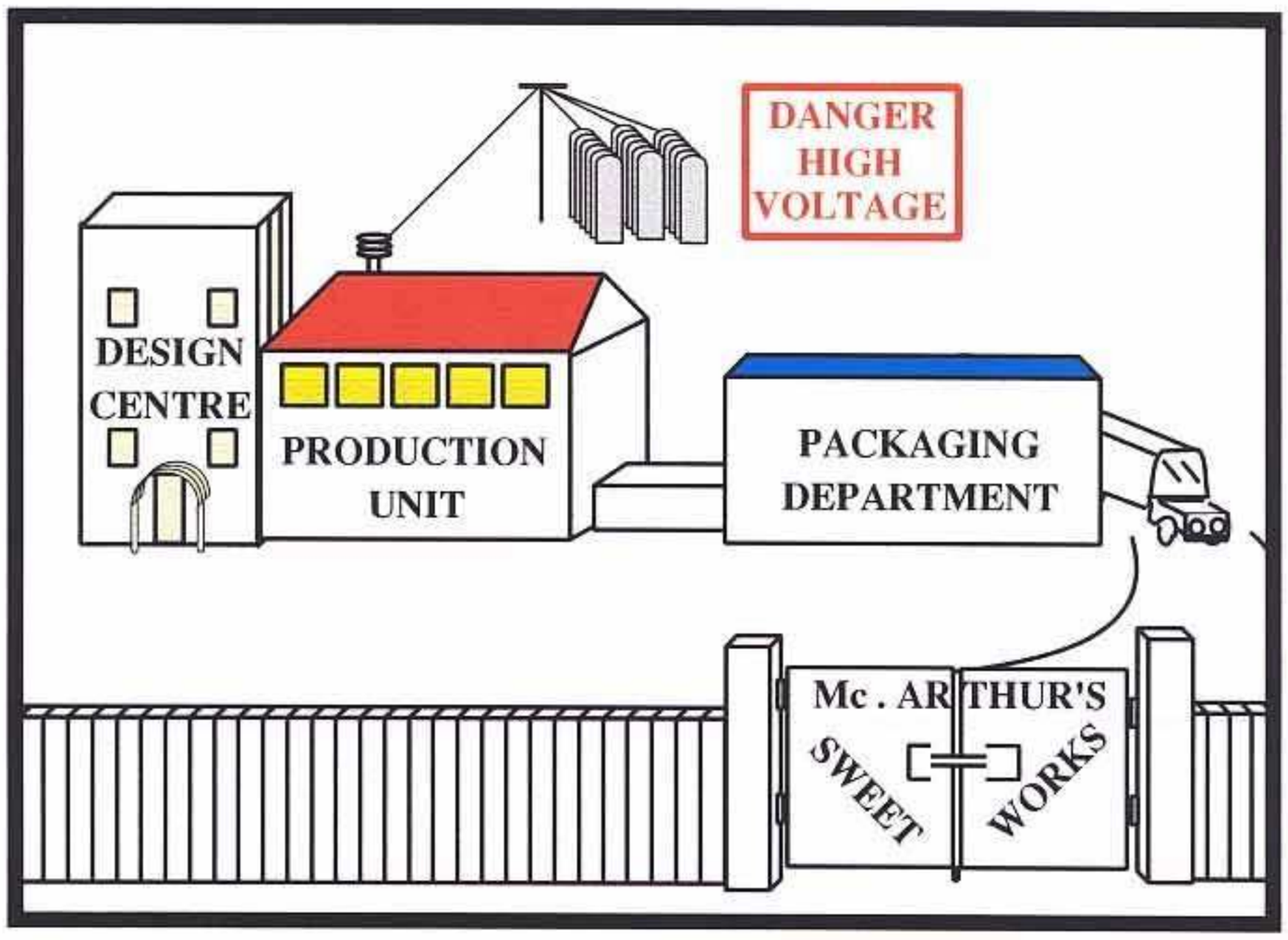
CHAPTER SIX

UNDERSTANDING VIRUSES

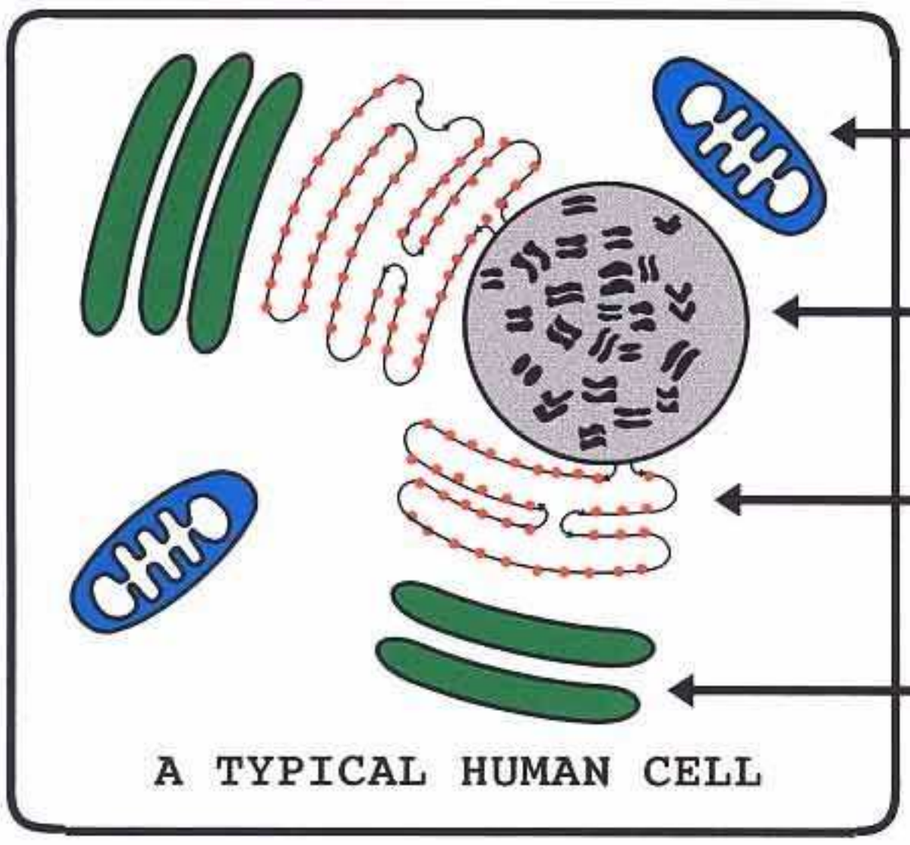
THE WORKINGS OF A NORMAL CELL



A cell is similar to a factory complex, where separate areas work together to produce a finished product.

Easy reading

Technical information



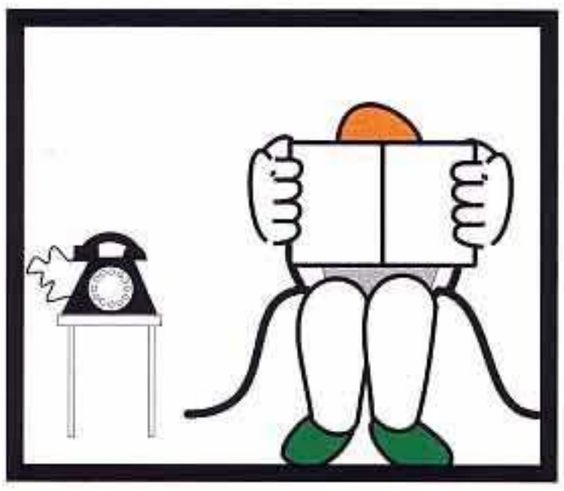
A mitochondria generates energy to power the cell.

The nucleus with its chromosomes, is the cell's 'design centre'.

The rough endoplasmic reticulum does all the 'production' work.

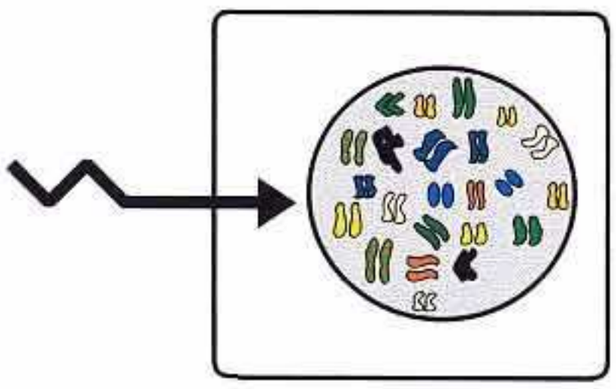
The golgi apparatus must then 'package' the finished product before it can leave the cell.

INSIDE THE NUCLEUS OF THE McARTHUR SWEET FACTORY

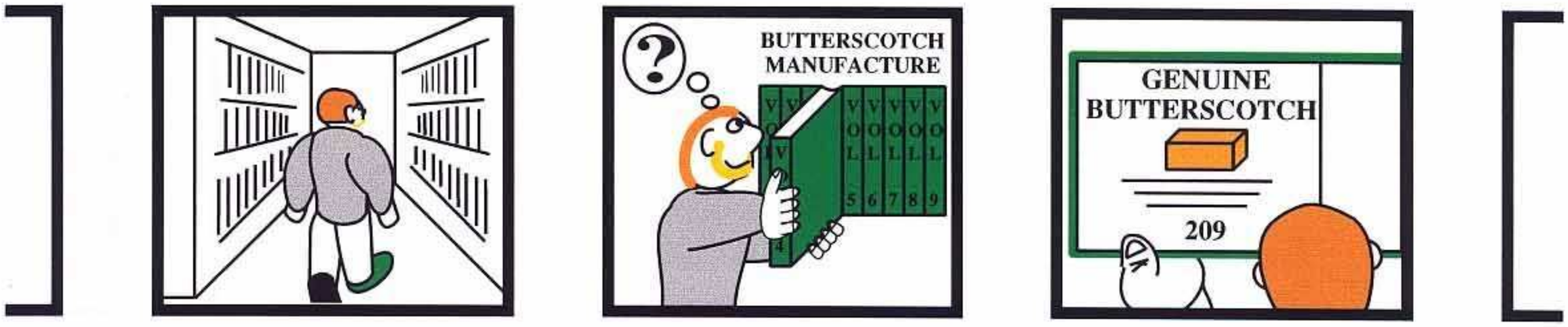


Nick, an enzyme in the nucleus, was reading his morning paper.

But he didn't have to wait long for the first order of the day to arrive.



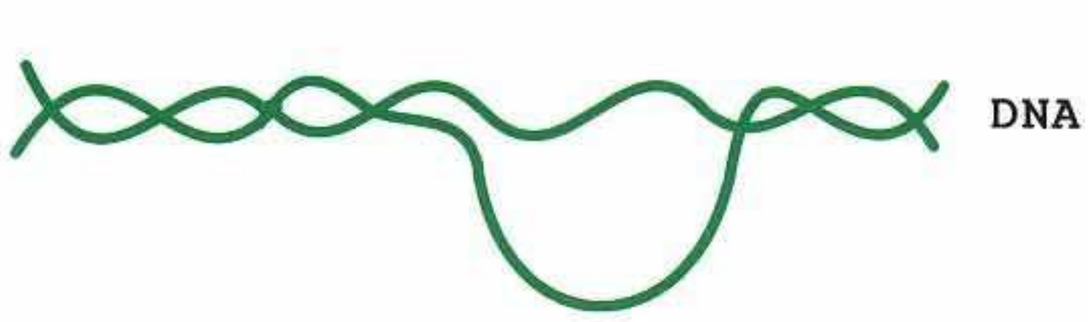
This cell receives a message (eg a hormone), which triggers it into making a particular product.



After receiving the phone call, Nick goes to the far end of his office where all the reference books are kept.

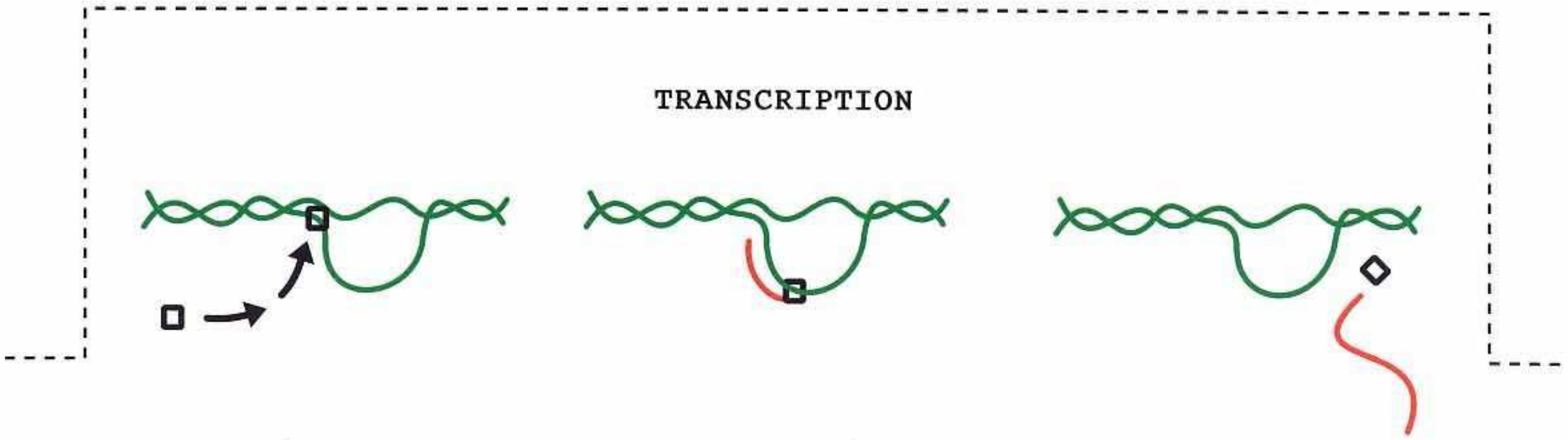
He now turns to the appropriate page.

GAINING ACCESS TO INFORMATION ON A CHROMOSOME

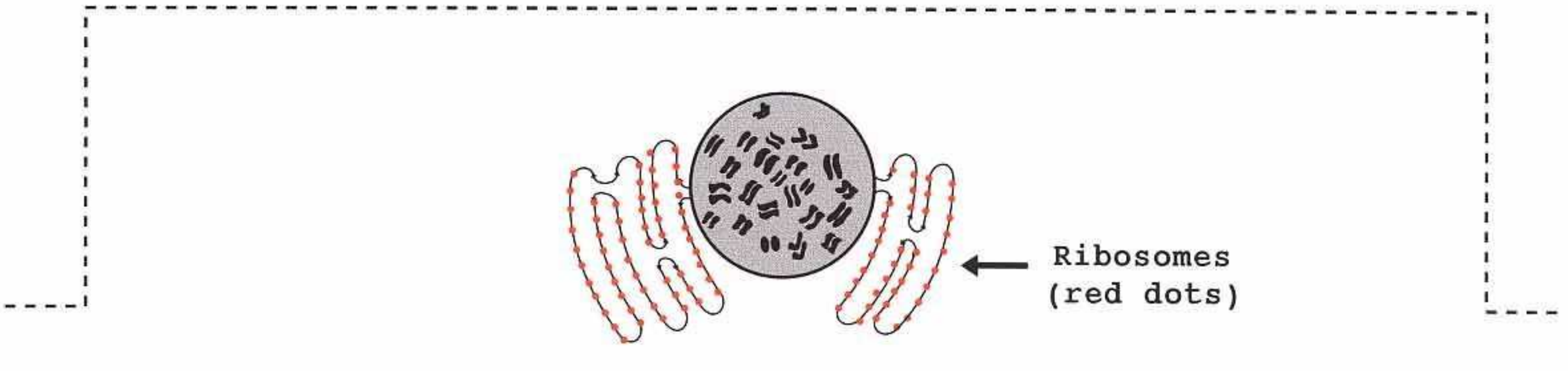


Enzymes inside the nucleus, unwind a small length of this chromosome's DNA.

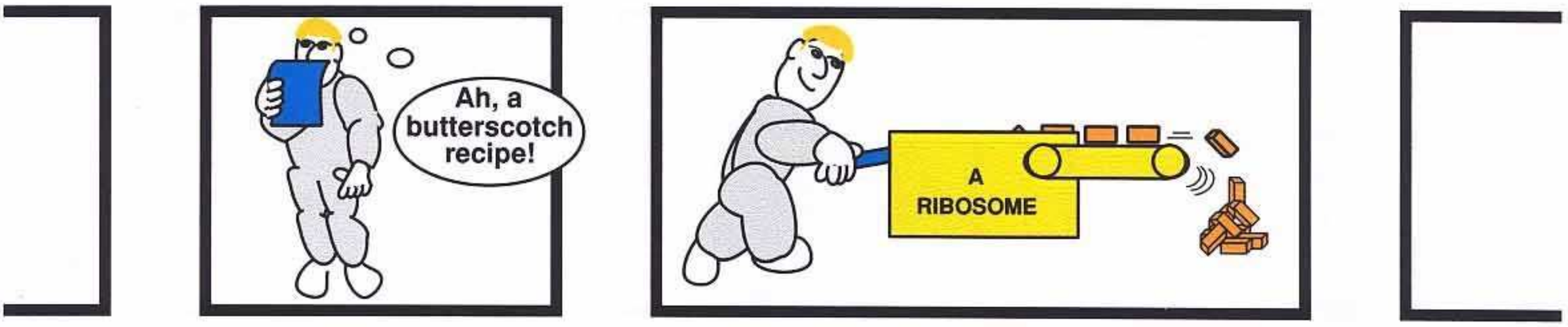
As the reference books are too valuable to be taken out of his office and onto the shop floor, Nick photocopies the recipe.



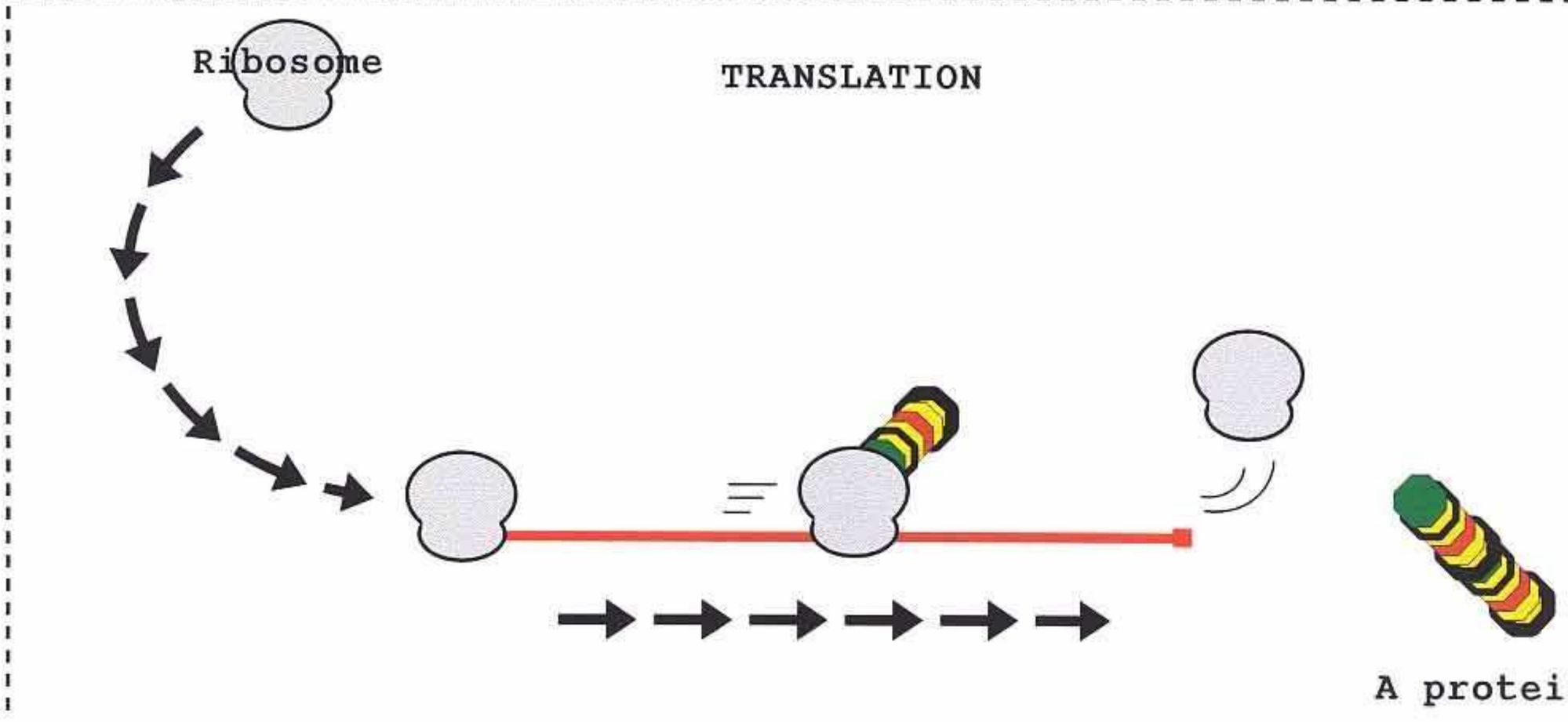
Alice takes the photocopied recipe and leaves the design centre for the production unit.



The messenger RNA is transported out of the nucleus and into the rough endoplasmic reticulum.



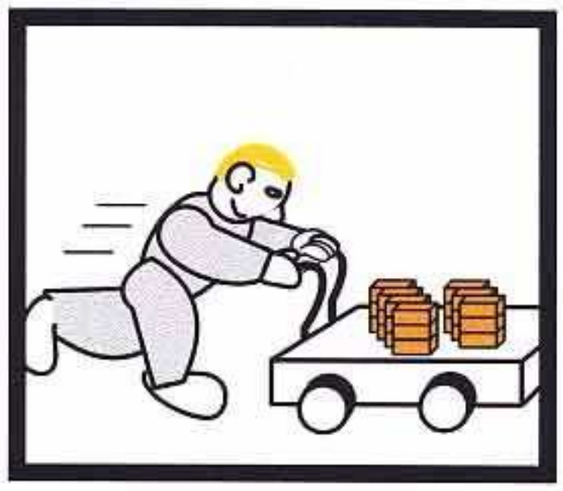
Frankie, one of the workers on the shop floor, inserts the recipe into a ribosome and butterscotch production begins.



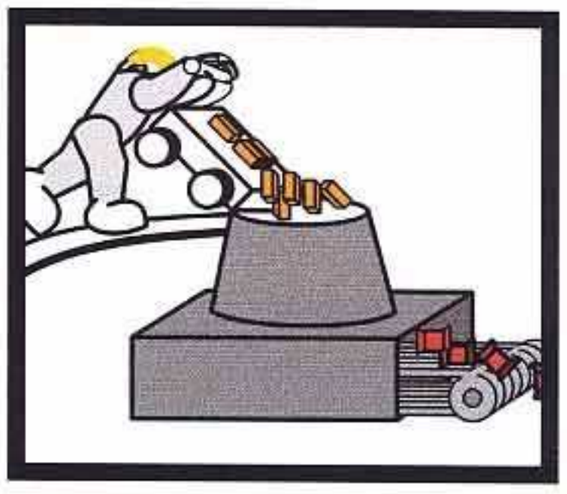
A ribosome attaches onto the mesenger RNA. Then as it moves along the RNA, protein synthesis begins.

Reaching the end of the RNA, the protein detaches and the ribosome returns to start another 'run' along the RNA.

Kieth, one of the other workers, now gathers up the butterscotch.

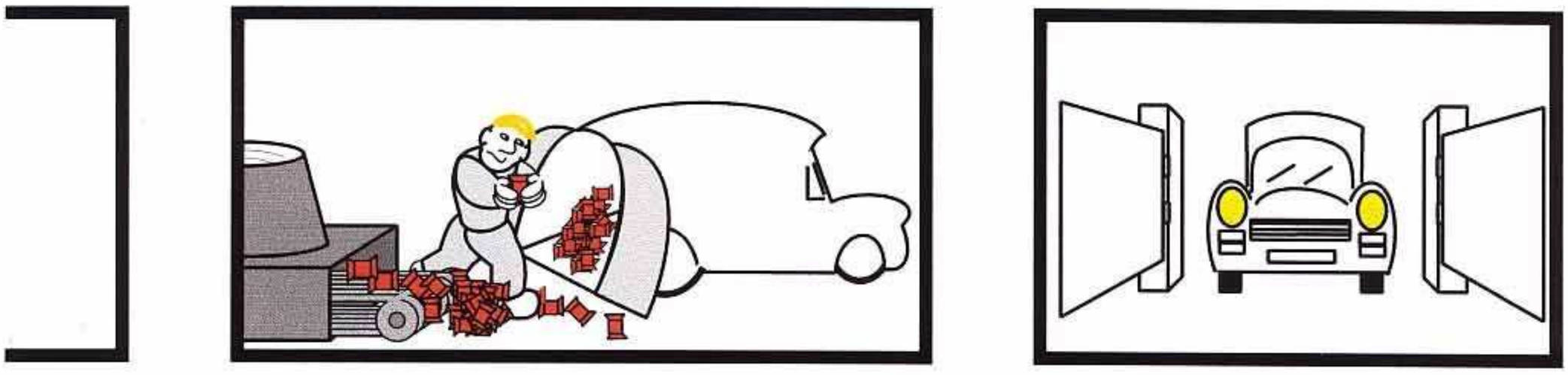


He then quickly speeds off to the factory's packaging department.



Soon things are wrapped up!!!.

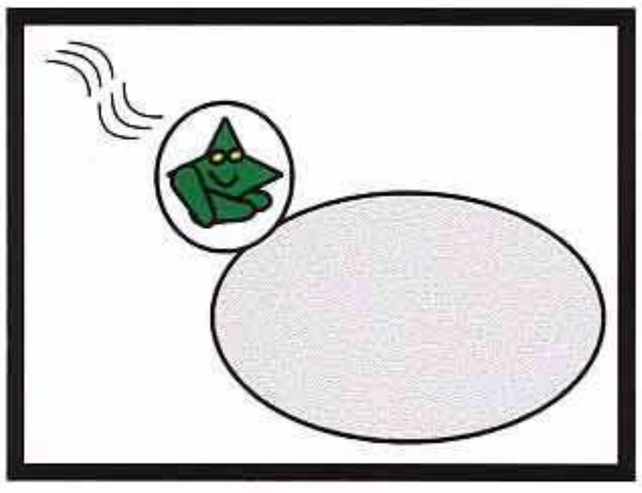
The protein is now transported to the golgi apparatus for 'packaging'.



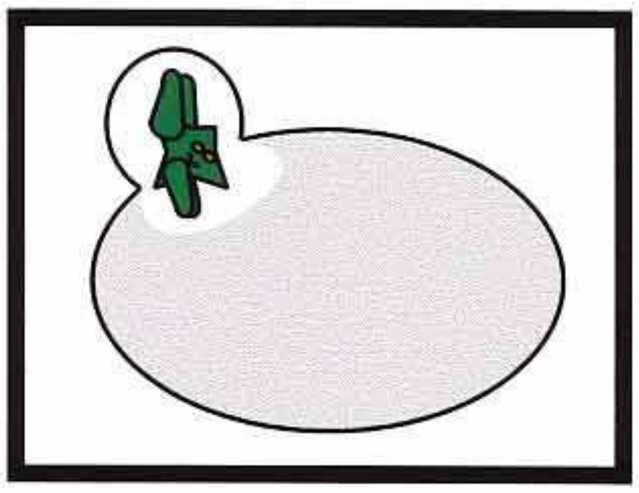
After being wrapped, the sweets are loaded into a van and are soon on their way.

Once 'packaged', the protein is released from the cell into the blood, so it can be utilised by another part of the body.

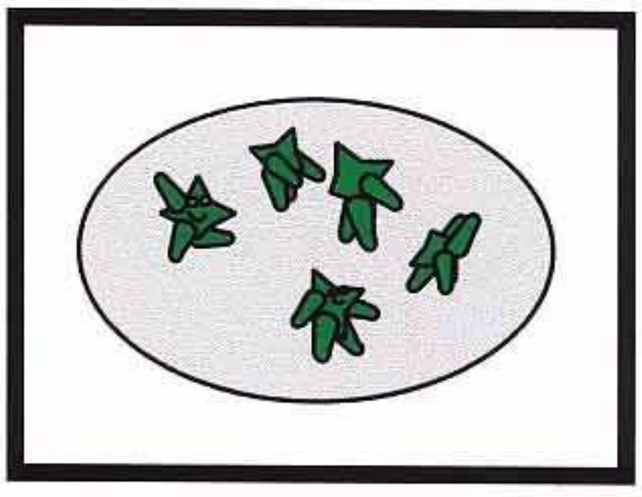
TO SURVIVE AND REPLICATE, A VIRUS MUST ENTER A LIVING CELL



A virus contacts the outer surface of this target cell.



The 2 membranes fuse, allowing viral material to flow into the target cell.



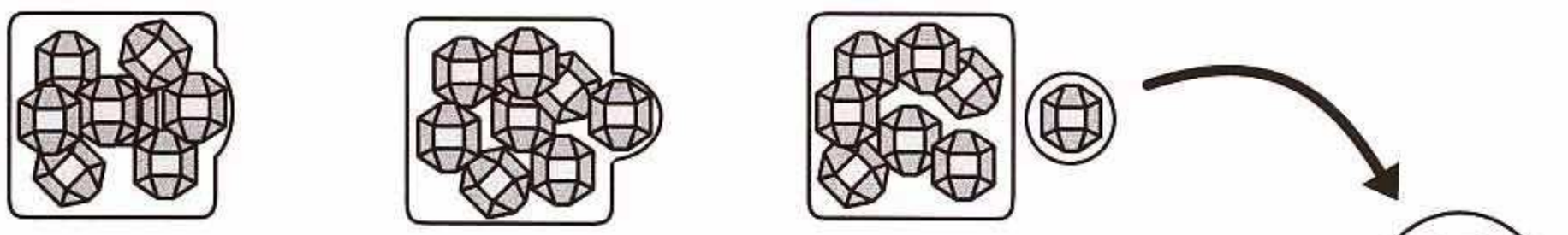
Viral replication can now start inside the cell.

A VIRUS

A virus is little more than a protein coat called a "capsid" (1), protecting a small amount of genetic material (2).

THE 2 WAYS A VIRUS CAN LEAVE A HOST CELL

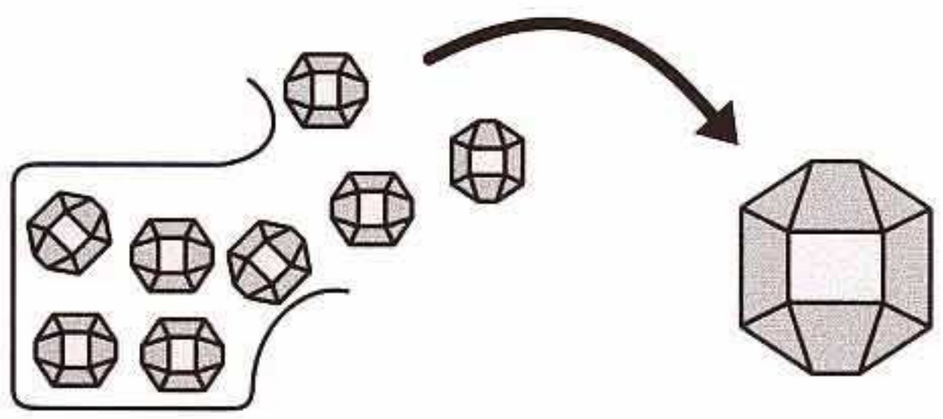
1



BUDDING

The emerging virus is coated in the host cell's membrane.

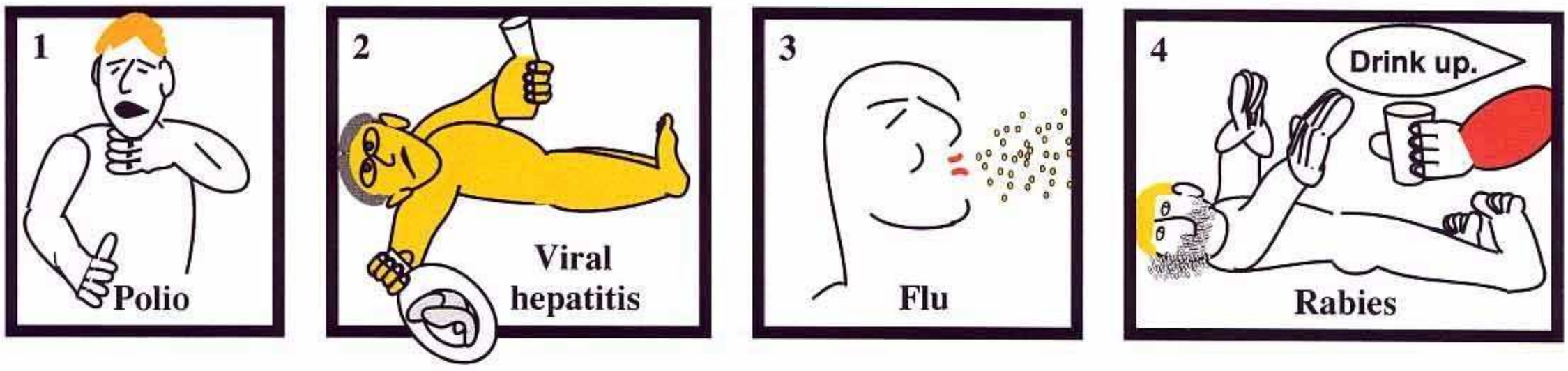
2



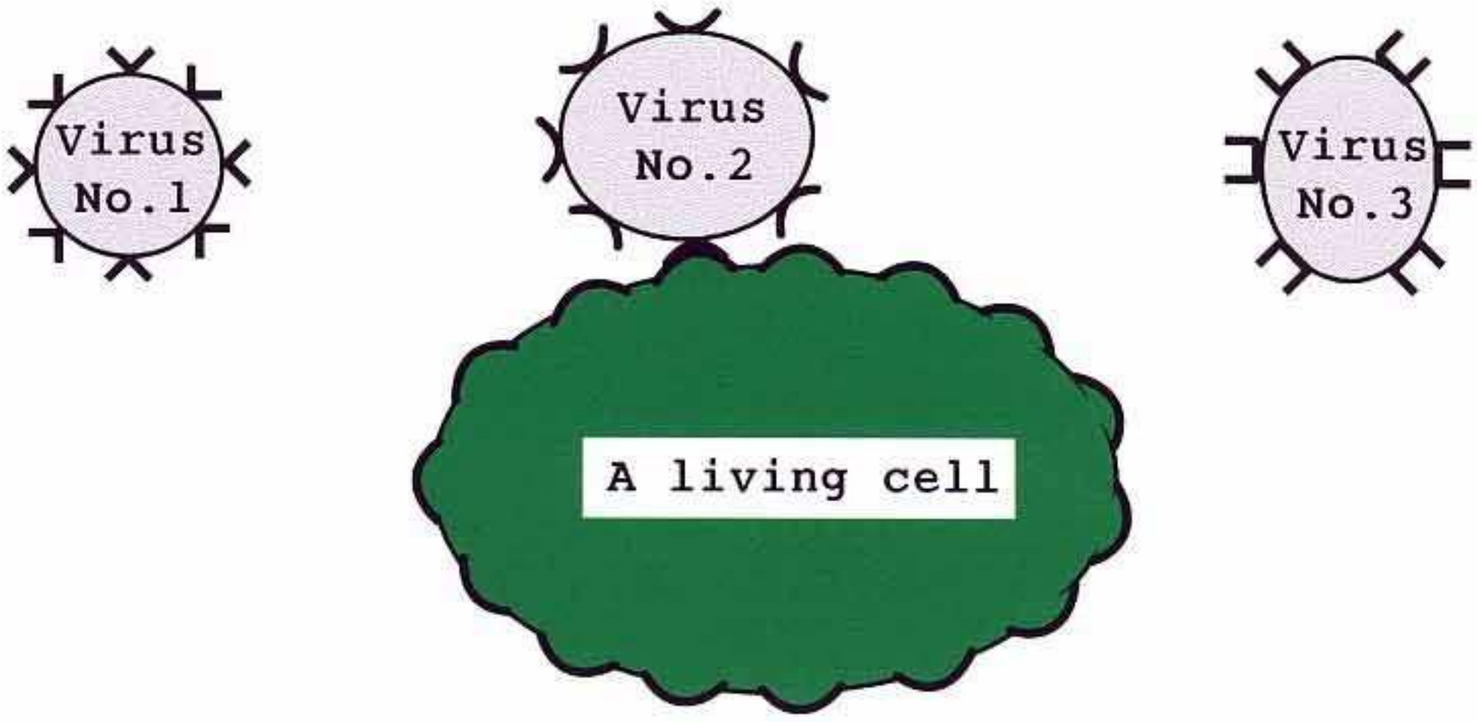
LYSIS

The infected cell bursts and this releases nude viral particles.

4 VIRAL INFECTIONS

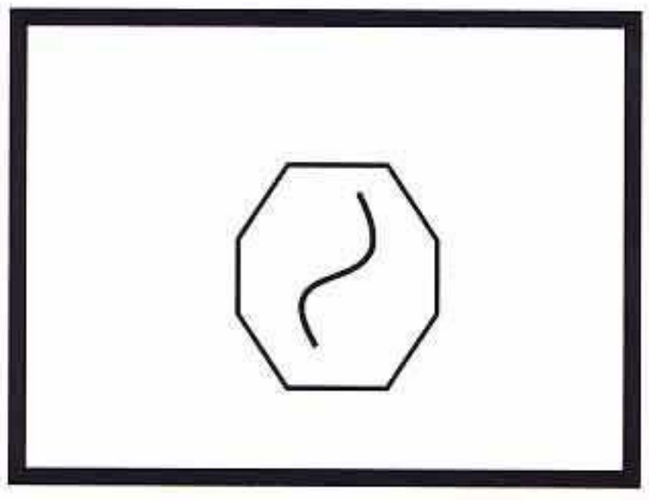


Each of these viral infections results in the appearance of very specific signs and symptoms. This is simply due to the fact that a virus is very limited in the cells it can infect (penetrate).

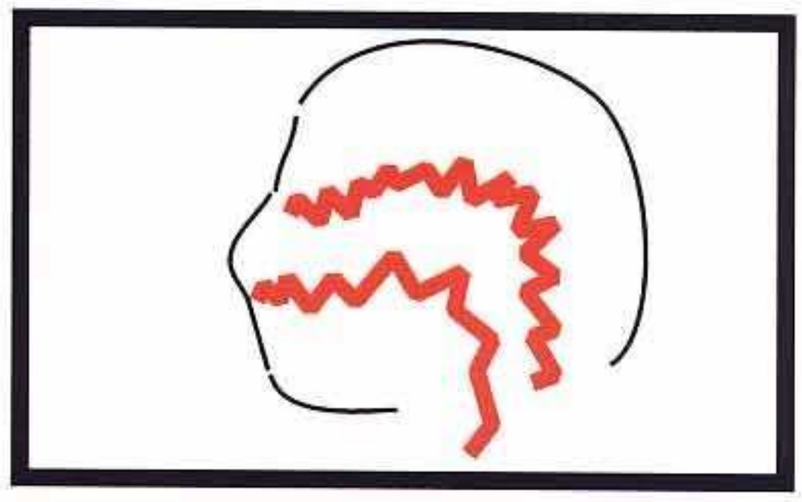


Before a virus can enter and infect a cell, it must have the right shaped surface receptors, to be able to attach onto the target cell's membrane.

THE COMMON COLD / RHINOVIRUS

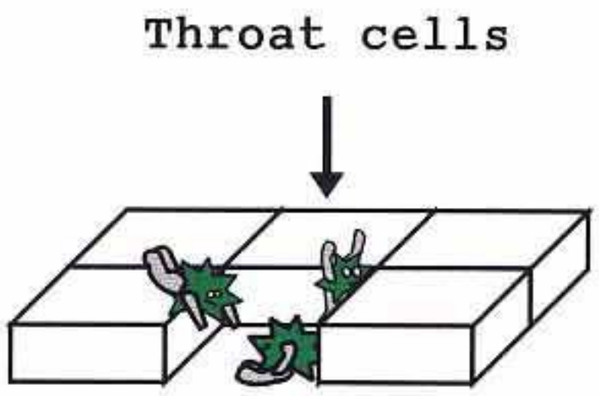


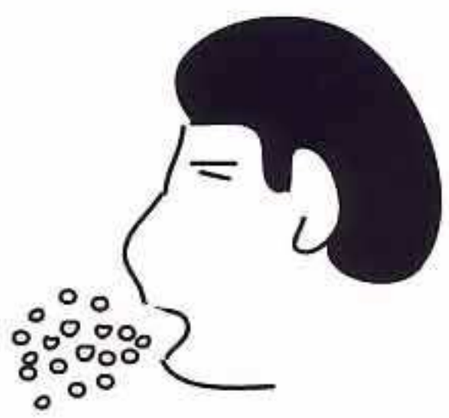
The rhinovirus contains a single strand of viral RNA.



It infects cells lining the upper respiratory tract. The resulting inflammation and oedema produces a dry cough and runny nose.

The rhinovirus remains fairly localised, as it can only function at around 33°C and the body's core temperature is 37°C.



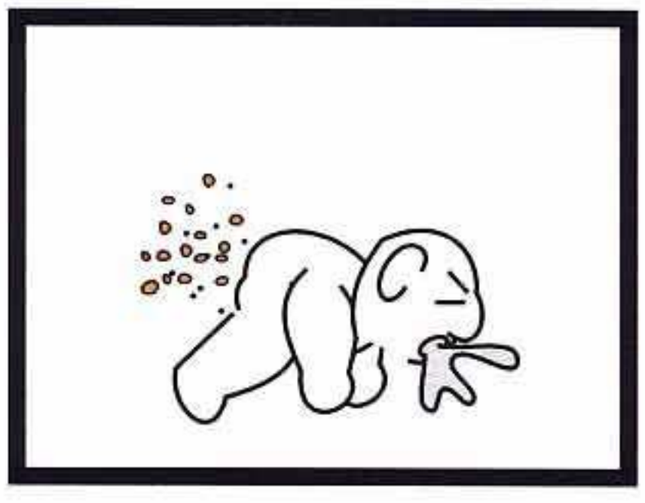


Damage caused by this virus can sometimes allow opportunistic bacteria to 'move in'.

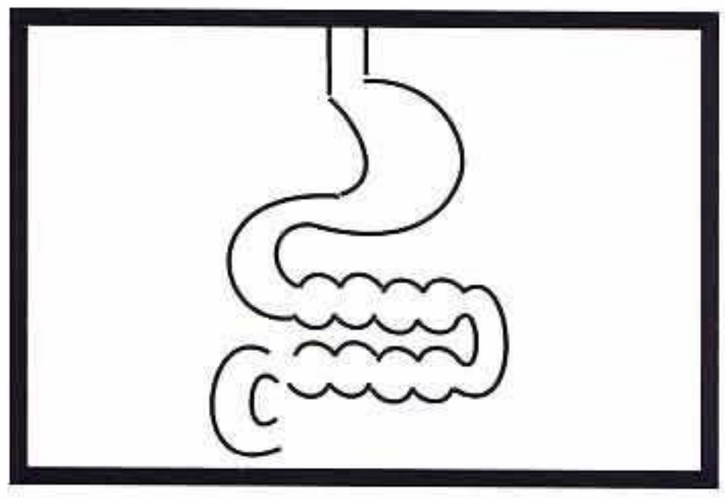
Now sputum starts to be expectorated and it is time for antibiotics.

THE ROTAVIRUS

The rotavirus is a double - stranded RNA virus.



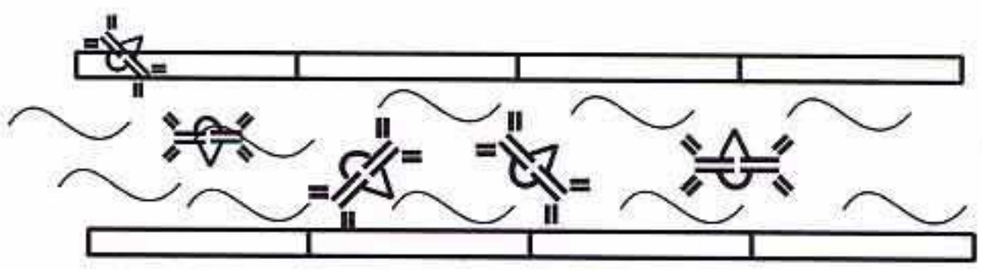
It mostly affects 6 to 24 month old babies, causing diarrhoea and vomiting.



The virus infects the lining of the small intestine, causing its microvilli to become flattened.

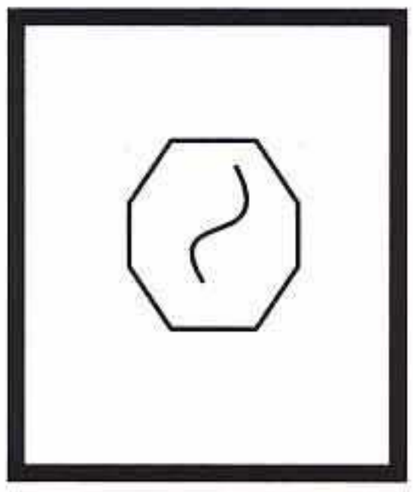
To help avoid this infection, it is important to wash your hands before feeding a baby.

POST INFECTION / IMMUNITY

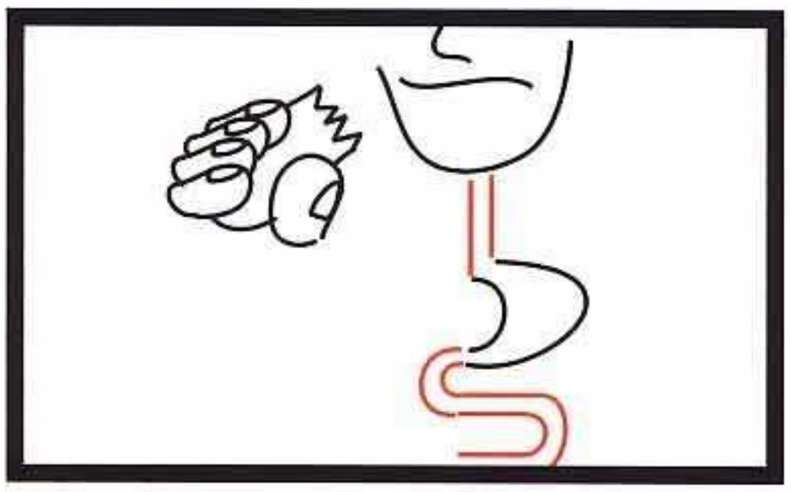


Following a rotavirus infection, IgA with 'hands' which fit this virus, are released into the gut.

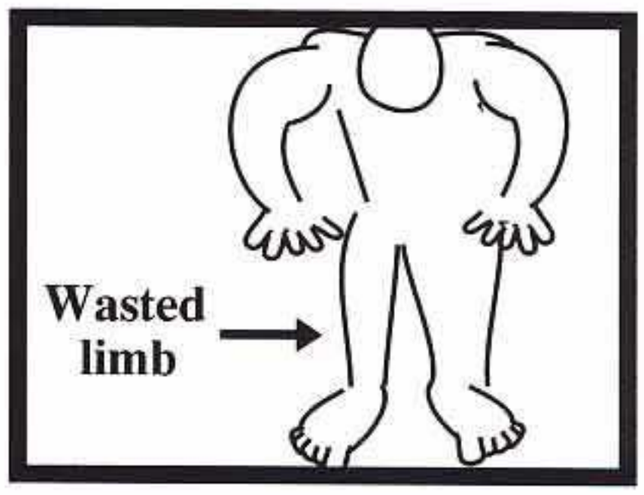
POLIOMYELITIS



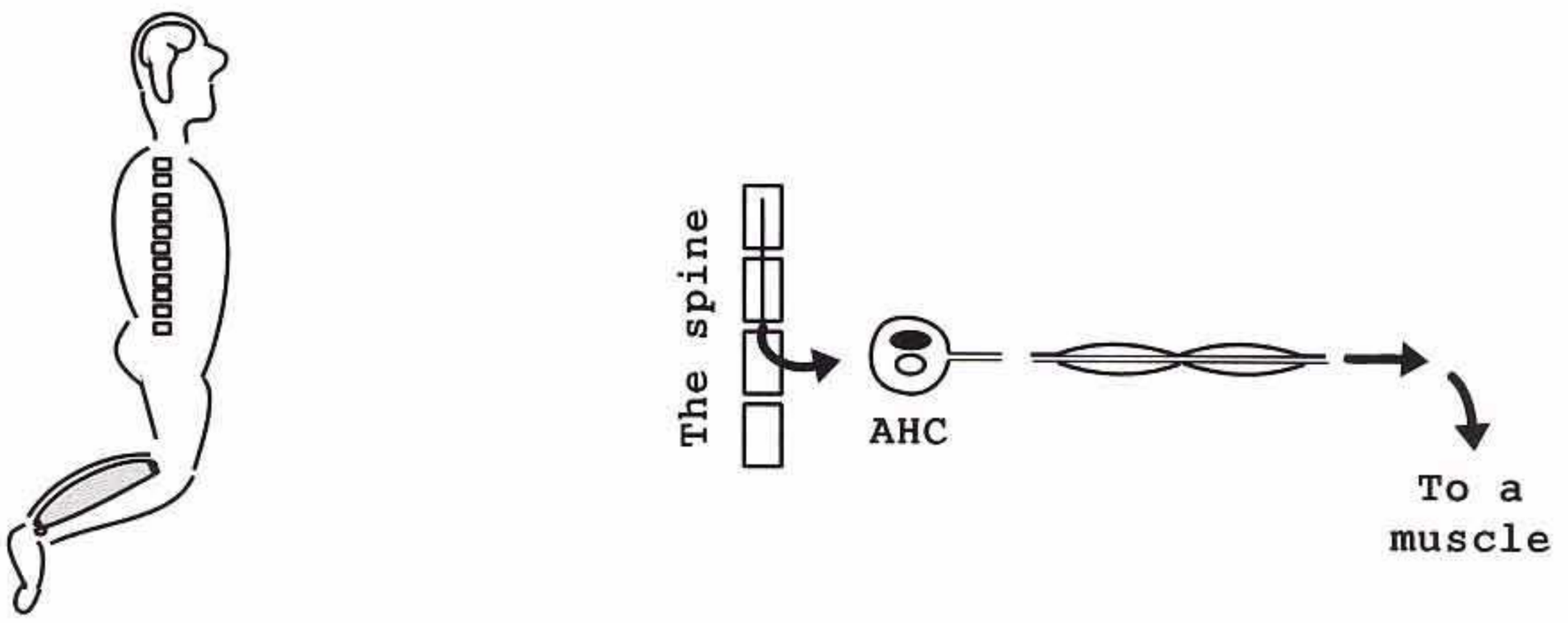
The poliovirus has a single strand of RNA.



The virus usually only infects the throat and intestines, producing mild symptoms (ie a sore throat).



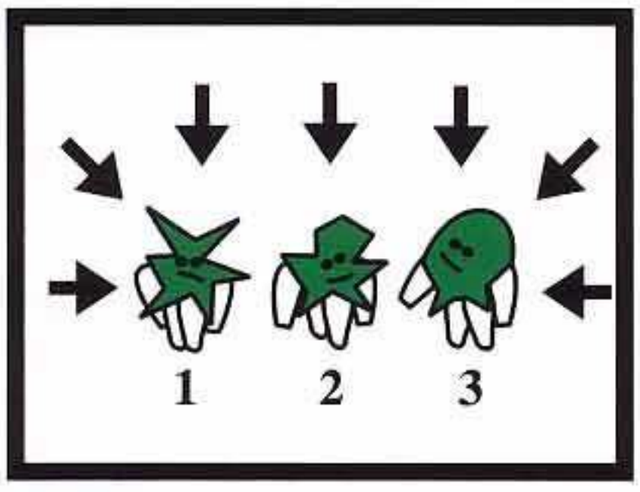
But in a few cases, the virus then reaches the spine and paralysis can now occur.



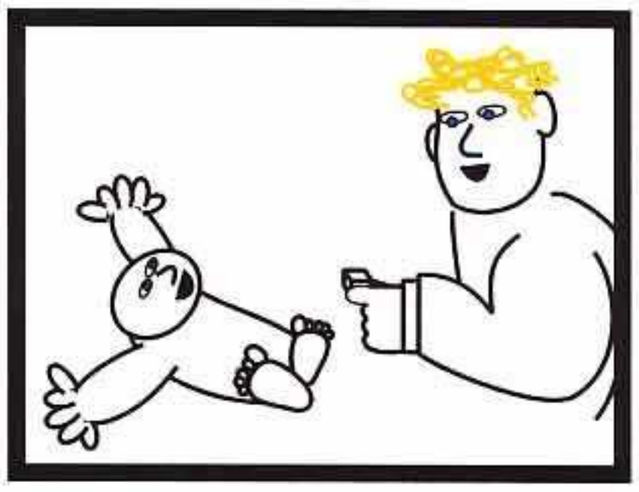
To move your foot, nerve impulses must pass from the brain, down the spine and out through the anterior horn cells (AHC's), to the muscles. The poliovirus can infect and destroy one or more AHC's which could prevent nerve impulses reaching the muscles and so lead to paralysis.

POLIO IMMUNISATION

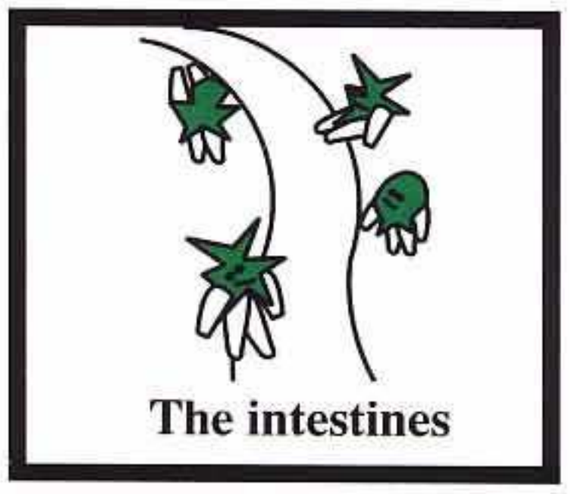
There are actually 3 closely related polioviruses.



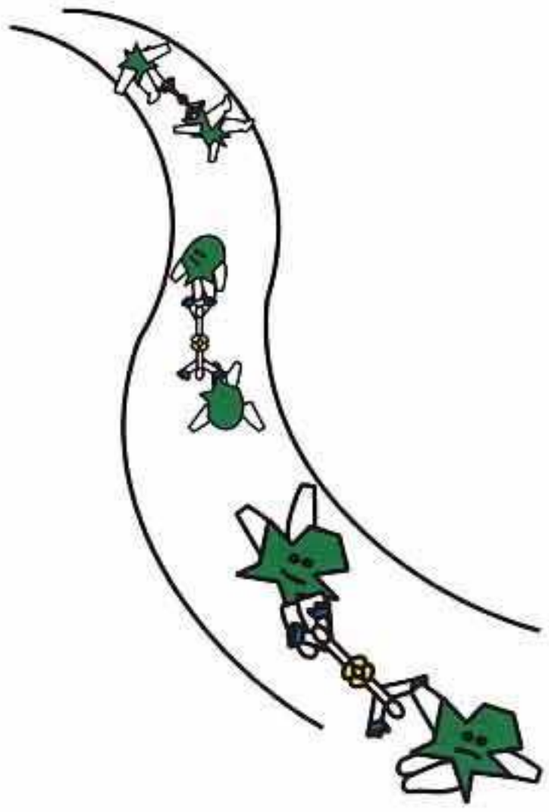
The 3 viruses are repeatedly breed (attenuated), so they remain localised in the gut.



The live (attenuated) vaccine is now given to a baby, sometimes on a sugar lump.



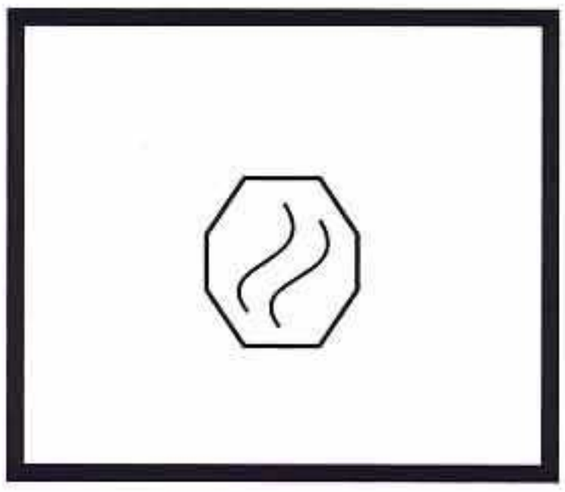
The treated viruses start to replicate in the gut.



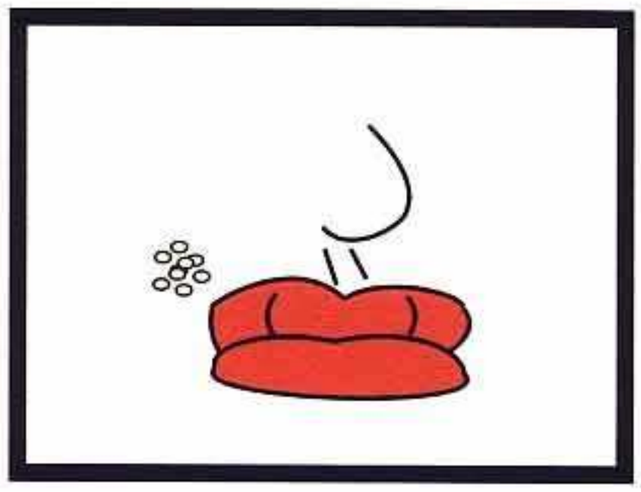
IMMUNITY (see page 48)

2 weeks later, anti - polio IgA are released into the gut. These attach onto the polioviruses so that they are flushed away. Anti-polio antibody production, will now continue for many years.

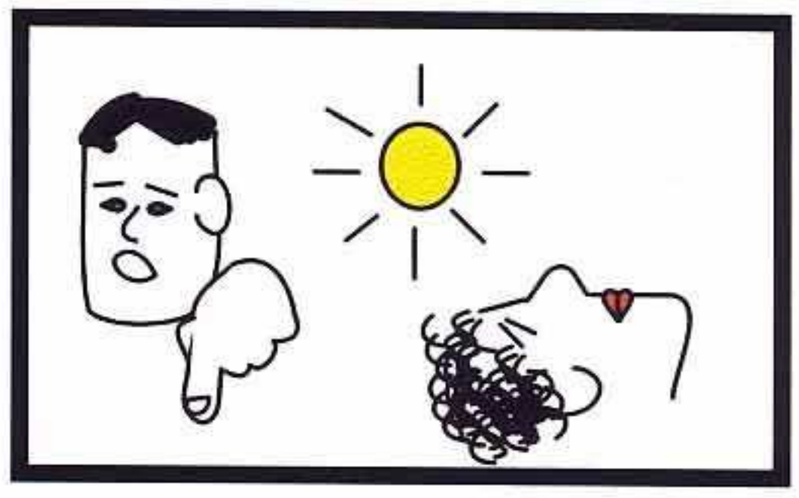
HERPES SIMPLEX



The herpes simplex virus is a double - stranded DNA virus.

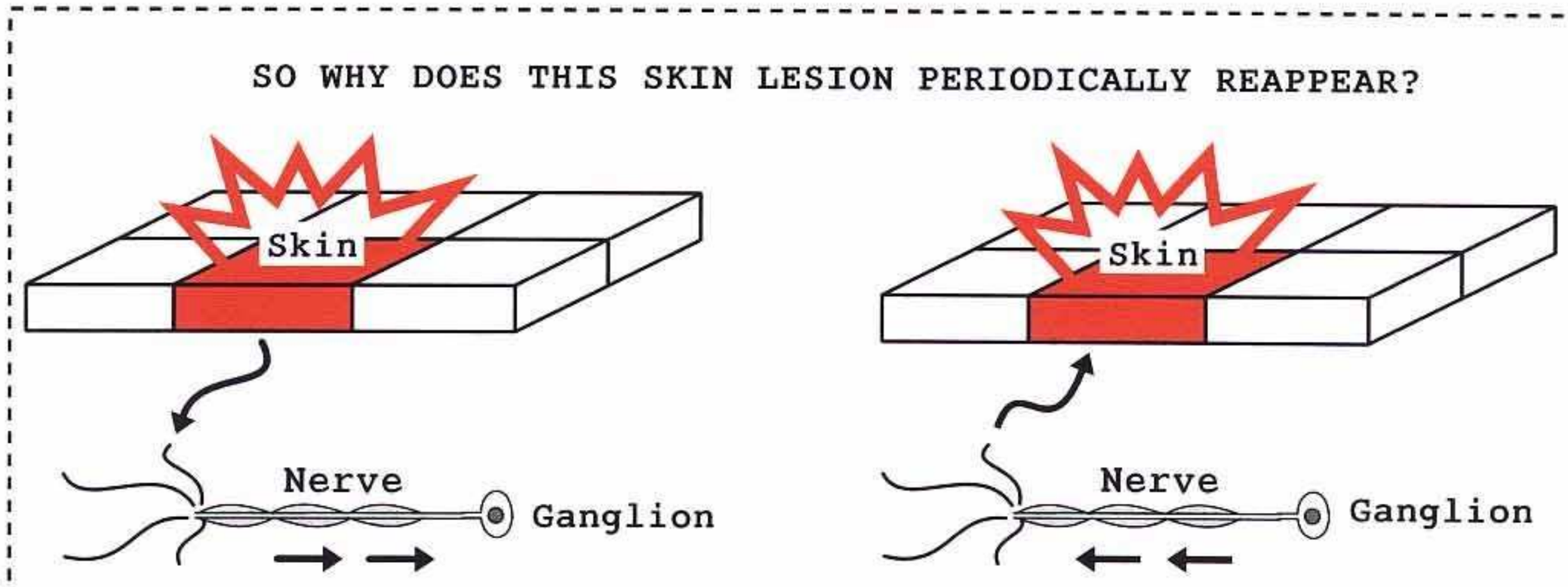


It causes painful blisters to erupt onto the skin, which then last a few days.



Weeks / months later, factors such as fear or sunlight can reactivate the virus and the cycle repeats itself.

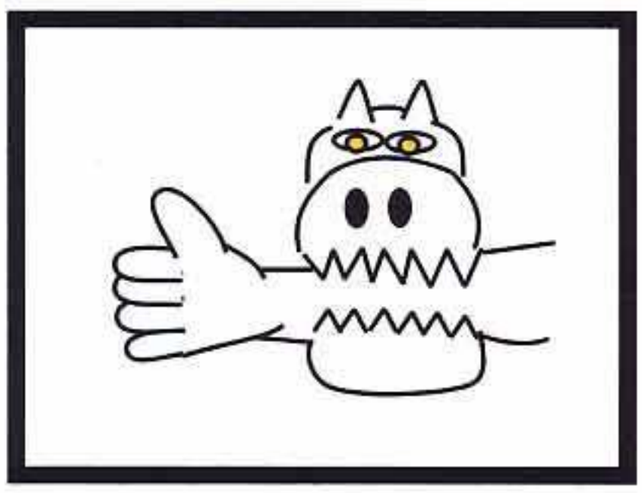
Close contact with other people must be avoided, whilst the virus is active.



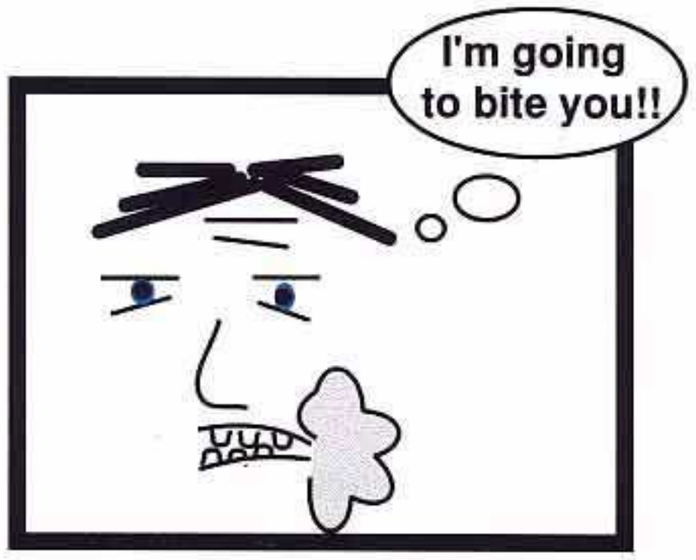
After infecting skin cells, the virus migrates along a sensory nerve to infect its ganglion. The infected skin cells are eliminated but not the infected nerve ganglion. Then at a later date, the virus reactivates and migrates back along the nerve, to reinfect skin cells.

RABIES

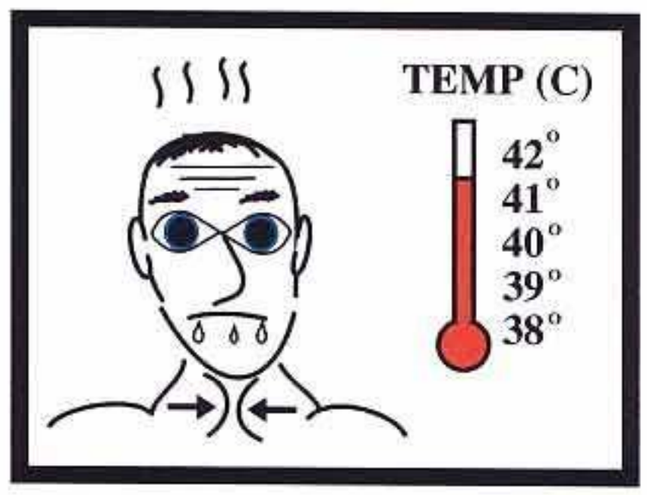
A single strand, RNA virus.



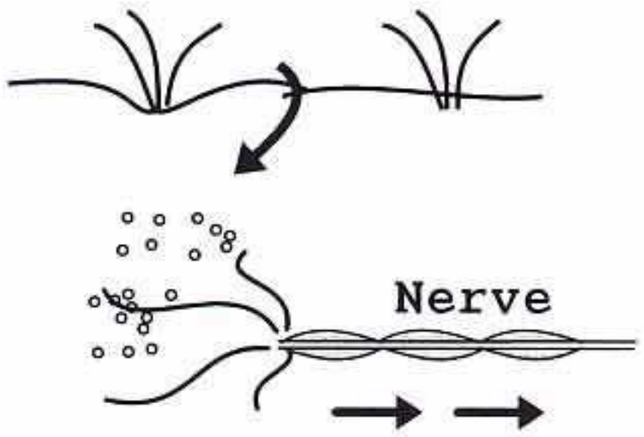
Rabies can be contracted if a bite from an infected animal, happens to puncture the victim's skin.



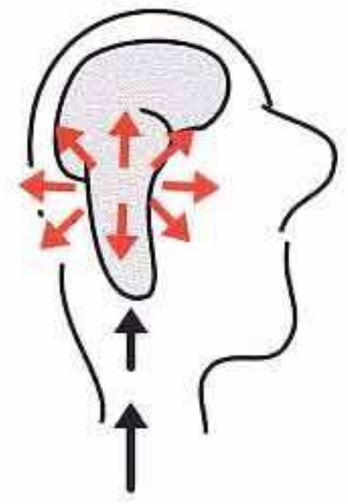
The virus will now target cells in the brain and the salivary glands.



Symptoms include:- dilated pupils, excessive salivation, fever, anxiety, hydrophobia and a desire to bite!!!

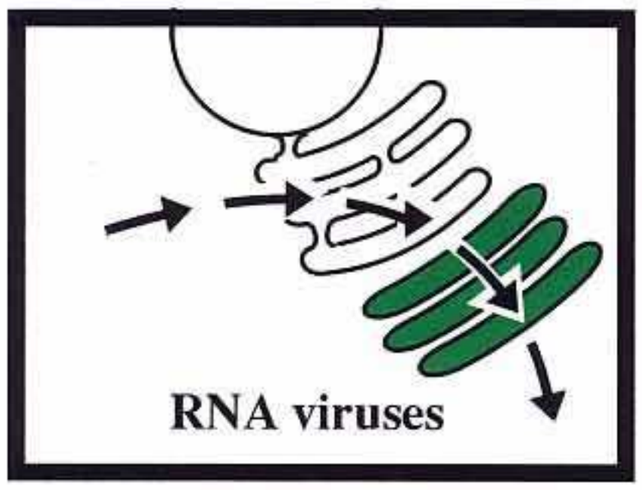


The rabies virus replicates under the skin, before tracking back along a nerve to the brain.

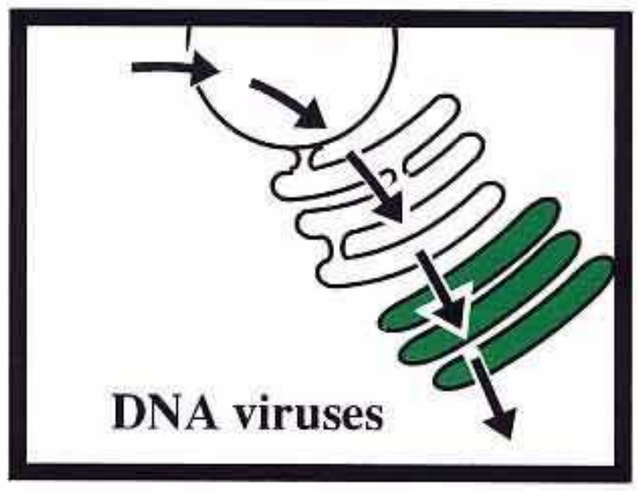


In the brain, the thalamus, hypothalamus and pons are all infected by this virus.

HOW VIRUSES USE OUR CELLS

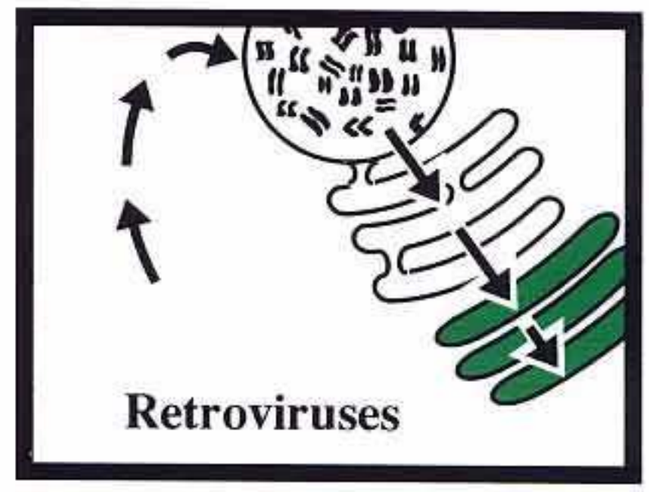


Viral RNA goes straight to the ribosomes and viral replication begins.



Viral DNA enters the cell's nucleus and is transcribed into viral RNA.

The viral RNA is then transported out to the ribosomes and viral replication begins.



Viral RNA enters the cell and is transcribed into viral DNA.

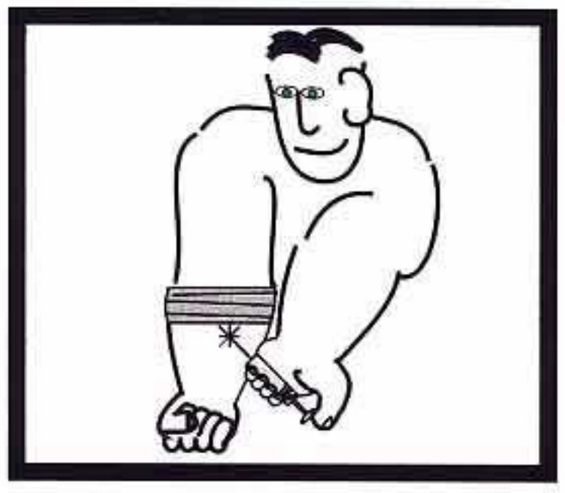
The viral DNA is then transported into the nucleus and incorporated onto one of the host's chromosomes.

At a later date the viral DNA is transcribed into viral RNA, transported to the ribosomes and viral replication begins.

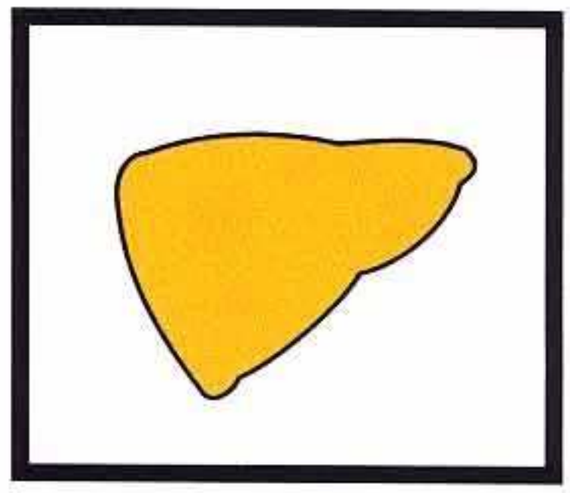
The virus which causes AIDS is an example of a retrovirus.

CAN AN IMMUNE RESPONSE TO A VIRAL INFECTION BE HARMFUL?

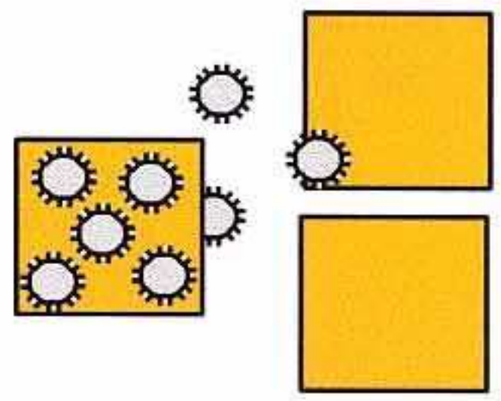
Although looking healthy, this man is actually infected with the hepatitis B virus.



So by using the same needle, the virus can enter his friend's body.

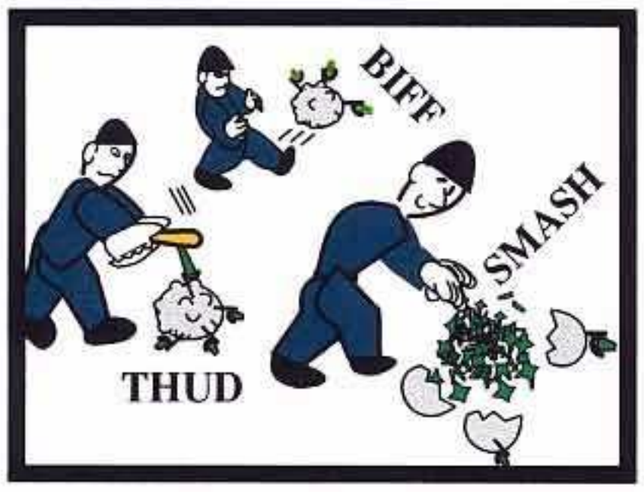


The virus has soon reached and infected his liver.

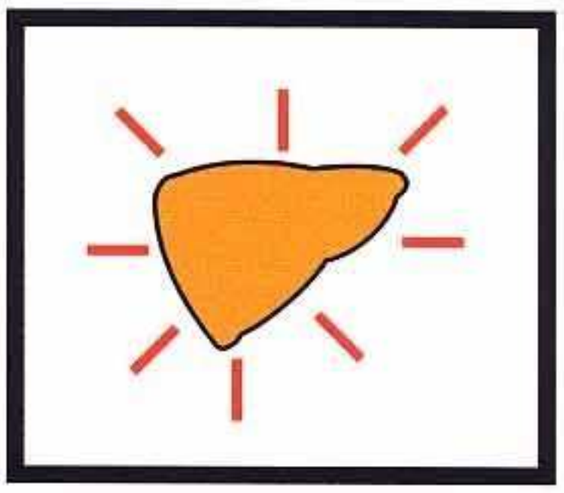


INSIDE THE FRIEND'S LIVER

After replicating inside a liver cell, these emerging hepatitis B viruses enter and infect adjoining liver cells.



Immune cells start to kill the infected liver cells.



The liver becomes acutely inflamed.

Now the patient develops jaundice and is very ill.

THERE ARE NOW 3 POSSIBLE OUTCOMES

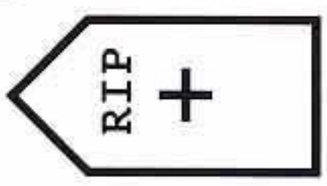
1

All the infected cells are destroyed.

The liver regenerates.

Immunity.

2

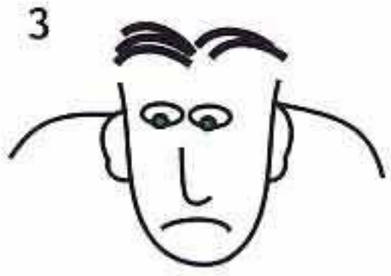


All the infected cells are destroyed.

Insufficient liver cells are now left.

Death.

3



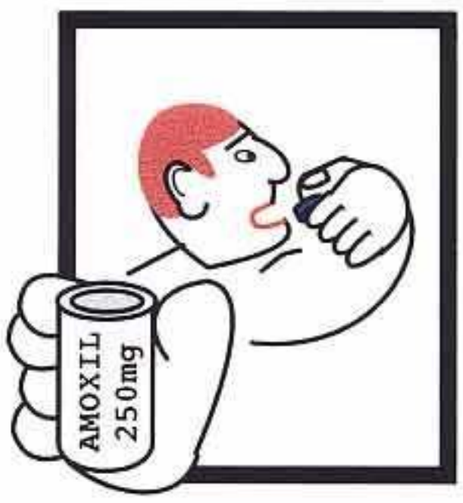
Only a few infected cells are eliminated.

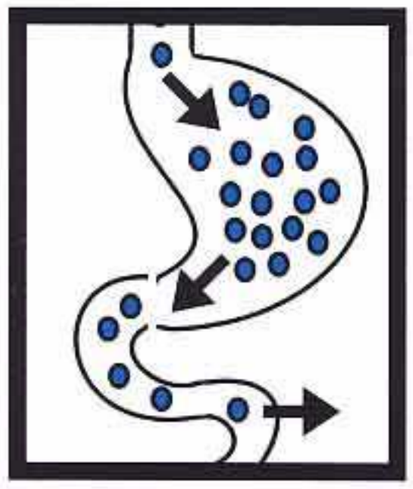
The immune assault stops.

The liver survives but remains infected.

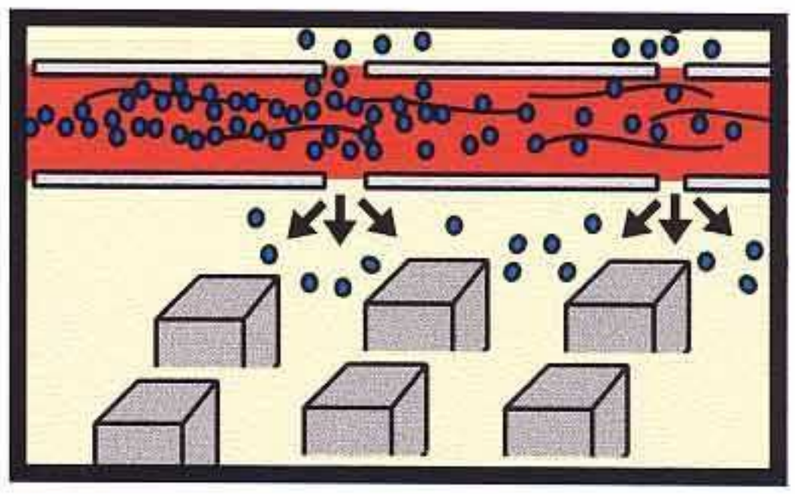
Infected / carrier status for life.

WHY ARE ANTIBIOTICS USELESS FOR VIRAL INFECTIONS?



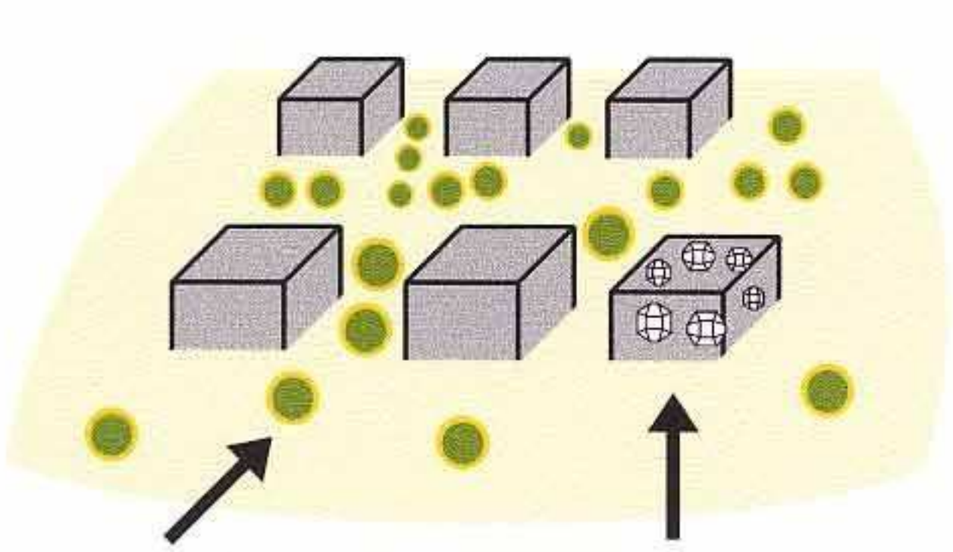


After being swallowed, antibiotics pass out of the gut, into the blood and around the body.



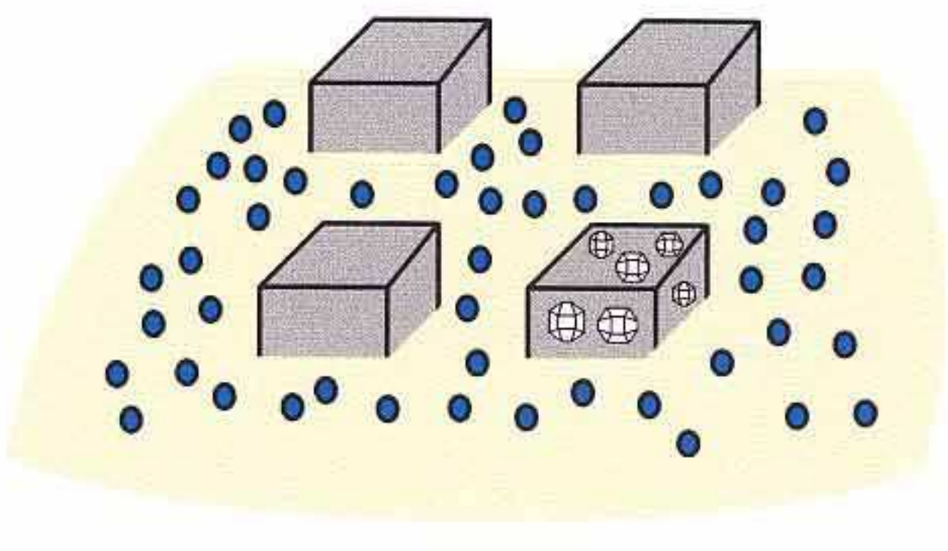
The antibiotics are small enough to pass through gaps in the capillaries and into the tissues.

IN THE TISSUES



Bacteria

Viruses



While viruses can 'hide' inside cells, most bacteria live out in the 'open'.

Antibiotics enter the tissues, reach and kill the bacteria but cannot get to the viruses.