GRADE 12 BIOLOGY

UNIT ONE

MICROORGANISMS

❖ Microorganisms?

- Microscopic organisms that cannot be seen with the naked eyes.
- Most of them are unicellular
- Some are multicellular.

Five main groups of microorganisms

1. Protozoa
2. Fungi
3. Some algae

* Viruses
*Bacteria

1. Protozoa

- Are unicellular
- No cell wall
- Most of them are motile
- Examples:- Amoeba, plasmodium, paramecium

2. Fungi

- Yeast is the only unicellular fungi.
- Some species are useful ex. Saccharomyces (baker's yeast) and some are harmful (ex-Candida-causes thrush in humans).
- Many fungi produce a mycelium(group of hyphae).
- They releases enzyme from hyphae to digest the material they growing on.
- Some are parasites
- Others are saprobionts
- Saprobionts:-organisms that digest their food externally and absorb the products

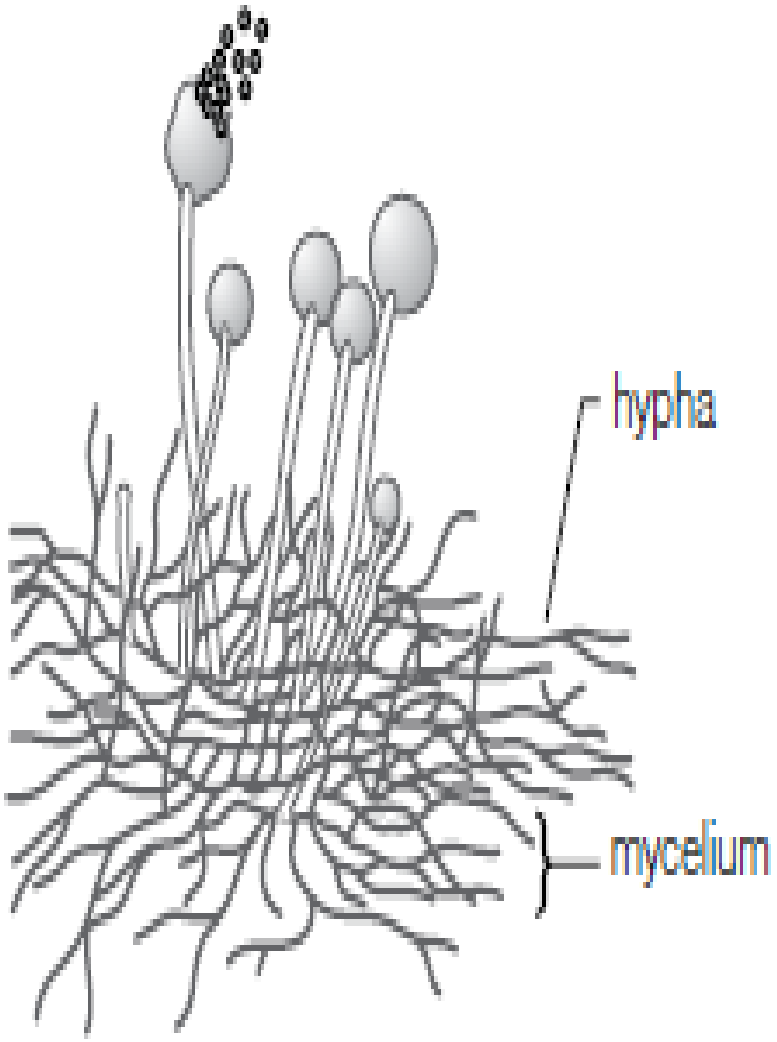


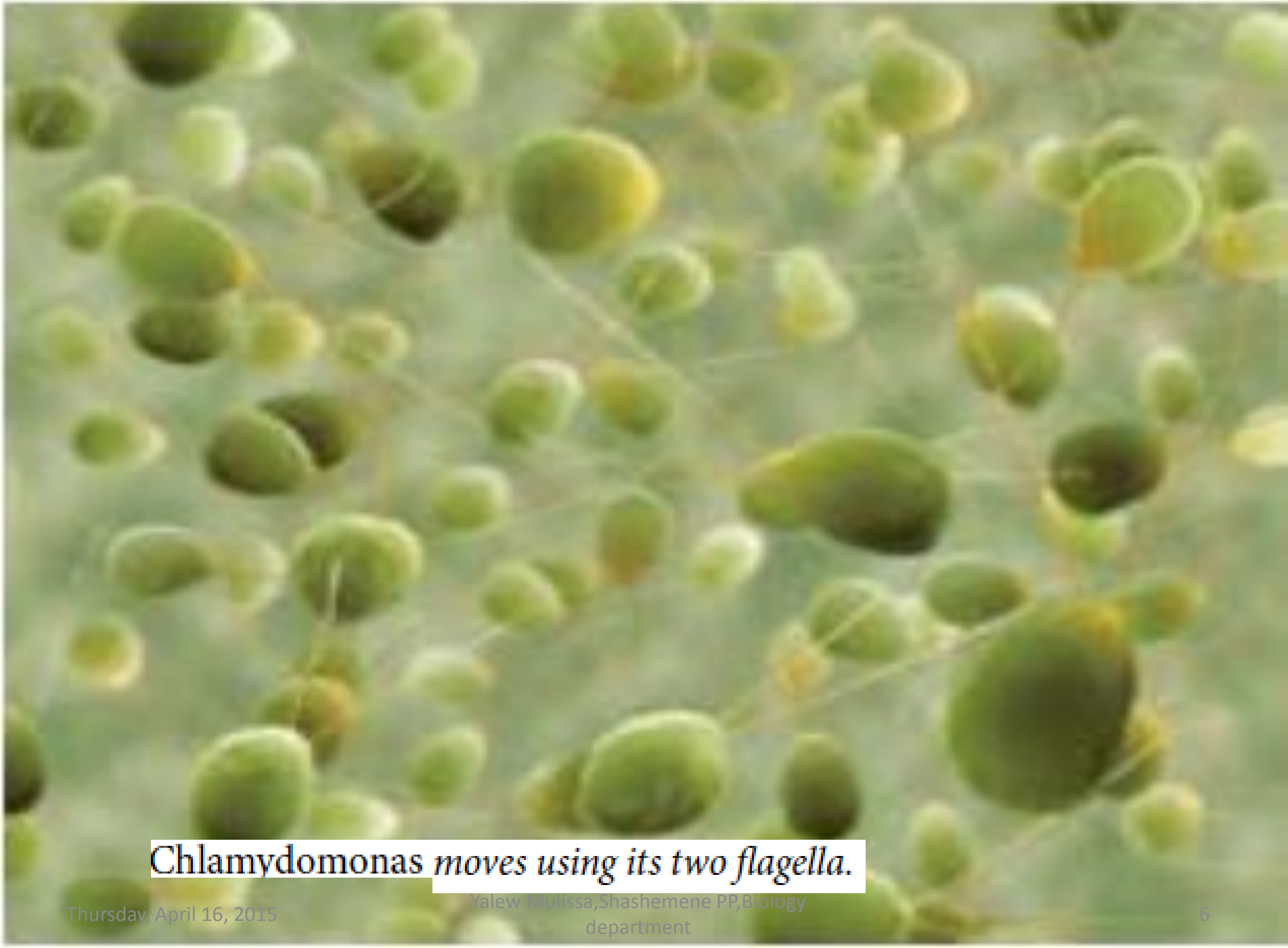
Figure 1.3 Fungal hyphae



Figure 2.4 Fungi (moulds) decomposing bread using extracellular digestion

3.Algae

- Many of them are large example Sea weeds
- Some are unicellular
- Are sources of food for fishes and other aquatic organisms.
- Produce far more oxygen during photosynthesis than all the forests in the world together.
- Some of the unicellular forms like Chlamydomonas are motile


Chlamydomonas *moves using its two flagella.*

4.Viruses

- Are an intermediate between living and non living.
- Cannot carry out any of the processes common to living organisms independently
- Only reproduce inside other cells.
- They are all parasites.
- The can even parasitize bacteria _ bacteriophage.
- No nucleus and cytoplasm.
- Have genetic material surrounded by a protein coat.

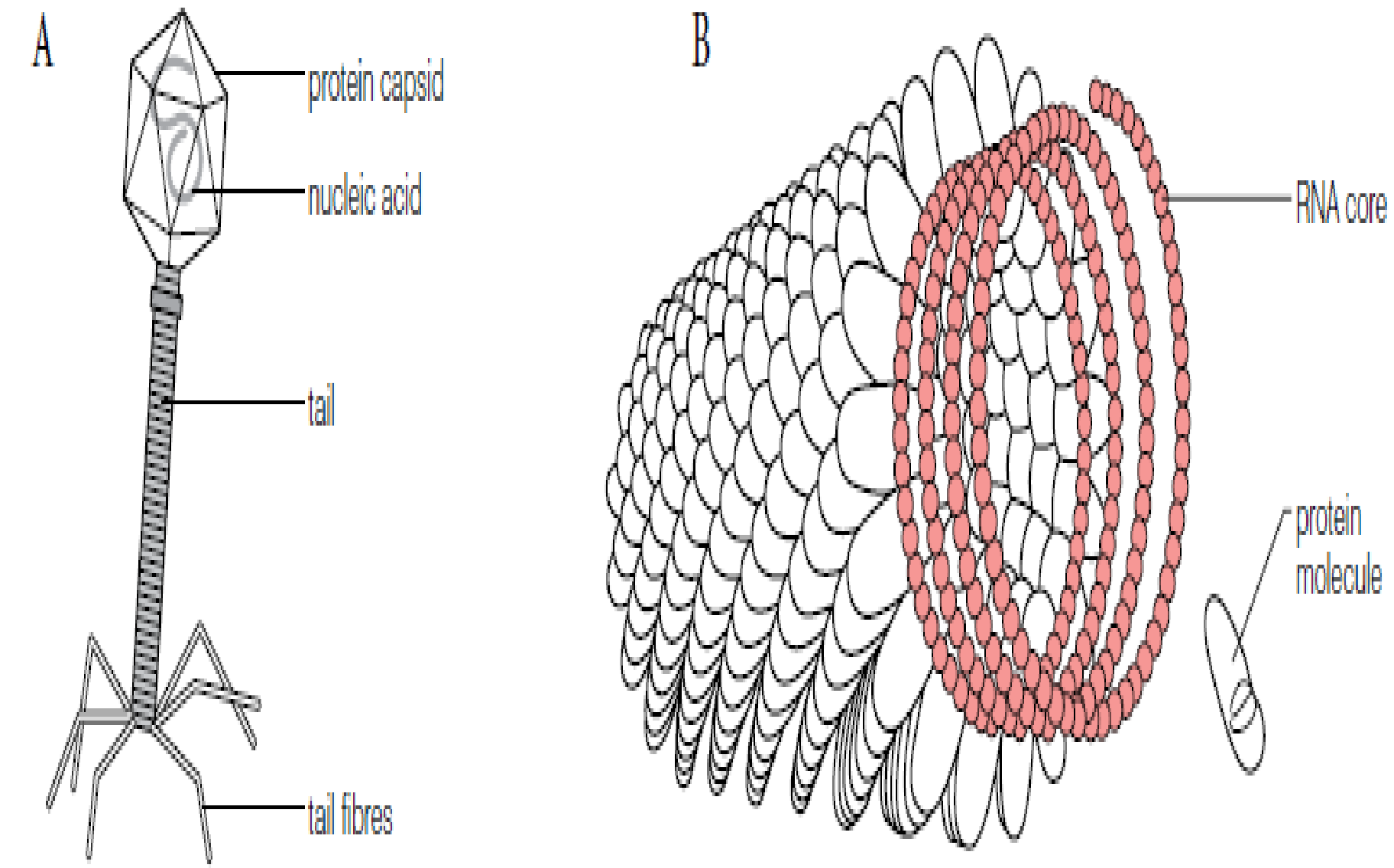


Figure 1.6 Some viruses. A Bacteriophages are viruses that parasitise bacteria; B Tobacco mosaic virus parasitises tobacco plants.

What are bacterial cells like?

Bacteria :-

- Have prokaryotic cells
- No true nucleus
- Their DNA forms a continuous loop that is intermingled with the cytoplasm
- Have cell wall made up of **peptidoglycan** which gives rigidity, cell membrane, cytoplasm, ribosome & DNA

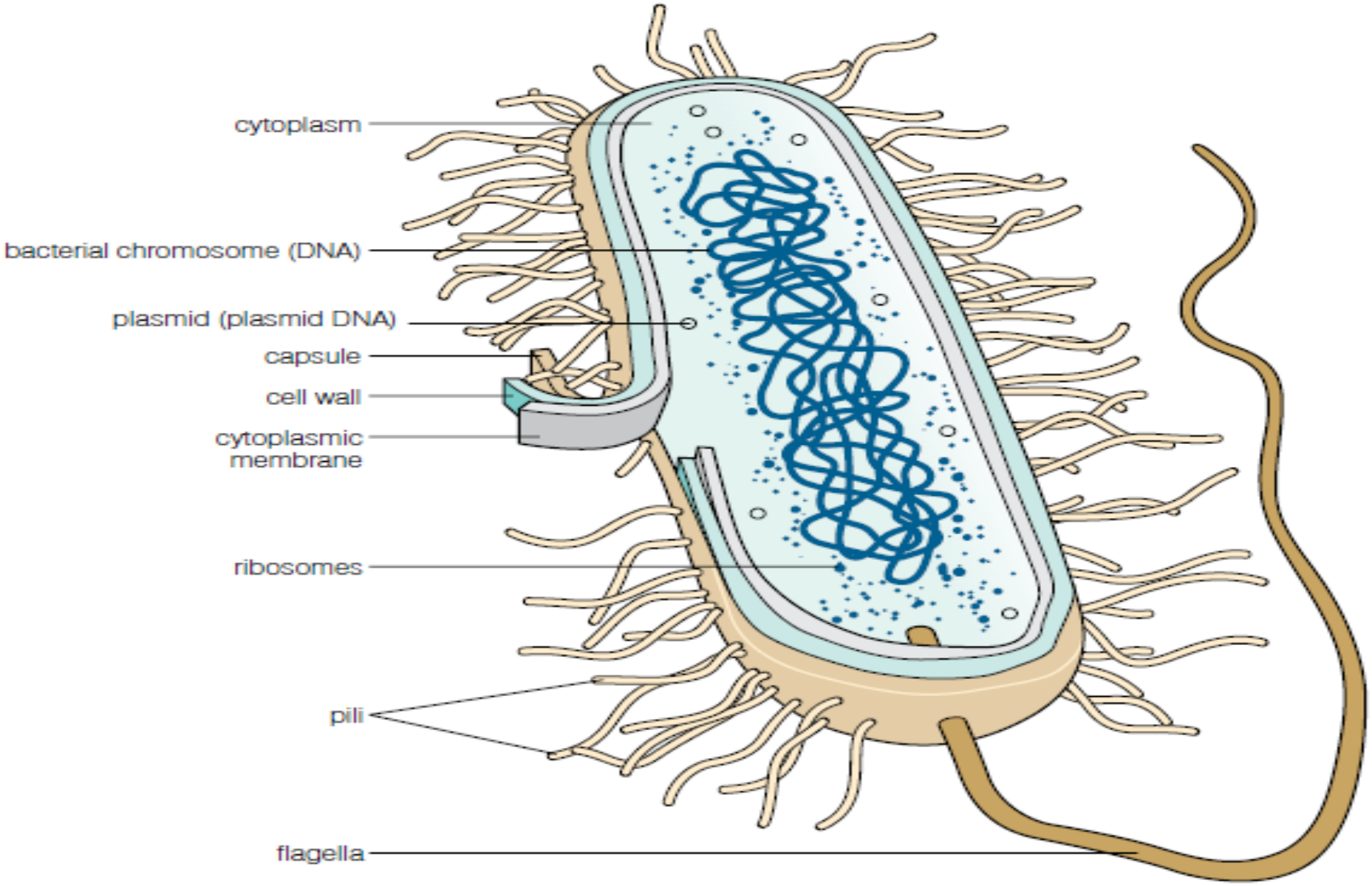


Figure 1.9 The structure of a bacterial cell

- They are usually much smaller than eukaryotic cells.
- Usually between 1 and 10µmlong.
- Eukaryotes are in between 10 & 100µm long.
- Photosynthesis takes place in the plasma membrane or membranes in the cytoplasm.
- Many of the reactions of respiration takes place in the cytoplasm, with some also occurring on the plasma membrane.

Classification

A. Depending on the shape

- Three main shapes of bacteria.

a) Cocci (coccus) –spherical bacteria

b) Bacilli (bacillus)- rod shaped

c) Spirochaetes- spiral or cork screw shaped bacteria

- Found singly, in group of two or in chains.

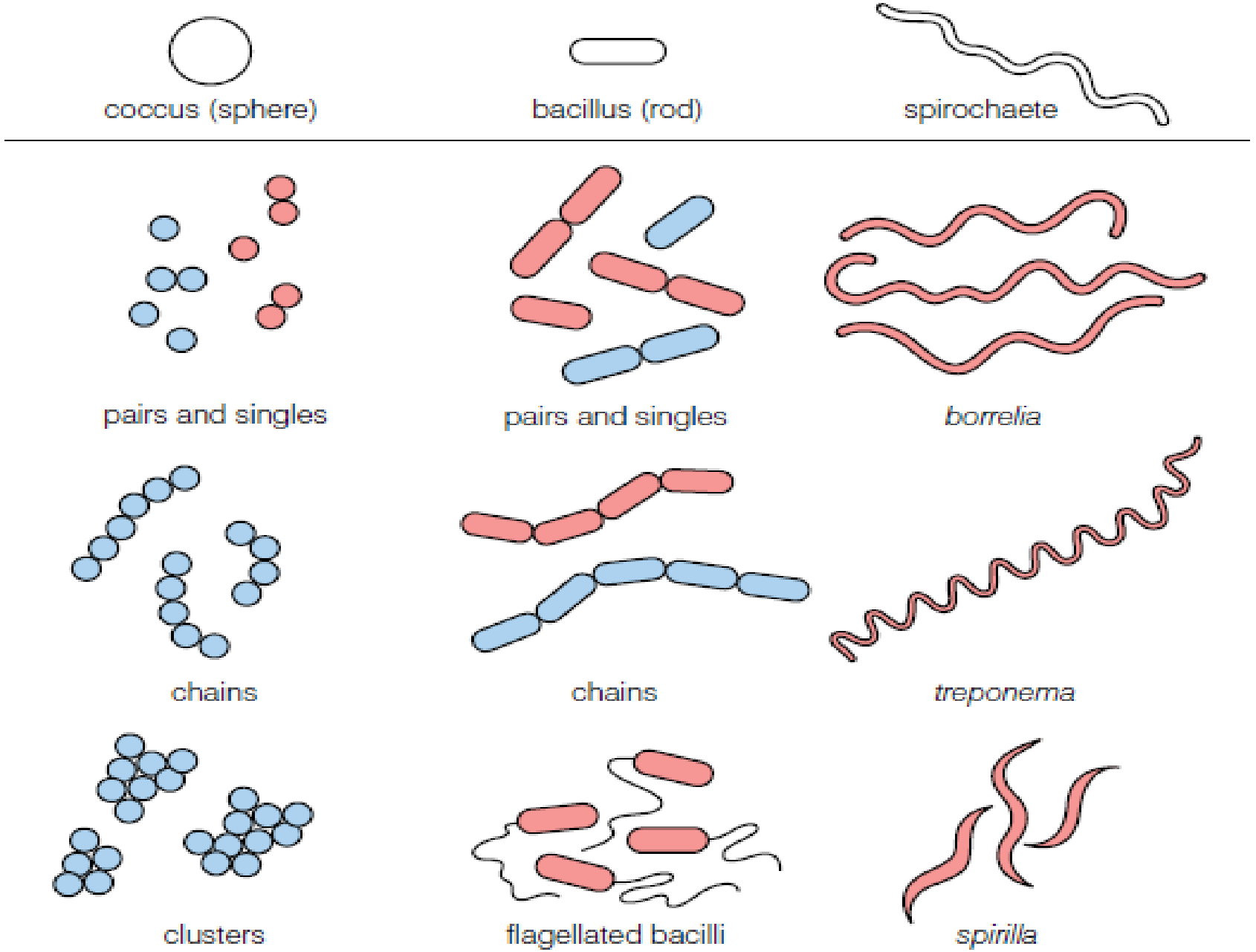


Figure 1.10 Bacterial cells come in three main shapes.

B.Depending on Gram's stain(differential stain)

1.Gram positive

- Stained purple by Gram's stain

2. Gram negative

- Stained pink by Gram's stain

- The difference is due to the structure of the cell wall of the different bacteria.

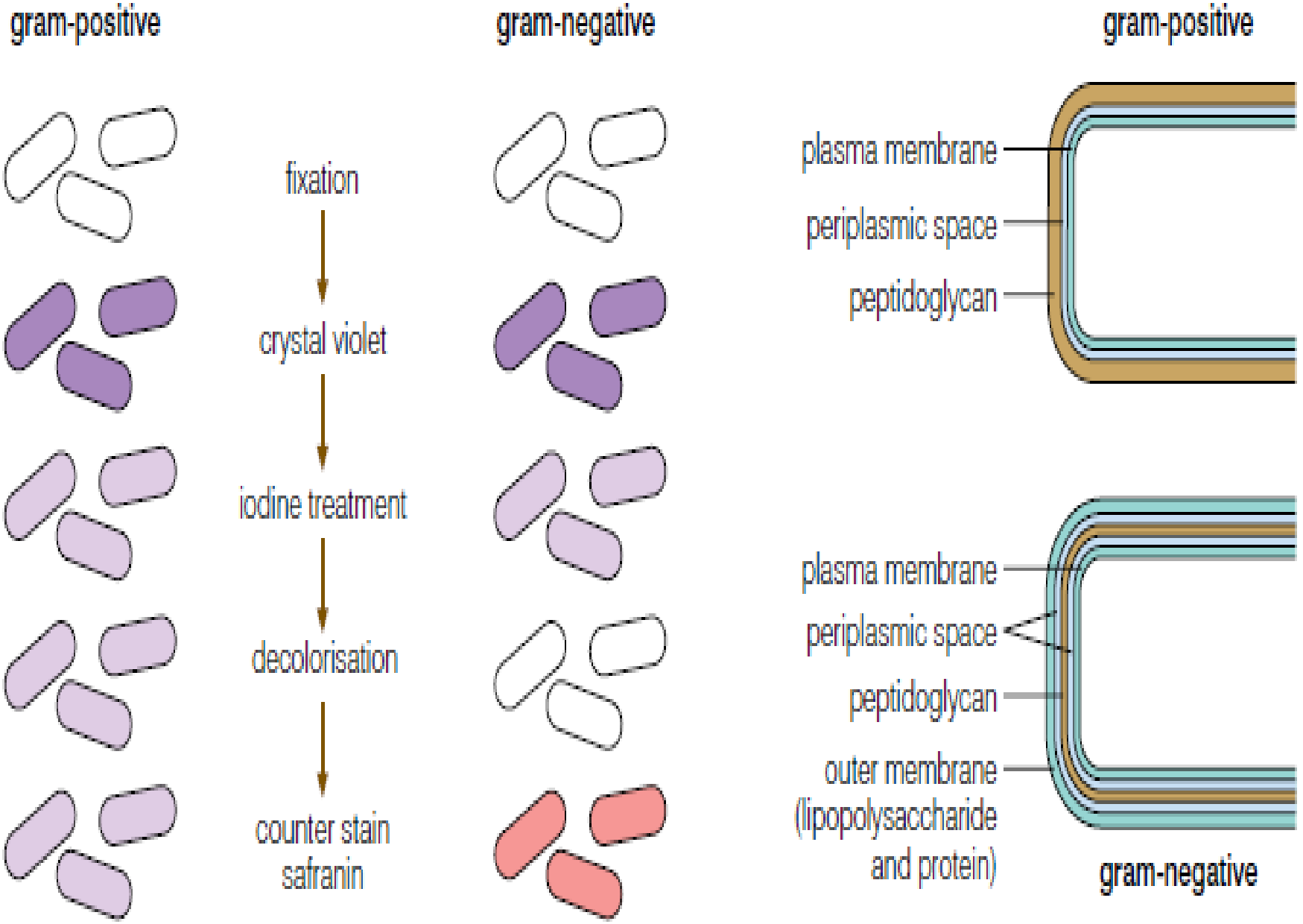


Figure 1.11 Gram staining

- Gram negative bacteria have much less peptidoglycan in their cell walls.
- It is this peptidoglycan that absorbs this stain.
- Gram negative bacteria also have a membrane out side the peptidoglycan cell wall, which gram positive bacteria do not have.
- This outer membrane secretes **endotoxins** that help the bacteria to resist antibiotics.
- So diseases caused by gram negative bacteria are more difficult to treat.
- Gram negative bacteria cause more serious disease, although there are exceptions.

The ecology and uses of bacteria

Where are bacteria found

- In every ecosystem .
- Ten bacterial cell inside you for every one of your own cells (mostly in large intestine).
- They are important because they

1. Cause diseases
2. Are used in many industrial processes.
3. Recycle mineral elements such as C, N, and S through ecosystem

The role of bacteria and other microorganisms in infectious diseases

Germ theory –

- states that diseases can be caused by microorganisms
- proposed by a French Chemist and microbiologist **Louis Pasteur**
- **Phatogens** – diseases causing microorganisms.
- Infectious diseases-a diseases caused by microorganisms infecting the body.
- **Robert Koch (1880)-** identified the microorganisms that causes TB and cholera

Koch's Postulate

1. The microorganisms must be always present when the diseases is present and should Not be present if the diseases is not present .
2. The microorganism can be isolated from an infected person and then grown in culture
3. Introducing such cultured microorganism in to a health host should result in diseases developing.
4. It should then be possible to isolate the microorganism from this newly diseased host and grow it in culture .

- **Postulate I** – establishes a link between microorganism and the diseases
- **Postulates II,III,,IV** – prove that the metabolism of a specific living microorganism, wh cause the dis



Type of micro-organism	How the micro-organism causes disease	Examples of diseases caused
Bacteria	Bacteria release toxins as they multiply. These toxins affect cells in the region of the infection, and sometimes in other regions of the body as well. Bacterial diseases can be treated with antibiotics, as each bacterium is a true cell with its own metabolic systems, and is capable of cell division. Some bacteria invade and grow in the tissues of organs, causing physical damage.	Pneumonia, cholera, pulmonary tuberculosis (TB)
Viruses	Viruses enter living cells and disrupt the metabolic systems of the cell. The genetic material of the virus becomes incorporated with that of the cell and instructs the cell to produce more viruses. Viruses cannot be treated with antibiotics as they are not true cells and are only active inside cells, which antibiotics cannot enter.	Influenza ('flu), AIDS, measles, common cold
Fungi	When fungi grow in or on living organisms, their hyphae secrete enzymes. These digest substances in the tissues, and the substances produced are absorbed. Growth of hyphae also physically damages the tissue. Some fungi also secrete toxins. Others can cause an allergic reaction (e.g. farmer's lung).	Athlete's foot, farmer's lung
Protozoa	Protozoa cause disease in many different ways.	Malaria, sleeping sickness

Table 1.1 How micro-organisms cause disease

How pathogens transmitted

- The origin of Microorganisms that infect other people is called the ***reservoir of infection***
- Reserviors of infection include
- Human being Ex diphtheria, common cold
- Mosquito Ex. **Malaria**
- Soil Ex. ***Tetanus***
- Water Ex. ***Amoeba, cholera***
- Food Ex. ***Typhoid***
- Contaminated objects Ex. **HIV/AIDS, Trachoma**
- Air Ex. Pneumonia , TB

Method of transmission	How the transmission route works	Examples of diseases
Droplet infection	Many of these diseases are 'respiratory diseases' – diseases affecting the airways of the lungs. The organisms are carried in tiny droplets through the air when an infected person coughs or sneezes. They are inhaled by other people.	Common cold, 'flu, pneumonia
Drinking contaminated water	The micro-organisms transmitted in this way often infect regions of the gut. When unclean water containing the organisms is drunk, they colonise a suitable area of the gut and reproduce. They are passed out with faeces and find their way back into the water.	Cholera, typhoid fever
Eating contaminated food	Most food poisoning is bacterial, but some viruses are transmitted this way. The organisms initially infect a region of the gut.	Salmonellosis, typhoid fever, listeriosis, botulism
Direct contact	Many skin infections, such as athlete's foot, are spread by direct contact with an infected person or contact with a surface carrying the organism.	Athlete's foot, ringworm
Sexual intercourse	Organisms infecting the sex organs can be passed from one sexual partner to another during intercourse. Some are transmitted by direct body contact, such as the fungus that causes candidiasis (thrush). Others are transmitted in semen or vaginal secretions, such as the AIDS virus. Some can be transmitted in saliva, such as syphilis.	Candidiasis, syphilis, AIDS, gonorrhoea
Blood-to-blood contact	Many of the sexually transmitted diseases can also be transmitted by blood-to-blood contact. Drug users sharing an infected needle can transmit AIDS.	AIDS, hepatitis B
Animal vectors	Many diseases are spread through the bites of insects. Mosquitoes spread malaria and tsetse flies spread sleeping sickness. In both cases, the disease-causing organism is transmitted when the insect bites humans in order to suck blood. Flies can carry micro-organisms from faeces onto food.	Malaria, sleeping sickness

Table 1.2 How diseases can be transmitted

Other types of diseases

- ***Health*** – a state of complete physical, mental and social well- being (WHO)
- ***Diseases*** - a condition with a specific cause in which part or all of a body is made to function in a non normal and less efficient manner

➢ Diseases can be caused by a number of other factors

A) Human – Induced diseases

➢ From a person life style and working conditions

Ex – Cancers, some forms of heart diseases & fibrosis

B) Degenerative Processes

- ✓ Result of aging
- ✓ are degenerative diseases

C) Genetic diseases

- ✓ From gene

ex. Hemophilia, sickle cell diseases

D) Deficiency diseases

- ✓ form lack of a nutrients in the diet

Ex-Kwashiorkor & Scurvy

E/Social diseases

- From social activities

ex. Alcoholism, drug addiction which may lead to dependency on the drug, isolation, clinical depression , and various level of antisocial behavior.

F/Multifactorial – from different factors

Ex- atherosclerosis (laying down fatty substances in arteries) may result from

- age
- feeding style
- gene
- Stress and high BP increase the rate at which atherosclerosis develops – (life Style)

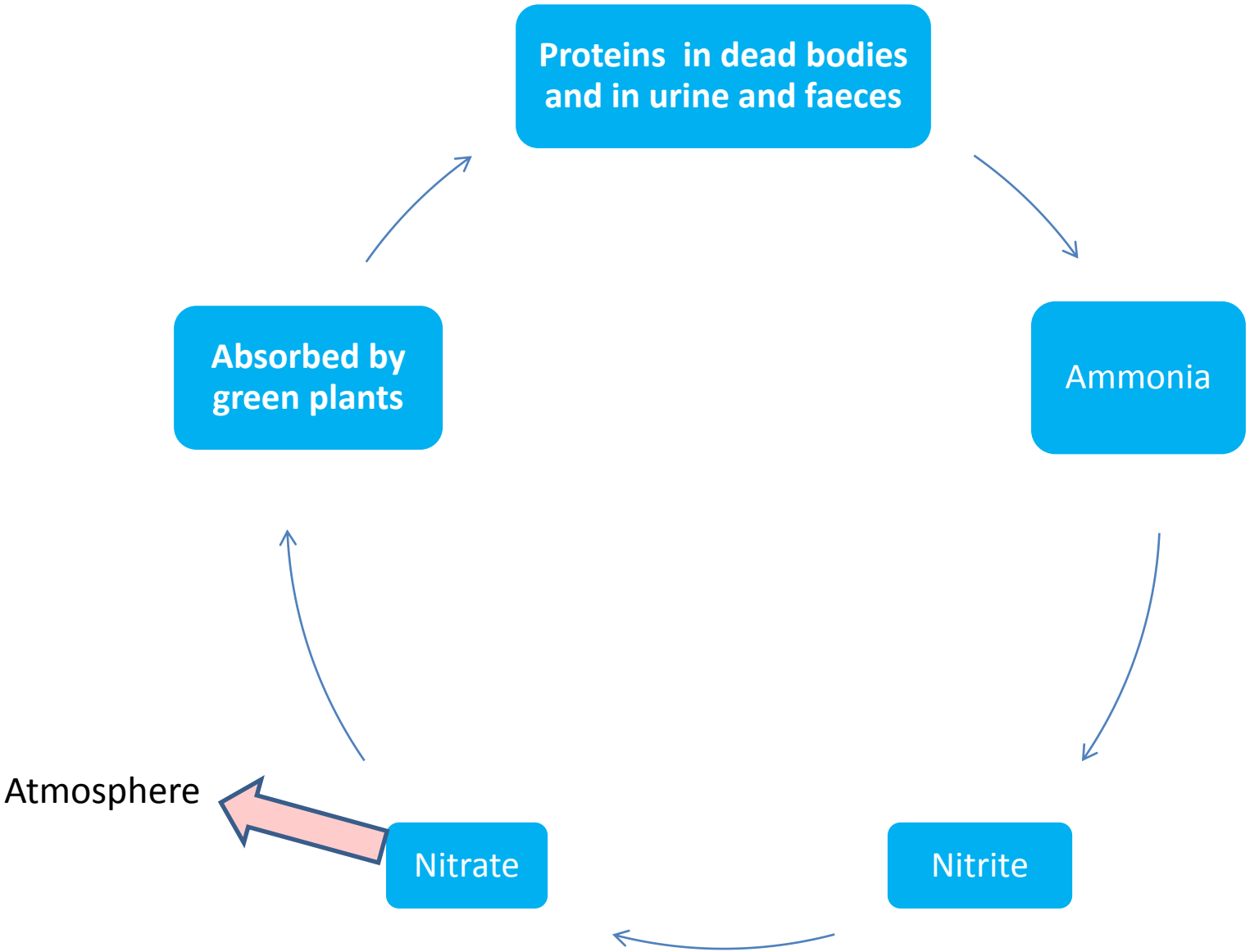
The role of bacteia in an ecosystem

- Many of them are decomposers.
- In decomposition process they release some minerals to the environment
- Many elements are recycled in this way,including
- Carbon * Sulphur
- Nitrogen * Phosphorus

1.Nitrogen cycle

- It is found in many organic molecules in all living organisms . These include
- Proteins *RNA
- DNA *ATP

Micro Organism	Process
Nitrogen – fixing bacteria e.g Rhizobium	Nitrogen gas is fixed in to forms other organisms can use
Amonifying bacteria (decompesers)	The decomposers break down protins in dead organisms and animal waste releasing ammonium ions , which can be converted to nitrates
Nitrifying bacteria, e.g. Nitrosomonas and Nitrobacter	Nitrification is a two – step process. Ammonia ammonium ions are oxidised first to nitrites (Nitrosomonas) and then to nitrates (Nitrobacter) which is the form most usable by plants
Denitrifying bacteria, e.g. Pseudomonas	Nitrates are reduced to nitrogen gas, returning nitrogen to the air and reducing the amount of nitrogen in the soil.


Proteins in dead bodies and in urine and faeces
Ammonia
Nitrite
Nitrate
Atmosphere
Absorbed by green plants



Root nodules

2. The sulphur cycle

- Sulphur is found in fewer types of organic molecule than Nitrogen
- Found in many proteins

Reaction	Bacteria involved	Conditions needed	Process
Decomposition	Desulphovibrio	Anaerobic	Sulphur is released from proteins of dead matter as hydrogen suphide (giving the rotten eggs' smell)
Oxidation of hydrogen sulphide	Photosynthetic sulphur bacteria	Anaerobic	Hydrogen sulphide is oxidised to release sulphur.
Oxidation of sulphur	Non- Photosynthetic sulphure bacteria	Aerobic	Sulphur is oxidised to sulphate ions .

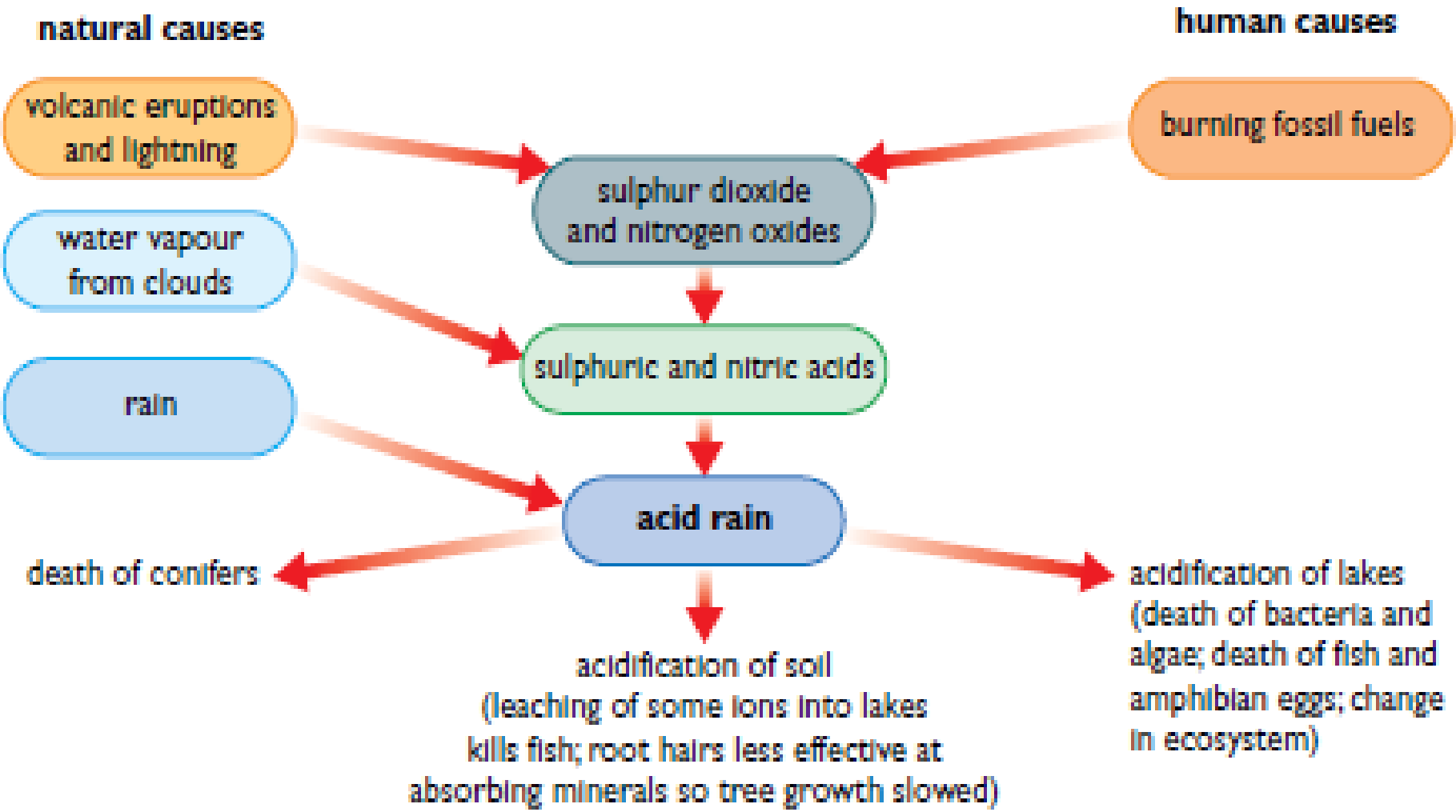


Figure 1.16 Acid rain has many serious effects on living organisms, and can also corrode stone and metal over a long period.

- If the populations of bacteria that are involved in the nitrogencycle and the sulphur cycle were reduced, then the cycling of theseelements could not occur, and all life would be impossible as a result.
- It is worth thinking about. We are made from atoms and molecules that have been in many other bodies before they were in ours.
- The micro-organisms that recycle carbon, nitrogen, sulphur and all the other minerals make them available again … and again … and again …

How are bacteria used in industrial processes?

Food and beverage fermentation

- Bacteria and other micro-organisms have been used in manufacturing processes for thousands of years. They have been used to make:

a) bread

b) alcohol

c) irgo or yoghurt

d) Vinegar and as well as many other products.

- They have also been used in key processes such as sewage treatment.

A.Production of vinegar

- Vinegar is a dilute solution of ethanoic acid in water. It also contains other substances that give the vinegar its flavour. Vinegar is used in two main ways:

a. to flavour foods

b. to preserve foods

- Vinegar is too acidic for most micro-organisms to grow and multiply, so keeping foods in vinegar is a good way of preserving them.
- We call this method of preserving food pickling

- Vinegar is produced by fermenting beer, wine or cider for a second time.
- A culture of a special bacterium called **Acetobacter** is used.
- The alcohol in the beer, wine or cider is oxidised to ethanoic acid. This takes place in a special fermenter.
- The fermenter is filled with wood shavings and the alcohol source is sprayed in from the top.
- It trickles down through the wood shavings, which are covered with Acetobacter bacteria.
- As the liquid flows past them, the bacteria

- Air is blown in at the bottom to supply the oxygen the bacteria need.
- The vinegar drips out at the bottom of the wood shavings and is tapped off.
- This type of production is called continuous production, as alcohol is continuously being fed in and ethanoic acid is continuously dripping out at the bottom of the fermenter.

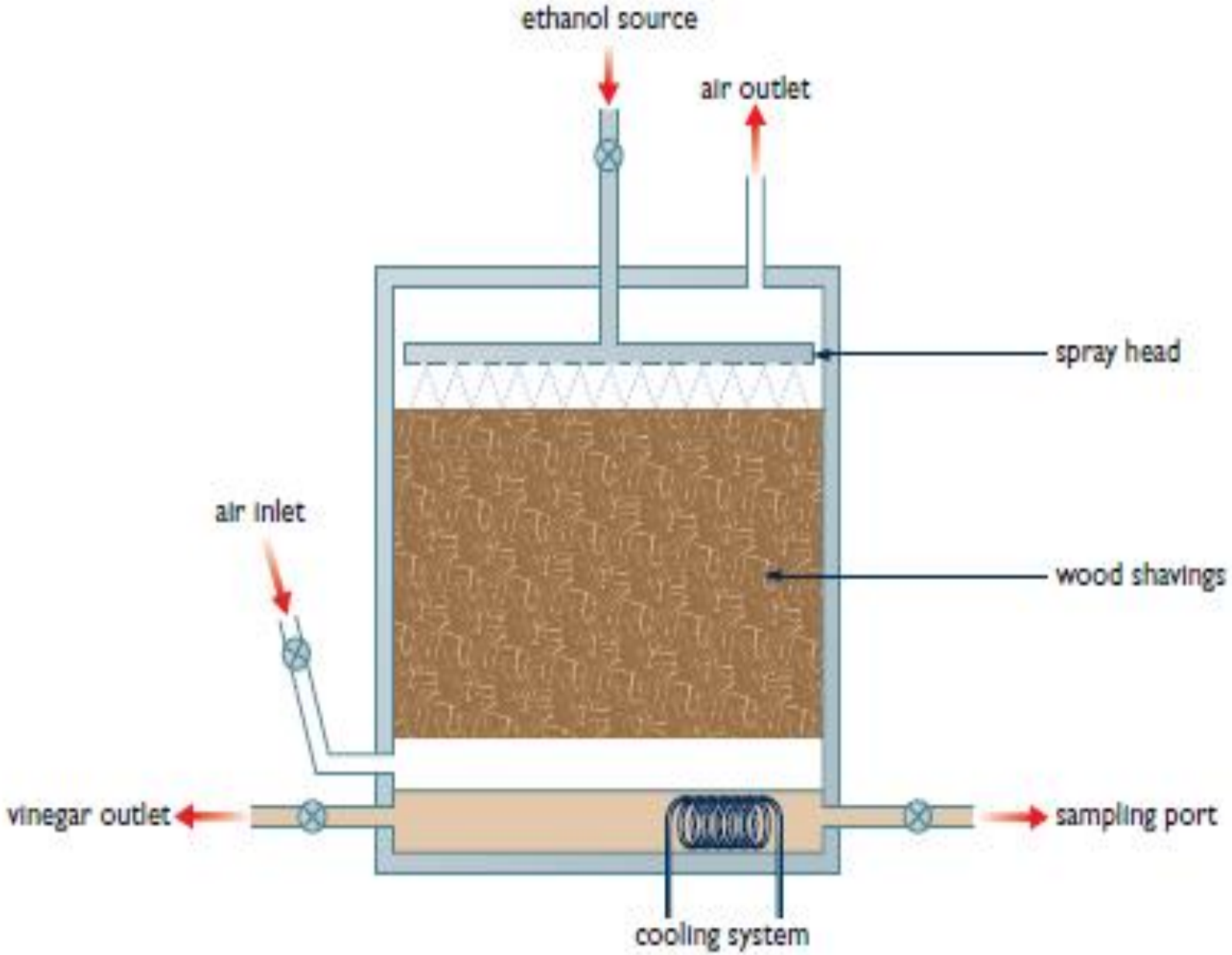


Figure 1.17 Vinegar production

Producing antibiotics

- The first antibiotics all came from fungi. Today, they are increasingly being made using genetically modified bacteria in huge fermenters.

Genetically modified bacteria are also used to produce:

- insulin
- antibiotics
- human growth hormone
- enzymes for washing powders
- human vaccines, such as the vaccine against **hepatitis B**



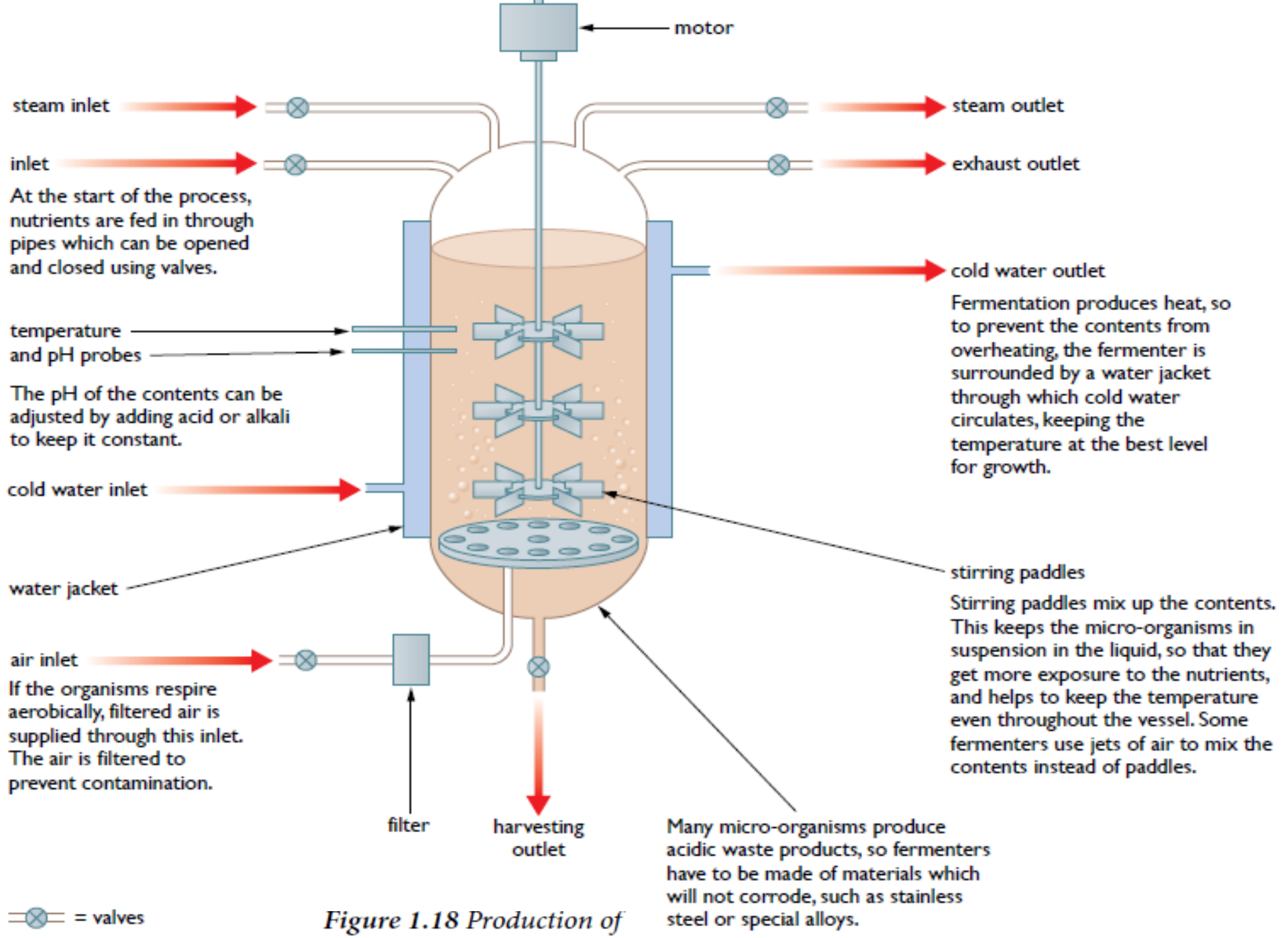


Figure 1.18 Production of antibiotics

Sewage treatment

- All types of sewage treatment rely on the action of a range of microorganisms to oxidise the organic matter present in sewage.
- There are two main methods:

1) the percolating filter method
2) the activated sludge method

- In the percolating filter method:

a) sewage is screened to remove large pieces of debris
b) it stands in a large settlement tank to allow suspended matter to settle out
c) it is then allowed to trickle through a bed of stones, each of which is covered in a layer of micro-organisms (bacteria, fungi and protozoa)
d) as the sewage trickles through the filter bed, the micro-organisms digest the organic matter and absorb the products
e) by the time the liquid reaches the bottom of the filter bed, the polluting organic matter has all been removed

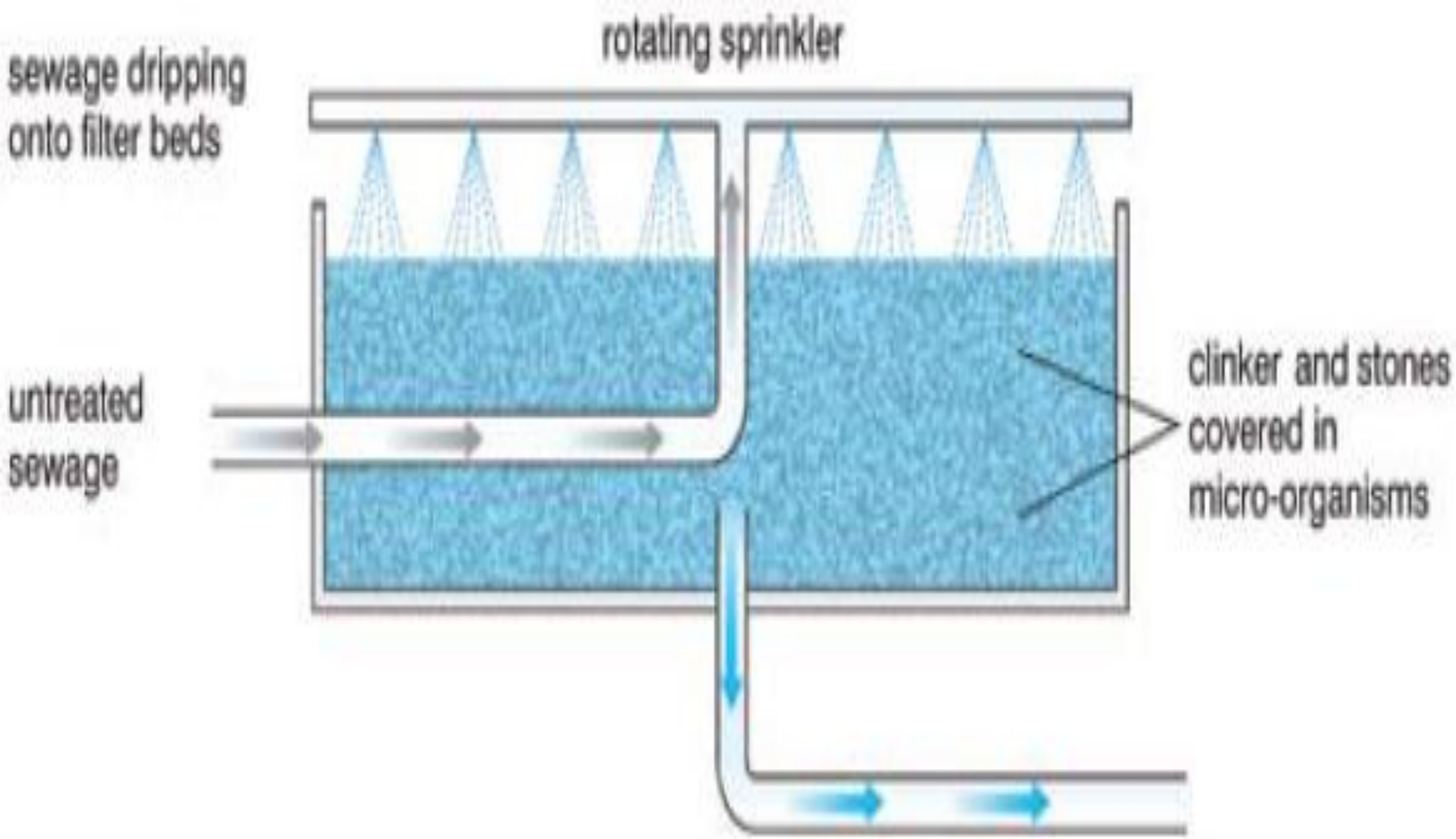


Figure 1.19 Percolating filter

In the activated sludge method:

1) sewage is screened and allowed to stand in settlement tanks, as in the percolating filter method
2) it is then pumped into treatment tanks, where: - activated sludge, rich in micro-organisms, is added - oxygen is blown through the mixture
3) in the oxygenated mixture, the micro-organisms from the added activated sludge oxidise the polluting organic matter, reproducing as they do so
4) some of the sludge formed is recycled to 'seed' new tanks.

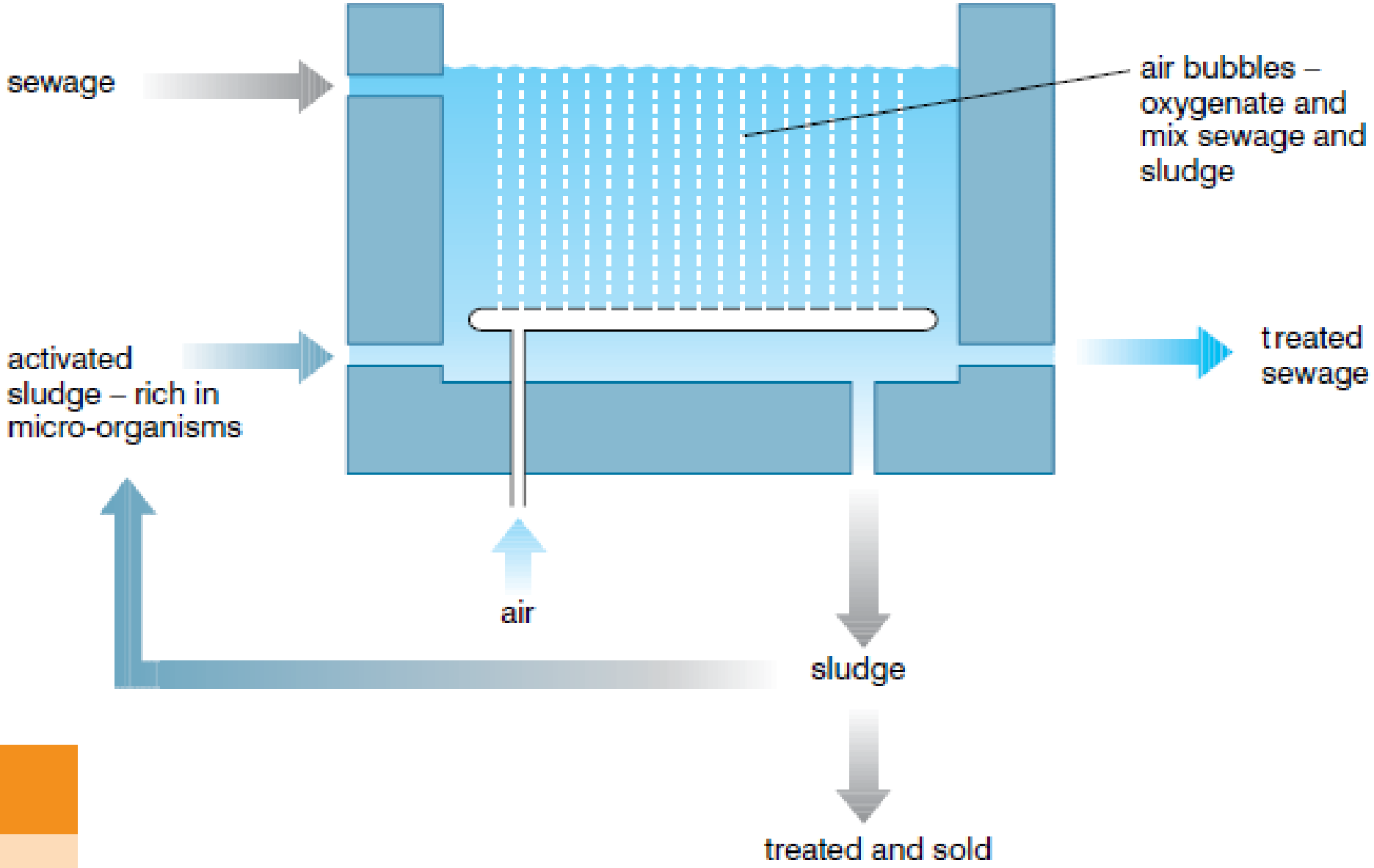


Figure 1.20 The activated sludge method

How are bacteria genetically modified?

- ***genetic engineering*** *the practice of transferring genes from one organism to another organism (either belonging to the same species or belonging to a different species).*
- ✓ *This is done by taking DNA from the first organism and transferring it to the second organism*.
- ➢ if a gene can be transferred successfully from one organism into a bacterium, the genetically modified bacterium will now make the protein that its 'new gene' codes for.

- The development of **three main techniques** made genetic engineering possible.

a) The discovery that genes can be 'cut' out of a DNA molecule using enzymes called restriction endonucleases.

b) The discovery that genes can be inserted ('tied') into another DNA molecule using a ligase enzyme.

c) Genes can be transferred into other cells using vectors. These are usually either plasmids (small pieces of circular DNA found in bacteria), or viruses.

- Once the gene has been inserted into the new bacterium, the bacterium becomes a genetically modified or transgenic organism.
- vector a means of transferring something.
- In genetic engineering, viruses are used as vectors to transfer genetic information between different organisms.

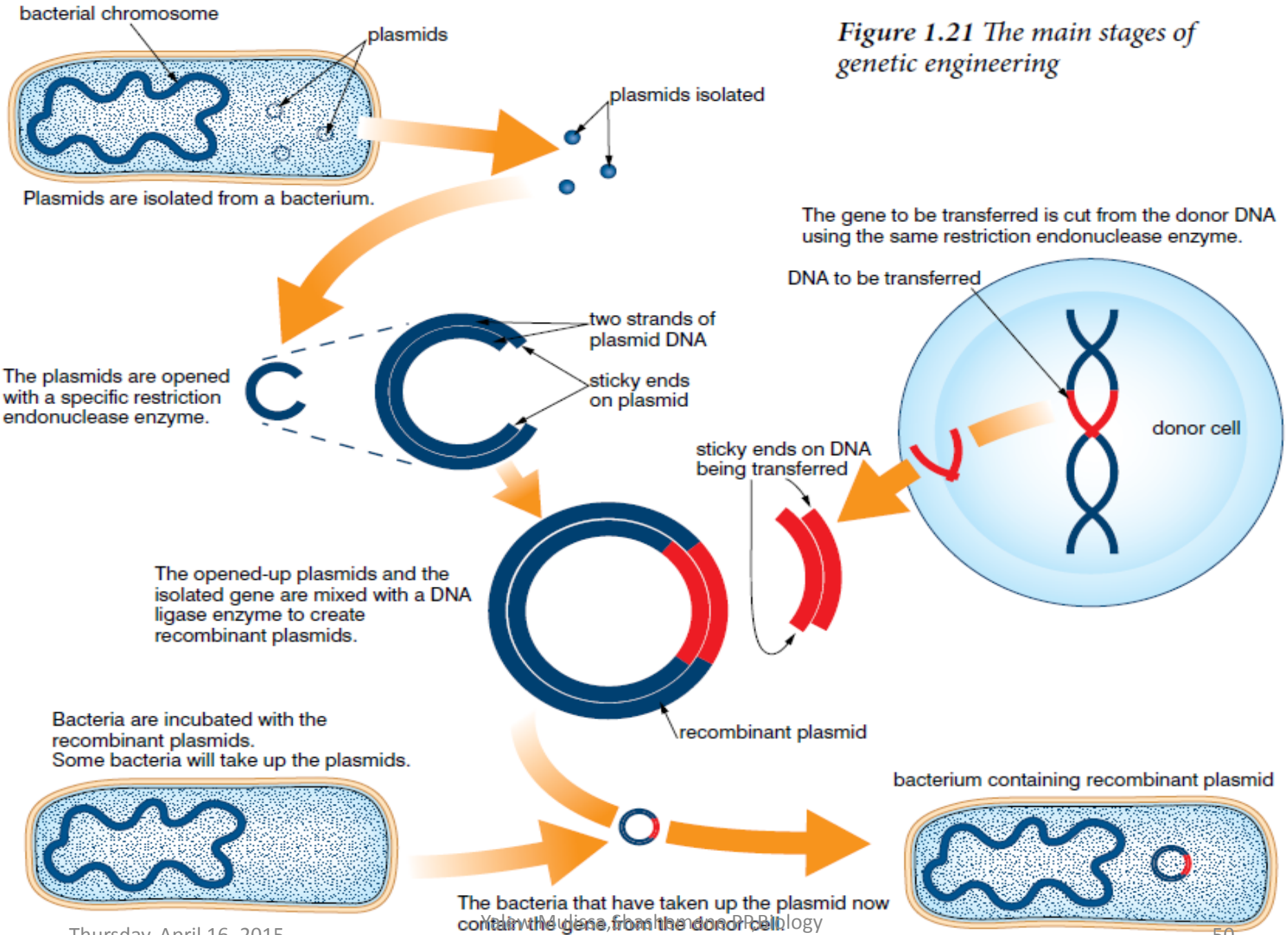


Figure 1.21 The main stages of genetic engineering

- ❖ Bacteria aren't the only organisms that have been genetically modified.
- ❖ Many crop plants have also had foreign genes inserted into them.
- ❖ These give the plants new properties, such as:

A. resistance to infectious disease
B. resistance to animal pests
C. a longer shelf-life before decaying

- ➢ Genetic engineering of plants posed problems for biologists, as plant cells will not accept plasmids in the same way as bacterial cells do.

- However, they discovered that one particular bacterium, called *Agrobacterium tumefaciens*, regularly infects plant cells.
- This bacterium can act as a vector to carry genes that have been inserted into a genetically modified *Agrobacterium* into plants.

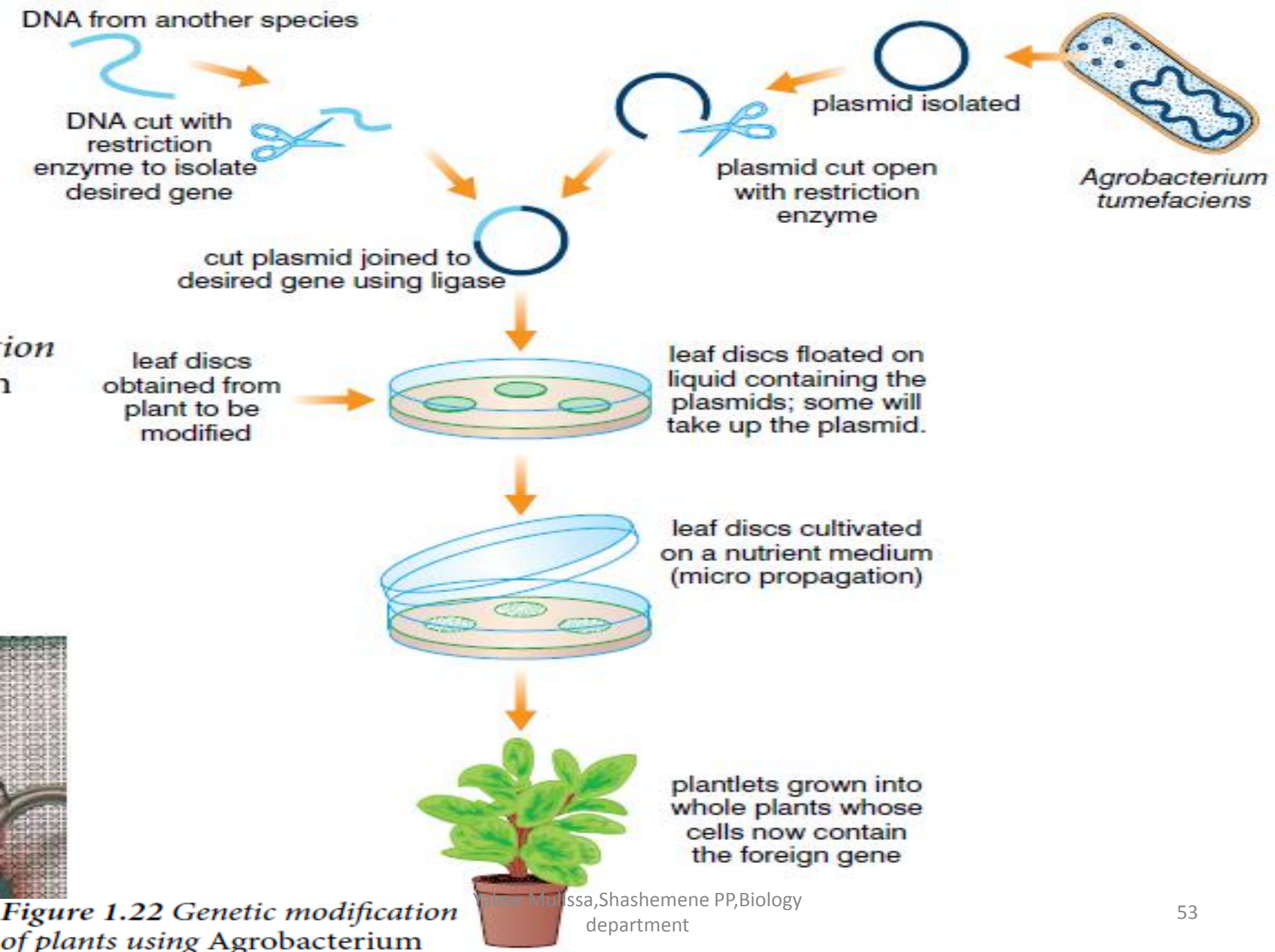


Figure 1.22 Genetic modification of plants using Agrobacterium

- However, *Agrobacterium* can't be used to genetically modify all types of plant.
- It will not infect cereals such as maize, for example.
- To solve this problem, biologists developed the gene gun.
- This literally shoots the genes into cells of plants, using as 'bullets' tiny pellets of gold that are covered in DNA.
- The gene gun has made it possible to genetically modify plants such as maize, tobacco, carrots, soybean and apple.

- For example, maize has had genes inserted into it that cause it to:

a. produce a pesticide that makes it resistant to some insect pests

b. be resistant to some fungal diseases



Figure 1.23 A scientist working with a gene gun

1.3 What are viruses?

- Viruses are much smaller than even the smallest bacterium.
- Most are between **0.01** and **0.1** µm in length or diameter.
- This makes them at least **1000** times smaller than the smallest bacterium and **1 000 000** times smaller than most human cells.

- The particle of a virus is called a virion.
- All virions contain at least two components:

I. a protein shell or capsid

II. DNA or RNA as the genetic material

- Some also have:

A. a membrane made from lipids and proteins outside the capsid

B. other proteins and enzymes inside the capsid

Feature	Virion (virus particle)
Size	0.01-0.1 µm
Nucleus	Absent
DNA	Tiny amount of linear DNA in some; others contain RNA but no chromosomes
Other cell organelles	Absent

- Because they do not have the major organelles that are present in living cells, virus particles can't carry out any of the normal metabolic processes of cells, such as:

a) Respiration
b) protein synthesis
c) DNA replication
d) Photosynthesis
e) active transport
f) facilitated diffusion
g) any other process requiring control by enzymes or the presenceof proteins

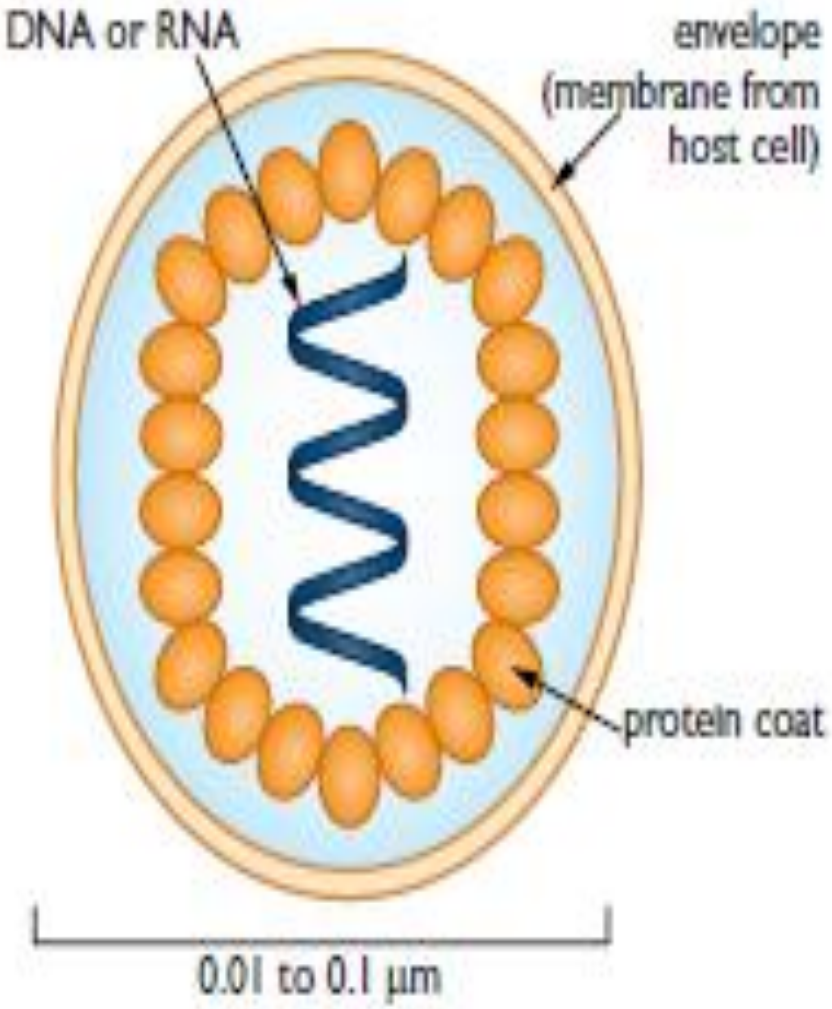


Figure 1.24 *The structure of a typical virus*

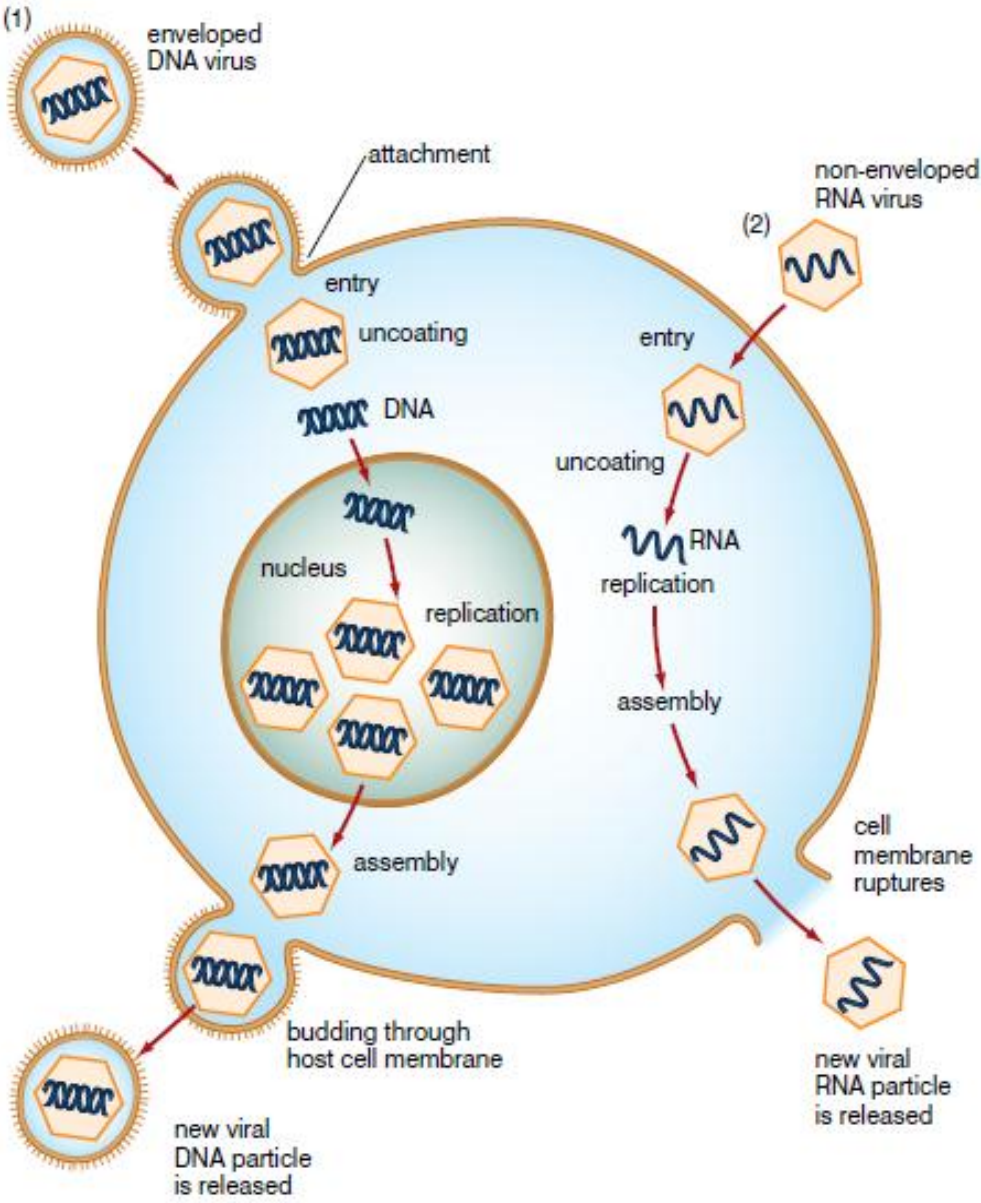


Figure 1.25 *Stages of virus infection of cells.*

Classifying viruses

- They can be classified into three main groups, based on the nature of their genetic material and the way in which it is expressed.
- These groups are:

I. **DNA viruses** - for example, Herpes simplex (causes cold sores)

II. **RNA viruses** - for example, H1N1 virus (causes swine flu)

III. **Retroviruses** - for example, HIV (causes AIDS)

KEY WORDS

- ***DNA virus*** contains genetic information stored in the form of DNA
- ***RNA virus*** contains genetic information stored in the form of RNA
- ***retrovirus*** an RNA virus that converts its genetic information from RNA into DNA after it has infected a host
- ***bacteriophage*** a virus that uses a bacteria to replicate its genetic information

1. DNA viruses

- When a DNA virus infects a cell, the viral DNA can replicate itself and can also control the synthesis of virus proteins, so that the new DNA and new protein can be assembled into new virus particles.

2.RNA viruses

- When an RNA virus infects a cell, its RNA can be used to synthesise more viral proteins, including an enzyme that controls the synthesis of more RNA.
- The new RNA and new proteins can be assembled into new virus particles.

- With the *exception* of the *RNA viruses*, all organisms store their permanent information in DNA, using RNA only as a temporary messenger for information.
- DNA is quite a stable molecule, is not very reactive with other molecules, and replicates very accurately.
- In contrast, RNA is quite unstable and makes frequent mistakes during copying.
- But these very properties make RNA ideal for the storage of viral information.

- Once the host's immune system has learned to recognise an infecting virus and create antibodies against it, it can quickly destroy it, and the virus needs to change its nature so that the host's immune system will no longer recognise it - it must mutate.
- The unstable nature of RNA allows RNA viruses to evolve far more rapidly than DNA viruses, frequently changing their surface structure.

3.Retroviruses

- Retroviruses also contain RNA, but replicate in a different way. When they infect cells, they release into the cells their RNA and an enzyme that causes it to be ‘reverse-transcribed’ into DNA.
- This then controls the formation of more viral protein and RNA that can be assembled into new virus particles.
- Viruses can also be classified by the type of organism they infect

1. animal-infecting viruses
2. plant-infecting viruses
3. bacteria-infecting viruses - these are called bacteriophages

❑ Bacteriophages have a really unusual shape

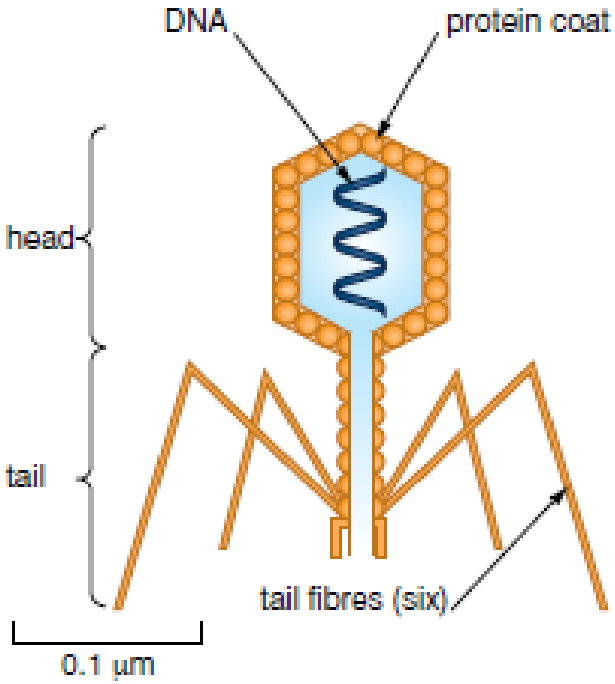
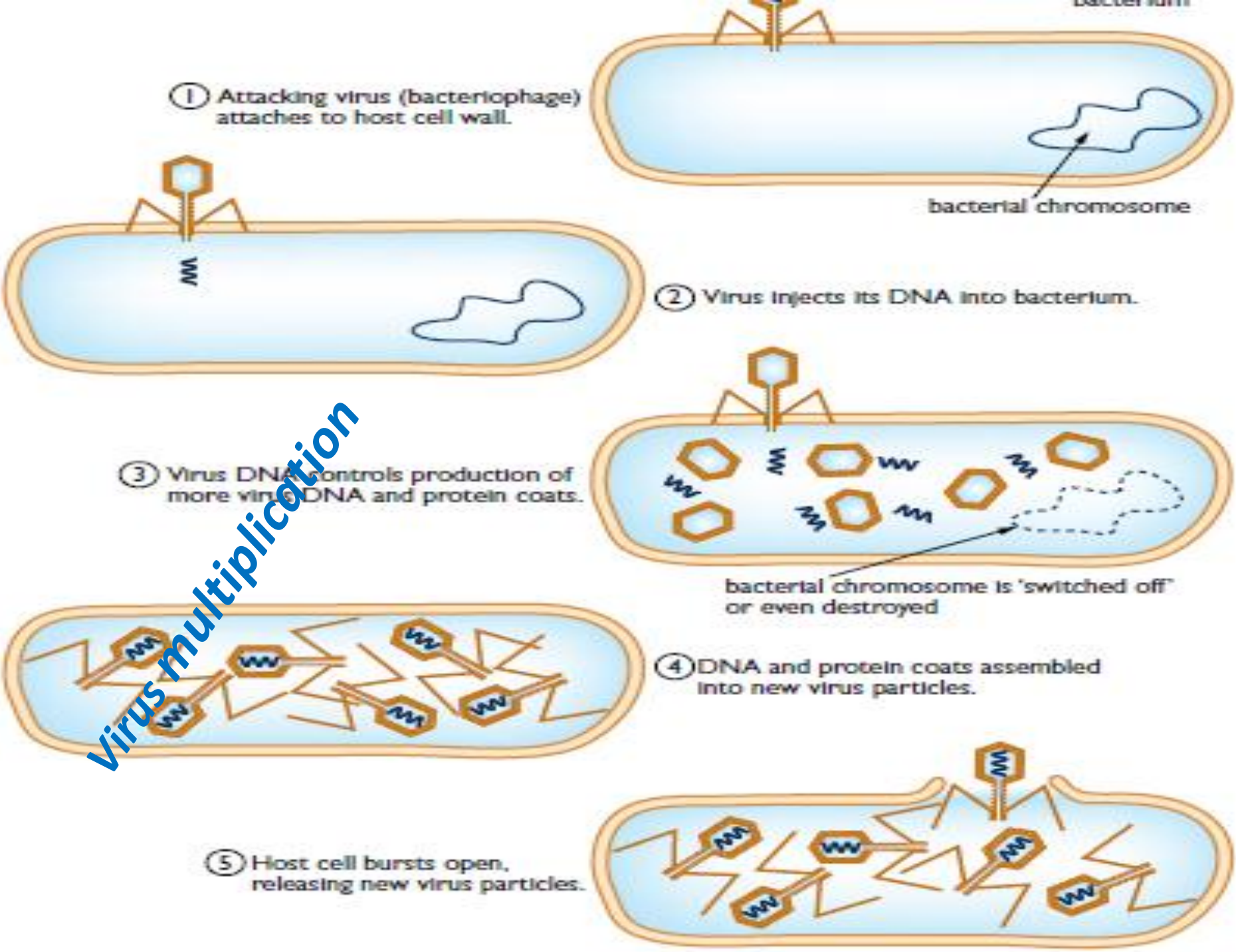


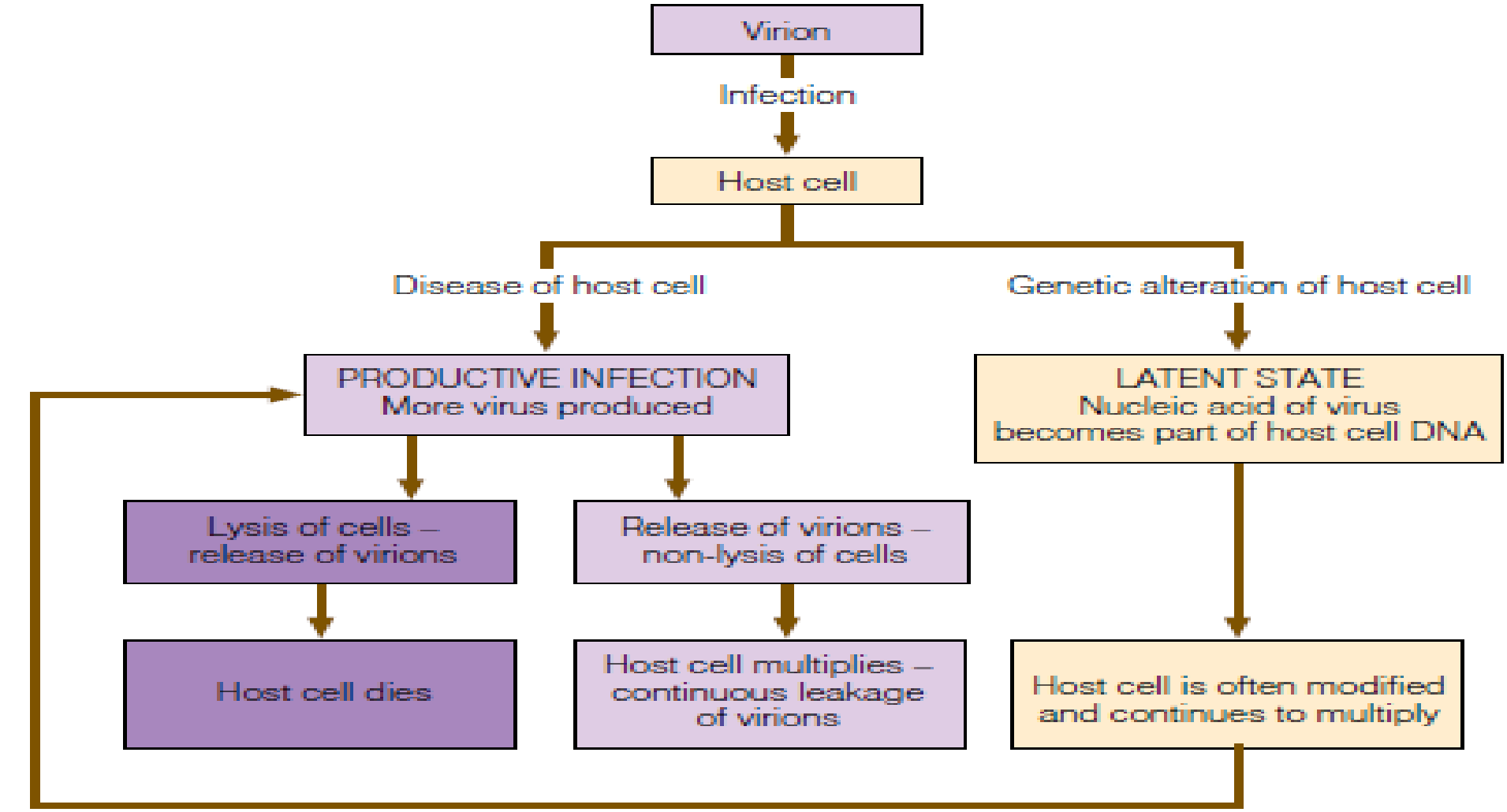
Figure 1.26 Structure of a bacteriophage

Virus multiplication



- This type of life cycle is called ***a lytic cycle*** because it causes the rupture *(lysis)* of the host cell.
- Sometimes, instead of causing the cell to burst and release the viruses all at once, a few at a time are released by ***exocytosis*** through the plasma membrane.
- This type of life cycle is called ***a chronic release cycle***, because release of new viruses is ongoing ***(chronic).***

- In other cycles, the ***virus's DNA*** becomes incorporated into the ***DNA of the host cell***.
- Each time the cell divides, the DNA is replicated, and each daughter cell gets a copy of the cell's DNA, which now includes the virus DNA.
- This can continue for many generations until some factor in the environment triggers the virus DNA to start producing virus proteins.
- Then whole viruses are assembled, which then leave the cell either by causing ***cell lysis*** (***splitting***), or by ***chronic*** (***ongoing***) ***exocytosis*** from the plasma membrane.
- This type of life cycle is called a **lysogenic cycle**.



Lytic cycle

Chronic release cycle

Lysogenic cycle

Figure 1.28 Reproductive strategies of viruses: lytic cycle, chronic release cycle and lysogenic cycle

Modes of virus transmission

Different viruses also enter cells in different ways.

A. The bacteriophage injects just its DNA; the rest of the virus remains outside the cell..\..\Important vedios\Phage.3GP

B. Many (but not all) animal viruses manage to get the whole virus inside the cell.

- This is done by tricking the cell into bringing the virus into the cell in the same way as it would with any large protein molecule - using the process of *endocytosis.*

HIV and AIDS

What is HIV like?

- Human Immunodeficiency Virus or HIV is one of the retroviruses.
- It has RNA as its genetic material.
- This is transcribed to DNA by the enzyme *reverse transcriptase*, which HIV contains together with the RNA.

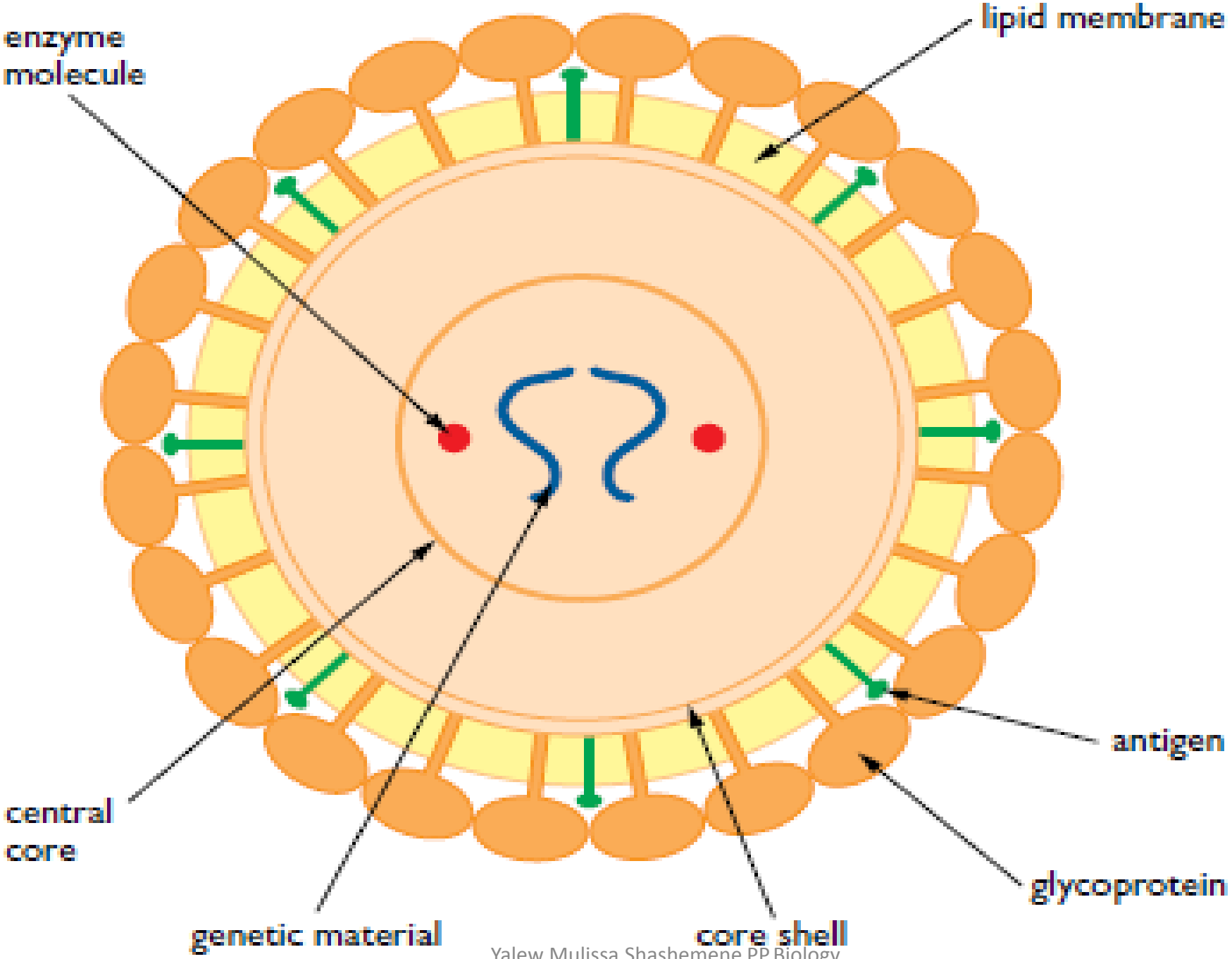


Figure 1.29 The structure of HIV

- HIV targets cells that form part of the immune system. Its main target is a type of cell called a *CD4 T-lymphocyte.*
- These cells are also called *T-helper cells*, because they 'help' other cells in the immune system to mount an immune response to pathogens in the body.
- Without this response, pathogenic micro-organisms can multiply in the body and cause disease.

- HIV has spikes on its surface, the heads of which are made from the **glycoprotein** known as **gp120**.
- This binds with CD4, a protein that protrudes from various types of human cell.
- A gp120 sticking out of an HIV virus particle connects with a CD4 sticking out of a cell like an egg fitting into an egg cup.
- Once the virus has attached to a cell, it can go on to the next stage and merge with the host cell.

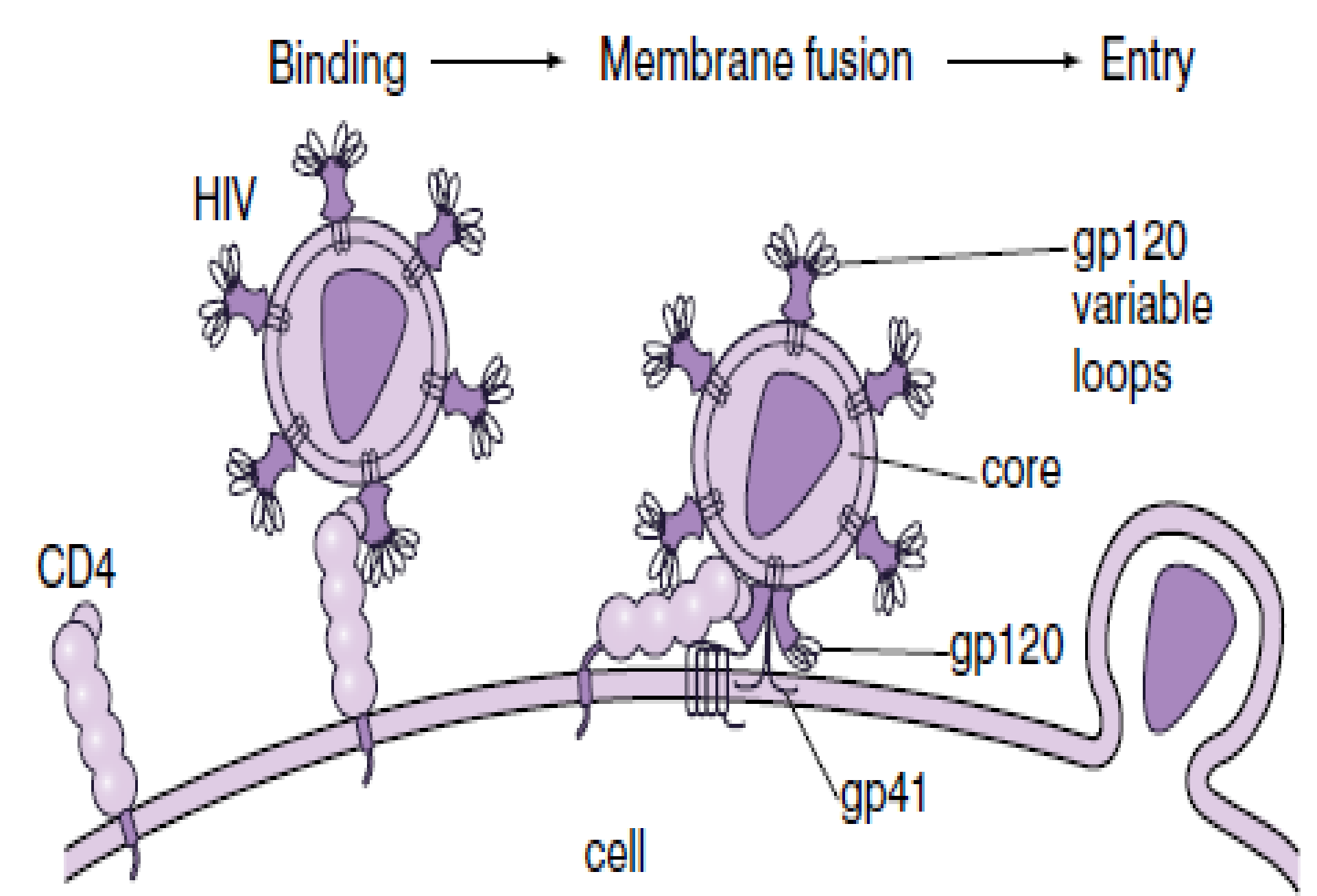
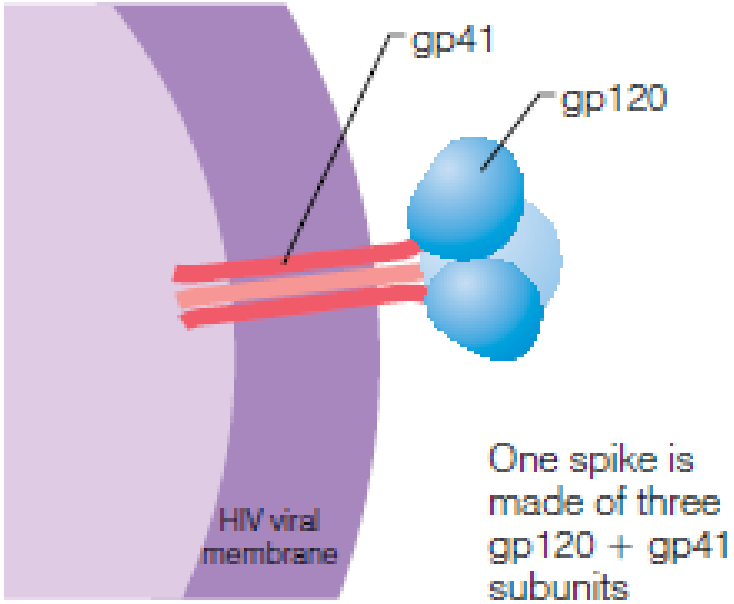


Figure 1.31 HIV infection of CD4

- The spikes on the surface of HIV are made from three ***gp120*** glycoprotein molecules attached to another molecule called **gp41.**
- The shape of these spikes allows them to bind with CD4 receptors on the T-helper cells. Because they have this particular receptor on their surface, they are called CD4 lymphocytes.



- Besides the T-helper cells, there are other types of cell that carry CD4 on their surface - such as **macrophages** and some **natural killer cells**.
- T-helper cells are the most important, though, because they are co-ordinators of the immune system.
- If their activity is impaired, it can have serious effects on the body's response to infections by other organisms.

How does HIV reproduce and cause AIDS?

- After HIV has bound to the CD4 receptors on the surface of the T-helper cell, the following events occur:

1. It fuses with the plasma membrane and then releases its RNA and reverse transcriptase enzyme into the cell.
2. The reverse transcriptase converts the RNA into DNA using building blocks called nucleotides, which are provided by the cell.
3. The viral DNA becomes incorporated into the cell's own DNA.

4. The viral DNA is transcribed to viral RNA, which starts producing viral proteins, including the enzyme reverse transcriptase.

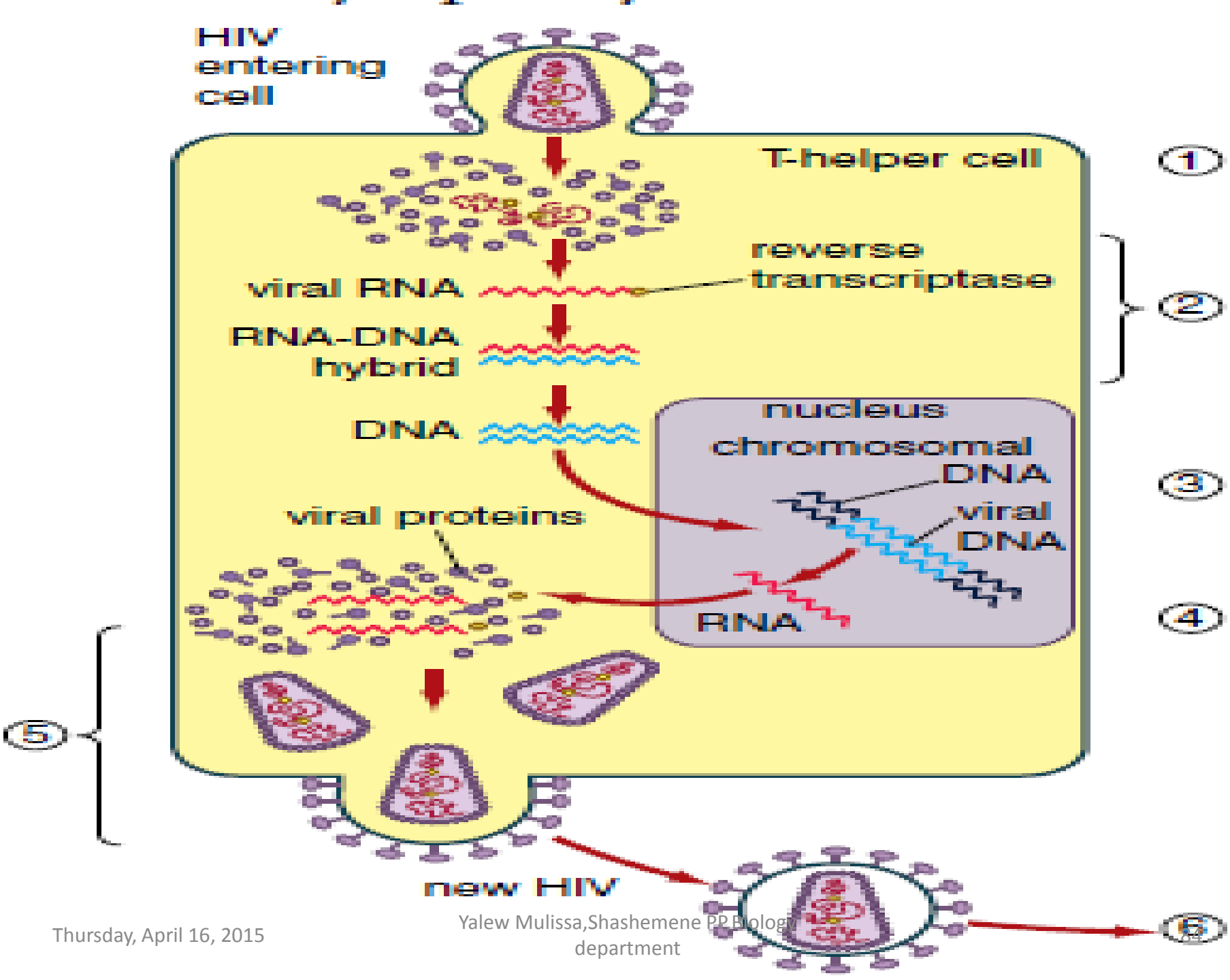
5. The RNA, proteins and reverse transcriptase molecules are assembled by the cell into new HIV particles that escape by 'budding' from the cell membrane - this is an example **chronic release**.

6. The viruses then infect other T-helper cells

- Some HIV proteins remain on the surface of the infected CD4 cell and are recognised by the immune system - these cells are destroyed.
- The cycle of infection, reproduction and destruction of infected cells repeats itself for as long as the body can keep replacing the CD4 lymphocytes.

KEY WORDS

1. *HIV* (human immuno-deficiency virus) is the virus now known to cause AIDS.
2. *AIDS* (*acquired immune deficiency syndrome*) is a disease that causes its victim's immune system to degenerate leaving them vulnerable to infectious diseases and some types of tumour.
3. *Macrophage* (also called a *white blood cell*) is a cell that surrounds and destroys pathogens.


HIV entering cell
T-helper cell
1
reverse transcriptase
viral RNA
RNA-DNA hybrid
2
DNA
nucleus
chromosomal DNA
3
viral DNA
viral proteins
RNA
4
5
new HIV
6

- Eventually, the body will not be able to replace these cells, and the number of free viruses in the blood will increase dramatically -HIV may infect other areas of the body, including the brain.
- Because of the drastic reduction in the number of *T-helper cells*, the immune function is severely reduced and many opportunistic infections may occur (including **pneumonia** and **tuberculosis**), together with rare cancers like *Kaposi's sarcoma*.



- As well as infected cells being destroyed by natural killer cells, other lymphocytes make antibodies that target any free HIV in the blood.
- The presence of these antibodies can be detected, and the person is diagnosed as being *HIV-positive*.
- The period when the body keeps replacing the *CD4 lymphocytes as fast as* they are destroyed is called *the latency period* and can last for many years.

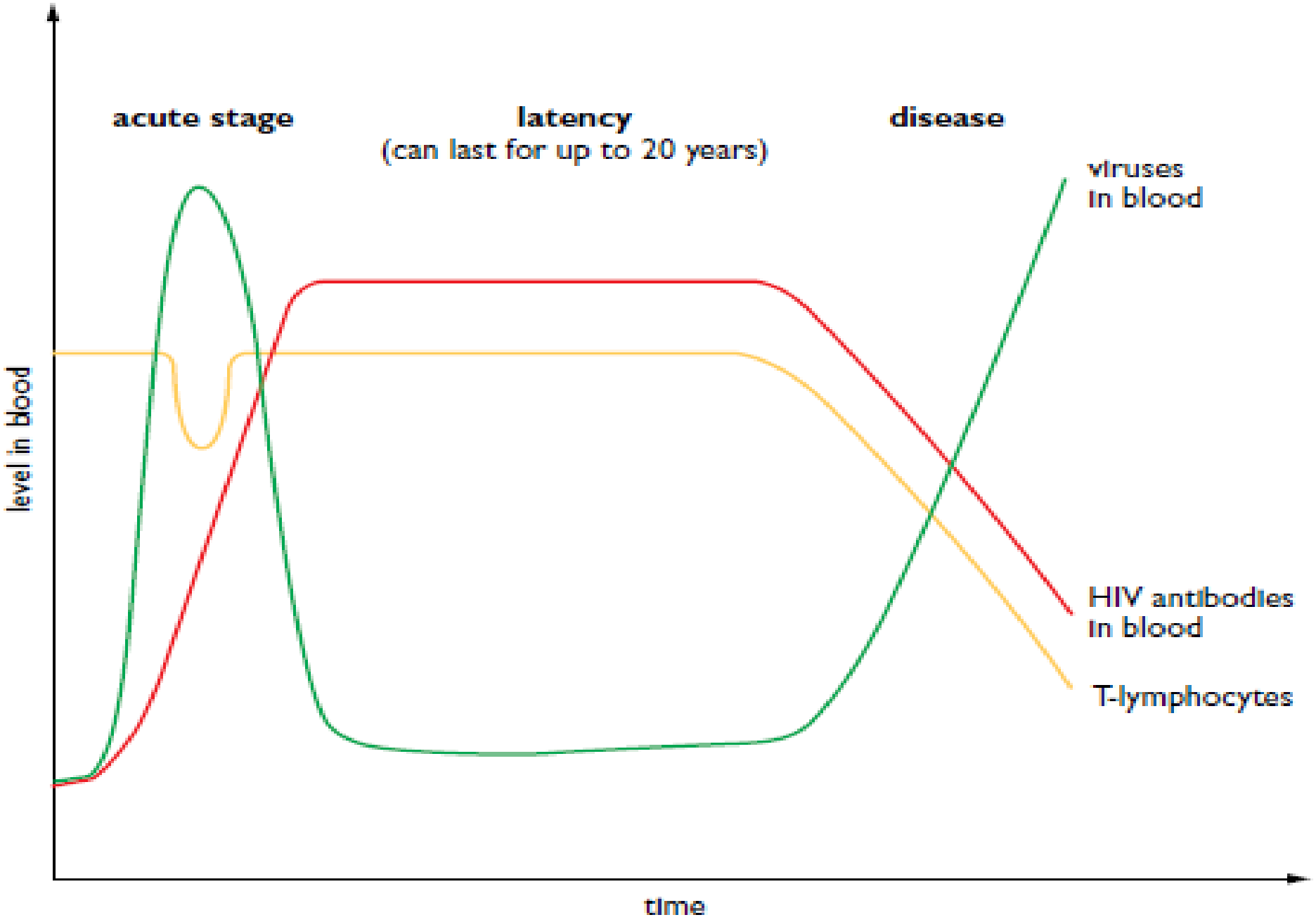


Figure 1.33 Changes in blood caused by HIV infection over time

Can AIDS be treated?

- No cure for AIDS
- *No vaccine* to give immunity against the infection.
- There are a number of drugs - called *anti-retroviral drugs* - that can be effective in slowing down the progression to AIDS.
- These drugs work by blocking the reproduction of the virus in the CD4 lymphocytes.
- There are several different drugs that act in different ways at different stages of the cycle of reproduction.

- Because the drugs act on different stages of the HIV life cycle, the most effective treatment is obtained when they are used together.
- This is called **H**igh **A**ctivity **A**nti-**R**etroviral **T**reatment (***HAART***).
- Although it is effective against HIV, it does have unpleasant side-effects.

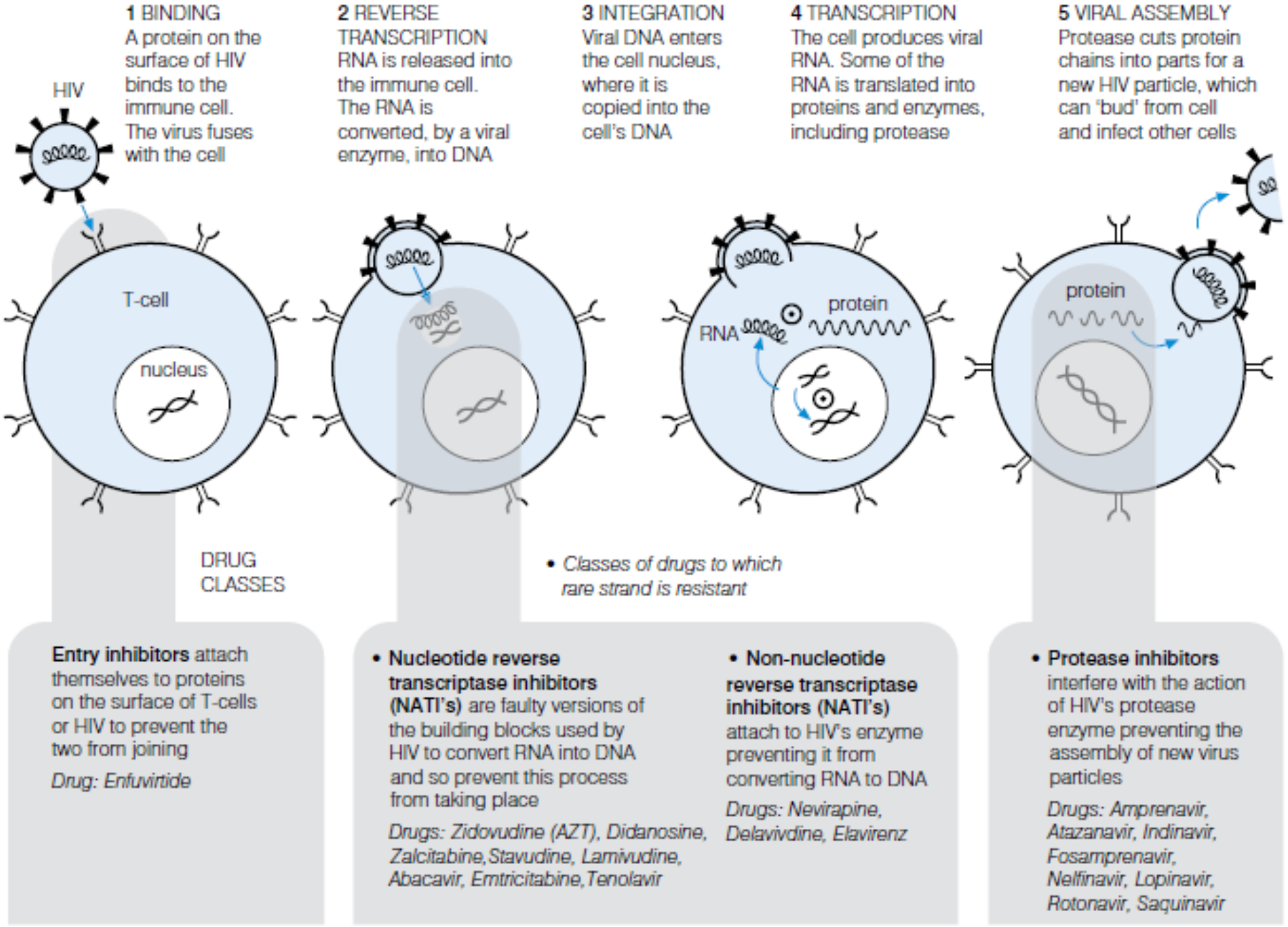


Figure 1.34 The effects of different anti-retroviral drugs

What is the social and economic impact of AIDS?

- Within families, the infection of family members is often not a subject for discussion.
- This is because of:

a) shame associated with admitting to being infected (which is connected with the taboo on speaking about sexuality)

b) fear of being isolated (or putting the family under pressure)

c) fear of losing a job, etc.

- Many affected families find themselves in a vicious circle:

a) an increasing amount of money is needed for medical treatment and burials, but

b) the number of breadwinners is decreasing.

- Nationally, AIDS has a serious economic impact in two main areas:

1. *labour supply* - the loss of young adults in their most productiveyears will affect overall economic output

2. costs:

- direct costs including expenditure for medical care, drugs and funeral expenses
- indirect costs including lost time due to illness, recruitment and training costs to replace workers, and for care of orphans
- if costs are financed out of savings, then the reduction in investment could lead to a significant reduction in economic growth

- The spread of AIDS can be limited by:

A. responsible sexual behaviour

- limiting the number of sexual partners - using condoms

B. male circumcision (this reduces the risk of males acquiring the disease)


The
End