Chapter2
part 1

Lesson 02-01: Intro to Respiration [Page 1]

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Let's establish some basic terminology for our discussion of Respiration.

We'll present the concepts of airflow, air pressure, and Boyle's Law, and then give you some definitions, to make sure you have a handle on these. We're going to quiz you after you read these, so pay attention!

Lesson 02-01: Intro to Respiration [Page 2]

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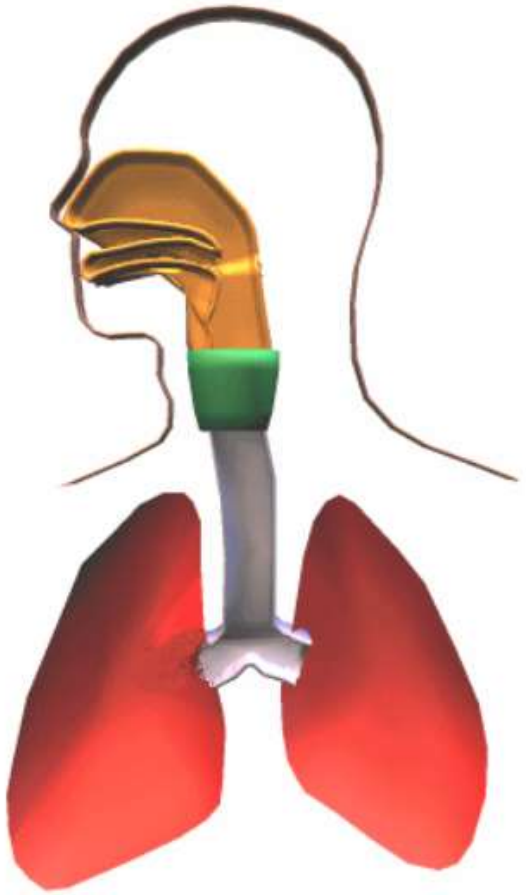

The RESPIRATORY SYSTEM consists of the LUNGS and the passageway connecting them with the outside environment. The TRACHEA is a long tube connecting the PHARYNX with the ORAL CAVITY (mouth) and the NASAL CAVITY (nose).

Push the buttons below to see these components until you are comfortable with the identification.

Respiratory system

Lungs

Trachea

Pharynx

Nasal cavity | Oral cavity

Lesson 02-01: Intro to Respiration [Page 3]

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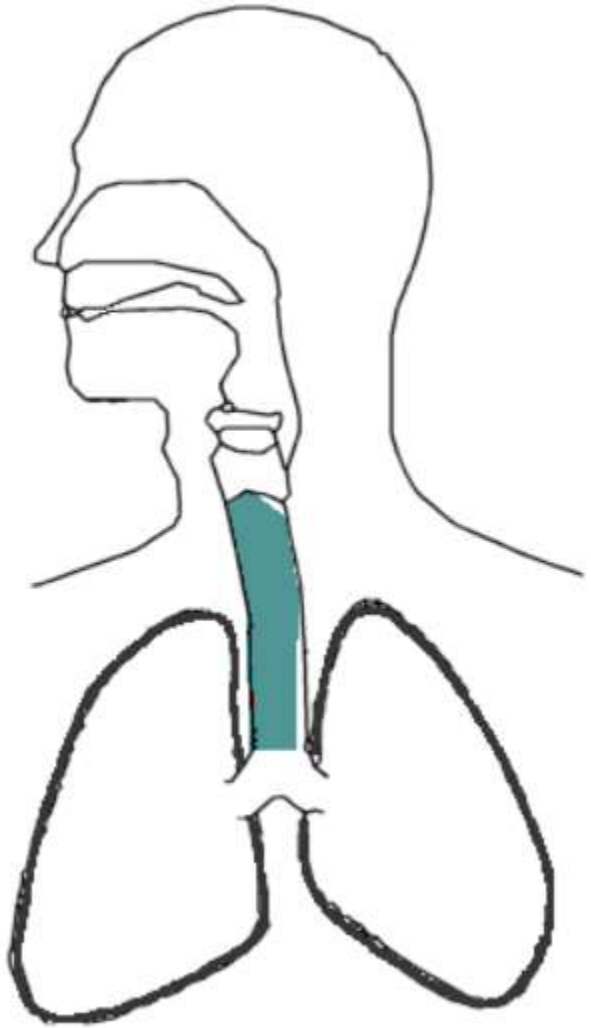

Now identify the same structures on the schematic image.
Click on the name of the flashing item.

- Lungs
- Pharynx
- Trachea
- Respiratory system
- Nasal cavity

Lesson 02-01: Intro to Respiration [Page 4]

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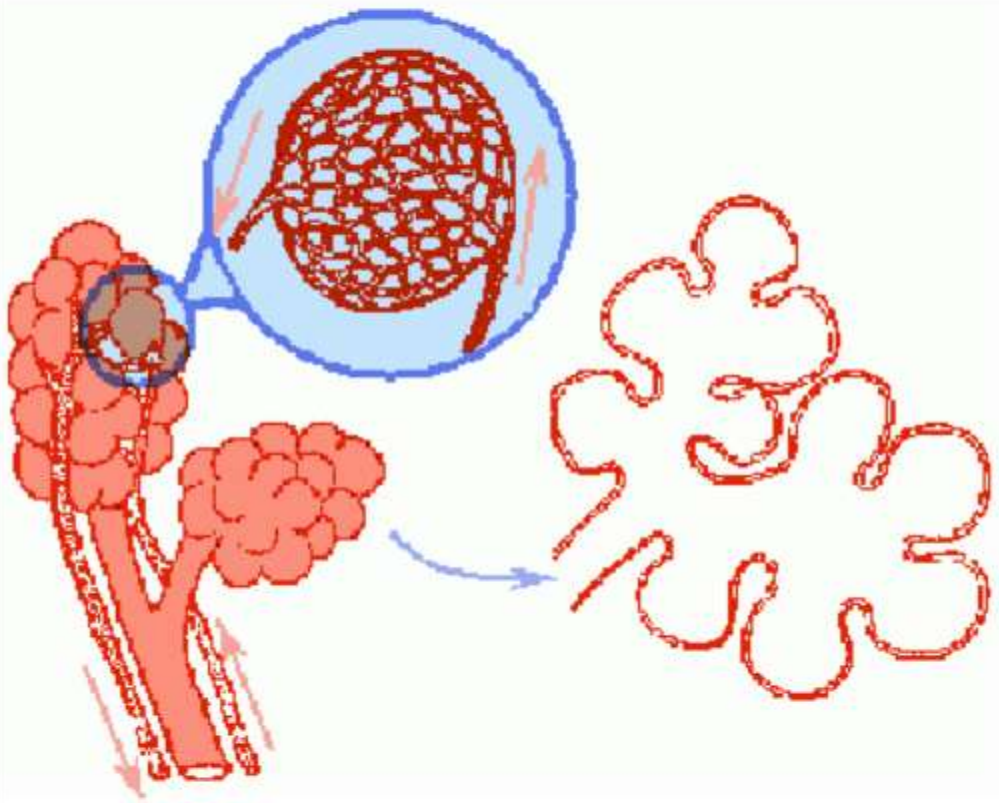

Gas exchange occurs within tiny air sacs known as the ALVEOLI deep within the lungs. Each ALVEOLUS is wrapped by a rich CAPILLARY BED so that GAS EXCHANGE can occur between your vascular supply and the environment outside of your body. ALVEOLI group in clusters at the end of the BRONCHIAL TREE.

A BRONCHIOLE is the passageway leading to a group of ALVEOLI.

Push the button bars to identify these components.

Alveolus (closeup) | Alveoli

Bronchiole | Capillary Bed

Lesson 02-01: Intro to Respiration [Page 5]

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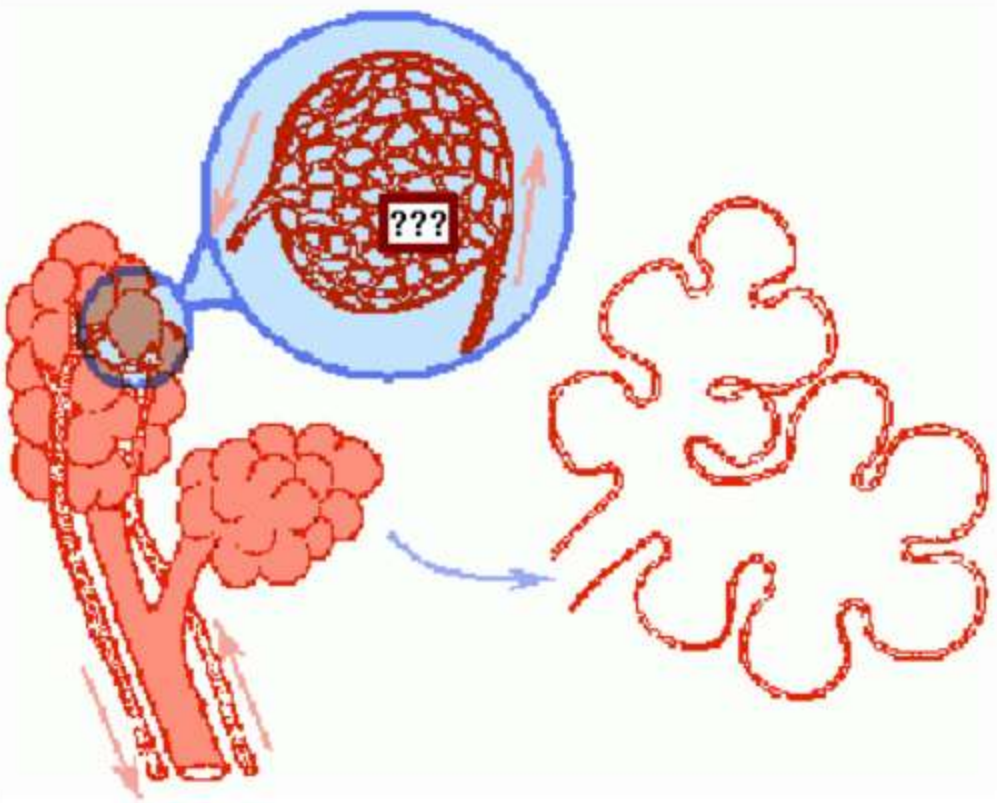

Now identify the components being highlighted:

Alveolus (closeup)

Alveoli

Bronchiole

Capillary Bed

Lesson 02-01: Intro to Respiration [Page 6]

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INSPIRATION is the process of drawing air into the lungs for RESPIRATION.

This depends on a fact of nature described in BOYLE'S LAW:
In a gas like air, volume and pressure are inversely related.

We increase the volume of the lungs, which thus decreases the pressure inside the lungs.

Since the pressure of the outside atmosphere has not changed, this creates a difference between inside and outside; the air molecules outside are more densely packed.

Air then flows from the denser outside atmosphere, through the airway, into the lungs, until it reaches equilibrium.

Lesson 02-01: Intro to Respiration [Page 7]

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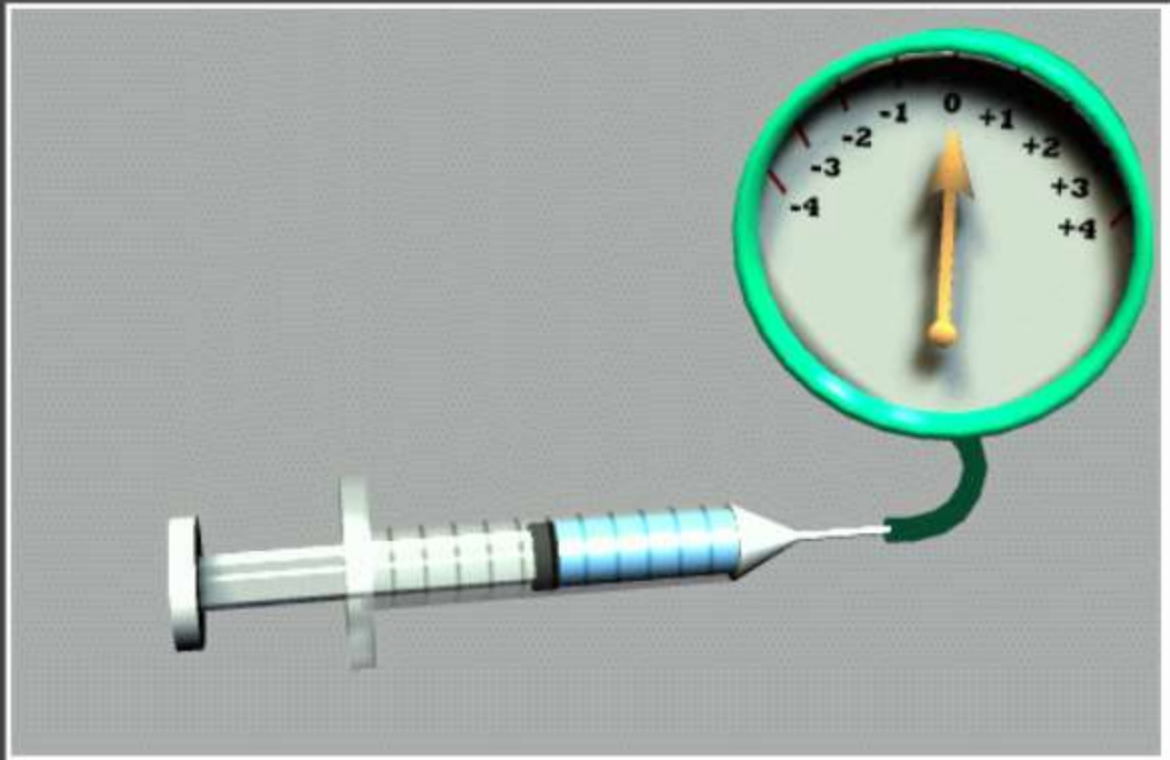
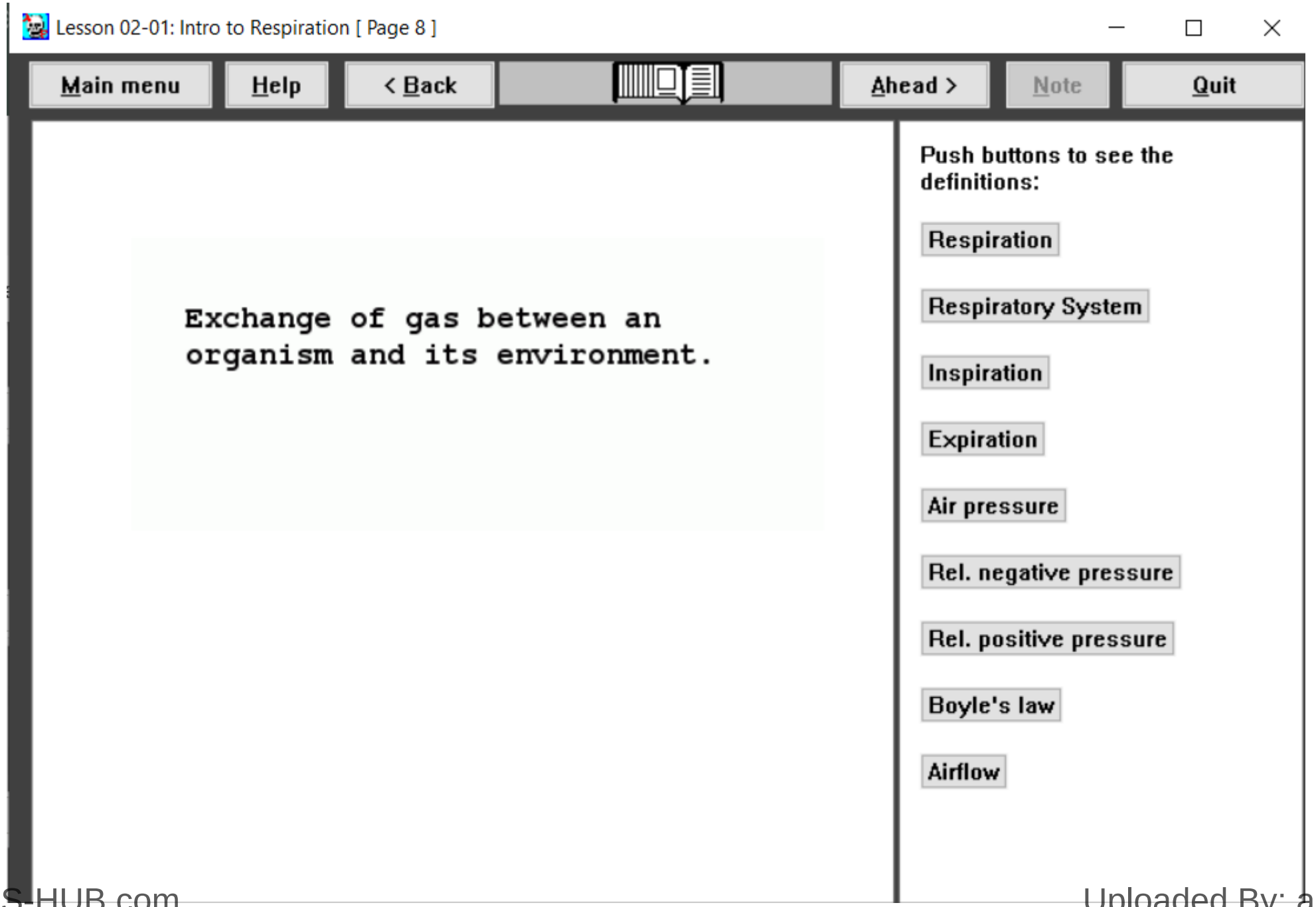


If you push on the plunger of the hypodermic needle in the picture it will increase the FORCE applied to an AREA (that is, it will increase the PRESSURE.) Using the slide bar, increase the force upon the plunger and watch the PRESSURE increase on the dial.

When you applied force to the plunger, you increased the FORCE applied to an AREA, and increased PRESSURE. This produced a POSITIVE AIR PRESSURE relative to the atmosphere outside of the plunger. A NEGATIVE AIR PRESSURE could be produced if you pulled the plunger back. Try that with the slider.

لكل وحدة
تعريف
على السفت
وير اكتبيهم



Vertebrae and vertebral column

Lesson 02-02: Vertebrae and Vertebral Column [Page 1]

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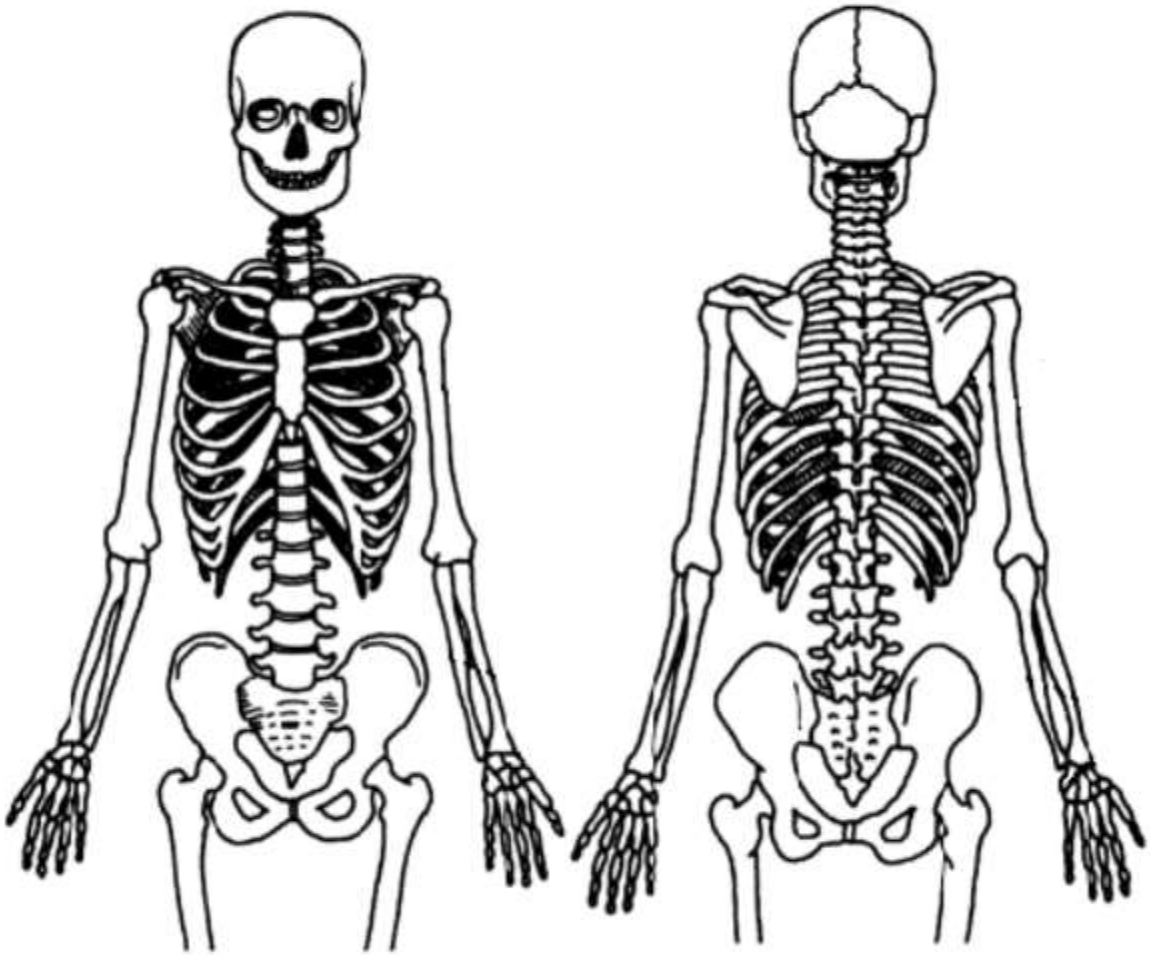

The THORAX or RIB CAGE houses the lungs. The thorax is made up of RIBS which form a barrel-shaped cylinder.

The STERNUM provides the front point of articulation for ribs, and the VERTEBRAL COLUMN or SPINAL COLUMN provides the rear point of articulation. Ribs are numbered from the top, starting with 1.→Push the button bars to highlight these areas.

Sternum | Thorax

3rd Rib | 5th Rib

Vertebral column

Lesson 02-02: Vertebrae and Vertebral Column [Page 2]

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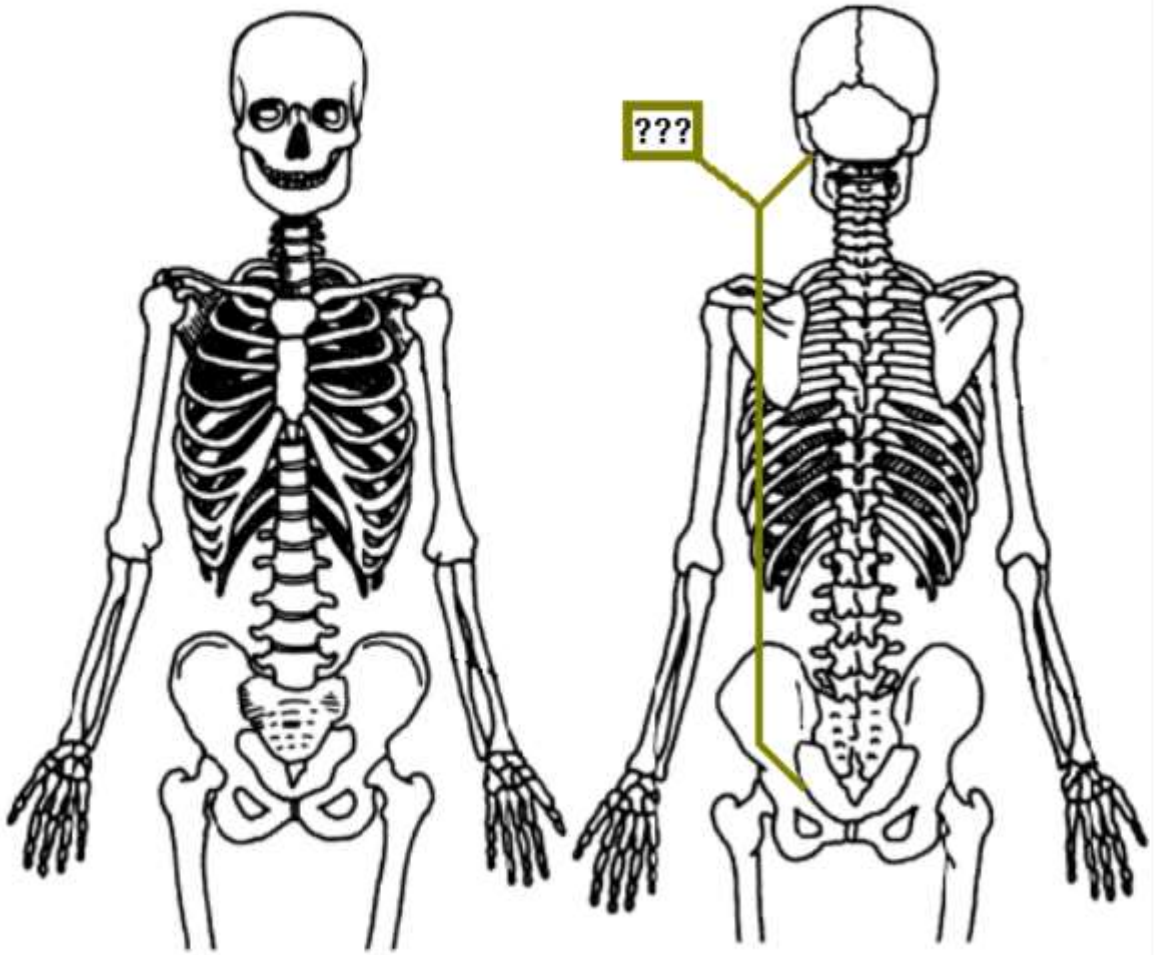

Now take a little quiz to keep you on your toes.
Click on the correct button for each flashing area....

- Sternum
- Thorax
- 3rd Rib
- 5th Rib
- Vertebral column

Lesson 02-02: Vertebrae and Vertebral Column [Page 3]

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The VERTEBRAL COLUMN is actually a series of 33 individual VERTEBRAE stacked on top of each other. As you can see from the schematic, the LUNGS will fit neatly into the region defined by the RIB CAGE.

The VERTEBRAL COLUMN is divided into five groups of VERTEBRAE. These groups correspond to anatomically distinct regions.

Lesson 02-02: Vertebrae and Vertebral Column [Page 4]

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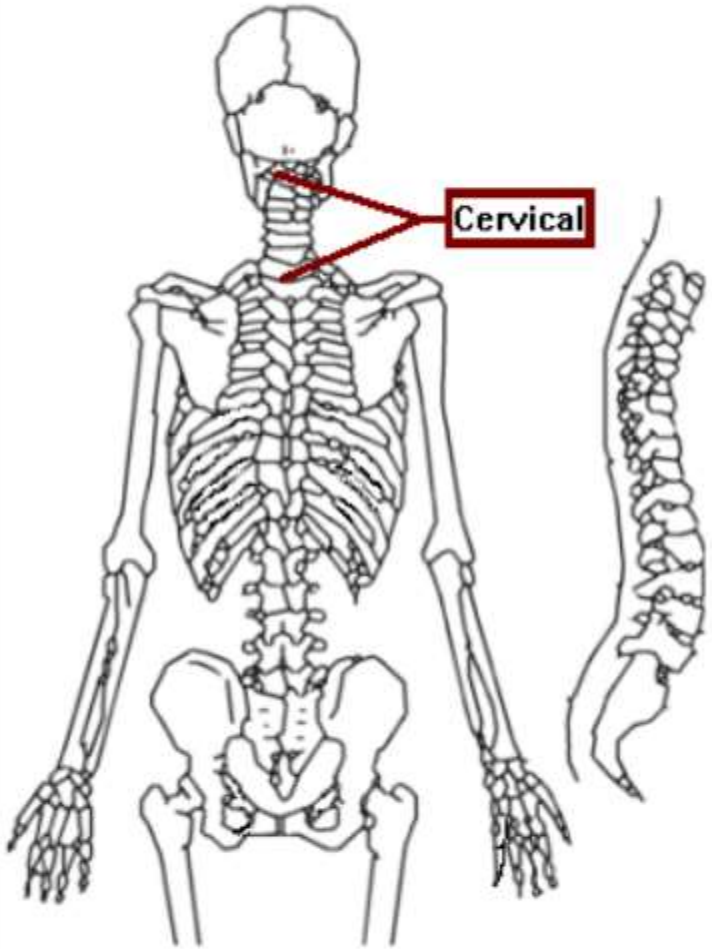

The CERVICAL VERTEBRAE are the top seven vertebrae, making up the region above the thorax. All vertebrae are labeled according to region and number.

So, the FIRST CERVICAL VERTEBRA is C1, the THIRD CERVICAL VERTEBRA is C3, and so on.

Lesson 02-02: Vertebrae and Vertebral Column [Page 5]

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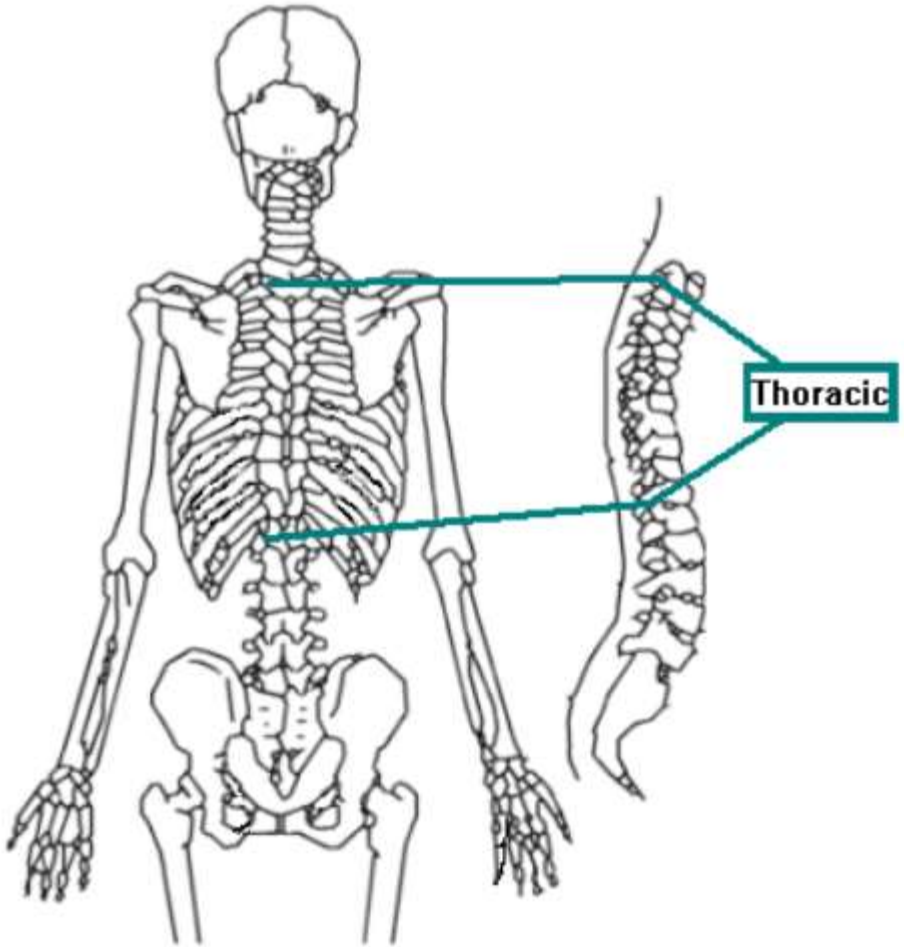

The THORACIC VERTEBRAE are those associated with the THORAX.

There are 12 thoracic vertebrae, T1 through T12.

Lesson 02-02: Vertebrae and Vertebral Column [Page 6]

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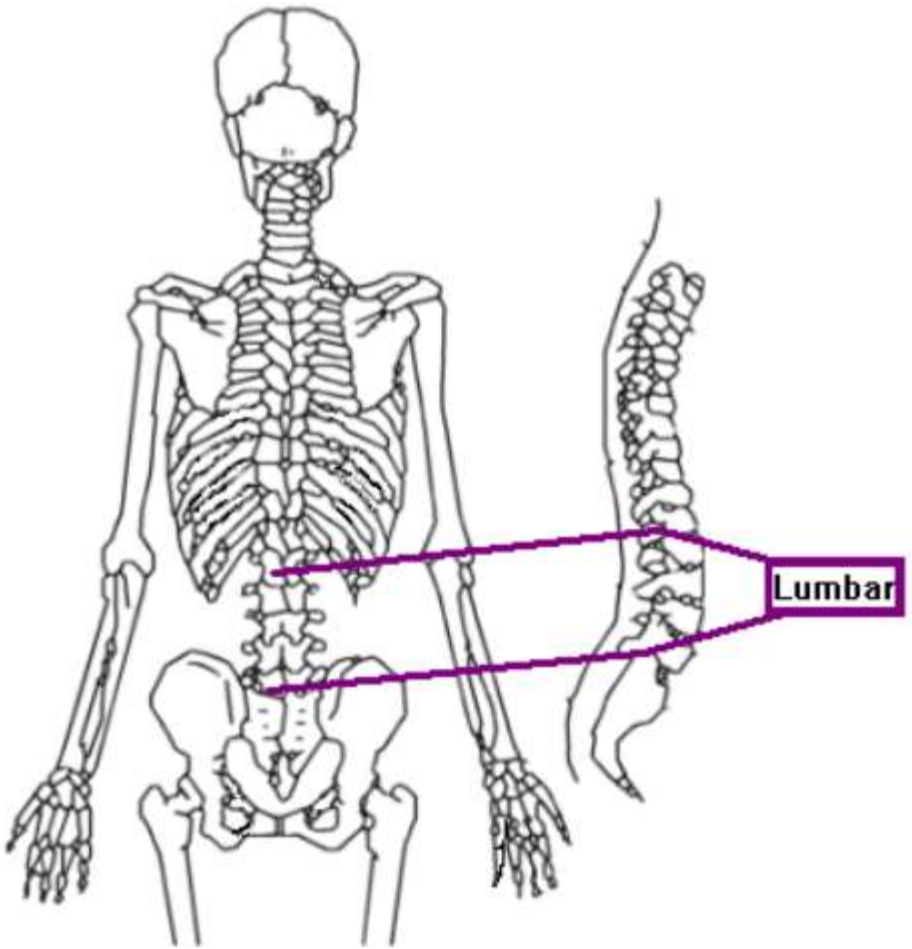

There are 5 LUMBAR VERTEBRAE, labeled L1 through L5.

Lesson 02-02: Vertebrae and Vertebral Column [Page 7]

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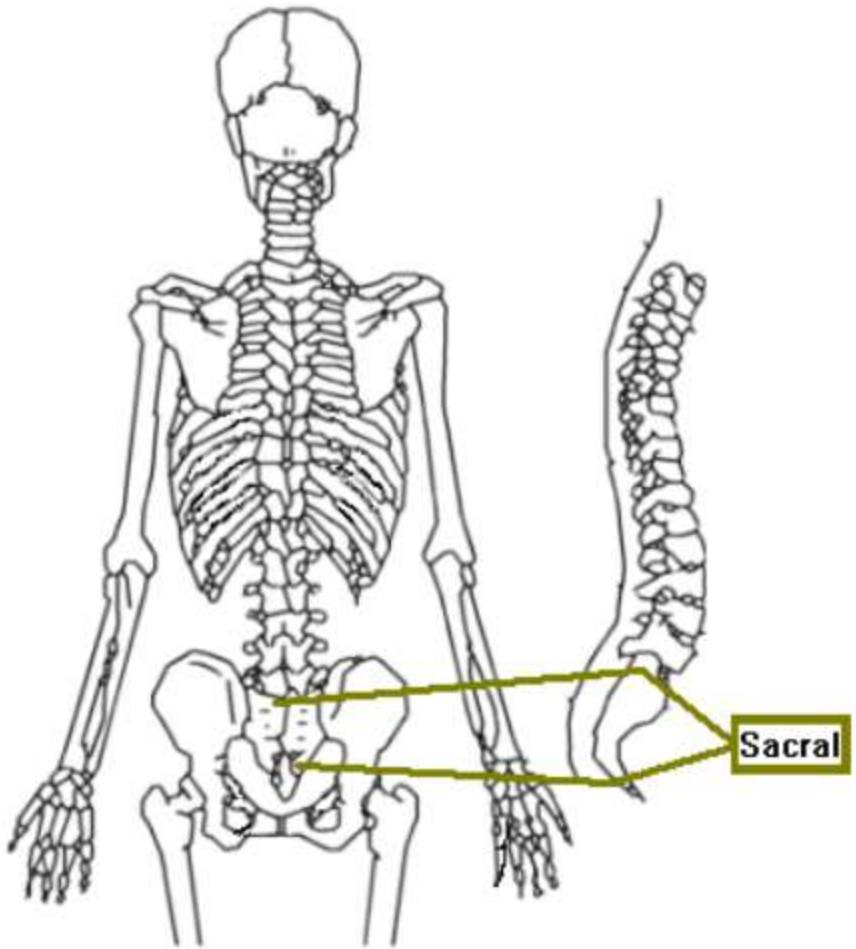

The SACRUM is made up of the five SACRAL VERTEBRAE.

The SACRUM was perhaps so named because it looked like a temple ("sacred").

Lesson 02-02: Vertebrae and Vertebral Column [Page 8]

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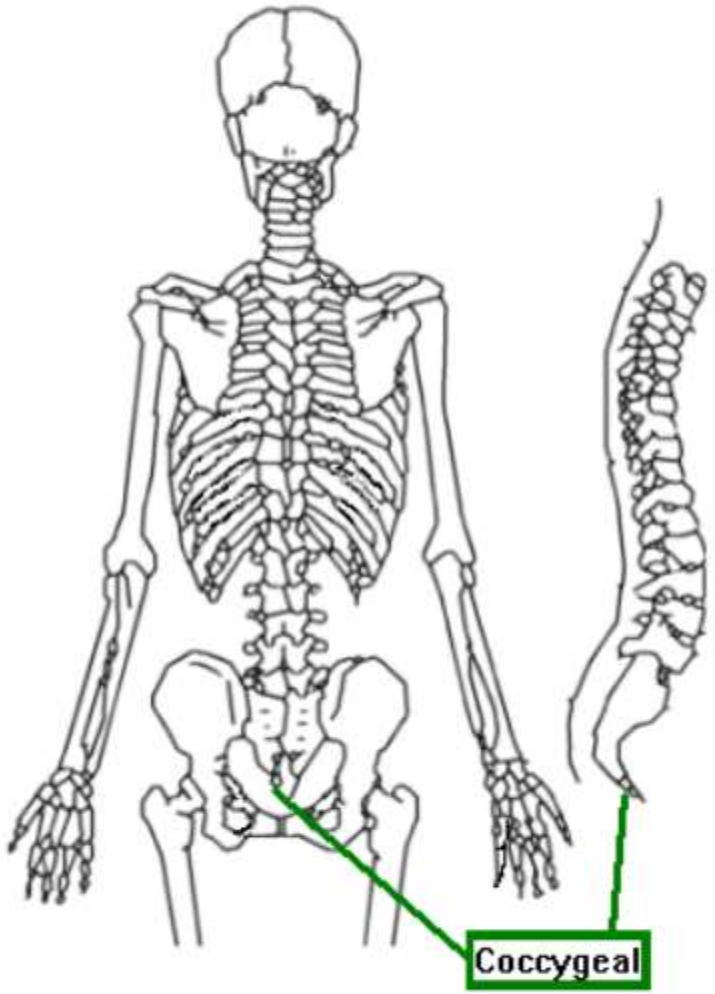

The COCCYX, commonly called the tailbone, is made up of four fused COCCYGEAL VERTEBRAE.

The COCCYX is the Latin word for cuckoo, apparently because it looked to someone like a cuckoo's beak!

Lesson 02-02: Vertebrae and Vertebral Column [Page 9]

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Before we go on, let's review those components, by number. Take your time. Push the button for each of the components listed, and then go to the next page to try your luck at some questions.

Cervical Vertebrae	C1	C7
Thoracic Vertebrae	T1	T7
Lumbar Vertebrae	L1	L5
Sacral Vertebrae		
Coccyx		

Lesson 02-02: Vertebrae and Vertebral Column [Page 12]

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The VERTEBRAL COLUMN is made up of individual vertebrae, and each anatomically distinct region of the vertebral column has its own characteristics. Let's take a close-up of the CERVICAL spine.

Lesson 02-02: Vertebrae and Vertebral Column [Page 13]

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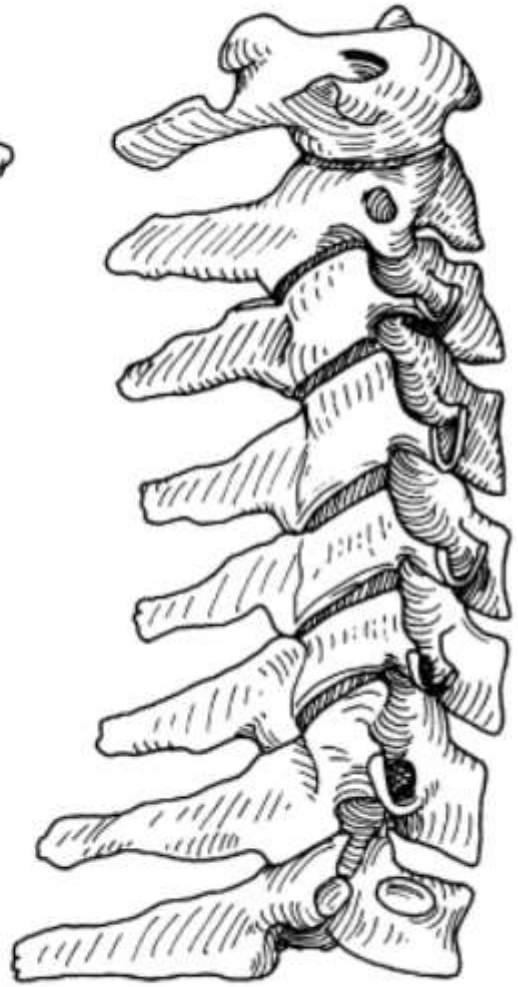

On the right side you can see the cervical vertebrae, stacked to form the cervical spine (the bottom vertebra is actually T1). On the left are the top two cervical vertebrae, the ATLAS and the AXIS, as seen from above. ATLAS (or C1) provides support for the skull, while AXIS (C2) lets ATLAS rotate.

Push the buttons to identify the components before we go on.

Atlas

Axis

C1 C2 C3 C4

C5 C6 C7 T1

Lesson 02-02: Vertebrae and Vertebral Column [Page 14]

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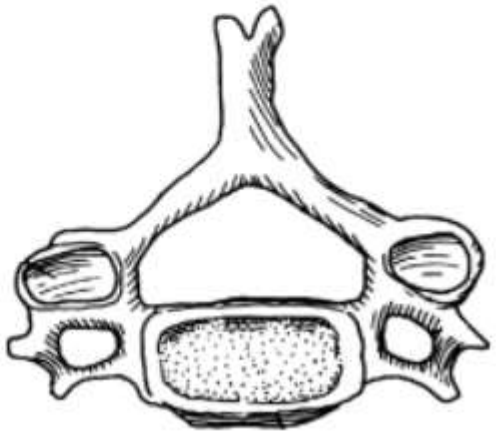

This is a typical cervical vertebra. On left is top view, on right is a view from the side.

Lesson 02-02: Vertebrae and Vertebral Column [Page 15]

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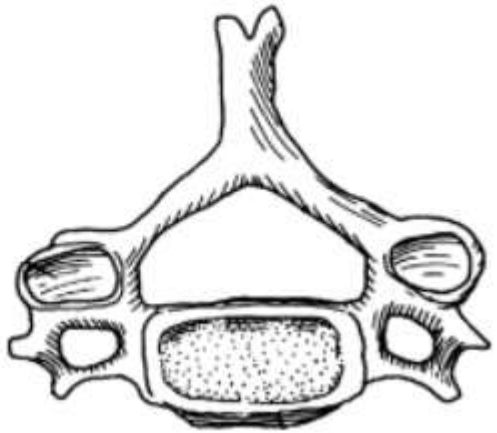

The VERTEBRAL CANAL protects the SPINAL CORD within it.

Lesson 02-02: Vertebrae and Vertebral Column [Page 16]

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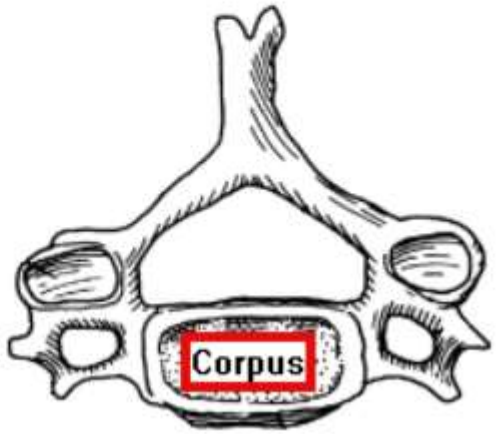

The CORPUS, or BODY, makes up the bulk of the vertebra.

Lesson 02-02: Vertebrae and Vertebral Column [Page 17]

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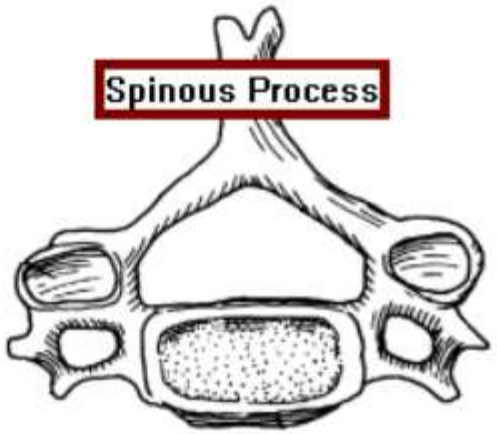

The SPINOUS PROCESS projects toward the back.

Lesson 02-02: Vertebrae and Vertebral Column [Page 18]

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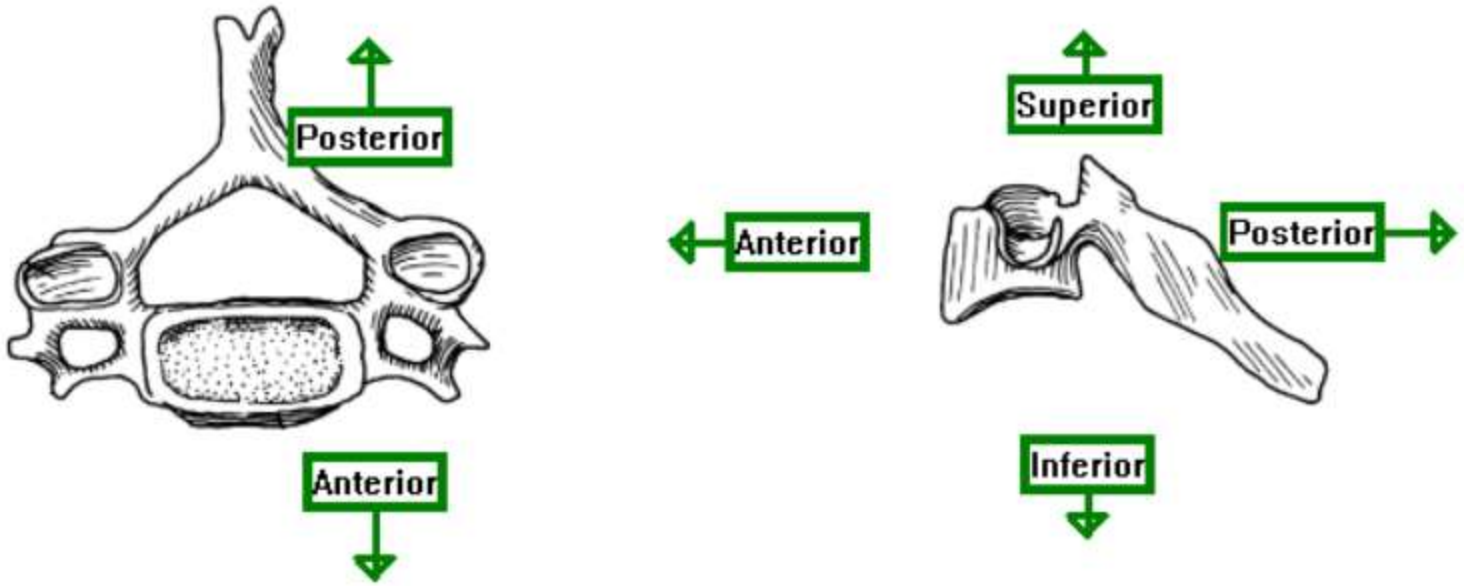

You can tell ANTERIOR, POSTERIOR, SUPERIOR, and INFERIOR by means of the SPINOUS PROCESS and CORPUS. The corpus is in front, and the spinous process is in back pointing downward.

Lesson 02-02: Vertebrae and Vertebral Column [Page 19]

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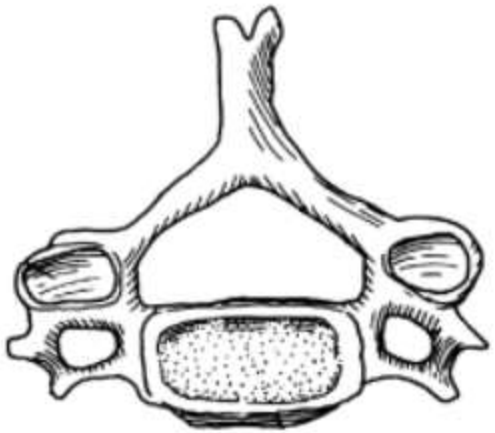

The SUPERIOR ARTICULAR FACET is the place upon which the vertebra above will rest. There is a corresponding INFERIOR ARTICULAR FACET. The TRANSVERSE FORAMINA hold the left and right VERTEBRAL ARTERIES. The TRANSVERSE PROCESS protrudes from the side of the vertebra.

Superior Articular Facet | Transverse Foramina | Transverse Process

Lesson 02-02: Vertebrae and Vertebral Column [Page 20]

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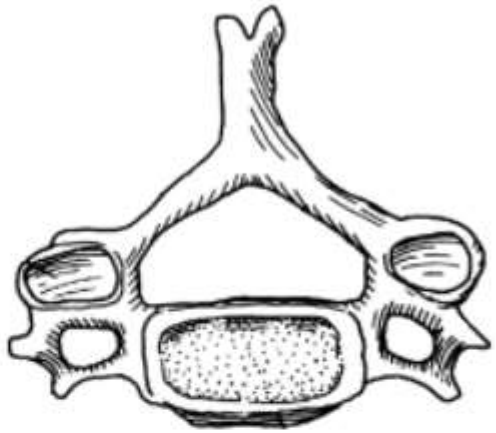

Now, press the buttons to verify the areas you've just studied.

Vertebral Canal

Spinous Process

Corpus

Superior Articular Facet

Transverse Foramina

Transverse Process

Anterior

Posterior

Superior

Inferior

Lesson 02-02: Vertebrae and Vertebral Column [Page 21]

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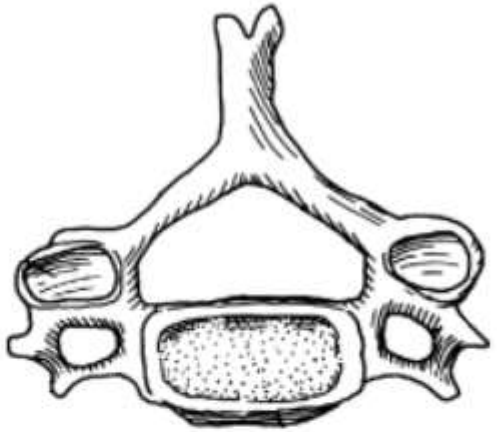

Put the cursor on the area through which the vertebral artery passes.

Lesson 02-02: Vertebrae and Vertebral Column [Page 22]

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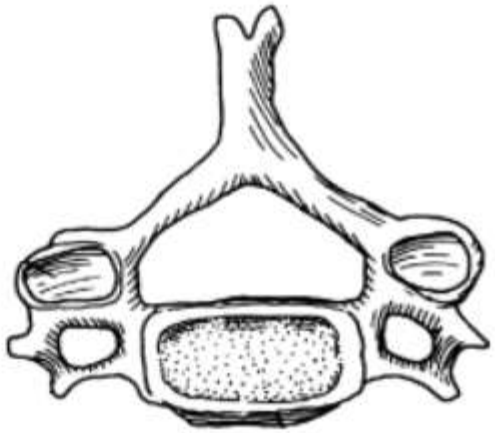

Put the cursor on the area through which the spinal cord passes.

Lesson 02-02: Vertebrae and Vertebral Column [Page 23]

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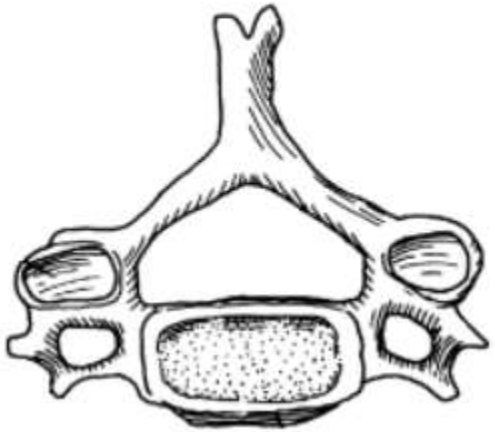

As each part or direction flashes, click the correct button:

Vertebral Canal | Spinous Process | Corpus

Superior Articular Facet | Transverse Foramina | Transverse Process

Anterior | Posterior | Superior | Inferior

Lesson 02-02: Vertebrae and Vertebral Column [Page 24]

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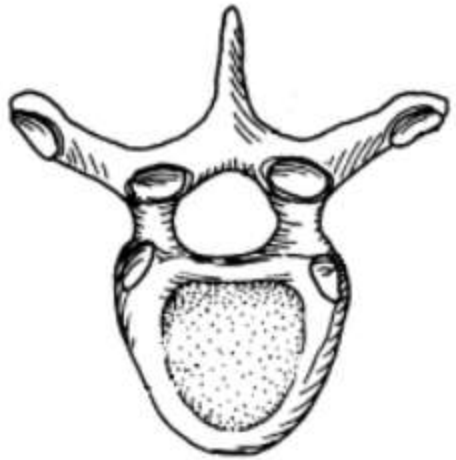

Now look at a THORACIC VERTEBRA. You can recognize the following landmarks which are the same as with the CERVICAL VERTEBRA. Take a moment to verify these.

Vertebral Canal | Spinous Process | Corpus | Superior Articular Facet

Anterior | Posterior | Superior | Inferior

Lesson 02-02: Vertebrae and Vertebral Column [Page 25]

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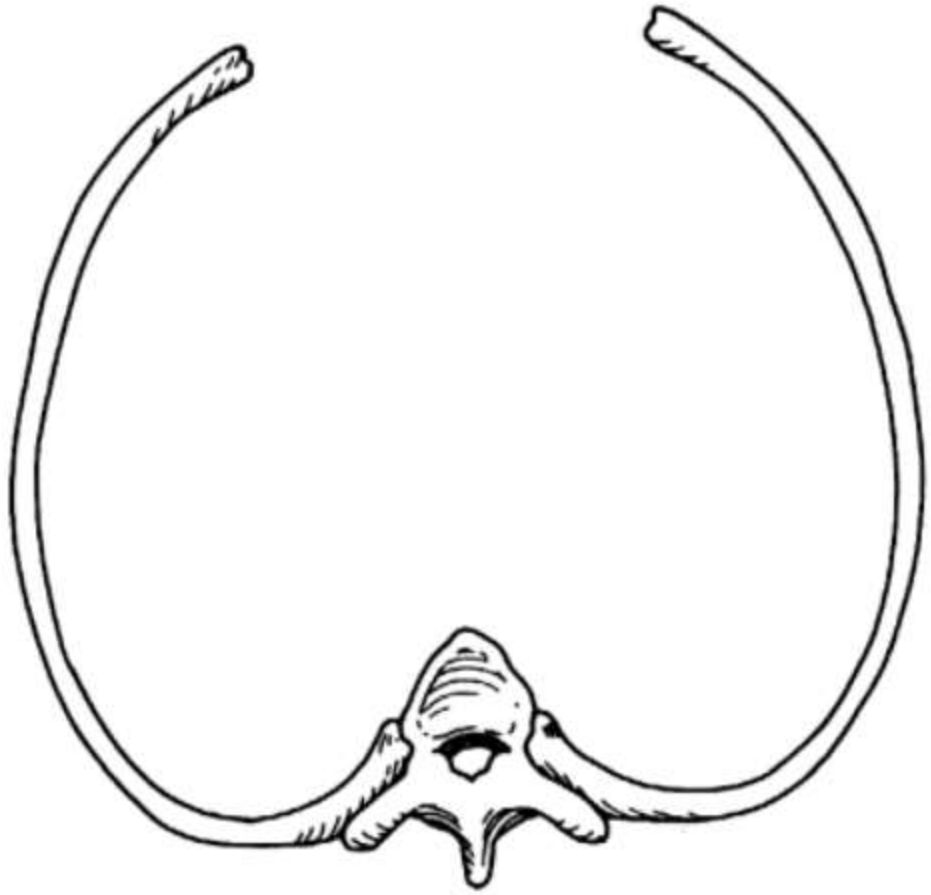

Here is a pair of RIBS as seen from above, along with one thoracic vertebra.

For ribs 2 through 9, each rib attaches to the thoracic vertebra of its number (e.g., T2), as well as the rib above it.

Ribs 1, 10, 11, and 12 don't make this double-vertebra articulation.

Lesson 02-02: Vertebrae and Vertebral Column [Page 26]

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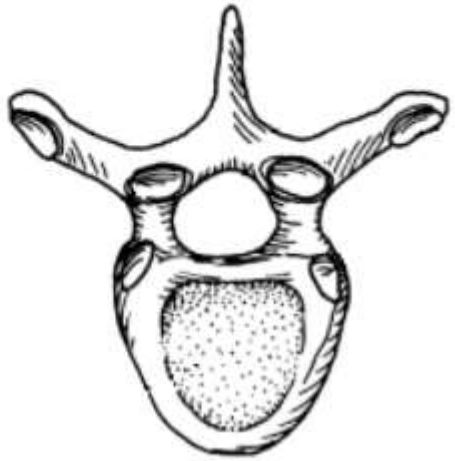

The Inf. Articular Facets and Sup. Articular Facets mate to let the vertebrae stack.

The Transverse Process, which supports ribs, is much larger than on the cervical spine.

The Sup. Costal Facet, Inf. Costal Facet and Costo-transverse Facet

are all points of rib articulation. The Inf. Vertebral Notch

forms a foramen through which spinal nerves exit the spinal cord.

Lesson 02-02: Vertebrae and Vertebral Column [Page 27]

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Move the cursor to a landmark that is a mating surface for another vertebra.

Rib cage

Lesson 02-03: Rib Cage [Page 1]

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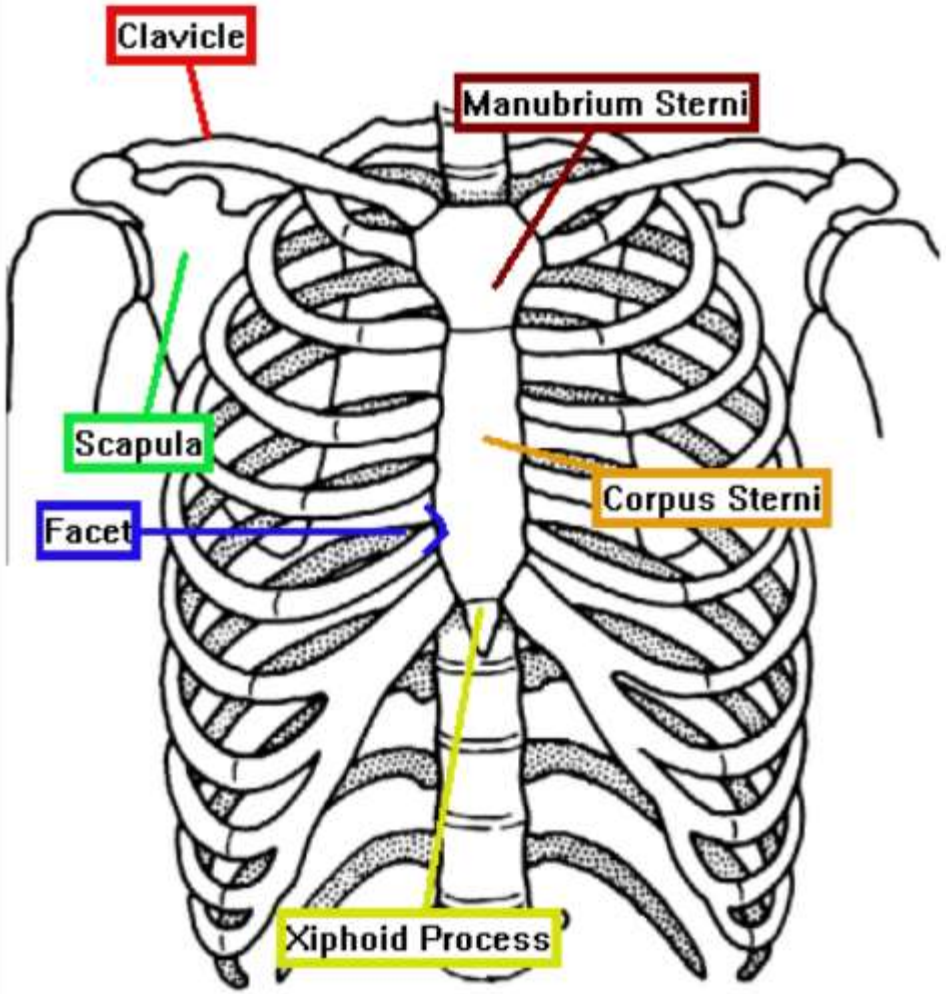

The rib cage is obviously more than just ribs and vertebrae. Let's look at the components of the rib cage in front.

The STERNUM is the prominent bone of the anterior rib cage. It is made up of three parts.

The upper "handle" of the sternum is the MANUBRIUM STERNI. In the middle is the CORPUS STERNI, and the small protrusion at the bottom is the ENSIFORM PROCESS or XIPHOID PROCESS.

The sternum has a number of FACETS or surfaces to which ribs attach.

Lesson 02-03: Rib Cage [Page 2]

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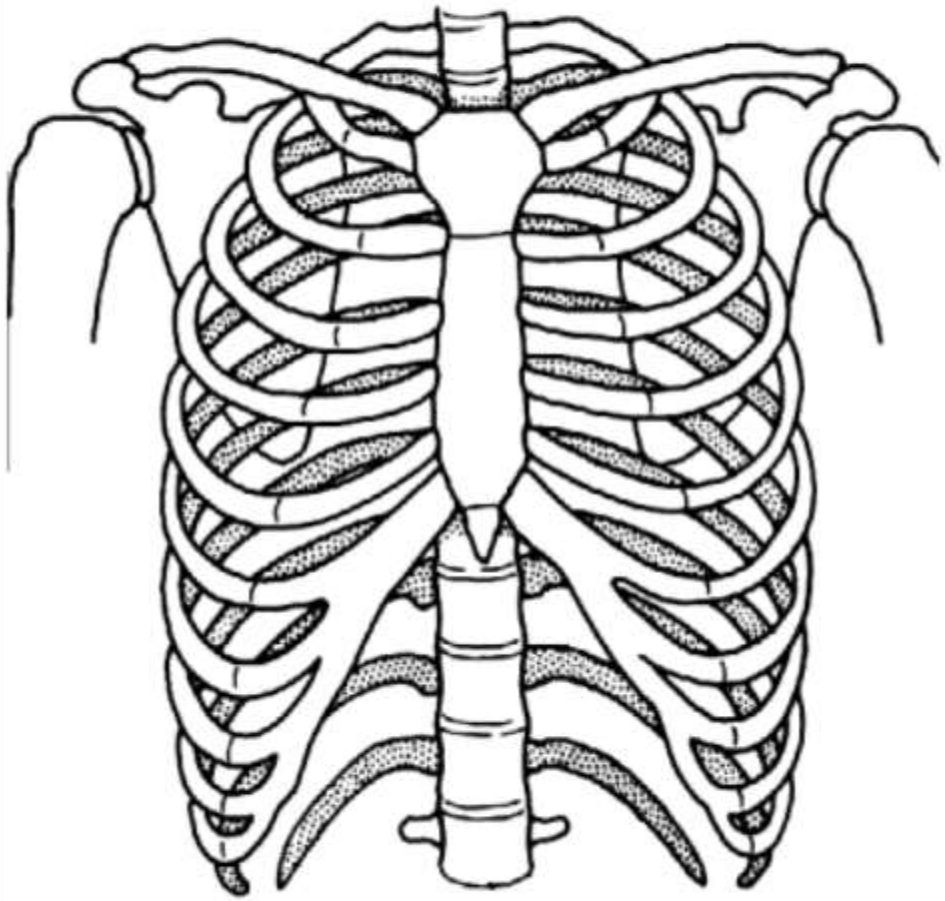

You can see the CLAVICLE attaching to the uppermost set of facets. The clavicle attaches to the MANUBRIUM STERNI and to the SCAPULA.
The FIRST RIB is the only rib to attach to the MANUBRIUM STERNI. You can see that the second rib attaches to the sternum at the junction of the MANUBRIUM STERNI.

Press the button bars to review:

Manubrium Sterni

Corpus Sterni

Xiphoid Process

Clavicle

Scapula

Lesson 02-03: Rib Cage [Page 3]

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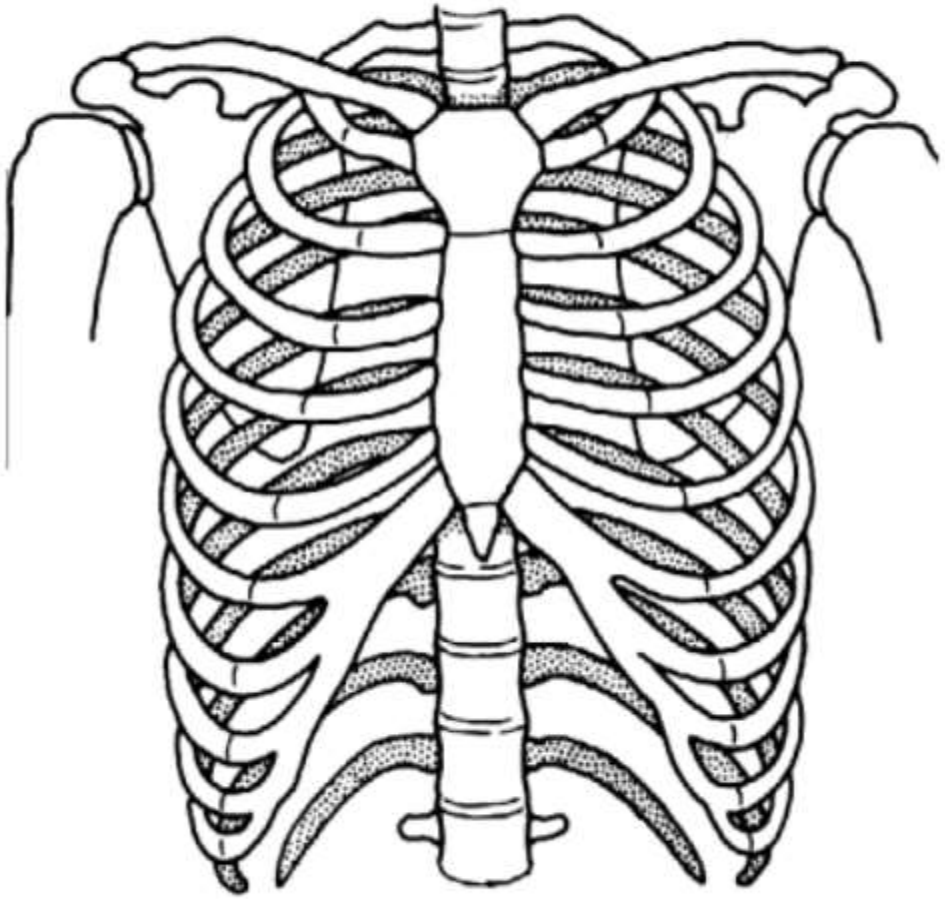

Now try your hand at it. Identify the structure that is highlighted.

- Sternum
- Manubrium Sterni
- Corpus Sterni
- Xiphoid Process
- Clavicle
- Scapula

Lesson 02-03: Rib Cage [Page 4]

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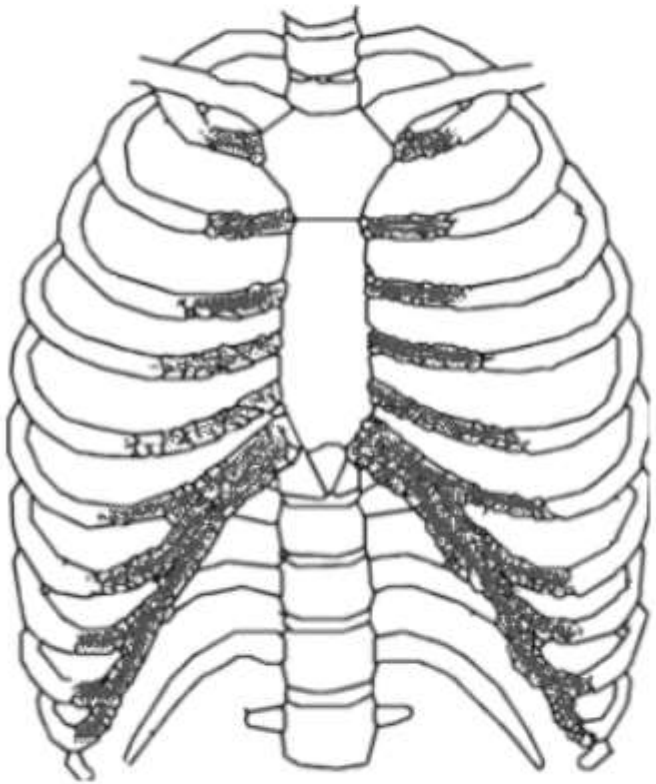

Notice on this picture that there is shading on the ribs lateral to the sternum. This represents CARTILAGE. This area is known as the CHONDRAL (CARTILAGINOUS) PORTION of the rib cage. As you know, the ribs are BONE.

CARTILAGE has unique and beneficial properties. It is FIRM and holds its shape, much as bone does. It is also ELASTIC, so that when it is deformed it tends to return to its original position.

Also notice that the ribs have different appearance. There are three types of ribs: TRUE RIBS, FALSE RIBS, and FLOATING RIBS.

Lesson 02-03: Rib Cage [Page 5]

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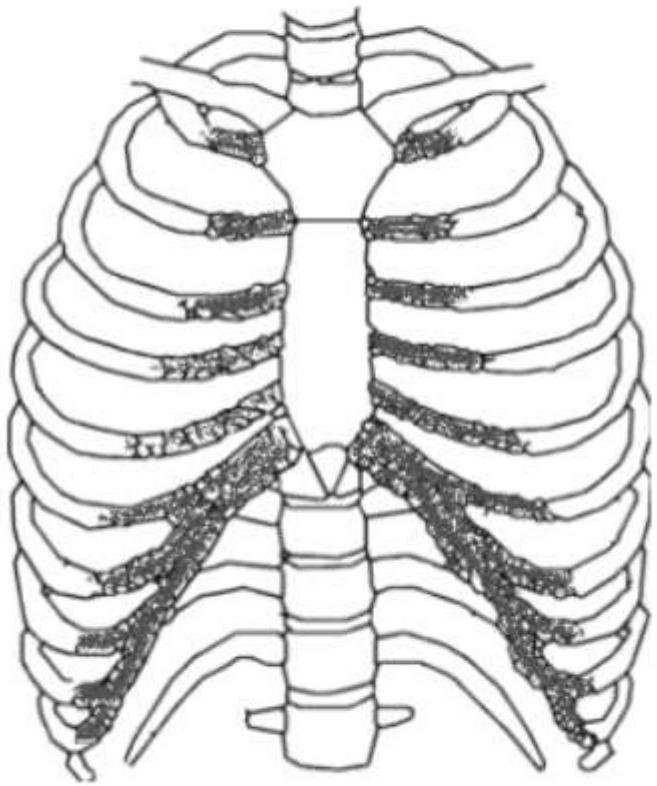

Ribs 1 through 7 are the TRUE RIBS. Push the button bar to see these. They make a rather direct connection to the sternum by means of a small CHONDRAL segment. Push the button to verify the CHONDRAL PORTION of the ribs.

Ribs 8 through 10 are called the FALSE RIBS. Their connection with the sternum is through a much more indirect cartilaginous attachment. Push the button bar to verify the FALSE RIBS.

Ribs 11 and 12 are termed FLOATING RIBS. They have no attachment to the sternum. Verify those ribs using the button bar.

True Ribs | Chondral portion

False Ribs | Floating Ribs

Lesson 02-03: Rib Cage [Page 6]

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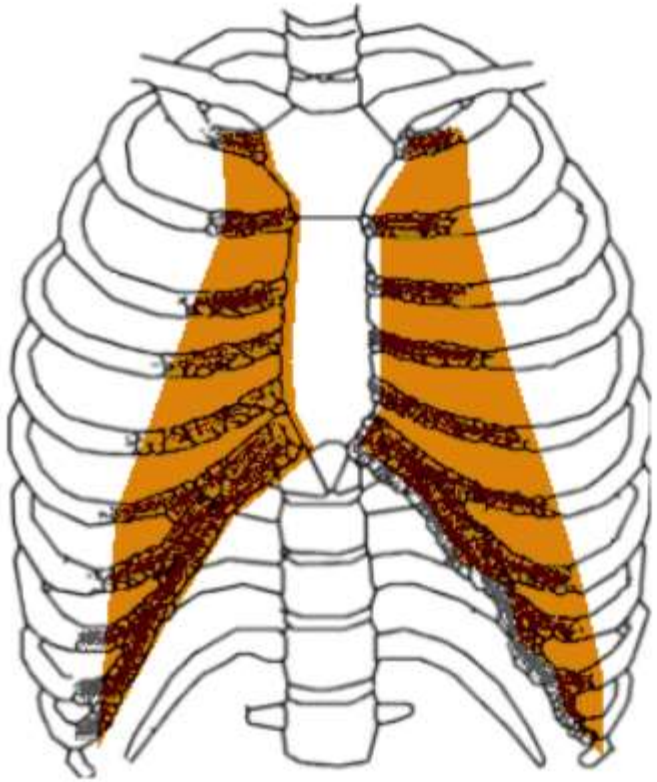

Now try your hand at identifying the anterior rib cage elements as they flash on this picture:

- Clavicle
- Corpus Sterni
- Chondral Portion
- Manubrium Sterni
- False Ribs
- Xiphoid Process
- Floating Ribs
- True Ribs

Lesson 02-03: Rib Cage [Page 7]

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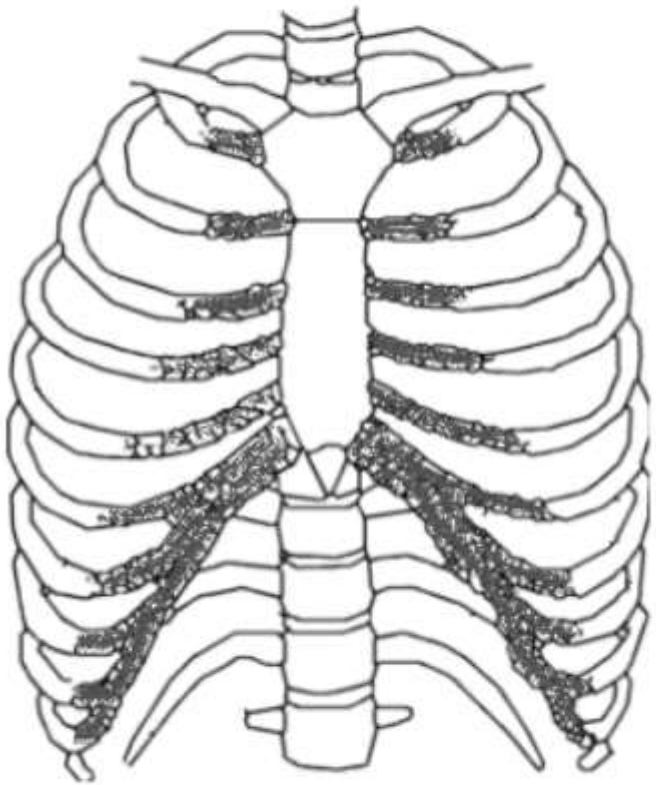

How many false ribs are on each side?

1 2 3 4 5 6

7 8 9 10 11 12

Lesson 02-03: Rib Cage [Page 8]

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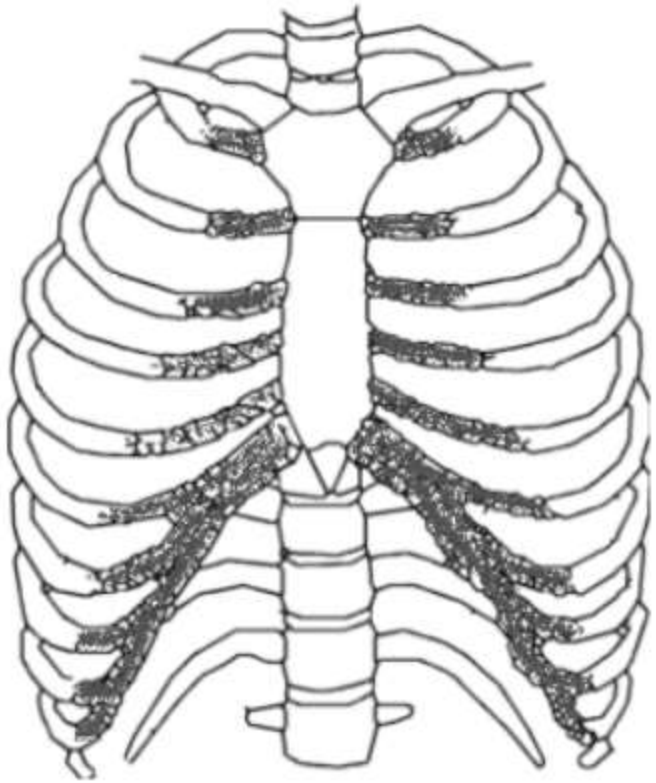

There is a reason for the CHONDRAL PORTION of the rib cage.

Ribs are bone, and bone is hard, inelastic, and generally incapable of bending (as you may know from your last ski trip).

Cartilage is reasonably hard, but also it is elastic. The combination of cartilage and bone makes it possible for the rib cage to be strong but mobile. Strength comes from the bone; cartilage gives the rib cage mobility.

Lesson 02-03: Rib Cage [Page 9]

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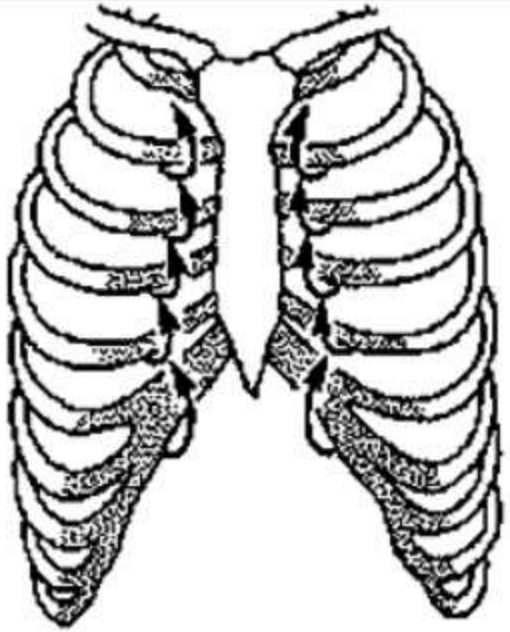

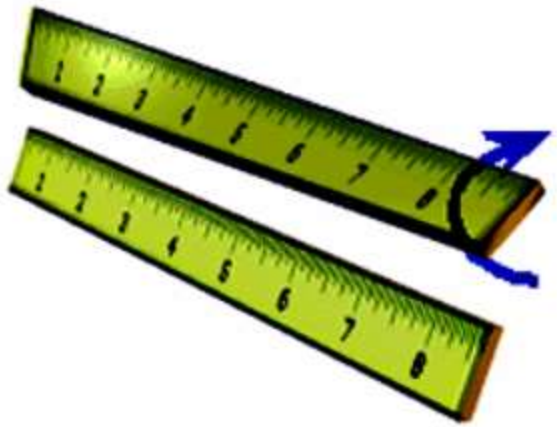

Look at the rib cage in a new light. In the back the ribs articulate by means of a gliding (arthrodial) joint with the thoracic vertebrae, and they are free to rotate upward a little.

Here in front, you can see the direction of movement of the rib cage, shown by the arrows.

The cartilage is capable of TORQUING between the rib and sternum. TORQUE is the rotation of one end of an object when the other end is held still.

Try it with a ruler as shown below. You can feel that the ruler wants to return to its original position, and that the desire to return gets stronger as you torque the ruler further. This is one example of ELASTICITY or STIFFNESS.

Lesson 02-03: Rib Cage [Page 10]

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Here is the rib cage as seen from the side.

When the rib cage is elevated for inspiration, the cartilages are TORQUED, which takes some effort. As the muscles are relaxed for expiration, that elastic energy is returned.

Elevating the ribs also increases the front-to-back measurement of the ribcage, which means that the total volume is greater.

كل وحدة برضو
الها تعريف اكتبه
جنبنهم بيجي في
تعبئة الفراغات

___ is hard but brittle.

Elasticity	Torqued
Bone	Elevate
Depresses	Increases
Decreases	Cartilage
Chondral portion	Volume

Lesson 02-03: Rib Cage [Page 12]

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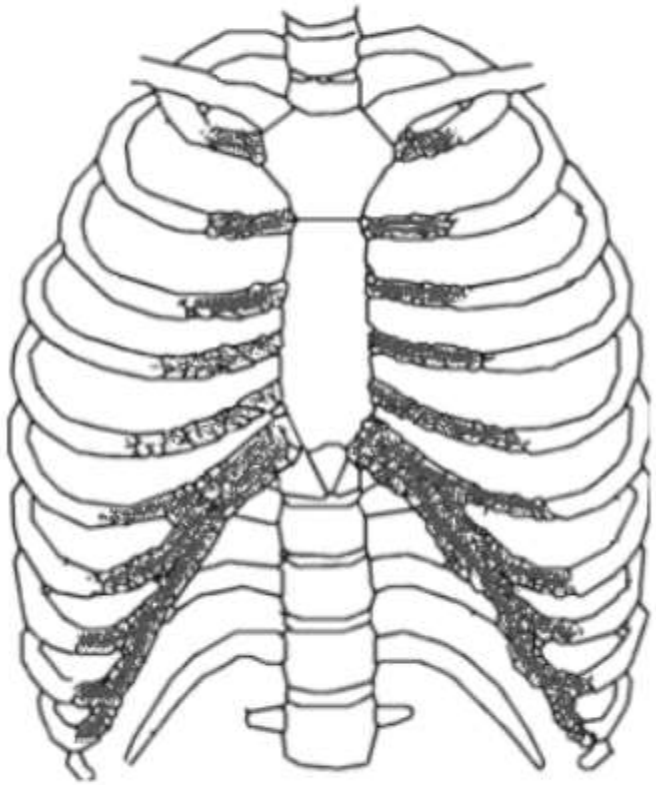

The thorax can be expanded in two dimensions by two essential mechanisms. We'll discuss this again after showing you the muscles and fine structure of the lungs, but we want to take this opportunity to reinforce a few ideas.

The rib cage can also be expanded in the TRANSVERSE dimension by means of the ACCESSORY MUSCLES of inspiration. When the ribs are elevated by the ACCESSORY MUSCLES, they rise in the sides and front. This ELEVATION INCREASES the VOLUME of the thorax and causes air to enter the lungs. Let's investigate both of these mechanisms.

The rib cage can be expanded in the VERTICAL DIMENSION by means of the DIAPHRAGM, and this is the primary means of inflation of the lungs. When the diaphragm contracts, the VOLUME of the THORAX INCREASES and air rushes in to fill the lungs.

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The second direction of change is the vertical dimension. When the rib cage elevates, the volume of the thorax also increases.

When the rib cage ELEVATES, the thorax INCREASES in VOLUME. When the VOLUME INCREASES, the air PRESSURE in the thorax DECREASES. This decrease in air pressure causes AIR to ENTER the THORAX.

The movement of the rib cage provides the changes in the transverse dimension. The movement of the diaphragm provides the changes in the vertical dimension.

Lesson 02-03: Rib Cage [Page 14]

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Answer some questions to firm up these concepts before we move on to the inner structure of the respiratory system.

When the rib cage elevates, the volume of the thorax will ___.

- Increase
- Decrease
- Into
- Out of

Lesson 02-03: Rib Cage [Page 15]

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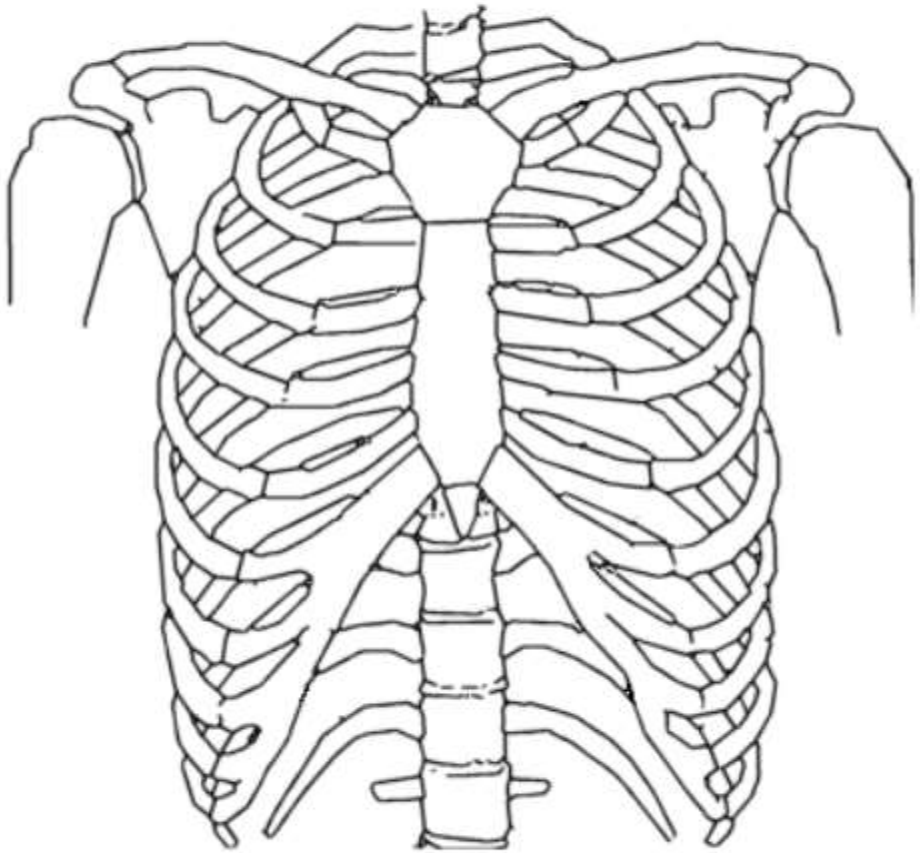

The PECTORAL GIRDLE (or shoulder girdle) is the superstructure of the upper body. From the front you can see the CLAVICLE, attached to the sternum in the anterior. Laterally, the CLAVICLE attaches to the SCAPULA. This is the only bone to which the SCAPULA (the shoulder blade) is attached. The PECTORAL GIRDLE permits attachment of the arms and lets you investigate your environment.
Push the buttons to verify the structures:

Clavicle | Pectoral Girdle

Scapula | Sternum

Sternal Notch | Manubrosternal Angle

Lesson 02-03: Rib Cage [Page 16]

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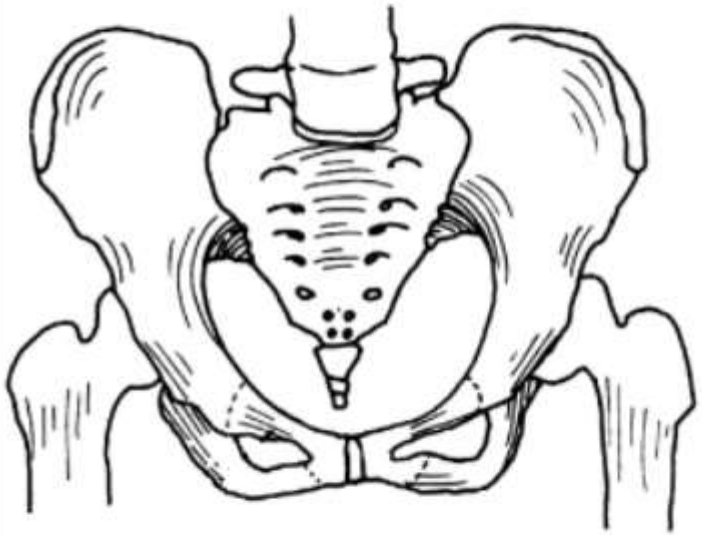

The PELVIC GIRDLE is the lower body counterpart to the pectoral girdle. The PELVIC GIRDLE, which provides structure for attachment of the legs, is made up of the ILIUM, SACRUM, PUBIC BONE, and ISCHIUM.

The ILIUM is a large, wing-like bone which provides most of the support for the abdominal musculature. The ILIAC CREST is the superior-lateral margin of the ILIAC BONE.

Press the button to verify the

Iliac Crest.

The PUBIC BONES are the medial inferior bones of the PELVIC GIRDLE. The point of union between the two pubic bones is the PUBIC SYMPHYSIS. Symphysis refers to a point of juncture. The ISCHIUM is between the PUBIC and ILIAC bones.

Lesson 02-03: Rib Cage [Page 17]

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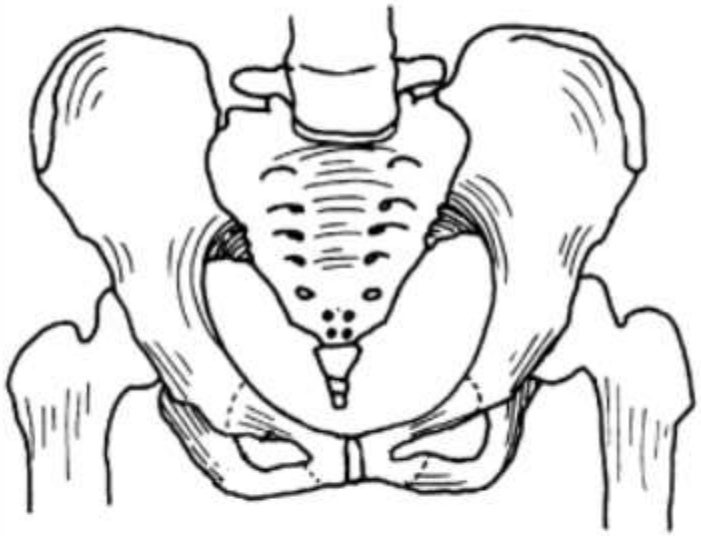

Verify these structures now.

- Pubic bones
- Ischium
- Ilium
- Iliac Crest
- Sacrum
- Pubic Symphysis
- Pelvic Girdle

Lesson 02-03: Rib Cage [Page 18]

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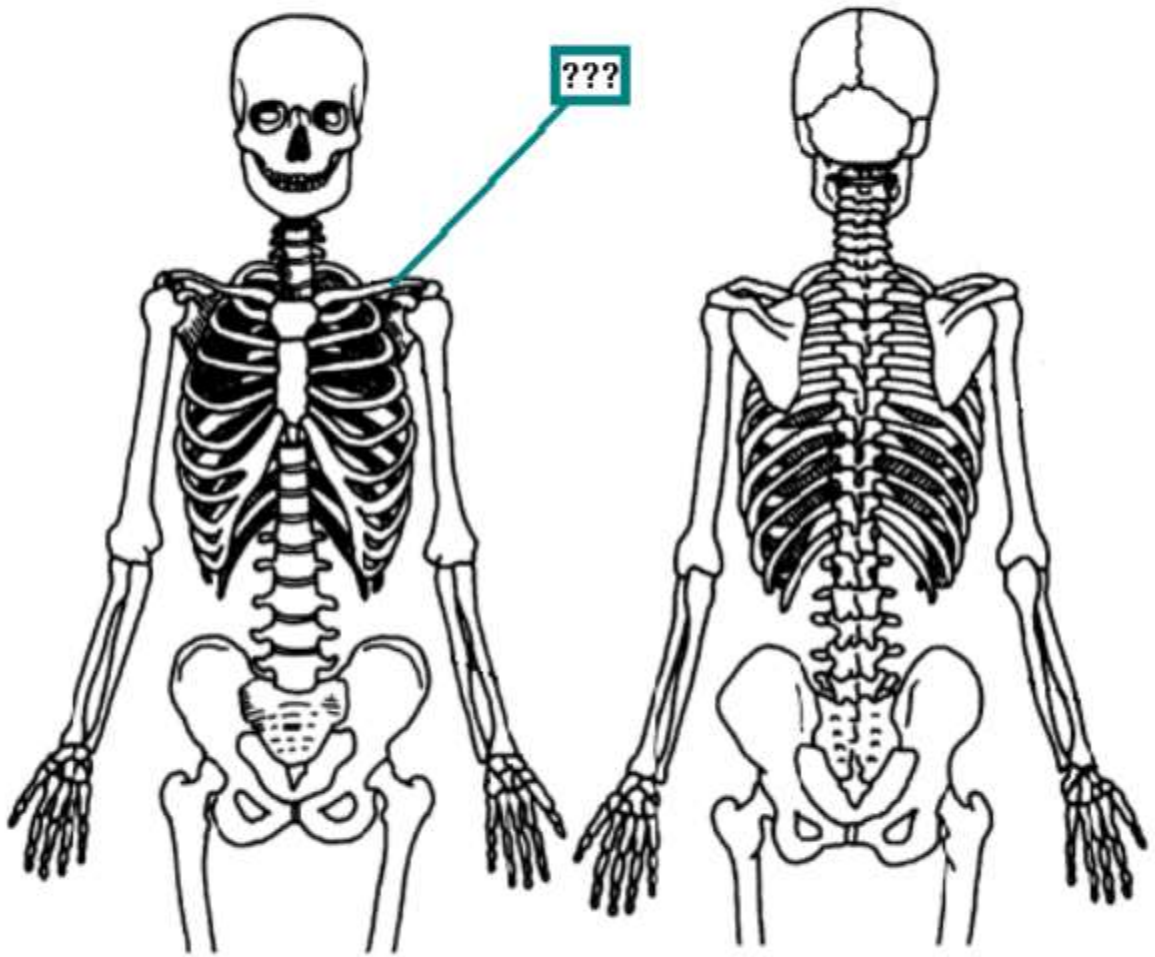

Now take a quiz about the pectoral and pelvic girdles. Identify the structure or landmark illuminated.

- Sacrum
- Scapula
- Ilium
- Clavicle
- Ischium
- Pectoral Girdle
- Pelvic Girdle
- Sternal Notch
- Iliac Crest
- Pubic Symphysis
- Manubrosternal Angle

Lung

Lesson 02-04: Lungs [Page 1]

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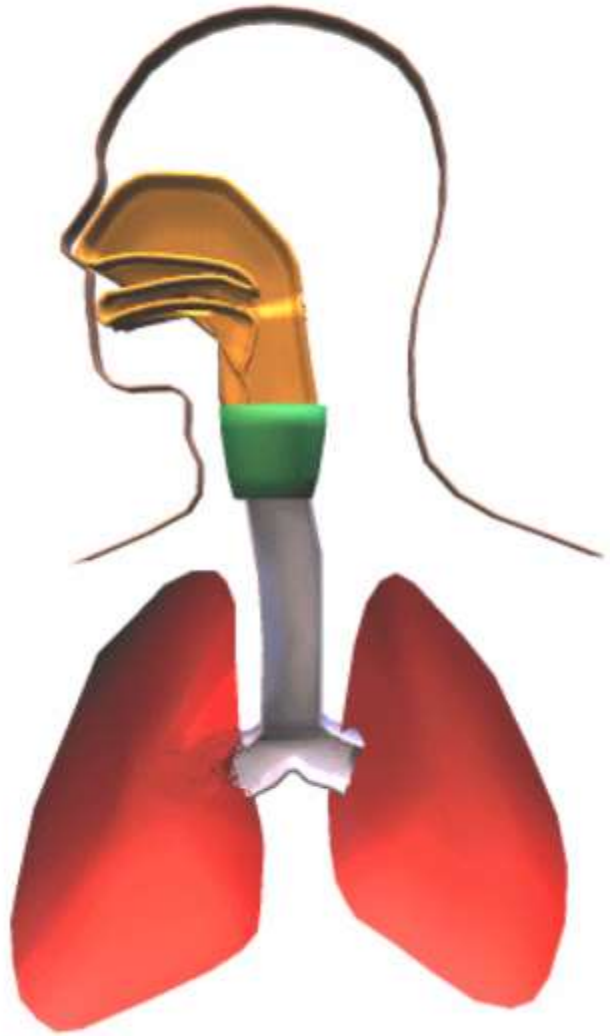

The lungs are safely housed within the rib cage. Beneath the lungs is the diaphragm, and to the side of the lungs are the ribs. The only means of communication between the lungs and the environment outside the lungs is through the respiratory tract.

The respiratory passageway is comprised of the oral and pharyngeal cavities, the larynx, trachea and bronchial tubes.

Lesson 02-04: Lungs [Page 2]

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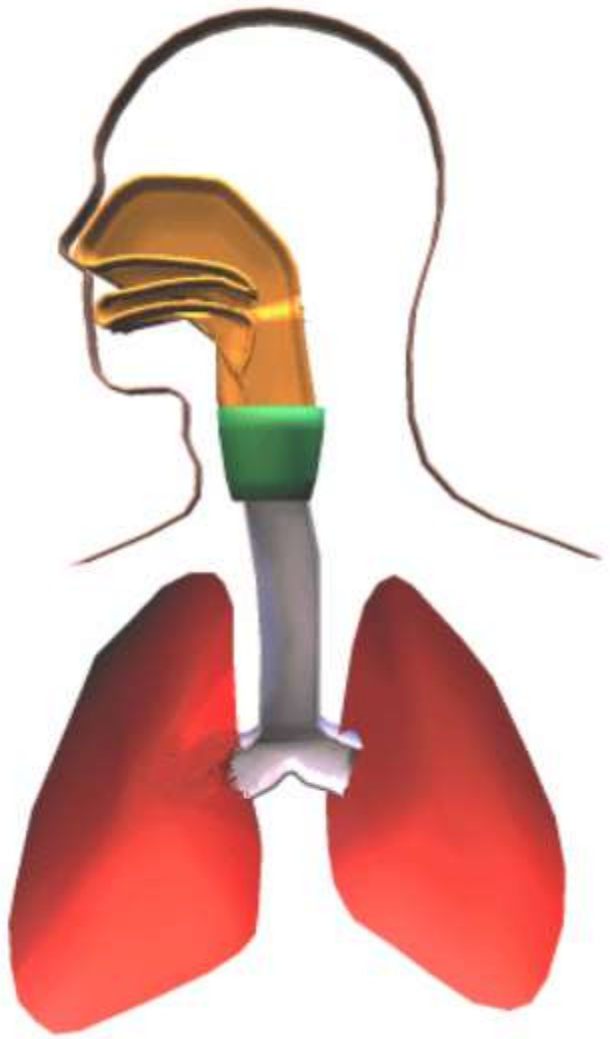

Using the buttons identify the areas.

- Oral Cavity
- Pharynx
- Larynx
- Trachea
- Bronchial Tubes
- Lungs

Lesson 02-04: Lungs [Page 3]

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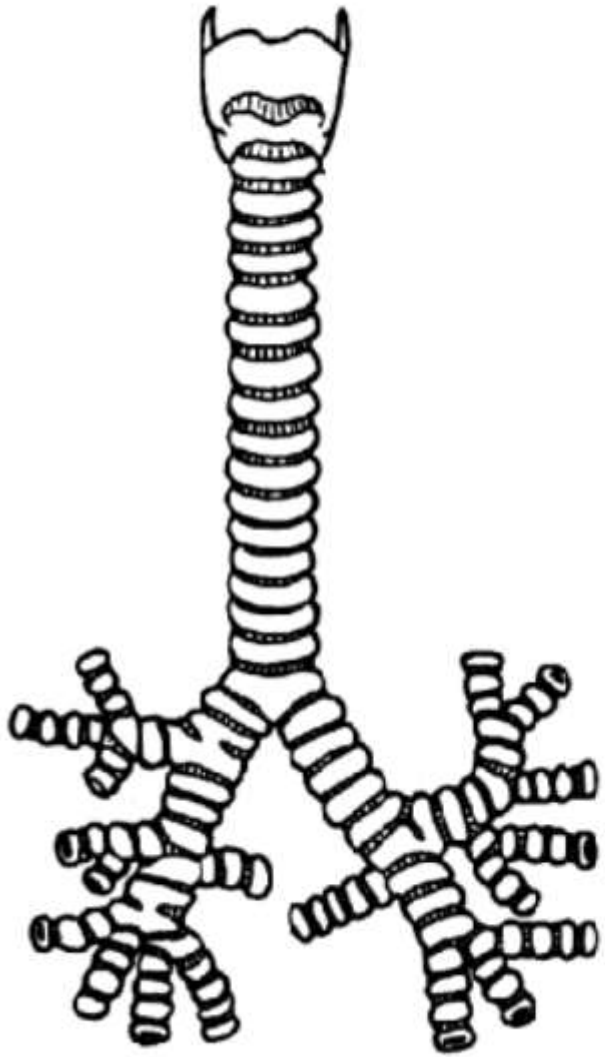

The TRACHEA needs to be both SUPPORTIVE and FLEXIBLE.↵It needs to be SUPPORTIVE because drops in air pressure would cause it to collapse if it were not.↵It needs to be FLEXIBLE to permit you to move your head and neck. The trachea meets these design requirements by being made of CARTILAGE. Cartilage is ELASTIC in nature, which means that when it is deformed it tends to return to its original structure. Cartilage is also supportive.

The trachea is composed of 16 to 20 cartilage rings, connected by membrane and muscle. Each ring is OPEN in the BACK. When the rings are combined they form a tube with an opening in the back that is spanned by MUSCLE. This muscle REMAINS CONTRACTED until your air need increases. During PHYSICAL EXERTION the muscle relaxes and lets the trachea OPEN WIDER.

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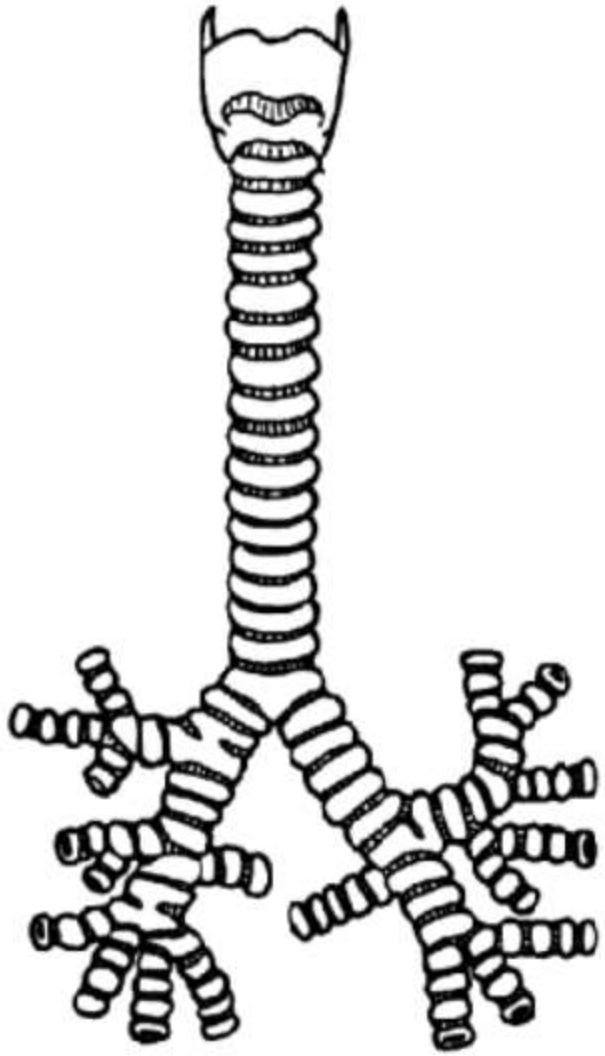

The FIRST BRONCHIAL DIVISION occurs at the base of the trachea. The CARINA TRACHEAE is the dividing point, separating left and right MAINSTEM BRONCHI. This is called a BIFURCATION.

The LEFT BRONCHIAL TUBE serves the LEFT LUNG; the right bronchial tube serves the right lung.

The BRONCHIAL TREE further divides into progressively smaller divisions. The SECONDARY DIVISIONS serve the LOBES of each lung.

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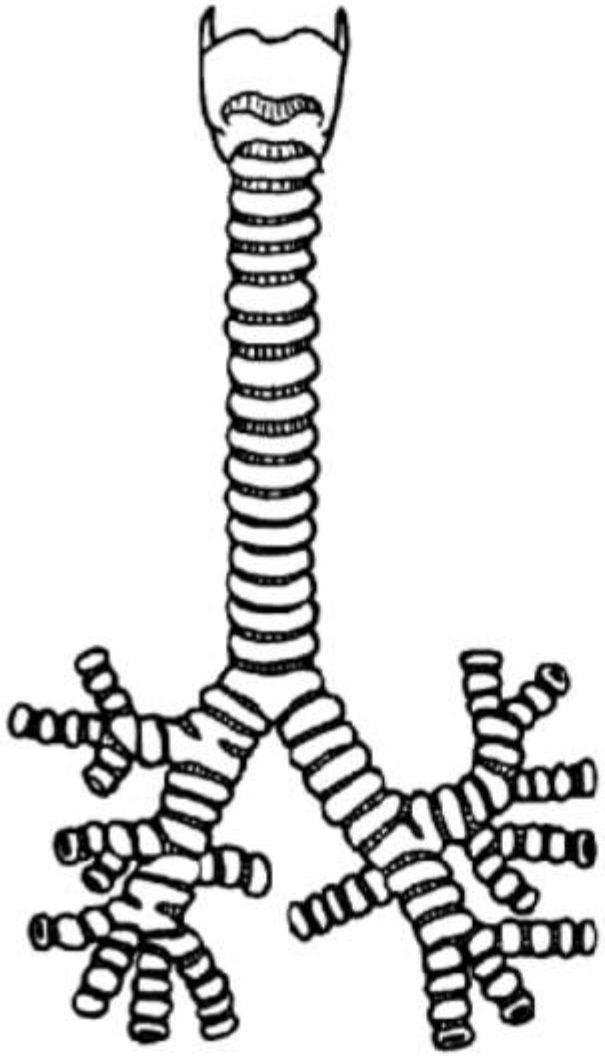

The LEFT lung has TWO LOBES, and the RIGHT lung has THREE LOBES, so that there is a total of five secondary bronchi. These bronchi are also called LOBAR BRONCHI, because they serve the lobes.

Each lobe is further broken into SEGMENTS, and the tertiary divisions called segmental bronchi divide to serve the segments. The bronchial tree undergoes 28 divisions before its final division, the TERMINAL RESPIRATORY BRONCHIOLE.

Lesson 02-04: Lungs [Page 6]

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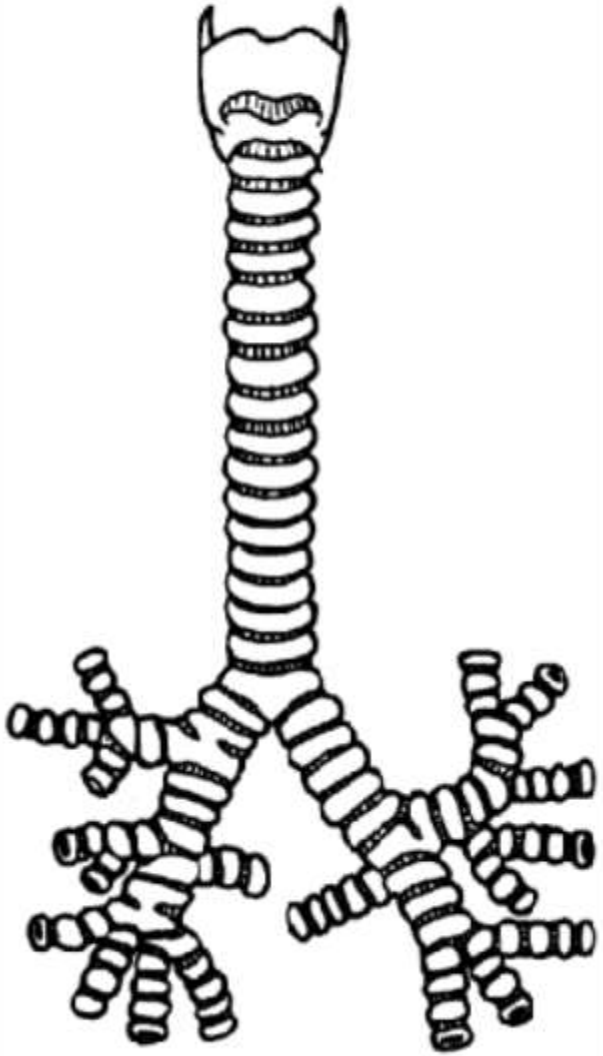

Verify these structures before we go on.

- Trachea
- Carina Tracheae
- Mainstem Bronchi
- Secondary (lobar) Bronchi
- Tertiary Bronchi

Lesson 02-04: Lungs [Page 7]

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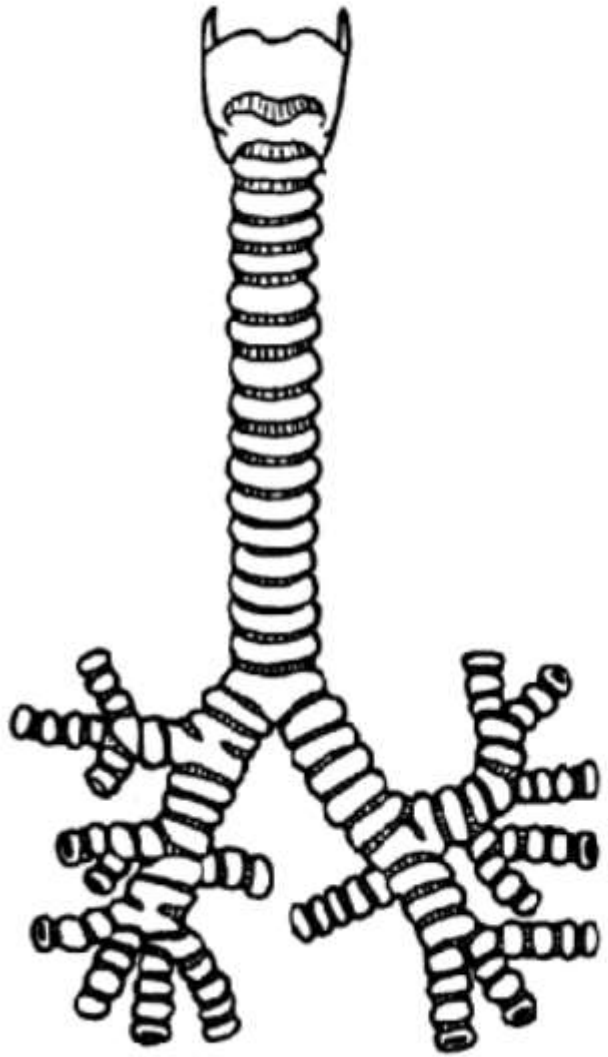

There are ___ lobes in the right lung.

collapsing	flexible
supportive	contracted
relaxed	carina tracheae
lobar bronchus	cartilaginous rings
mainstem bronchus	segmental bronchi
greater surface area	term. resp. bronchiole

1 2 3 4 5

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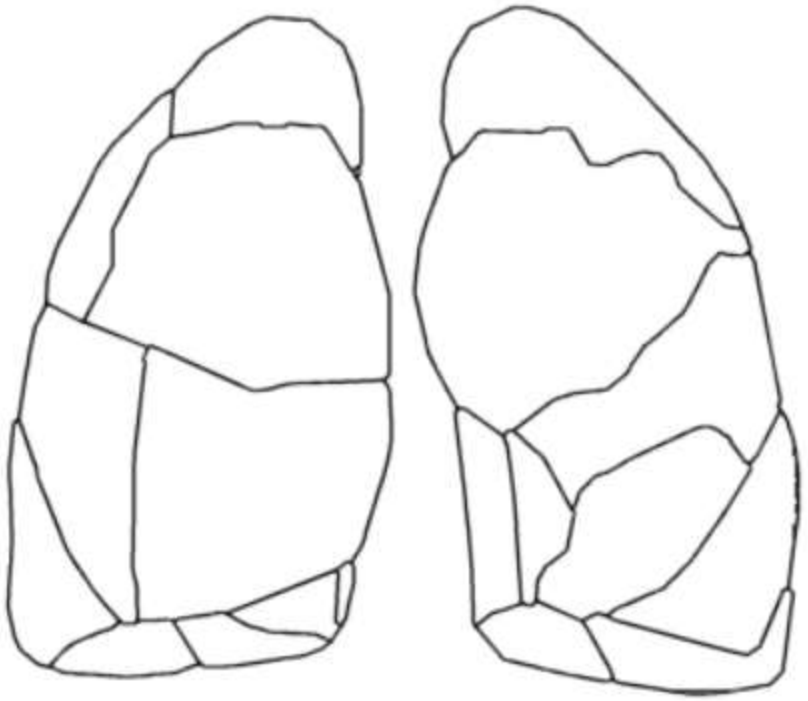

Here are the right and left lungs.

The right lung has three lobes, the upper, middle, and lower lobe.

The left lung has two lobes, the upper and lower. The heart lies between the lungs, and takes up space from the left lung so that there are only two lobes. The heart rests in the cardiac impression.

Beneath the lungs is the diaphragm, and the impression on the bottom of the lungs is the diaphragmatic impression.

The top and bottom of each lung are called APEX and BASE respectively; these are just names for regions, unlike lobes which are actual parts.

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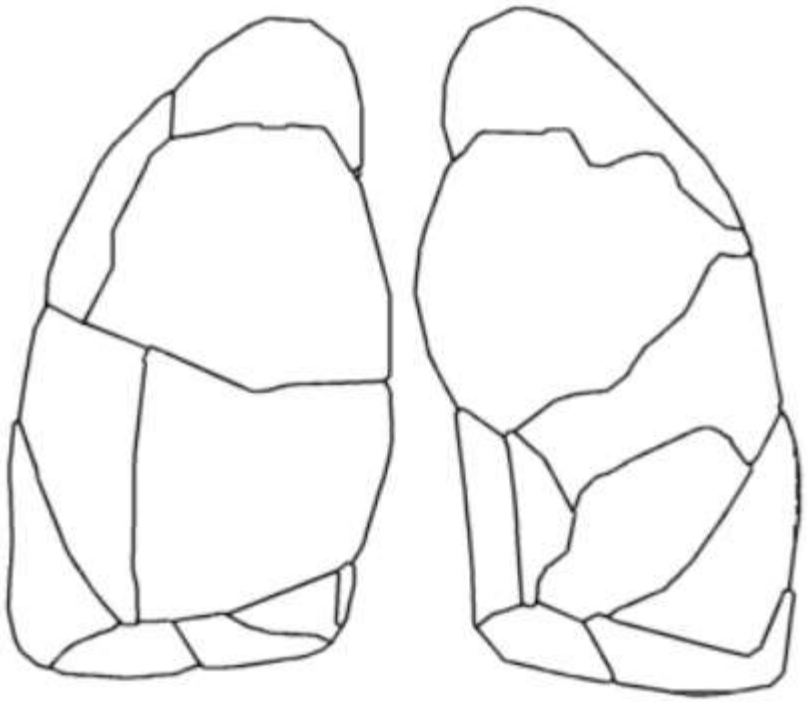

Press the buttons and identify these landmarks.

- left lung
- right lung
- upper lobes
- middle lobe
- lower lobes
- diaphragmatic impression
- cardiac impression
- base
- apex

Lesson 02-04: Lungs [Page 10]

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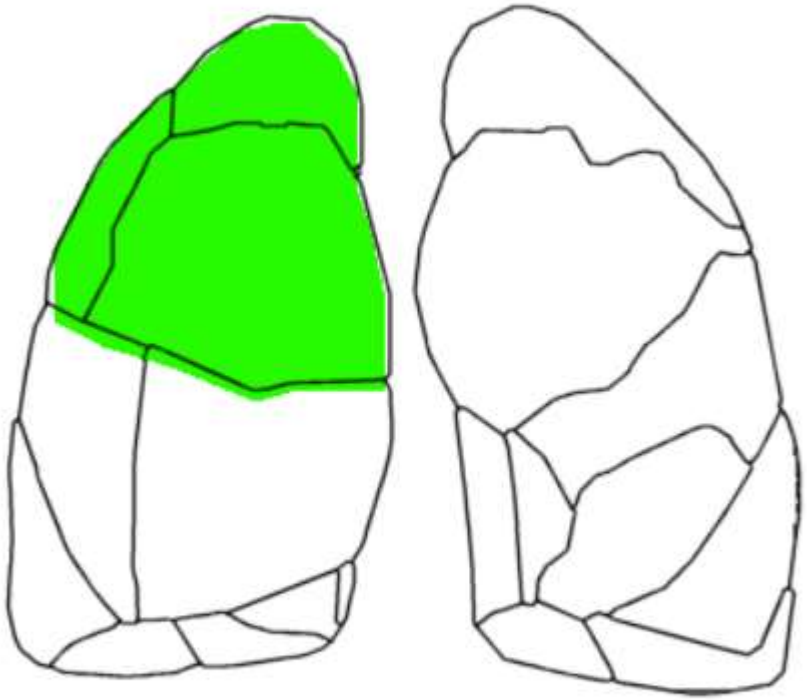

Try your hand at these structures.

- left lung
- right lung
- upper lobe, right lung
- middle lobe, right lung
- lower lobe, right lung
- upper lobe, left lung
- lower lobe, left lung
- diaphragmatic impression
- cardiac impression

Lesson 02-04: Lungs [Page 11]

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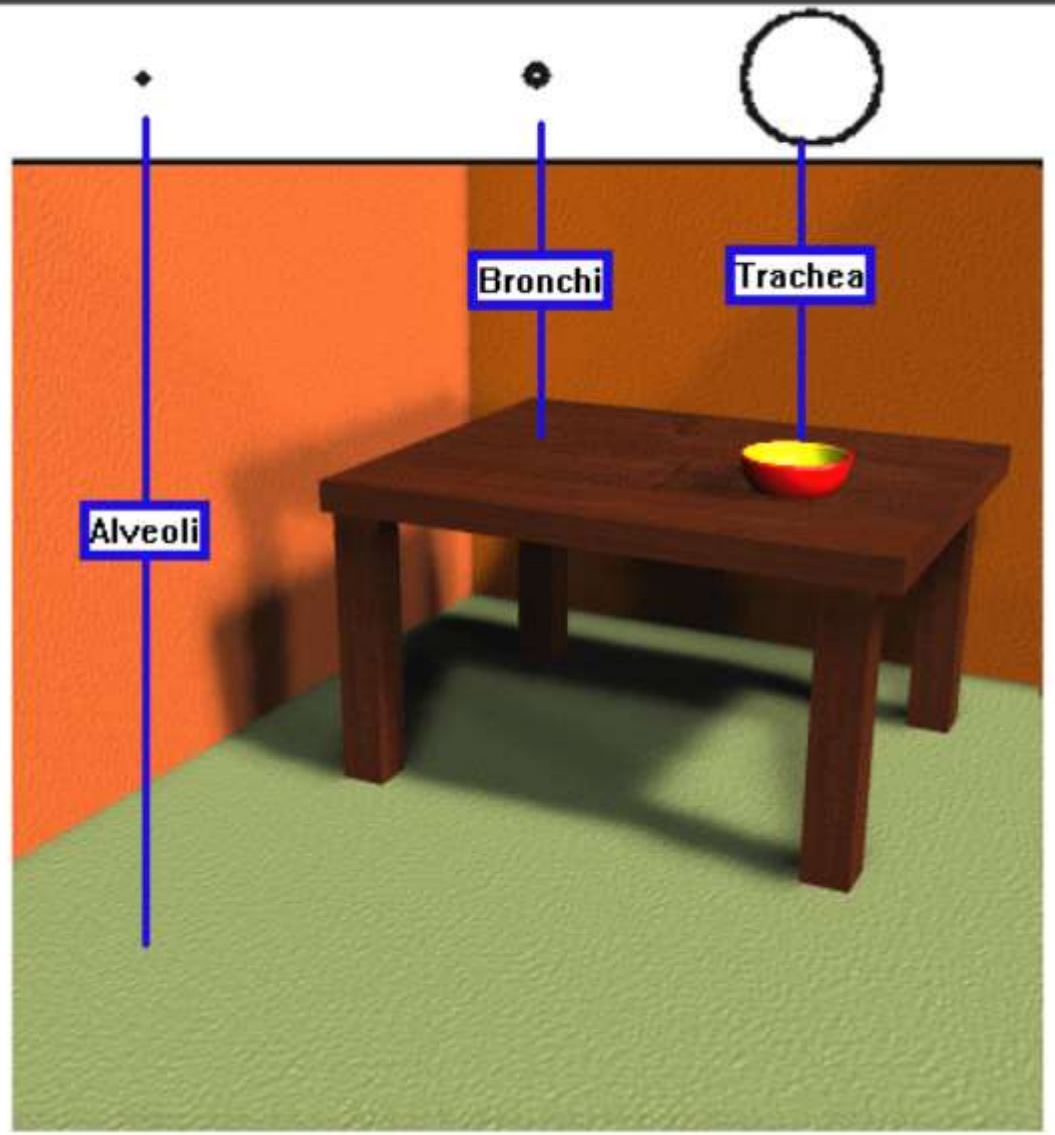

The upper figure shows comparative cross-sections. In cross-section, the trachea is about the diameter of a quarter. In contrast, each terminal respiratory bronchiole is about the width of a fat pencil line. The alveoli that cluster at the end of the respiratory tree are the width of a thin pencil line.

The surface area of the trachea is about the same as the area of the bowl in the lower figure; the surface of all the bronchi is about the same as a table (10 square meters); and the surface of the 300 million alveoli adds up to the floor area of a a good-sized room (70 square meters). The latter area is where gas exchange actually occurs.

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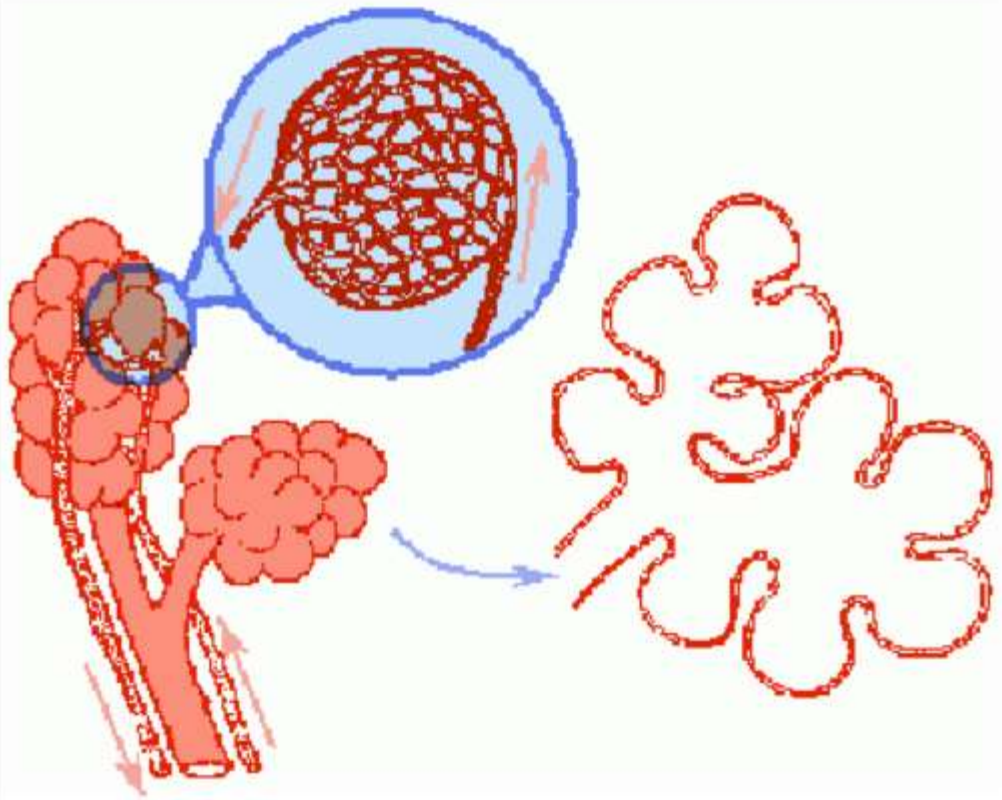

The first 9 divisions of the bronchial tree are CONDUCTING PASSAGEWAY only. They transport gasses between the lungs and the environment, but do not participate in gas exchange.

The final divisions are RESPIRATORY ZONES. These include RESPIRATORY BRONCHIOLES, ALVEOLAR DUCTS, and ALVEOLI.

This figure shows a nearly-microscopic view of the final division in the respiratory tree. At upper right is an even closer view of the capillaries surrounding one bronchiole; at lower right a cut-open view of the air passages inside this final division.

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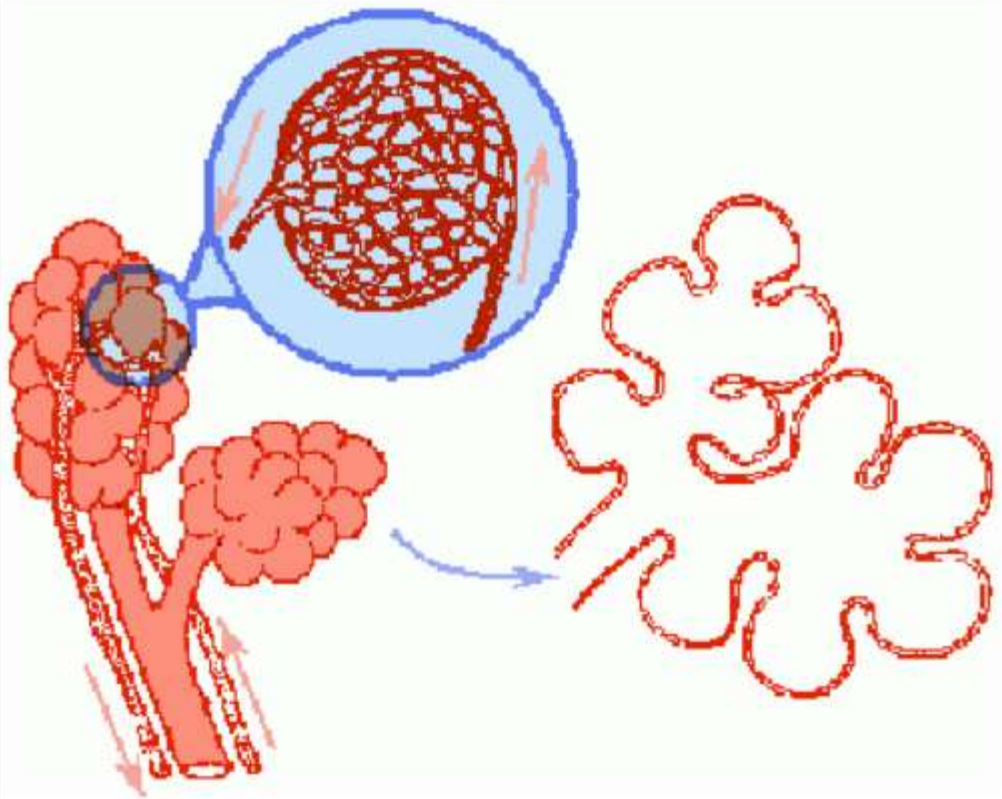

Let's examine each component of the terminal end of the respiratory tree.

- Respiratory Bronchiole
- Alveoli
- Alveolus (closeup)
- Alveolar Duct
- Capillary Bed

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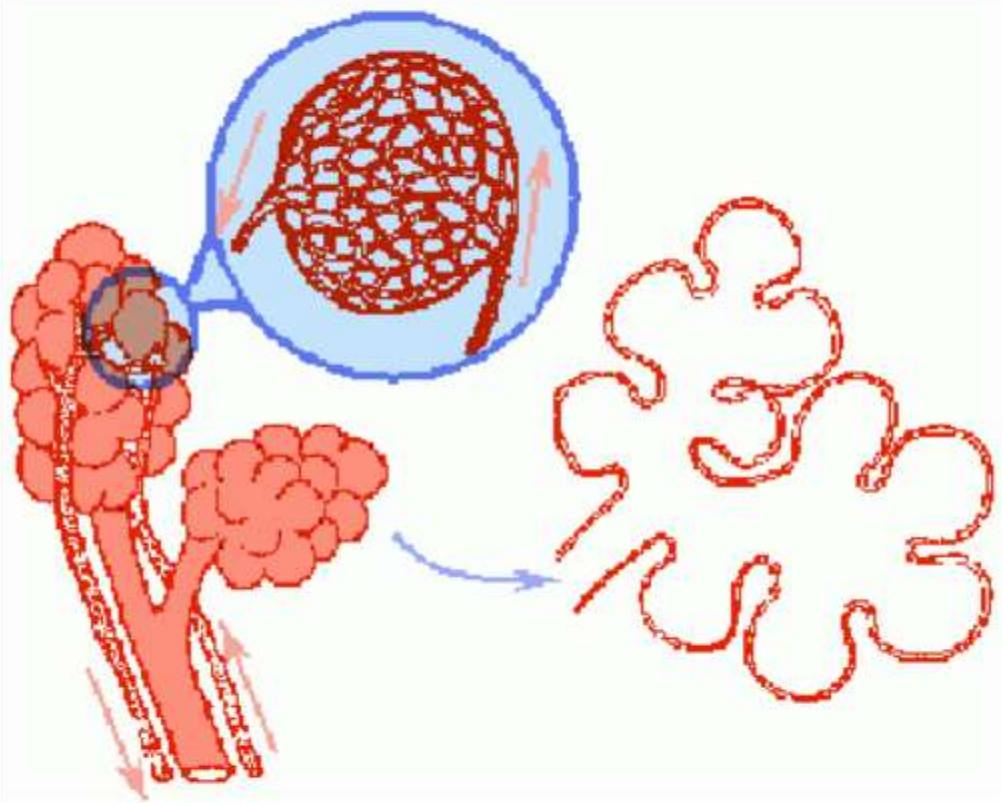

The ALVEOLUS is where the work of respiration occurs. It has a rich supply of BLOOD.

There are 2,000 CAPILLARIES on each alveolus, meaning that there are over 600 trillion capillaries in the lungs involved in GAS EXCHANGE! This is the densest "bed" of capillaries in the body.

The WALLS of the alveolus are extremely THIN, and oxygen and carbon dioxide may pass through the walls.

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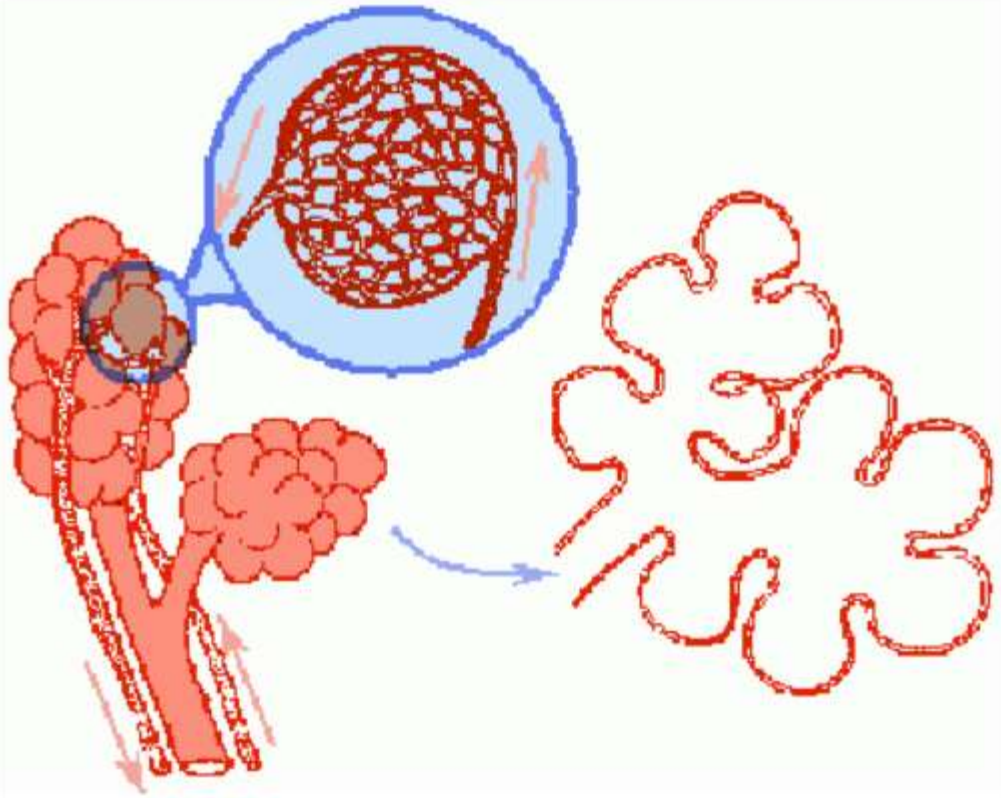

This rich mat of alveoli is supported by the CARTILAGINOUS NETWORK supplying them. The combination of airy ALVEOLI, the firm and elastic lacework of CARTILAGE, and BLOOD SUPPLY make the lungs SPONGY.

Cells within the lungs produce surfactant, which is a substance that lowers surface tension.

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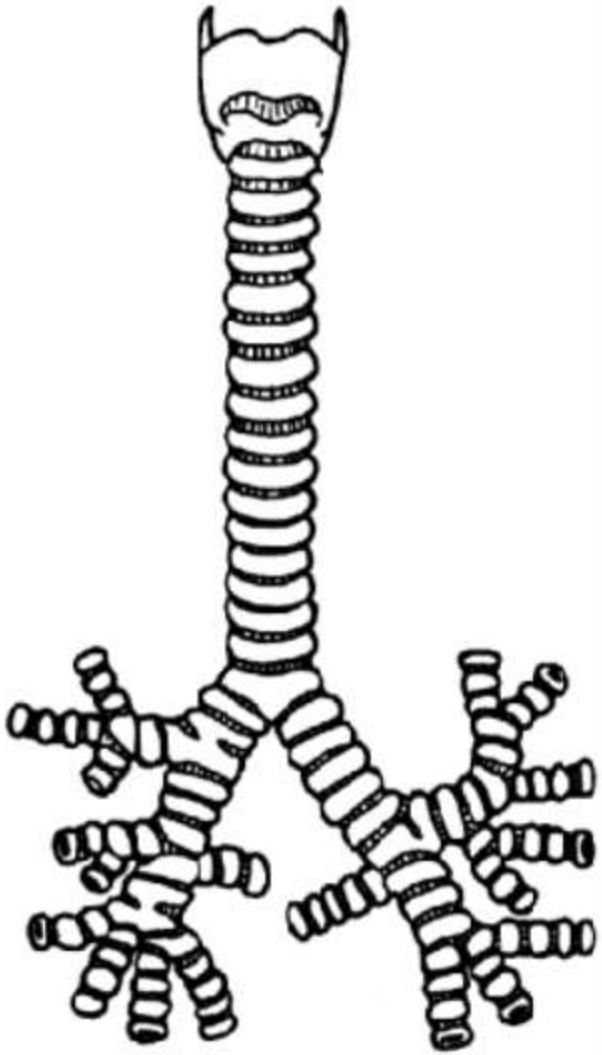

The ___ of the trachea permits movement of the head relative to the chest.

- rigid
- flexibility
- cartilaginous rings
- mainstem bronchus
- segmental bronchi
- contracted
- term. resp. bronchiole
- supportive
- collapsing
- carina tracheae
- lobar bronchus
- greater surface area
- relaxed

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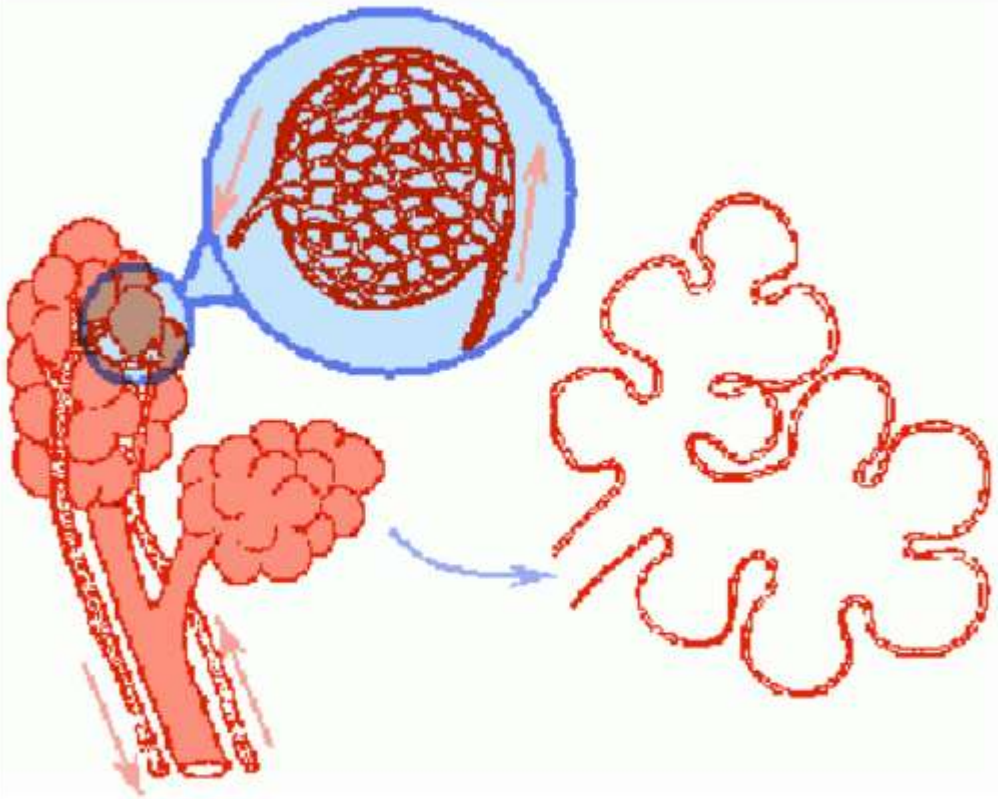


The upper nine divisions of the bronchial tree are ___.

terminal bronchiole

alveolus (closeup)

conducting passageway

respiratory zones

alveolar duct

extremely thin walls

alveoli

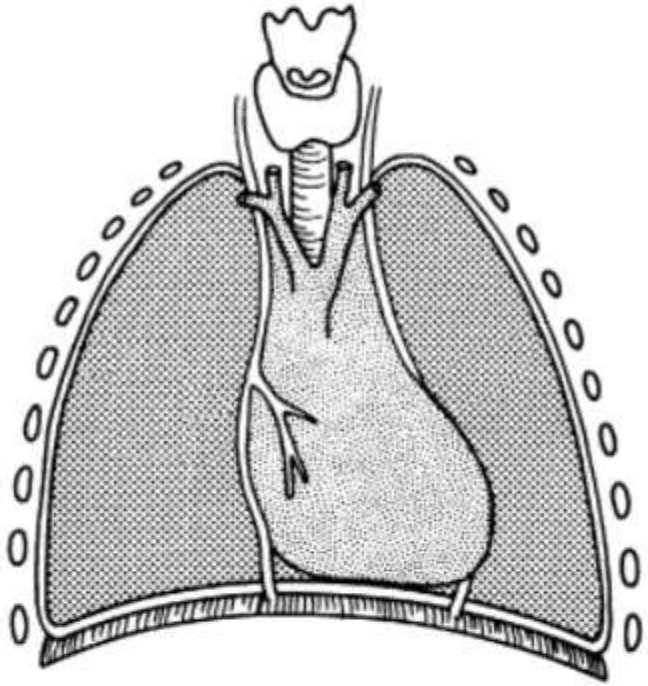
gas exchange

1500

2500

2000

1000



The PLEURAE

You already know that lungs expand as a result of ENLARGING the structure surrounding them.

You CONTRACT the DIAPHRAGM to enlarge the VERTICAL DIMENSION (superior-inferior dimension).

You ELEVATE the RIB CAGE to enlarge the TRANSVERSE DIMENSION (antero-posterior dimension).

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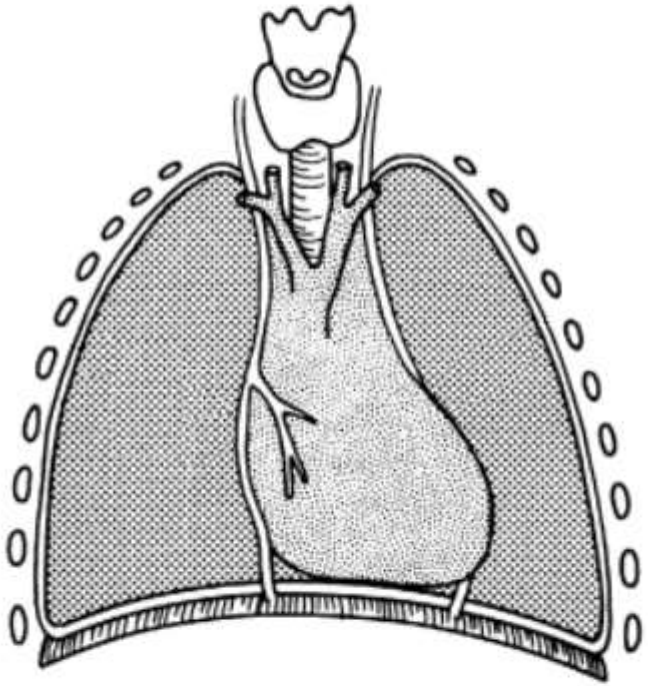

The thorax is a CLOSED SYSTEM: The DIAPHRAGM is in the INFERIOR aspect, and the RIB CAGE is invested with MUSCLE that separates the lungs from the outside world. The only way to the outside environment is through the bronchial tree and ultimately the trachea.

But how are the lungs held in the thorax? The lungs are simply placed within the thoracic cavity. They are not held by ligaments or cartilage.

The lungs are surrounded by a THIN, MEMBRANOUS LINING referred to as the VISCERAL PLEURAE. This thin lining completely WRAPS the LUNGS.

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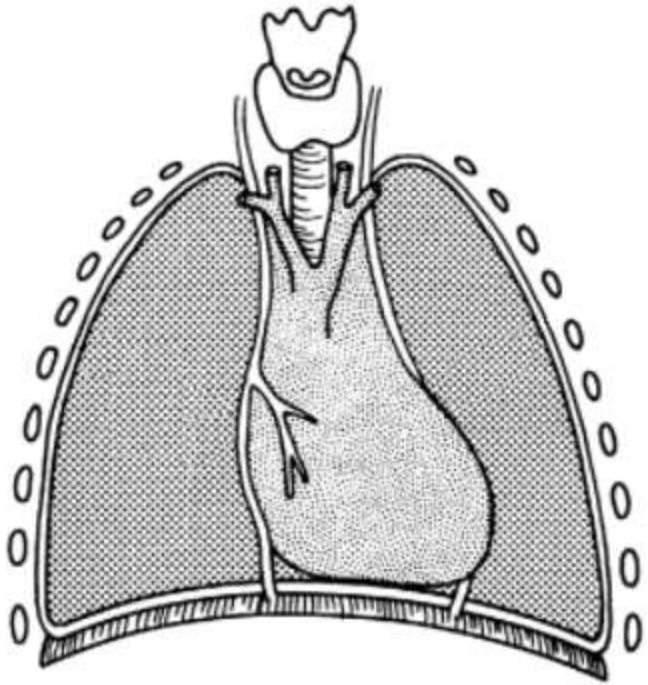


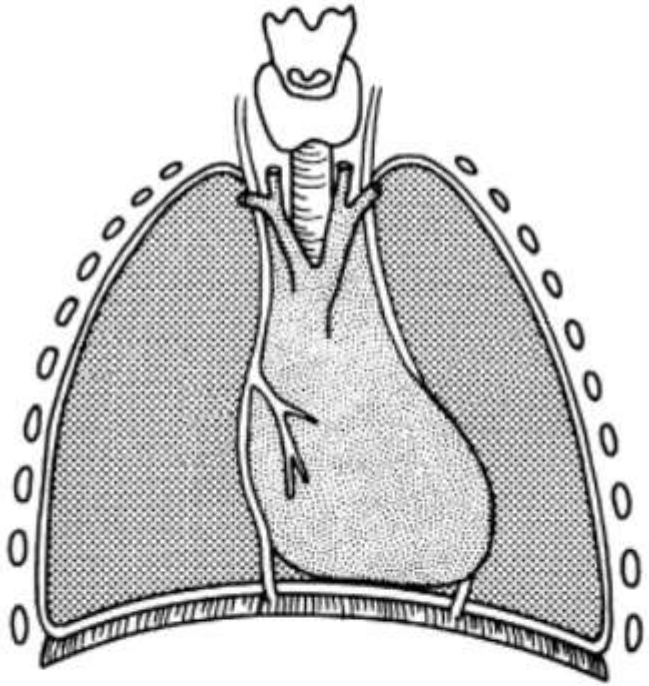
The INNER SURFACE of the THORAX is also lined with pleural lining, called the PARIETAL PLEURAE. We refer to REGIONS of the PARIETAL PLEURAE based upon the areas being covered by this CONTINUOUS MEMBRANE.

The COSTAL PLEURAE covers the RIBS. The DIAPHRAGMATIC PLEURAE cover the DIAPHRAGM. The MEDIASTINAL PLEURAE cover the MIDDLE SPACE containing the heart.↵The APICAL PLEURAE cover the APICES, the topmost parts of the LUNGS. On this figure, only the APICAL, COSTAL, and DIAPHRAGMATIC are clearly visible.

apical pleurae

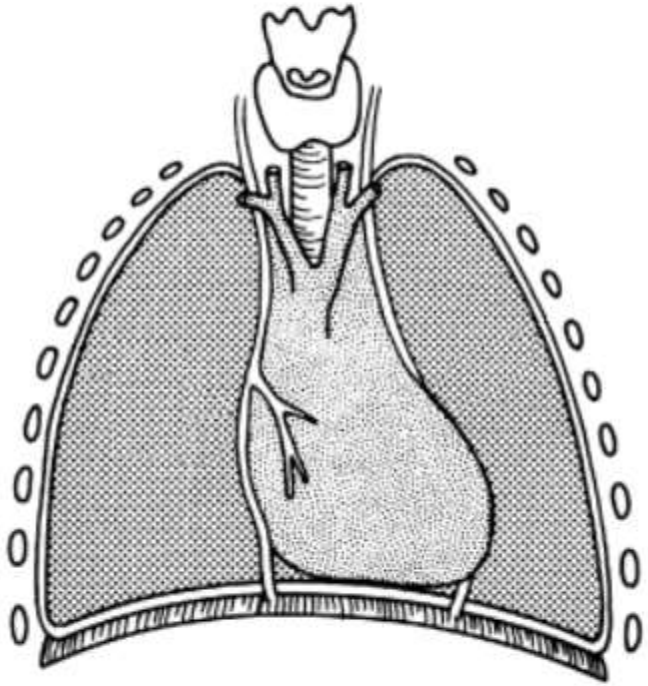
costal pleurae

diaphragmatic pleurae



These linings are actually the same lining covering different structures.↵There is one pleural lining per lung, completely separating the two lungs.↵In each lung, the visceral pleural lining simply doubles over onto itself to cover the inner rib cage and so on.

These linings have fluid between them, and the fluid provides a slippery connection between them.↵The parietal and visceral linings make constant contact, but slide back and forth over each other for an almost friction-free coupling of the rib cage and the lungs.



Because the linings are air-tight, make constant contact, and are slippery, the lungs are going to follow the rib cage and diaphragm when they move.

When the diaphragm pulls down, the visceral pleurae pull down too because they make an air-tight connection with the parietal pleurae. The lungs are attached to the visceral pleurae, so they pull down as well.

When the rib cage expands, the pleurae and lungs follow.

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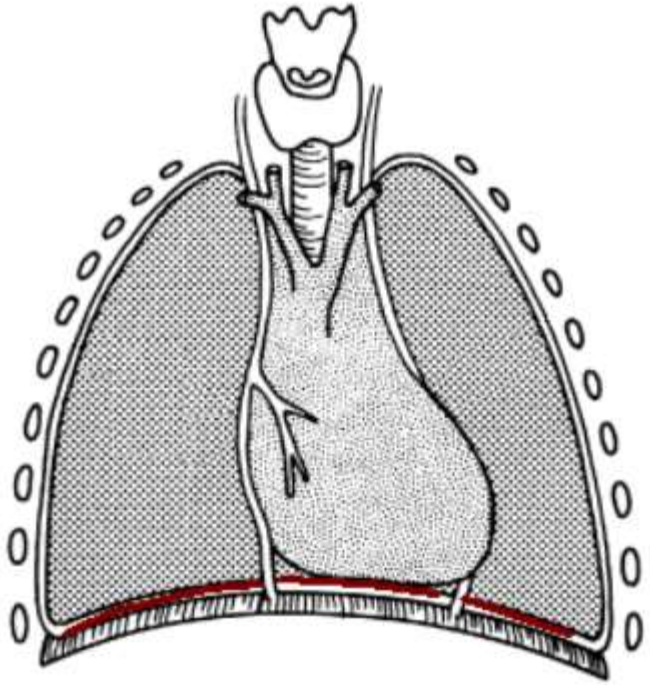

What's flashing?

air

move down

move out

move in

move up

lungs

expand

visceral pleurae

costal pleurae

parietal pleurae

diaphragmatic pleurae

apical pleurae

mediastinal pleurae

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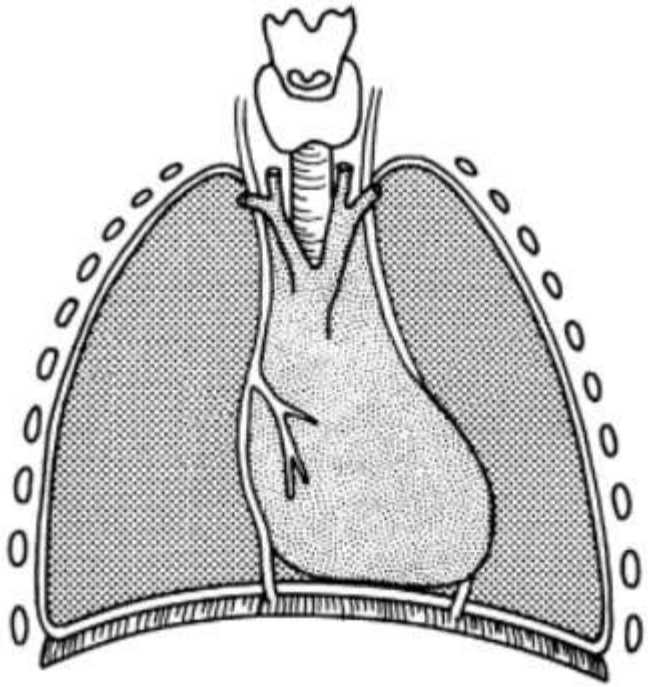
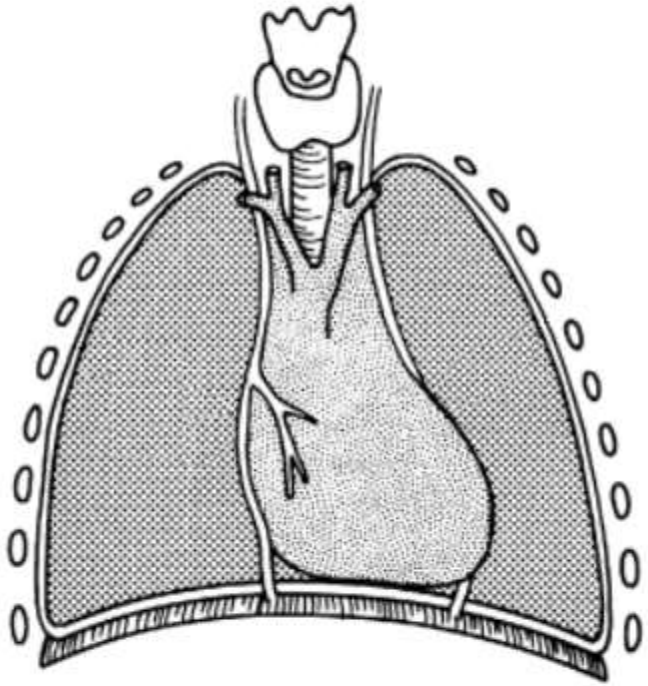


What makes the two pleurae follow each other closely?➢
It's much like two pieces of plastic food wrap. You know that if you put a little water between two thin plastic sheets they are quite hard to separate.

The SURFACE TENSION between the two sheets makes it difficult to pull them apart, but the fluid is MUCOSAL in nature, so it is SLIPPERY as well. The SLIPPERY FLUID lets the lungs SLIDE around within the thorax as the thorax expands. Without the fluid, the linings would be rough and would not slide.



More important than surface tension, there is a NEGATIVE PRESSURE between the two linings. The linings are AIR TIGHT. As they are PULLED APART during contraction of the diaphragm or elevation of the rib cage, the VOLUME within the intrapleural space INCREASES. Boyle's Law says that as volume in the space INCREASES the pressure in that space DECREASES.

That is, as the RIB CAGE EXPANDS and DIAPHRAGM CONTRACTS, a NEGATIVE PRESSURE is generated BETWEEN the parietal and visceral linings. The two linings will tend to stay together because of this "suction" effect, and the lungs will tend to follow the thorax.

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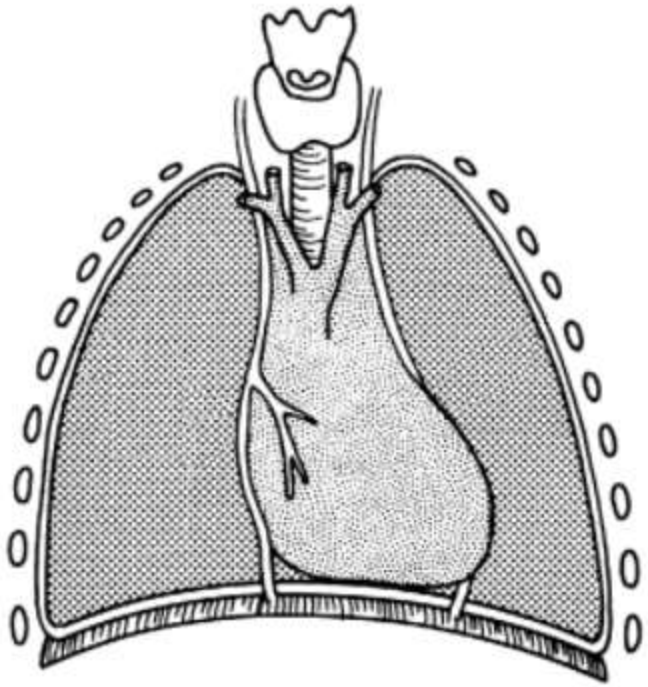

Through a quirk of nature the lungs are SMALLER than the THORAX. An infant's lungs exactly fit the thorax, but as she develops her THORAX grows faster than her LUNGS, so that the lungs are STRETCHED to fill the space.

An adult's lungs are like a small sponge stretched to fill a large bottle. The linings continually pull the lungs into this STRETCHED position.

When the thorax expands, the lungs stretch even more.

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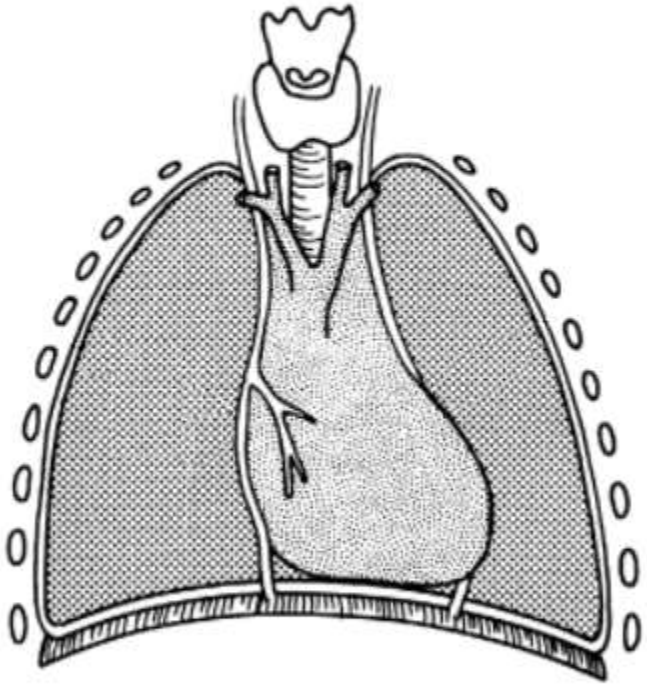

The fluid between the parietal and visceral pleurae is ___ which makes the surfaces slippery.

- increases
- decreases
- surface pressure
- negative pressure
- mucosal
- air-tight

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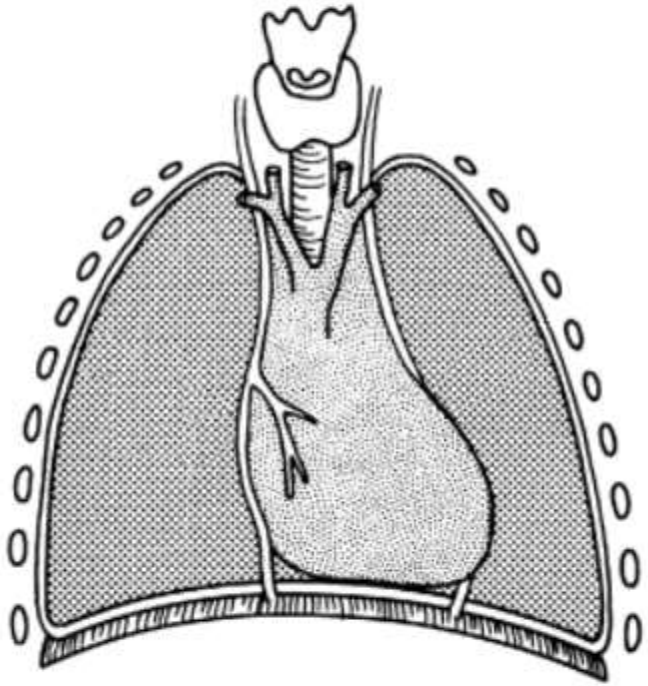

Deep in the thorax is the most important muscle of the body. The heart lies within the MEDIASTINUM, or "middle space."

Within the mediastinal pleurae are the heart, esophagus, nerves and blood vessels.

The mediastinum is deep and protected. The heart must be hidden from external trauma. The thorax is muscle and bone. Within the thorax are the lungs. Deepest to all of these is the heart.

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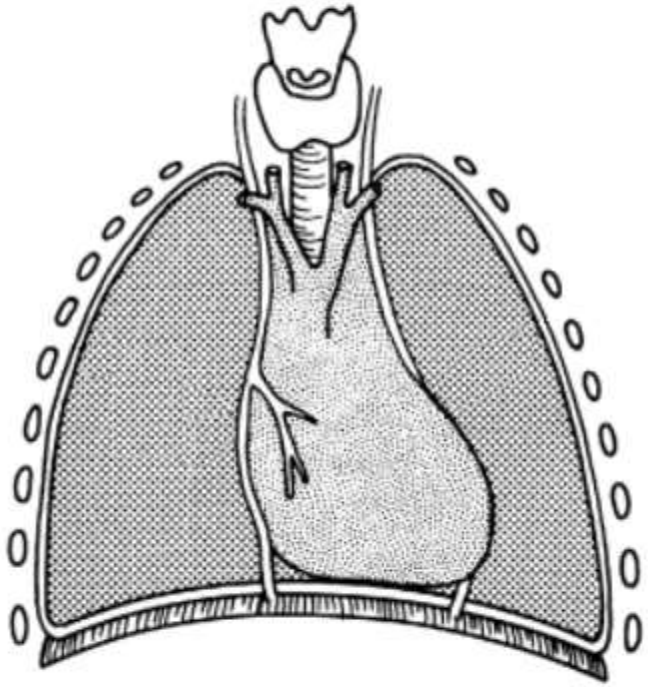

Identify the mediastinum and associated structures before we take a quiz!

- mediastinum
- trachea
- lungs
- costal pleurae
- diaphragmatic pleurae
- apical pleurae
- ribs

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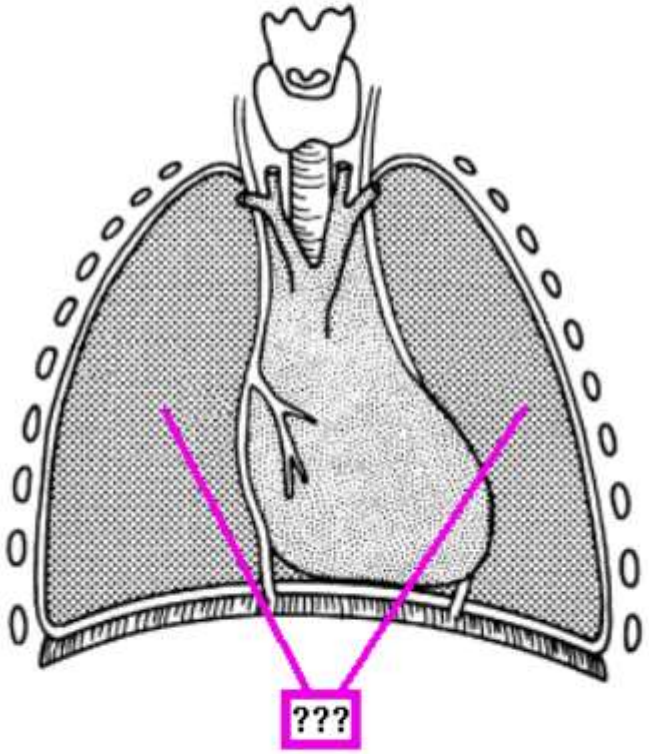

What's highlighted now?

- mediastinum
- trachea
- lungs
- costal pleurae
- diaphragmatic pleurae
- visceral pleurae
- ribs

Good Luck