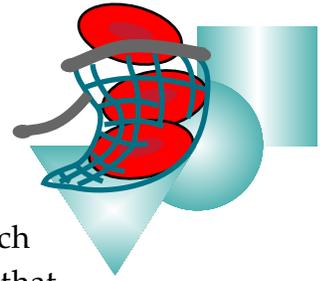


# Gammagauntlet: Fighting Infection

## Student Information Page 1B



### Introduction:

We have all experienced a common cold or other illness - what happens inside your body if you get a really serious infection? Did you know that each time an organism such as a virus or bacteria invades and attacks your body that there are “warriors” inside you ready to go to war and destroy these invaders? These “warriors” are special cells called *immune cells*. They move throughout your body fighting invaders using the circulatory and lymphatic systems. Without these warriors you could die of a common cold! Read the background information to find out how your body survives infection by mobilizing an army of immune cells when invaders attack.

### Activity Background:

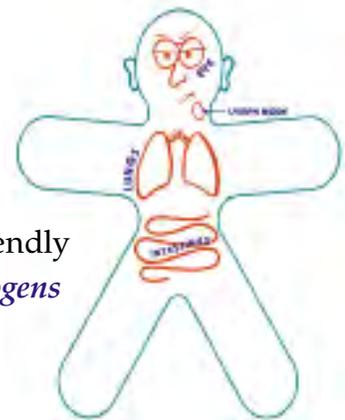
#### *Immune Defense: Nonspecific and Specific*

Every day we are exposed to substances that can potentially make us sick, fortunately, we have a very advanced defense system called our *immune system*. Our immune system is made up of white blood cells (*leucocytes*) of various types which have the ability to signal each other through chemical signals or cell-to-cell contact in an elaborate cooperative effort to defend our bodies against harmful invaders. Our immune system works because it is able to tell the difference between *self* (belongs in the body) and *non-self* (does not belong in the body). Human defense against disease-causing agents (*pathogens*) is categorized into *nonspecific* and *specific immunity*. *Nonspecific defense* against infection refers to a general response to any pathogen and includes our skin, mucous membranes, scavenger cells (phagocytes), fever, substances that have antimicrobial action, and inflammation. *Specific defense* or resistance to individual types of pathogens is mediated by special white blood cells (lymphocytes) called *B cells* and *T cells* along with *antibodies* (immunoglobulins/gammaglobulins). The components of our specific immune response are able to organize individualized attacks against invaders such as bacteria or viruses.

#### *Bodily Barricades and Scavenger Cells: Nonspecific Immunity*

Your body has a lot of ways to protect against invaders like viruses and bacteria. The *first strategy* the body uses is to prevent invaders from ever entering the body. Your skin, mucous membranes, and friendly microbes that live on them are your *first line of defense* against *pathogens* (disease causing organisms) or harmful substances.

Nevertheless, you breathe in and ingest (eat or drink) thousands of germs (*pathogens*) everyday. They are everywhere! They are floating around in the air you breathe, growing in the food you eat and living on almost every surface you touch during an average day. The ones you eat or drink are usually trapped by mucous and destroyed by acids in your digestive tract. The ones you touch are



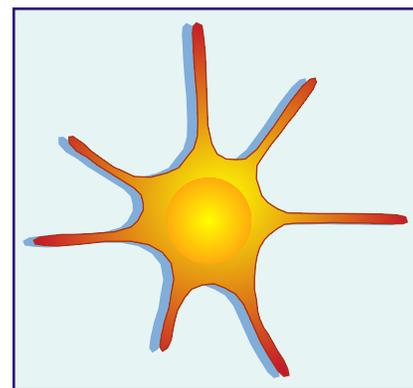
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usually stopped by your skin and friendly microbes living there. The mucous membranes and friendly organisms of your respiratory tract trap and destroy most of the pathogens you breathe in. But what happens if disease-causing bacteria or viruses get past the first line of defense through a cut or other break as in *Figure 1* First Line of Defense? If that happens, your body has a *second* and a *third line of defense!*

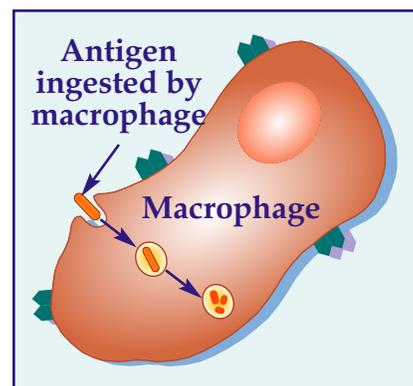
The *second line of defense* is fever, inflammation, and special cells called *phagocytes*. Phagocyte means “eating cell”. These scavenger cells track down and eat the invaders! This process is called *phagocytosis*. The names of some phagocytes from your second line of defense system are *natural killer cells* and *macrophages*. *Dendritic cells* (not to be confused with dendrites of neurons) are found in most tissues of the body and are often the first cells to detect the presence of foreign invaders, see *Figure 2*. They present markers (*antigens*) from foreign invaders to the immune system. *Natural killer (NK) cells* seek and destroy any cells that have been invaded by bacteria or viruses. *Macrophages* are white blood cells that, moving like amoeba, can leave the blood stream to enter tissues of the body. In these body tissues, macrophages act as scavengers, seeking and destroying foreign invaders, see *Figure 3*. Your first and second line of defenses against pathogens is called your *non-specific resistance to disease* or *nonspecific immunity*. It is called non-specific because it defends against any pathogen that enters or attempts to enter your body and cause an infection.



**Figure 1 First Line of Defense**



**Figure 2 Dendritic Cell**



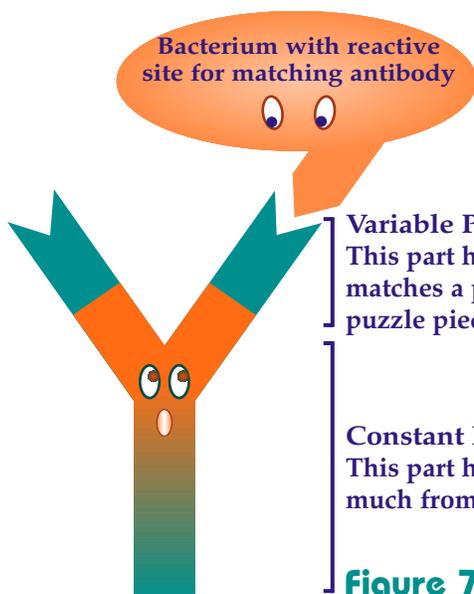
**Figure 3 Macrophage**



## Specific Immunity

Your *third line of defense* is different. It is a customized attack on pathogens. The cells that make up this specific response to invaders have special sites on their surfaces that allow them to recognize, communicate about, and target a particular invader. Macrophages communicate with other white blood cells called Helper T cells by presenting identifiable parts of the invader to the Helper T cell, see *Figure 4*. As shown on *Figure 5*, Helper T cells then let white blood cells called B cells know what antibodies to make during the specific immune response. *Antibodies* are special molecules that identify and target invaders so they may be destroyed by other cells. The Helper T cells also communicate with other immune cells. The second is the *Killer T cell*. The *Killer T cells* are phagocytes like the macrophages and natural killer cells. The *Killer T cells* are used to destroy viruses, virus-infected body cells, and cancer cells, as shown in *Figure 6*. *Memory T cells* and *Memory B cells* remember the invader in case it tries to cause trouble again in the future. This system of cells and antibodies is known as *specific resistance to disease or specific immunity*.

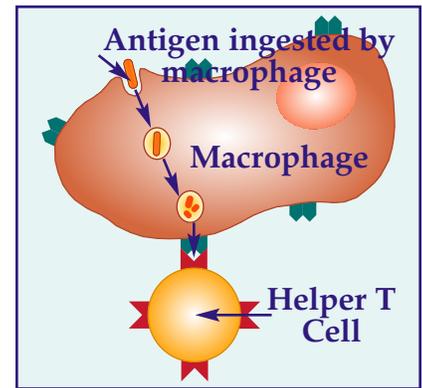
*Antibodies* are used to tag or identify pathogens like bacteria and viruses so that *phagocytes* can destroy them. They have areas with very specific shapes that can bind only to pathogens with the correct fit, much like a lock and key fit together. *Figure 7* is an illustration of a bacterium and an antibody. The antibody has a special site (variable region) that perfectly fits the corresponding site on the antigen and locks together with it. Once locked together, they are known as an antigen-antibody complex.



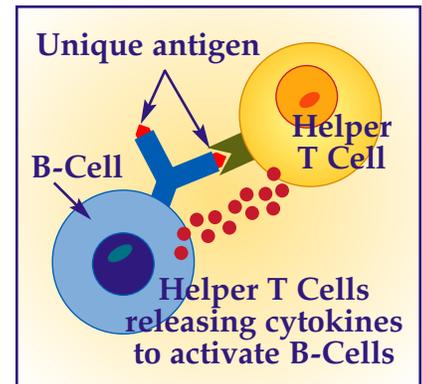
**Variable Part of the Antibody:**  
This part has a shape that exactly matches a pathogen/ antigen like one puzzle piece fits another.

**Constant Part of the Antibody:**  
This part has a shape that does not change much from one anti-body to the next.

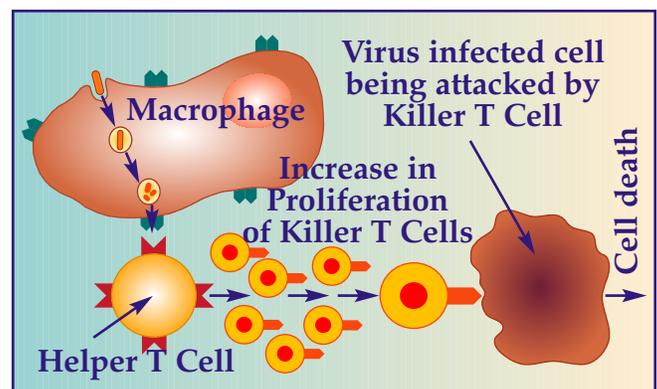
**Figure 7 Antigen and Antibody**



**Figure 4 Macrophage and Helper T Cell**



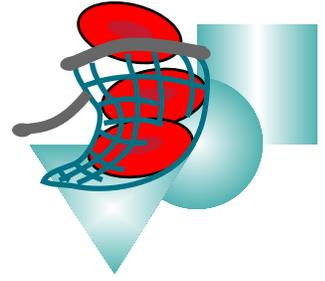
**Figure 5 B Cells**



**Figure 6 Killer T Cells**

## Activity Materials:

- ◆ Jumbo 2" paperclips
- ◆ Large pipe cleaners in various colors
- ◆ Permanent marker or chalk to draw *Gamma Master* outline
- ◆ 6 foot sheet of bulletin board paper or large, flat white sheet for *Gamma Master* outline
- ◆ Character Cards (lamine for durability and reusability)
- ◆ Yarn
- ◆ 1 Pair of Large Dice
- ◆ 10 small packets to represent granzymes (gelatin, silica, or anything else you wish to use)
- ◆ Stretchy "Sticky Hands" (Available at Discount or Craft Stores)
- ◆ Score card
- ◆ 1 Large IgM antibody (lamine for durability and reusability)
- ◆ Invader cards (lamine for durability and reusability)
- ◆ Transparency of Gammagauntlet Score Card
- ◆ Water-based overhead marker
- ◆ Old key (represents protein key)
- ◆ License to activate
- ◆ 1 Stopwatch
- ◆ 1 Whistle (Optional)
- ◆ 1 copy *Student Data Page* (per student)
- ◆ 1 copy of *Student Information Page* (class set)



## Activity Instructions:

### *Part 1:*

1. Read the *Activity Background* included in these *Student Information Pages* carefully and then check your understanding by completing the *Gamma Map* on *Part 1* of your *Student Data Page*. You will keep your *Gamma Map* with you as you to review the cast of characters as you act out the immune response.

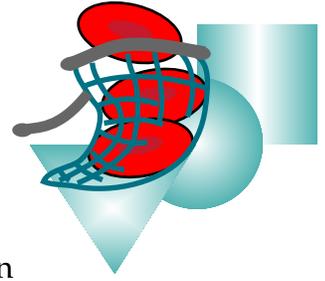
### *Part 2:*

1. Now that you and your team mates understand how the immune system works, you are ready to run the *Immunogauntlet* to find out how the body will fight off an attack by a disease-causing invader. The object is to eliminate your target infection *faster* than the invader can outnumber the immune cell warriors.
2. Remember to refer to the *Gamma Map* you made in *Part 1* to help you remember the cell types. You may also refer to the *Character Badge* you are wearing for information.



## The Gammagauntlet –

A gauntlet in this case is a series of challenges that will result in victory for one of two groups – the *Body* or the *Invaders*.



1. To begin, every student will randomly draw a *Character Badge* and will attach yarn so the badge becomes a banner to be worn around the neck that will help students know their roles and the roles of other students in the simulation.
2. If your *Character Badge* is two-sided, be sure to wear the badge with the side marked “**Front**” showing.
3. All students will “**circulate**” around the *Gamma Master* with the exception of those students who are simulating the *Invaders*; these students stay around the outside of the body waiting to get in and cause disease!



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