## Pressbooks Sandbox

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NSALMON

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## Main Body

Chapter Robot

## Overlay effect experiment

## Fade in Overlay

Hover over the image to see the effect.


I'm a tree

## Anchor Example Page

## Section 1

For demonstration purposes, this is where I'd like to place a hyperlink to a later point in my chapter.
All legislative Powers herein granted shall be vested in a Congress of the United States, which shall consist of a Senate and House of Representatives.

## Section 2

1: The House of Representatives shall be composed of Members chosen every second Year by the People of the several States, and the Electors in each State shall have the Qualifications requisite for Electors of the most numerous Branch of the State Legislature.

2: No Person shall be a Representative who shall not have attained to the Age of twenty five Years, and been seven Years a Citizen of the United States, and who shall not, when elected, be an Inhabitant of that State in which he shall be chosen.

3: Representatives and direct Taxes shall be apportioned among the several States which may be included within this Union, according to their respective Numbers, which shall be determined by adding to the whole Number of free Persons, including those bound to Service for a Term of Years, and excluding Indians not taxed, three fifths of all other Persons. ${ }^{2}$ The actual Enumeration shall be made within three Years after the first Meeting of the Congress of the United States, and within every subsequent Term of ten Years, in such Manner as they shall by Law direct. The Number of Representatives shall not exceed onefor every thirty Thousand, but each State shall have at Least one Representative; and until such enumeration shall be made, the State of New Hampshire shall be entitled to chuse three, Massachusetts eight, Rhode-Island and Providence Plantations one, Connecticut five, New-York six, New Jersey four, Pennsylvania eight, Delaware one, Maryland six, Virginia ten, North Carolinafive, South Carolina five, and Georgia three.

4: When vacancies happen in the Representation from any State, the Executive Authority thereof shall issue Writs of Election to fill such Vacancies.

5: The House of Representatives shall chuse their Speaker and other Officers; and shall have the sole Power of Impeachment.

## Relevant Section Heading

This is the section I'd like to be able to link to from another paragraph.

1: The Senate of the United States shall be composed of two Senators from each State, chosen by the Legislature thereof, ${ }^{3}$ for six Years; and each Senator shall have one Vote.

2: Immediately after they shall be assembled in Consequence of the first Election, they shall be divided as equally as may be into three Classes. The Seats of the Senators of the first Class shall be vacated at the Expiration of the second Year, of the second Class at the Expiration of the fourth Year, and of the third Class at the Expiration of the sixth Year, so that one third may be chosen every second Year; and if Vacancies happen by Resignation, or otherwise, during the Recess of the Legislature of any State, the Executive thereof may make temporary Appointments until the next Meeting of the Legislature, which shall then fill such Vacancies. ${ }^{4}$

3: No Person shall be a Senator who shall not have attained to the Age of thirty Years, and been nine Years a Citizen of the United States, and who shall not, when elected, be an Inhabitant of that State for which he shall be chosen.

4: The Vice President of the United States shall be President of the Senate, but shall have no Vote, unless they be equally divided.

5: The Senate shall chuse their other Officers, and also a President pro tempore, in the Absence of the Vice President, or when he shall exercise the Office of President of the United States.

6: The Senate shall have the sole Power to try all Impeachments. When sitting for that Purpose, they shall be on Oath or Affirmation. When the President of the United States is tried, the Chief Justice shall preside: And no Person shall be convicted without the Concurrence of two thirds of the Members present.

7: Judgment in Cases of impeachment shall not extend further than to removal from Office, and disqualification to hold and enjoy any Office of honor, Trust or Profit under the United States: but the Party convicted shall nevertheless be liable and subject to Indictment, Trial, Judgment and Punishment, according to Law.
\{"annotations":null,"assetRoot":null,"branding":null,"clientUrl":"https://hypothesis-h5p.s3.us-east-2.amazonaws.com/
boot.js","oauthEnabled":null,"onLayoutChange":null,"openLoginForm":null,"openSidebar":null,"query":null,"s ervices":null,"showHighlights":"always","sidebarAppUrl":"https://hypothesis-h5p.s3.us-east-2.amazonaws.com/app.html","subFrameIdentifier":"010369979486613645","pluginClasses":\{\}\}

Assignment: Interactive video

## Annotating an Image



## biocore quizzing style

To write effectively, you have to consider not only the substance and style of your paper, but also punctuation and grammar. The following list represents some of the most common errors we have seen in student papers over the years. For others, consult one of the comprehensive style manuals listed in the References on Writing section of this manual. The UW-Madison Writing Center also has a very useful grammar and punctuation website.

## Agreement in Number

- Subject and Predicate: A predicate is a verb or verb phrase of a sentence. Predicates should agree in number with their subjects. Units of measure are often used in the collective sense and the verb should be singular.

The datum is... (singular)
The data are...(plural)
Five milliliters of water was added to the mixture.

- Pronouns: Pronouns should agree in number with the noun to which they refer.

Everyone (singular) must hand in his (not their) lab report on time.

## Tense

Ask yourself whether you did something (past tense), are doing something (present tense), or will do something (future tense).

- Describe your completed observations and procedures (e.g., the Methods and Results sections) and published research in the past tense.

We obtained samples from three different sites.
Leaf area increased in plants grown under higher light intensities.

McGee (2010) reported that taller Biocore students wore larger shoes.

- Use the past perfect tense when events are repeated or continued from the past to the present.

Gall formation in goldenrods has been studied in many geographic locations.

- Describe generalizations, conclusions, and references to conditions that continue to be true in the present tense.

Streptomycin inhibits the growth of M. tuberculosis.

Our data suggest that algae, like all autotrophs, require and may be limited by light, water, gases, and mineral nutrients.

## Punctuation

- Comma: Include commas after each word, phrase, or clause in a series, and before the conjunction separating the last two.

Grasses, legumes, and composites grow in Wisconsin prairies.
Commas should follow that is, for example, moreover, i.e., and e.g.
For example, most Iron Age graves consist of burial mounds sheltering only one individual.

The Nature Conservancy has completed a preliminary series-level (i.e., dominant plant species) classification for the western United States.

- Semicolon and Colon: Use a semicolon between parts of a compound sentence (two or more independent clauses) not connected by a conjunction, such as and, but, or.

Light consists of energy packets called photons; the shorter the wavelength of light, the more energy in its photons.

Put a semicolon before, and a comma after, each conjunctive adverb, such as moreover, therefore, nevertheless, consequently, or furthermore, when connecting two parts of a complex sentence. Use commas when these words are used at the beginning of a sentence or when they are part of a simple sentence. (In general, avoid these "filler" words as much as possible!)

The deionized water was not available; however, we still completed the experiment.
Therefore, the results were significant.
Researchers working in other areas, however, failed to document the importance of competition, predation, and disturbance.

Use semicolons when commas occur within one or more of the elements of a series.

Familiar examples of species that are extremely vulnerable to human activity are the northern spotted owl, threatened by logging of old-growth forests in the Pacific Northwest; the red-cocked woodpecker, endangered by logging of longleaf pine forests in the Southeastern Coastal plain; and the desert tortoise, often shot or run over by motorized recreationists.

Three cities I will visit are Madison, Wisconsin; Northfield, Minnesota; and Chicago, Illinois.

Use colons to introduce a part of a sentence that expands or clarifies the meaning of what precedes it.
The instructor expects the following students to complete their lab reports early: Anna, Dmitry, Jaafar, and Darla.

- Quotation Marks: Place a comma or period inside the quotation marks whether or not it is part of the quotation; place punctuation other than a comma or period outside the quotation marks unless the punctuation is part of the quotation.

We don’t label data as "good" or "bad"; however, we can label them "surprising."

- Parentheses: Use parentheses (these things) sparingly. If the words you are enclosing within a parenthesis are not important enough to be included in the sentence, they may be superfluous. Use parentheses for comments or explanations that are independent of the sentence.

Solar energy is the basis of virtually all food chains (rare exceptions include chemically based communities in deep-sea vents) and is converted to chemical energy by photosynthetic plants.

Use parentheses to enclose abbreviations and acronyms after they are spelled out.

The Global Biodiversity Strategy (GBS) was developed by the World Resources Institute (WRI) and the United Nations Environmental Program (UNEP).

- Underlining and Italics: Italicizing and underlining are used for the same purposes. Italics are preferred and are easy to do with a computer. Italicize the titles of books and periodicals.

Curt found the article in the journal Ecology.
Italicize a genus or species name (and capitalize the genus name).
Poison ivy (Toxicodendron radicans) produces a secondary compound which causes an irritating rash on the skin of many people.

Italicize foreign words and abbreviations based on them (e.g., the abbreviation e.g.)

- Dangling Participles: Participles are verb forms having qualities of both verb and adjective. In the present tense, participles frequently end in -ing (asking); in the past tense, participles commonly end in
-en or -ed (asked, spoken).Dangling participles are participles (often acting as adjectives) that modify the "wrong" noun.

POOR: A bubble was observed in the jar using a magnifying glass. (The jar is not really using a magnifying glass!)

BETTER: We used a magnifying glass to observe a bubble in the jar.

- Abbreviations, Acronyms, Numbers: Write out a term the first time before abbreviating it.

The enzyme isocitrate dehydrogenase (IDH) catalyzes the oxidation of...

Express numbers as figures; do not write out the number name. A sentence, however, should never begin with a figure: Twenty-two gazelles ran past me. Next I counted 10 antelope.

## Styling

## Heading 1

## Heading 2

## Heading 3

## Heading 4

## Heading 5

## Heading 6

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ita ceterorum sententiis semotis relinquitur non mihi cum Torquato, sed virtuti cum voluptate certatio. Eaedem enim utilitates poterunt eas labefactare atque pervertere. Restant Stoici, qui cum a Peripateticis et Academicis omnia transtulissent, nominibus aliis easdem res secuti sunt. Duo Reges: constructio interrete. Nec vero alia sunt quaerenda contra Carneadeam illam sententiam. Habent enim et bene longam et satis litigiosam disputationem. Nemo igitur esse beatus potest. Quae duo sunt, unum facit. Praetereo multos, in bis doctum hominem et suavem, Hieronymum, quem iam cur Peripateticum appellem nescio. Ut scias me intellegere, primum idem esse dico voluptatem, quod ille don.

Pull Quote: Nec vero alia sunt quaerenda contra Carneadeam illam
sententiam. Habent enim et bene longam et satis litigiosam disputationem. Nemo igitur esse beatus potest. Quae duo sunt, unum facit.
textbox

## troubleshooting Davis

## Sections

- Respiratory Epithelium
- Larynx
- Cartilages
- Joints
- Ligaments
- Muscles
- Internal Anatomy
- Trachea and Bronchi
- Lungs
- Pleural Sacs and Recesses
- Lobes and Fissures
- Hilus of the Lungs
- Bronchopulmonary Segments
- Bronchioles and Alveoli
- Thoracoabdominal Diaphragm \& Phrenic Nerve

The respiratory system consists of two classes of airways: conducting airways, which function to condition inspired air and deliver it to the alveoli of the lungs, and respiratory airways, where gas exchange occurs. The conducting airways consist of the nasal cavity, most of the pharynx, the larynx, the trachea, the bronchi, and the bronchioles (through the terminal bronchioles). The respiratory airways include respiratory bronchioles and alveoli.

## Respiratory Epithelium



Section through the wall of the trachea. The luminal surface (left) is covered with pseudostratified columnar ciliated epithelium with goblet cells. Seromucous glands are found in the lamina propria. Hyaline cartilage rings are to the right and stained purple. http://www.lab.anhb.uwa.edu.au/mb140/

With a few exceptions, the conducting portion of the respiratory system is lined with pseudostratified columnar ciliated epithelium with goblet cells (also called respiratory epithelium). Underlying this epithelium is a lamina propria layer containing many seromucous glands. Both the goblet cells and the glands produce fluid which coats the luminal surface of the conducting passageways and traps inhaled particulates. The cilia on the surface of the respiratory epithelium beat toward the pharynx, moving the mucus and trapped particles up so they can be expelled from the body, or swallowed.


Higher power view of respiratory epithelium. Notice the abundant cilia on the apical surface of the epithelium and the intermittent goblet cells filled with mucus (dark purple). A layer of mucus covers the luminal surface of the epithelium. http://medpics.ucsd.edu/ index.cfm?curpage=image\&course=hist\&mode=browse\&lesson=45\&img=863

Respiratory epithelium contains multiple cell types. (You are expected to know the two cell types marked with asterisks.)

- Ciliated epithelial cells*: Cilia beat toward the pharynx to expel mucus and trapped particles.
- Goblet cells*: Unicellular mucous glands
- Granule cells: Endocrine and paracrine function
- Brush cells: Sensory cells associated with nerve endings
- Basal cells: Stem cells

The characteristics of the lining of the conducting airways change the closer you get to the respiratory passageways where gas exchange occurs, as illustrated in the figure below.


The composition of the linings of the conducting airways change from the trachea to the bronchioles. https://commons.wikimedia.org/wiki/ File:Respiratory_Tract_Histological_Differences.png

The height of the epithelium decreases as the airway proceeds distally, becoming more cuboidal in the terminal bronchioles. The number of goblet cells and ciliated cells decrease distally, as does the concentration of glands in the lamina propria.

The walls of the conducting airways also contain smooth muscle and elastic fibers, allowing expansion and contraction of the airway diameter, both passively and actively. Through the level of the bronchi, the walls of the airways also contain hyaline cartilage, to ensure that the tubes remain patent. Notice in the above figure that the amount of hyaline cartilage decreases distally. Bronchioles have no cartilage, yet retain the smooth muscle component of the wall. Elastic fibers, crucial to passive expiration, continue distally to the level of the respiratory airways (respiratory bronchioles and alveoli).

Larynx


Structures and relationships of the larynx, in sagittal section. Modified from Netter Presenter.


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Structures of the larynx, in coronal section. Modified from Netter Presenter.

The larynx is immediately anterior to the inferior part of the pharynx and is the connection between the pharynx and the trachea. It extends from the top of the epiglottis to the first tracheal ring. Its two primary functions are to maintain a patent airway and to close off the airway as needed, particularly during swallowing. The larynx is also responsible for speech and sound production.

The larynx has a cartilaginous skeleton held together by connective tissues and skeletal muscles. This cartilaginous framework ensures that the airway always remains patent. The skeletal muscles move the cartilages and other tissues to regulate the size and shape of the airway, which is crucial to sound production as well as keeping foreign objects out of the lower airway.

Most of the interior of the larynx is lined by respiratory epithelium, with the exception of the true vocal folds which are covered with stratified squamous epithelium. The movements and vibrations of the vocal folds generate significant friction. Stratified squamous epithelium covers those areas subject to high frictional forces.

## Cartilages of the Larynx



Anterior view of cartilages of the larynx. Modified from Netter Presenter.

The larynx has a total of nine cartilages linked by ligaments, membranes, and skeletal muscles. We will study five of these cartilages: the unpaired thyroid, cricoid and epiglottic cartilages, and the paired arytenoid cartilages. All of the cartilages of the larynx are hyaline cartilage, with the exception of the epiglottis which is elastic cartilage.


Cartilages of the larynx, in sagittal section. Modified from Netter Presenter.


Posterior View of Laryngeal Cartilages
Image from Netter Presenter

Posterior view of the cartilages of the larynx. Modified from Netter Presenter.

Thyroid cartilage: This is the largest laryngeal cartilage. It surrounds the anterior and lateral parts of the larynx, but not the posterior part. Due to hormonal differences, it is larger in males than in females. At the anterior midline is the thyroid prominence (Adam's apple). The thyroid cartilage is suspended from the hyoid bone in the neck by the thyrohyoid membrane.

Cricoid cartilage: This is the only cartilage that forms a complete ring around the airway. In both its size and shape, it resembles a ring that you might wear on your finger. It is narrow anteriorly and much broader posteriorly.

Epiglottis: This leaf-shaped cartilage attaches to the inside wall of the thyroid cartilage and to the hyoid bone. It passively flips down to cover the laryngeal aditus during swallowing, covering the airway. The epiglottis does not 'seal off' the airway, but rather directs food and liquid to the sides of the pharynx and away from the opening to the larynx.

Arytenoid cartilages: These three-sided pyramids sit on top of the posterior part of the cricoid cartilage. Although they are very small, they are important because the vocal ligaments attach to their anterior surfaces. The vocal ligaments underlie the vocal folds. When muscles pull on the arytenoid cartilages, the vocal folds move, changing the size and shape of the airway.

## Joints and Ligaments of the Larynx



Sagittal section through larynx illustrating cartilages and fibrous structures. From Drake, Gray's Anatomy for Students, 3rd edition, Churchill Livingstone, Inc. 2015.

The vocal ligaments extend from the arytenoid cartilages to the inside of the thyroid cartilage and underlie the vocal folds (true vocal folds). (The vocal ligaments are covered by the mucosa of the larynx to form the true vocal folds. Due to the constant vibration of the true vocal folds, which generates a lot of friction, these structures are lined by stratified squamous epithelium, rather than respiratory epithelium.)

Superior to the vocal ligaments are the vestibular ligaments, which are actually the free edge of a sheet of connective tissue that runs between the epiglottis and the arytenoid cartilages. The vestibular ligaments also run from the arytenoid cartilage to the inside of the thyroid cartilage. With the overlying laryngeal mucosa, they form the false vocal folds that close when you try to increase intra-abdominal pressure (such as when you are preparing to lift something very heavy - the Valsalva maneuver) or when you swallow.


Movements of the laryngeal cartilages at the cricothyroid joints (A) and the cricoarytenoid joints (B and C). From Drake, Gray's Anatomy for Students, 3rd edition, Churchill Livingstone, Inc. 2015.

There are two pairs of synovial joints of the larynx, the cricothyroid and cricoarytenoid joints, which allow movements that change the length, tension, and/or proximity of the vocal folds. The cricothyroid joints are between the inferior parts of the thyroid cartilage and the cricoid cartilage. The cricoarytenoid joints are synovial joints between the bases of the arytenoid cartilages and the superior surface of the posterior cricoid. These joints are moved by a complicated set of skeletal muscles.

## Muscles of the Larynx

The skeletal muscles that connect the cartilages of the larynx are named by their attachments and locations, as shown in the figures below. Their function is to move the cartilages at the joints to regulate the opening to the airway, change the length and tension of the vocal ligaments, and contract all of the muscles together to close off the airway (i.e. during in the cough reflex). All laryngeal muscles are innervated by the vagus nerve (cranial nerve X).


## Posterior View

Posterior view of the laryngeal cartilages and muscles. From Netter Presenter.


Lateral view of the laryngeal cartilages and cricothyroid muscle. From Netter Presenter


## Internal Anatomy of the Larynx



Internal structure of the larynx. From Drake, Gray’s Anatomy for Students, 3rd edition, Churchill Livingstone, Inc. 2015.

There are three regions of the larynx:

- The vestibule is between the laryngeal inlet (aditus) and the vestibular (false) folds.
- The ventricle is between the vestibular (false) and vocal (true) folds. It contains glands whose secretions keep the vocal folds moist.
- The infraglottic cavity extends from the vocal folds to the beginning of the trachea.

The entire interior of the larynx is extremely sensitive to stimulation by foreign objects. Sensory innervation of the laryngeal mucosa is through branches of the vagus nerve, cranial nerve X . The superior laryngeal nerves carry sensation from the vestibule and ventricle of the larynx (superior to the vocal folds). The recurrent laryngeal nerves carry sensation from the larynx inferior to the vocal folds (the infraglottic cavity). Sensory stimulation from the mucosa of the larynx will result in severe bouts of coughing.

## Video Review of Laryngeal Anatomy

## KNOWLEDGE CHECKS

## Trachea and Bronchi

The trachea begins in the neck at the inferior margin of the larynx and lies immediately anterior to the esophagus for its entire length. In the thorax, the arch of the aorta crosses the trachea anteriorly. The trachea ends by bifurcating into right and left primary (main) bronchi at the level of the T 4 or T 5 vertebral body. At the bifurcation, or carina, it is covered anteriorly by fibers of the cardiopulmonary plexus of nerves (made of sympathetic, parasympathetic, and viscerosensory fibers) which innervate the thoracic organs. The right main bronchus is shorter, wider, and oriented more vertically than the left. As a consequence, aspirated foreign objects tend to become lodged in the right main bronchus or one of its branches, rather than in the left.


Relationship of the trachea, esophagus and thoracic aorta.

The trachea is a fibrocartilaginous tube made of a series of 16-20 C-shaped pieces of hyaline cartilage which are open posteriorly and spanned by a smooth muscle (the trachealis muscle). Since the trachea lies just anterior to the esophagus, the opening in the back of the trachea allows the esophagus to expand during swallowing. The trachea is lined by respiratory epithelium, with seromucous glands in the underlying connective tissue.

Primary bronchi have a similar histological appearance to the trachea. As you proceed distally through the bronchial tree, the cartilage changes from continuous C-shaped pieces to discontinuous plates.


Left: Orientation of trachea relative to esophagus. From Marieb et al., Human Anatomy, 7th Edition, Pearson Education, 2014. Right: Transverse section through trachea illustrating hyaline cartilage ring anteriorly and laterally, trachealis muscle posteriorly. From http://histology.med.yale.edu/respiratory_system/respiratory_system_reading.php

## KNOWLEDGE CHECKS

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## Lungs

## Pleural Sacs and Recesses

Fluid-filled pleural sacs surround the lungs. Though these sacs are closed (like a balloon) and their walls are continuous, we divide them into two parts: a visceral pleura that covers the surface of the lungs (green in the figure below) and a parietal pleura that lines the thoracic wall (red in the figure below). The two layers are continuous at the hilus of each lung (where vessels and airways enter and exit the organ). The parietal pleura can
be named more specifically, based on its location. The diaphragmatic pleura lines the diaphragm. The costal pleura lines the inner surface of the rib cage and the mediastinal pleura lines the midline organs of the thorax. The visceral and parietal layers of pleura are smooth and glide against each other with relatively little friction as the lungs expand and recoil during inhalation and exhalation.


Coronal and transverse sections through the thorax illustrating the arrangement of parietal (red) and visceral (green) pleura.

Because the lungs do not completely fill the pleural sacs, in certain locations the parietal pleura reflects on itself to form pleural recesses (see figure above). Inferiorly, the costal and diaphragmatic pleurae form the costodiaphragmatic recess (at the costophrenic angle: the angle between the ribs and the diaphragm) and anteriorly the costal and mediastinal pleurae form the costomediastinal recess (at the cardiophrenic angle: the
angle between the heart and the diaphragm). The recesses of the pleural cavity are almost fully occupied by the lungs during inspiration, but not during expiration. Normally, the recesses contain a thin film of fluid, but they may accumulate significant amounts of fluid with an infection or a wound (hydrothorax, hemothorax). Depending on the position of the patient, fluid will accumulate in a particular recess. For example, in the upright position, the fluid would accumulate in the costodiaphragmatic recess, and produce a fluid line on an x-ray.


Lobes of the lungs.

## Lobes and Fissures of the Lungs

The left lung is divided by the oblique (major) fissure into upper (superior) and lower (inferior) lobes. Along its anterior margin, the heart forms an indentation called the cardiac notch. The small, tongue-like projection below the notch is the lingula; it is part of the upper lobe. The right lung is divided by the oblique (major) and horizontal (minor) fissures into upper (superior), middle and lower (inferior) lobes.

## Hilus of the Lung



Structures of the hilus of the right and left lungs.

Many organs have a region called the hilus, where structures enter or leave the organ. Structures at the hilus of each lung include:

- primary bronchus
- pulmonary artery
- pulmonary veins
- bronchial arteries and veins
- lymphatic vessels (and hilar lymph nodes)
- branches of the pulmonary plexus of nerves

Each of these structures plays a role in the function of the lung and you are expected to understand these functions. It is of special interest that some oxygenated blood must enter the lungs via the bronchial arteries to nourish the
bronchial tree. Bronchial arteries branch directly from the thoracic aorta and bronchial veins drain to the azygos system of veins.

When you remove the lungs, you should identify the bronchi, pulmonary arteries, and pulmonary veins. The bronchus has the thickest wall of the structures at the hilus. Because the airway must be open constantly, the bronchi are held open by hyaline cartilage. The pulmonary veins have the thinnest walls, and are usually the most anterior and inferior vessels at the hilus. The locations of the pulmonary arteries differ slightly in the right and left lungs. The position of the pulmonary artery relative to the primary (main) bronchus in each lung is summarized by the acronym RALS. In the right lung, the pulmonary artery is anterior to the bronchus (RA= right anterior), and in the left lung the pulmonary artery is superior to the bronchus ( $\mathrm{LS}=$ left superior).

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## Bronchopulmonary Segments

The air passages (trachea, primary/main, secondary/lobar, and tertiary/segmental bronchi, and bronchioles) subdivide progressively and distribute throughout the lung, terminating in alveolar sacs. The region of the lung aerated by a single tertiary bronchus is called a bronchopulmonary segment. The diagrams below illustrate the boundaries of the ten bronchopulmonary segments in each lung. Bronchopulmonary segments are pyramidal in shape. The apex of the segment is directed toward the hilus, so the outlines of the segments on the lung surface represent the base of each segment. Each segment is named according the segmental (tertiary) bronchus that supplies it.

| Lobe | RIGHT LUNG <br> Bronchopulmonary Segment | Lobe | LEFT LUNG <br> Bronchopulmonary Segment |
| :---: | :---: | :---: | :---: |
| Superior | Apical <br> Anterior <br> Posterior | Superior | Apical <br> Anterior <br> Posterior |
| Middle | Lateral <br> Medial |  | Superior Lingular <br> Inferior Lingular |
| Inferior | Superior <br> Anterior Basal <br> Medial Basal <br> Lateral Basal <br> Posterior Basal | Inferior | Superior <br> Anterior Basal <br> Medial Basal <br> Lateral Basal <br> Posterior Basal |

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Anterior (top) and posterior (bottom) views of the bronchopulmonary segments. From Netter Presenter.


Lateral (top) and medial (bottom) views of the bronchopulmonary segments. From Netter Presenter.

Branches of the pulmonary arteries travel alongside the branches of the bronchi to each bronchopulmonary segment: primary/main, secondary, and tertiary bronchi, etc. Pulmonary veins, on the other hand, run separately and are found at the interfaces between bronchopulmonary segments; they receive tributaries from both segments at the interface. Thus, the pulmonary arterial branches are intrasegmental, while the corresponding veins are intersegmental. Understanding the anatomy of bronchopulmonary segments is essential for accurate interpretation of radiographs and for surgical resection of diseased areas of the lung.

Look at the figure below for an appreciation of the tertiary bronchi which aerate each of the bronchopulmonary segments. Note that each segmental/tertiary bronchus branches from the secondary bronchus at a specific angle. This means that in order to place a specific bronchopulmonary segment in an appropriate dependent position for drainage, the patient should be placed in a specific head-up or head-down position, in combination with a specific semi-prone or semi-supine position.


Bronchial tree from the trachea through the tertiary bronchi.

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## Bronchioles and Alveoli

Tertiary bronchi will continue to branch to form smaller bronchi and, eventually, bronchioles. Histologically, bronchi are distinguishable from bronchioles because they contain pieces of cartilage in their walls. Bronchioles have no cartilage, which makes the smooth muscle in their walls more prominent.


Histological section showing an intrapulmonary bronchus (green) with cartilage in the walls (asterisks) and a bronchiole (yellow). Both are lined with respiratory epithelium. From http://histologyatlas.wisc.edu/

Distally, bronchioles branch into terminal bronchioles, part of the conducting airway, and then to respiratory bronchioles, which directly give rise to alveoli and are part of the respiratory airway, involved in gas exchange. All bronchioles have abundant smooth muscle and elastic tissue in their walls.

All gas exchange occurs in the alveoli of the lungs. The walls of the alveoli contain many different cell types:

- Type 1 pneumocytes
- 95\% of alveolar cells
- Flattened cells which form part of the diffusion barrier for gas exchange.
- Type II pneumocytes
- $5 \%$ of alveolar cells
- Secrete surfactant to cover the inner surface of each alveolus. Surfactant acts to reduce surface tension, facilitating expansion of alveoli during inspiration
- Macrophages (also called dust cells)
- Phagocytic cells which ingest particulates and foreign bodies within the alveoli
- Macrophages travel freely within the alveoli and their walls.

There are extensive capillary beds surrounding each alveolus. The diffusion barrier for gas exchange consists of:

- endothelial cells lining the capillaries
- shared basement membrane
- process of type I pneumocyte
- surfactant


Alveoli (gas-filled Type II (surfactantair spaces) secreting) cell
(c) Detailed anatomy of the respiratory membrane

Diagram of alveolar cell types and the diffusion barrier for gas exchange. Image from Marieb et al., Human Anatomy, 7th Edition, Pearson Education, 2014.

KNOWLEDGE CHECKS
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## Thoracoabdominal Diaphragm \& Phrenic Nerves



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The thoracoabdominal diaphragm is a dome-shaped sheet of skeletal muscle that separates the thorax and abdomen. Its muscle fibers radiate away from a central tendinous region and attach to the ribs, sternum and vertebral column. On the posterior side of the left diaphragm is a weak spot, devoid of muscle fibers, called the lumbocostal trigone. This area is prone to hernias.

When the diaphragm contracts, it flattens, increasing the thoracic volume (and decreasing thoracic pressure). This
motion draws air into the lungs during inspiration. Relaxation of the diaphragm makes it more dome-shaped, reducing thoracic volume (increasing thoracic pressure) during expiration.

All somatomotor innervation of the diaphragm is by the phrenic nerves (right and left) that arise from cervical spinal levels C3-5. The phrenic nerves enter the superior mediastinum between the subclavian artery and the forming brachiocephalic veins. The right phrenic nerve is found on the right side of the right brachiocephalic vein, the superior vena cava, and the right atrium. At the level of the right atrium, it lies between the mediastinal pleura and the fibrous pericardium. The left phrenic nerve crosses the arch of the aorta, then travels inferiorly along the pericardium over the surface of the left atrium and left ventricle. It is also located between the mediastinal pleura and the fibrous pericardium. Both phrenic nerves pass anterior to the root (hilus) of their respective lung.

Since the phrenic nerves are derived from spinal nerves, they contain somatomotor fibers, somatosensory fibers, and sympathetic fibers (just like all spinal nerve derivatives). The many sensory fibers of the phrenic nerve transmit information from the mediastinal pleura, pericardium and diaphragm.

Pain from the diaphragm radiates to two different regions, reflecting its dual sensory innervation. Irritation of either the diaphragmatic pleura or the abdominal peritoneum of the diaphragm refers pain to the left shoulder (dermatomes C3-5). Sensory information from these areas of the diaphragm is conveyed to the same region of the spinal cord that receives sensory input from the base of the neck and the upper limbs. As a result, irritation of the diaphragm may be perceived as pain in the base of the neck and the shoulder region. This phenomenon is called referred pain. Irritation of the peripheral rim of the diaphragm is referred to the skin over the costal margin, via intercostal nerves, by the same mechanism.

Many structures are found in both the thorax and the abdomen and must pass through the thoracoabdominal diaphragm, including the inferior vena cava, the esophagus, and the aorta. The openings in the diaphragm for these and other structures will be better visualized when we dissect the abdominal cavity.

## KNOWLEDGE CHECKS

# iframe / oembed recovery 

https://www.youtube.com/embed/kwpzKk7i7M8

## Iframe Recovery Comparison

## Plotly



## sample text - glossary troubleshooting

## Plot summary

The novel opens with Mrs. Bennet trying to persuade Mr. Bennet to visit Mr. Bingley, an eligible bachelor who has arrived in the neighborhood. After some verbal sparring with Mr. Bennet baiting his wife, it transpires that this visit has already taken place at Netherfield, Mr. Bingley's rented house. The visit is followed by an invitation to a ball at the local assembly rooms that the whole neighbourhood will attend.

At the ball, Mr. Bingley is open and cheerful, popular with all the guests, and appears to be very attracted to the beautiful Miss Jane Bennet. His friend, Mr. Darcy*, is reputed to be twice as wealthy; however, he is haughty and aloof. He declines to dance with Elizabeth, suggesting that she is not pretty enough to tempt him. ${ }^{[3]}$ She finds this amusing and jokes about the statement with her friends. Mr. Bingley's sister, Caroline, later invites Jane to visit.

When Jane visits Miss Bingley, she is caught in a rain shower on the way and comes down with a serious cold. Elizabeth visits the ill Jane at Netherfield. There Darcy begins to be attracted to Elizabeth, while Miss Bingley becomes jealous, since she has designs on Darcy herself.


Illustration by Hugh Thomson representing Mr. Collins, protesting that he never reads novels
Mr. Collins, a cousin of Mr. Bennet and heir to the Longbourn estate, visits the Bennet family. He is a pompous
and obsequious clergyman, who expects each of the Bennet girls to wish to marry him due to his inheritance. He quickly decides to propose to Elizabeth when he is led to believe Jane is taken.

Elizabeth and her family meet the dashing and charming George Wickham, who singles out Elizabeth and tells her a story of the hardship that Mr. Darcy has caused him by depriving him of a living (position as clergyman in a prosperous parish with good revenue that, once granted, is for life) promised to him by Mr. Darcy’s late father. Elizabeth's dislike of Mr. Darcy is confirmed. ${ }^{[3]}$

At a ball at Netherfield, Elizabeth reluctantly dances with Mr. Darcy. Other than Jane and Elizabeth, several members of the Bennet family show a distinct lack of decorum. Mrs. Bennet hints loudly that she fully expects Jane and Bingley to become engaged and the younger Bennet sisters otherwise expose the family to ridicule.

Mr. Collins proposes to Elizabeth, who rejects him, to the fury of her mother and the relief of her father. Shortly thereafter, they receive news that the Bingleys are suddenly leaving for London, with no intention to return. After his humiliating rejection by Elizabeth, Mr. Collins proposes to Charlotte Lucas, a sensible young woman and Elizabeth's friend. Charlotte is slightly older and is grateful to receive a proposal that will guarantee her a comfortable home. Elizabeth is aghast at such pragmatism in matters of love. Heartbroken, Jane goes to visit her Aunt and Uncle Gardiner at an unfashionable address in London. Miss Bingley clearly does not want to continue the friendship and Jane is upset though very composed.

In the spring, Elizabeth visits Charlotte and Mr. Collins in Kent. Elizabeth and her hosts are invited to Rosings Park, the imposing home of Lady Catherine de Bourgh, patroness of Mr. Collins and Mr. Darcy’s extremely wealthy aunt. She expects Mr. Darcy to marry her daughter. Mr. Darcy and his cousin, Colonel Fitzwilliam, are also visiting at Rosings Park. Colonel Fitzwilliam tells Elizabeth how Mr. Darcy managed to save a friend from a bad match. Elizabeth realizes the story must refer to Jane and is horrified that Darcy has interfered and caused her sister so much pain. Mr. Darcy, meanwhile, has fallen in love with Elizabeth and proposes to her. She rejects him angrily, stating that she could not love a man who has caused her sister such unhappiness and further accuses him of treating Mr. Wickham unjustly. The latter accusation seems to anger Mr. Darcy, and he accuses her family of wanting propriety and suggests he has been kinder to Bingley than himself. They part, barely speaking.

Later, Mr. Darcy gives Elizabeth a letter, explaining that Mr. Wickham had refused the living he claimed he was deprived of, and was given money for it instead. Wickham proceeded to waste the money and, then impoverished, demanded the living again. After being refused, he tried to elope with Darcy's 15-year-old sister, Georgiana, for her great dowry. Darcy also writes that he believed Jane, because of her reserved behavior, did not love Mr. Bingley. Darcy apologizes for hurting Jane and Elizabeth begins to change her opinion of Mr. Darcy.


Elizabeth tells her father that Darcy was responsible for uniting Lydia and Wickham, one of the two earliest illustrations of Pride and Prejudice. ${ }^{[4]}$ The clothing styles reflect the time the illustration was engraved (the 1830s), not the time in which the novel was written or set.

Some months later, Elizabeth and her Aunt and Uncle Gardiner visit Darcy's estate in Derbyshire, Pemberley. On a tour there, Elizabeth hears the housekeeper describe him as being kind and generous. When Mr. Darcy returns unexpectedly, he is overwhelmingly kind and later invites Elizabeth and the Gardiners to meet his sister and go fishing. Elizabeth is surprised and delighted by the kindness to herself and her aunt and uncle. She then suddenly receives news from Longbourn that her sister Lydia had eloped with Mr. Wickham. She tells Mr. Darcy immediately and departs in haste, believing she will never see him again, since Lydia's disgrace has ruined the family's good name.

After an agonizing wait, Mr. Wickham is somehow persuaded to marry Lydia. With some degree of decency restored, Lydia visits her family and tells Elizabeth that Mr. Darcy was at her wedding. Mrs. Gardiner informs Elizabeth that it is Mr. Darcy who has made the match at great expense, and hints that he may have "another motive" for doing so.

At this point, Mr. Bingley and Mr. Darcy return to Netherfield. Shortly thereafter, Bingley proposes to Jane and is accepted. Lady Catherine, having heard rumors that Elizabeth intends to marry Darcy, visits Elizabeth and demands that she promise not to accept his proposal. Elizabeth makes no such promise and Lady Catherine leaves, outraged by Elizabeth's perceived insolence. Darcy, heartened by Elizabeth's refusal to promise that she wouldn't accept such a proposal, again proposes to Elizabeth and is accepted. He visits Longbourn to ask Mr. Bennet for his permission. Elizabeth wants her father to understand that she is not marrying for money, and it is only after she speaks about Mr. Darcy's true worth that he is happy about the wedding.

## Main characters[edit]



Scenes from "Pride and Prejudice", by C. E. Brock


Elizabeth and Mr. Darcy by Hugh Thomson, 1894

- Elizabeth Bennet - the second of the Bennet daughters, she is twenty years old and intelligent, lively, playful, attractive, and witty - but with a tendency to judge on first impressions. As the story progresses, so does her relationship with Mr. Darcy. The course of Elizabeth and Darcy's relationship is ultimately decided when Darcy overcomes his pride, and Elizabeth overcomes her prejudice, leading them both to surrender to their love for each other.
- Mr. Fitzwilliam Darcy - the wealthy friend of Mr. Bingley. A newcomer to the village, he is ultimately Elizabeth Bennet’s love interest. Mr. Darcy is the wealthy, twenty-eight year old owner of the renowned family estate of Pemberley in Derbyshire, and is rumoured to be worth at least $£ 10,000$ a year. While being handsome, tall, and intelligent, Darcy lacks ease and social graces, and so others frequently mistake his aloof decorum and rectitude as further proof of excessive pride (which, in part, it is).
- Mr. Bennet - A late-middle-aged landed gentleman of a modest income of $£ 2000$ per annum, and the dryly sarcastic patriarch of the now-dwindling Bennet family (a family of Hertfordshire landed gentry), with five unmarried daughters. His estate, Longbourn, is entailed to the male line.
- Mrs. Bennet - the middle-aged wife of her social superior, Mr. Bennet, and the mother of their five daughters. Mrs. Bennet is a hypochondriac who imagines herself susceptible to attacks of tremors and palpitations ("[her] poor nerves"), whenever things are not going her way. Her main ambition in life is to marry her daughters off to wealthy men. Whether or not any such matches will give her daughters happiness is of little concern to her.


In a letter to Cassandra dated May 1813, Jane Austen describes a picture she saw at a gallery which was a good likeness of "Mrs. Bingley" - Jane Bennet. Deirdre Le Faye in The World of Her Novels suggests that "Portrait of Mrs. Q-" is the picture Austen was referring to. (pp. 201-203)

- Jane Bennet - the eldest Bennet sister. Twenty-two years old when the novel begins, she is considered the most beautiful young lady in the neighbourhood and is inclined to see only the good in others. She falls in love with Charles Bingley, a rich young gentleman recently moved to Hertfordshire and a close friend of Mr. Darcy.
- Mary Bennet - the middle Bennet sister, and the plainest of her siblings. Mary has a serious disposition and mostly reads and plays music, although she is often impatient to display her accomplishments and is rather vain about them. She frequently moralises to her family. According to James Edward Austen-Leigh’s A Memoir of Jane Austen, Mary ended up marrying one of her Uncle Philips' law clerks and moving into Meryton with him.
- Catherine "Kitty" Bennet - the fourth Bennet daughter at 17 years old. Though older than Lydia, she is her shadow and follows her in her pursuit of the officers of the militia. She is often portrayed as envious of Lydia and is described a "silly" young woman. However, it is said that she improved when
removed from Lydia's influence. According to James Edward Austen-Leigh’s A Memoir of Jane Austen, Kitty later married a clergyman who lived near Pemberley.
- Lydia Bennet - the youngest Bennet sister, aged 15 when the novel begins. She is frivolous and headstrong. Her main activity in life is socializing, especially flirting with the officers of the militia. This leads to her running off with George Wickham, although he has no intention of marrying her. Lydia shows no regard for the moral code of her society; as Ashley Tauchert says, she "feels without reasoning."[5]
- Charles Bingley - a handsome, amiable, wealthy young gentleman who leases Netherfield Park, an estate three miles from Longbourn, with the hopes of purchasing it. He is contrasted with Mr. Darcy for having more generally pleasing manners, although he is reliant on his more experienced friend for advice. An example of this is the prevention of Bingley and Jane's romance because of Bingley's undeniable dependence on Darcy's opinion. ${ }^{[6]}$ He lacks resolve and is easily influenced by others; his two sisters, Miss Caroline Bingley and Mrs. Louisa Hurst, both disapprove of Bingley’s growing affection for Miss Jane Bennet.
- Caroline Bingley - the vainglorious, snobbish sister of Charles Bingley, with a dowry of £20,000. Miss Bingley harbours designs upon Mr. Darcy, and therefore is jealous of his growing attachment to Elizabeth. She attempts to dissuade Mr. Darcy from liking Elizabeth by ridiculing the Bennet family and criticising Elizabeth's comportment. Miss Bingley also disapproves of her brother's esteem for Jane Bennet, and is disdainful of society in Meryton. Her wealth and her expensive education seem to be the two greatest sources of Caroline Bingley's vanity and conceit. The dynamic between Caroline Bingley and her sister, Louisa Hurst, seems to echo that of Lydia and Kitty Bennet's; that one is a no more than a follower of the other, with Caroline Bingley in the same position as Lydia, and Louisa Hurst in Kitty's.
- George Wickham - Wickham has been acquainted with Mr. Darcy since infancy, being the son of Mr. Darcy's father's steward. An officer in the militia, he is superficially charming and rapidly forms an attachment with Elizabeth Bennet. He later runs off with Lydia with no intention of marriage, which would have resulted in her complete disgrace, but for Darcy's intervention to bribe Wickham to marry her by paying off his immediate debts.
- Mr. William Collins - Mr. Collins, aged 25 years old as the novel begins, is Mr. Bennet’s distant second cousin, a clergyman, and the current heir presumptive to his estate of Longbourn House. He is an obsequious and pompous man who is excessively devoted to his patroness, Lady Catherine de Bourgh.
- Lady Catherine de Bourgh - the overbearing aunt of Mr. Darcy. Lady Catherine is the wealthy owner of Rosings Park, where she resides with her daughter Anne and is fawned upon by her rector, Mr. Collins. She is haughty, pompous, domineering, and condescending, and has long planned to marry off her sickly daughter to Darcy, to 'unite their two great estates', claiming it to be the dearest wish of both her AND her late sister, Lady Anne Darcy (née Fitzwilliam).
- Mr. Edward and Mrs. M Gardiner - Edward Gardiner is Mrs. Bennet’s brother and a successful
tradesman of sensible and gentlemanly character. Aunt Gardiner is genteel and elegant, and is close to her nieces Jane and Elizabeth. The Gardiners are instrumental in bringing about the marriage between Darcy and Elizabeth.
- Georgiana Darcy - Georgiana is Mr. Darcy's quiet, amiable (and shy) younger sister, with a dowry of $£ 30,000$, and is aged barely 16 when the story begins. When still 15, Miss Darcy almost eloped with Mr. Wickham, but was saved by her brother, whom she idolises. Thanks to years of tutorage under masters, she is accomplished at the piano, singing, playing the harp, and drawing, and modern languages, and is therefore described as Caroline Bingley's idea of an "accomplished woman".
- Charlotte Lucas - Charlotte is Elizabeth's friend who, at 27 years old (and thus very much past contemporary prime marriage age), fears becoming a burden to her family and therefore agrees to marry Mr. Collins to gain financial security. Though the novel stresses the importance of love and understanding in marriage, Austen never seems to condemn Charlotte's decision to marry for money. She uses Charlotte to convey how women of her time would adhere to society's expectation for women to marry even if it is not out of love, but convenience. ${ }^{[7]}$ Charlotte is the daughter of Sir William Lucas and Lady Lucas, neighbours of the Bennet family.


## Testing Glossary 2

Mr. Darcy

Mr. Darcy*

Charlotte Lucas
decorum decorum

## Sample Chapter to Copy

## What is a CS / CR Activity?

CS / CR stands for "Case Scenario / Critical Reader" and refers to an interactive tool that instructors at UW began using in 2011. The CS/CR tool promoted active learning by allowing participants to read course materials and engage in simulation activities. UW's Knowledgebase provides more information about CS/CR activities.

Although the University of Wisconsin has discontinued its use of the CS/CR tool, there are a number of ways to translate CS/CR activities into Pressbooks using Pressbooks H5P activities, the Hypothes.is annotation layer, and Canvas integration tools. This walkthrough provides guidance on how to approach this conversion process. This is an evolving resource: we will be updating these materials over the course of the next few months to address instructor questions as they arise.

## Organization and Workflow

A CS / CR activity is made up of multiple components working in concert with one another. In this tutorial, you will learn how to do the following:
1.
a. Insert your source text into the Pressbooks editing pane
i. add a part and chapter
ii. name your chapter and add hyperlinks to your text
b. Add visual media and audio recordings into the Pressbooks media library and insert them into the chapter text

1. Add interactive glossary items to the chapter text
2. Create interactive activities-(quizzes, short answer, etc.)-using the H5P plugin
3. Create annotations in Hypothesis that combine images, text, and multiple interactive activities


## H5P Activities

## Assignment: Multiple Hotspots

This photograph of a mountain, lake, and trees in Banff was taken by Emily Allen and is licensed under a Creative Commons Attribution 2.0 Generic License.


## Opportunities:

Vocabulary quizzes, item identification activities.

## Challenges:

The selection areas can sometimes be persnickety if you include multiple overlapping selection components and edit the activity frequently.

For example, the selection feedback areas for the quiz above look like this:

Hotspots *
Choose appropriate figure for your hotspot, configure it, then drag and resize it into place.


As of early 2018, these boxes can move around somewhat behind the scenes when you edit the activity. The developers may fix this within the coming months, however.

## Text box experiments

words here
rcorners2
words
words again

## Out-There Experiments

an experiment


[^0]:    *In the left lung's superior lobe, the apical and posterior segments sometimes have a common tertiary bronchus and are referred to as the "apicoposterior" segment.

