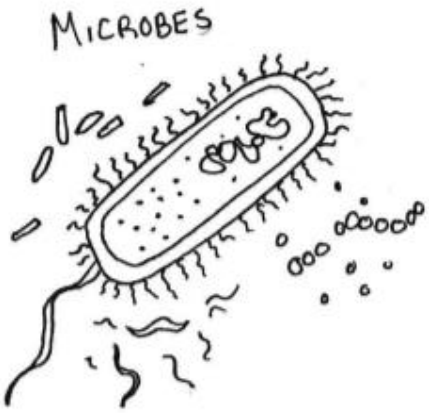
FLAGS, TAGS, LOCKS & KEYS

Part II: The Immune System

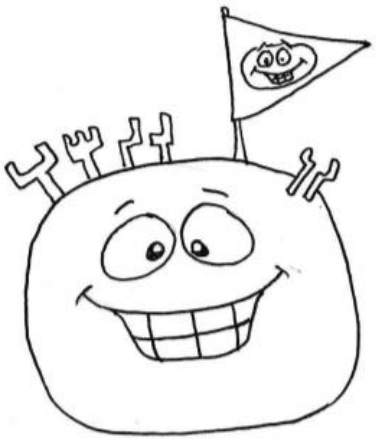
Name: _____

When you are a single celled organism you only need to worry about you and your surroundings. If something changes in the environment you respond. Some organisms in this group have the ability to sense if there are changes in the levels of light, levels of chemicals, or even if the gravitational pull has changed.

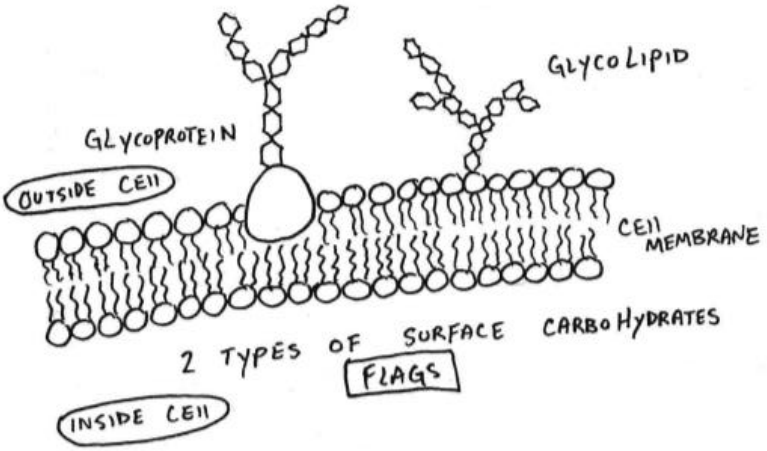


But what if you are a big organism that is made of tons of cells that are all small. How do all these cells coordinate? How does one cell know to do its "job" or to stop doing its "job"? The answer… they talk to each other. So then the next question is how do they talk to each other?

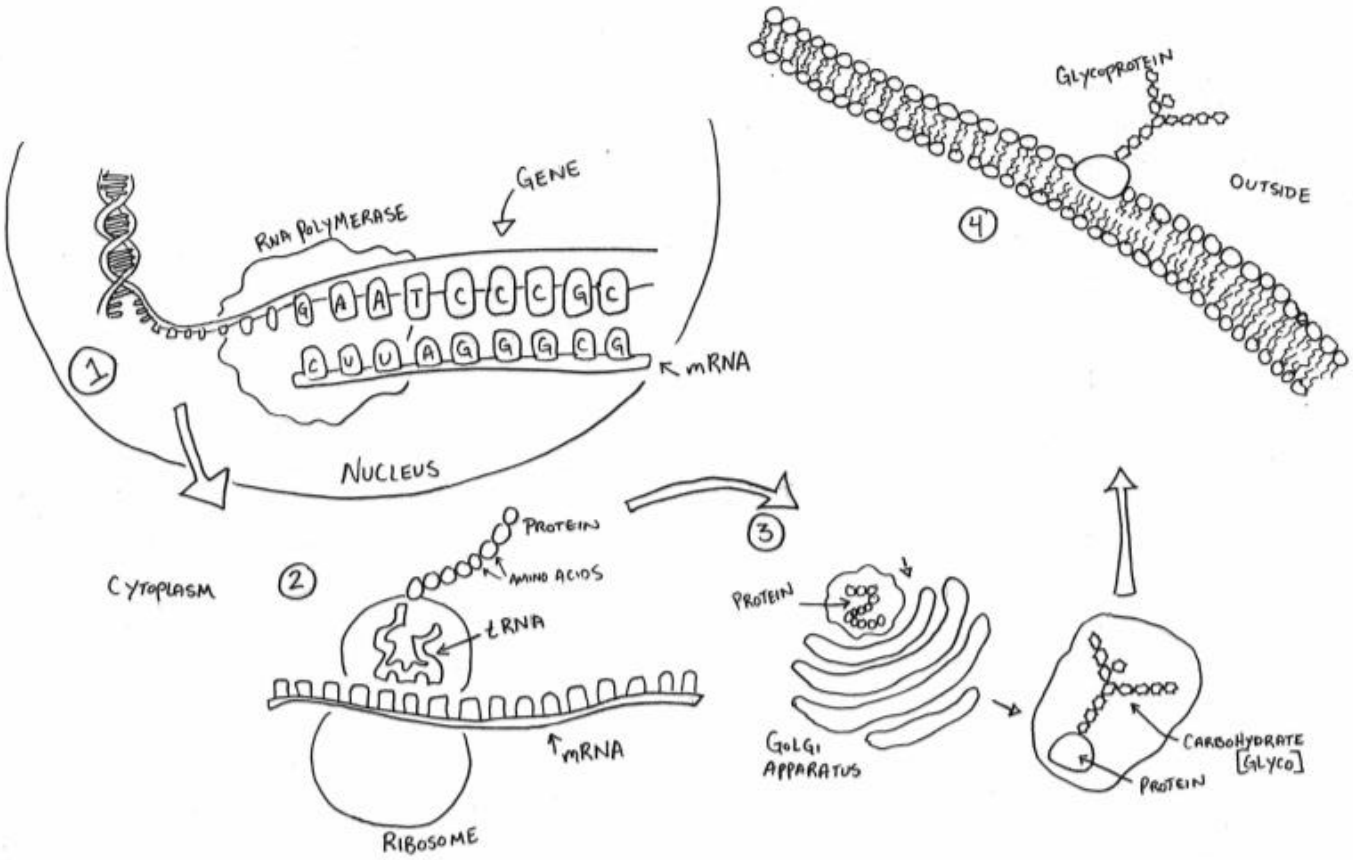
When you call or text a friend it is important that you have a phone with your own number. When cells "talk" to each other they too need their own Identification number. We are going to call these I.D.s flags



In science these flags have all kinds of fancy names like glycolipids, glycoproteins, oligosaccharides.
These flags are made of proteins, lipids, and carbohydrates and the cell makes them on the inside of the cell and then push them out to the cell membrane surface.



So cells have the information to build these flags in their DNA. (Protein synthesis connection)



Now that the cell has an I.D. the next portion of communication is to send the message. Cells don't send messages with radio waves like cell phones they send messages with molecules.

What kinds of messages do you think cells send to each other? Think about what your body needs to do in order to respond to different situations throughout your day.

Change in the environment	Cell that needs the message	Response
It is getting hot outside or you are exercising	Sweat glands (sudoriferous glands)	Release sweat that allows your skin to cool off - evaporative cooling
Virus or bacteria gets into your body	White blood cells (macrophages, T-cells, B-cells, etc.)	Stop them from replicating and DESTROY them.

Let's take a quick moment and look up a couple signal molecules and see what they do in the human body. Below are some common molecules the body uses for communication. Look up what they do in your body and cite your source

Molecule	Purpose	Information Source
Insulin		
Epinephrine		
Serotonin		

Now let's focus on Dr. Allison's work and how revolutionary his discovery is for us. First, we need to look at our immune system.

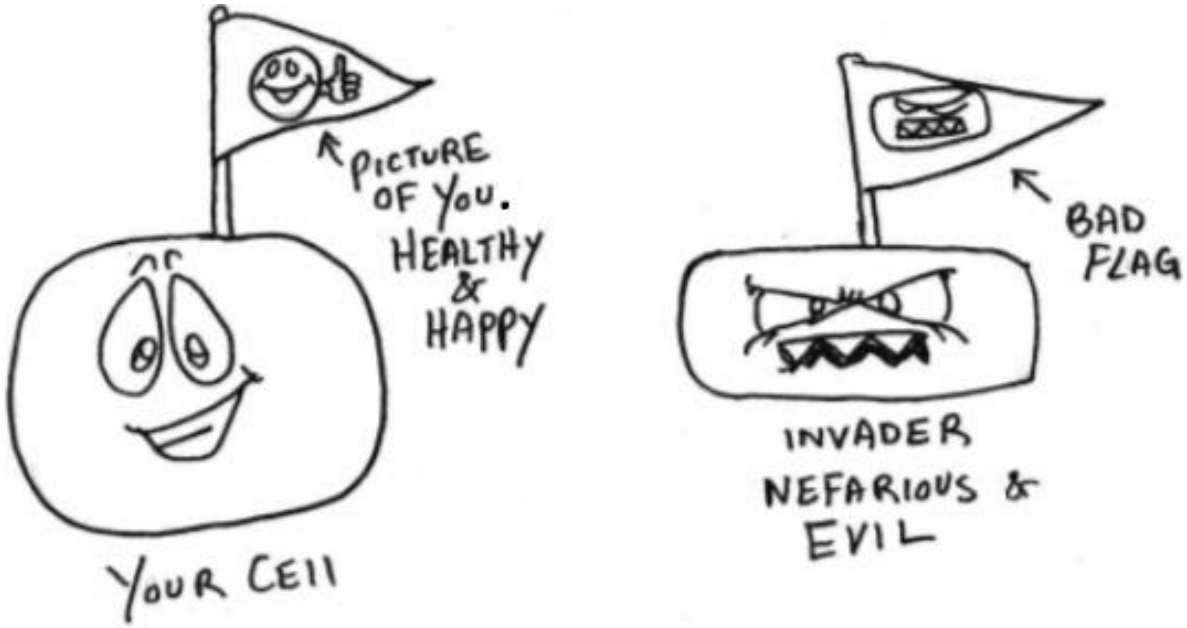
Dr. Jim Allison

" Everybody thought I was a troublemaker. I wasn't, I was just trying to do what is right. If you don't agree with something you need to stand your ground. If it hurts it hurts. "

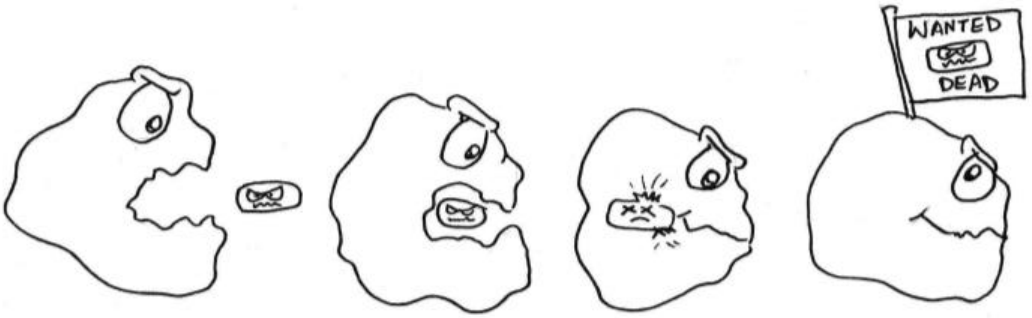
Your immune system is basically at war. It is a war of you vs. them. Here is the 4-step process:

1. Invader gets into your body
2. You need to I.D. the invader
3. Then you need to seek out all invaders that match that initial invader
4. Neutralize and destroy all of the invaders.

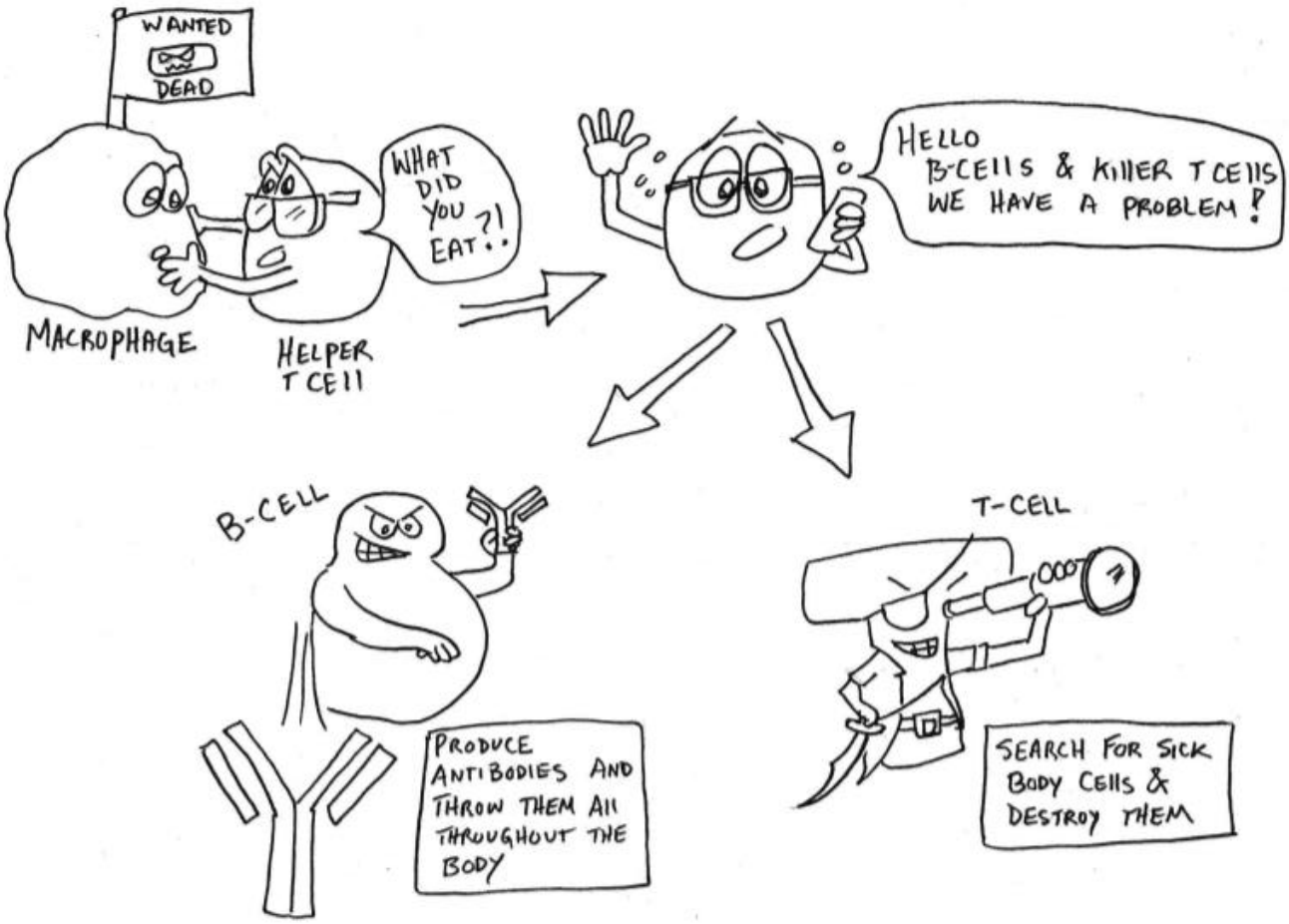
In an immune response your body recognizes its own flags/tags and it recognizes those that aren't itself.



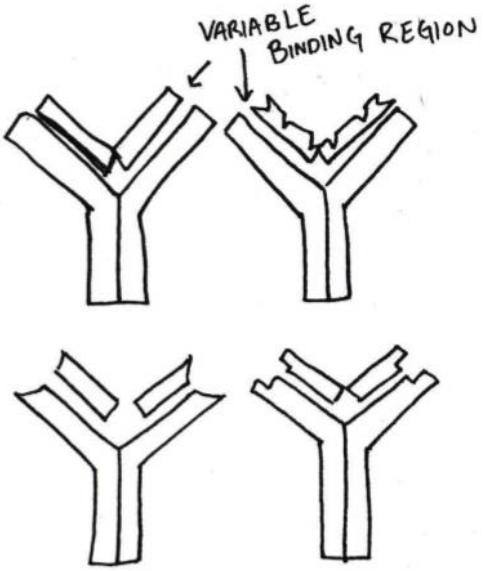
When your white blood cells (macrophage- big eater) find an invader, they eat them and then present a portion of the invader on their flag (eat and present).



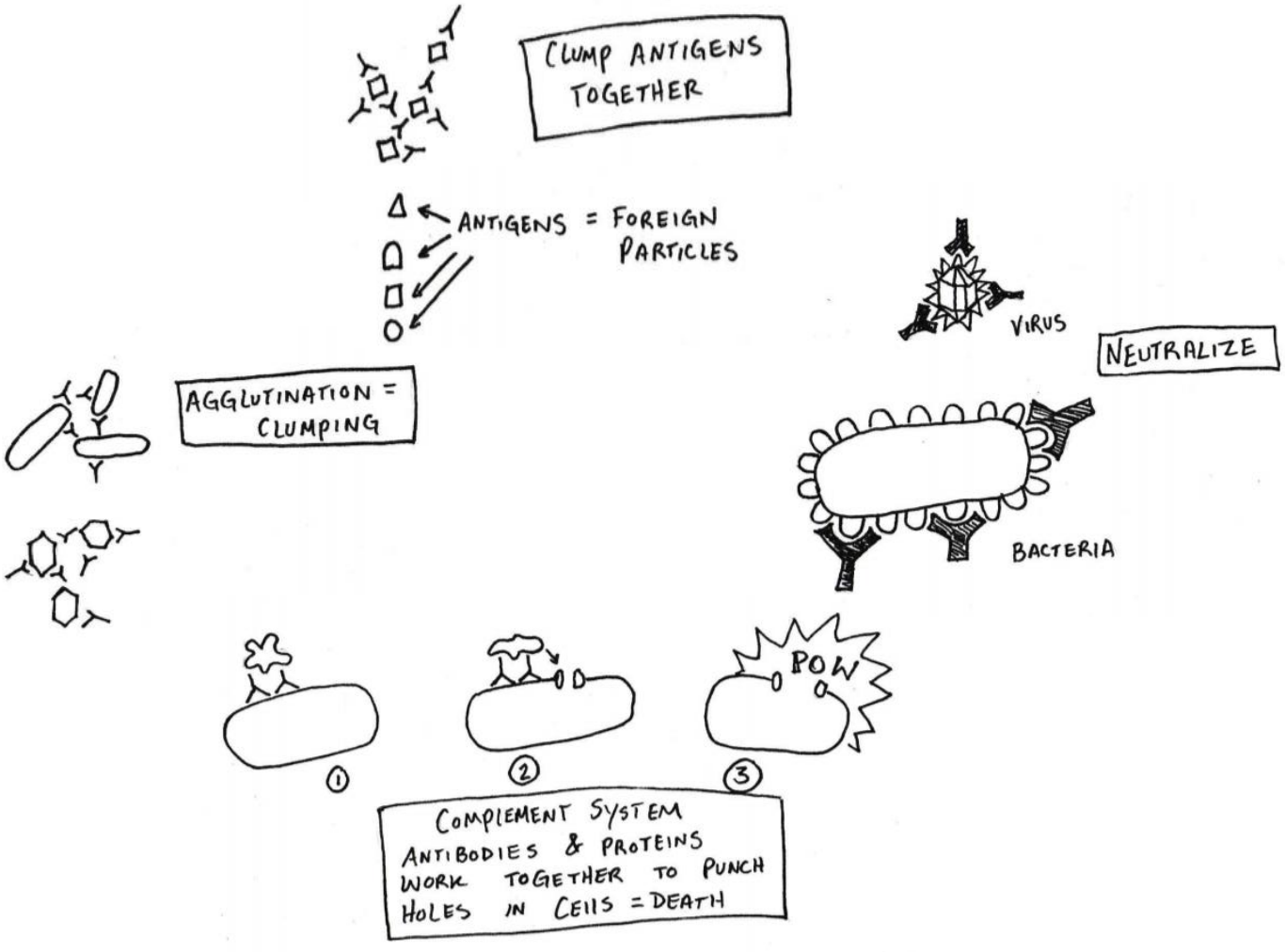
Then a smart white blood cell (helper T-cell) reads the flag of the macrophage and sends messages to other white blood cells to mount an attack against all of the rest of the invaders. (molecule signals- talking)



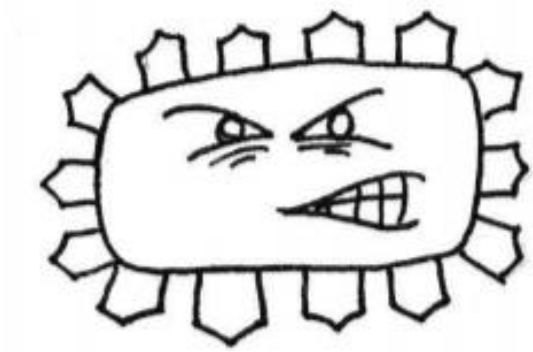
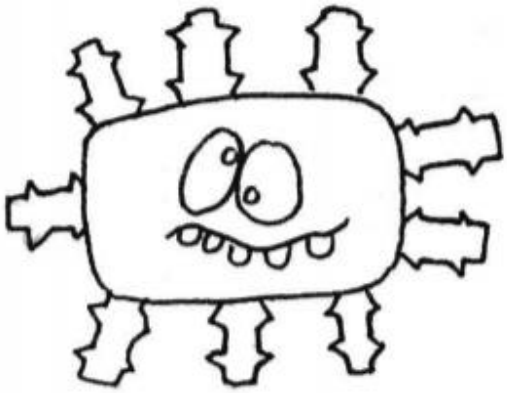
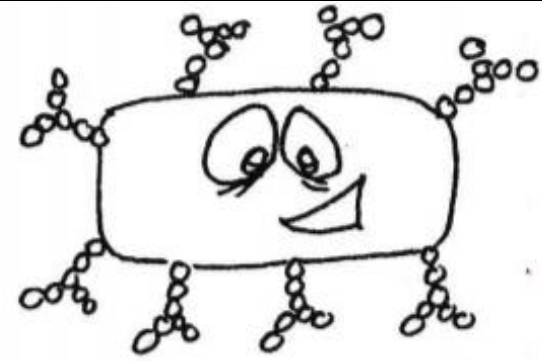
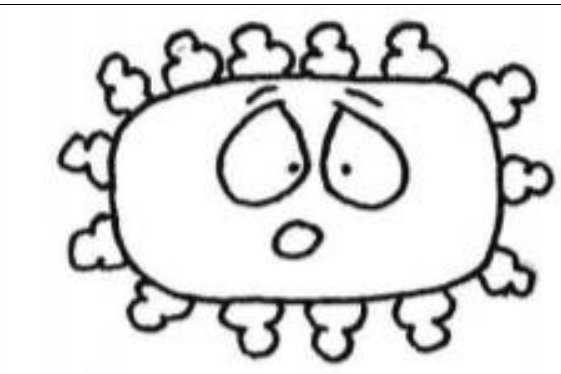
One of the really cool things that your body can make to help fight the war faster is to make a protein molecule called an antibody. Your body makes them specifically to bind to and attack the invader. Below is a general shape of one of the most common types of antibodies your body makes. Notice that there is a variable binding region. This means your body makes them specifically to attach to the specific invader.



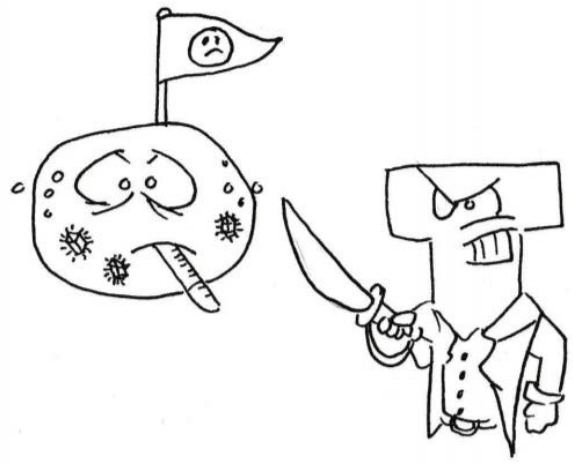
So what can the antibodies do for you? They can help clump together the invader or antigen so that it is easier for the macrophages to "eat them", it can stop them from replicating, and it can even work with a protein system to destroy the invader.



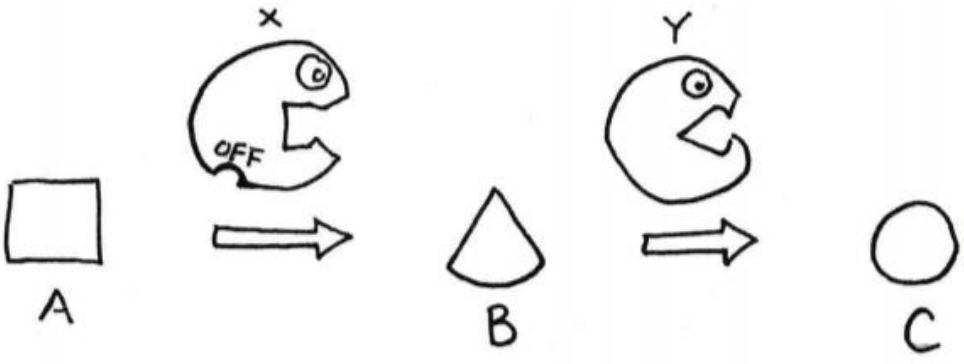
Once your body "knows" the invader it can use protein synthesis to create specific antibodies to attach to the antigens on a bacteria or virus surface. On the next page are some examples of fictitious bacteria. As a scientist, predict the shape of the antibodies you would need to make in order to neutralize the bacteria.

What the invader looks like	Your predicted antibody shape
	
	
	
	

Your own T-cells can detect if your own body cells are sick and can destroy them to keep you healthy. This is what happens if you cells get viruses inside of them or if your cells become cancerous.



Dr. Allison found out that cancer has a way to "trick" T-cells to turn off their attack by pushing a negative feedback system that normally exists in the T-cell. The normal feedback system T-cells have is that they will turn off if they have been overworked. This is to ensure that the T cells don't destroy healthy cells. Look at the basics of a negative feedback system below.



The goal in this system is to create C. Enzymes X and Y help to get this done. When enough C is created it fits into enzyme X and turns off the system. This is called NEGATIVE FEEDBACK. When those T cells work too long they turn themselves off.

If a T-cell has an inability to turn off it can damage healthy cells. This is called an autoimmune disease.

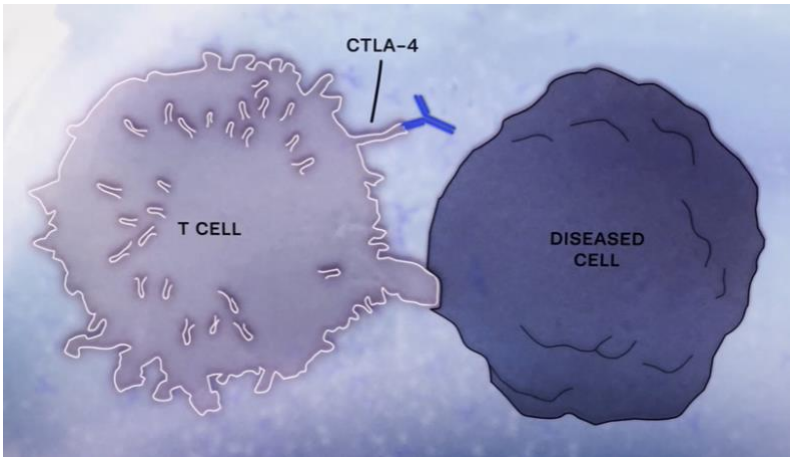
Look at the shapes of both the substances (A,B,C) and the enzymes (X,Y).

Where can A bind?	
Where can B bind?	
Where can C bind?	
What will happen if there is too much C produced in the cell?	

Do some research and fill in the table below on Autoimmune diseases.

Autoimmune Disease	**Cells in the body affected by the T-cells**	**Source of information**
Type 1 Diabetes		
Multiple Sclerosis		
Rheumatoid arthritis		

In the video Dr. Allison figured if he could keep the T-cells turned on and continue attacking the cancer they could help the body continue to fight for itself (direct connection to negative feedback system). Look at the 2 pictures below and determine what the purpose is of the antibody (Y-shaped structure) that Dr. Allison's lab created.



How does the CTA-4 Antibody work?

Claim	
Evidence	
Reasoning	