

This lab involves two exercises in the lab manual entitled "*Anatomy of the Respiratory System*" and "*Respiratory System Physiology*".

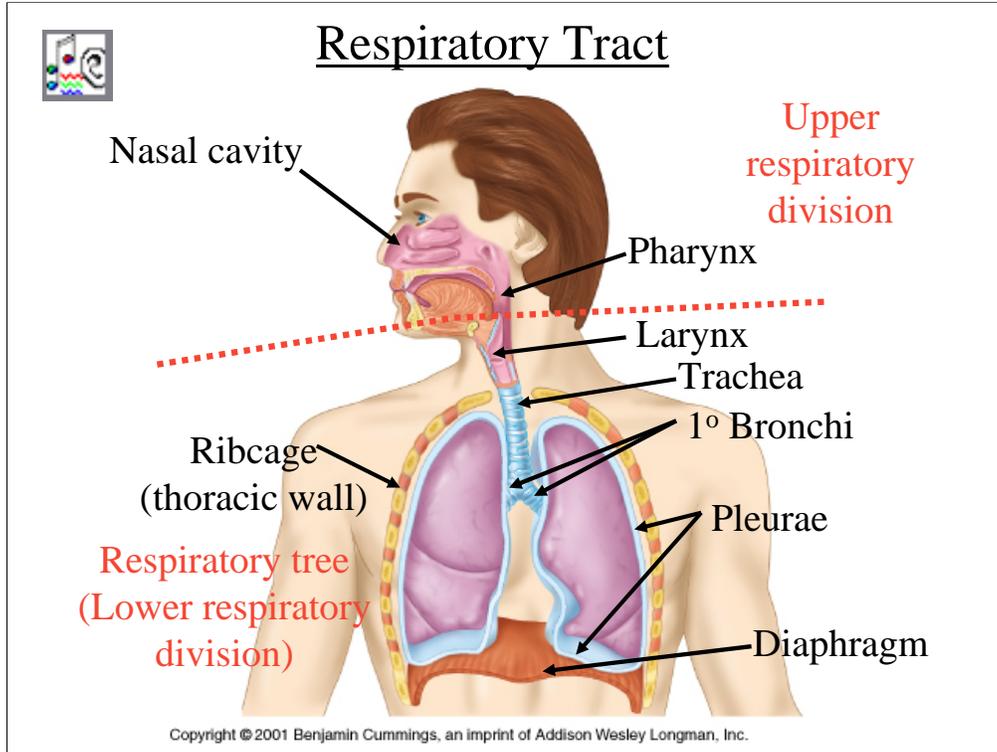
In this lab you will look at lung histology, gross anatomy, and physiology.

Complete the review sheets from the exercise and take the online quiz on respiration, As an alternate your instructor may have you submit a drawing of lung tissue from the Virtual Microscope or other histology site. Use the PhysioEX software to measure and analyze respiratory volumes.

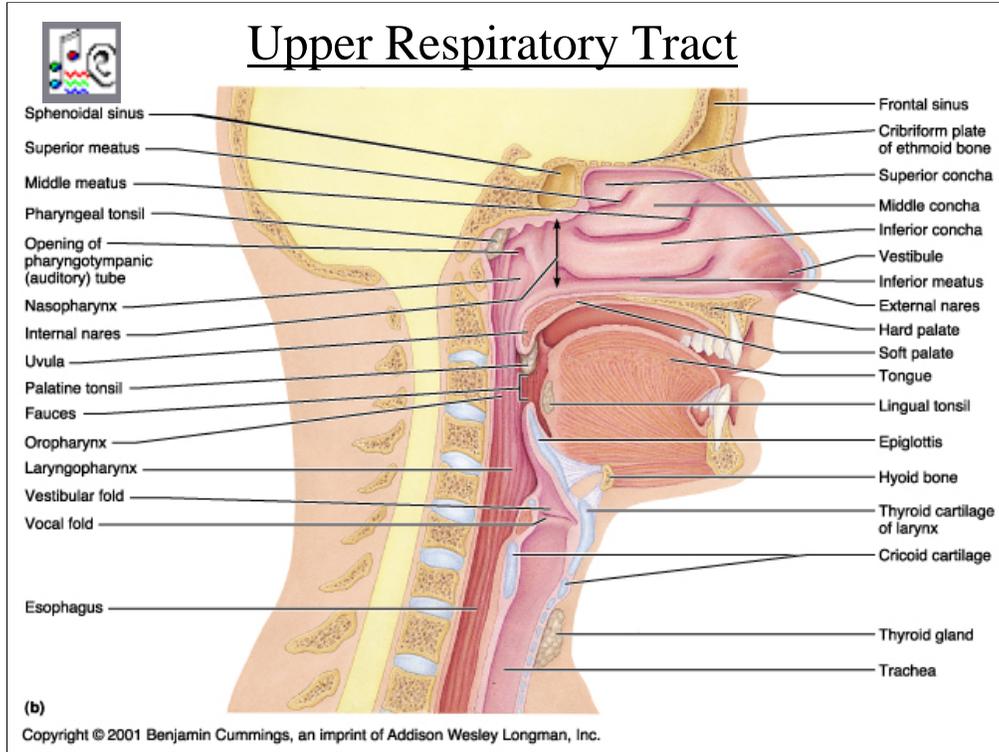
There is also a video showing cadaver dissection of the respiratory tract.

Click on the sound icon for the audio file (mp3 format) for each slide.

There is also a link to a downloadable mp4 video which can be played on an iPod.



The respiratory tract can be thought of as consisting of two parts: the **upper respiratory tract** has the **nasal cavity**, and the **pharynx**; The **lower respiratory tract** has the **larynx** and the **respiratory tree** from the **trachea** through the various divisions of **bronchi** to the **bronchioles**. Essentially the upper division is where the cilia beat down to move mucus down to the throat to be swallowed, and the lower division is where cilia beat up to move mucus to the throat to be swallowed.

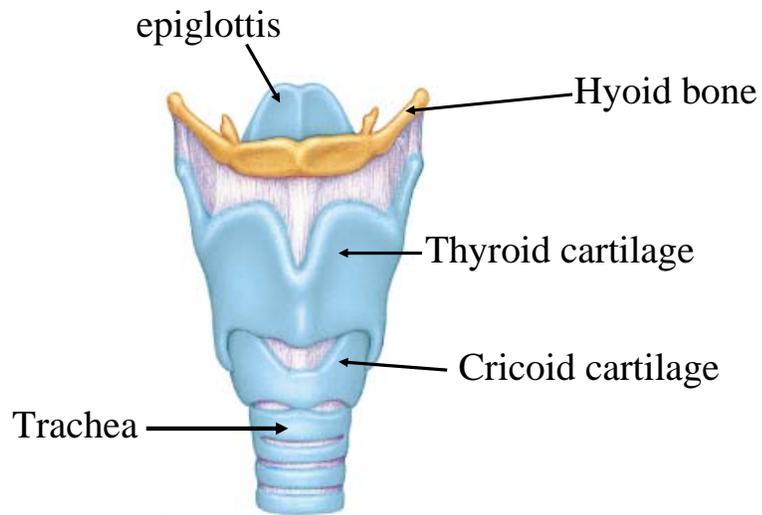


See the Lab Manual for items you are responsible for in the **Upper Respiratory Tract**.



The Larynx

Anterior view



(a)

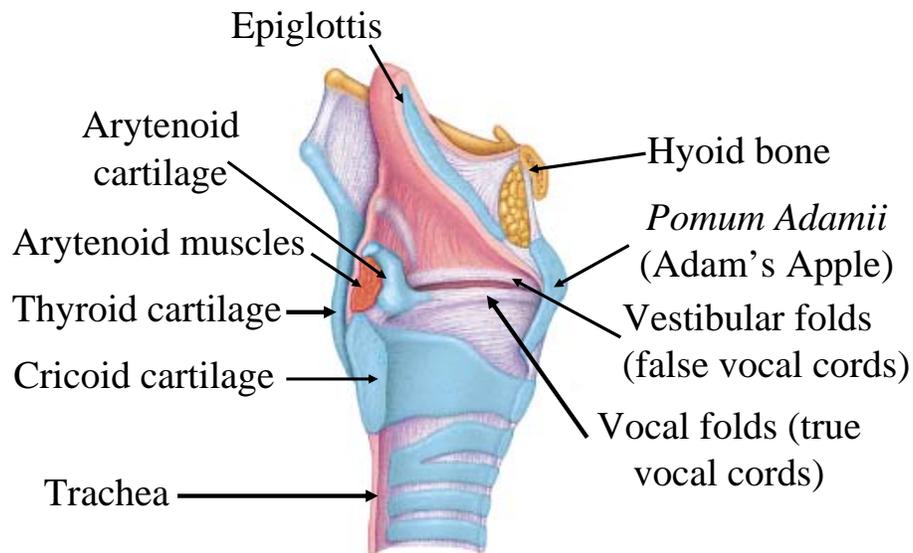
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Mispronunciation of the **larynx** is an anatomical pet peeve. It is pronounced **lair-inks**, and consists of a number of cartilages along with the ligaments which connect them. The larynx is connected to the hyoid bone by the **thyrohyoid ligament**. The **thyroid cartilage** is the largest and its anterior prominence is the “**Adam’s Apple**”.



Sagittal Section of the Larynx

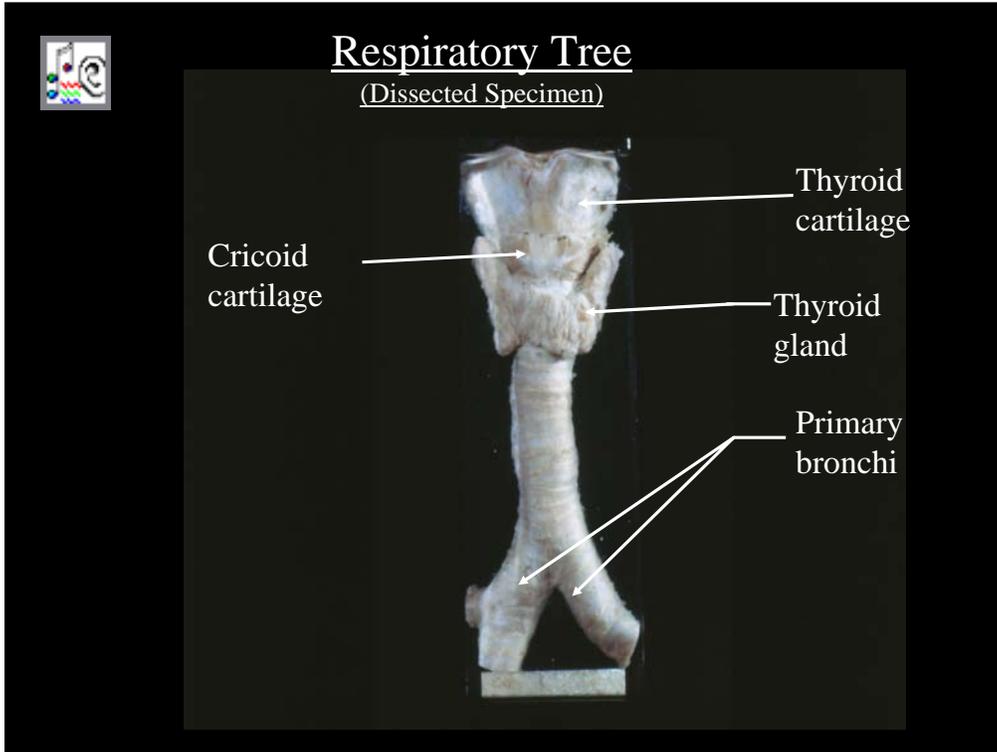


(b)

i, Inc.

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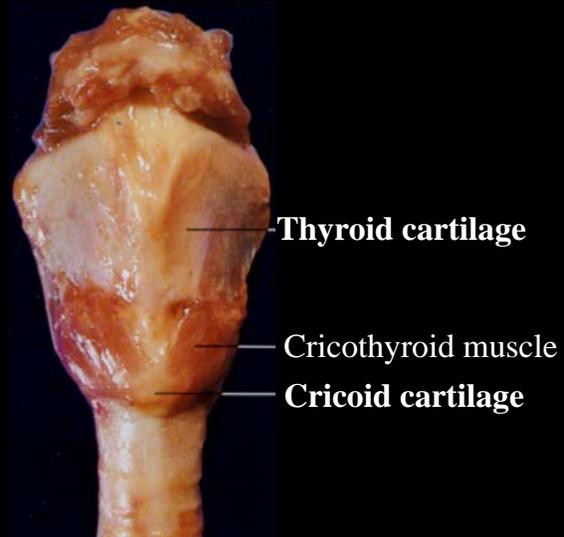
When you swallow the hyoid bone lifts up and this causes the cartilaginous **epiglottis** to hinge backwards, guarding the opening into the glottis to prevent aspiration. The **glottis** is the opening between the **vocal folds**, which are the vocal cords. The vocal folds are guarded by the **vestibular folds**. The **arytenoid cartilage**, controlled by **arytenoid muscles**, swivels to regulate tension on the vocal folds in producing the pitch of the voice.



A dissected cadaver specimen of the larynx with its attachment to the respiratory tree.



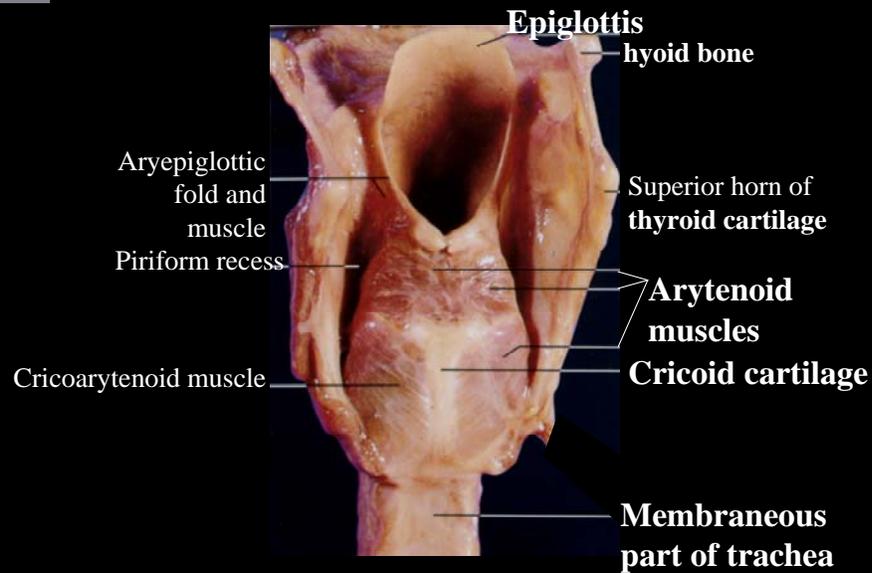
Larynx, anterior view



The many small muscles found attached to the larynx have been removed from this specimen, along with the thyroid gland.



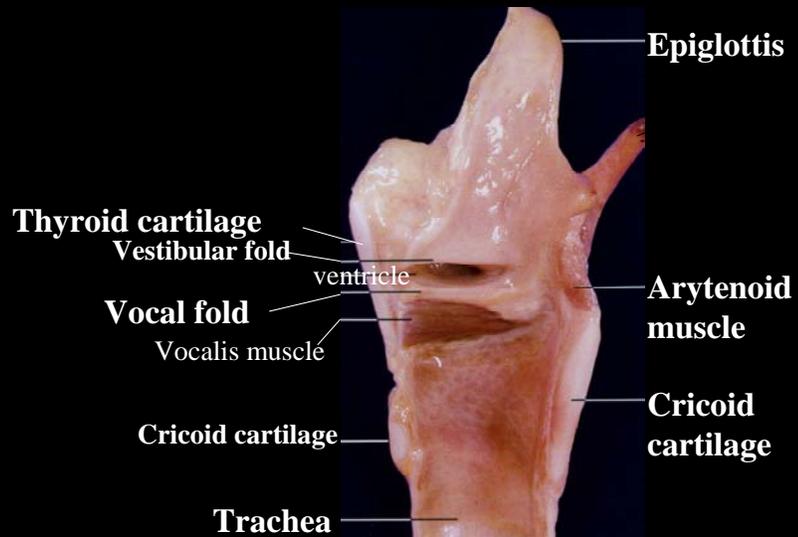
Larynx, posterior view



The epiglottis is not a separate “leaf-like” structure as it is often pictured, but rather is attached to the aryepiglottic fold to form more of a trumpet shape.



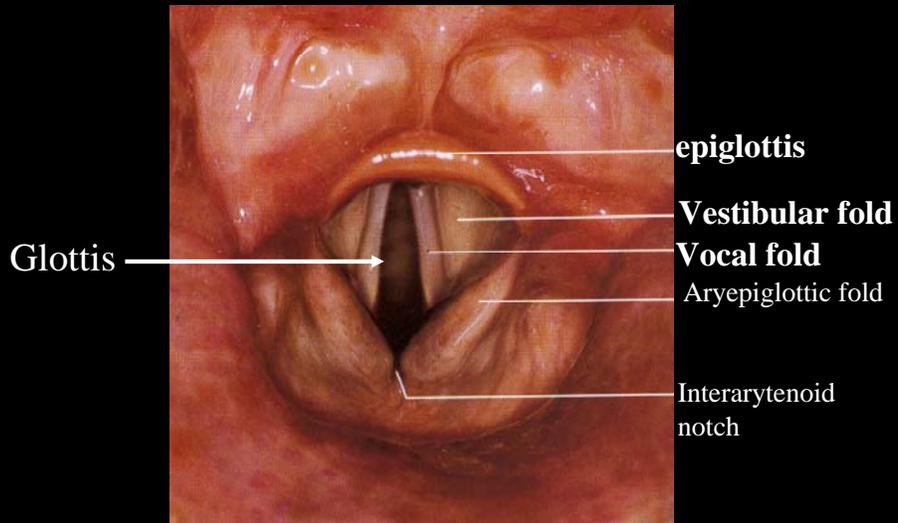
Larynx, sagittal section



Cadaver larynx in sagittal section.



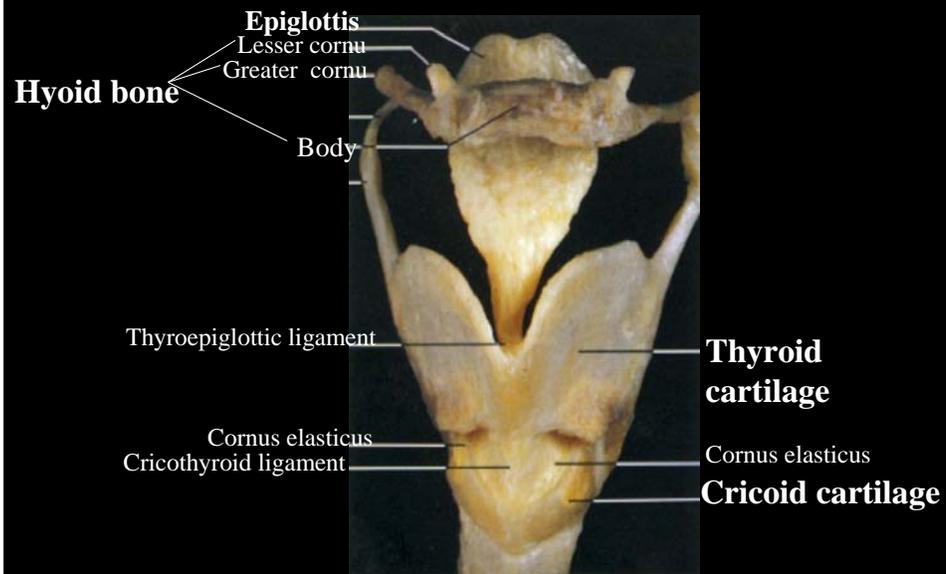
Glottis, superior view



A view of the glottis from above. When sound is produced the vocal folds tighten and loosen to produce different pitches, controlled by the arytenoid cartilages and arytenoid muscles.



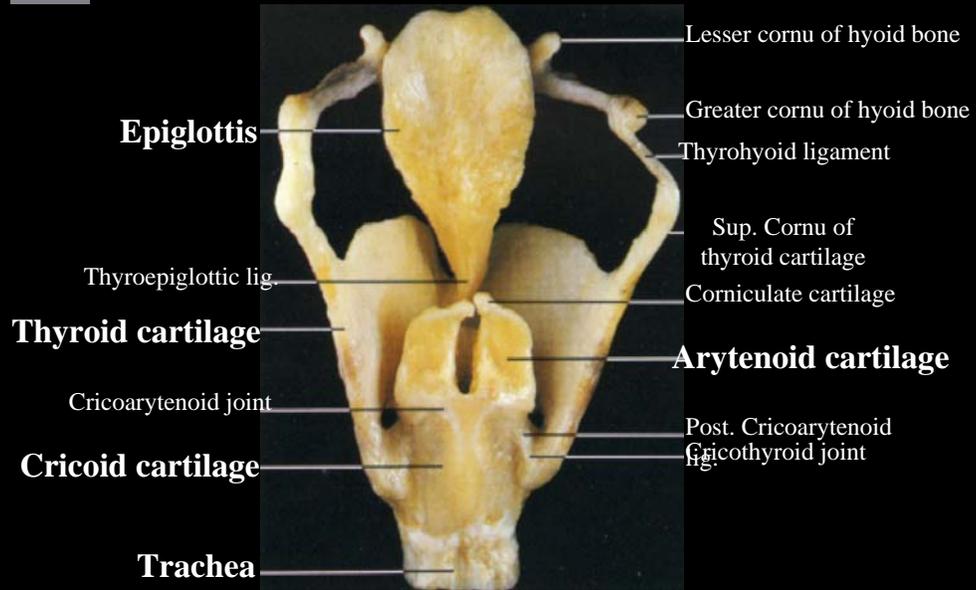
Laryngeal Cartilages, anterior view

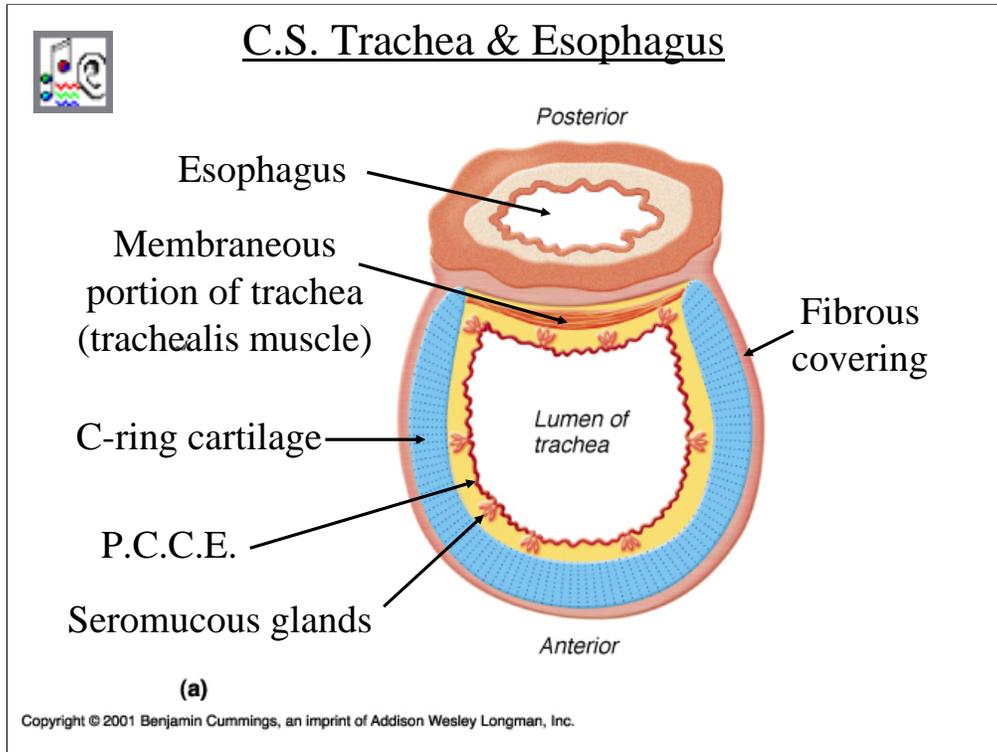


When the soft tissues are removed, the cartilages of the larynx are distinct.



Laryngeal Cartilages, posterior view

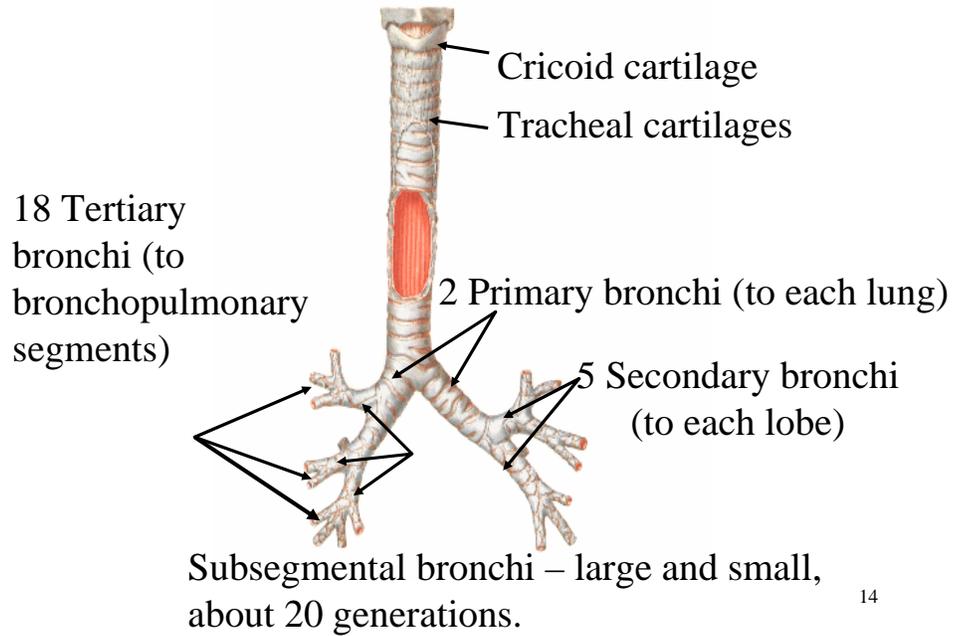




A cross section of the trachea at the level of one of the C-ring cartilages shows how the esophagus fits into the membraneous portion of the trachea. This permits swallowing of a bolus of food. The trachealis muscle actually is a complete layer around the trachea, but is thicker at the posterior portion. Within the submucosa of the trachea lie seromucous glands. The mucous they secrete helps to remove particulates through the action of the ciliated lining tissue (PCCE).



The Respiratory Tree

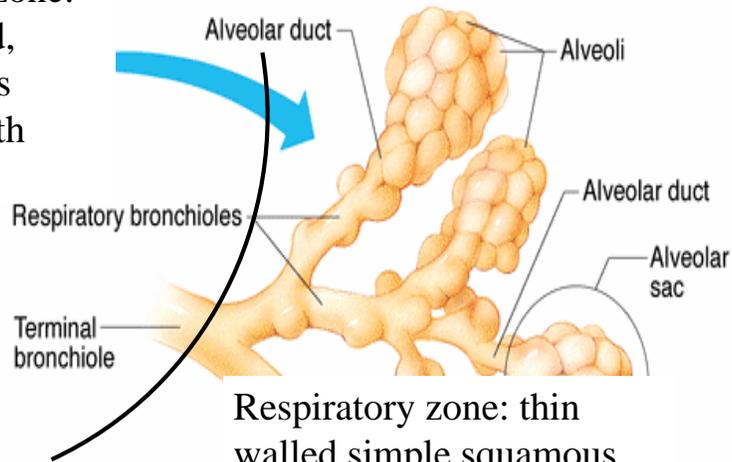


This is the bronchial portion of the respiratory tree.



Respiratory Zone

Conducting zone:
mucosa lined,
allows no gas
exchange with
blood.



Respiratory zone: thin
walled simple squamous
epithelium, allows gas
exchange with blood.

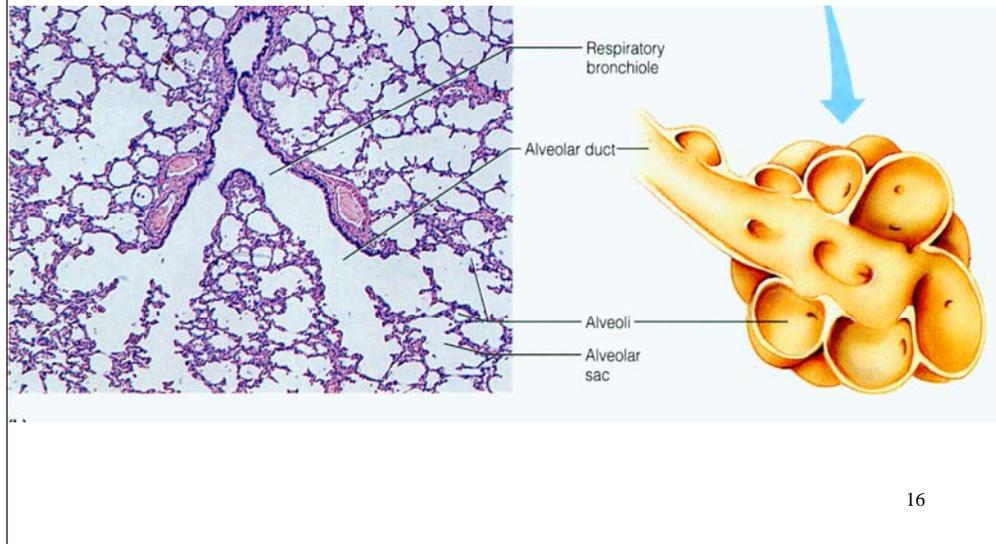
(a)

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The **large bronchioles** and **terminal bronchioles** are still part of the conducting zone, which gets the air to and from the internal **alveolar sacs** of the lungs. The **respiratory bronchioles** and **alveolar sac systems** are the **respiratory zone**, the part which allows gas transport by diffusion between the lungs and the blood.



Branch into Respiratory Bronchiole



The respiratory zone structures are composed of **simple squamous epithelium** for transport.



A Bronchus



Hyaline
cartilage plate

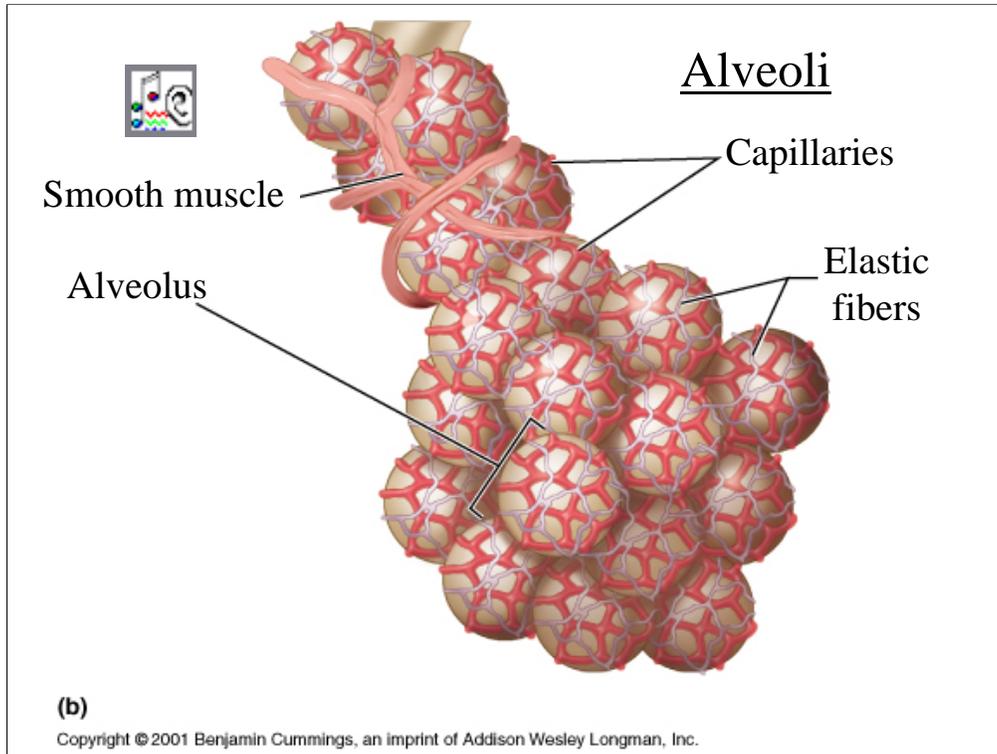
Pseudostratified
ciliated columnar
epithelium

Smooth
muscle

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Also see photos available on [The Virtual Microscope](#)

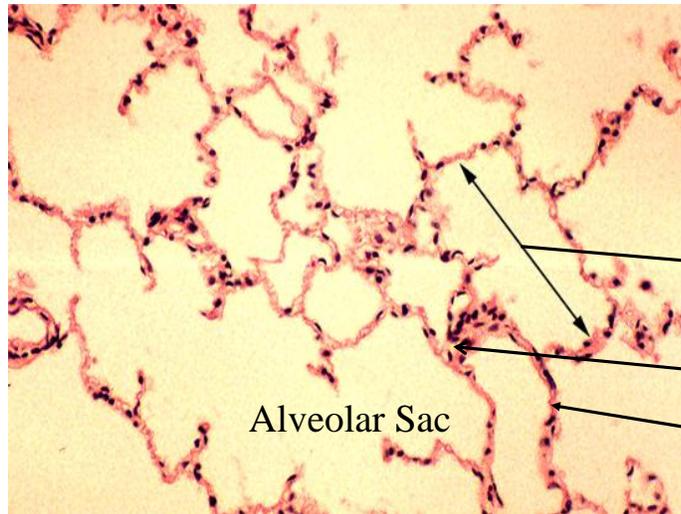
A bronchus, at whatever level, is lined with pseudostratified ciliated columnar epithelium. Smooth muscle and a small amount of cartilage are also present.



Alveolar sac systems (the sacs and their alveoli and ducts which lead to them) are **simple squamous epithelium**. Note how the alveoli, the little chambers, are surrounded by blood **capillaries** for transport. A small amount of **elastic tissue** forms the **stroma** of the lungs, and permits elasticity and recoil.



Alveolar Sacs and Alveoli



Alveolar sac

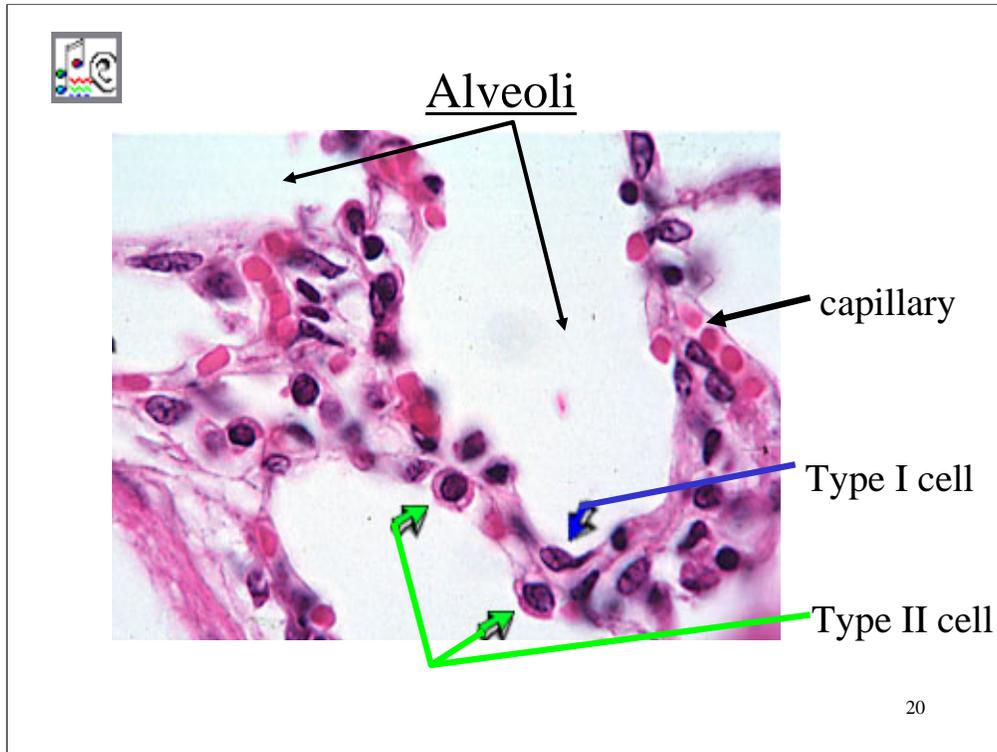
capillary

Simple
squamous
epithelium

Alveolar Sac

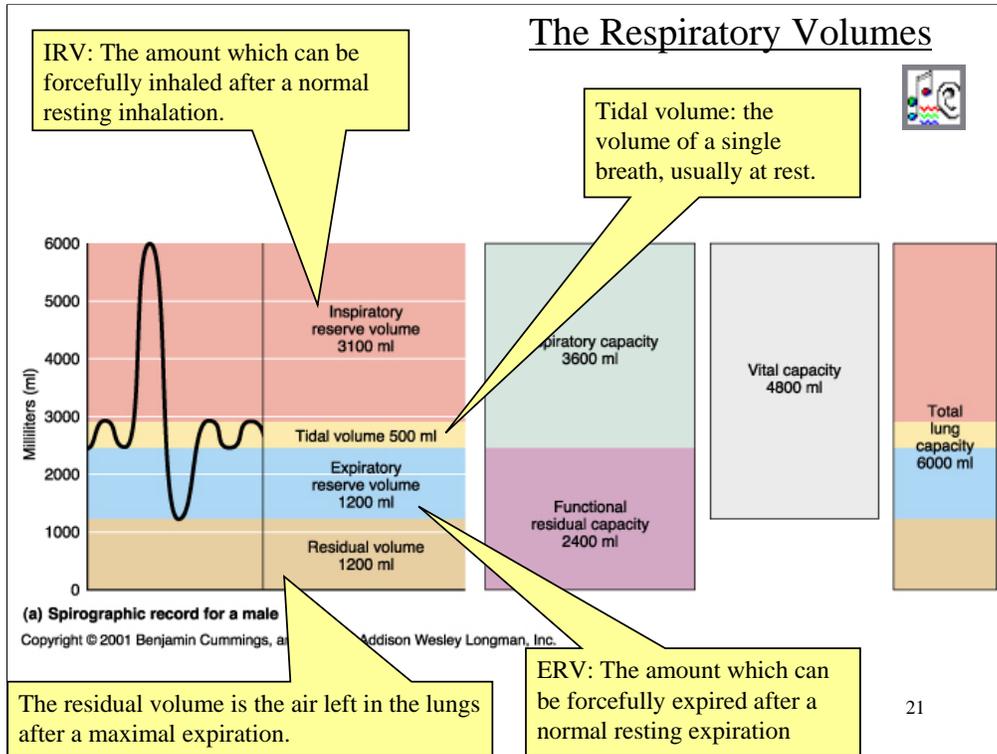
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Lung tissue seen under the microscope looks much like a sponge might look. The thin walls of simple squamous epithelium incorporate blood capillaries, the tiny spaces.



In this extremely high magnification view the nuclei of the **Type I** (structural) simple squamous cells are visible, along with **Type II surfactant**-secreting cells. Note the capillaries with red blood cells within them.

The Respiratory Volumes

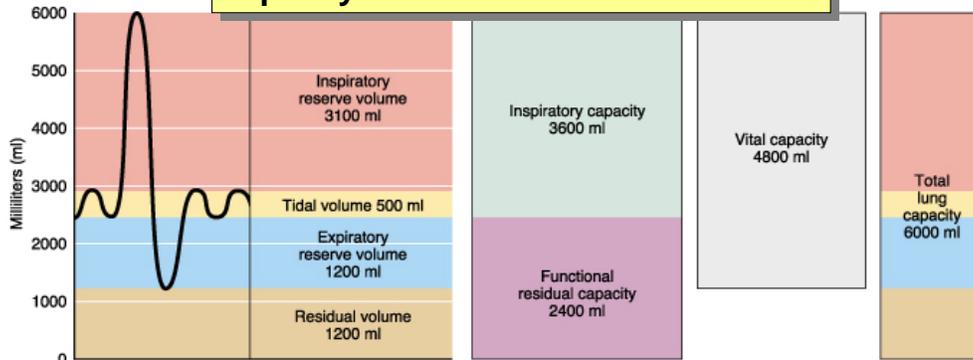


In a lab you might record a **spirograph**, similar to this one, and measure the values shown. You may also use **PhysioEX** to measure and analyze hypothetical respiratory volumes.



The Vital Capacity

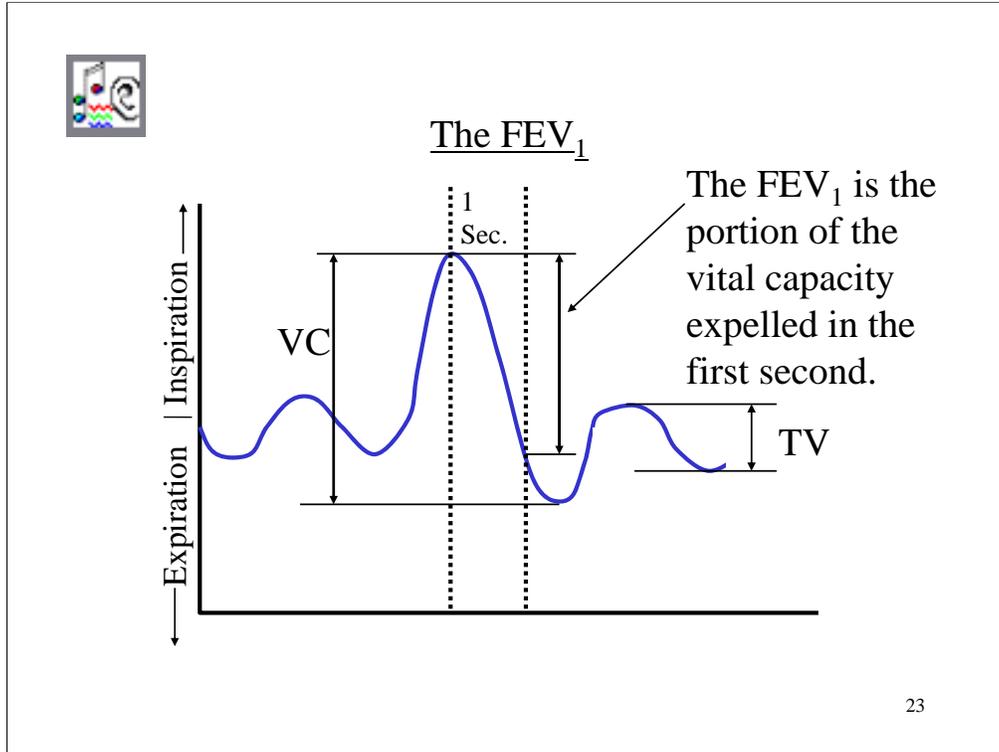
**TV + IRV + ERV = Vital Capacity (VC),
the maximum amount of air which
can be exchanged in a single breath.
The VC should be 80% of total lung
capacity.**



(a) Spirographic record for a male

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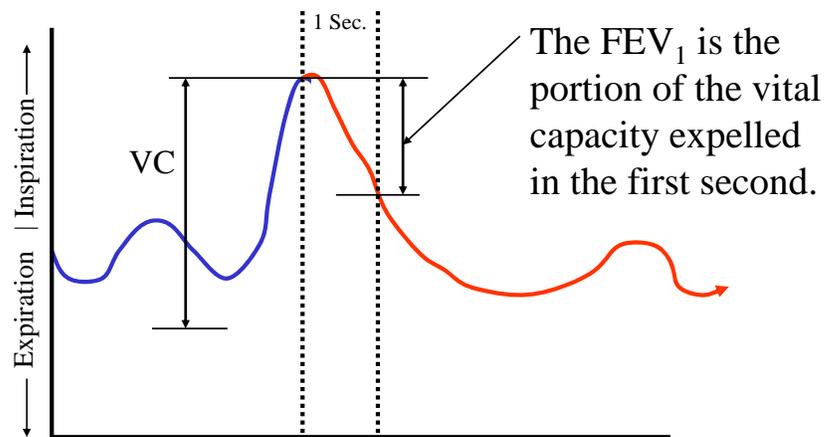
You may also use the small handheld **spirometers** to measure the **Vital Capacity**, a useful measurement for evaluating respiratory performance.



An **obstructive disorder** such as **bronchitis** or **asthma** does not, by itself, reduce the vital capacity. It does impede the airways and reduce the easy and rate of expiration. This is measured with the **FEV₁**, which should be at least 75% of vital capacity.



The FEV₁



A person with an obstructive disorder has difficulty expelling the VC and the proportion expelled in the first second decreases below 75%

Here you can see the effect of an obstructive disorder, somewhat exaggerated, in reducing the FEV₁.



Lab Protocol

- 1) Complete the Review Sheet for this exercise .
- 2) Take the quiz on the respiratory system.
- 3) Use ADAM to identify structures of the respiratory system. (See next slide)
- 4) Use PhysioEX to measure and analyze respiratory volumes.
- 5) View the cadaver video on the respiratory tract.

Lab Protocol

ADAM Interactive Anatomy

Dissectible Anatomy, Male, Anterior, Window centered on chest, Layer indicator 162

Dissectible Anatomy, Male, Anterior, Window centered on chest, Layer indicator 252, scroll from diaphragm to larynx.

Dissectible Anatomy, Male, Medial view, Window centered on chest, Layer indicator 35, Window centered on nasal cavity

Dissectible Anatomy, Male, Medial view, Window centered on chest, Layer indicator 96, Window centered on left lung.

Atlas Anatomy, Region, Thorax, Bronchial Tree (Ant)

Atlas Anatomy, Region, Thorax, Bronchial Tree (Post)