Vaccination Factsheet **Primary source material reprinted from Fischetti, Mark (2001) "Preparing for Battle" Scientific American 284(2): 82-3 and Haseltine, William A. (2001) "Beyond chicken soup" (antiviral drugs) Scientific American 285(5): 56-63. (C) Scientific American, Inc. Edited for Bio 111, SUNY Cortland.**

Treatments are only effective if they are used for the correct pathogen. The common cold and influenza are caused by *viruses*. Viruses do not contain the chemical machinery (enzymes) needed to carry out the chemical reactions for life. So, a virus must have a host cell (bacteria, plant or animal) in which to live and make more viruses. Strep throat and tuberculosis are caused by *bacteria*. Bacteria are able to reproduce asexually through simple cell division, although they can also swap DNA. In the appropriate environment their populations can boom rapidly. Ringworm and athlete's foot are caused by *fungus*. These fungi are living organisms that colonize the surface of the body.

Vaccination *can be effective against viruses and sometimes bacteria and other pathogens (for example, the bacteria that causes tetanus).* Some vaccines provide a lifetime of protection. Others may need regular or yearly "boosters": oftentimes, this is to keep up with the changing genetics of the pathogen. For example, the influenza virus mutates rapidly, so entirely new vaccines must be developed on an annual basis.

***"Active immunity vaccination**" is created by exposure to a weak, killed, or otherwise disabled virus.* This direct exposure to antigens establishes *long term immunity* by the creation of memory cells:

1 *An inactivated form of the virus is injected.* Macrophages and fast acting white blood cells, the immune system's front-line guards, identify the virus as an intruder because they do not have the body's MHC proteins markers.
2 Macrophages locate viruses and engulf them, then *display the antigens* on their own cell membranes. *This alerts the body to make the B and T cells to attack that pathogen.* Because the injected flu virus was disabled, it actually poses no health threat, but its presence is enough to cause the immune system to respond: the body makes B and T cells, and the B cells make antibodies. (If you feel sick after a vaccination, it is usually the immune response you are feeling, which may also include inflammation.).
3 If you inhale the live virus sometime in the future, there are two immune system defenses that are now prepared to attack the infection immediately:
--the antibodies that were generated in response to the vaccination may linger on in the body and will help limit invaders.
--most importantly, "memory" T and "memory" B cells were created as well: they stay in the body and are primed to attack that specific invader. Memory B and T cells will initiate a secondary immune response that includes the production of more white blood cells and the production of new antibodies. So, by exposing you to antigens, vaccines allow your body to mount a secondary response without having to get sick in the first place.

"Passive immunity vaccination" is achieved by *directly injecting antibodies* that were made in the lab or by a infected stock animal (i.e. horses or pigs). This is only a *short-term solution* because the body *cannot continue to make more antibodies: the B cells have not been taught to recognize the pathogen.*

Vaccines can be very successful: polio had been essentially eradicated in the US because of vaccination. However, federal studies indicate that fewer than 50 percent of U.S. children now receive the complete regimen of recommended vaccines. Because some people are hesitant to vaccinate children, outbreaks of measles, mumps, and even polio are being increasingly documented

in the Europe and the US. These diseases are also more prevalent in poorer countries where vaccination is limited by expense.