

Name:  
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## Vaccines and the Body Systems

**Background:** A vaccine against a disease works by generating an immune response in the body against some kind of pathogen—a virus, bacterium or some other agent that causes the disease. Normally when a pathogen invades the body, the immune system works to get rid of the pathogen. Often, though, the immune system gets a slow start, which gives the pathogen time to multiply and cause trouble. What a vaccine does is expose the immune system to a less-threatening version of a pathogen and, in effect, prime it to recognize and quickly eliminate the innocuous (harmless) pathogen's harmful counterpart, should it ever invade the body.

**How Vaccines Work:** Vaccines help develop immunity by imitating an infection. This type of infection, however, does not cause illness, but it does cause the immune system to produce T-lymphocytes and antibodies. Sometimes, after getting a vaccine, the imitation infection can cause minor symptoms, such as fever. Such minor symptoms are normal and should be expected as the body builds immunity. Antibodies recognize specific antigens found on the vaccine and related virus. The body continues to build antibodies that stay in your body and travel in the circulatory system. If the actual virus invades, these antibodies will recognize the antigens and “kill” the invading virus before it can cause harm.

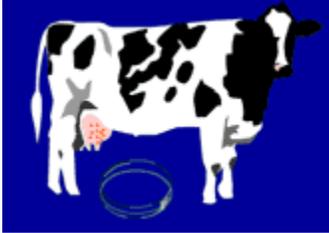
**Look at the CLASS COPY “Making Vaccines” and read how a vaccine is made.**

### Questions:

1. What is a pathogen?
2. What does the immune system do when a vaccine enters the body?
3. What is the role of antibodies?
4. How is the circulatory system involved in killing viruses?
5. Why might you get a mild case of the flu after getting a flu vaccine?
6. Why is cowpox used to treat smallpox?
7. Why is the virus isolated from the fluid removed from the “pus” of a cowpox sore (pustule)?

## Making Vaccines

Similar-pathogen vaccine: smallpox virus

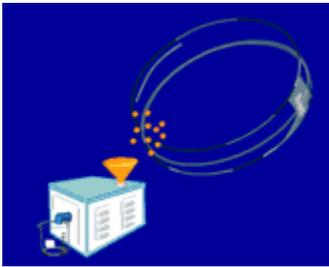


### Step 1

Use the sterile petri dish to collect fluid from pustules on the cow's udder.

To create a vaccine that will protect you against a pathogen, you usually begin with that pathogen and alter it in some way. Not so with smallpox. To create this vaccine, you begin with another virus that is similar to the smallpox virus, yet different enough not to bring on the smallpox disease once it enters your body. This similar virus is cowpox.

The cow to the left has been intentionally infected with cowpox virus. The fluid that you collect from virus-caused pustules on the cow's udder contains many copies of the virus.



### Step 2

Use the purifier to isolate the viruses

Smallpox vaccines contains cowpox viruses but not the bacteria and other impurities found in the fluid collected from such pustules.

To make the vaccine, therefore, you'll need to separate the cowpox viruses from the rest of the fluid.



### Step 3

Fill the syringe with the purified cowpox viruses.

The smallpox vaccine is a live vaccine; the cowpox viruses it contains will invade cells in your body, multiply, and spread to other cells in your body, just as the smallpox viruses would. And as with smallpox, the body's immune system will mount an attack against the cowpox and subsequently always "remember" what it looks like. Then, if cowpox or the similar smallpox ever enters the body, the immune system will quickly get rid of the invaders.

Congratulations. You have just created a vaccine for smallpox.



### Done

The smallpox vaccine is complete.

At one time, cows were used to create the smallpox vaccine. In fact, the decades-old stockpile in the U.S. today was made using live calves through a process similar to the one outlined here. Advancements in biotechnology, however, have led to more efficient procedures that make use of bioreactors.