



Name:

Date:

The Research Side of Vaccine Development: Tissue Imaging

Directions:

While listening to Ms. Christian's lesson, please listen very carefully and fill in the blanks.

Let's learn more about the _____ side of vaccine development! Today, we will discuss one of many ways to understand three things:

1. How _____ and other pathogens behave
2. How our body responds to these pathogens
3. A way to develop treatments and vaccines to keep us and our loved ones safe and healthy.

All of these things can be accomplished by using a special research approach called _____ imaging!

First, we must review the building blocks of life! A _____ is the most basic unit of life. Cells are so tiny that they cannot be seen with the naked eye; however, cells are so mighty that they make up all living organisms, including humans! The human body is made up of _____ trillion cells! Cells contain our DNA, create proteins and carry out the processes that give us the

energy we need to survive among other very important jobs. Despite cells being so tiny, we have developed technology to be able to see them! We must use _____ to see cells.

Now that we understand that cells are the basic unit of life, let's build! Multiple cells organize themselves based on the job they perform, forming structures called _____. These tissues perform unique functions because they are made of special cells. There are four basic types of tissues: epithelial tissue, connective tissue, nervous tissue and _____ tissue. Each tissue type has its own jobs:

1. Epithelial tissue is made of epithelial cells. Epithelial tissue is what protects us by covering our body and our organs. Our _____ contains epithelial tissue!
2. Connective tissue is made of many different kinds of cells including fibroblasts that produce the protein collagen. Together, these cells serve the function of supporting the other types of tissues and helping them carry out their functions.
3. Nervous tissue is made of nerve cells. These nerves carry messages to other tissues, allowing us to think, eat, drink, sleep, feel, and ultimately be alive.
4. Muscle tissue is made of three types of muscle cells: skeletal, cardiac and smooth. Muscle tissue serves the function of contracting to allow our bodies to _____ or to pump blood through the body!

Tissues then organize themselves into _____ like our skin, heart, lungs, brain and others. These organs organize themselves into organ systems like our digestive system, nervous system and respiratory system. And finally these organ systems create organisms like _____ beings and animals!

When we get sick it is because one or more of these tissues or organs has been invaded by a pathogen. Pathogens are bacteria, viruses, or other tiny organisms that can cause _____.

We just learned from Dr. Corbett about how we defend against viruses using vaccines that motivate natural protective mechanisms - more about the details in a minute but first let's talk more about one of many research methods used to gain the knowledge we need to make a good _____. We need to study how the pathogens grow and damage our tissues and because they are so small, we need to use powerful magnifiers - microscopes - to do this. We also need to understand how the _____ of our tissues interact with these organisms and how our IMMUNE defenses respond so we can figure out how to get such protective responses without our actually being infected or sick. This is what happens during the research method of tissue imaging: we take _____ and slice them very thinly. Then, we treat the tissue slices with stains to make the cells visible and look at these stained tissues under the microscope. Finally, we are able to see if our cells are in a healthy state or in a sick state infected with pathogens. Once we see our cells in either their healthy state or fighting off pathogens, we take _____ of what we see.

Developing images of the tissues allows us a sneak peek into life at the smallest level. Imaging helps us learn more about the pathogens that invade our bodies and make us sick and how our cells respond to these invasions. Through tissue imaging, we are able to see how viruses and other pathogens behave in our body, study their interactions with our cells and tissues and develop ways to outsmart them.

While performing tissue imaging, we are able to perform experiments to test and understand the following:

1. What healthy _____ and _____ look like and how they behave.
2. How _____ spread in our tissues and make us sick.
3. If a treatment will work to kill the pathogen and restore health to our bodies.
4. If a vaccine will work to _____ our bodies from illness.

Within our body, we have an organ system called the lymphatic system. The components of the lymphatic system _____ infections and other diseases. The lymphatic system is made of different organs like our spleen and lymph nodes. During an infection or after vaccination, these lymphoid organs develop special sites called germinal centers where several cell types work together to produce the antibodies that fight off infection and keep us healthy.

Germinal centers contain many kinds of cells but today we will focus on three types:

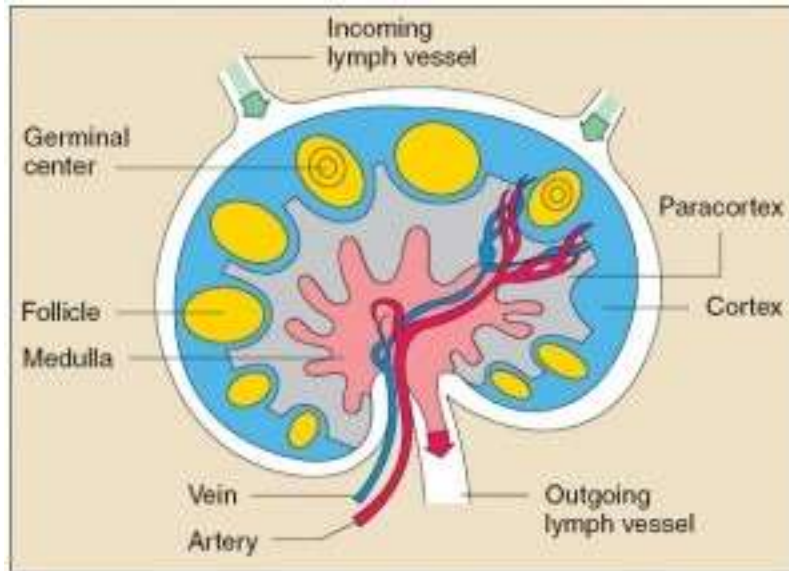
1. B-cells, a type of _____ blood cell called a lymphocyte

2. Fibroblasts
3. T-cells, another type of lymphocyte

To start a response to a pathogen or vaccine, a special cell type called a dendritic cell captures the pathogen or the vaccine material. After these cells capture the pathogen or vaccine material, they alert the B and T cells that there's an intruder or vaccine and trigger an immune response.

Instead of waiting for a pathogen to make us sick and then cause our immune system to create protective substances like antibodies, vaccines expose our bodies to _____parts of pathogens so that the immune system gets a head start and makes the protective response BEFORE the pathogen invades. This keeps our cells from becoming infected and causing disease. I will now show you a movie that our lab created through a special type of live tissue imaging. In the video we see our dendritic cells in green, capturing the vaccine particle in yellow that is reaching the lymph node through lymph fluid in blue that drains from the site of injection. These dendritic cells then start the immune response that produces the germinal center that makes the antibodies that protect us from the _____pathogen.

Please review the anatomy of one of our lymphoid organs, the lymph node:



Now, I will introduce you all to our microscope named Bertha. This microscope allows us to take pictures of tissues and study how our cells interact with and fight off pathogens.



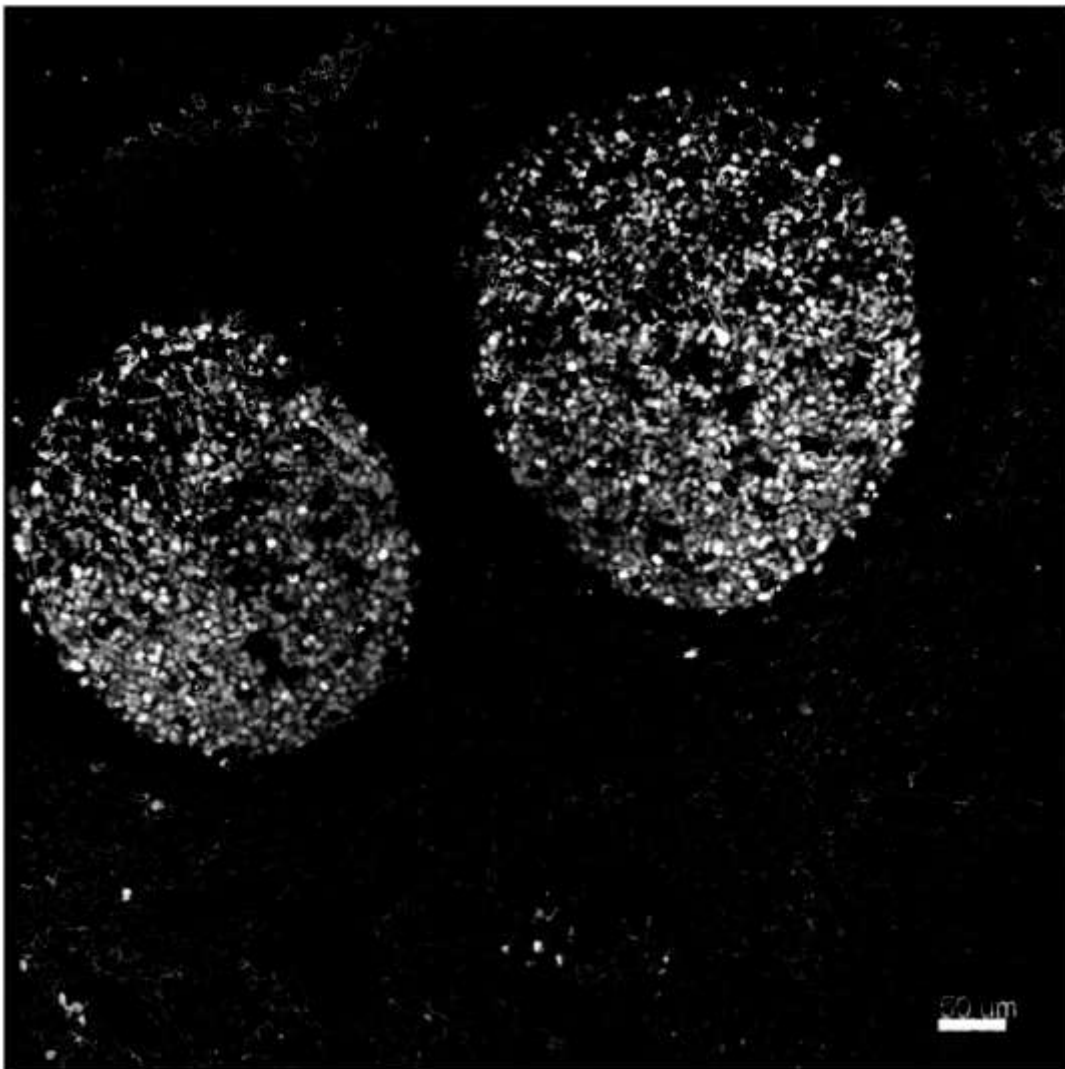
Coloring Activity

Please complete the coloring activity after our talk to better understand germinal centers!

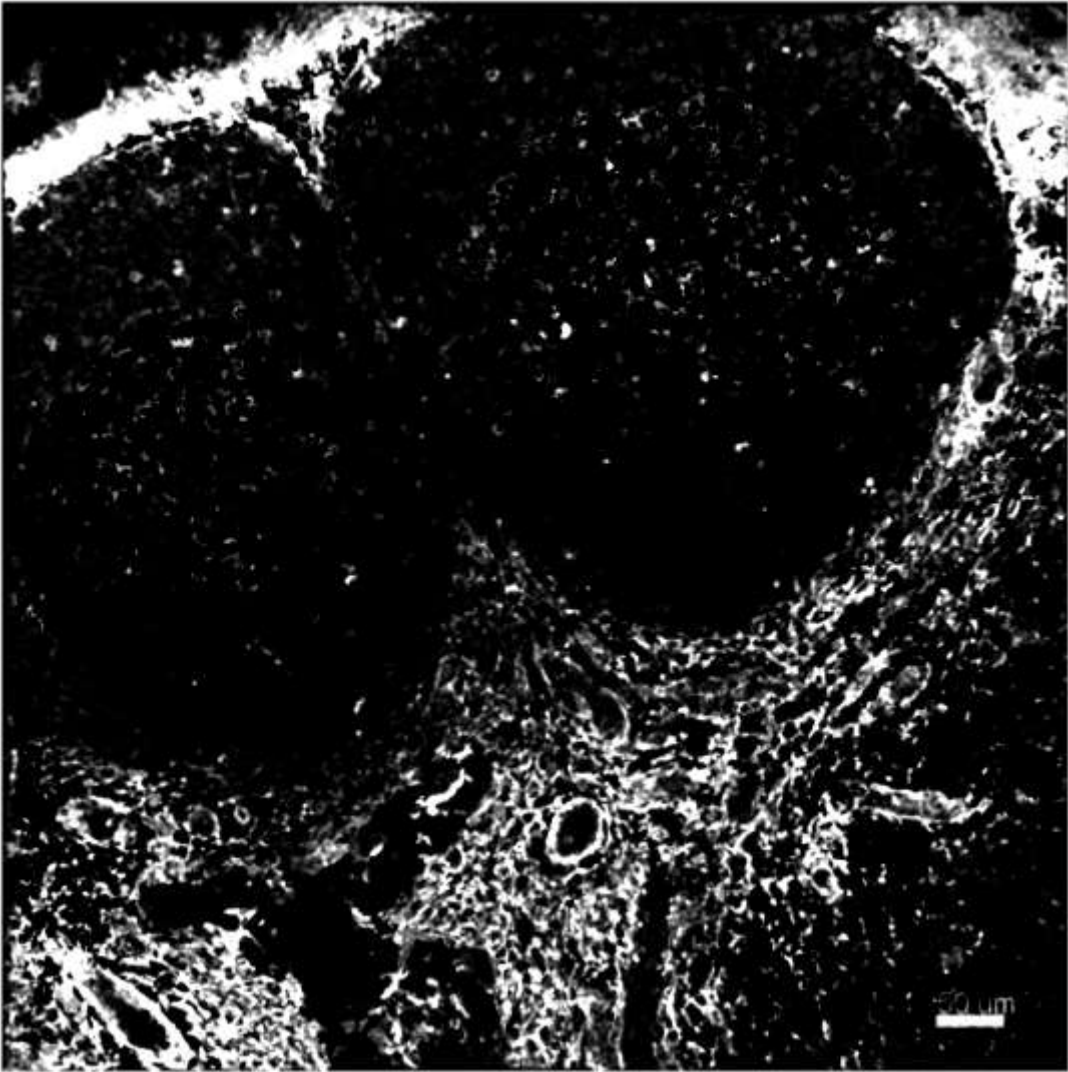
Directions:

Coloring Activity: Using markers, color the different immune cells found in the germinal centers of our lymph nodes according to the key below and then look at the last page of this packet to see all of these cells living and working together in harmony!

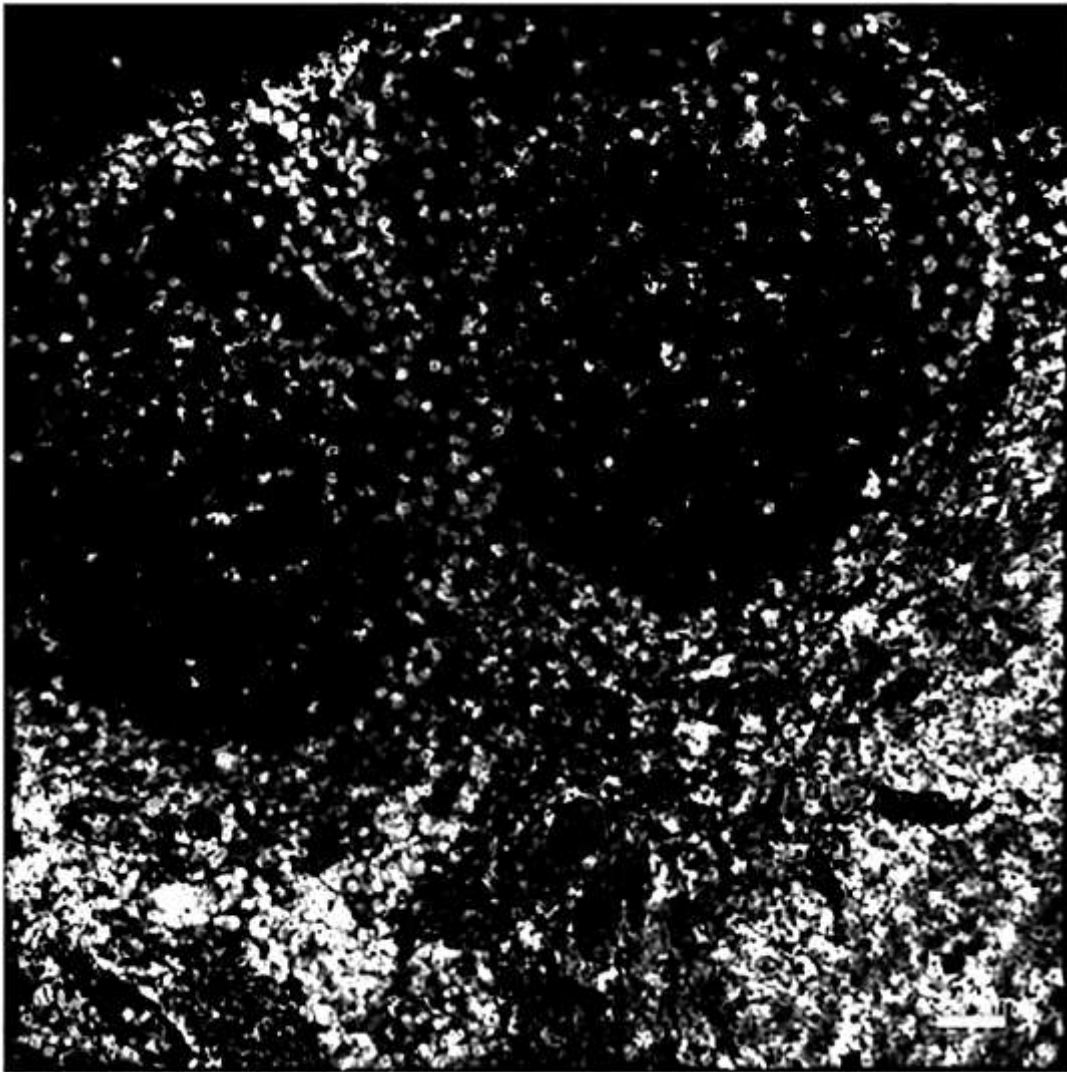
Step 1: Color the B-cells in RED.



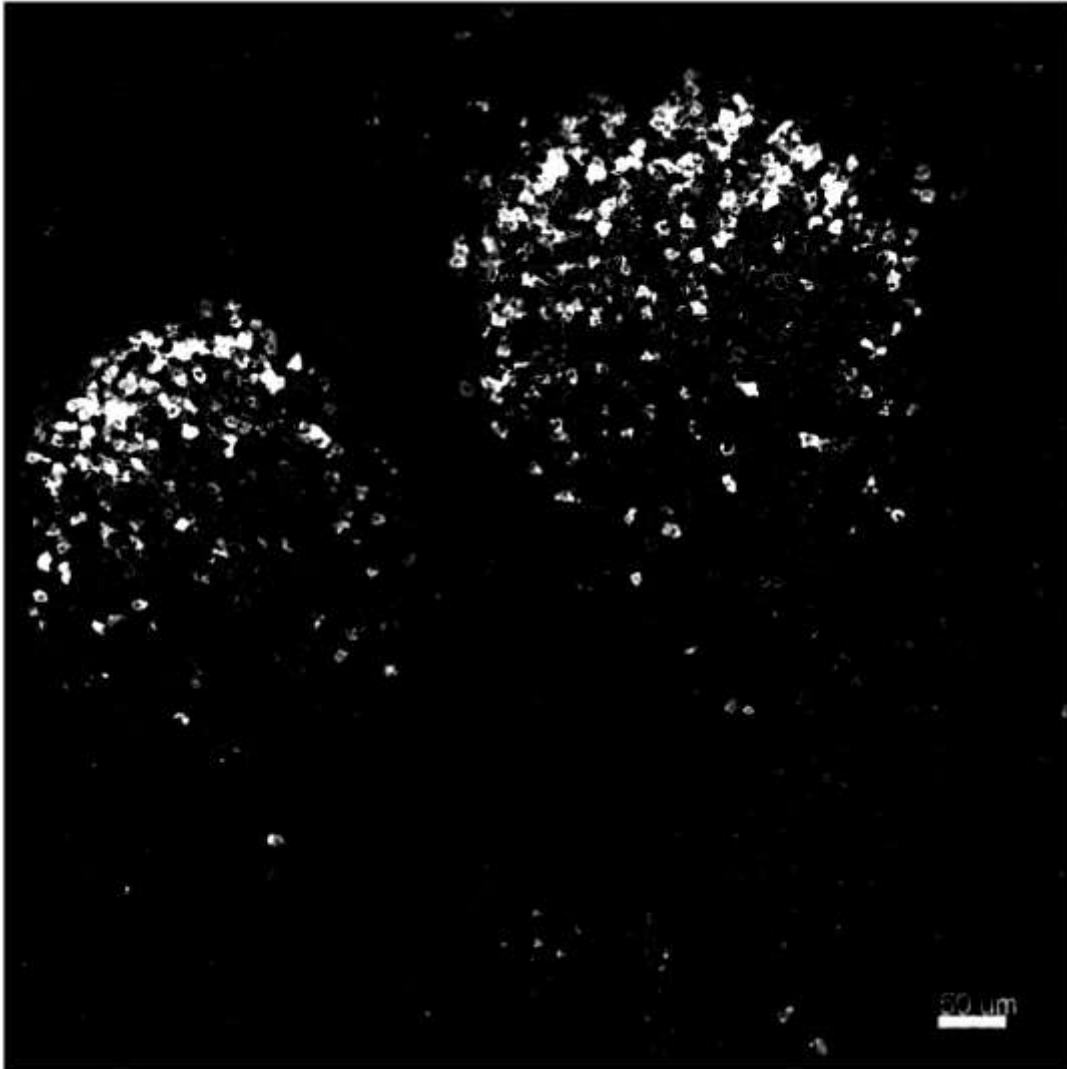
Step 2: Color the Fibroblast cells in GREEN.



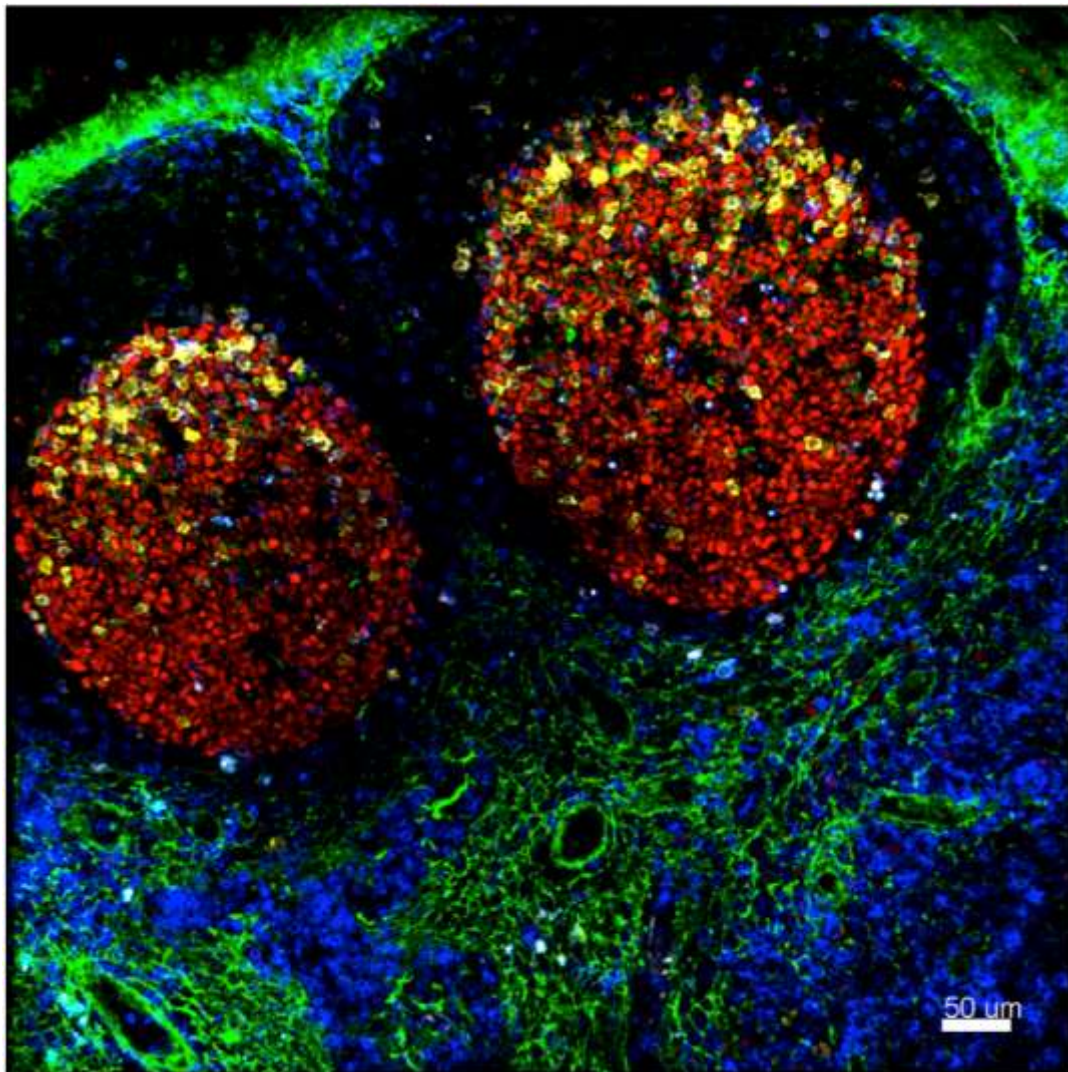
Step 3: Color the Resting T-cells in BLUE.



Step 4: Color the Activated T-cells in YELLOW.



Complete Germinal Center: Now, this is how all of the cells you have colored in truly exist within the germinal centers of our lymph nodes! Great job!



Fill in the Blank Activity Key (Parents, please only use to verify your student's answers.)

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6. A way to develop treatments and vaccines to keep us and our loved ones safe and healthy.

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First, we must review the building blocks of life! A cell is the most basic unit of life. Cells are so tiny that they cannot be seen with the naked eye; however, cells are so mighty that they make up all living organisms, including humans! The human body is made up of **37.2 trillion** cells! Cells contain our DNA, create proteins and carry out the processes that give us the energy we need to survive among other very important jobs. Despite cells being so tiny, we have developed technology to be able to see them! We must use microscopes to see cells.

Now that we understand that cells are the basic unit of life, let's build! Multiple cells organize themselves based on the job they perform, forming structures called tissues. These tissues perform unique functions because they are made of special cells. There are four basic types of tissues: epithelial tissue, connective tissue, nervous tissue and muscle tissue. Each tissue type has its own jobs:

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8. If a vaccine will work to protect our bodies from illness.

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