

The Immune System:

Hard at Work to Keep you Healthy

Every day your immune system is at work, defending you from harmful bacteria, viruses and infections. This complex system is made up of a variety of cells and signalling molecules that work together to help keep you healthy. Most of the time you don't even notice that your immune system is at work; it is only when the system fails, and you get sick that you begin to see some of its actions. In fact, many of the uncomfortable symptoms you experience like fevers and sneezing are actually your immune system's strategies for fighting infection.

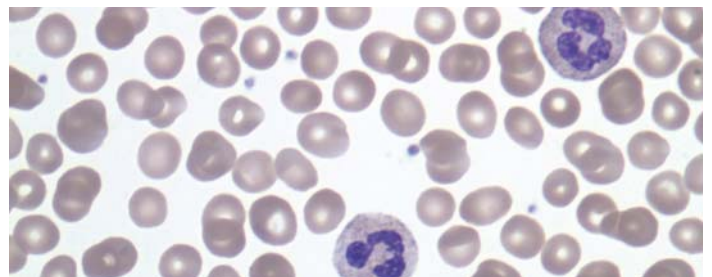
Non-Specific Defences

The body's system of defences includes non-specific defences, which provide general barriers to infection as well as specific defence mechanisms, which include all the various cells of the immune system (see Table 1). The body's first line of defence is the skin. This massive organ covers your body and protects it from invading pathogens. It provides a physical barrier against pathogens; however, cuts and tiny abrasions may still allow them to enter.¹

Table 1: An Overview of the Body's Defences¹

Non-Specific Defense Mechanisms		Specific Defense Mechanisms
First Line of Defense	Second Line of Defense	Third Line of Defense
Skin Mucous Membranes	Phagocytic white blood cells Antimicrobial proteins Inflammatory response	The Immune System Lymphocytes Antibodies

This is where the second line of defence comes into play. This mechanism includes white blood cells that non-specifically attack and destroy microbes and infected cells throughout the body. One type of cell that accomplishes this is the phagocyte. Phagocytes are cells that consume other cells. The human body has two types of phagocytic cells: neutrophils and macrophages. Neutrophils make up 60-70% of all white blood cells, and are attracted to areas of infection where they consume bacteria. Macrophages are large and very effective phagocytes.¹ The body also has a special kind of cells called Natural Killer Cells, which act to destroy the body's own infected cells, helping to prevent the spread of viruses, as well as abnormal cells that could form tumours.¹



Normal human blood showing red blood cells (pink) and white blood cells or immune system cells (purple)

The inflammatory response and antimicrobial proteins are also part of the body's non-specific defences. One antimicrobial protein that may sound familiar is interferon. Interferons are actually a group of three proteins that can help protect cells from infection by viruses.¹ Interferons are produced commercially through recombinant DNA technology, and can be used for the treatment of various diseases. For example, certain types of interferons are used to help treat various forms of cancer, viruses, multiple sclerosis and more.²

Specific Defences

Specific defences act to target and destroy particular viruses and microbes. This level of the body's defences is what is typically termed the immune system. There are four key features that characterize the immune system: Specificity, Diversity, Memory and Self/Non-self recognition (see Table 2)

Table 2: The Four Key Characteristics of the Immune System

Specificity	The immune system can recognize and eliminate specific viruses or microbes This is accomplished through antibodies
Diversity	The immune system can recognize and respond to millions of different kinds of invaders
Memory	The immune system can remember invaders it has encountered before, and respond faster This is called acquired immunity
Self/Nonself Recognition	The immune system can distinguish its own molecules from foreign ones When this fails, auto-immune diseases can result

The specific/adaptive immune system is made up of two main kinds of white blood cells, T cells and B cells. These cells are involved in the body's specific attacks on pathogens. This generally occurs through two different routes. The first is called cell-mediated immunity. This is generally carried out by T cells which act to identify cells of the body that have been infected by bacteria or viruses. They also act against fungi, protozoa or worms that invade the body.¹ The second is called humoral immunity, and involves the production of antibodies that bind to specific invaders, marking them for destruction. The humoral response involves mostly B cells, and is also unique in the regard that special B cells called memory cells "remember" pathogens they have seen before. It is for this reason that having chicken pox as a child generally results in life-long immunity. The body's immune system remembers this virus and is therefore able to react quickly and effectively if you are ever exposed again, eliminating the virus before you get sick.¹

Cold and Flu

We have all suffered from colds or the flu and would prefer not to ever have them again. However, each year brings a new round of cold and flu season. On average, adults have 2-5 colds each year and children have 7-10 cold each year.³ Colds and the flu are both caused by viruses. The most common cold viruses include rhinoviruses (30-50%), coronaviruses (10-15%) and the respiratory syncytial virus (5%). The flu on the other hand is caused by the influenza A or influenza B viruses.^{3,4} There are a variety of subtypes of all of these virus types; for example, over 100 different subtypes of Rhinovirus have been identified. Another example is "swine flu" or H1N1 flu virus, which is a subtype of influenza A. Because they are caused by viruses, antibiotics are useless against colds and the flu.



Symptoms and Duration

Cold and flu are spread through direct person-to-person contact or through the inhalation of virus-containing droplets released into the air when infected individuals cough or sneeze. Symptoms of the common cold include a sore throat, runny nose, nasal congestion, sneezing, coughing, headache and fever. The flu is generally more severe than a cold, with symptoms including chills, high fever, muscle and joint pain, malaise, headache and respiratory symptoms.⁷ Colds generally have a gradual onset of symptoms, beginning 1-3 days after infection and lasting approximately 7 days. Flu symptoms appear more abruptly, about 1-2 days after infection, usually improving after 1-2 days although coughing and general weakness may last for several more days.⁴

Box 1. The Flu by the Numbers

- Every year the flu infects 5-15% of the global population
- Every year, young, healthy people are hospitalized due to influenza
- The flu causes severe illness in 3-5 million people and leads to 250,000 to 500,000 deaths worldwide
- Most deaths occur in infants, the elderly and the chronically ill
- The flu is the 7th leading cause of death in the US and the CDC estimates that, on average, 36,000 people die of seasonal-flu related causes each year
- In Canada, the average flu claims between 2000 and 8000 lives each year
- In comparison, cancer and cardiovascular diseases each claim over 68,000 deaths in Canada each year
- Certain groups such as pregnant women, diabetics, obese individuals, immune-compromised individuals and cardiac patients are more likely to have severe illness when infected with the influenza virus

Complications

Although colds and the flu are generally self-limited illnesses of short duration, they can be associated with other complications. Colds can sometimes lead to secondary infections including ear infections, sinusitis or pneumonia. In children approximately 20% of secondary ear infections are associated with upper respiratory tract infection.⁵ Influenza viruses can have serious complications, and approximately 1% of all individuals who get the flu will require hospitalization (see Box 1).



The most common serious complication of the flu is pneumonia, which can be caused either by the virus itself or by a secondary bacterial infection. Elderly individuals, children and individuals with chronic illnesses are most likely to be affected by complications of the flu virus. Children under one year of age have an increased risk of not only pneumonia, but also other serious infections like meningitis and encephalitis. It is recommended that individuals with an increased risk of complications get an annual influenza vaccination or flu shot. In fact, the CDC recommends flu shots to all individuals over the age of 6 months, although individuals with a severe egg allergy, a previous allergic reaction to a flu shot, or a history of GBS after receiving a flu shot should consult a physician before getting a flu shot.

A Note of Flu Shots

The flu shot is an inactivated vaccine containing weakened versions of three seasonal flu strains. New flu shots are created every year to keep up with the constant mutation of influenza viruses. The flu shot is generally given with a needle in the arm. The flu shot is approved for all individuals older than 6 months of age.



Pros of the Flu Shot

- Most vaccinated individuals produce the antibodies required to fight the flu within 10 days of being vaccinated
- Once vaccinated, the immune system is ready to target the flu virus and offers protection against all viruses included in the vaccine
- The vaccine has been shown to prevent influenza in about 70%-90% of healthy persons younger than age 65 years old⁶
- Among elderly persons living outside chronic-care facilities (such as nursing homes) and those persons with long-term (chronic) medical conditions (such as asthma, diabetes, or heart disease), the flu shot has been shown to be between 30% and 70% effective in preventing hospitalization for pneumonia and influenza⁶
- Among elderly nursing home residents, the shot has been shown to be between 50% and 60% effective in preventing hospitalization or pneumonia and 80% effective in preventing death from the flu

Cons of the Flu Shot

- Even if you get the flu shot, you may still get the flu. Viruses evolve rapidly, so vaccines do not always cover all strains that you may encounter.
- Research has shown that in animals, infection with influenza A viruses can induce protective immunity against other unrelated subtypes. Immunizations, on the other hand, do not increase immunity to other flu subtypes. This means that if you have been immunized, but become infected with another strain of the flu, the severity of the infection could be more severe.
- The flu shot may have some side effects or cause allergic reactions in rare cases. Generally side-effects are mild and include soreness at the injection site or headaches.
- Flu vaccines may be associated with an increased risk of a rare side effect called Guillain-Barre Syndrome (GBS), a rare and serious illness in which individuals experience inflammation of the peripheral nervous system causing progressive paralysis. This paralysis may be temporary or permanent, and in some cases leads to death. In 1976, 40 million Americans were inoculated against H1N1; the program was halted due to 500 reported cases of GBS. This represents 0.00125% of immunized individuals (far less than the lethal rate for the seasonal flu).

Supporting your Immune System

Exercise and the Immune System

Studies have shown that regular, moderate exercise can help boost your immune system. One study found that recreational runners reported fewer colds after starting the exercise and another showed that individuals who walked for 40 minutes per day had half as many sick days due to colds or sore throat compared to individuals who did not exercise.⁷ Research suggests that regular, moderate exercise increases the body's production of macrophages and also increases the circulation of immune cells throughout the body, thereby improving the body's immune response.⁸

However, it is important to note that too much intense exercise can actually reduce immunity, with research showing that athletes engaging in more than 90 minutes of high-intensity endurance exercise are more susceptible to illness for up to 72 hours after the exercise session.⁹ When you are sick you should be careful not to exercise too intensely, as this could prolong your illness.

Stress and the Immune System

Psychological stress has also been associated with an increased incidence of cold and flu infection. For example, individuals experiencing the stress of caring for a loved one with Alzheimer's disease and found that they experienced twice as many colds as non-caregivers.¹⁰ A large meta-analysis found that psychological stress was associated with a significant decrease in various measures of immune system function, including natural killer cell activity and the number of circulating white blood cells.¹¹ Therefore, taking steps to reduce stress could also help to reduce your frequency of illness.

Diet and the Immune System

Proper nutrition is essential for the support of a healthy immune response. Malnutrition, anorexia and obesity have all been linked to a suppressed immune system. Many minerals and vitamins play important roles in metabolic pathways and immune cell functions, and marginal deficiencies in these nutrients can therefore have a negative impact on immune system function.



Some of these key nutrients include vitamin A, beta-carotene, folic acid, vitamin B6, vitamin B12, vitamin C, vitamin D, vitamin E, riboflavin, iron, zinc, and selenium.¹² If you are not obtaining adequate amounts of these nutrients in your daily diet, it may be a good idea to consider a nutritional supplement.

Antioxidants, like vitamin C and vitamin E, for example, play a very important role in immunity, by helping to prevent oxidative stress in immune cells.¹² In fact; studies have shown that high doses of vitamin C can help to significantly reduce the severity of cold symptoms.¹³ Other nutrients, including essential fatty acids, certain mushroom extracts and probiotics, have also been shown to have a positive effect of the immune system.

Staying Healthy

Your body's defenses are highly complex, and work every day to help keep you healthy. While it is impossible to avoid getting the occasional cold or flu, there are ways you can help to keep yourself and others healthy. For example, certain common sense actions should be taken, including washing your hands frequently and thoroughly, avoiding touching your face, coughing and sneezing into your sleeve or in a tissue rather than your hand and cover both your nose and mouth, staying home if you are sick and avoiding close contact with sick individuals. Furthermore, by maintaining a healthy lifestyle and reducing the stress in your life you can help to make sure your immune system is healthy and reduce your risk of getting infected with a cold or flu virus.

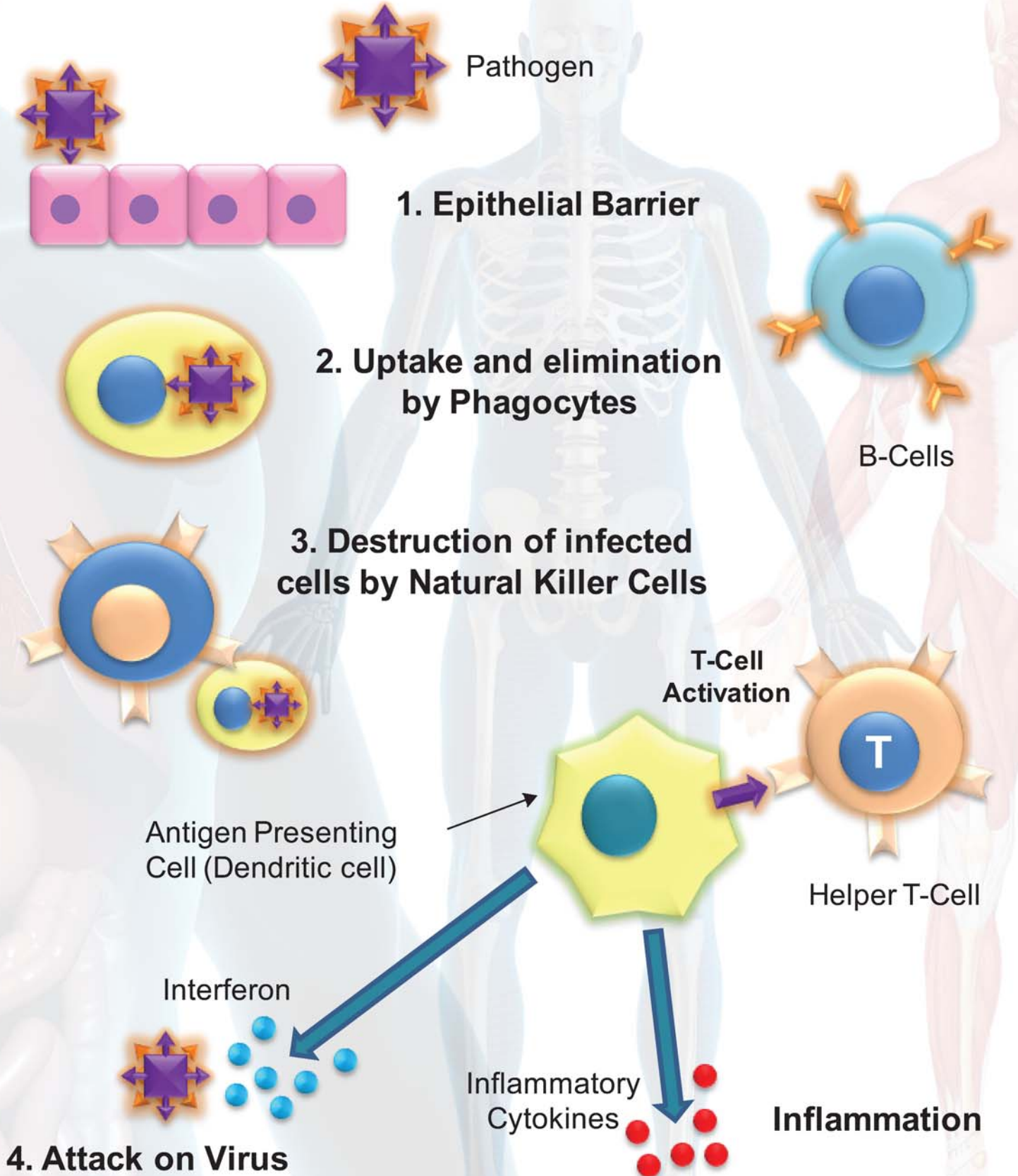
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The advertisement is divided into two main sections. On the left, there is a white plastic bottle of 'Advanced Series Immune Support' capsules. The label is purple and white, featuring the 'AOR' logo and text including 'EN: 151954', 'advanced series', 'IMMUNE SUPPORT FORMULA', 'FORMULE DE SUPPORT POUR LE SYSTEME IMMUNITAIRE', 'IMMUNE SUPPORT', 'WITH/AVEC Immune Multi', '60 VEGI-CAPS', '627 mg', and '100% VEGETARIAN'. To the right of the bottle, the text 'Superior Cold and Flu Protection' is written in a large, bold, purple font. On the far right, there is a photograph of a woman with dark hair and large hoop earrings, wearing a light-colored top, sneezing into a white tissue.

Innate (non specific) Immunity

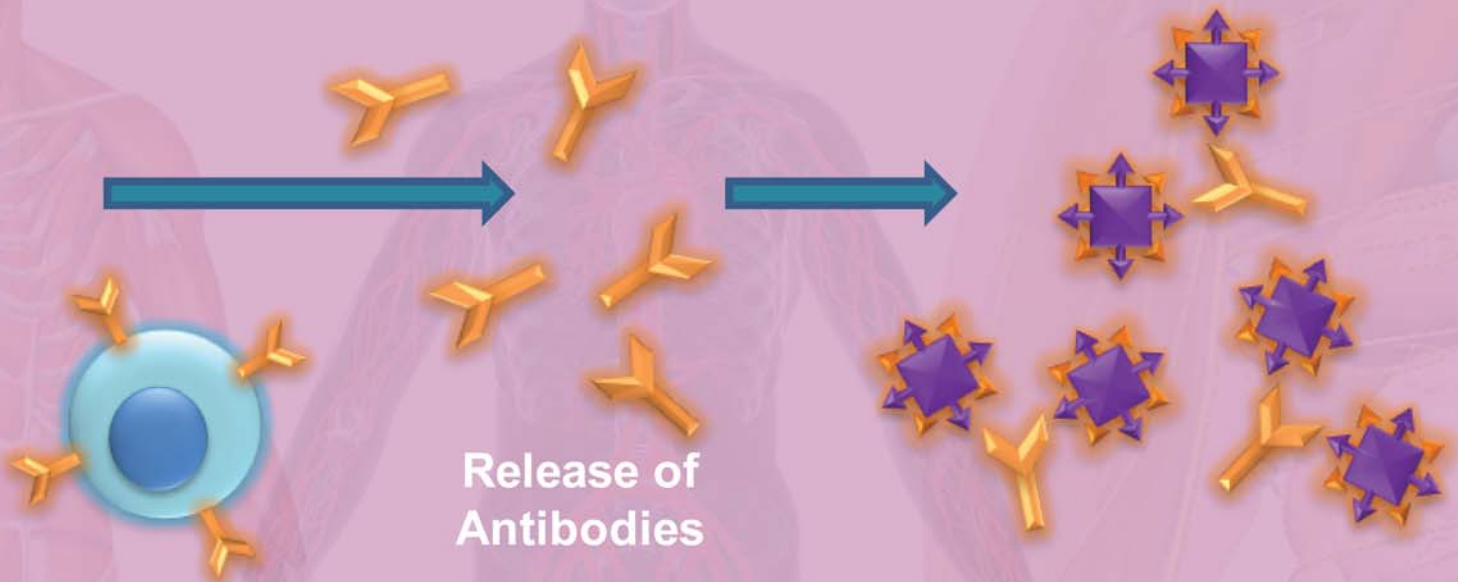


0 - 12 HOURS AFTER INFECTION

Adaptive (specific) Immunity

Humoral Immunity

Neutralization and Destruction of Pathogens

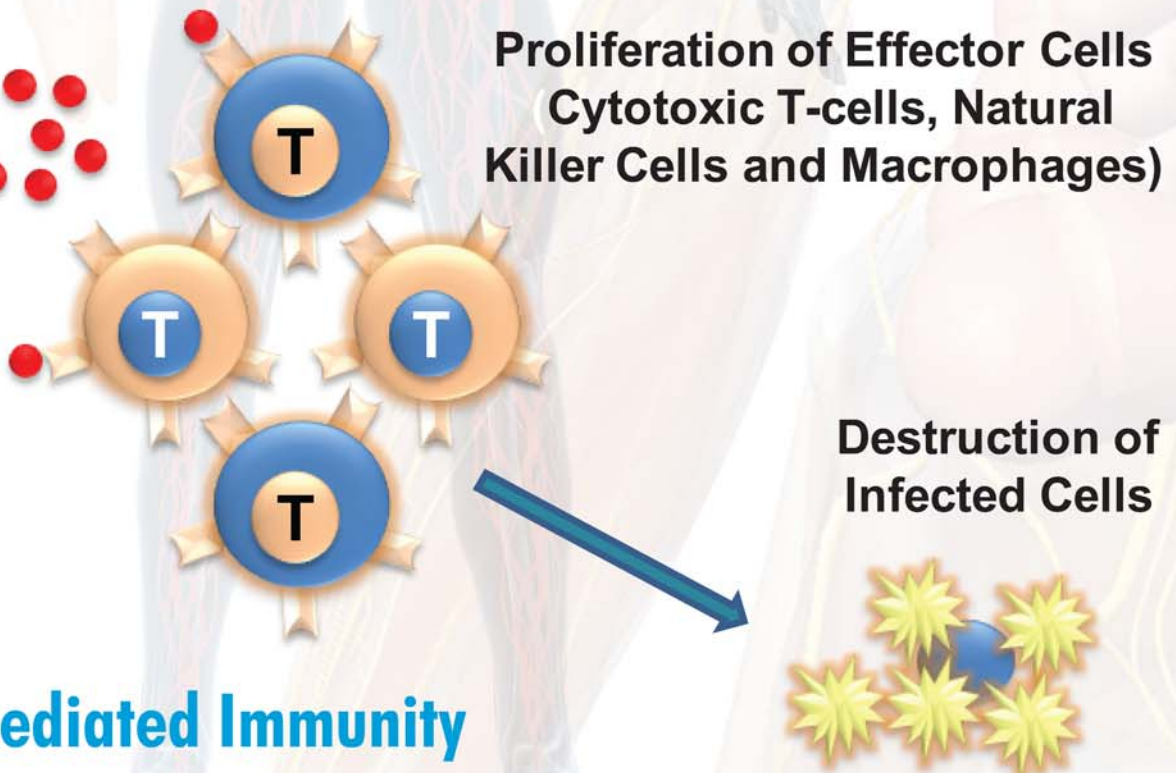


Release of Cytokines

Proliferation of Effector Cells
(Cytotoxic T-cells, Natural
Killer Cells and Macrophages)

Cell-Mediated Immunity

Destruction of Infected Cells



1 - 5 DAYS AFTER INFECTION