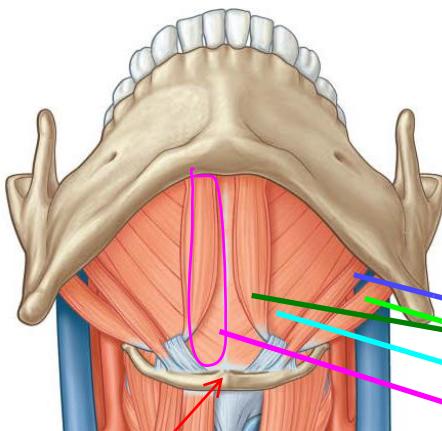
#### Muscles:

4 pairs, all superior to the hyoid bone (suprathyroid)

1. Stylohyoid m.
2. Digastric m. (**posterior** and **anterior** bellies)
3. Mylohyoid Wide and flat. Connects 2 sides of mandible
4. Genihyoid Not seen. Underneath mylohyoid

Other structures: submandibular and sublingual salivary glands, and hypoglossal nerve CN12

Hyoid bone. All muscles above this are called suprathyroid bones



# Head and Neck (5): Oral Cavity and Palates; Review of the Neck II

November 26, 2015

Dr. Paweł Kindler  
Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture you should be able to identify, define and /or describe:

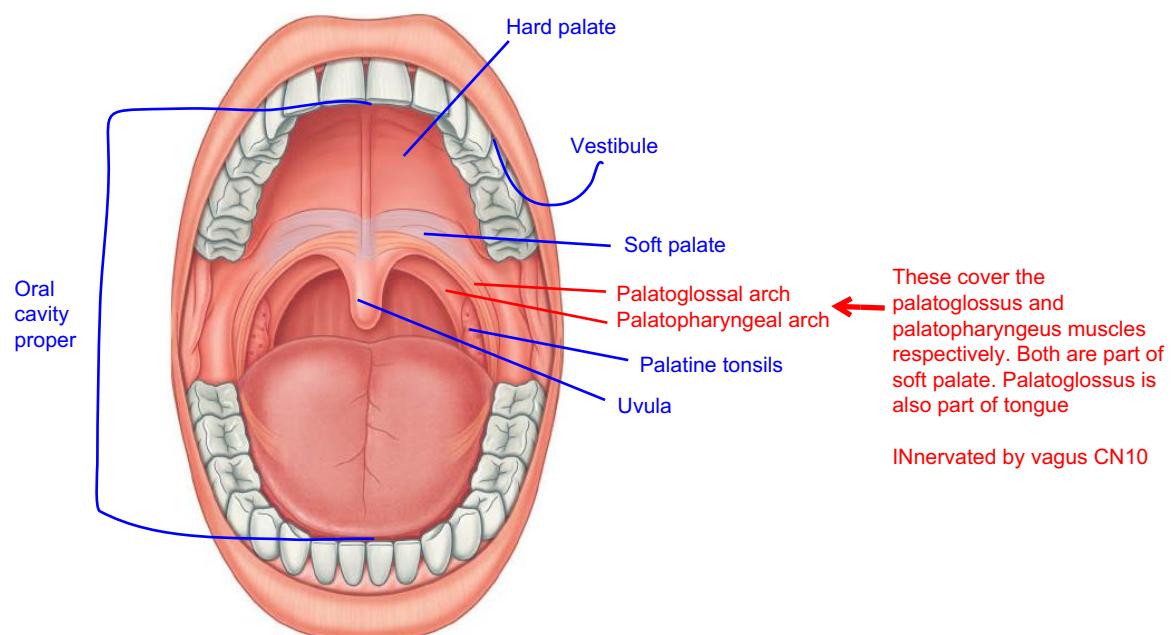
- Contents of the oral cavity
- Location and innervation of the tongue
- Hard and soft palates, including innervation and blood supply
- Innervation of the teeth and gums
- Superficial muscles and major blood vessels of the neck
- Larynx and pharynx
- Lymphatics of the head and neck

## Oral cavity

- Inferior to the nasal cavities
- Separated into two regions:
  1. Oral vestibule: space between the lips and cheeks externally + teeth and gums internally
  2. Oral cavity proper
    - The roof = hard + soft palates
    - The floor = muscles + the tongue
    - Lateral walls = dental arches
    - The anterior opening = oral fissure
    - The posterior aperture = oropharyngeal isthmus

Mouth has 2 main areas:

1. Vestibule
  2. Oral cavity proper
- ROOF = hard/soft palate  
-FLOOR = muscles and tongue  
-WALLS = dental arches  
-POSTERIOR = oropharyngeal isthmus.  
Opens into oropharynx which can be opened/closed by soft palate and tongue

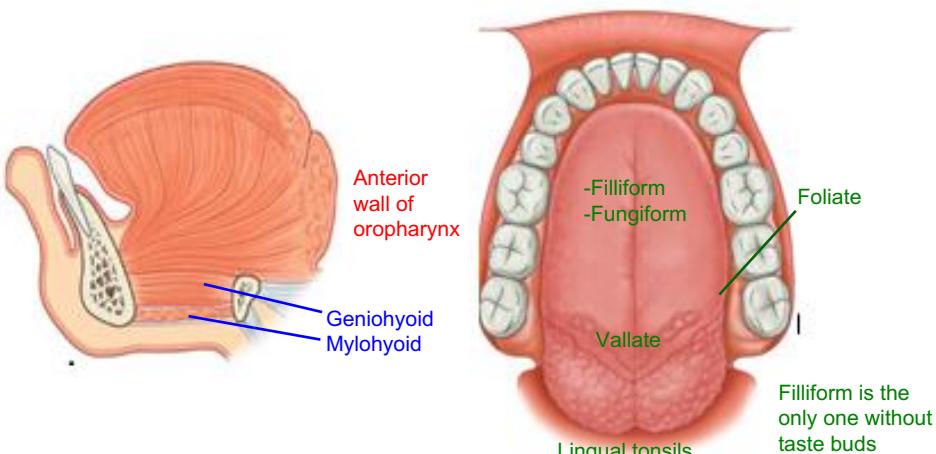


## Tongue

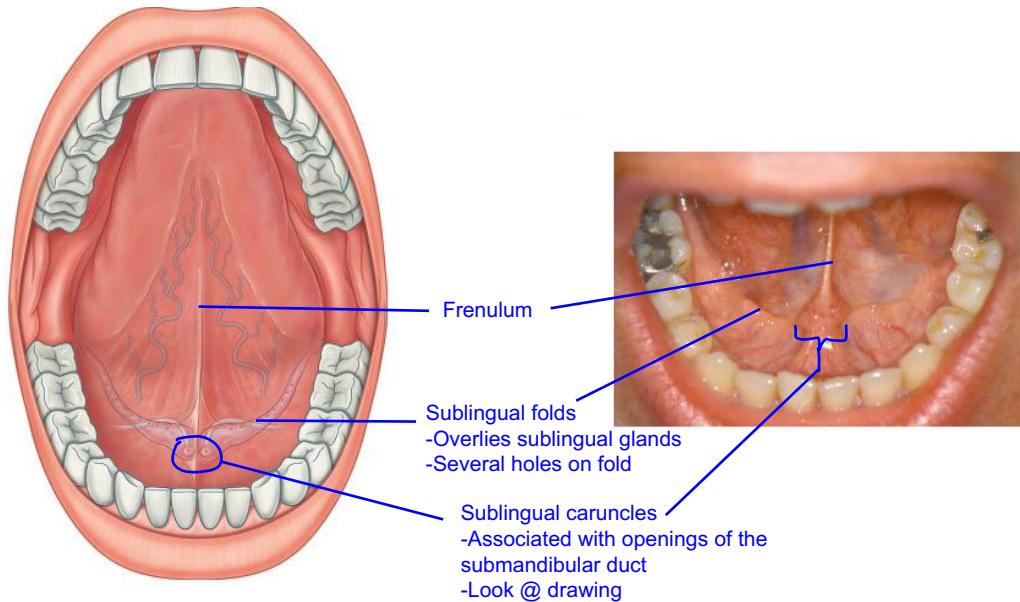
Oral part: in the oral cavity

- Pharyngeal part: forms part of the anterior wall of the oropharynx; attached to the mandible and hyoid bones  
Hyoid bone
  - a key bone in the neck: connects the floor of oral cavity with larynx and pharynx
- Oral surface: filiform, fungiform, vallate and foliate papillae; all except the filiform have taste buds on their surfaces.
- Pharyngeal surface: lingual tonsil consisting of numerous small nodules of lymphoid tissue.
- V-shaped terminal sulcus: separates the two surfaces.

Tongue has 2 parts:  
1. ORAL PART - the part we see  
2. PHARYNGEAL PART - anterior wall of oropharynx



## Sublingual region



## Innervation of the tongue

### Sensory (anterior 2/3)

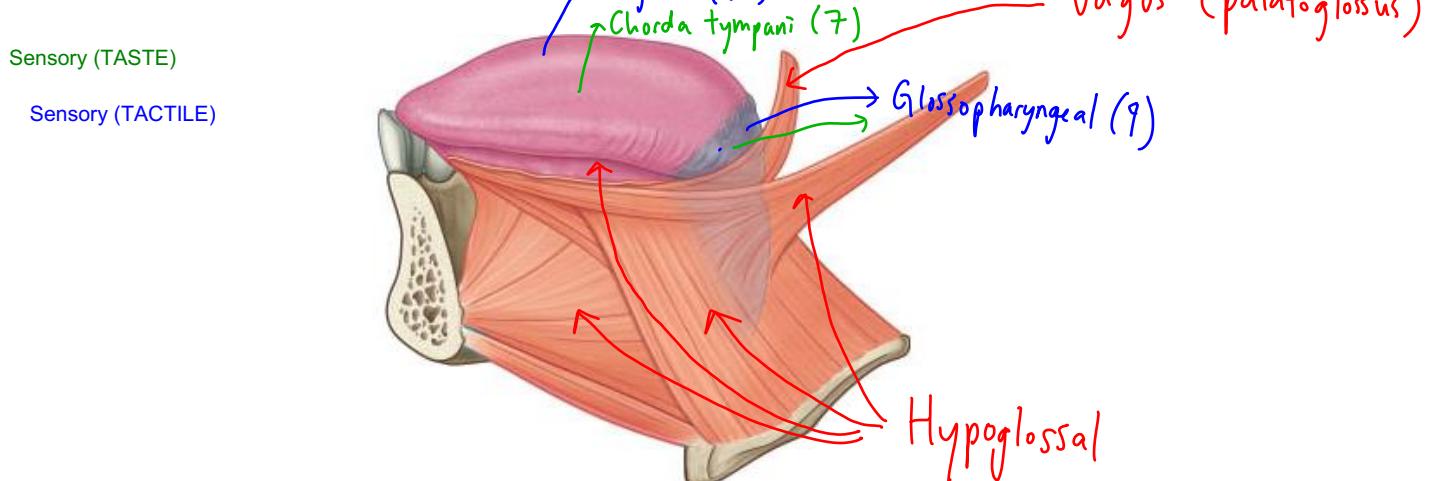
- General sensation: mandibular n. (V3) via lingual n.
- Taste: facial n. (VII) via chorda tympani

### Sensory (posterior 1/3)

- General and taste sensations via glossopharyngeal n. (IX)

### Motor

- Provided by hypoglossal n. (XII) to all muscles, except for one which is innervated by vagus n. (X)



## Palates

Hard palate: palatine + horizontal processes of maxillary and palatine bones, respectively.

Soft palate: a movable muscular valve - can close oropharyngeal isthmus (or separate nasopharynx from oropharynx); is attached to the tongue and pharynx by palatoglossal and palatopharyngeal arches, respectively.

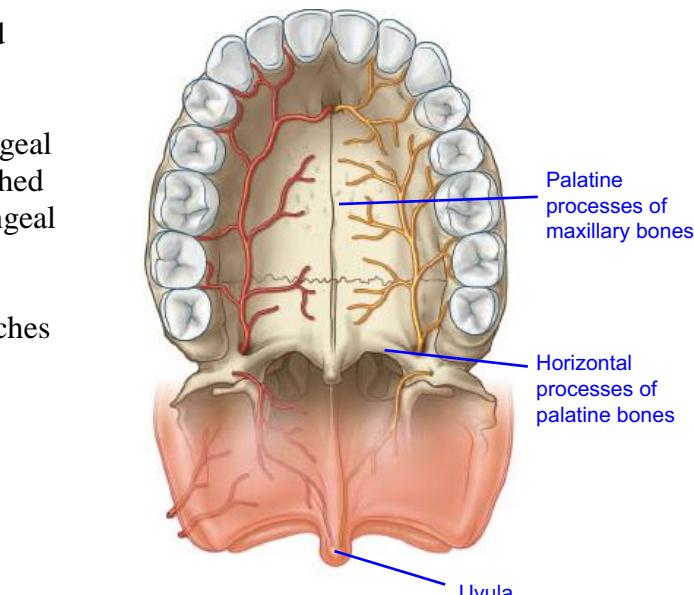
Nerve supply: greater palatine and nasal (nasopalatine) branches of the maxillary nerve (from the pterygopalatine ganglion)

Blood supply: mainly by greater and lesser palatine arteries

In addition to palatoglossus and palatopharyngeus, muscles of the palate include tensor and levator veli palatini and musculus uvulae



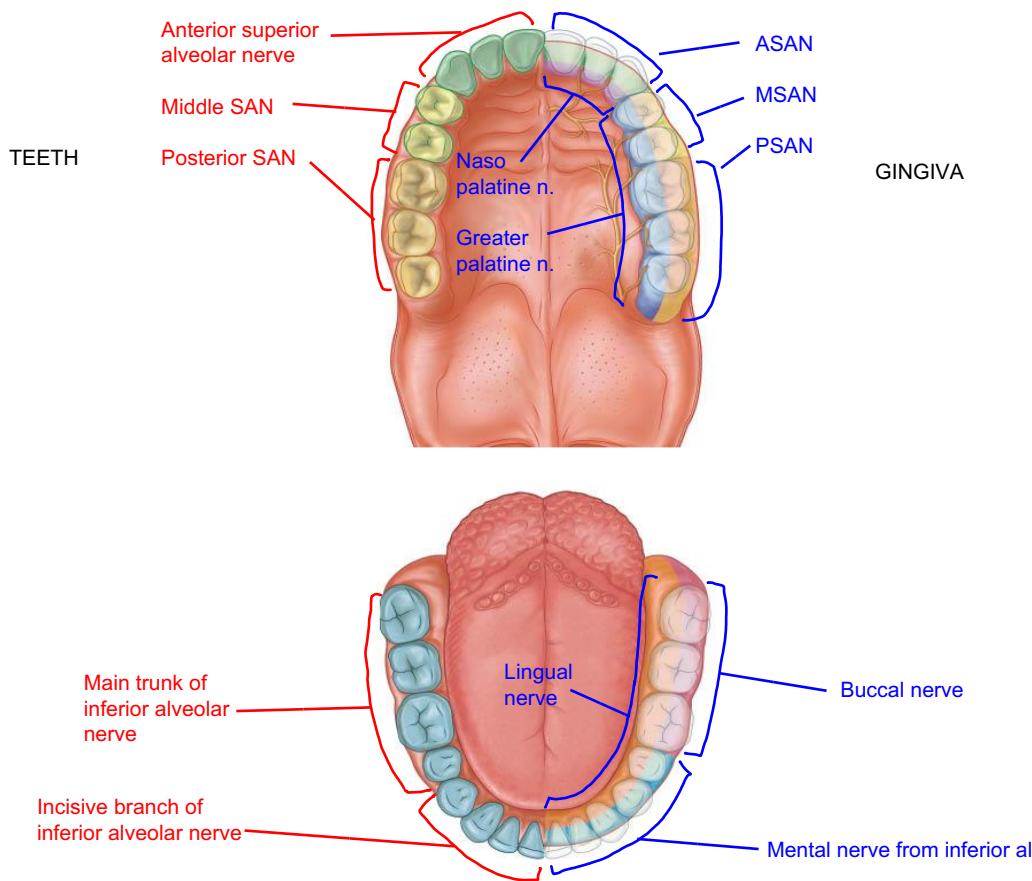
Support soft palate from skull  
(Suspends from above and supports from below)



Gag reflex  
-Sensory: Glossopharyngeal  
-Motor: Vagus

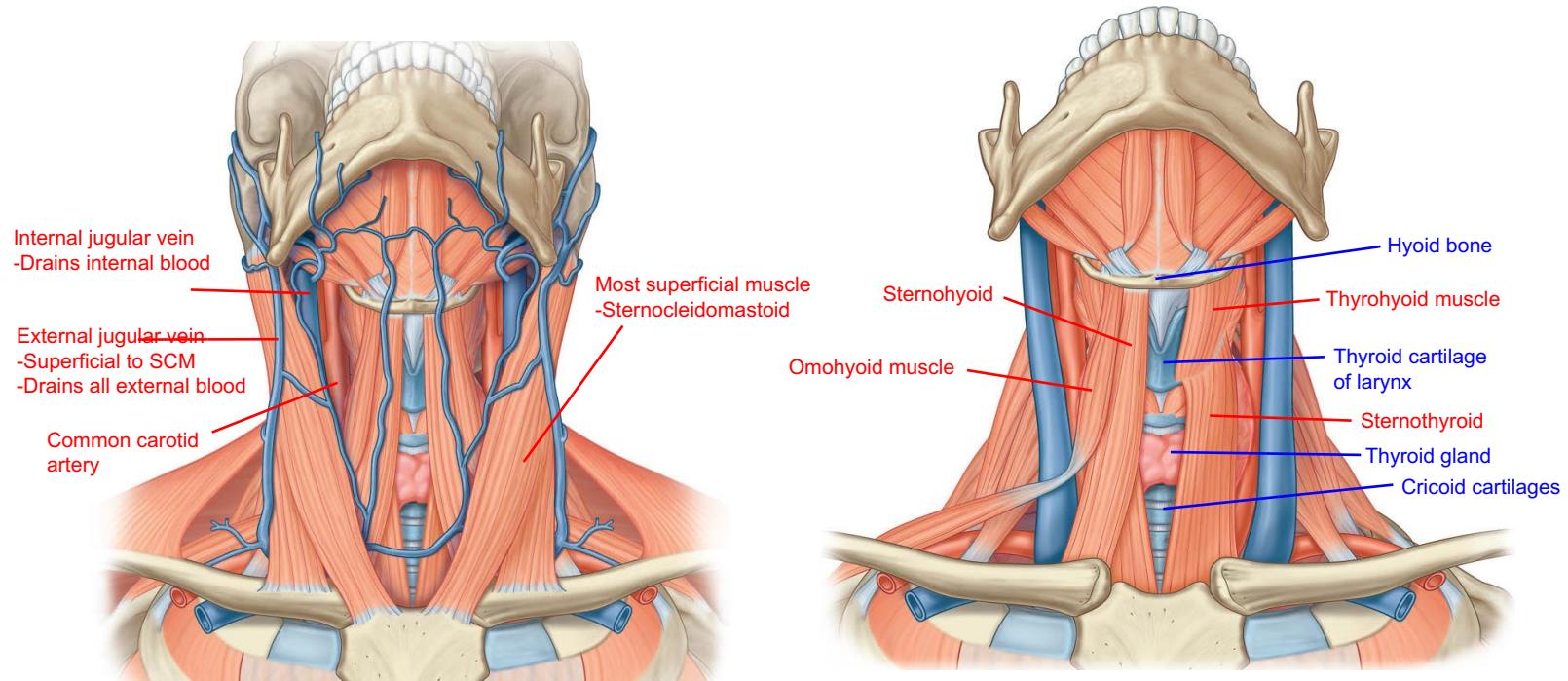
Note: ALL upper teeth and gingiva are innervated by V2, just different branches  
 Note: ALL lower teeth and gingiva are innervated by V3, just different branches

## Innervation of teeth and gums



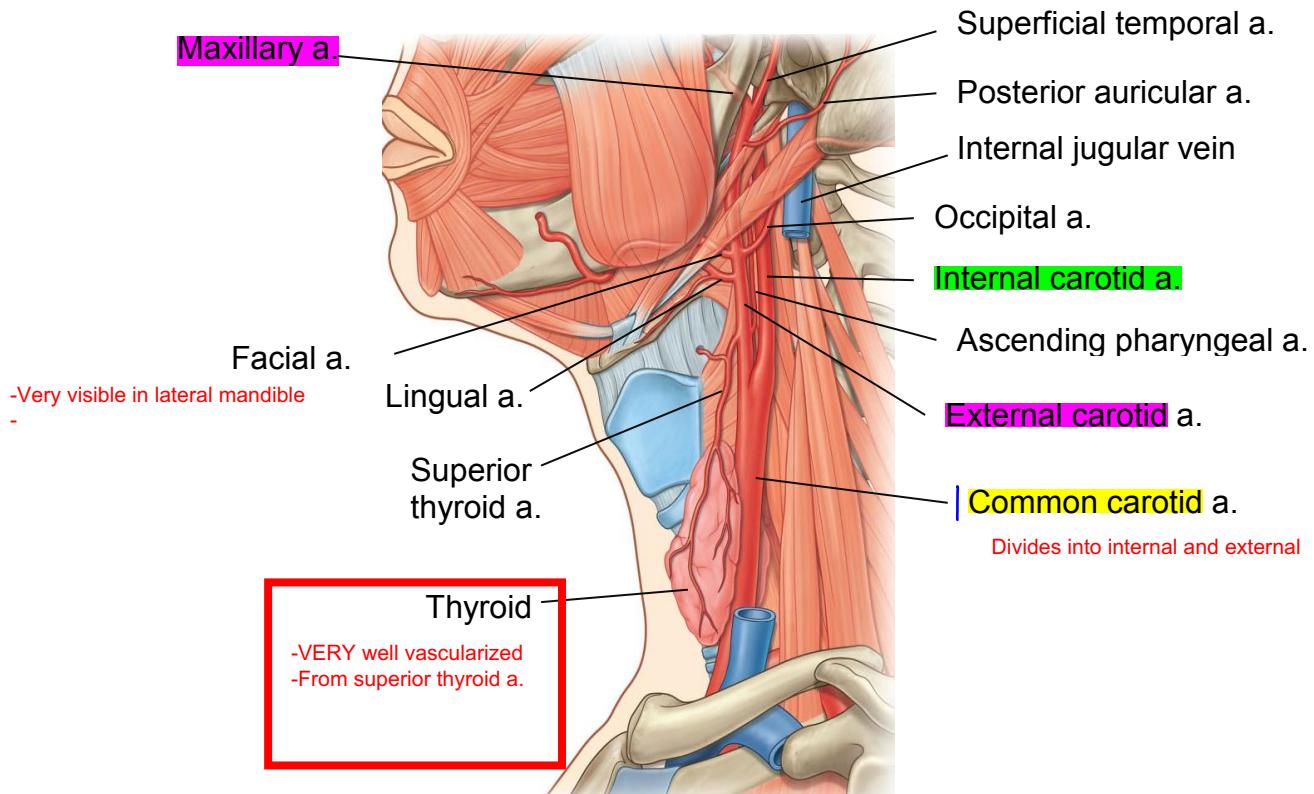
## Review of the neck

### Muscles and vessels



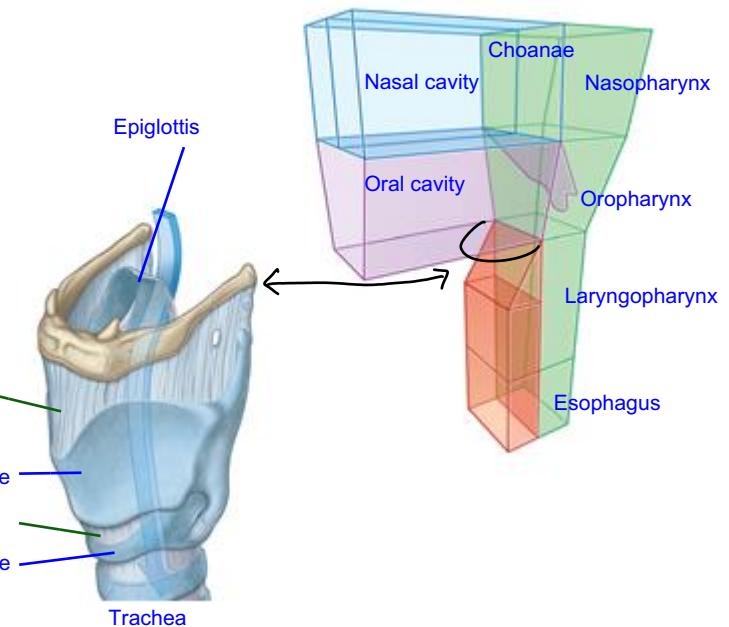
## Carotid system

Watch this part on lecture capture



## Larynx

- Hollow; framework composed of several cartilages
- Cavity continuous with the trachea (inferiorly) and laryngopharynx (posteriorly and superiorly)
- Acts as a:
  1. Sphincter (to close the lower respiratory tract)
  2. Sound generator (contains vocal cords)
- Thyroid gland is located inferiorly and laterally to the thyroid cartilage



## Pharynx

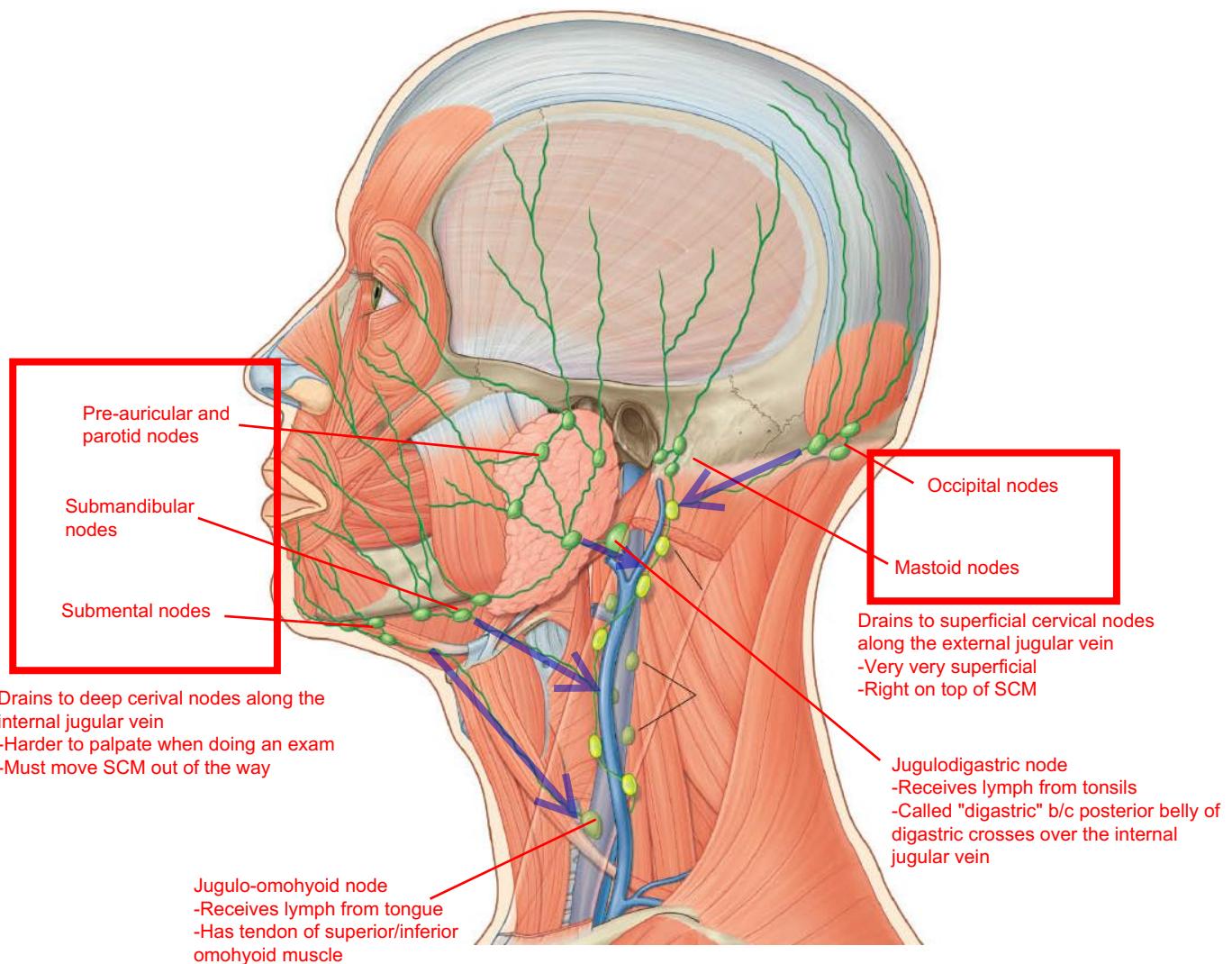
- Half-cylinder consisting of muscles and fascia
- Links oral and nasal cavities to the larynx (at the level of hyoid bone) and esophagus (at vertebral level CVI)

## Lymphatics of the head and neck

- A system of superficial nodes around the head and along the external jugular vein and deep nodes along the internal jugular vein
- Superficial lymph nodes around the head include:

Occipital Mastoid → drain to superficial nodes along the external jugular v.

Pre-auricular and parotid  
Submandibular  
Submental → drain to deep nodes along internal jugular v.



# Thorax (1): General Organization of the Thoracic Walls, Pleural Cavities and Lungs

December 3, 2015

Dr. Paweł Kindler

Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture, you should be able to describe, define and/or identify:

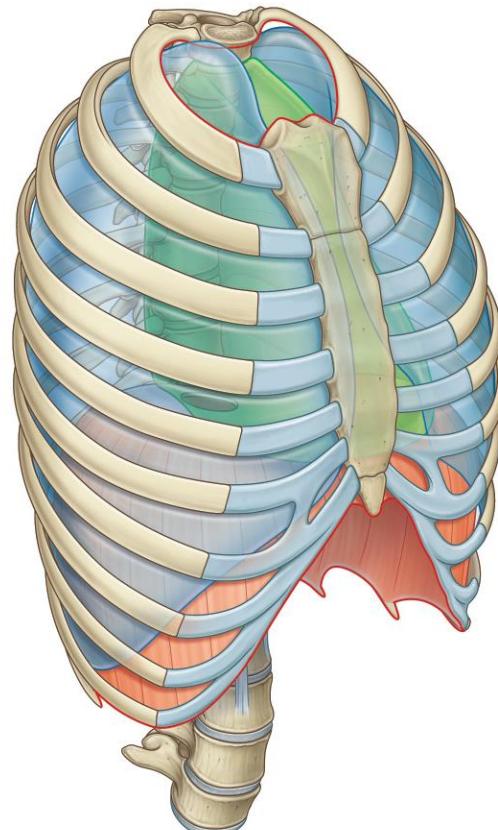
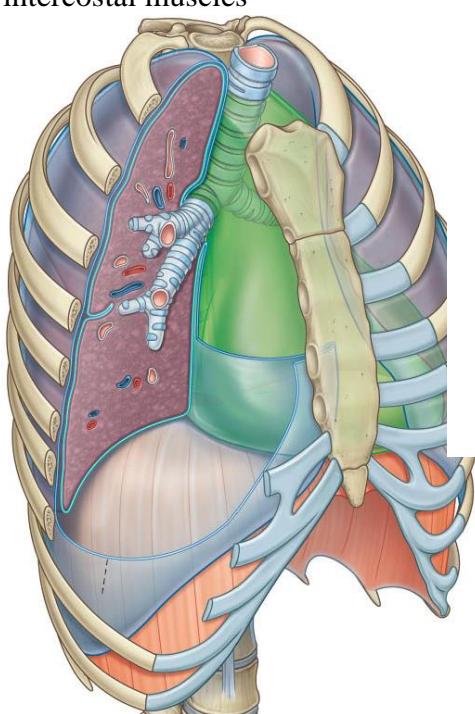
- General functions and components of the thorax
- Skeletal framework and muscles
  - Thoracic vertebra, ribs and sternum
  - Intercostal muscles and spaces
  - Thoracic apertures
- Thoracic cavity: pleura, lungs and bronchial tree
- The anatomical and clinical importance of the horizontal plane joining the sternal angle with the TIV/V intervertebral disc
- Mediastinum and its parts

**Thorax:** a cylinder with two openings (superior and inferior apertures)

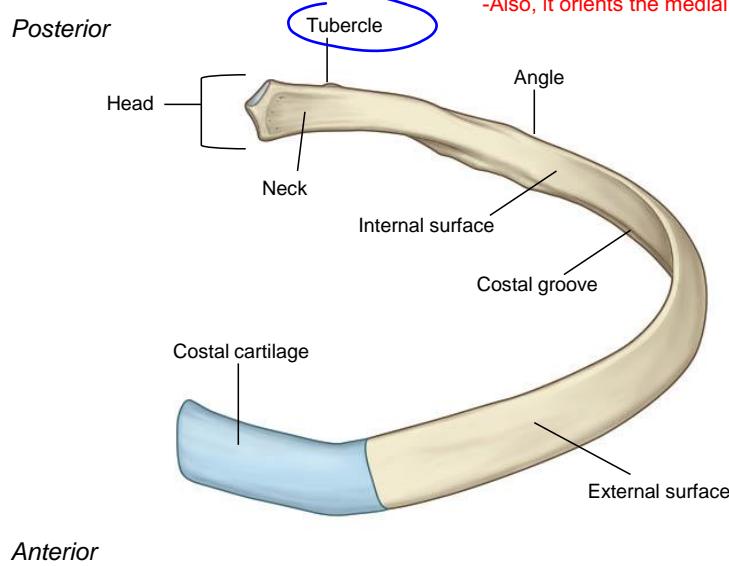
Functions  
-Breathing  
-Protect organs  
-Conduit

## Components:

- Thoracic wall:  
ribs + sternum + intercostal muscles
- Apertures
- Thoracic cavity:  
pleura +  
lungs +  
mediastinum

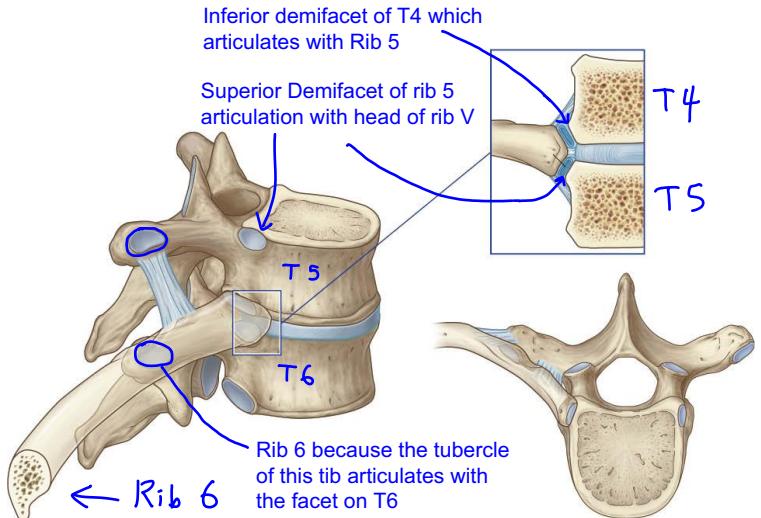


## Thoracic wall: ribs



-VAN and stuff are in the costal groove  
-Also, it orients the medial inferior side of the rib

## Articulation of two adjacent thoracic vertebrae with a rib



## Thoracic wall: sternum and muscles

3 layers of muscles in intercostal spaces

### EXTERNAL INTERCOSTAL M

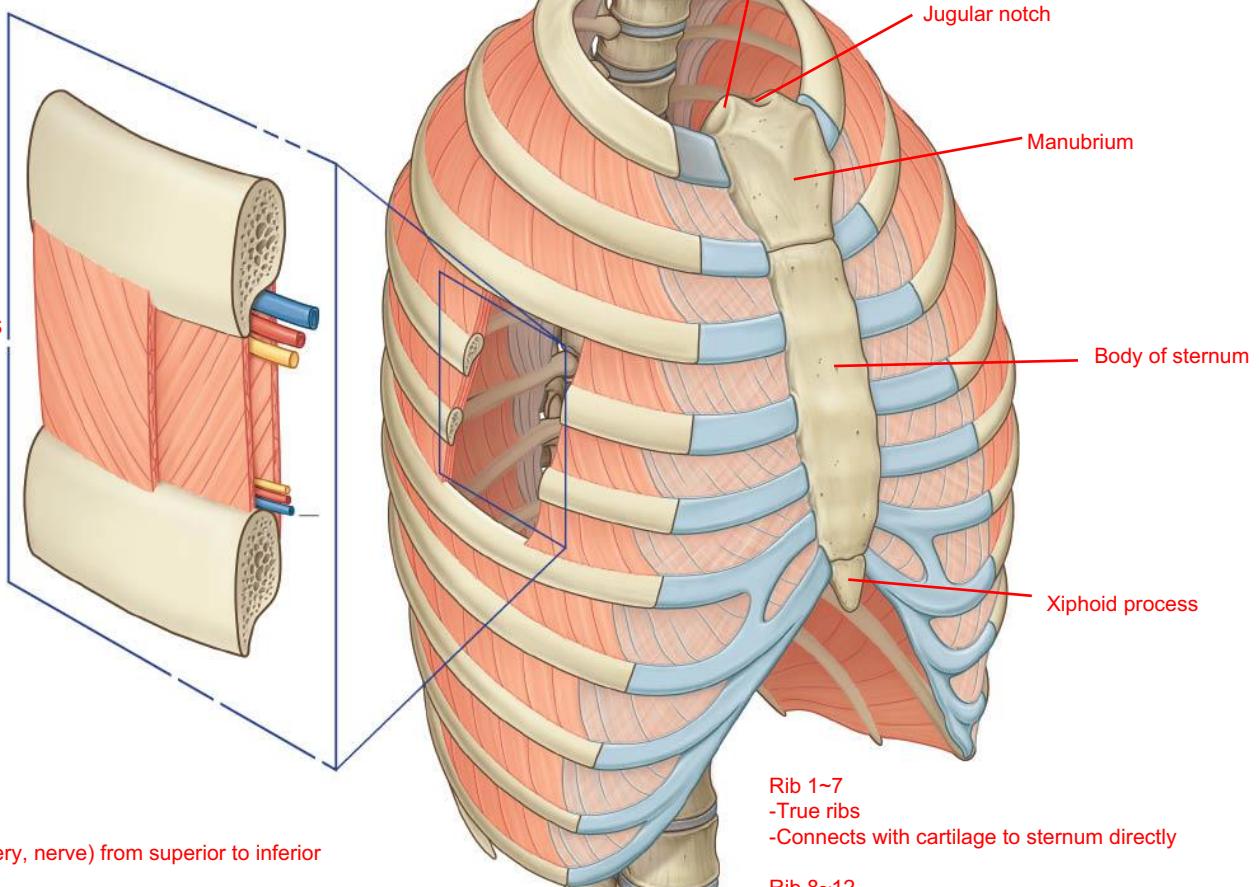
- Oriented like pockets in coats
- Doesn't exist just lateral to sternum
- Instead, there is external intercostal membrane
- Muscles only go to TUBERCLES to COSTAL CARTILAGES

### INTERNAL INTERCOSTAL M

- Opposite to external
- Go from STERNUM to ANGLE OF RIBS

### INNERMOST INTERCOSTAL M

- Lateral thoracic wall



In between muscles

- Blue = intercostal vein
- Red = intercostal red
- Yellow = intercostal nerve

-Remember VAN (vein, artery, nerve) from superior to inferior

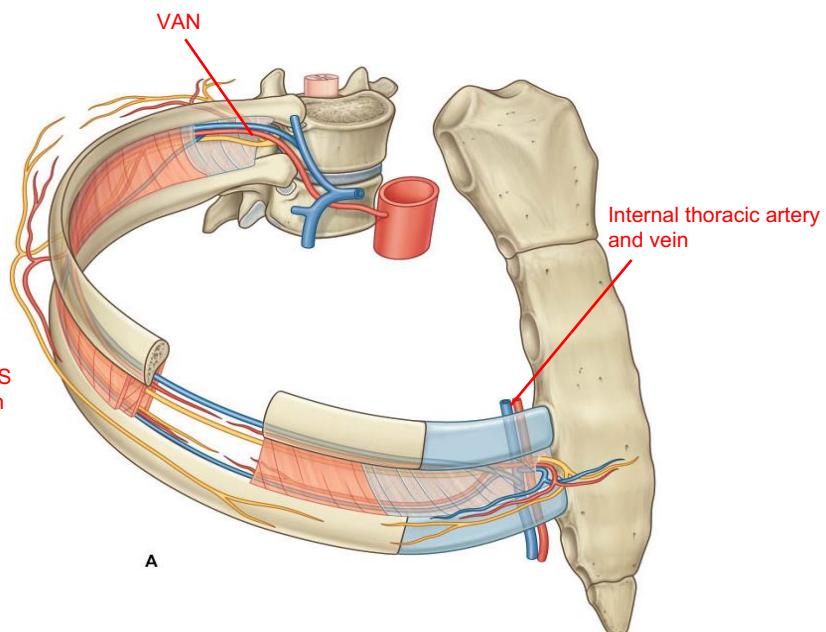
Rib 1~7  
-True ribs  
-Connects with cartilage to sternum directly

Rib 8~12  
-False ribs

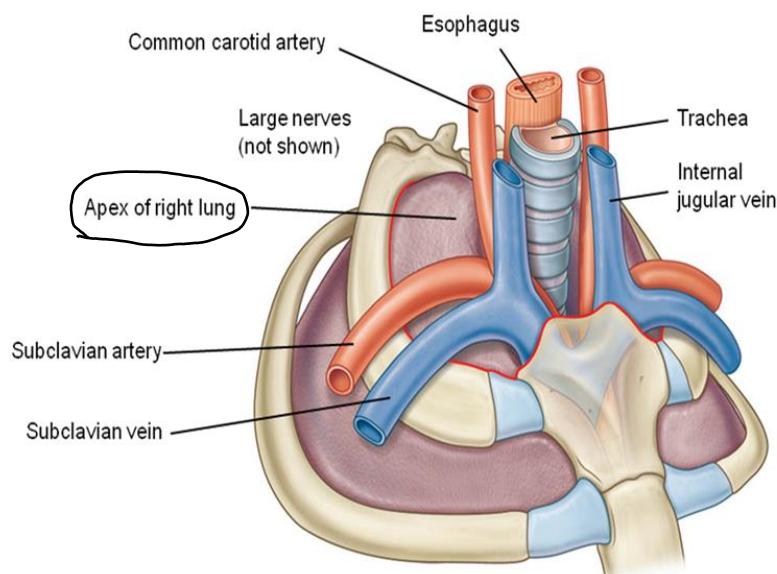
Rib 11~12  
-Floating ribs

## Intercostal spaces

- This is between rib 4 and 5
- When nerves leave the spine, it divides into ant/post ramii
- This is the ANTERIOR RAMUS of the spinal nerve
- Intercostal nerves are ANTERIOR RAMII
- 



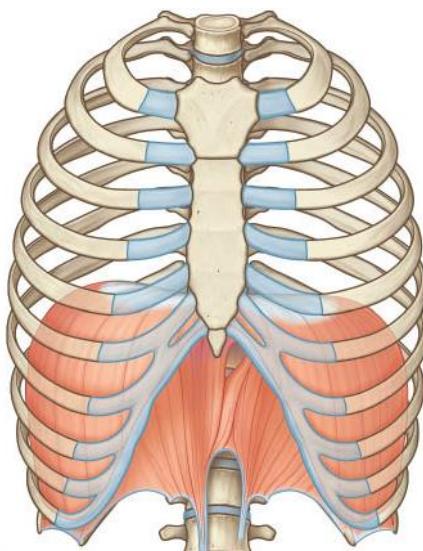
## Superior and inferior thoracic apertures



- Superior aperture:
- the body of vertebra T1
  - medial margin of rib I
  - manubrium

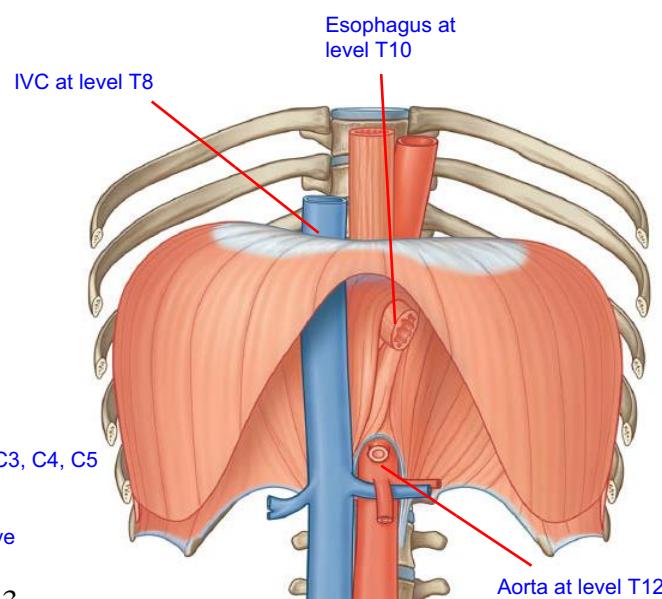
## Inferior aperture:

Large and expandable; closed by diaphragm

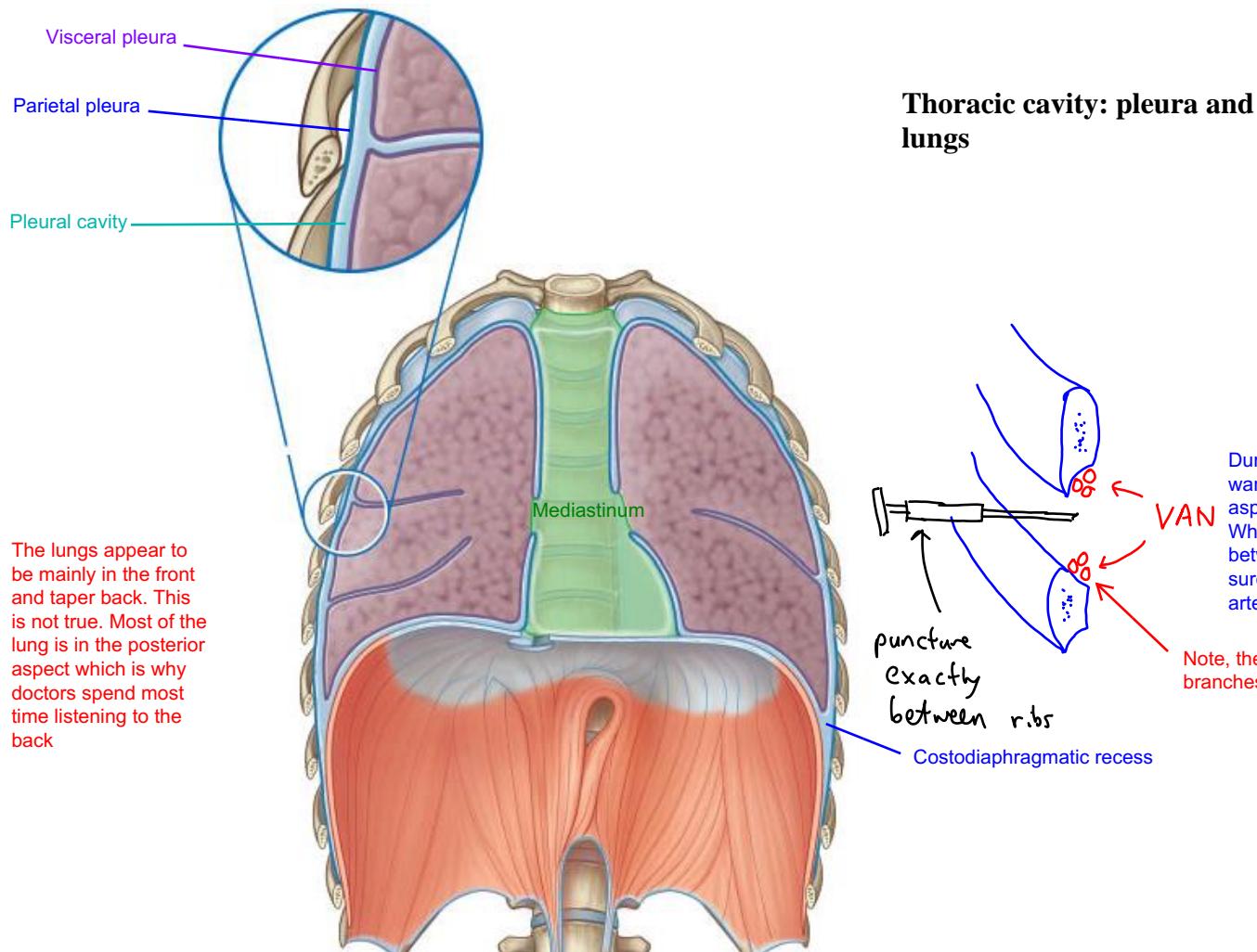


Diaphragm innervated by C3, C4, C5  
 PHRENIC NERVES  
 3, 4, 5, keep your body alive

These 3 structures have to pierce the diaphragm



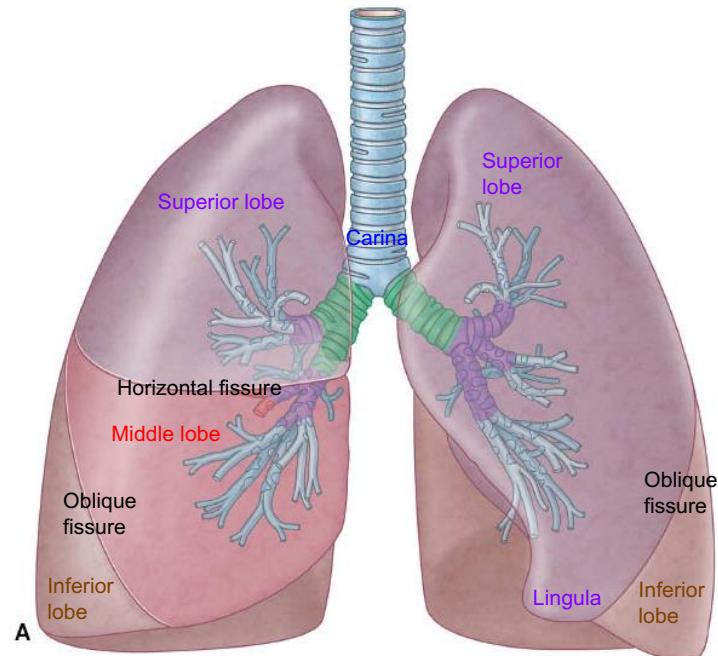
-Negative pressure keeps the lungs attached to the walls  
 -Perforation = lung will collapse = pneumothorax



## Lungs and bronchial tree

Teeth and objects usually end up in the right lobe because there's more air going there and it's more vertical

Green = bronchus = rings of cartilage  
 Purple = Secondary lobar bronchus = plates of cartilage



## Mediastinum

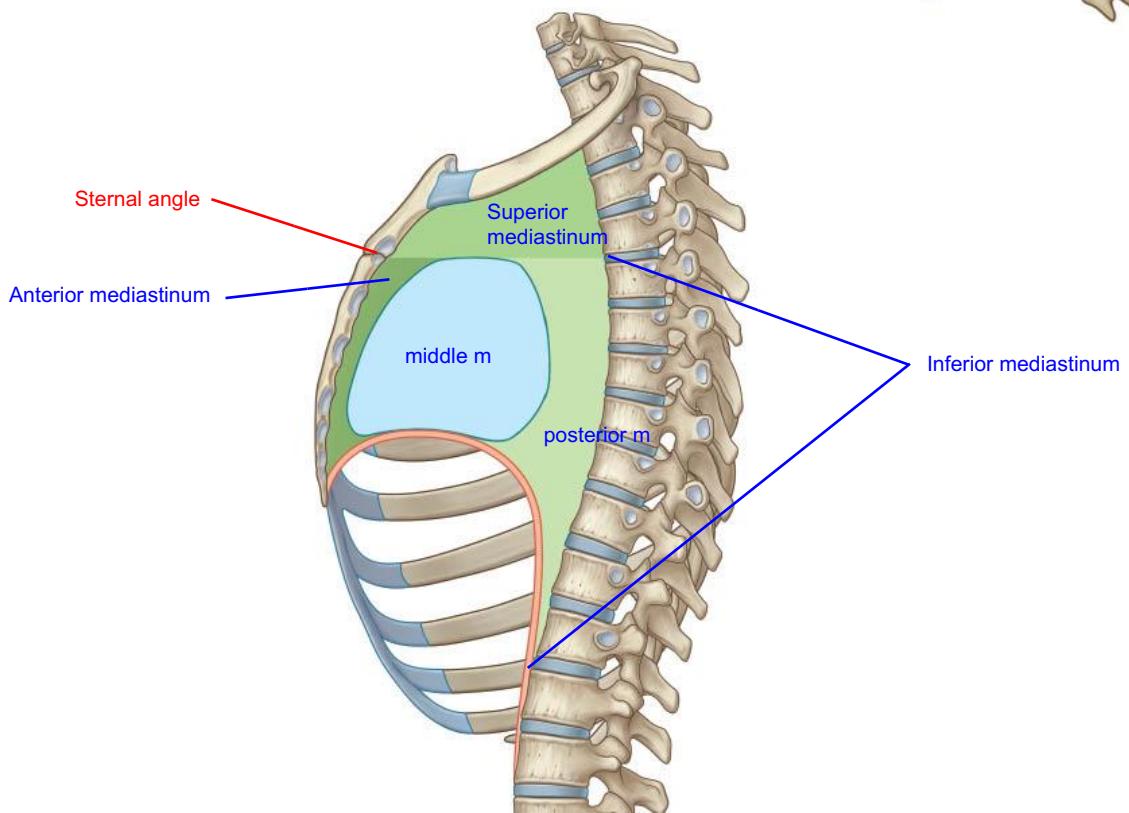
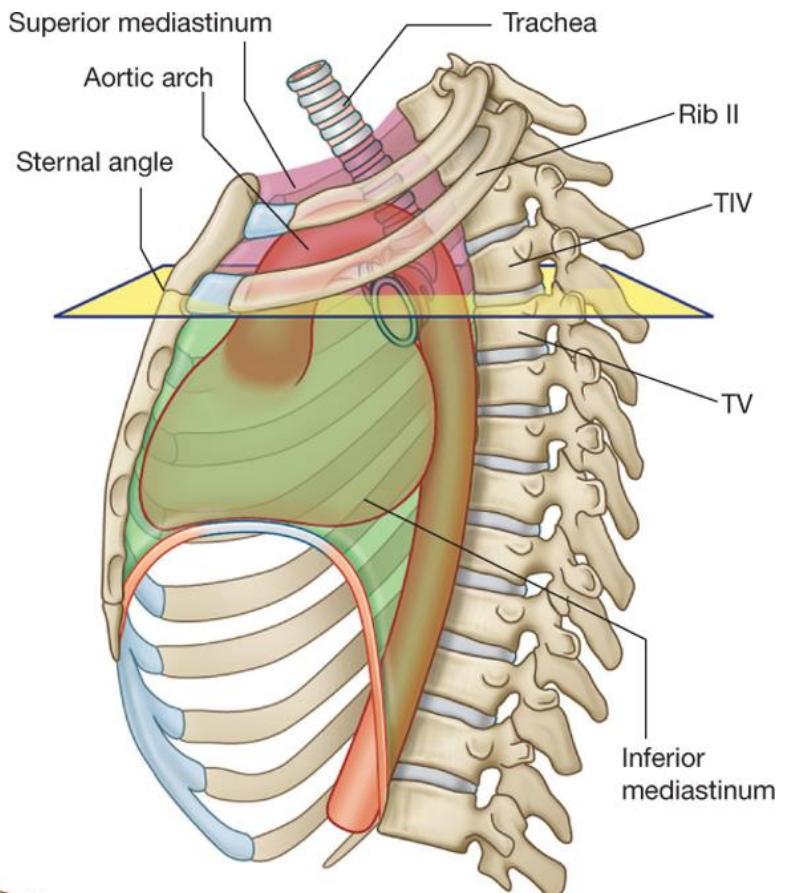
The horizontal plane joining the **sternal angle** with the **TIV/V** intervertebral disc is one of the most significant planes in the body because it:

- Separates superior mediastinum from inferior mediastinum
- Indicates the **location of rib II**
- Marks where the arch of aorta begins and ends
- Marks the level at which the trachea bifurcates into left and right bronchi

Trying to find landmarks on a patient

-Feel the sternal angle

-Go laterally, this is rib 2



# Thorax (2): Middle Mediastinum and Heart; Superior and Posterior Mediastinum

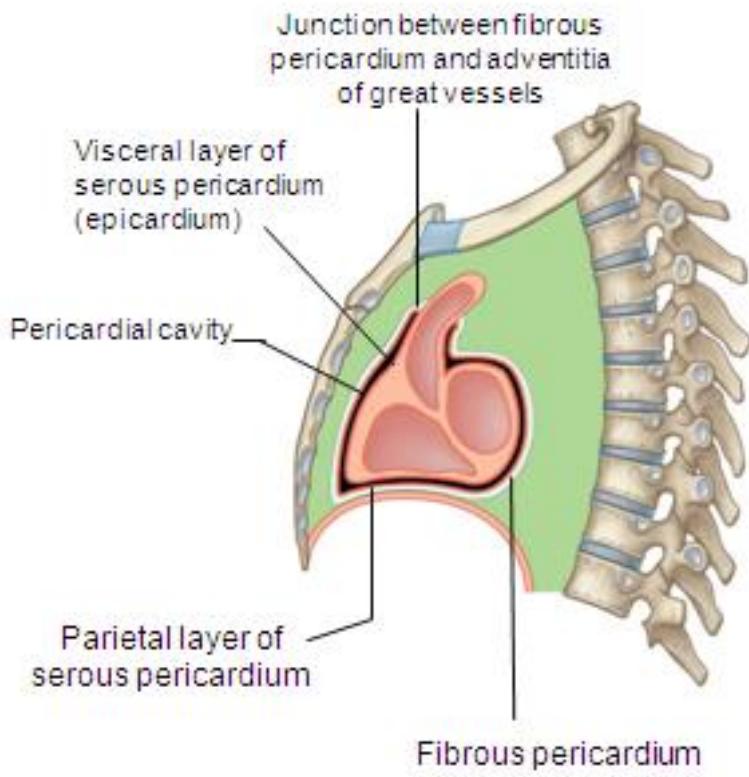
December 10, 2015

Dr. Paweł Kindler  
Department of Cellular and Physiological Sciences &  
MD Undergraduate Program  
LSC 1545

Following the lecture, you should be able to describe and/or define:

- Location and contents of the middle mediastinum, including:
  - ✓ Components of pericardium
  - ✓ Coronary blood vessels
  - ✓ Internal cardiac structures within each of the four chambers
- Location and contents of the superior mediastinum
- Location and contents of the posterior mediastinum

## Middle mediastinum



## Pericardium

Fibrous pericardium (external sac)

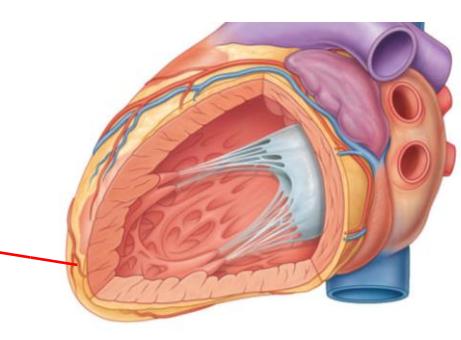
Serous pericardium (internal sac)

**Parietal** layer (lines deep surface of fibrous pericardium)

**Visceral** layer (epicardium)

## Heart wall:

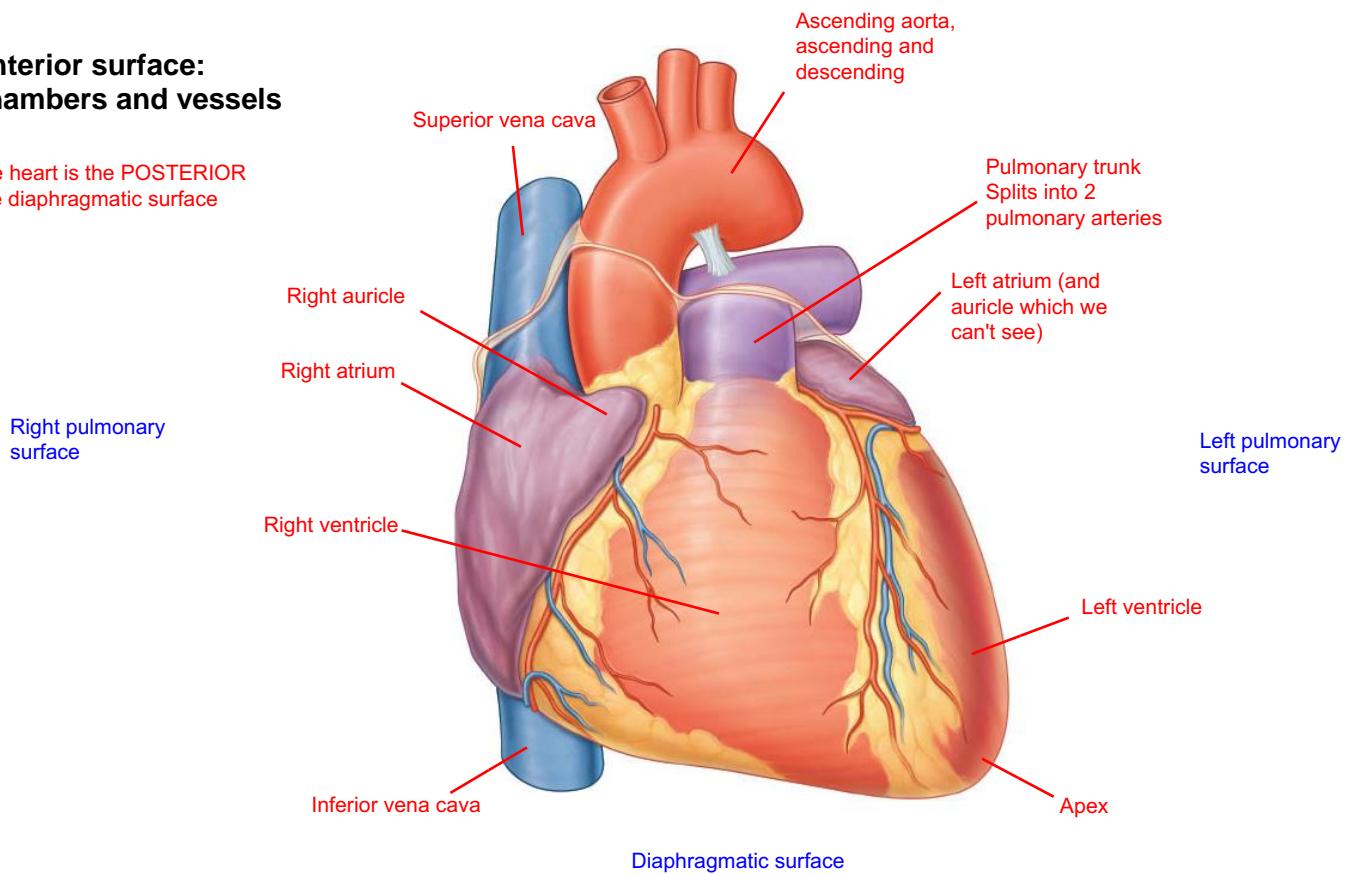
Epicardium - outermost layer found on the surface of the heart



Layers  
-Epicardium  
-Myocardium  
-Endocardium

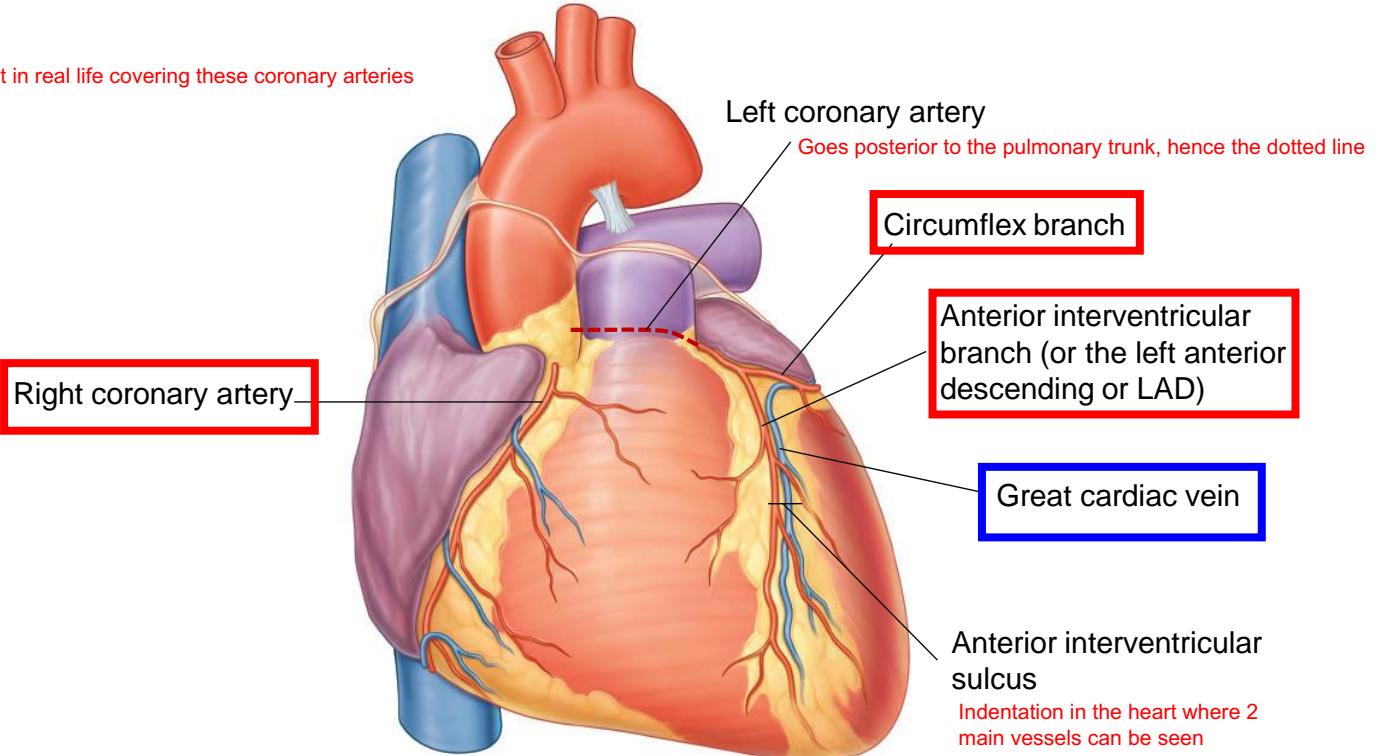
## Anterior surface: chambers and vessels

The base of the heart is the POSTERIOR surface, not the diaphragmatic surface



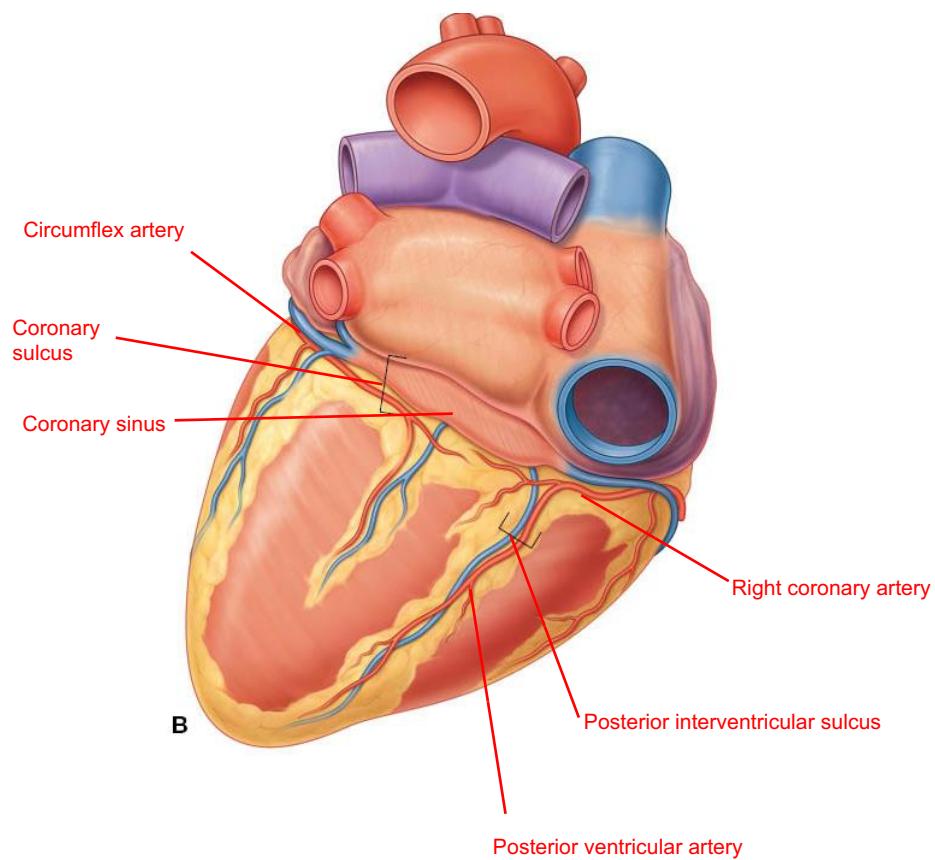
## Anterior surface: coronary blood vessels

Lots of fat in real life covering these coronary arteries

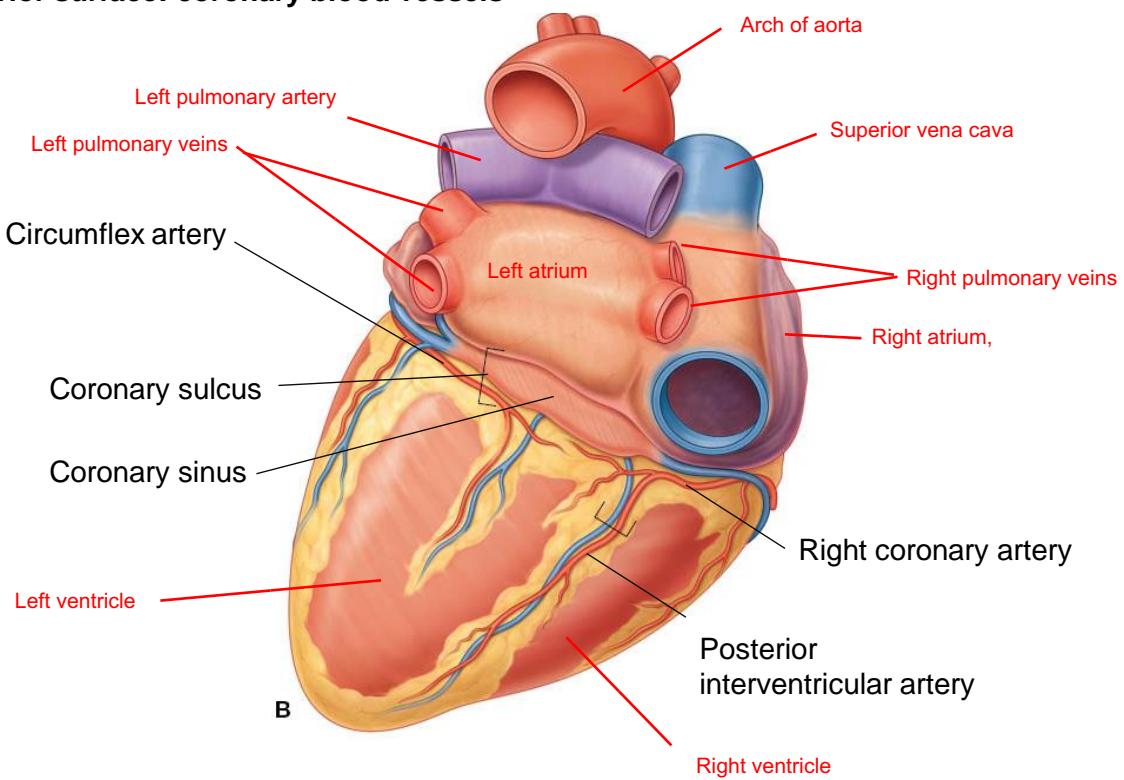


Heart attack due to LAD being blocked is very very serious - called "widow maker" artery because it supplies the left ventricle

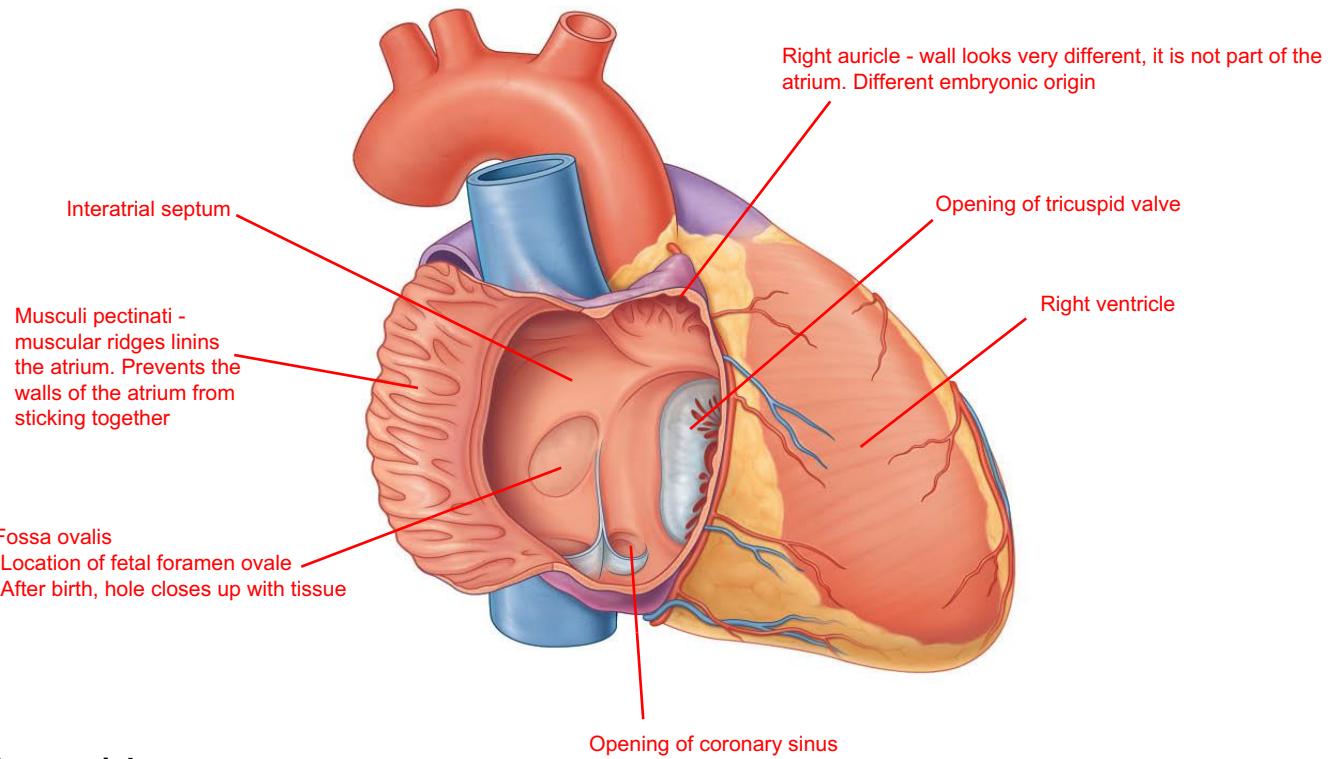
## Posterior surface



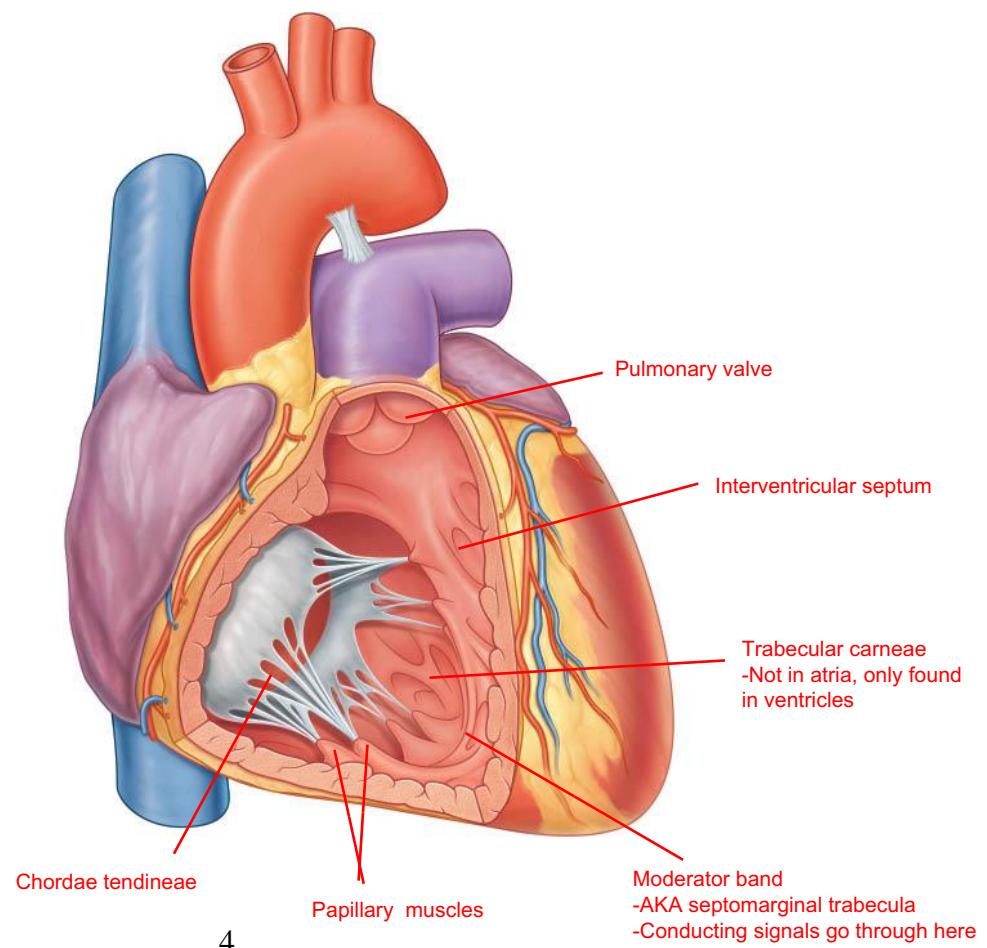
## Posterior surface: coronary blood vessels



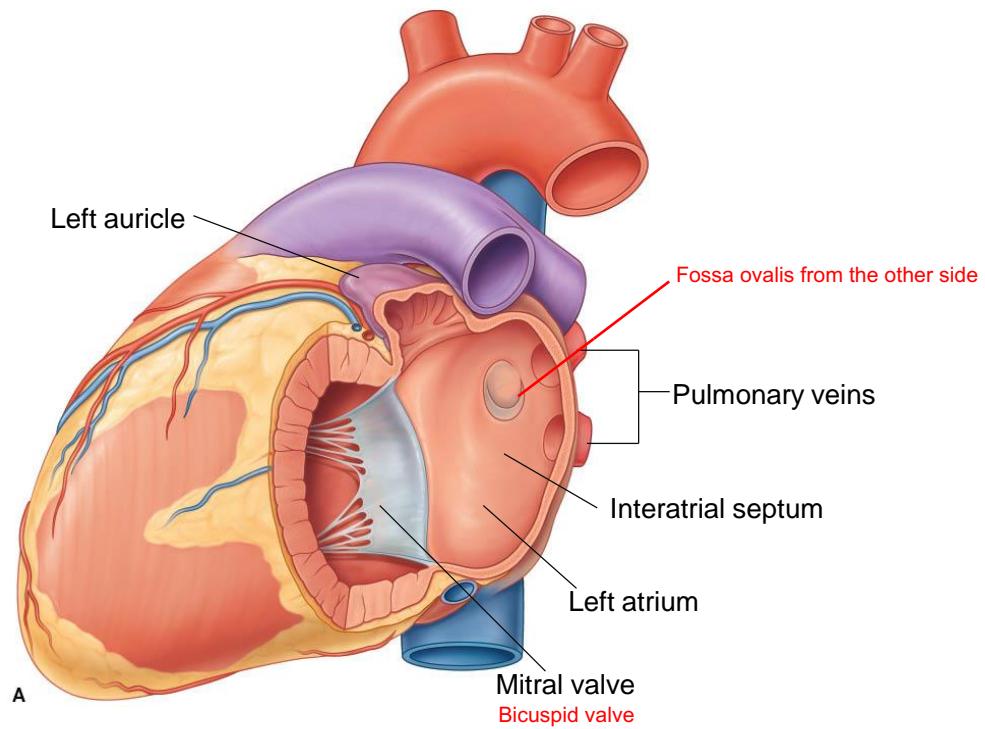
## Right atrium



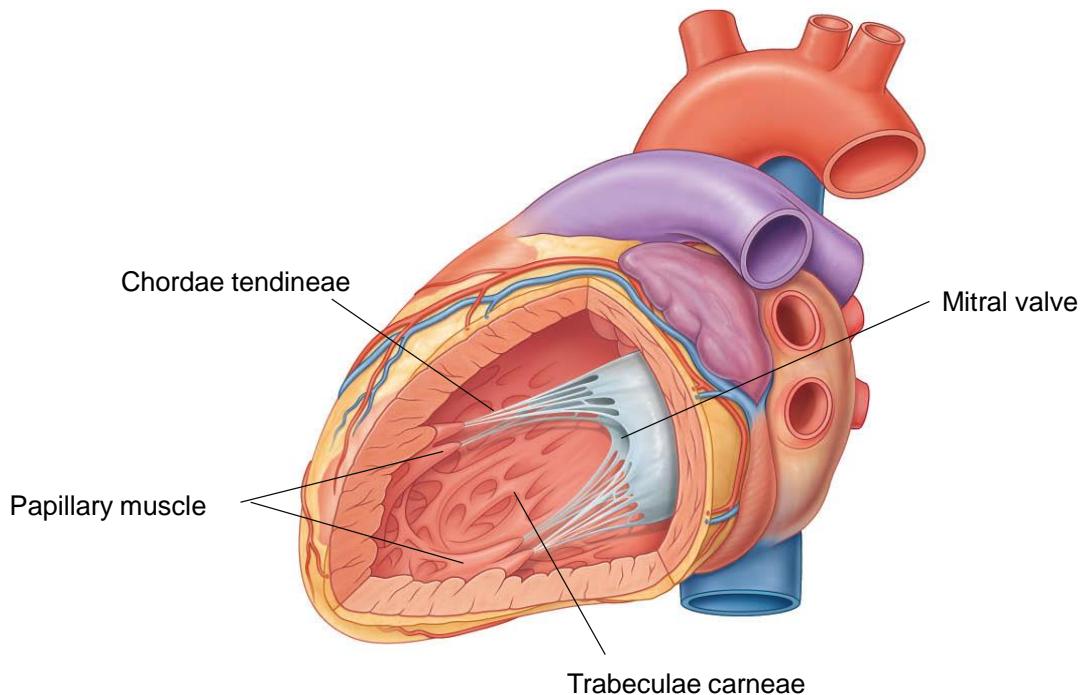
## Right ventricle



### Left atrium



### Left ventricle

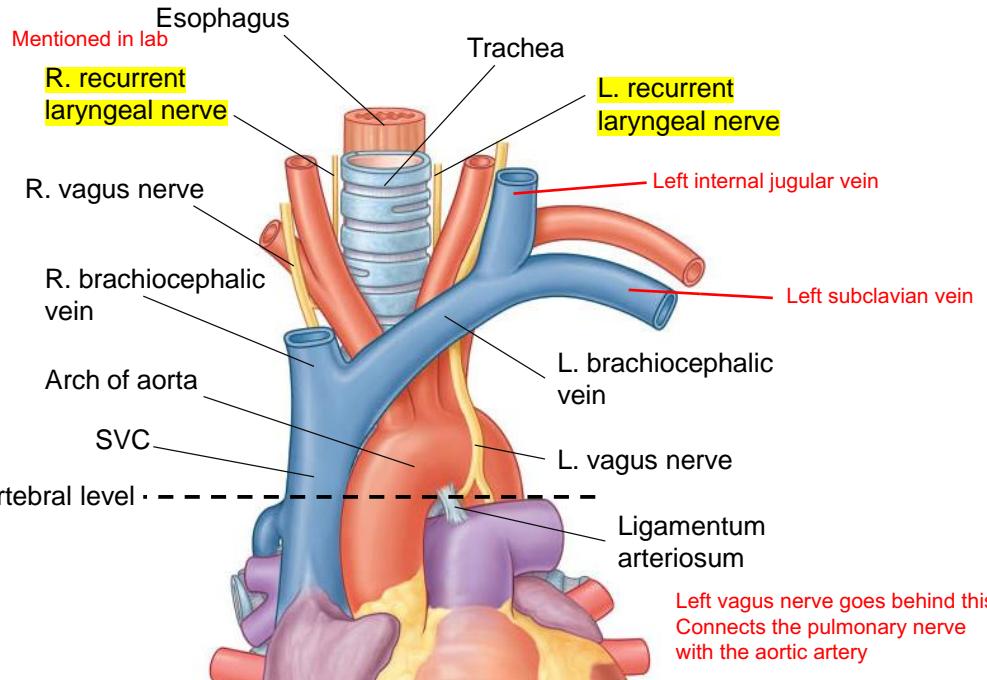
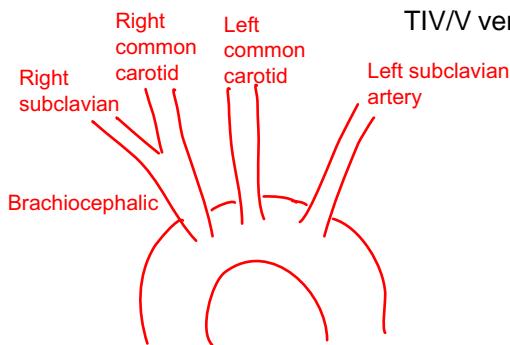


Left RLN  
-Inferior margin of the aorta  
Right RLN  
-Inferior margin of the right subclavian artery

### Superior mediastinum

Additional structures:

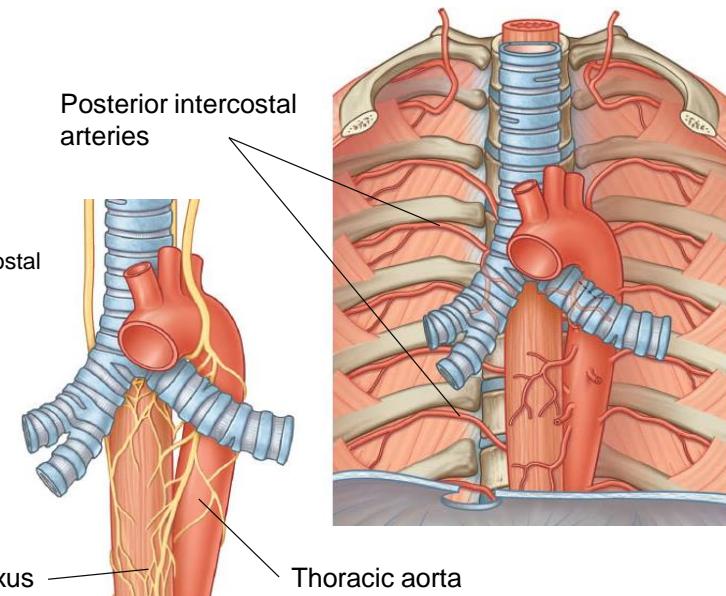
- Thymus (atrophies after puberty)
- Phrenic nerves
- Thoracic duct



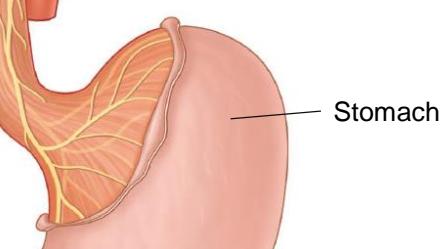
### Posterior mediastinum

Major structures:

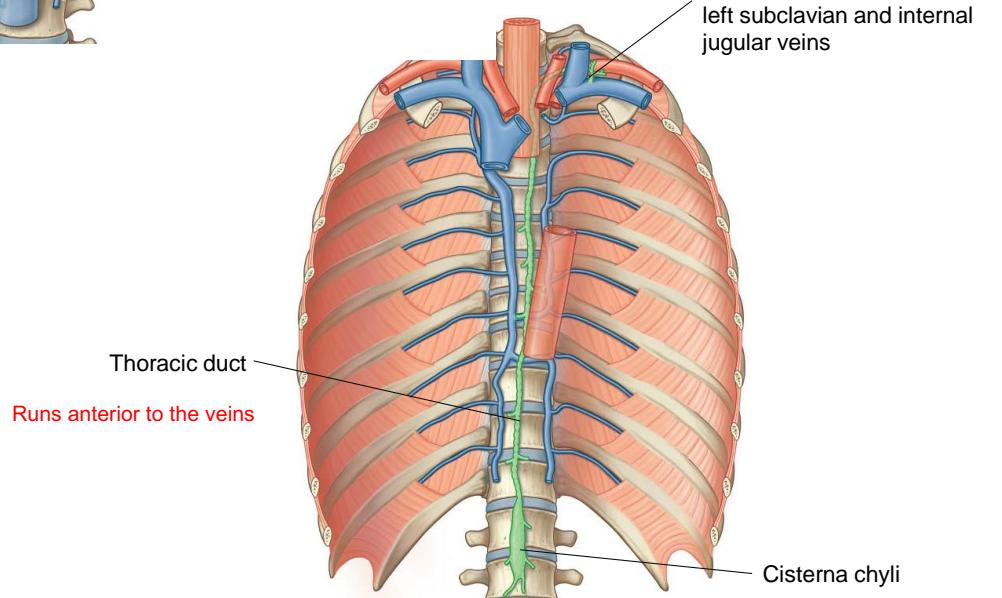
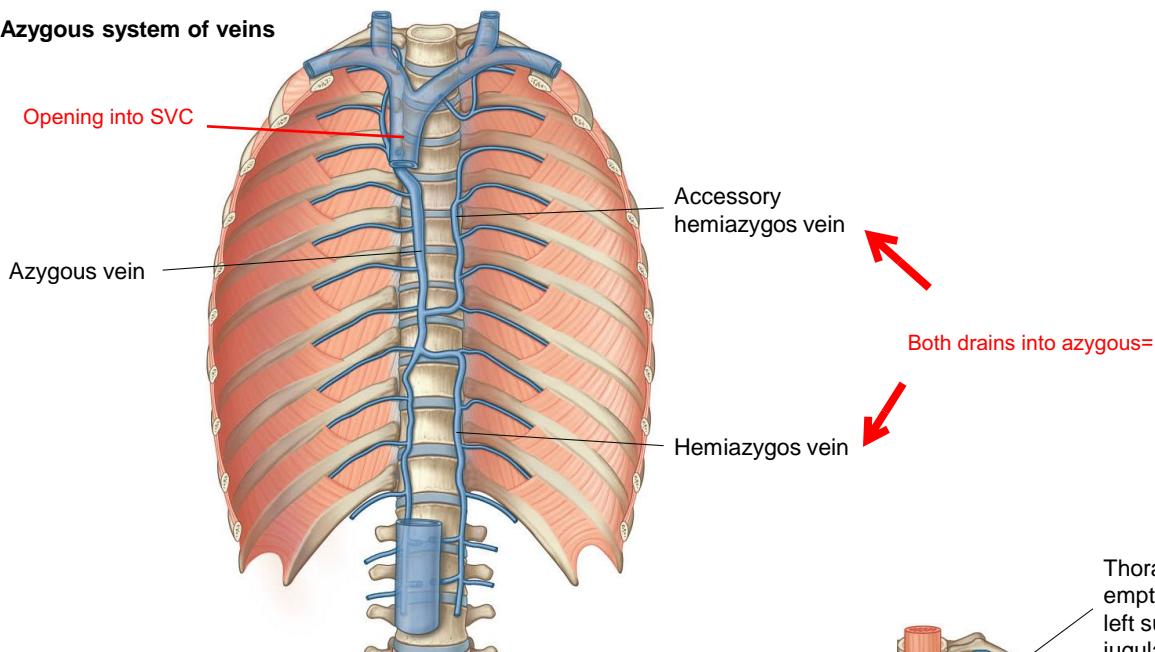
- Esophagus and esophageal plexus
- Thoracic aorta and posterior intercostal arteries
- Azygos system of veins
- Thoracic duct
- Sympathetic trunks and thoracic splanchnic nerves



Left vagus is anterior to the esophageal plexus  
Right vagus is posterior to the esophageal plexus



### Azygous system of veins



### Sympathetic trunks and thoracic splanchnic nerves

