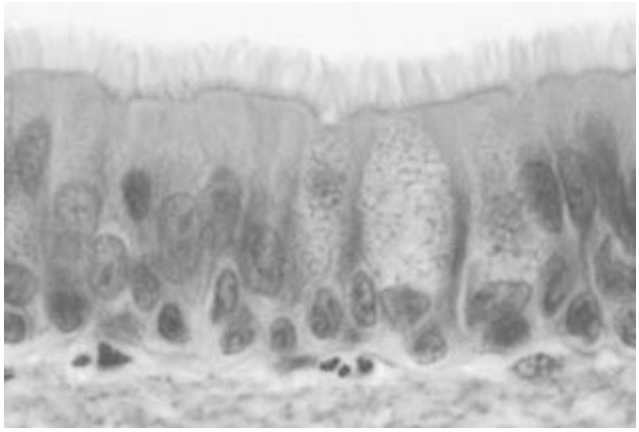
RESPIRATORY SYSTEM

Intro:

The pulmonary system can be divided into two parts, the conducting, where air is brought to the lungs, and the respiratory zone, where gas exchange occurs. The conducting zone is an area where no gas exchange occurs. This is a region called anatomical dead-space but this is where air is warmed, filtered, and humidified. Most of the tissue lining the conducting zone is Ciliated pseudostratified columnar epithelium, which is only interrupted in the Pharynx, lined by stratified squamous epithelium.

Ciliated pseudostratified columnar epithelium in this area has a specialized type of cell called a goblet cell which secretes mucus which coats the Cilia. Particles in air will get trapped in the mucus thus cleaning it from the air that will make it to the lungs. The cilia then beat to move the mucus towards the mouth where it will be swallowed. Under the Ciliated pseudostratified columnar epithelium, we find capillary beds which will lose heat to warn the air. These capillaries will also lose water to humidify the air entering.

1. Below draw and label what is seen in a slide of Ciliated Pseudostratified columnar epithelium and label the following:
    a. Columnar epithelial Cell
        i. Cilia
        ii. Basement membrane
        iii. Nuclei
    b. Goblet Cell



The lungs are the site where gas exchange can take place so are made up of simple squamous epithelium. The lungs are connected to the conducting zone by the bronchioles which enter the lungs via the Alveolar ducts. The alveolar ducts which lead to the alveolar sac which are formed by type one alveolar cells which are the simple squamous epithelial cells. The other alveolar cell you see is the type two Alveolar cell which makes the surfactant, a chemical that keeps the pressures across alveolar sacs even and keeps the sacs from collapsing completely as well.

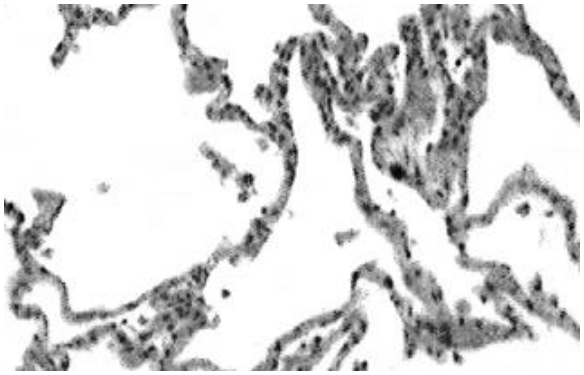
To allow the movement of gas to and from the alveoli and blood supply, many arterioles are present. These arterioles will form capillaries around the alveoli sacs. On a gross level, when the sacs are filled with gas, percussion will produce a different sound than over solid organs.

2. What type of tissue is found in the lungs?

3. What is a type I Alveolar cell?

4. What is a type II Alveolar cell?

5. In the image provided label the following.
    a. Type I alveolar cell
        i. Basement membrane
    b. Type II alveoli cell
    c. Alveoli
    d. alveolar sac
    e. alveolar duct.



Following air as it enters the nares, we see hairs which can help filter out large particles. Then we enter the nasal cavity which is divided by the nasal septum. The air in each nostril will hit the nasal turbinates which cause change the air flow to become more turbulent. The air is conducted through the nasopharynx and oropharynx to the Larynx which starts at the hyoid bone and the top of the epiglottis.

6. Looking at the skeletal lab, determine which are the bones of the nasal cavity?

7. Which bones form the nasal septum?

8. What is the purpose of the nasal conchae?

After the hyoid bone, we find the Thyroid cartilage which is made of hyaline cartilage and housed within the lumen of the Thyroid cartilage we find the rest of the epiglottis, an elastic cartilage structure that keeps food from entering the lungs. The happens as when you swallow the larynx rises causing the epiglottis to act as a closed door.

Also, inside the lumen of the Thyroid cartilage, towards the base, we find the Arytenoid cartilages which are involved in producing sound. When intubating a patient, clinicians will look at the vocal cords which are attached to the Arytenoid cartilage and guide tube in. Just inferior to the Arytenoid cartilage we find he cricoid cartilage which finally leads to the trachea.

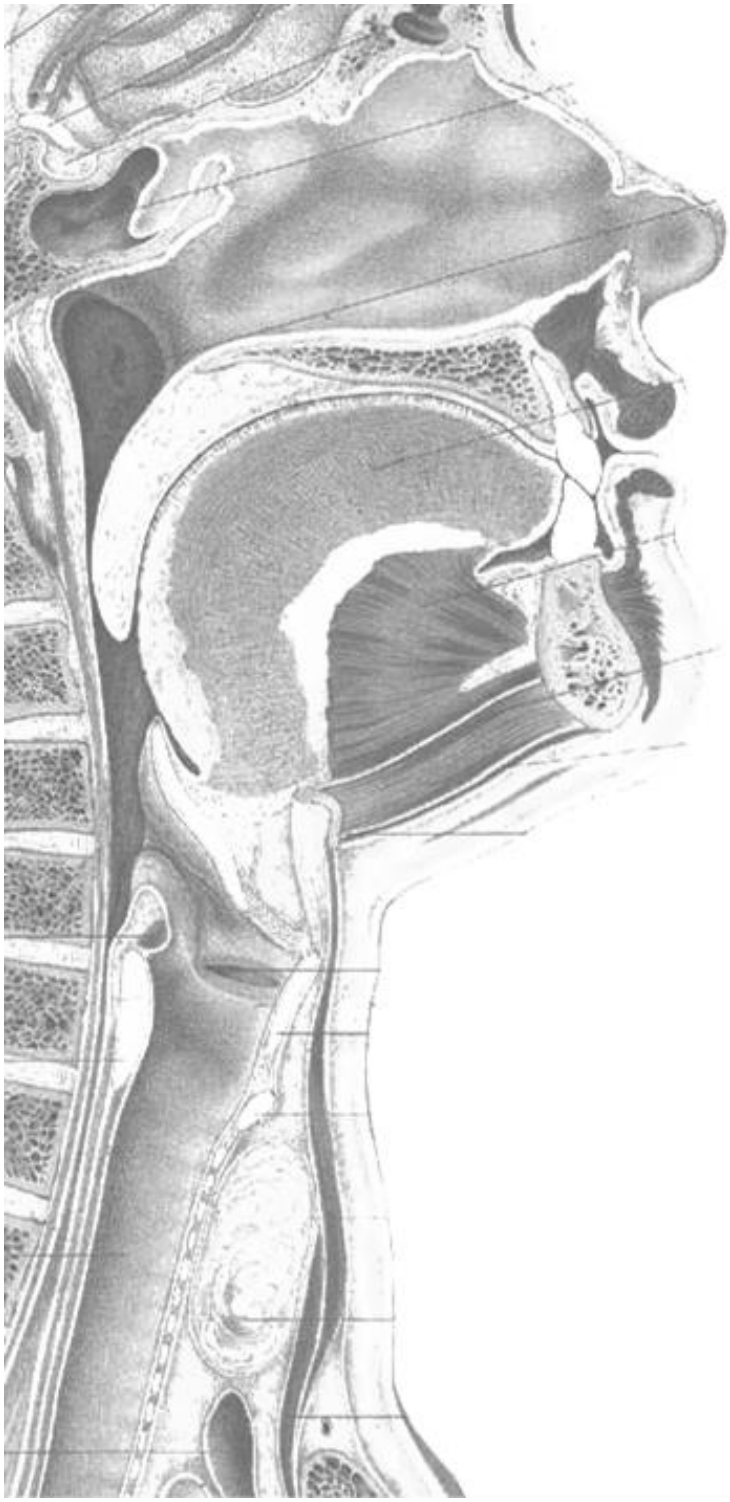
There are two thick folds of mucous membrane, each enclosing a narrow band of fibrous tissue. The top one is the false vocal fold which covers the vestibular ligament. This ligament attaches to the angle of the thyroid cartilage immediately below the attachment of the epiglottis, and behind to the antero-lateral surface of the arytenoid cartilage, just above the base of the Arytenoid cartilage. Under that we can see the vocal cords which are a mucus membrane over the vocal ligament. This structure can be used to cut off the trachea when swallowing as well as producing sound.

The trachea is a tube made up of Hyaline cartilage signet rings connected by dense regular connective tissue. This tube branches giving rise to two bronchi, of which the right tends to go more direct than the left Bronchi due to the location of the heart. Like the Trachea, the bronchi are made of hyaline cartilage rings, connective tissue, and smooth muscle.

One can see that the trachea continues down and into the thoracic region. It is found in a specific division of the Thoracic Cavity called the mediastinum. Near the area of T2 (close to the sternal angle) the trachea bifurcates. These two tubes are called a bronchus. The right bronchus tends to be at a more abtuse

angle than the left. This is due to the position of the heart in the chest. What this means is that when aspiration occurs, the things aspirated have an easier time dropping into the Right bronchus.

9. On the picture provided label the following:
    a. Nasal septum
    b. Palatine plate of Maxilla
    c. Pharynx
        i. Oro
        ii. Nasal
        iii. Laryngeal
    d. Epiglottis
    e. Thyroid Cartilage
    f. True vocal folds
    g. False vocal folds
    h. Trachea



The first two bronchus are called primary bronchus. Each Bronchus is different as they are going to different lungs. If we start with the right Bronchus, we see that it divided into three secondary bronchi. These are called the Superior, Middle and Inferior. The Left bronchus, having only two lobes of lung will only have the Superior and inferior.

Each Bronchus is then divided into tertiary bronchi which will no longer have cartilage rings but will have cartilage plates. The tertiary bronchi will divide further into bronchioles which lose the remaining of the cartilage.

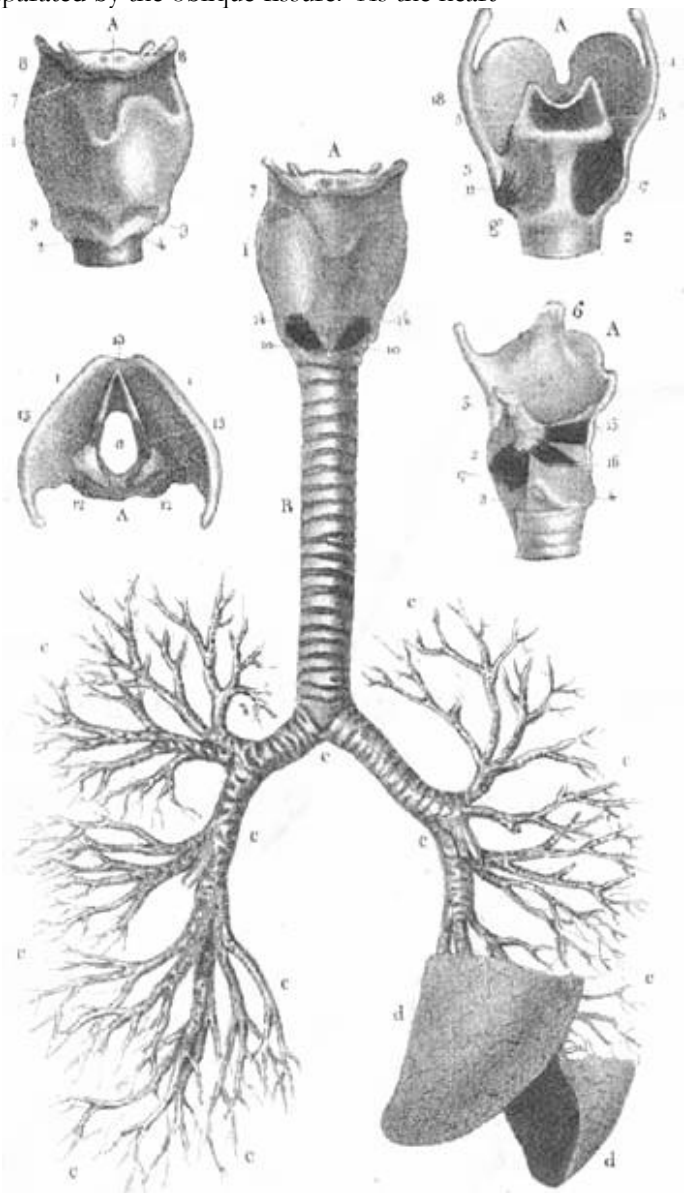
In the end the bronchioles are attached to the alveoli lobules which is where those alveoli sacs are found. It is not until you reach the area of the lobules that gas exchanged can occur.

Just like the heart is protected by a membrane, the lungs are contained in the thoracic cavity in the division called the pulmonary cavity and are also covered by a serous membrane for protection. This membrane is called the Pleura and is made up of two layers separated by a small cavity. These layers are the Parietal pleura and visceral pleura.

The lungs themselves are divided into different lobes. Just like there was a variation between the right and left bronchus, there is also variations between the right and left lungs. The right lung, having more space has three lobes separated from each other by two fissures. The superior lobe is separated from the middle lobe by the horizontal fissure and

from the inferior lobe by the Oblique fissure. The Middle lobe is separated from the Inferior Lobe by the oblique fissure.

The left lung only has two lobes, the Superior and inferior, but the superior lobe has a projection called the lingual (means tongue in Latin) The two lobes are separated by the oblique fissure. As the heart protrudes to the left, the left lung has the Cardiac impression as well as the impression of the Aorta.



10. On the image provided of the respiratory tract, label the following:
    a. Hyoid bone
    b. Thyroid cartilage
        i. Thyroid prominence
    c. True vocal folds
    d. Arytenoid cartilage
    e. Cricoid cartilage.
    f. Primary Bronchus (right and left)
    g. Secondary bronchus
        i. Superior
        ii. Middle
        iii. Inferior

When you look at both, complete lungs. It is evident that they both have a base, which is where it rests on the diaphragm. There is also a point on the top called the apex. Each lung will also have a Pulmonary Artery and Pulmonary vein. Where these structures and the bronchus come in is called the hilum.

Besides areas of anatomical dead space and the lungs, it is important to understand all the other structures that allow for breathing, or ventilation, to occur. We should start with the thoracic cage and the ribs. In the skeletal chapter, you saw how the ribs were attached to the sternum by hyaline cartilage which has some flexibility. In skeletal muscles, you learned that the diaphragm could contract to increase abdominal pressure. The contraction of the diaphragm causes the thoracic cavity to become bigger. This causes a decrease in pressure which causes the alveolar sacs to expand.

With the expansion of the alveolar sacs, air from the bronchioles moved into the alveolar ducts and sacs to make the pressure the same with the outside air. This causes a vacuum in the bronchus and up the respiratory tract until you reach the nares which are attached to the outside air. Once the lungs are filled, the diaphragm relaxes and the elastic recoil from the elastic tissue around the lungs and alveolar sacs force the gas out. This is your quiet breathing.

Ventilation, described previously, is divided into two parts, inspiration (breathing in) and expiration (breathing out) yet there are different types of breathing. There is normal quiet breathing and forced or

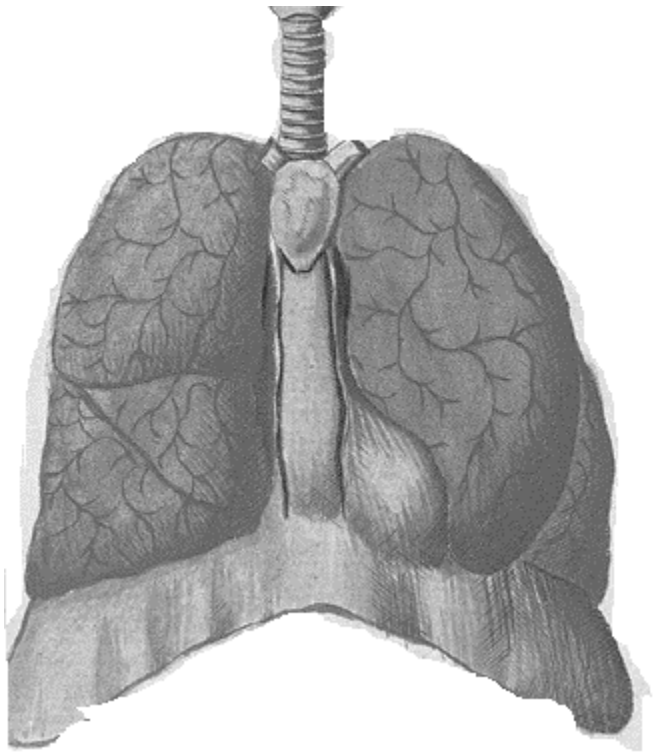
labored breathing. There are both muscle of normal and forced respiration. Quiet breathing is mostly accomplished by the contraction and relaxation of the diaphragm.

As human are active, sometime more oxygen is needed so muscles of forced respiration are called to work. In forced Inspiration, we can see that the main ones will be the scalenes and the sternocleidomastoids, but they are helped by the pectoralis minor and serratus anterior.

While expiration is usually caused by elastic recoil, when the body requires faster ejection of gas, the muscles of forced expiration can be used. These are the transverse abdominis, rectus abdominis, internal and external oblique muscles. The muscles of forced expiration work by increasing intraabdominal pressure. This is referred to as the Valsalva Maneuver and causes the diaphragm to be pushed up.

11. What is the serous membrane around the lungs called?

12. On the picture of the anterior view of the gross structure of the lungs label all the lobes, the lingual, all the fissures, the apex, base and hilum.



13. List the muscles of normal inspiration, give the origins and insertions as well as how do they work in inspiration?

14. What is the cause of normal expiration?

15. What muscles are known as muscles of forced inspiration? Where are they located (origin and insertion)?

16. What causes normal expiration?

In physiology, you will learn about spirometry. This is a graph of a person's breathing. It is made up of tidal volume (normal quiet breathing) Forced inspiratory volume, forced expiratory volume. There are normal values for each of these which a range is used. Any changes beyond the range of normal for these measurements is a sign of pathology.

With an understanding of the structures of the respiratory tract, we can understand the basics of Physiological dead space. This is the area of the lungs which can be used for gas exchange but now it is not. The third type of dead space is called Pathological Dead Space which is where gas exchange was once possible but due to a disease process, no gas exchange can occur.

Percussion and auscultation of lungs:
Method:

The art of percussion will come into play here. You are to start by placing your palm on your partners back near the neck. Then strike your own finger with the fingers of your other hand while you listen to the sound. Go down until the resonance changes.

17. At what vertebrae did it change?

Next tell them to take a deep breath and hold it as you start percussion two vertebrae up and start down again,

18. Did the level stay the same? Why or why not?

Using your new skill of percussion determine where resonance differs on the lateral border of the thoracic cavity.

19. What level did it change at?

20. Is this the same level you expected, why or why not?

Take a stethoscope and listen to your partners lungs start at the apex which should be around the superior angle of the scapula and the vertebral spine. Now place your stethoscope at about T6 and listen to both sides of the ribcage.

21. What should happen if you were to have a hole in the chest cavity to these breath sounds?

22. What would you expect in a person with reactive airway disease (Asthma)

23. What about pneumonia?

24. How would percussion change in someone with pneumonia?

25. Draw an image of the heart, vascular and pulmonary system so that you can place arrows showing how the respiratory system delivers oxygen into the organism.