

Anatomy Review: Respiratory Structures

Graphics are used with permission of:
adam.com (<http://www.adam.com/>)
Benjamin Cummings Publishing Co (<http://www.aw.com/bc>)

Page 1. Introduction

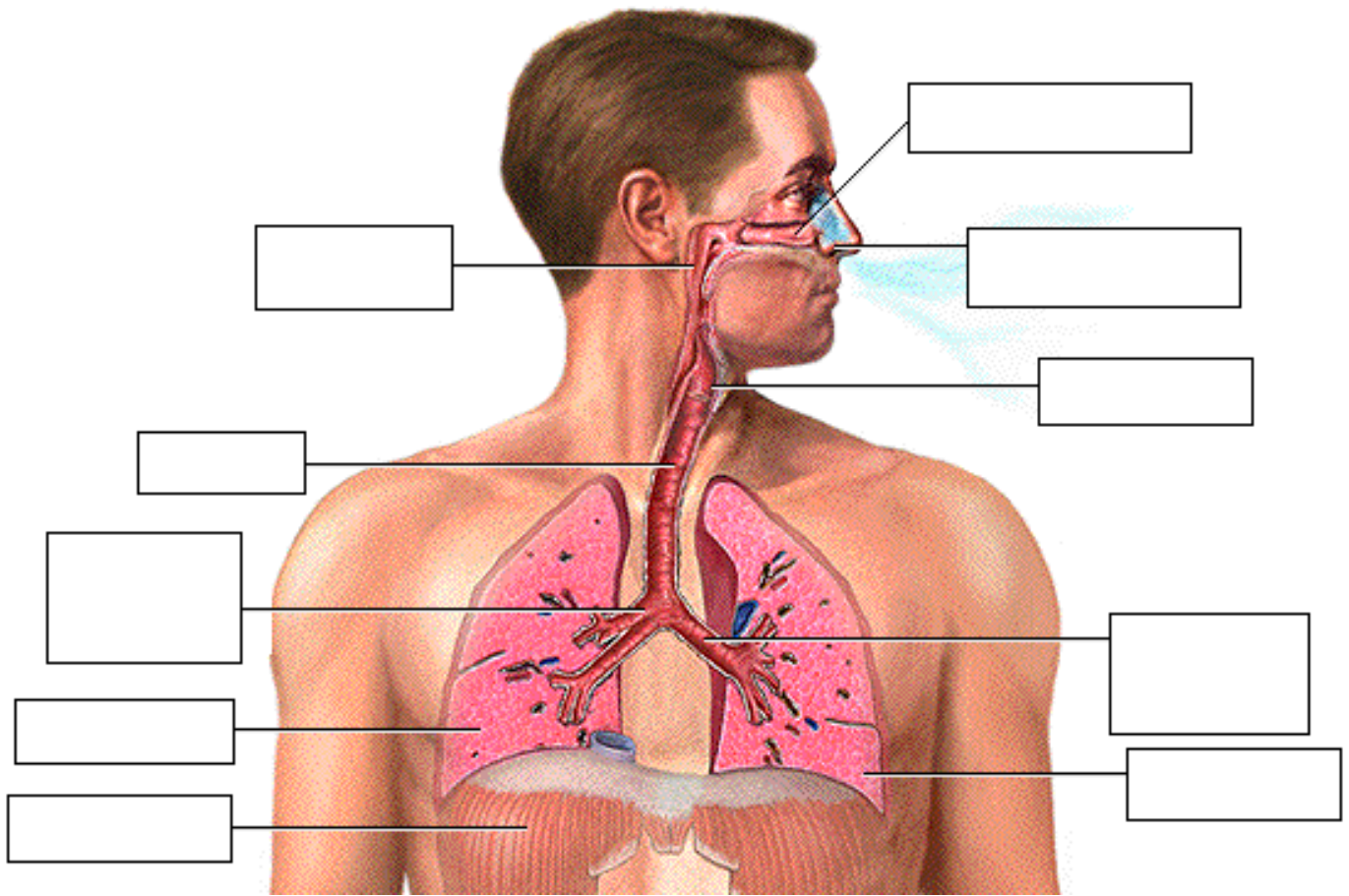
- As they function, our cells use oxygen and produce carbon dioxide.
- The respiratory system brings the needed oxygen into and eliminates carbon dioxide from the body by working closely with the cardiovascular system.
- The blood transports these gases, carrying oxygen to the tissues and carbon dioxide to the lungs.

Page 2. Goals

- To review the major organs of the respiratory system.
- To examine the structures of the respiratory zone of the lungs.
- To explore the microscopic anatomy of an alveolus.

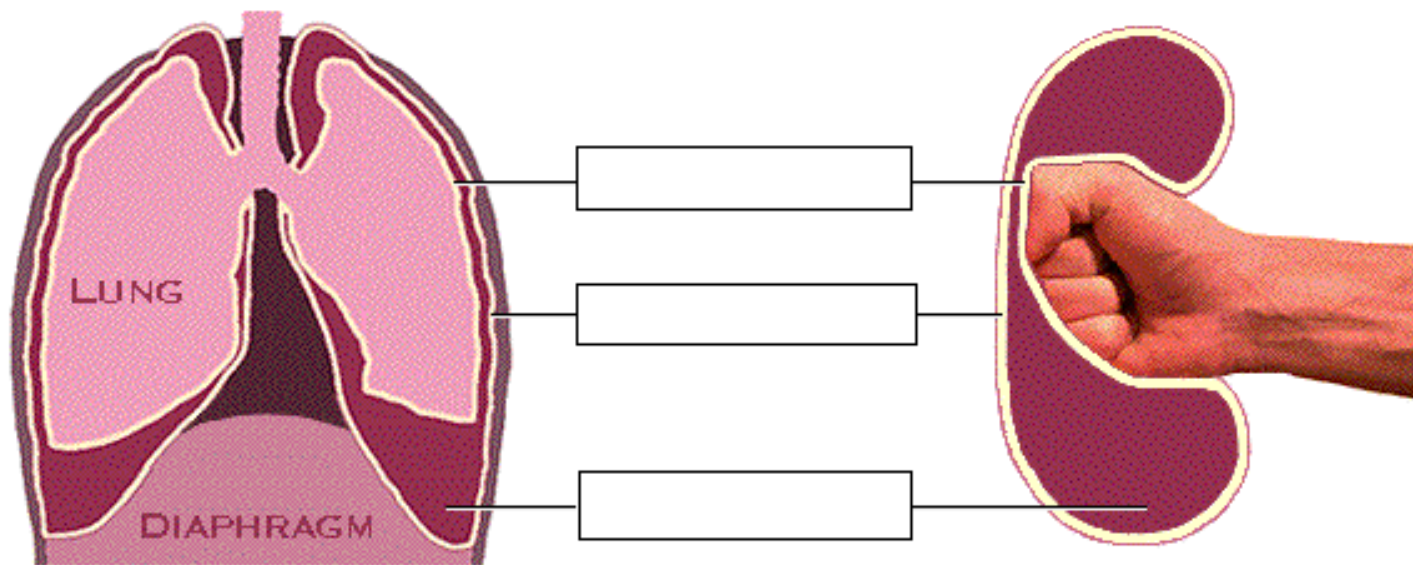
Page 3. Overview: Respiratory System Organs

- Let's review the organs of the respiratory system by following the flow of air.
 - Air enters the **nose** by passing through two openings called the **external nares**, or nostrils.
 - Within the nose, the air passes through the **nasal cavity**, and then travels through the **pharynx**, a muscular tube which carries both food and air throughout most of its length.
 - Air then enters the **larynx**.
 - After passing through the larynx, air enters the **trachea**, which is held open by incomplete rings of cartilage.
 - The trachea divides into a right and a left **primary bronchus**, which carry the air into the lungs.
- Although not part of the respiratory system, the diaphragm and the intercostal muscles play important roles in breathing.
- Label the diagram:



Page 4. Demonstration of Pleurae and the Lungs

- Each lung is surrounded by two layers of serous membrane known as the pleurae.
- The relationship between the pleurae and the lungs can be demonstrated by pushing a fist into a water-filled balloon. The balloon represents the pleurae, and the fist represents the lung.
 - As the fist pushes into the balloon, notice how the balloon wraps around it, and the opposite surfaces of the balloon almost touch.
 - The inner part of the balloon which wraps around the fist represents the visceral pleura. The visceral pleura is the part of the pleura which covers the surface of the lungs.
 - The outer part of the balloon represents the parietal pleura, which lines the mediastinum, the diaphragm, and the thoracic wall.
 - Notice that the visceral and parietal pleurae are actually a continuation of the same membrane.
 - The water-filled space between the two layers represents the pleural cavity, which contains pleural fluid.



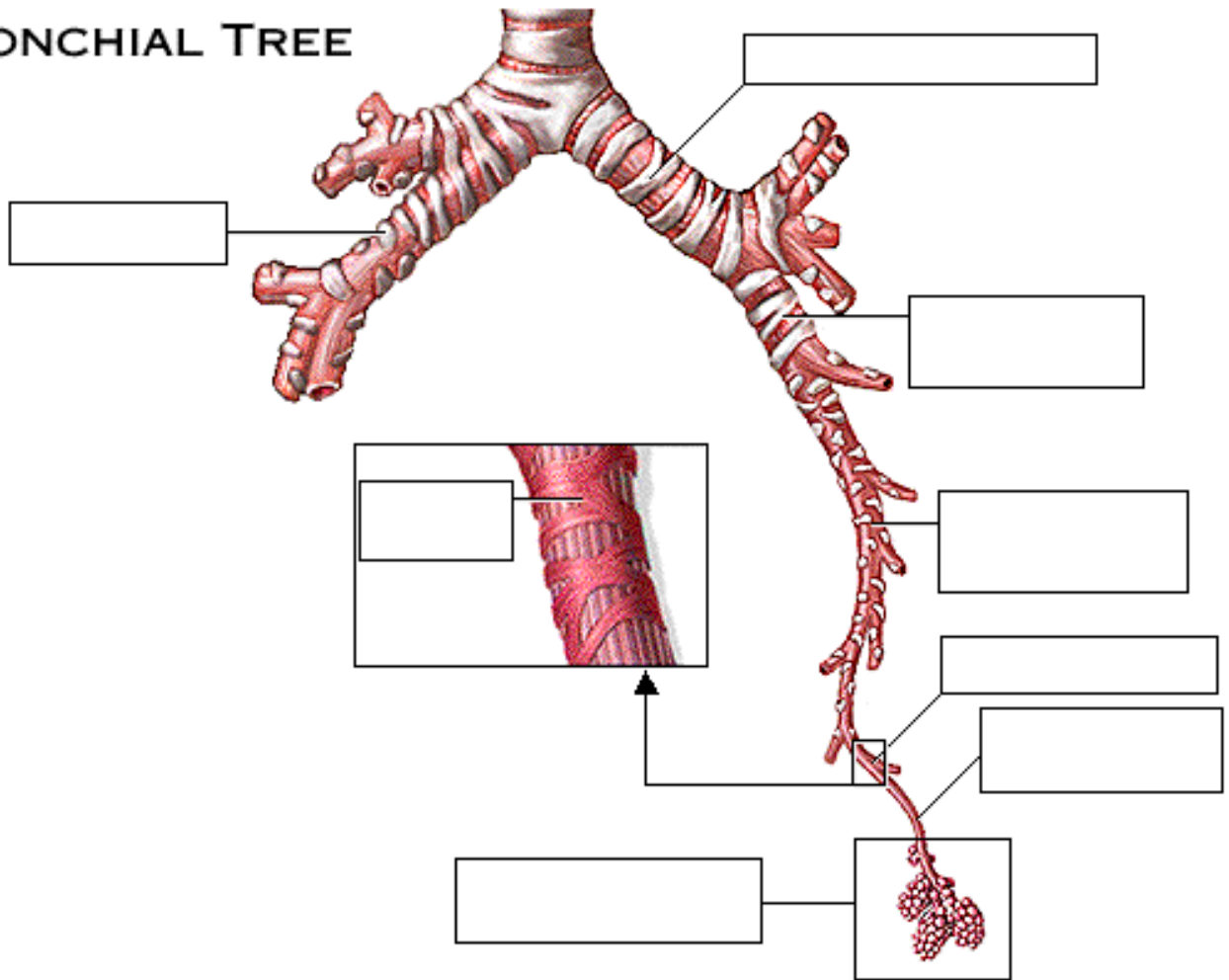
Page 5. Visceral and Parietal Pleura

- The visceral pleura and parietal pleura enclose each lung in a separate sac. The frosty layer you see here covering the lung is the portion of the parietal pleura that lines the anterior thoracic wall.
- The visceral pleura covers the surface of the lungs and the cut edges of the parietal pleura.
- The pleural cavity is an extremely thin, slit-like space between the pleurae, separating them by a thin layer of pleural fluid. The pleural fluid assists in breathing movements by acting as a lubricant.
- The parietal pleura lines the mediastinum, the superior surface of the diaphragm, and the inner thoracic wall.

Page 6. Bronchial Tree

- The lungs contain many branching airways which collectively are known as the bronchial tree.
- Air enters the lungs through the primary bronchi, which branch into secondary bronchi, which in turn branch into tertiary bronchi.
- The trachea and all the bronchi have supporting cartilage which keeps the airways open.
- Air flows deeper into the lungs as the tertiary bronchi branch repeatedly into smaller bronchi, which eventually branch into bronchioles.
- Bronchioles lack cartilage and contain more smooth muscle in their walls than the bronchi. These features allow airflow regulation by altering the diameter of the bronchioles.
- Bronchioles branch further into terminal bronchioles.
- The airways from the nasal cavity through the terminal bronchioles are called the conducting zone. The air is moistened, warmed, and filtered as it flows through these passageways.
- Beyond the terminal bronchioles, the air enters the respiratory zone, the region of the lung where gas exchange occurs.
- Label the diagram on the next page.

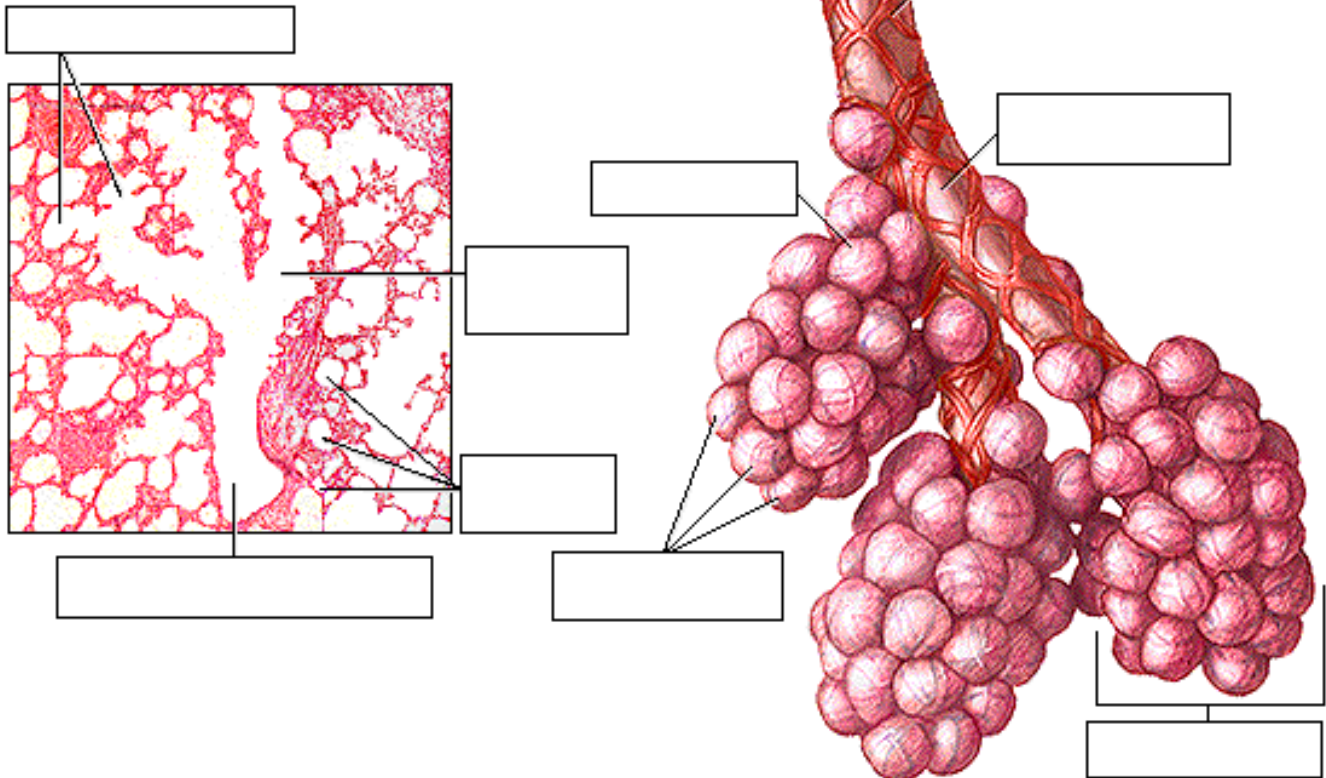
BRONCHIAL TREE



Page 7. Respiratory Zone

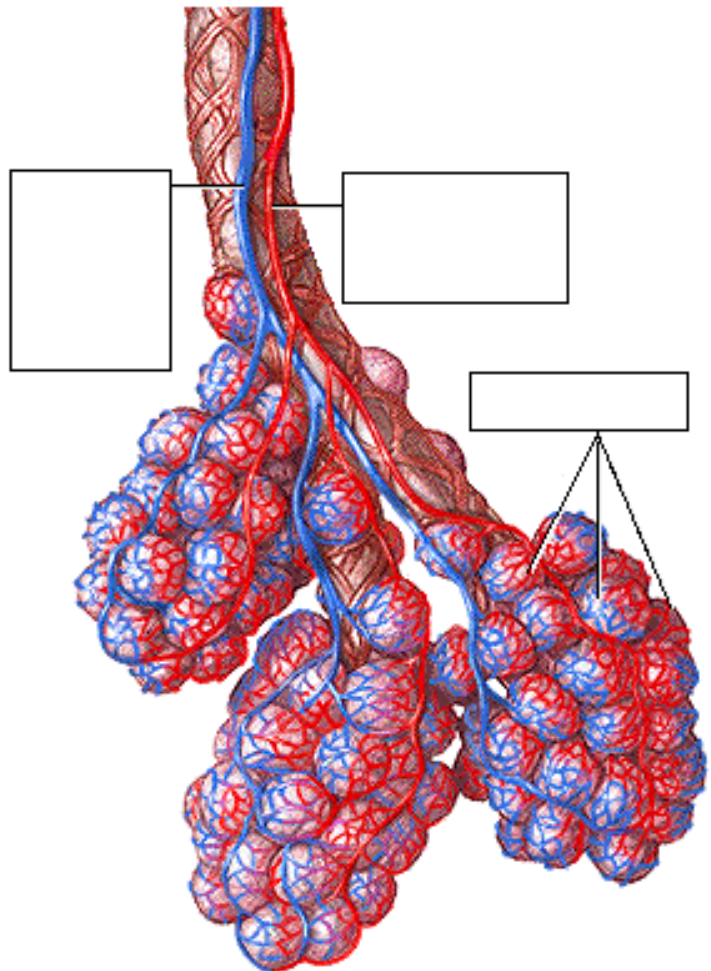
- Beyond the terminal bronchioles lie the structures of the respiratory zone, where we begin to find alveoli, tiny thin-walled sacs where gas exchange occurs.
- Respiratory bronchioles have scattered alveoli in their walls. They lead into alveolar ducts, which are completely lined by alveoli. These ducts end in clusters of alveoli called alveolar sacs.
- Label the diagram on the next page.

RESPIRATORY ZONE



Page 8. Alveoli and Pulmonary Capillaries

- The pulmonary arteries carry blood which is low in oxygen from the heart to the lungs.
- These blood vessels branch repeatedly, eventually forming dense networks of capillaries that completely surround each alveolus.
- This rich blood supply allows for the efficient exchange of oxygen and carbon dioxide between the air in the alveoli and the blood in the pulmonary capillaries.
- Blood leaves the capillaries via the pulmonary veins, which transports the freshly oxygenated blood out of the lungs and back to the heart.

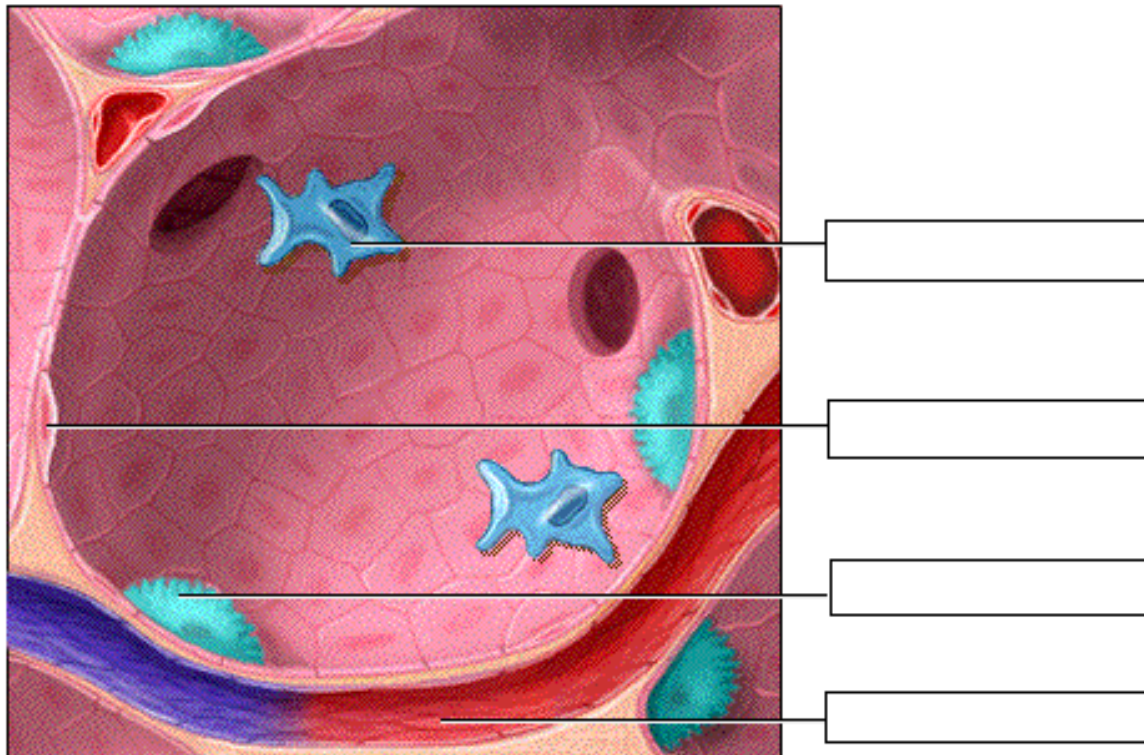


** Now is a good time to go to quiz questions 1-3:

- Click the Quiz button on the left side of the screen.
- Work through questions 1-3.
- After answering question 3, click the Back to Topic button on the left side of the screen.
- To get back to where you left off, click on the scrolling page list at the top of the screen and choose "9. Structure of an Alveolus".

Page 9. Structure of an Alveolus

- Structure of the inside of an individual alveolus shows three types of cells:
 1. simple squamous epithelium
 2. alveolar macrophages
 3. surfactant-secreting cells
- The wall of an alveolus is primarily composed of simple squamous epithelium, or Type I cells. Gas exchange occurs easily across this very thin epithelium.
- The alveolar macrophages, or dust cells, creep along the inner surface of the alveoli, removing debris and microbes.
- The alveolus also contains scattered surfactant-secreting, or Type II, cells.



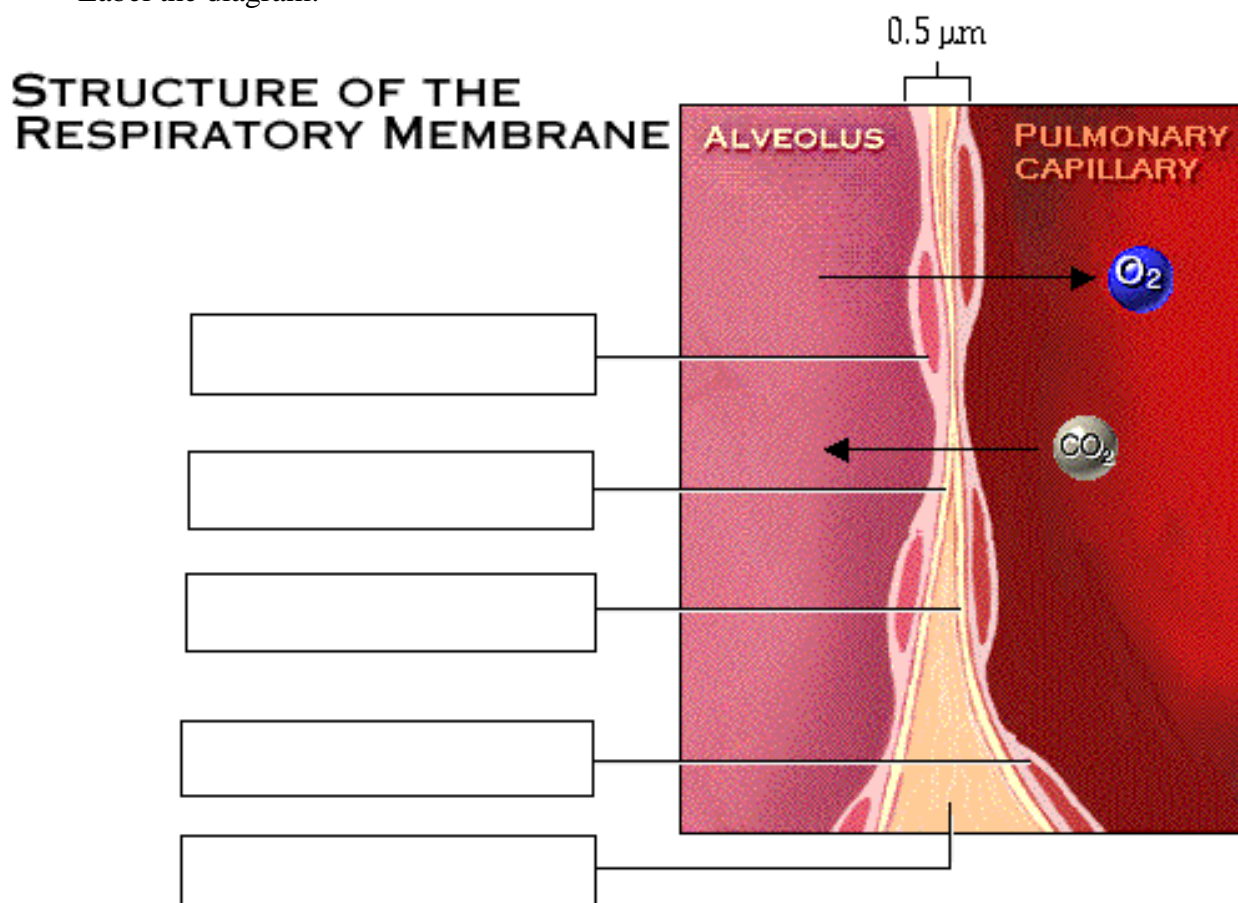
Page 10. Role of Surfactant

- The inside surface of the alveolus is lined with alveolar fluid.
- The water in the fluid creates a surface tension. Surface tension is due to the strong attraction between water molecules at the surface of a liquid, which draws the water molecules closer together.
- As seen here, this force pulls the alveolus inward and reduces its size. If an alveolus were lined with pure water, it would collapse.
- Surfactant, which is a mixture of phospholipids and lipoproteins, lowers the surface tension of the fluid by interfering with the attraction between the water molecules, preventing alveolar collapse.
- Without surfactant, alveoli would have to be completely reinflated between breaths, which would take an enormous amount of energy.

Page 11. Structure of the Respiratory Membrane

- The wall of an alveolus and the wall of a capillary form the respiratory membrane, where gas exchange occurs.

- The respiratory membrane is made up of two layers of simple squamous epithelium and their basement membranes. This membrane is extremely thin, averaging 0.5 micrometers in width.
- Notice also that in many regions of the membrane there is no interstitial fluid. This is because pulmonary blood pressure is so low that little fluid filters out of the capillaries into the interstitial space. Oxygen and carbon dioxide can diffuse easily across this thin respiratory membrane.
- Label the diagram:



Page 12. Review: Respiratory System Structures

Page 13. Summary

- The respiratory system consists of the nose, pharynx, larynx, trachea, bronchi, and lungs.
- The visceral pleura covers the surface of the lungs. The parietal pleura covers the mediastinum and the diaphragm, and lines the thoracic wall.
- The lungs contain the bronchial tree, the branching airways from the primary bronchi through the terminal bronchioles.
- The respiratory zone of the lungs is the region containing alveoli, tiny thin-walled sacs where gas exchange occurs.
- Oxygen and carbon dioxide diffuse between the alveoli and the pulmonary capillaries across the very thin respiratory membrane.

****** Now is a good time to go to quiz questions 4 and 5:

- Click the Quiz button on the left side of the screen.
- Click on the scrolling page list at the top of the screen and choose "4a. Functional Cell Types in Alveoli".
- Work through all parts of quiz questions 4 and 5.

Notes on Quiz Questions:

Quiz Question #1a: Airflow Pathway

- This question asks you to label the parts of the bronchial tree.

Quiz Question #1b: Airflow Pathway

- This question asks you to label the respiratory zone structures.

Quiz Question #2: Relationship Between Lungs and Pleurae

- This question asks you to label the parts of the pleural membrane.

Quiz Question #3: Respiratory Zone Structures

- This question asks you to match the histology of the respiratory zone to a diagram.

Quiz Question #4a,b,c: Functional Cell Types in Alveoli

- This question asks you to match the cell type within the alveoli to its name.

Quiz Question #5a,b: Respiratory Membrane: Effects of Edema

- This question allows you to predict what will happen when a patient has pulmonary edema.

Study Questions on Anatomy Review: Respiratory Structures:

1. (Page 1.) What is the main function of the respiratory system?
2. (Page 3.) Label the diagram on p. 3.
3. (Page 3.) Trace the pathway of air from the outside of the body into the body.
4. (Page 4.) Label the diagram on p. 4.
5. (Page 4.) Describe the location of the visceral pleura.
6. (Page 4.) Describe the location of the parietal pleura.
7. (Page 4, 5.) What is inside the pleural cavity?
8. (Page 5.) What is the function of pleural fluid?
9. (Page 6.) Label the diagram on p. 6. Indicate the conducting zone.
10. (Page 6.) What is the bronchial tree?
11. (Page 6.) Trace the pathway of air from the trachea to the respiratory zone.
12. (Page 6.) Describe the difference between bronchi and bronchioles in terms of smooth muscle and cartilage.
13. (Page 6.) What is the function of the smooth muscle of the bronchioles?
14. (Page 6.) Where is the conducting zone and what is its function?
15. (Page 7.) Label the diagram on page 7.
16. (Page 7.) What are alveoli?
17. (Page 7.) Where are three places alveoli are found?
18. (Page 8.) What are the names of the blood vessels that carry blood to the lungs?
19. (Page 8.) What are the names of the blood vessels that carry blood away from the lungs?
20. (Page 8.) Which contain blood that is higher in oxygen, the pulmonary arteries or the pulmonary veins?
21. (Page 8.) Where are the pulmonary capillaries found within the lung?
22. (Page 9.) Label the diagram on p. 9.
23. (Page 9.) What three cell types are found within alveoli?

24. (Page 9.) What is the function of the simple squamous epithelium, or Type I cells, within alveoli?
25. (Page 9.) What is the function of the alveolar macrophages, or dust cells, within alveoli?
26. (Page 10.) What is the function of the surfactant-secreting, or Type II cells, within alveoli?
27. (Page 10.) What is present on the inside surface of alveoli?
28. (Page 10.) What would happen if there were no surfactant in alveolar fluid?
29. (Page 11.) Label the diagram on page 11.
30. (Page 11.) What is the respiratory membrane composed of?
31. (Page 11.) Why is there no interstitial fluid in between the two layers of simple squamous epithelium in the respiratory membrane?
32. (Page 11.) What two important gases diffuse across the respiratory membrane? In which direction does each gas flow?