

What's Included?

Unit Planning

- State & NGSS Standards document
- Unit Pacing Guide for 50 min classes
- Vocabulary terms for prefix/suffix work
- Differentiation ideas for honors students and virtual students ***Digital links for virtual learning found here**
- Honors assignment list

Notes

- 35-slide editable Respiratory System PPT
- Cornell Notes
 - Fill-in-the-blank student pages (5 pgs)
 - Editable Version
 - Cornell Notes Answer Keys
- Doodle Notes (5 pgs)
 - Keys & Student Examples
 - Guide to Using Doodle Notes

Student Pages

- This folder contains duplicate copies of every student page. They are in order according to the pacing guide for QUICK PHOTOCOPYING if you are using the pacing guide as is.

Activities

- Vocal Cords Lab (3 pgs)
- Lung Capacity Lab (4 pgs)
- Microscopy Lab (1 pg)
- Disease Poster Project (2 pgs)
- Answer keys or grading rubrics for all activities

Extensions

- Lab Extension: Respiratory Disease & Lung Capacity*
- Digging Deeper: Gas Exchange*
- Respiratory Homeostasis
- Data Analysis: Hemoglobin*
- Digging Deeper: Vaping
- All Extension Answer Keys

*Honors Options

Review and Assessment

- Editable Task Card Review (22 cards) with answer sheet (answer key included)
- 2 diagrams- overall respiratory system & anatomy of the larynx (answer key included)
- Respiratory System Quiz through Google Forms
- Respiratory System Test (paper)- both Honors and Regular versions with answer sheets (answer keys included)

Unit Planning:

NGSS and State Standards Document

If your state isn't listed, contact me by email (support@suburbanscience.com) and I'll help you figure out which ones are covered!

What's Included?

Included Resources by Folder:

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- Unit Pacing Guide for 50 min classes
- Vocabulary terms for prefix/suffix work
- Differentiation ideas for honors students and virtual students *Digital links for virtual learning found here
- Honors assignment list

Notes

- 35-slide Respiratory System PPT
- Cornell Notes
 - Cornell Notes Quick Print (5 pgs)
 - Editable Cornell Notes
 - Cornell Notes Keys

- Doodle Notes
 - Respiratory Doodle Notes (5 pgs)
 - Keys & Student Examples
 - Guide to Using Doodle Notes

Activities

- Vocal Cords Lab (3 pgs)
- Lung Capacity Lab (4 pgs)
- Microscopy Lab (1 pg)
- Disease Poster Project (2 pgs + grading rubric)

Extensions

- Lab Extension: Respiratory Disease & Lung Capacity*
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- Data Analysis: Hemoglobin*
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- All Extension Answer Keys

*Honors Options

Review and Assessment

- Editable Task Card Review (22 cards) with answer sheet (answer key included)
- 2 diagrams- overall respiratory system & anatomy of the larynx (answer key included)
- Respiratory System Quiz through Google Forms (Make a copy of this file to your Drive. Do NOT assign to students using this link.)
- Respiratory System Test (paper)- both Honors and Regular versions with answer sheets (answer keys included)

Student Pages

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Supplementary Resources

- Make a [working lung model](#) to illustrate the use of the diaphragm in breathing
- Have students design infographics or posters to warn other students/teens about the hazards of vaping
- Investigate the effects of COVID-19 on the lungs
- Use [Case Study for Respiratory System: Legionnaire's Disease](#)

Materials Needed

- General classroom use: colored pencils, markers, crayons, index cards for prefixes and suffixes
- Vocal Cords Lab: Binders, boxes, or textbooks, pack of large rubber bands, pencils
- Lung Capacity Lab: Round balloon for each student, metric rulers, calculators
- Microscopy Lab: trachea cross-section slide, lung/alveoli slide, microscopes or use
- Disease Poster Project: computers

Not included:



Unit Overview Page

plus

Supplementary Resource Ideas and Materials Lists

Unit Guide

Standards:

Topic:	State:	Standards:
Breathing	OH	AP.AE.2 Process involved in the respiratory system include respiration mechanics and gas exchange. Respiration mechanics is the process by which humans breathe and includes the movement of the diaphragm and pressure-volume relationships. Gas exchange refers to the diffusion of gas across the alveolar epithelium in the respiratory system and capillary endothelium of the cardiovascular system. Lung volumes and capacities can be measured using spirometry. Homeostatic imbalances are explored.
	CO	NCHSE: 1.13M Analyze basic structures and functions of human body systems; Respiratory (structures and functions of respiratory system, physiology of respiration)
	IN	AP.11.1 Identify and locate major organs of the respiratory system and discuss their functions.
	UT	Standard 12, Standards 1-6 Identify the general functions of the respiratory system. Sequence the organs of the respiratory system in the order in which air will pass through them from the exterior. Identify the three regions of the pharynx. Identify the following anatomical structures of the larynx: epiglottis, glottis, hyoid bone, thyroid cartilage, cricoid cartilage, true vocal cords, false vocal cords. Identify the coverings of the lungs and the gross anatomical features of the lungs. Identify the site at which gas exchange occurs in the lungs (alveoli).
	FL	SC.912.L.16.44 Describe the physiology of the respiratory system including the mechanisms of ventilation, gas exchange, gas transport, and the mechanisms that control the rate of ventilation.
Respiratory Disease	OH	AP.AE.2 The respiratory system is comprised of the airways, lungs and diaphragm. The airways include the nasal and oral cavities, pharynx, larynx, trachea, bronchi, bronchioles and alveoli. The respiratory system transports and exchanges gases including oxygen and carbon dioxide.
	CO	NCHSE: 1.13M Analyze basic structures and functions of human body systems; Respiratory (structures and functions of respiratory system, physiology of respiration)
	IN	AP.11.1 Identify and locate major organs of the respiratory system and discuss their functions.
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	FL	SC.912.L.16.44 Describe the physiology of the respiratory system including the mechanisms of ventilation, gas exchange, gas transport, and the mechanisms that control the rate of ventilation.

*Note: NGSS is a register that developed the Next product, and do not end

Unit Guide

Standards:

Choosing Standards:
Although many states use NGSS, there are some states that do not. I worked hard to find other state standards, but if yours are not addressed, please send me an email at support@suburbanscience.com and I can help you determine which of your state standards are covered in this unit. Thank you!

NGSS for the Unit:

- HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

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Editable Pacing Guide

The daily topic coincide with the previous standards document.

Lesson planning is now quick and easy!

Respiratory System Unit Pacing Guide					
50 min classes		Day	Intro	Instruct	Assess
Anatomy of the System	1	Students add to prefix/suffix flashcards: • rhin-/naso-, oro-, lingua-	• Respiratory System PPT- Section 1 & Section 2 • Cornell Notes (Upper Respiratory Tract Parts 1 & 2)	• Cornell Notes summaries • Informal discussion and questions	
	2	Prefix/suffix flashcards: • pneumo-, spir-	• Vocal Cord Lab • Respiratory System PPT- Section 3 • Cornell Notes (Lower Respiratory Tract) Materials: Binders, boxes, or textbooks Pack of large rubber bands, Pencils (2 for each lab pair)	• Collect Vocal Cord Lab • Informal questioning during lab activity • Cornell Notes summaries • Informal discussion and questions	
Breathing	3	Prefix/suffix flashcards: • pulmon-, -itis, -alveol-	• Respiratory System PPT- Section 4 • Cornell Notes (Breathing) • Lung Capacity Lab Materials: Round balloon for each student, metric rulers- 1 per pair, calculators	• Cornell Notes summaries • Informal discussion and questions • Collect Lung Capacity Lab • Informal questioning during lab activity	<u>Honors:</u> Lab Extension: Respiratory Disease & Lung Capacity
	4	Prefix/suffix flashcards: • hyper-, hypo-, -pnea	• Respiratory System PPT- Section 5 • Cornell Notes (Ventilation Control) • Respiratory Homeostasis	• Cornell Notes summaries • Informal discussion and questions	Study for Respiratory System Quiz <u>Honors:</u> Digging Deeper: Gas Exchanges
Review	5	Review prefix/suffix flashcards	• Respiratory Online Quiz (need computers) • Trachea and Lung Microscopy Lab Materials: trachea slide, lung/alveoli slide and microscopes or virtual slide	• Informal check microscopy lab for accuracy/completion	<u>Honors:</u> Data Analysis: Hemoglobin
Respiratory Disease	6	Review prefix/suffix flashcards	• Digging Deeper: Vaping • Disease Poster (need computers)	• Informal discussion and questions • Rubric for Respiratory Disease Poster	Study for test
Review	7	Review prefix/suffix flashcards	Task Card Review	• Observe student progress during task cards • Informal questioning, if necessary	Study for test
	8	Review notes for test	• Go over Task Card Review making sure students have correct answers to study for test • Respiratory System Diagram • Anatomy of the Larynx Diagram	• Assess student understanding based on task card answers • Information questioning • Informal check of diagram accuracy	Study for test
Assess	9	Review notes for test	Respiratory System Test	• Formal assessment	

Coincide with State Standards document in Unit Planning Folder

***Bold items** must be photocopied.



This icon is found on the top right corner of Honors pages for easy identification.

Using this Pacing Guide as is? You can print all the student pages in order from the "Student Pages" folder.

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Differentiation Ideas for:

- Student Interest
- Student Ability
- Teaching Pace
- Teaching Environment (Virtual, in-class, or hybrid)

Differentiation

Differentiation is a key component to any unit. Here are some tips for differentiating based on student interest, ability and teaching environment.

Student Interest/Choice

- Both Cornell notes and Doodle Notes™ are included in this unit. Although most of my students preferred the Doodle Notes™, they may not resonate with everyone. Some students may prefer the structure of the Cornell notes.

the disease topic of their choice for the respiratory disease as a topic that is not listed and it is helpful to allow students to

Differentiation

Teaching Environment

- Virtual or Hybrid students
 - Digital Options:
 - Links for PowerPoints
 - Digital Students pages using Google Slides™ for students to type on
 - Digital Doodle Notes™
 - YouTube links for lab demonstrations
 - All histology labs can be completed using virtual slides on [Histology Guide](#).
 - Digital drag-and-drop diagrams can be provided for students to self-check and turn in electronically. I have these [available for every body system](#). Digital diagram quizzes are included as well.

All found on the following page.

Notes OR Doodle Notes

et (Part 2)

Honors Assignment List

Although there are no official education standards for what makes an "honors" class, **honors assignments generally provide one of three options:**

- Greater depth of knowledge
- Additional critical thinking
- More independent work

In this unit, you can find some additional assignments used to increase knowledge for honors students. **These can certainly be used for all students also be helpful for extra credit, homework, or sub days if you need it.** Because answers to these assignments are often less straightforward, grading for completion and then **discussing the answers** to make sure

Assignment	Type of work	Skills addressed
Lab Extension: Respiratory Disease & Lung Capacity	Lab Extension Reading assignment	Critical thinking
Digging Deeper: Gas Exchange	Reading assignment	Reading graphs, critical thinking
Data Analysis: Hemoglobin	Interpreting graphs	Reading line graphs, trends

All honors assignments are designated by a in the top right corner for identification.

For additional skill-work in pathology or for students thinking of going into the field, I also use my Anatomy case studies. There is one for each body system that require critical thinking, research, and allow students to integrate top body system to another.

[Click here to see the Case Studies](#)

Differentiation

Differentiation is a key component to any unit. Here are some tips for differentiating based on student interest, ability and teaching environment.

Student Ability

- Advanced students**
 - Honors options are included in the student pages. These can be given to a whole advanced class or individual students, as needed.
 - Editable Cornell notes** (found in the Notes folder)
 - Delete the **fill-in-the-blank notes on the right side** leaving only questions for a more independent note-taking experience.
 - Delete the **summary** and allow students to come up with their own.
 - When using **diagrams**, use the option without the word bank and/or grade on spelling of the structures.
 - Tests: Don't allow students to use prefix/suffix flashcards** on the test. Use more or all of the **short answer questions**. Delete the **word banks** on the diagrams.
- Struggling students**
 - Eliminating homework altogether** may work well for students that have trouble thinking independently or have home situations that don't allow for work outside of class. Make sure to account for the extra class time needed to complete all assignments in class.
 - Although I always help students during labs and answer questions as they complete lab worksheets, these students **may need to have each lab answer discussed** and checked the following day rather than grading the labs for accuracy.
 - Microscopy labs can be eliminated** for these students in order to simplify material.
 - Editable Cornell notes** (found in the Notes folder)
 - Use the **fill-in-the-blank style** of notes for these students so they can focus on material and less on summarizing.
 - Using the **fill-in-the-blank summary**, see if students can come up with the words that go in the blanks before providing the summary to them.
 - Diagrams:** Use the option with the word bank or use the option without the word bank but don't grade spelling.
 - Tests: Allow students to use prefix/suffix flashcards** on the test rather than memorizing them. Eliminate some or all of the **short answer questions**. Use **word banks** for the diagrams.
- For any ability**
 - Both the PowerPoints and the Cornell notes have **editable options** so whole topics or vocabulary words can be added or deleted.

Every student page also comes in a **digital** version on Google Slides

Virtual, hybrid, or absent students can stay right on track!

Breathing

How do internal and external respiration differ?	External respiration	Internal respiration
	Pulmonary blood vessels ↕ Alveoli	Blood ↕ Body tissues

What process precedes external respiration? **Ventilation/ Breathing**

How does breathing occur?

What muscles are involved in breathing and where are they located?

Diaphragm - flat muscle under ribs
External intercostals - between each rib

Muscle contraction → increase in volume of lungs → decrease in pressure within lungs → air rushes in (called inspiration)

Muscle relaxation → decrease in volume of lungs → increase in pressure within lungs → air rushes out (called expiration)

How is lung capacity determined?

Define the following terms:

- Tidal volume = the amount of air exchanged by lungs at rest
- Inspiratory reserve volume = additional amount of air that can be inhaled consciously
- Expiratory reserve volume = additional amount of air that can be exhaled consciously
- Residual volume = amount of air remaining in lungs after a forced exhalation
- Vital capacity = amount of air someone can consciously exchange with the environment
- Total lung capacity = vital lung capacity + residual volume

Summary: External respiration is preceded by breathing. Muscle movements lead to volume and pressure changes, causing air to move in and out. Total lung capacity can be divided into several partial volumes.

Breathing

How do internal and external respiration differ?	External respiration	Internal respiration
	Pulmonary blood vessels exchange with alveoli	Blood exchanges with body tissues

What process precedes external respiration? **Ventilation/ breathing**

How does breathing occur?

What muscles are involved in breathing and where are they located?

Muscle contraction → increase in _____ of lungs → decrease in _____ within lungs → air rushes in (called _____)

Muscle relaxation → decrease in _____ of lungs → increase in _____ within lungs → air rushes out (called _____)

Can be used in Google Classroom, Microsoft OneDrive or many other platforms!

Greek and Latin Roots for Medical Terminology Practice

Anatomical Prefixes/Roots/Suffixes:

	Term	Definition
Respiratory System	rhin-/naso-	nose
	oro-	mouth
	lingua-	tongue
	pneumo-	air
	spir-	breathe
	pulmon-	lung
	-itis	inflammation of
	alveol-	small cavity
	hyper-	over, above
	hypo-	below normal
	-pnea	respiration

Using Prefixes/Suffixes in your Classroom:

Why study prefixes and suffixes at all?

The basis of scientific terminology comes from Latin & Greek. By teaching science students Latin & Greek prefixes, suffixes and root words, they can learn to dissect new scientific terms when they come across them in news articles or textbooks. This is a great way to train our students to be scientifically literate adults. Even if they don't remember all the facts they've memorized in this class, they can interpret scientific information from the media and from their own doctors.

How can you use them in class?

- **How I do it:**
 - **Beginning of the year:** I ask students to bring in a stack of 300 3"x5" index cards. I always have a few extra on hand for students that forget or can't afford them, although they're fairly inexpensive.
 - **Beginning of (almost) every class:** I write any prefixes and suffixes that are relevant to that day's topic on the board along with the definition. Students record the prefix/suffix on one side of an index card and the definition on the other. If there aren't any terms for that day, students can review the terms they already have written down.
 - **On test day:** I add approximately two scientific words to the end of every unit test. These are words that relate to the unit but are not ones we have discussed in class. Students must use the prefixes/suffixes we've studied to interpret the meaning of the new term. For on-level or advanced classes, I recommend not letting students use their index cards on the test, but for low-level students, it may be beneficial to allow it.

Pneumo-

Uses in your Classroom:

Helpful tips for using cards:

- Always have a master list of the terms you've given out or keep your own set of notecards. It may be helpful to have students write the date in the top corner of the card. This allows absent students to copy the terms they missed when they return.
- Starting class with these terms is a great way to give yourself a few more minutes to get organized. Students can always review their index cards or quiz each other if you need a few more minutes.
- Students will need some way to keep the cards organized- put them on a ring, rubber band them together, or keep them in a bag.
- Students add to these index card stacks throughout the year without removing terms. The course builds on itself, so it's always beneficial to review terms from previous units as well as the current unit. You may find that some terms are duplicated from one unit to another. No need to have students write the same term twice.
- For advanced students, you may want to have them look up the definition in a textbook rather than providing it to them.

Be sure to mention these prefixes and suffixes again as they come up in class. Using the terms in context is the best way for students to recognize and remember them.

Prep sub plans:

Students can type the terms into Quizlet or a similar site and quiz themselves.

Students can make up scientific terms (real or not) and have other students interpret the meaning of the term.

Use a blank bingo board (provided on the next page) and have students fill in the definitions for the current or past unit in any blank. The sub can call out a prefix or suffix and students mark off the definition until someone wins bingo.

*This is another important reason to have a master list or set of cards for all the terms students have already learned.

A great way to encourage scientific literacy and prepare students for higher level science courses.

Highly Visual PowerPoint Presentation

35 editable, fully-animated slides

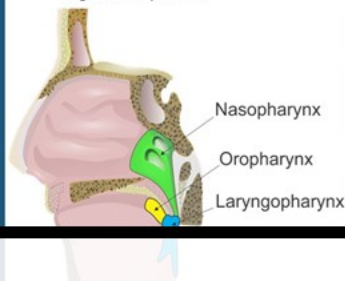
What is the purpose of the nasal cavity?

- The nose is divided by the **nasal septum** into **nostrils**.
- The **nasal cavity** is posterior to the nostrils, lined with **mucosa lining**, which warms incoming air and traps foreign objects.
- Ciliated cells in the nasal mucosa propel trapped debris towards the **throat** for **digestion**.



What are the major structures of the pharynx?

- **Pharynx**= the "throat"
- Shared by both respiratory and digestive systems



Divided into:

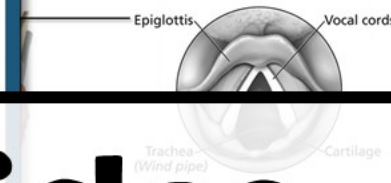
1. **Nasopharynx**- nasal portion of pharynx
2. **Oropharynx**- oral (mouth) portion of pharynx
3. **Laryngopharynx**-

opening of pharynx and esophagus. Contains epiglottis.

The **epiglottis** is a flap of elastic cartilage that protects the superior opening of the

During **breathing**, the epiglottis allows air to pass into the lower respiratory tract.

During **eating**, the epiglottis tips to cover the opening, directing food through the esophagus rather than into the lungs.

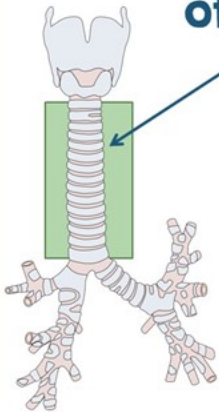


Sample Slides

What is the anatomy of the trachea?

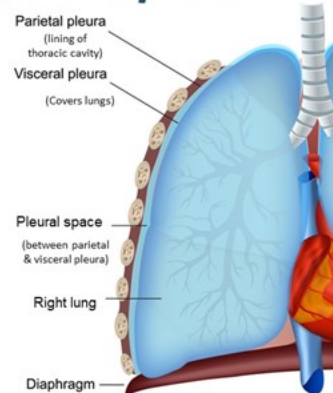
Trachea= "wind pipe"

- The trachea is a **rigid tube** about 4-5 inches long **surrounded by C-shaped cartilage rings** that open posteriorly.
- These rings prevent the trachea from collapsing, while the space between them maintains the flexibility of the neck.



What are the structures of the lower respiratory tract?

- The lungs are covered with a thin membrane called the **pleura**.
- The **pleural space** contains **pleural fluid**, which reduces friction between the lungs and the rest of the thoracic cavity.

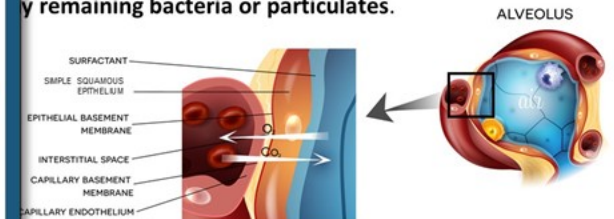


What structures make up the respiratory zone?

The thin-walled **alveoli** and the surrounding capillaries make up the **respiratory zone**, which is the site of **gas exchange** within the respiratory system.

The **respiratory membrane** is found between the capillary and each alveolus.

Alveolar macrophages move in and out of the alveoli **collecting** any remaining bacteria or particulates.



Two note-taking styles are included:

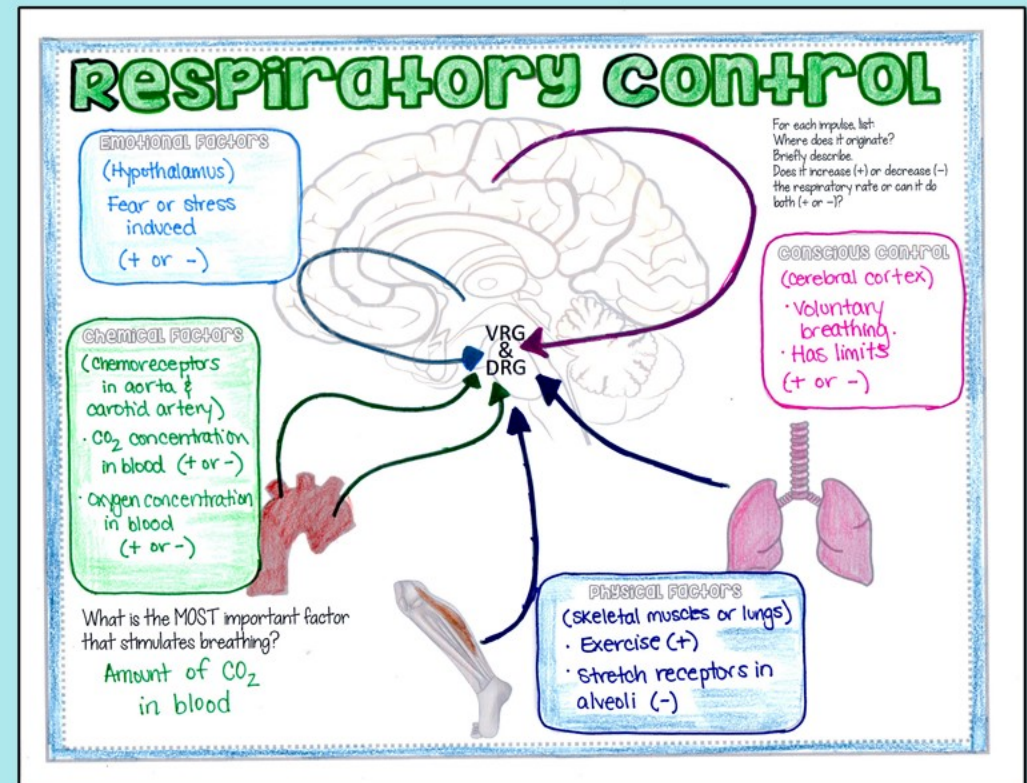
Cornell Notes

Ventilation Control

<p>What structures regulate breathing?</p> <p>How can respiratory rate and depth be altered?</p>	<p>The <u>rate</u> of respiration is primarily controlled within the <u>medulla</u> and <u>pons</u> of the brainstem.</p> <p>Within medulla:</p> <ul style="list-style-type: none"> • <u>Ventral respiratory group (VRG)</u> - control's quiet, regular breathing • <u>Dorsal respiratory group (DRG)</u> - collects sensory information & passes info to VRG. <p>Within pons:</p> <ul style="list-style-type: none"> • <u>Modifies timing & smooth control of breathing by communicating with the VRG.</u> <p>The respiratory rate and depth can change based on several factors:</p> <ol style="list-style-type: none"> 1. Physical factors- <u>talking, coughing, exercising, or body temp.</u> Lungs have <u>stretch receptors</u> to prevent overinflation. 2. Conscious control- <u>voluntary breathing</u> ↳ Brainstem will ignore conscious control if extremes are reached. 3. Emotional factors- <u>gasping when scared, rapid breathing from stress</u> 4. Chemical factors- <u>level of O₂ and CO₂ in the blood.</u> <p>What is the MOST important stimulus for breathing? <u>The amount of CO₂</u></p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>↑ or ↓ in CO₂ concentration</p> <p>↓</p> <p>pH change in blood</p> <p>↓</p> <p>Impulses sent to respiratory centers in medulla</p> </div> <div style="text-align: center;"> <p>↑ or ↓ in O₂ concentration</p> <p>↓</p> <p>Recognized by chemoreceptors in aorta & common carotid artery</p> <p>↓</p> <p>Impulses sent to respiratory centers in medulla</p> </div> </div>
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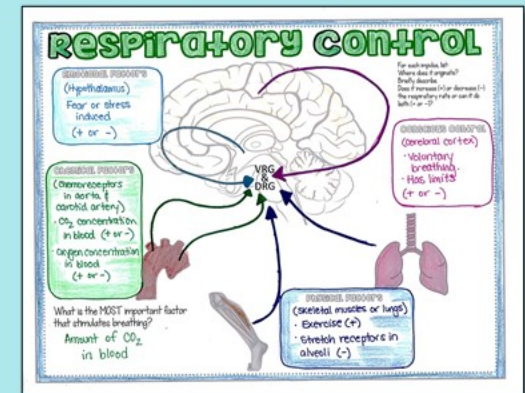
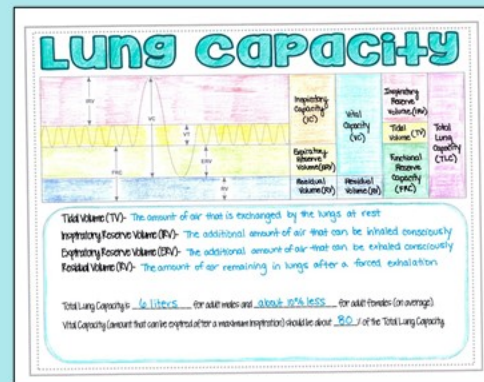
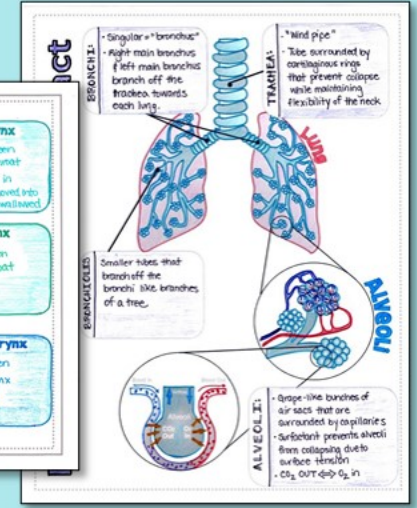
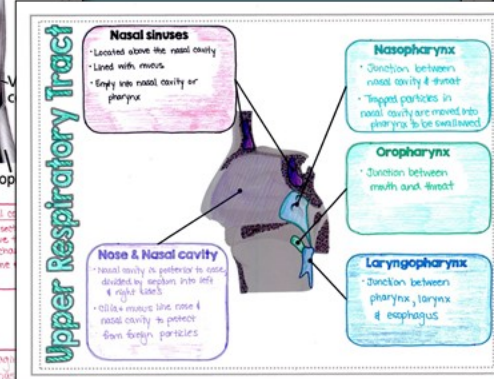
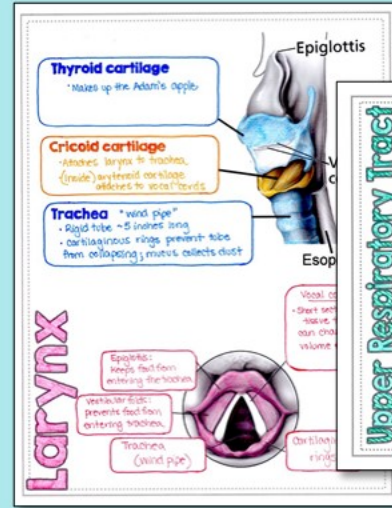
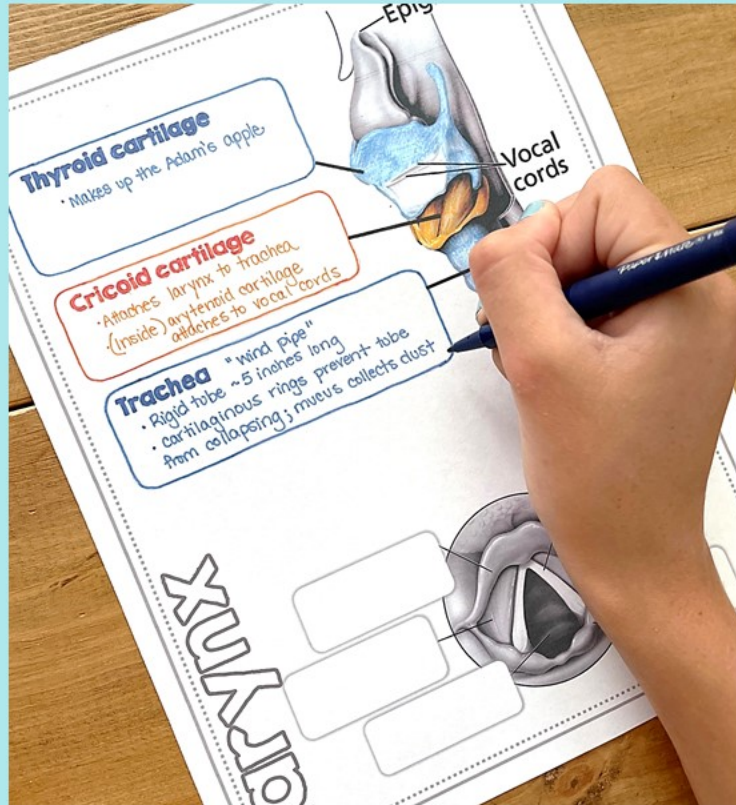
Summary: Respiratory rate and depth is controlled by the medulla and the pons. They regulate respiration by physical and emotional factors, conscious control and the level of oxygen and carbon dioxide in the blood.

Doodle Notes



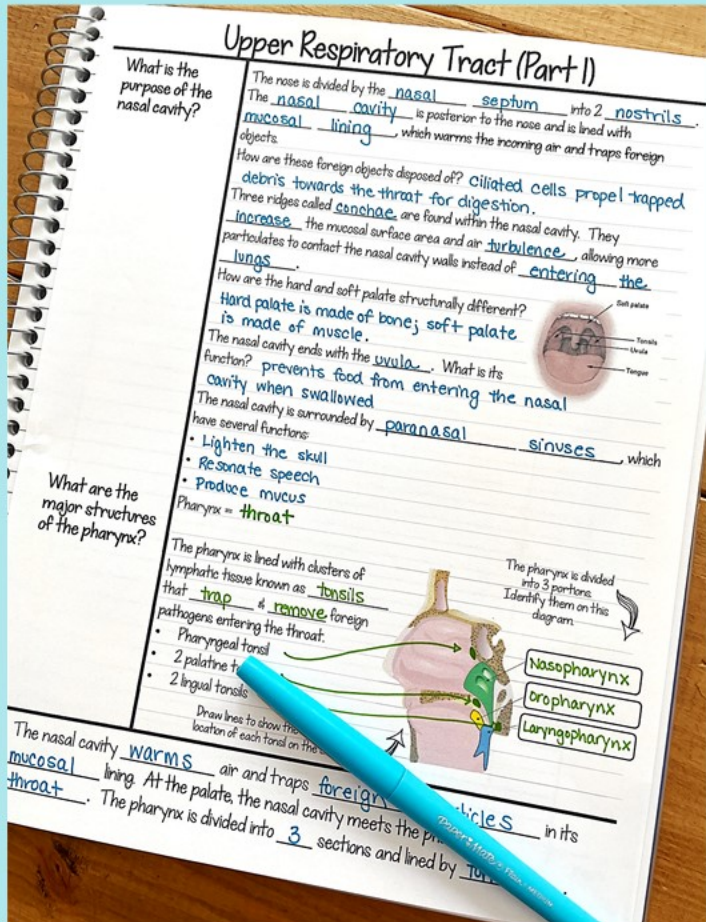
Both coincide perfectly with the presentation for
error-proof notes!

5 pages of Doodle Notes



Doodle Notes™ increase student focus and memory-
and they're great fun!
A guide for using them in your classroom is included.

5 pages of Cornell Notes



Big
concept
questions

Content
summary for
each page

Upper Respiratory Tract (Part 2)

What are the major structures and functions of the larynx?

Where is the larynx located? Connects the pharynx to the trachea.

The larynx has three functions. Describe the structures that accomplish each:

1. Provide an open airway (cartilage)
Hyaline cartilage in the larynx and trachea keeps the soft tissue from collapsing during breathing.
2. Divert air and food into the proper pathways
Epiglottis - allows air to pass into trachea, but tips to cover larynx during eating.
3. Produce sound
Vocal cords or vocal folds, vestibular folds lateral to vocal cords.

Vocal cords change the sound of your voice in several ways:

- Volume - pushing more air through vocal cords
- Pitch - changing tension/thickness of vocal cords
- Articulation - using tongue, lips, mouth & teeth to produce various sounds

Trachea = "wind pipe"

The trachea is a rigid tube about 5 inches long.

Describe the structure and function of the cartilaginous rings that surround the trachea.

- Trachea is surrounded by horse shoe-shaped cartilaginous rings.
- Rings open towards posterior to allow esophagus to move when food is swallowed.

Label these structures: Thyroid cartilage, cricoid cartilage, trachea, larynx.

Label these structures: Epiglottis, hyoid bone, thyroid.

Label these structures: Thyroid cartilage, cricoid cartilage, trachea, larynx.

Summary: The larynx and trachea are lined with cartilage to provide open pathways for air. The epiglottis blocks food from entering the lungs and the vocal cords produce sound in the larynx.

Each page is **editable**.
Add and delete text, questions, and summaries
to meet the needs of your students.

Includes 4 Activities

- Vocal Cord Lab
- Microscopy Lab
- Lung Capacity Lab
- Disease Poster Project

Discussion Questions:

1. How did the pitch of the rubber band change as the length of the band was increased?
2. Draw a sound wave for the following:

a) A long rubber band

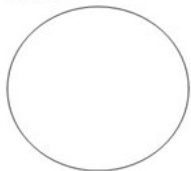
Vocal Cord Lab
Sample Pages

Vocal Cord Lab

Materials for each person:

• A long rubber band • Two pencils or pens • 2 Pencils

4. What are the three layers in a vocal cord?
5. When you are speaking, are you vibrating?
6. When you've watched the video to illustrate their structure during High note:

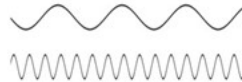


Background:

Sound waves are made by vibrations of air. In your body, your vocal cords are responsible for vibrating to produce sound.

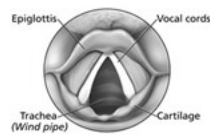
The frequency of a wave is the number of waves that pass a given point per second. So, the faster an object vibrates, the higher the frequency of the wave will be. In music, frequency is interpreted as pitch. When you hear a higher pitched note, that sound wave has a higher frequency.

Look at the waves on the right. The one on the bottom has a higher frequency (and thus higher pitch) than the one on the top because the waves are closer together.



Your vocal cords are folds of tissue that vibrate as air from your lungs is pushed past them. These vibrations create sounds such as speaking and singing. The vibrations can be altered by lengthening/tightening or shortening/relaxing the vocal cords.

In addition to making sounds, the vocal cords work with your epiglottis to prevent food from entering the trachea and getting lodged in your lungs.



Today you will model the vibrations of the vocal cords using rubber bands to alter the frequency and pitch of sounds.

Directions:

1. Wrap your rubber band around the longest part of your box. It should be fairly tight against the box.
2. Tuck the two pencils perpendicularly under the rubber band.
3. Spread the pencils as far apart as you can and then pluck the rubber band.
4. Put the pencils closer together and pluck the rubber band again.
5. Move the pencils a few more times, noting what happens to the pitch of the rubber band each time they are moved.
6. Watch the video at this link: [https://www.youtube.com/watch?v=...](#) then answer the discussion questions.

Trachea Microscopy

Structures to identify and label:

- Ciliated columnar epithelial cells
- Tracheal cartilage
- Connective tissue

1. Are the epithelial cells simple, stratified, or pseudostratified? How can you tell?

2. What is the function of the trachea?

Microscopy Lab
Sample Page

Magnification: _____

Lung Microscopy

Structures to identify and label:

- Alveolar ducts (connect bronchioles with alveoli)
- Alveoli
- Capillaries

1. Are the epithelial cells of the alveoli simple, stratified, or pseudostratified? Why is this important?
2. You may be able to see some alveolar macrophages (dust cells). What function do these have?

Magnification: _____

Part 2: Totallung capacity

The total lung capacity is very difficult to measure because your lungs never fully empty. They must maintain a "residual volume" to keep them from fully collapsing.

Therefore, we will use your **theoretical total lung capacity**. This is the amount of air your lungs would likely be able to hold based on your body size and gender.

For adult males, the theoretical total lung capacity is about 6000 cm³ and for adult females, the theoretical total lung capacity is about 4200 cm³.

Based on your gender, your theoretical lung capacity is = _____

Part 3: Residual volume

The residual volume is what is left in your lungs after you exhale as much as you can. This can be

Theoretical lung cap

Since you've already the residual volume.

Residual volume =

Discussion Questions

1. In healthy individuals, how does the residual volume change?

Directions:

Lung Capacity Lab Student Instructions

Lung Capacity Lab Sample Pages

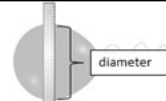
Part 1: Vital lung capacity

Vital lung capacity is the amount of air that is moved in and out by voluntary force.

When you breathe in and out, you are moving air in and out of your lungs. You may want to blow up a balloon up one time just to decrease its resistance.

1. When you are ready, inhale as much air as possible, then exhale as much as possible into the balloon. Use only 1 breath. Pinch the end of the balloon so the air does not

2. How would the vital lung capacity change if you were to breathe in and out more times? Measure the diameter with the metric ruler (in cm). Record this number in the "Trial 1" section of the table below.



Trial	1	2	3	4	5	Average Diameter
Diameter						

3. Repeat this 4 more times. Each time, record the diameter of the balloon in the chart. You may rest between trials if needed.

4. Now, we will use a formula to calculate the volume of air that you blew into the balloon. This will be your vital lung capacity.

First, divide your average diameter in half to get the radius: _____

Then, use the following "volume of a sphere" formula to calculate your vital lung capacity volume in cm³.

$$V = \frac{4}{3} \pi (r^3)$$

Vital Lung Capacity = _____ cm³

Respiratory System Disease Poster Teacher Instructions

Objective: Students will become familiar with several diseases of the respiratory system.

In this brief project, students will independently research a disease of the respiratory system. Two electronic posters will be created from this research- one for the upper respiratory tract and one for the lower respiratory tract. This is meant to provide an overview of respiratory diseases and give students background on the disorders that can occur in the respiratory system. It is not meant to be a comprehensive investigation of each disease.

During class:

Each student may choose a disease or disorder from the list below or a structure to study.

Disease/disorder choices:

Respiratory System Disease Poster Student Instructions

In this project, you will be briefly researching a disease or disorder of the respiratory system. Your research will be added to an informational poster for either the upper respiratory tract or lower respiratory tract. You only need to research one disease and then will collaborate with other students to fill in the full informational poster.

1. The teacher will provide you with a list of diseases/disorders to research.
2. After you have chosen your disease/disorder, you will use the black informational poster document provided by your teacher. Make the poster neat and consistent. It should look like a real anatomical poster when you're finished.

You must include:

- Name of the disease/disorder
- One sentence overview of the disease/disorder.
- Cause of the disease/disorder.
- Symptoms of the disease/disorder.
- Treatment options, if available
- An image of the disease

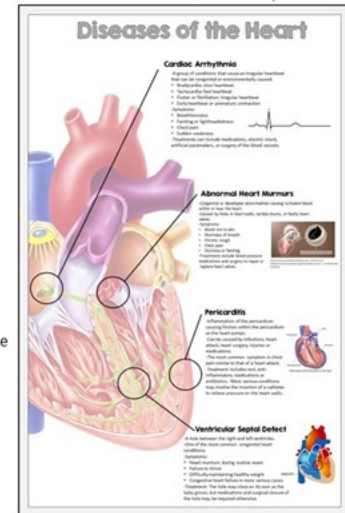
Disease/disorder choices:

Upper Respiratory Disorders:

- Chronic sinusitis
- Cleft palate
- Deviated nasal septum
- Allergic rhinitis
- Vocal cord paralysis
- Sleep apnea
- Spasmodic dysphonia
- Tracheomalacia
- Tracheal stenosis

Lower Respiratory Disorders:

- Chronic Obstructive Pulmonary Disease (COPD)
- Asthma
- Emphysema
- Lung Cancer
- Pneumonia
- SIDS
- Tuberculosis
- Cystic Fibrosis



Extension Pages

Lab Extension: Respiratory Disease & Lung Capacity

Background:

Respiratory lung conditions can be categorized into obstructive and restrictive diseases.

In an **obstructive respiratory disease**, individuals are unable to expel all the air in their lungs. The amount of fresh air circulating in the lungs decreases over time and the air that should have been expelled remains in the lungs. Chronic obstructive pulmonary disease (COPD), emphysema, chronic bronchitis, and asthma are all obstructive respiratory diseases. Lung irritation from smoking, environmental irritants, or chemicals can lead to COPD.

In contrast, **restrictive respiratory diseases** prevent individuals from fully inhaling. The lungs are restricted from fully expanding because of damaged muscles or nerves. Restrictive respiratory diseases include interstitial lung disease, sarcoidosis, amyotrophic lateral sclerosis (ALS), and asbestosis.

Discussion Questions:

- Pretend your teacher has asked you to complete the lung capacity lab again, but this time with a belt tightened around your chest. Which type of disease would this illustrate: obstructive respiratory disease or restrictive respiratory disease? Why?
- Look at the lung capacity graph again.
 - Which lung volume would be most affected by an obstructive respiratory disease?
 - Which
- Individuals with Corticosteroids, commonly administered for asthma, can experience side effects.
 - Which
 - Which
 - How did



Digging Deeper: Gas Exchanges

Diffusion of Gases

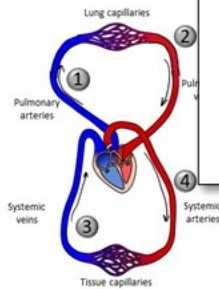
The exchange of oxygen gas (O_2) and carbon dioxide (CO_2) in the blood occurs through simple diffusion. As a reminder, diffusion is the natural movement of molecules from an area of greater concentration to an area of lesser concentration. It does not cost energy to move molecules by diffusion.

Both the movement of oxygen and the movement of carbon dioxide is equally important within the body. Oxygen is brought in through the lungs and carried through the body until it is distributed to body tissues. Carbon dioxide is a by-product of cellular metabolism and builds up in the tissues. It must diffuse back into the bloodstream to be removed during exhalation.

Maintaining Blood pH

Oxygen is generally insoluble in water, while carbon dioxide is soluble. Since blood is mostly water, the carbon dioxide is readily diffused into the bloodstream. In fact, it is 20 times more soluble in the blood than oxygen. When carbon dioxide reacts with water molecules in the blood, it is converted into carbonic acid (H_2CO_3). When carbon dioxide (and therefore carbonic acid) amounts are high within the blood, a condition known as **acidosis** can occur if the pH of the blood is lower than 7.35.

To prevent acidosis, most of the carbon dioxide in the blood is immediately converted into bicarbonate ions. These ions act as buffers to prevent large swings in blood pH. The reaction then reverses in order to release the carbon dioxide into the lungs to be expelled.



Discussion Questions:

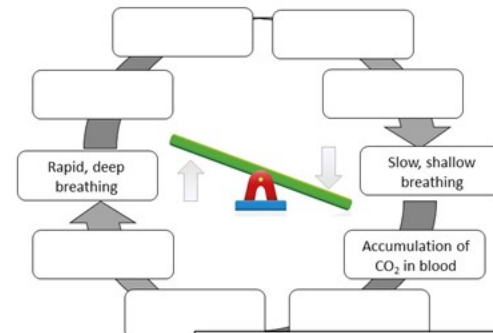
- Below are bar graphs showing relative concentrations of oxygen and carbon dioxide. Match each graph with the correct location where these concentrations can be found on the image above.
 - For O_2 , the concentration is 20 mm Hg.
 - For CO_2 , the concentration is 40 mm Hg.
- Which 2 of these locations represent internal respiration? Which 2 represent external respiration?
- Write the chemical equation for the formation of carbonic acid.
- Hyperventilation, often caused by anxiety, leads to the expulsion of too much carbon dioxide and creates a condition known as alkalosis. Hyperventilating individuals can get relief from this condition by breathing into a paper bag. Explain.
- Would individuals with alkalosis have low pH levels in the blood or high pH levels? Explain.

Respiratory Homeostasis



Acid-Base Balance

The respiratory system contributes to one of the greatest homeostatic regulations in the body. The amounts of oxygen and carbon dioxide in the body can change quickly. When carbon dioxide builds up, it reacts with water in the blood to form carbonic acid. Carbonic acid causes a drop in the pH of the blood, which the body recognizes and regulates by increasing the rate of respiration to remove the excess carbon dioxide.



Discussion Questions:

- Fill in the following statements on accumulation of carbonic acid, depth and rate of breathing, and respiration rate.
- The other reason respiratory rate increases is hypoxia, how would you expect the rate of breathing to change?
- You try to hold your breath, but after a few minutes, you feel the need to breathe. What in your body/lungs that causes your brain to tell you to breathe?

Digging Deeper: Vaping

Background:

The use of e-cigarettes, commonly called vaping, has seen a dramatic rise in popularity. Unlike traditional cigarettes which burn tobacco to create smoke, vape pens or e-cigarettes heat up a liquid which vaporizes and is then inhaled. They have been touted as the safer alternative to cigarettes because they don't contain the toxic additives traditionally found in cigarettes. However, these devices have only been available for a few years so the long-term effects of vaping are still largely unknown.

Medical professionals do have some idea of the short-term effects of vaping on the respiratory system, though. E-cigarettes are used to deliver nicotine, which is highly addictive and can harm the developing brains of teens and children. Additionally, the additives used to vaporize the oily liquids bathe the lungs in chemicals. The immune system often attacks these chemicals causing an inflammatory response which can permanently destroy lung tissue. One of these chemicals, diacetyl, is also used as a food additive to simulate butter flavor in popcorn. Diacetyl is safe when eaten, but a harmful irritant to the lungs when inhaled. The inflammation and scarring of the lungs caused by this chemical is commonly known as "popcorn lung". There is no treatment for the permanent scarring that occurs from this disease.

Another common result from vaping is a primary spontaneous pneumothorax (collapsed lung). A lung collapses when a tiny blister or tear in the lung ruptures, disrupting the pressure balance. Some teens are more susceptible to these blisters because of rapid growth spurts during adolescence. Although the



Vaping hasn't been around long enough to know whether it causes lung cancer, but the addition of tiny particles into lung tissues always carries a carcinogenic risk. Because of the vast number of risk factors involved in lung cancer, the continued use of heavily regulated substances and additives in e-cigarettes is a concern. The FDA has issued warnings about the health risks of vaping, but the industry continues to market towards minors.

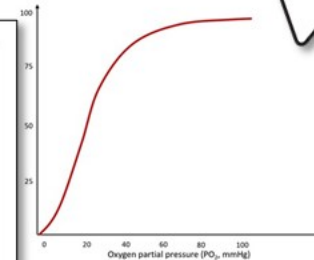
5. Name 3 health risks associated with e-cigarettes or vaping.

Skills check!

Interpretation of graphs
(great for standardized test prep)

Data Analysis: Hemoglobin

The graph below is called the oxygen-hemoglobin dissociation curve. It shows the relationship between partial pressure of O_2 and the number of oxygen molecules a hemoglobin molecule can hold within a particular region of the body. Since every hemoglobin molecule can hold 4 O_2 molecules, a 25% saturation of hemoglobin means 1 of the 4 heme groups are carrying O_2 molecules.



1. The P_{O_2} in the atmosphere is about 100 mm Hg. Most hemoglobin molecules are carrying how many O_2 molecules per molecule?

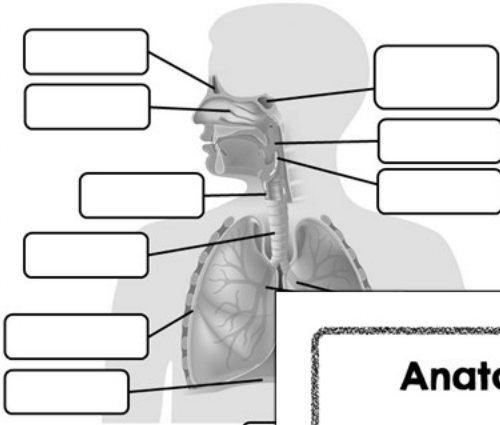
2. The P_{O_2} in the atmosphere is only about 80%. What do you notice about the saturation of hemoglobin as the P_{O_2} drops from 100 mm Hg to 80 mm Hg?

3. Tissues (like skeletal muscle) have a P_{O_2} of only 40 mm Hg, allowing the extra O_2 to be released to the body tissues. What is the percentage of hemoglobin saturation at this P_{O_2} ?

4. Metabolizing quickly only have a P_{O_2} of 20 mm Hg. How much hemoglobin is saturated? Why is it beneficial for the hemoglobin near these tissues to NOT pick up O_2 ?

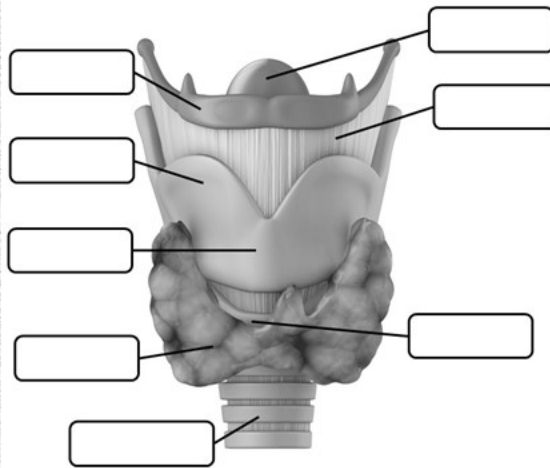
Anatomical Diagrams

Respiratory System



Word bank: larynx, epiglottis, b
cavity, sphenoidal sinus, nasal c
trachea, bronchi, diaphragm

Anatomy of the Larynx

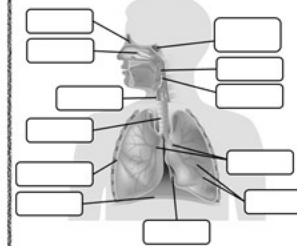


Word bank: hyoid bone, laryngeal prominence, epiglottis,
tracheal cartilage, cricoid cartilage, thyrohyoid membrane,
thyroid cartilage, thyroid gland

Each diagram comes in 4 versions:

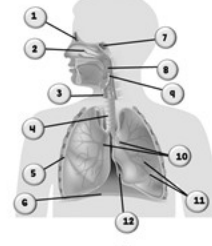
1. Fill-in the blank
2. Numbered quiz
3. Labeled black & white
4. Labeled color

Respiratory System



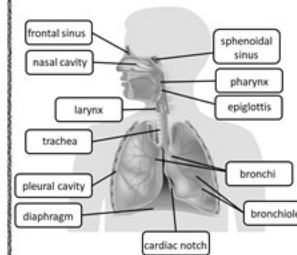
Word bank: larynx, epiglottis, bronchioles, frontal sinus, pleural
cavity, sphenoidal sinus, nasal cavity, pharynx, cardiac notch,
trachea, bronchi, diaphragm

Respiratory System

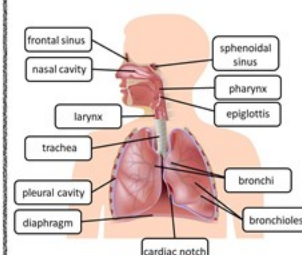


1. _____ 7. _____
2. _____ 8. _____
3. _____ 9. _____
4. _____ 10. _____
5. _____ 11. _____
6. _____ 12. _____

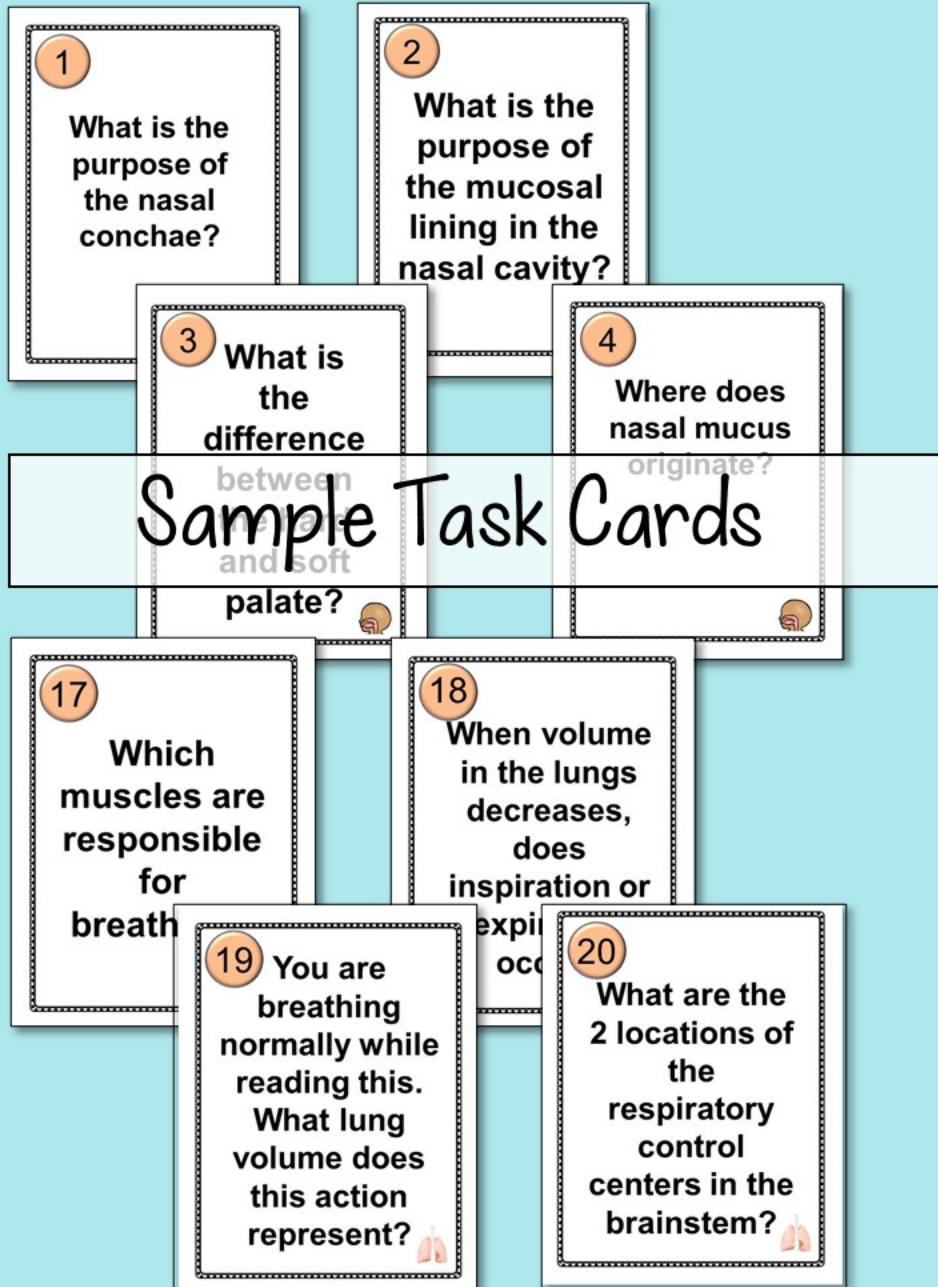
Respiratory System



Respiratory System



22 Editable Task Cards for Review



Using Editable Task Cards

How to set-up:

1. Print the cards on cardstock or paper.
2. Cut the pages so that each card is separate. If you'd like to use them in future years, it may be worth laminating them to protect them from student writing and other damage.
3. Place each task card at a seat around the room.
4. Students will rotate to each seat until all cards are finished. Answers are recorded on their "Task Card Answer Sheet" or notebook paper.

*TIP: It is important to set a timer. Usually 1-2 minutes is appropriate. Without a timer, students will get backed up while rotating and chaos will ensue. ☺

Teacher Tips

Modifications:

- These task cards are editable so you can change the text on any card.
- There are additional cards at the end of the document for adding questions. Be sure to add the correct number, as well!
- Each card has an icon in the bottom right corner.



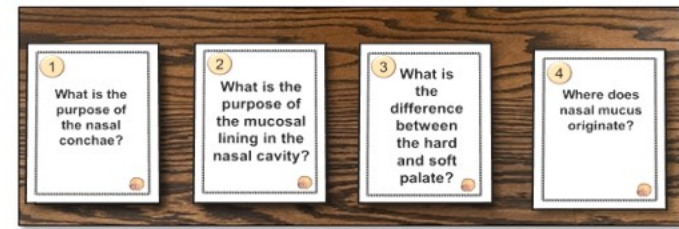
Questions about upper respiratory tract



Questions about lower respiratory tract

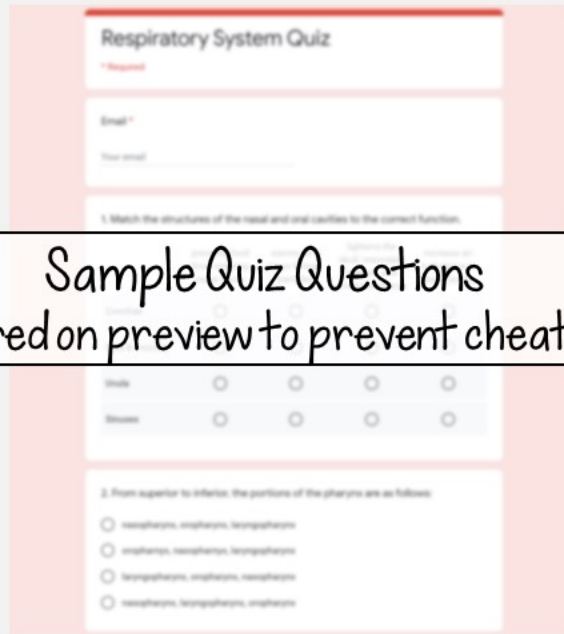
If you'd prefer to divide the unit, you can use the upper respiratory task cards only, then use the lower respiratory questions later.

- If moving around your room isn't possible, you can have students pass the cards in one direction.
- Other options:
 - Students can use notes or not depending on the level of memorization you expect prior to reviewing.
 - Students can work in pairs, which adds confidence.



Assessments

Editable Online Quiz through Google Forms

A screenshot of a Google Form titled "Respiratory System Quiz". The form includes a "Required" label, an "Email" field, and a question: "1. Match the structures of the nasal and oral cavities to the correct function." Below the question are two rows of radio button options. The second question is: "2. From superior to inferior, the portions of the pharynx are as follows:" followed by four radio button options: "nasopharynx, oropharynx, laryngopharynx", "oropharynx, nasopharynx, laryngopharynx", "laryngopharynx, oropharynx, nasopharynx", and "nasopharynx, laryngopharynx, oropharynx".

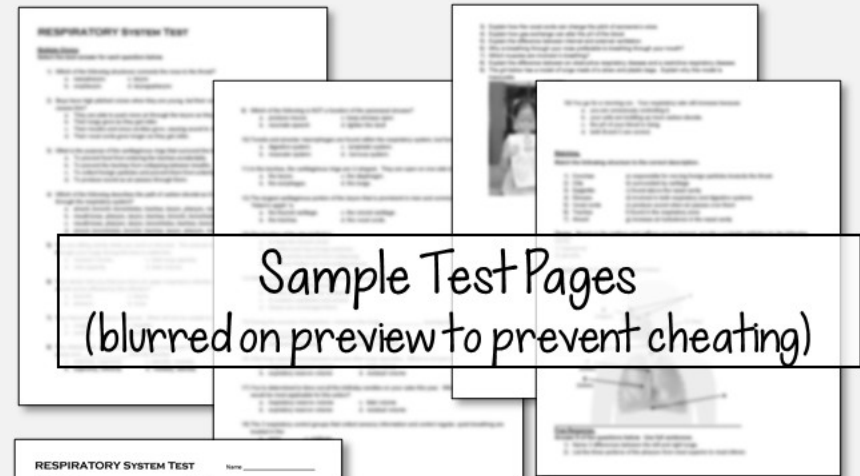
Sample Quiz Questions
(blurred on preview to prevent cheating)

- 12 multi-part questions
- Fully editable
- Answer key included for automatic grading

Editable Unit Test

- 19 multiple choice questions
- 7 matching questions
- 2 Greek/Latin term questions
- 1 labeled diagram
- 9 free response questions

Two Versions: Honors & Regular



Sample Test Pages
(blurred on preview to prevent cheating)

A sample student answer sheet for the "RESPIRATORY SYSTEM TEST". It includes sections for "Multiple Choice" (1-19), "Matching" (1-7), and "Terms" (1-2). There are also sections for "Labeling" (A-H) and "Free Response" (1-9). The sheet is designed for students to write their answers to the test questions.

Student answer
sheet & answer keys
included
(both fully editable)

I'd love to hear from you!

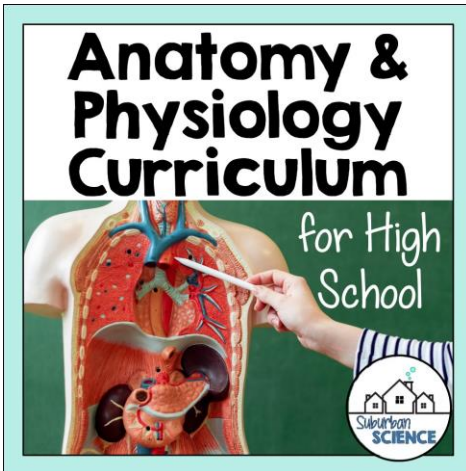
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Sincerely,
Anne from Suburban Science

