

# 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

- PowerPoints
  - Lymph Vessels PPT (17 slides)
  - Immune Response PPT (25 slides)
- Cornell Notes Pages
  - Fill-in-the-blank (6 pgs)
  - Editable versions of all Cornell notes
- Doodle Notes (6 pgs)
  - Guide to Using Doodle Notes
  - Doodle Note Keys & Examples

## 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

- Lymphatic System Board Game (4 pgs)
- Immune System Comic Strip (2 pgs)
- Diseases of the Lymphatic System Research Activity (1 pg)
- Answer keys or grading rubrics for all activities

## Extensions

- Digging Deeper: Inflammation (1 pg)\*
- Data Analysis: Antibodies (3 pgs)\*
- Immune System Overview Concept Map (1 pg)
- Answer Keys for all Extensions

\*Honors Options

## Review and Assessment

- Editable Task Card Review (24 cards) with answer sheet
- 2 diagrams of the lymphatic system- Overview (1 pg), Lymph Node Anatomy (1 pg)
- Lymph Vessels Quiz through Google Forms
- Immune Response Quiz through Google Forms
- Lymphatic System Test (paper)- both Honors and Regular versions with answer sheets and keys

# Unit Planning:

## NGSS and State Standards Document

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

Included Resources by Folder:

### What's Included?



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- PowerPoints
  - Lymph Vessels PPT (17 slides)
  - Immune Response PPT (25 slides)
- Cornell Notes Pages
  - Lymphatic System (2 pgs)
  - Immune Response (4 pgs)
- Doodle Notes Pages
  - Lymph Vessels & Nodules (3 pgs)
  - Immune Response (3 pgs)
  - Guide to Using Doodle Notes
  - Doodle Note Keys & Examples

#### Activities

- Lymphatic System Board Game (4 pgs)
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- [Lymph Vessels Quiz through Google Forms](#) (Make a copy of this file to your Drive. Do NOT assign to students using this link.)
- [Immune Response Quiz through Google Forms](#) (Make a copy of this file to your Drive. Do NOT assign to students using this link.)
- Lymphatic System Test (paper)- both Honors and Regular versions with answer sheets and keys

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#### Supplementary Resources

- [Watch real lymph move through a lymphatic vessel](#)
- Video: [Could Growing Vaccines in Plants Save Lives?](#)
- [Bozeman Science Video: Vaccines & Herd Immunity](#)
- [Case Study on Multiple Sclerosis](#) (an autoimmune disease)

#### Materials Needed

- General classroom use: computers, colored pencils, markers, and crayons, index cards for prefixes and suffixes
- Lymphatic System Board Game: Printed game board (included in multiple sizes), paper clips

Not included:

### Lymphatic System Unit Guide

#### Standards:

Topic:	State:	Standards:
Lymphatic System Diseases	OH	AP.1.3 Homeostatic imbalances are explored. These include, but are not limited to, autoimmune disorders, parasitic diseases, allergies, bacterial & viral infections, and ringworm.
	CO	None
	IN	None
	UT	Strand 10, Standard 6 Identify the following diseases and disorders associated with the lymphatic system: AIDS, measles, mumps, rubella, tetanus.
	FL	None

\*Note: NGSS is a registered trademark of the Next Generation Science Standards, and does not endorse any product, and does not endorse any product.

#### 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](mailto: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.

#### Topic: State: Standards:

Lymphatic Anatomy	OH	AP.1.3 The lymphatic system includes lymph, lymphatic vessels, lymph nodes and the immune system. The lymphatic system has multiple, interrelated functions. They include the removal of fluid from tissues, absorption of large fatty acids in small intestines and transport of white blood cells to the lymph nodes. The immune system consists of white blood cells that destroy foreign antigens. Tissue fluid that has entered into lymphatic capillaries becomes lymph. Multiple lymphatic capillaries form lymphatic vessels. As lymph circulates through the body, it passes through multiple lymph nodes. These lymph nodes contain lymphocytes which destroy foreign antigens.
	CO	-Describe the structures and functions of the lymphatic organs and explain how lymph moves through the body.
	IN	AP.11.1 Identify the primary structural components of the lymphatic system and their functions. Analyze the relationship with activities of bone marrow, thymus gland, and overall importance in maintaining homeostasis.
	UT	Strand 10, Standards 1-2 Identify the components of the lymphatic system: tonsils, spleen, thymus, lymph nodes, bone marrow, lymph vessels. -Describe how lymph is moved through the body.
	FL	SC.912.L.14.42 Describe the anatomy and the physiology of the lymph system.
Immune Response	OH	AP.1.3 Processes of the lymphatic system include defense through nonspecific and specific resistance. Examples of nonspecific resistance include mechanical barriers such as the skin, enzymes, species resistance and mucous membranes. In specific resistance, antibodies are produced that defend the body against foreign antigens. Memory cells are produced following an infection that allow for possible immunity against a specific antigen upon re-exposure. A comparison of primary versus secondary immune responses can be explored.
	CO	-Compare and contrast antibodies and antigens. -Identify the roles of T-cells and B-cells in the immune response. -Distinguish between active and passive immunity and natural & artificial immunity.
	IN	AP.11.2 Investigate the difference between innate and acquired immunity. Examine how cellular and non-cellular components work collectively to defend the body against foreign pathogens and how they contribute to maintaining homeostasis.
	UT	Strand 10, Standards 3-6 -Contrast antigens and antibodies. -Describe the general roles of T-cells and B-cells in the immune response. -Distinguish between active and passive immunity and natural & artificial acquisition of immunity.
	FL	SC.912.L.14.52 Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.

## Unit Overview Page

plus

## Supplementary Resource Ideas and Materials Lists

# Editable Pacing Guides

	Day	Intro	Instruct	Assess	Homework
Immune Response	7	Review prefix/suffix flashcards	<b>Comic Strip Activity</b>	<ul style="list-style-type: none"> <li>Informal check of understanding and progress during activity</li> </ul>	
	8	Review prefix/suffix flashcards	<ul style="list-style-type: none"> <li>Finish Comic Strip Activity</li> <li><b>Lymphatic System Diagram</b></li> <li><b>Lymph Node Diagram</b></li> </ul>	<ul style="list-style-type: none"> <li>Informal questioning</li> <li>Informal check of diagram accuracy</li> <li>Collect Comic Strip Activity and grade according to rubric provided</li> </ul>	<u>All:</u> Study for Immune System Quiz
Diseases of Lymphatic System	9	Review for quiz	<ul style="list-style-type: none"> <li>Immune System Online Quiz (need computers)</li> <li><b>Diseases Research Page</b> (need computers)</li> </ul>	<ul style="list-style-type: none"> <li>Summative quiz grade</li> <li>Informal check of Diseases Research Page</li> </ul>	
Review	10	Review notes for test	<b>Task Card Review</b>	<ul style="list-style-type: none"> <li>Observe student progress during task cards</li> <li>Informal questioning, if necessary</li> <li>Assess based on</li> </ul>	<u>All:</u> Study for test
Assess	11	Review notes for test	<b>Unit Test</b>	<ul style="list-style-type: none"> <li>Summative</li> </ul>	



Coincide with State Standards document in Unit Planning Folder

\***Bold items** must be photocopied.



This icon is found on

Using this Pacing Guide as is? You can print all the student pages

"Student Pages" folder.

The daily topic coincide with the previous standards document.

Lesson planning is now quick and easy!

## Lymphatic System Unit Pacing Guide

	Day	Intro	Instruct	Assess	Homework
Lymphatic Anatomy	1	Students add to prefix/suffix flashcards: <ul style="list-style-type: none"> <li>lymph-, inter-</li> </ul>	<ul style="list-style-type: none"> <li>Lymph Vessels PPT- Section 1 &amp; Section 2</li> <li><b>Cornell Notes</b> (Lymph &amp; Lymph Organs/Nodes)</li> </ul>	<ul style="list-style-type: none"> <li>Cornell Notes summaries</li> <li>Informal discussion and questions</li> </ul>	
	2	Prefix/suffix flashcards: <ul style="list-style-type: none"> <li>inflam-, cyte-/cyto-</li> </ul>	<ul style="list-style-type: none"> <li><b>Lymph Vessels Board Game</b> Materials: Fluid Factory board game page (in 11x17 or 8.5x11), student question pages, game pieces (coins, etc.), paper clips, pencils</li> </ul>	<ul style="list-style-type: none"> <li>Informal questioning during game</li> <li>Check "checkpoint" questions on student pages after finishing</li> </ul>	<ul style="list-style-type: none"> <li>Study for Lymph Vessels Quiz</li> </ul>
	3	Prefix/suffix flashcards: <ul style="list-style-type: none"> <li>immun-, phago-, path-, pyro-</li> </ul>	<ul style="list-style-type: none"> <li>Online Lymph Vessels Quiz (need computers)</li> <li>Immune Response PPT- Section 1</li> <li><b>Cornell Notes</b> (Innate Immunity)</li> </ul>	<ul style="list-style-type: none"> <li>Summative quiz grade</li> <li>Cornell Notes summaries</li> <li>Informal discussion and questions</li> </ul>	<u>Honors:</u> <ul style="list-style-type: none"> <li><b>Digging Deeper: Inflammation</b></li> </ul>
Immune Response	4	<ul style="list-style-type: none"> <li>Discuss homework &amp; review quiz answers</li> <li>Prefix/suffix flashcards: -edema, -itis, macro-</li> </ul>	<ul style="list-style-type: none"> <li>Immune Response PPT- Section 2 &amp; Section 3</li> <li><b>Cornell Notes</b> (Acquired/Specific Immunity &amp; Humoral Immunity)</li> </ul>	<ul style="list-style-type: none"> <li>Cornell Notes summaries</li> <li>Informal discussion and questions</li> </ul>	<u>Honors:</u> <ul style="list-style-type: none"> <li><b>Data Analysis: Antibodies</b></li> </ul>
	5	<ul style="list-style-type: none"> <li>Discuss homework answers</li> <li>Prefix/suffix flashcards: auto-, -lysis</li> </ul>	<ul style="list-style-type: none"> <li>Immune Response PPT- Section 4</li> <li><b>Cornell Notes</b> (Cell-mediated Immunity)</li> <li><b>Immune Response Overview</b></li> </ul>	<ul style="list-style-type: none"> <li>Cornell Notes summaries</li> <li>Informal discussion and questions</li> <li>Informal check of Immune Response Overview</li> </ul>	



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.



# 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.

standards and student interests, you may want to adjust the Disease Research Page.

h to write a story with only words for the Comic Strip Activity, ic strip. The grading rubric will need to be adjusted if you

### 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 **diagram quizzes**, 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.
  - Add a microscopy lab in which students examine spleen or lymph node tissues.
- 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 activities and answer questions as they complete worksheets in class, these students **may need to have each game checkpoint answer discussed** and checked the following day rather than grading the activity for accuracy.
  - Editable Cornell notes** (found in the Unit Planning 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.
  - Diagram Quizzes:** 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.

### 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™
- Students can print the Lymphatic System Board Game and play it at home with a family member.
- Digital drag-and-drop diagrams can be provided for students to self-check and turn it electronically. I have these [available for every body system](#). Digital diagram quizzes are included, as well.
- Pacing

All found on the following page.


### 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

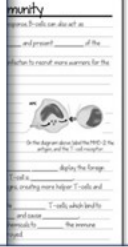
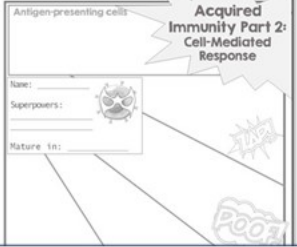
Assignment	Type of work	Skills addressed
Digging Deeper: Inflammation	Reading assignment	Critical thinking
Data Analysis: Antibodies	Reading assignment & Math extension	Critical thinking Interpretation of graphs

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 to medical 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 to body system to another.

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

### Notes OR Doodle Notes

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

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

**Innate (Non-specific) Immunity**

What are the 2 layers of the immune response?

How do innate defenses prevent infection?

The immune system is a set of specialized cells that work with the lymphatic system to fight off foreign substances (known as pathogens) that enter the body.

1. Innate (Non-specific) defenses
2. Acquired (Adaptive) defenses

Innate resistance starts with barriers.




1. External barriers prevent pathogens from entering body.
  - a. Skin: Keratinized cells create a physical barrier; Oil & sweat inhibit bacterial growth.
  - b. Mucous membranes: Mucus physically traps pathogens & cilia sweep them towards the mouth for removal.  
- Secretions: gastric juice, saliva, tears contain enzymes.
2. Internal barriers activated once pathogen passes into body tissues.
  - a. Phagocytes: "eat" foreign invaders.
    - Neutrophils: Kill bacteria from die (pus)
    - Macrophages: cytoplasmic extensions for ingesting
  - b. Natural Killer Cells: Lyse (explode) infected or abnormal body cells based on lack of "self" receptors
  - c. Inflammation:
    - Basophils & mast cells cause vasodilation
    - swelling (edema) allows macrophages to arrive quickly
    - Pyrogenic chemicals cause fever to speed up repair
  - d. Antimicrobial proteins:
    - Complement proteins: work with other defenses by lysing bacteria or marking pathogens for easier phagocytosis (called opsonization)
    - Interferons: warning signals secreted by virally-infected cells

What are cytokines? Chemical signals used to help cells communicate during an immune response.

**Summary** Innate immune defenses are not specialized to detect particular pathogens. The skin & mucous membranes provide an external barrier while immune cells activated by inflammation & antimicrobial proteins fight pathogens once they pass into body tissues.

How do innate defenses prevent infection?

Innate resistance starts with barriers.

1. External barriers: prevent pathogens from entering body
  - a. Skin: Keratinized cells create a physical barrier; oil and sweat inhibit bacterial growth
  - b. Mucous membranes:
2. Internal barriers: activated once pathogen passes into body tissues.
  - a. Phagocytes:
    -  Neutrophil
    -  Macrophage
  - b. Natural Killer Cells: 
  - c. Inflammation:

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



# Greek and Latin Roots for Medical Terminology Practice

## Guide to using this course

### Anatomical Prefixes/Roots/Suffixes:

	Term	Definition
Lymphatic System	auto-	self
	cyte-/cyto-	cell
	-edema	swelling
	inter-	between
	immun-	protection
	inflam-	set on fire
	-itis	inflammation of
	lymph-	clear water
	-lysis	destruction
	macro-	big
	path-	disease
	phago-	eat
	pyro-	fire

## 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.

-lysis

## 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.

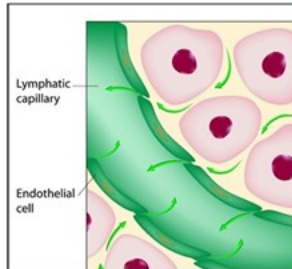
A great way to encourage scientific literacy and prepare students for higher level science courses.

# 2 Highly Visual PowerPoint Presentations

42 editable, fully-animated slides

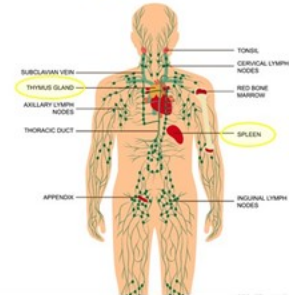
## How do lymph capillaries collect lymph?

- Unlike blood vessels that are all connected, lymph vessels have “dead ends” called **lymph capillaries**.
- Lymph capillaries are lined with overlapping **epithelial cells** that allow fluid to enter.
- These capillaries open into large **lymph vessels**.
- Valves within the vessels prevent the backwards flow of fluid.



## What other structures are part of the lymphatic system?

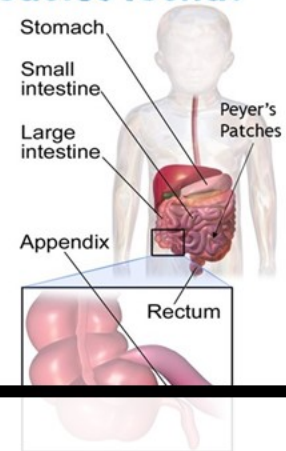
- Lymph nodes are one of many lymphoid **organs**.
- Other lymphoid organs (spleen & thymus) also protect the body from **infection**, but do not **filter lymph**.
- **Lymph nodules** are loosely associated tissues and are



## Where are lymph nodules found?

### Patches & Appendix

lymphocytes near intestine that filter out food and beneficial bacteria from intestines from infection in the rest



# Sample Slides

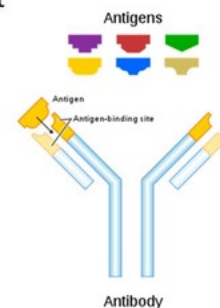
## How do innate defenses prevent infection?

- Innate resistance starts with barriers.
- 1. **External barriers:** prevent pathogen entering body
  - a. **Skin:**
    - Keratinized cells create a physical barrier
    - Skin produces oil and sweat which inhibit bacteria



## What is an antigen?

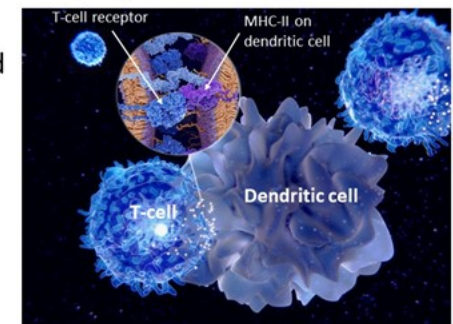
- If the non-specific defenses don't stop the infection, the body will create an immune response **specific** to that **pathogen**.
- Substances that trigger this response are called **antigens**.
- The cells responsible for this specific response are called **lymphocytes**. Lymphocytes produce **antibodies** that match certain **antigens**.



## What are antigen-presenting cells?

The antigen fragment is presented on a **receptor** known as an **MHC-II** (major histocompatibility complex-2).

cells will bind this **MHC-II** and mount a **stronger** response against the antigen.





# Two note-taking styles are included:

## Cornell Notes

### Humoral Immunity

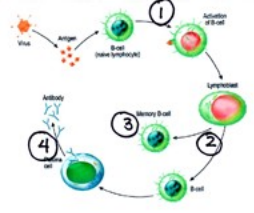
What is involved in the humoral response?

How is humoral immunity acquired?

Summary: Humoral immunity involves the activation of B-cells. Once activated by a foreign antigen, B-cells produce both cloned plasma B-cells and memory B-cells for future infections. Immunity can be earned through active immunity or borrowed from another through passive immunity.

1. B-lymphocytes (B-cells) recognize a foreign antigen.
2. B cells rapidly divide, creating cloned plasma B cells and memory B cells.
3. Memory B cells are long-lived and produce a swift and strong response if the same antigen is encountered in the future ("secondary response").
4. The antibodies produced by the plasma B cells can:
  - Neutralize the antigen by physically surrounding it
  - Immobilize the antigen by agglutination (clumping)
  - Activate macrophages to destroy antigen

Mark the steps above (1-4) on the portion of the image that illustrates that step.



Immunity can be EARNED or BORROWED.

- Active immunity is earned because it is developed by the creation of our own antibodies.
- Passive immunity is when we borrow the immunity that another individual has already created.

Describe a situation that would provide each of the 4 types of immunity listed below

	Active	Passive
Natural	Contraction of the flu virus	Antibodies are passed from mom to baby through breastmilk or placenta.
Artificial	Administration of the flu vaccine	Receiving blood serum from an individual with covid antibodies

## Doodle Notes

### Acquired Immunity Part I: Humoral Response

**B-lymphocytes (B-cells)** recognize a foreign antigen

B-cells rapidly divide creating cloned plasma cells that secrete antibodies at a rate of 2,000 per second!

Memory B-cells are long-lived and defend immediately if same antigen is encountered in the future

Antibodies produced by plasma B-cells can:

- neutralize the antigen by surrounding it
- immobilize the antigen by agglutination (clumping)
- activate macrophages to destroy antigen

Name: Bcell

Superpowers: Ability to recognize invading antigens & clone itself

Mature in: Bone marrow

**How can humoral immunity be acquired?**

- Natural active immunity ⇒ when we contract an infection
- Artificial active immunity ⇒ when we are given a vaccine
- Natural passive immunity ⇒ antibodies passed from mother to child (breastmilk or placenta)
- Artificial passive immunity ⇒ when we are injected with blood serum from an individual that has already been infected.

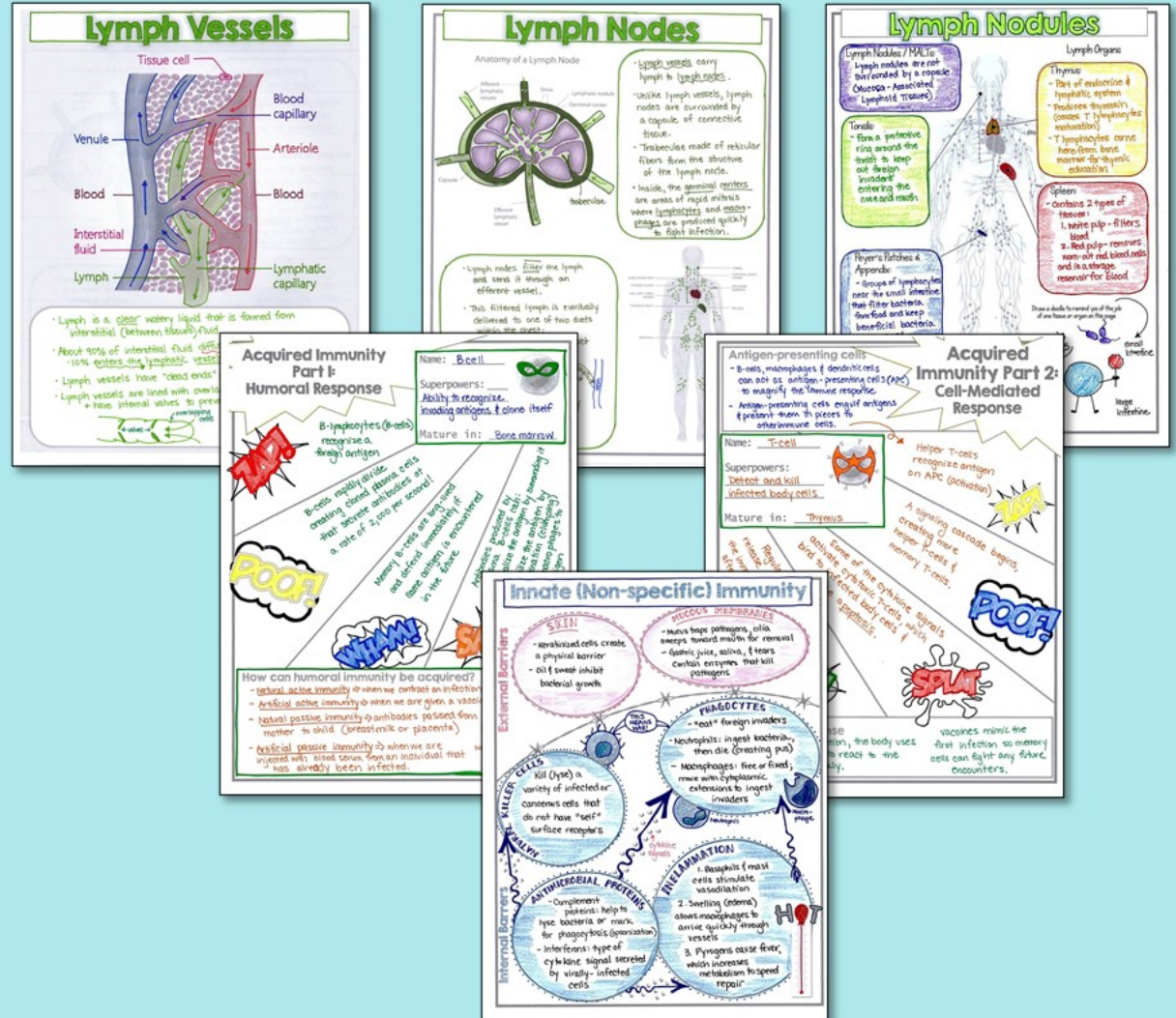
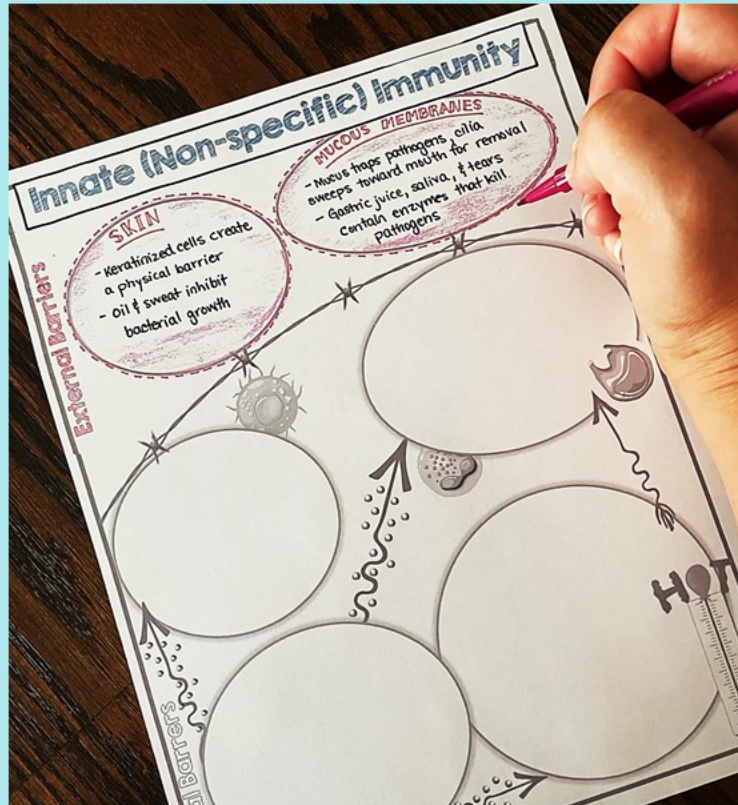
Acquired Immunity

- Active (earned)
  - Natural
  - Artificial
- Passive (borrowed)
  - Natural
  - Artif.

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



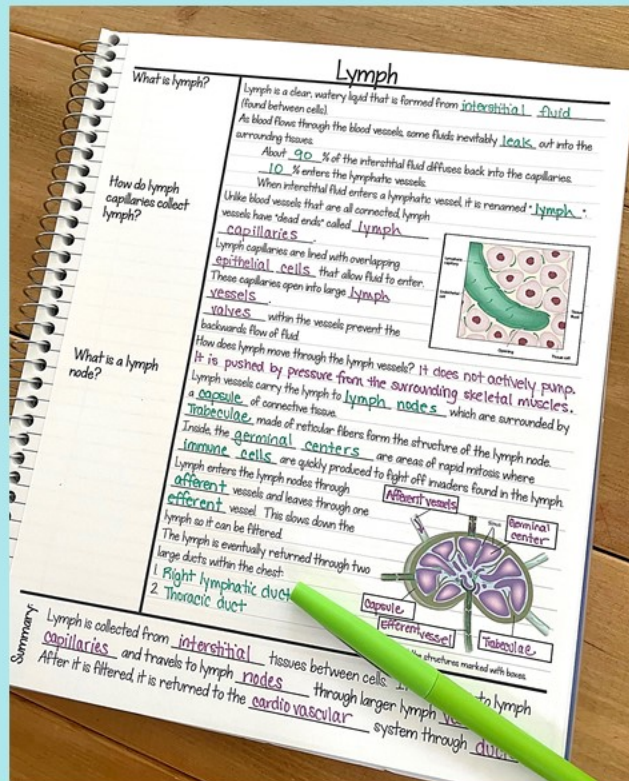
# 6 pages of Doodle Notes



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



# 6 pages of Cornell Notes



Big  
concept  
questions

Content  
summary for  
each page

## Lymph

<b>What is lymph?</b>	<p>Lymph is a clear, watery liquid that is formed from <u>interstitial fluid</u> (found between cells).</p> <p>As blood flows through the blood vessels, some fluids inevitably <u>leak</u> out into the surrounding tissues.</p> <p>About <u>90</u> % of the interstitial fluid diffuses back into the capillaries.</p> <p><u>10</u> % enters the lymphatic vessels.</p> <p>When interstitial fluid enters a lymphatic vessel, it is renamed <u>lymph</u>.</p> <p>Unlike blood vessels that are all connected, lymph vessels have "dead ends" called <u>lymph capillaries</u>.</p> <p>Lymph capillaries are lined with overlapping <u>epithelial cells</u> that allow fluid to enter. These capillaries open into large <u>lymph vessels</u>.</p> <p><u>valves</u> within the vessels prevent the backwards flow of fluid.</p> <p>How does lymph move through the lymph vessels? It does not actively pump. It is pushed by pressure from the surrounding skeletal muscles.</p> <p>Lymph vessels carry the lymph to <u>lymph nodes</u>, which are surrounded by a <u>capsule</u> of connective tissue.</p> <p>Inside, the <u>trabeculae</u>, made of reticular fibers form the structure of the lymph node.</p> <p>Inside, the <u>germinal centers</u> are areas of rapid mitosis where <u>immune cells</u> are quickly produced to fight off invaders found in the lymph.</p> <p>Lymph enters the lymph nodes through <u>afferent</u> vessels and leaves through one <u>efferent</u> vessel. This slows down the lymph so it can be filtered.</p> <p>The lymph is eventually returned through two large ducts within the chest:</p> <ol style="list-style-type: none"><li>1. <u>Right lymphatic duct</u></li><li>2. <u>Thoracic duct</u></li></ol>
<b>How do lymph capillaries collect lymph?</b>	<p>Diagram illustrating the structure of a lymphatic vessel. The vessel is shown with a green lumen and a single layer of overlapping epithelial cells. The vessel is surrounded by interstitial fluid. The diagram is labeled with 'Capillary wall', 'Epithelial cell', and 'Lumen'.</p>
<b>What is a lymph node?</b>	<p>Diagram illustrating the structure of a lymph node. The node is shown with a green capsule and a central medulla. The capsule is labeled with 'Capsule', 'Afferent vessel', 'Efferent vessel', and 'Trabeculae'. The central medulla is labeled with 'Germinal center'.</p>
<b>What is a lymph node?</b>	<p>Diagram illustrating the structure of a lymph node. The node is shown with a green capsule and a central medulla. The capsule is labeled with 'Capsule', 'Afferent vessel', 'Efferent vessel', and 'Trabeculae'. The central medulla is labeled with 'Germinal center'.</p>
<b>Summary</b>	<p>Lymph is collected from <u>interstitial</u> tissues between cells. It squeezes into lymph <u>capillaries</u> and travels to lymph <u>nodes</u> through larger lymph <u>vessels</u>.</p> <p>After it is filtered, it is returned to the <u>cardiovascular</u> system through <u>ducts</u>.</p>

Each page is **editable**.

Add and delete text, questions, and summaries to meet the needs of your students.

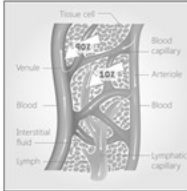


# Includes 3 Activities

- Lymph Vessels Board Game
- Immune System Comic Strip
- Diseases Research

## Fluid Factory Game: Student Info

The lymphatic system is a network of vessels that work closely with the circulatory system. It has a few functions in the body including fat absorption, fluid balance and immunological defense against pathogens. This game focuses mainly on the responsibility of the lymphatic system to maintain, clean, and circulate fluids within the body.

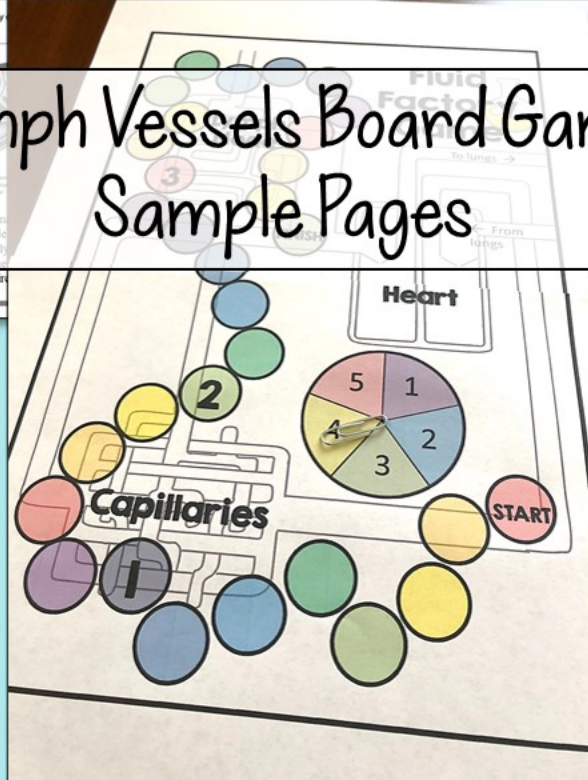


As blood flows through the blood vessels, some fluids inevitably leak out into the surrounding tissues. This clear fluid is called **interstitial** (between cells) **fluid**. About 90% of this interstitial fluid diffuses back into the capillaries of the blood vessels. Ten percent, however, enters the **lymph capillaries** and is then known as **lymph**. The lymph capillaries are intertwined with the blood vessel capillaries, which allows the fluid to easily flow into them through tiny overlapping cells.

The lymph capillaries open into larger **lymph vessels**. Valves within these vessels prevent the lymph from flowing backwards. Skeletal muscle pressure around the lymph vessels also helps to move the fluid in the correct direction.

Anatomy

## Lymph Vessels Board Game Sample Pages



## Diseases of the Lymphatic System

Research the following diseases of the lymphatic system. Explain how the body is affected and why. List available treatments, if any.

Lymphedema

Anaphylactic Shock

## Diseases Research Sample Page

Immunodeficiencies  
(SCID & AIDS)

Autoimmune Diseases

## Comic Strip Examples



## Immune System Comic Strip

### Assignment:

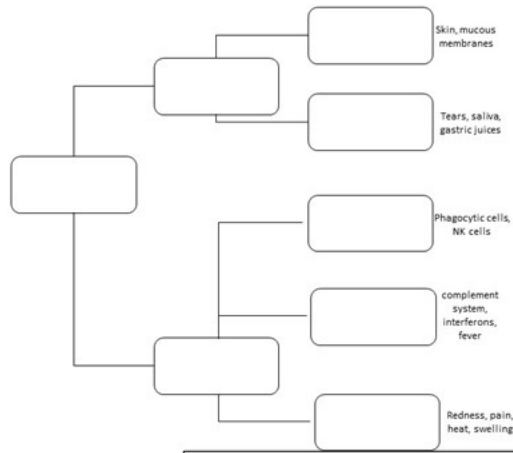
Create a story in comic strip form to demonstrate how one of the specialized immune cells responds when a foreign substance enters the body. You may describe a B cell, Helper T Cell, memory cell (either B or T), Macrophage, Natural Killer Cell, or Cytotoxic T cell.

## Comic Strip Sample Pages

Category	Points Possible	Points Earned
Content	10	
Scenes	10	
Dialogue & Vocabulary	10	
Creativity	5	

# Extension Pages

## Immune Response Overview



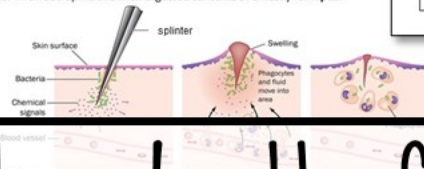
Fill in the boxes about the **mediated response**, **defense**, **third line of defense**, **acquired**

## Digging Deeper: Inflammation

You are likely familiar with the symptoms of an inflammatory response. This occurs when you are injured, for example when you get a splinter.

In the first step of the inflammatory response, the injured cells release chemicals such as **kinins**, which cause blood vessels to dilate and become more permeable. The vasodilation and heat, which are classic signs of inflammation. Heat increases the metabolic rate of the injured cells and the additional permeability of the blood vessels allows fluid to leak out of the vessels, causing **edema** (swelling). Swelling of an injured area encourages you to be gentle with the area to temporarily reduce movement of an injured joint, which leads to faster healing. The heat also stimulates the nerve endings nearby to send a pain impulse.

Additionally, the signals released from the injured cells initiate a set of chemical events that lead to the site of injury. Neutrophils enter the blood from the bone marrow to the injured cells by **chemotaxis**. Marker proteins called **selectins** line the injured blood vessel, and the neutrophils slowly roll along the blood vessel wall when they reach the selectins, they stop (**margination**), then squeeze through the leaky capillary walls (**diapedesis**). These neutrophils then ingest any bacteria or foreign substances that have entered through the blood vessel. The neutrophils and their digested contents eventually form pus.



### Discussion Questions:

- On the diagram above, mark the locations of these events. Use the letters provided.  
A-diapedesis  
B-edema  
C-release of chemical signals
- The cardinal signs of inflammation are redness, heat, pain, and swelling. Explain how it relates to the healing process.

Redness	Histamines & kinins cause blood vessel dilation	Dilated blood vessels allow leukocytes to arrive quickly
Heat		
Pain		
Swelling		

## Data Analysis: Antibodies

Antibodies, or **immunoglobulins** (Igs) are soluble glycoproteins secreted by plasma B-cells. They are found in blood serum, tissue fluids, and mucosal surfaces. Antibodies bind with a specific antigen so there is a huge variety of them, but every antibody has a similar structure.

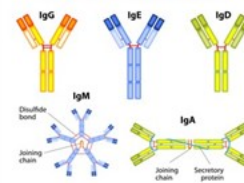
All antibodies consist of four polypeptide chains—two **light chains** and two **heavy chains**. Heavy and light are words used to describe the length of the chains since the heavy chains are about twice as long as the light chains. The chains are arranged symmetrically into a Y-shape, with each side consisting of one heavy chain and one light chain. The two heavy chains are connected by a **disulfide bond**.

In addition to these two types of chains, antibodies are made of two regions—**constant regions** and **variable regions**. The variable regions are found on the ends of the “Y” and form the particular antigen-binding sites that are necessary for recognizing specific antigens. The constant regions form the stem of the “Y” and are common to every antibody within a class. They determine the function of the antibody and what cells it can bind with.

There are 5 classes of immunoglobulins: IgM, IgA, IgD, IgG, IgE. You can remember them using the acronym **MADGE**. IgG, IgE and IgD exist as single, Y-shaped **monomers** while IgA can be a monomer or **dimer** and IgM is a **pentamer**.

Each class of immunoglobulin has a distinct function and location:

### ANTIBODY CLASSIFICATION



Ig	Location	Function
IgM	Surface of B-cells and circulating in blood plasma	Activates complement proteins
IgA	In saliva, sweat, intestinal juice & breastmilk	Prevents pathogens from attaching to epithelial tissues
IgD	Surface of B-cells	Acts as B-cell antigen receptor/activator
IgG	Circulating in blood & tissue	
IgE	Skin, mucous membranes	

Antibodies are unable to destroy antigens themselves, but cells can attack them. Antibodies work in four basic ways. **PLAIN** of attack.

**P- Precipitation:** Antibodies bind soluble antigens together.

**L- Lysis:** By activating the complement system, pores are formed in the cell membrane.

**A- Agglutination:** Using both antigen-binding sites at once, antibodies clump molecules that are easily engulfed by phagocytes.

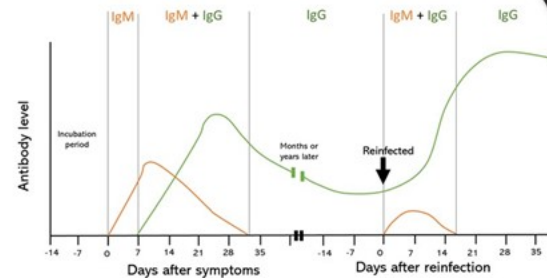
**N- Neutralization:** By blocking the active sites on toxic chemicals, antibodies prevent them from acting on target cells, thereby effectively neutralizing them until they are destroyed.

Although antibodies are quite effective at eliminating foreign pathogens, they can also cause problems. For example, antibodies can sometimes attack the body's own cells, leading to autoimmune diseases.



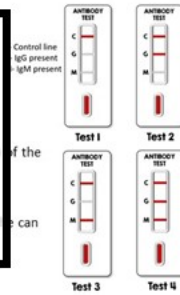
## Data Analysis: Antibodies

As you've learned, each antibody has a different function. Because of this, they are not all secreted at the same time in the body. The graph below shows the presence of the antibodies IgM and IgG during and after a viral infection. Use the graph to help you answer the questions that follow.



### Discussion Questions:

- Why is the total antibody level higher after the second infection?
- The four test strips to the right are antibody tests done on 4 different individuals. Write the test number on the section(s) of the infection graph with which it coincides. Note: One test may coincide with more than one section of the graph.
- The individual that gave the sample for test 2 is wondering if the test is safe to work without infecting others. What is your recommendation?
- You conduct a viral antibody test for an individual and no lines are visible. What can you infer from this?



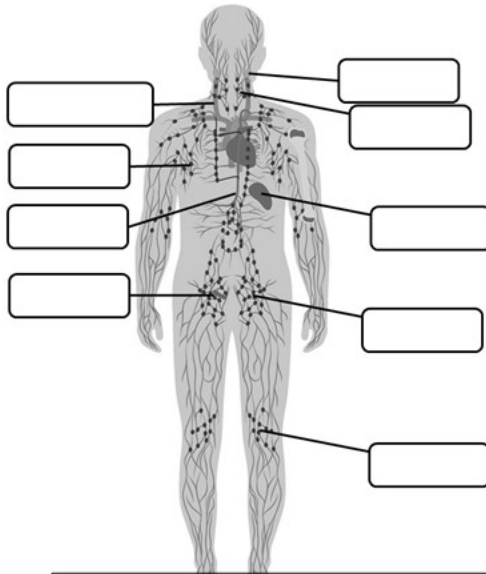
Skills check!  
Interpretation of graphs  
(great for standardized test prep)

Greater depth of knowledge, scientific literacy, & critical thinking



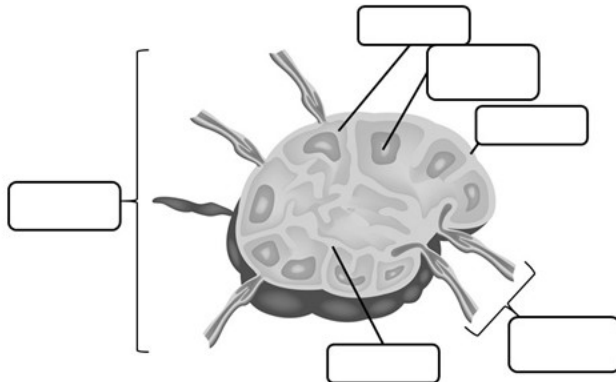
# Anatomical Diagrams

**Lymphatic System**



Word bank:  
popliteal  
subclavian

**Anatomy of a Lymph Node**

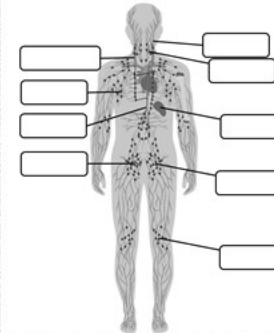


Word bank: afferent vessels, trabeculae, sinus, capsule, germinal center, efferent vessels

**Each diagram comes in 4 versions:**

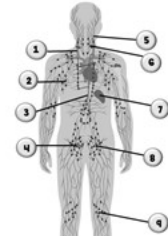
1. Fill-in the blank
2. Numbered quiz
3. Labeled black & white
4. Labeled color

**Lymphatic System**



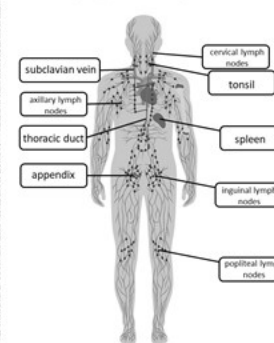
Word bank: tonsil, cervical lymph nodes, spleen, inguinal lymph nodes, popliteal lymph nodes, appendix, thoracic duct, axillary lymph nodes, subclavian vein

**Lymphatic System**

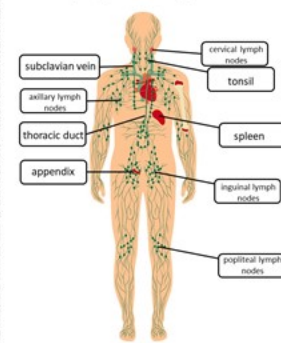


1. \_\_\_\_\_  
2. \_\_\_\_\_  
3. \_\_\_\_\_  
4. \_\_\_\_\_  
5. \_\_\_\_\_  
6. \_\_\_\_\_  
7. \_\_\_\_\_  
8. \_\_\_\_\_  
9. \_\_\_\_\_  
10. \_\_\_\_\_

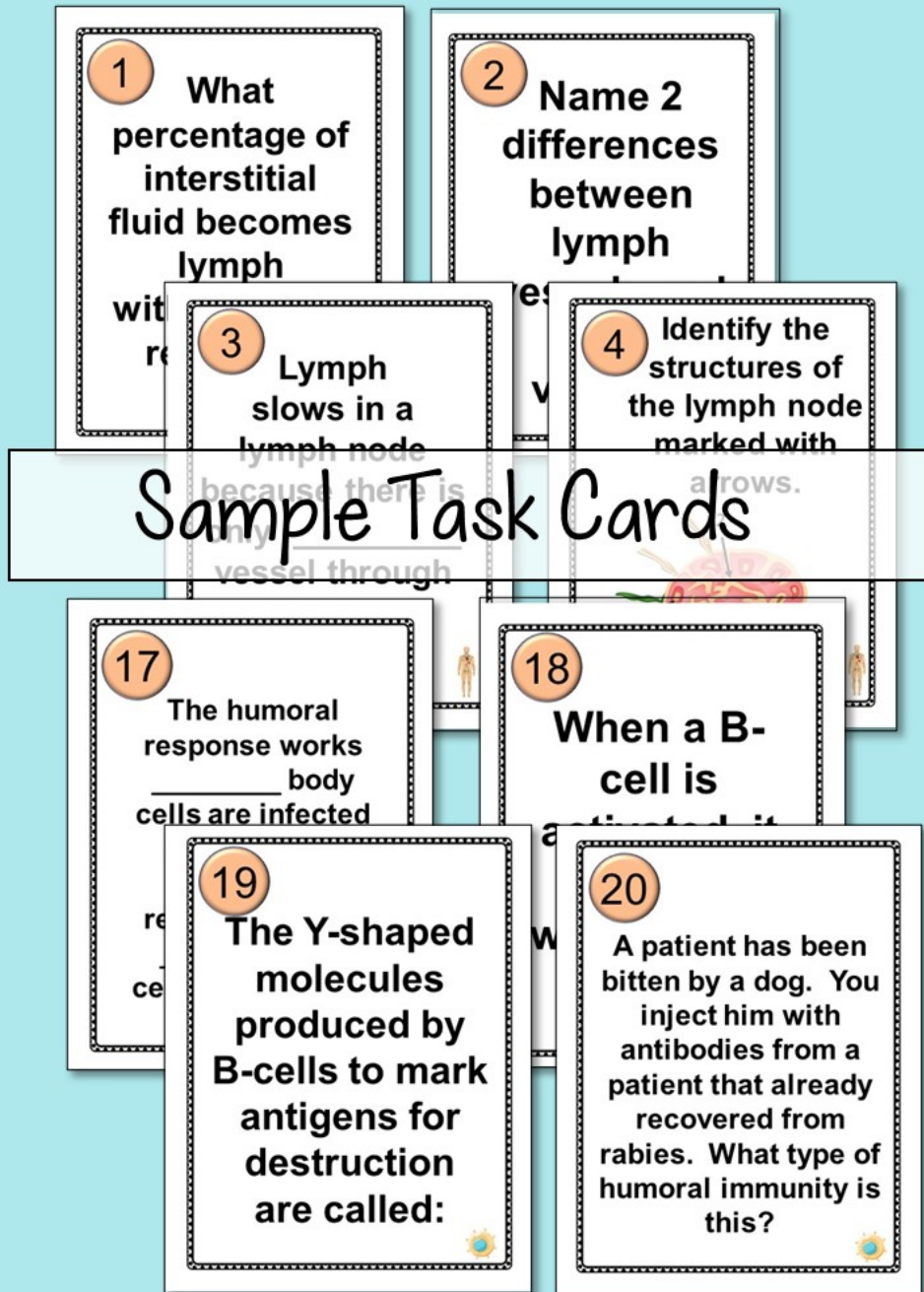
**Lymphatic System**



**Lymphatic System**



# 24 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.



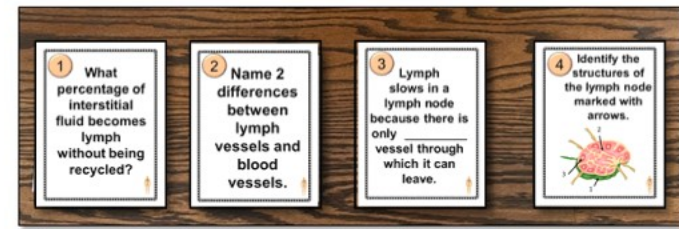
Questions about the lymph vessels & tissues



Questions about the immune response

If you'd prefer to divide the unit, you can use the lymph vessel task cards only, then use the immune response questions later.

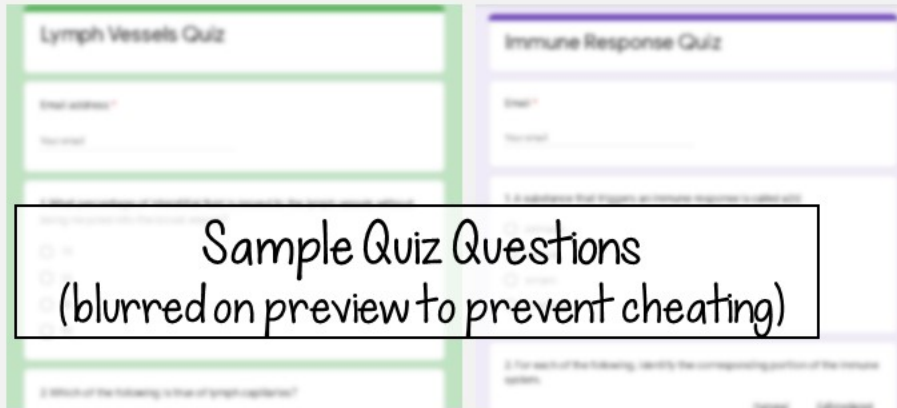
- If moving around your room isn't possible, you can have students pass the cards in one direction.
- Other options:
  - Students can use notes or not depending on the level of memorization you expect prior to reviewing.
  - Students can work in pairs, which adds confidence.





# Assessments

## Editable Online Quiz through Google Forms

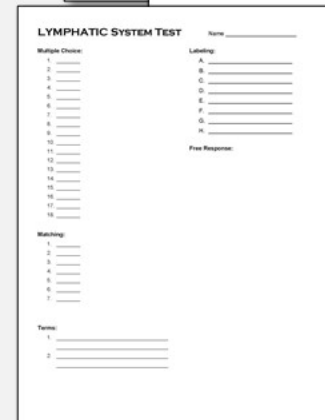
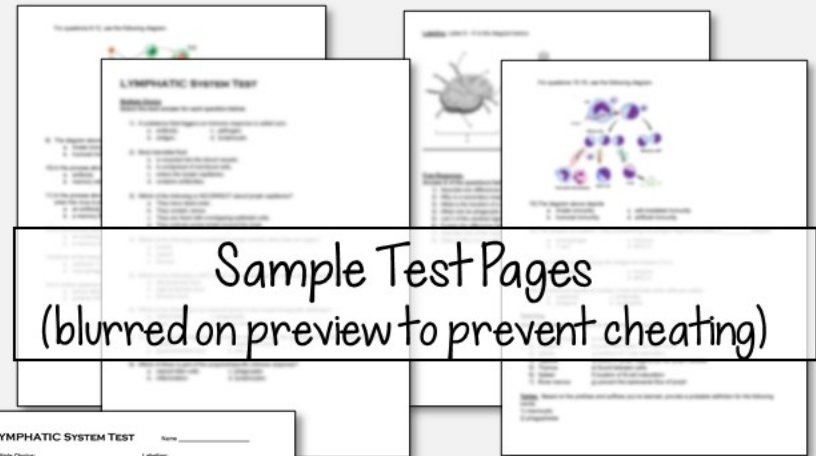


- 17 multi-part questions
- Fully editable
- Answer key included for automatic grading

## Editable Unit Test

- 18 multiple choice questions
- 7 matching questions
- 2 Greek/Latin term questions
- 2 labeled diagram
- 8 free response questions

Two Versions: Honors & Regular



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

# I'd love to hear from you!

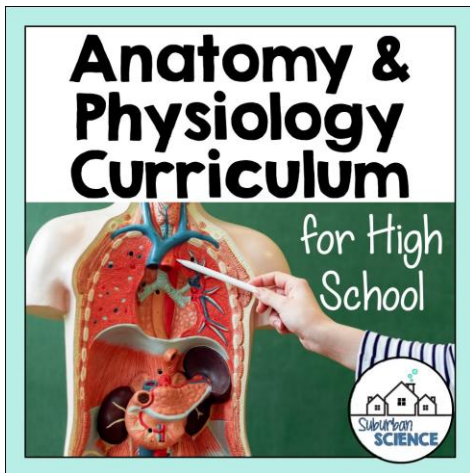
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Sincerely,  
Anne from Suburban Science

