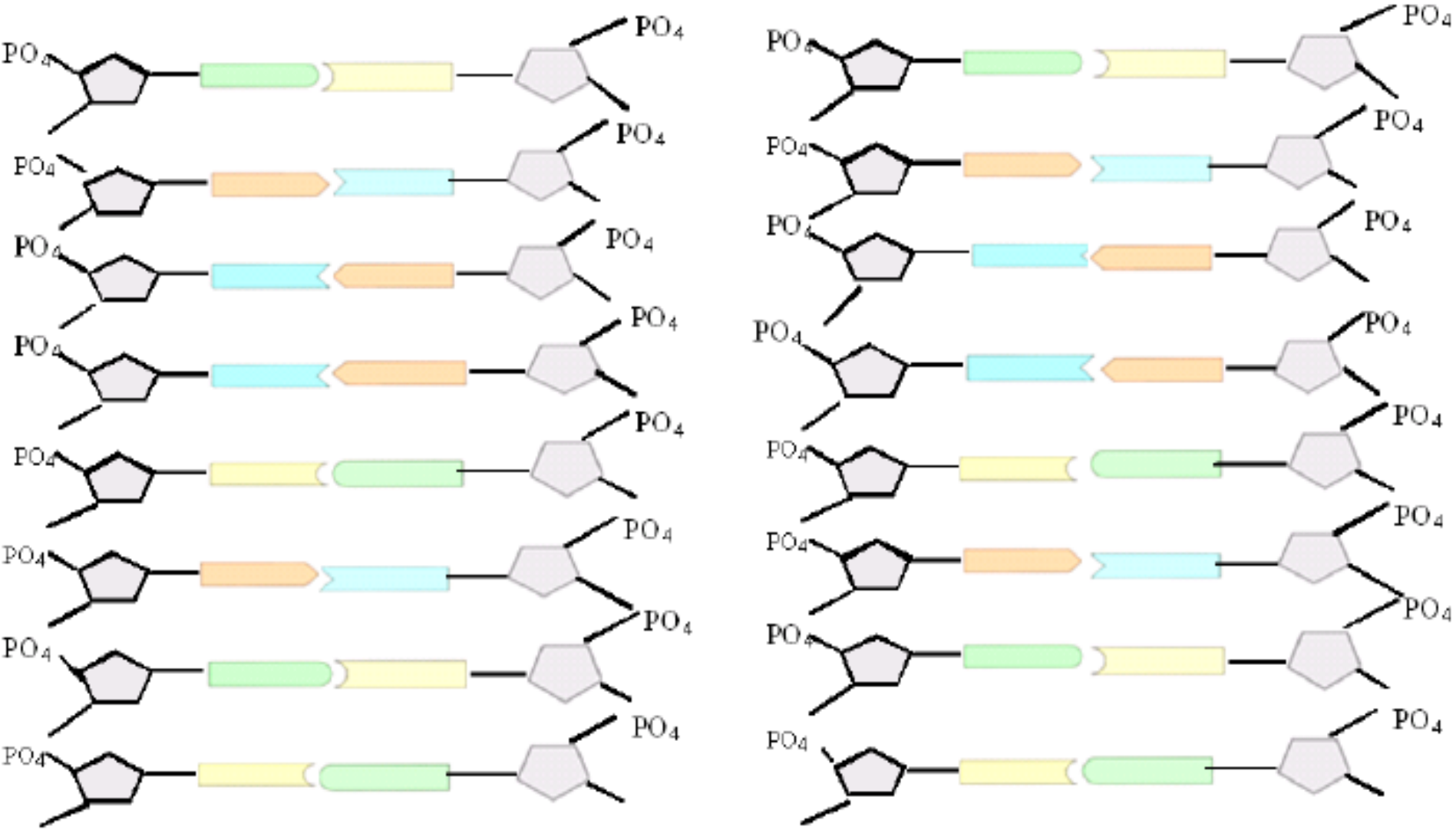
Each strand builds up its partner by adding the appropriate nucleotides



Practice - DNA replication

The following is a DNA molecule that has been split by enzymes. Fill in the base pairs to complete replication.

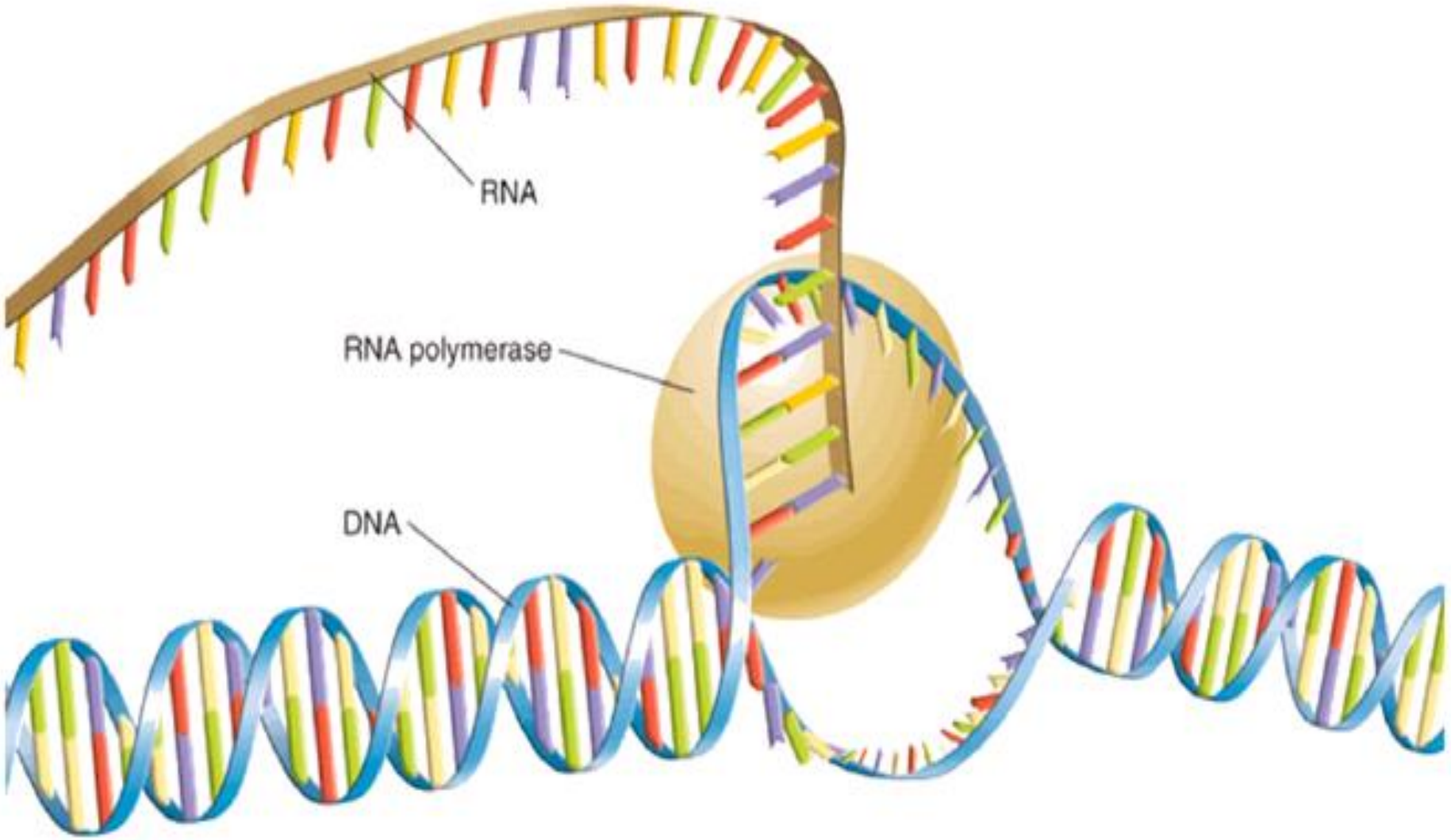
C T A A G G C T A C

_ _ _ _ _ _ _ _ _ _

_ _ _ _ _ _ _ _ _ _

G A T T C C G A T G

12-3 RNA and Protein Synthesis

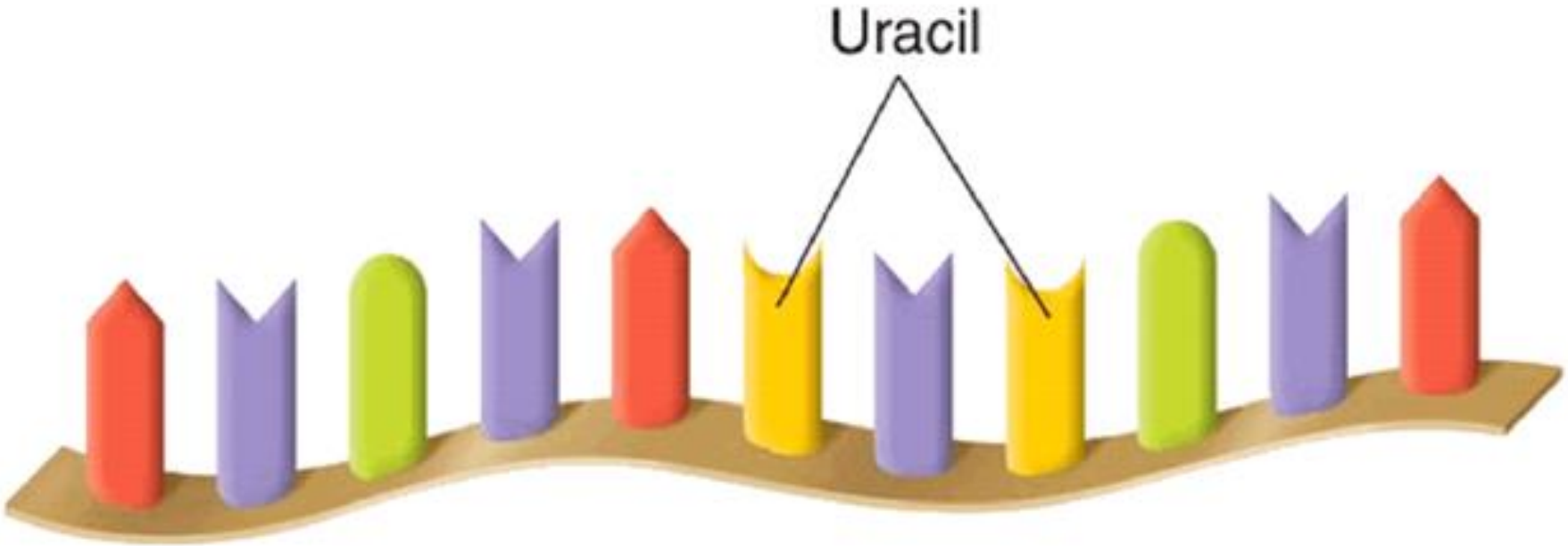


The Structure of RNA

- differences between RNA and DNA:
  1. Sugar in RNA is ribose instead of deoxyribose.
  2. RNA is single-stranded.
  3. RNA contains uracil in place of thymine.

- There are three main types of RNA:
  - messenger RNA
  - ribosomal RNA
  - transfer RNA

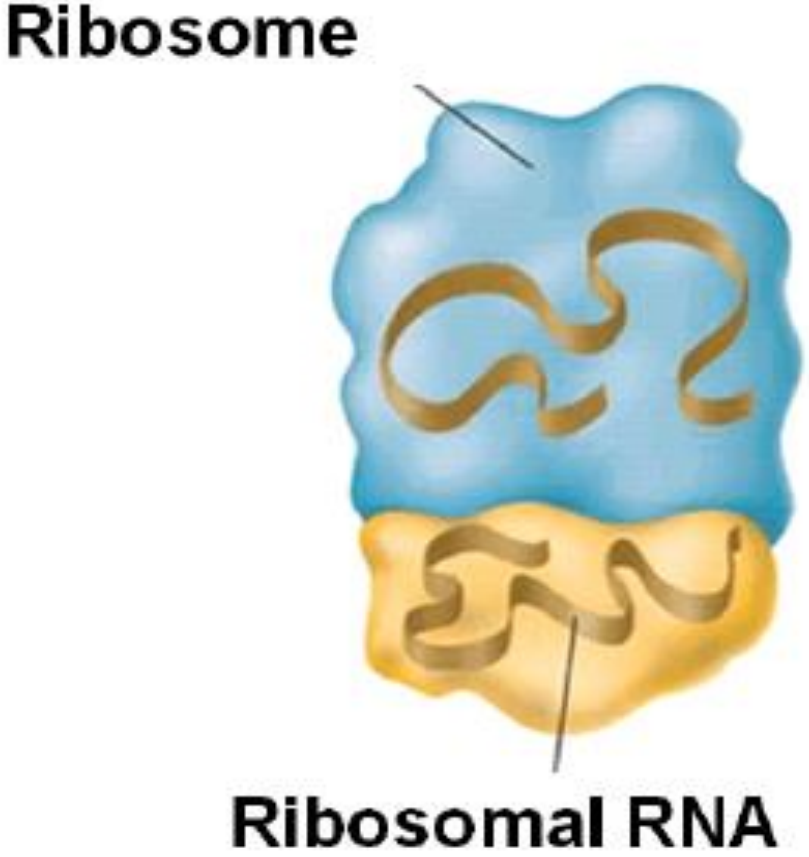
Types of RNA



Messenger RNA

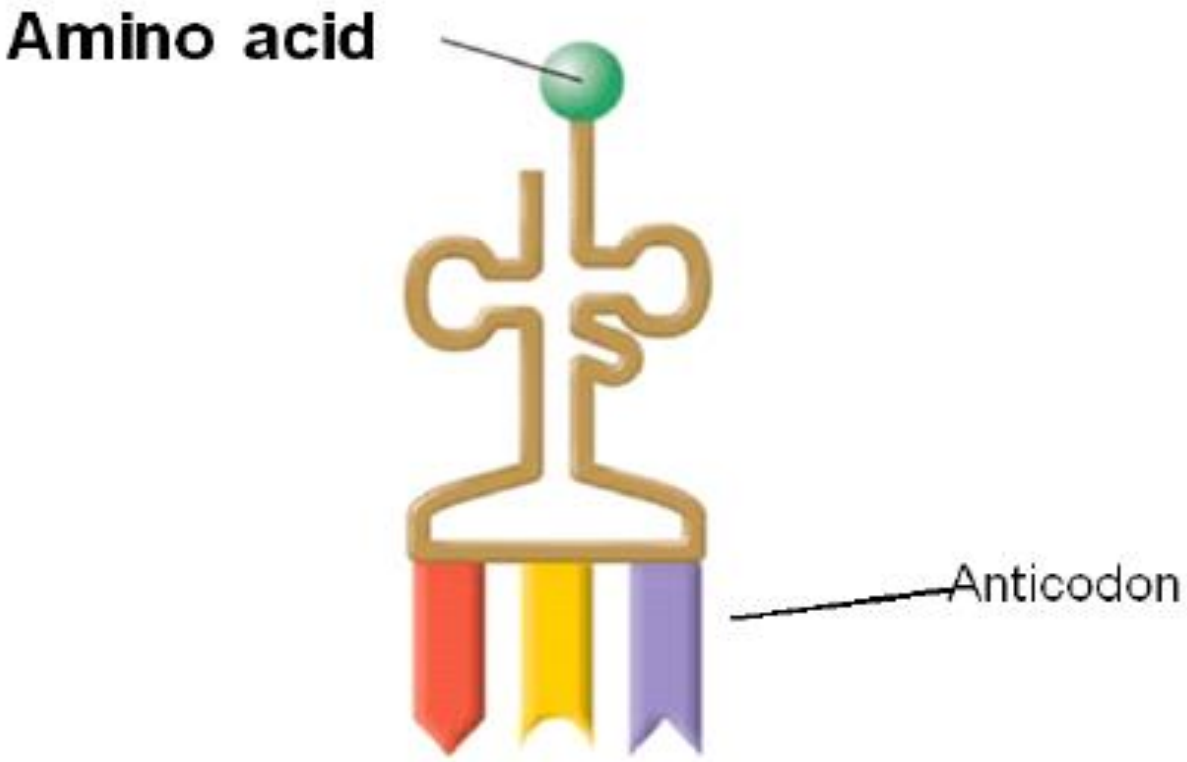
- **Messenger RNA** (mRNA) carries copies of instructions for assembling amino acids into proteins.

Types of RNA



- Ribosomes are made up of proteins and **ribosomal RNA** (rRNA).

Types of RNA



- During protein construction, **transfer RNA** (tRNA) transfers each amino acid to the ribosome.

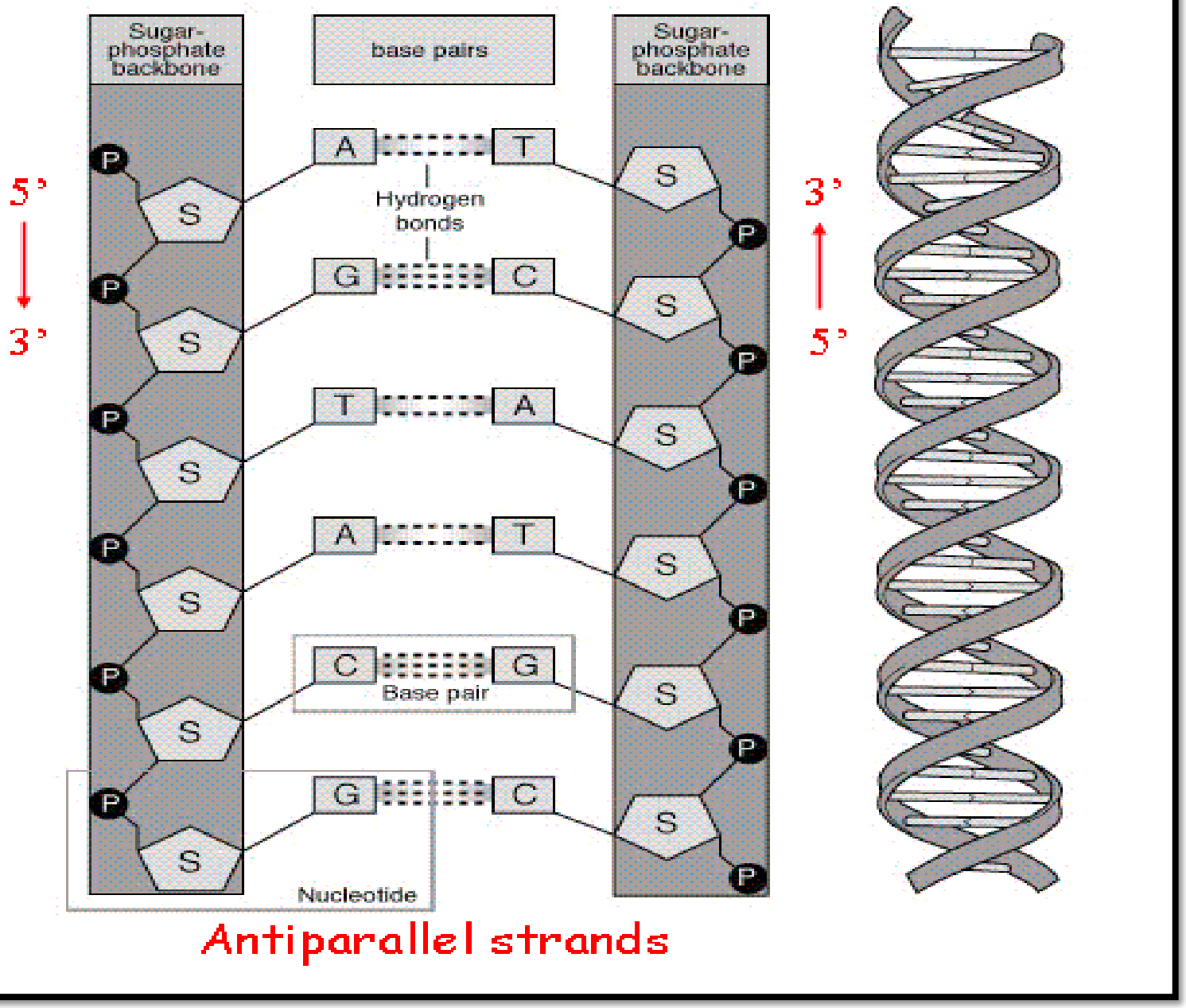
Transcription

- **transcription** - copying part of a nucleotide sequence of DNA into a complementary sequence in RNA
- requires the enzyme **RNA polymerase**
  - -RNA polymerase binds to DNA and separates the DNA strands
  - -binds only to regions of DNA known as **promoters** - signals in DNA that indicate to the enzyme where to bind to make RNA

Replication of DNA

The DNA molecule is composed of two strands held together by hydrogen bonds. In a single strand of DNA nucleotides are chained together . The hydroxyl group on the 3’ carbon of one nucleotide forms a bond with the phosphate group on the 3’….. of the ….. nucleotide. The different strands in the helix run in opposite antiparallel directions, meaning that while one strand runs from 3’ to 5’. Its complementary strand (the other half of the double helix) runs from 5’ to 3’.

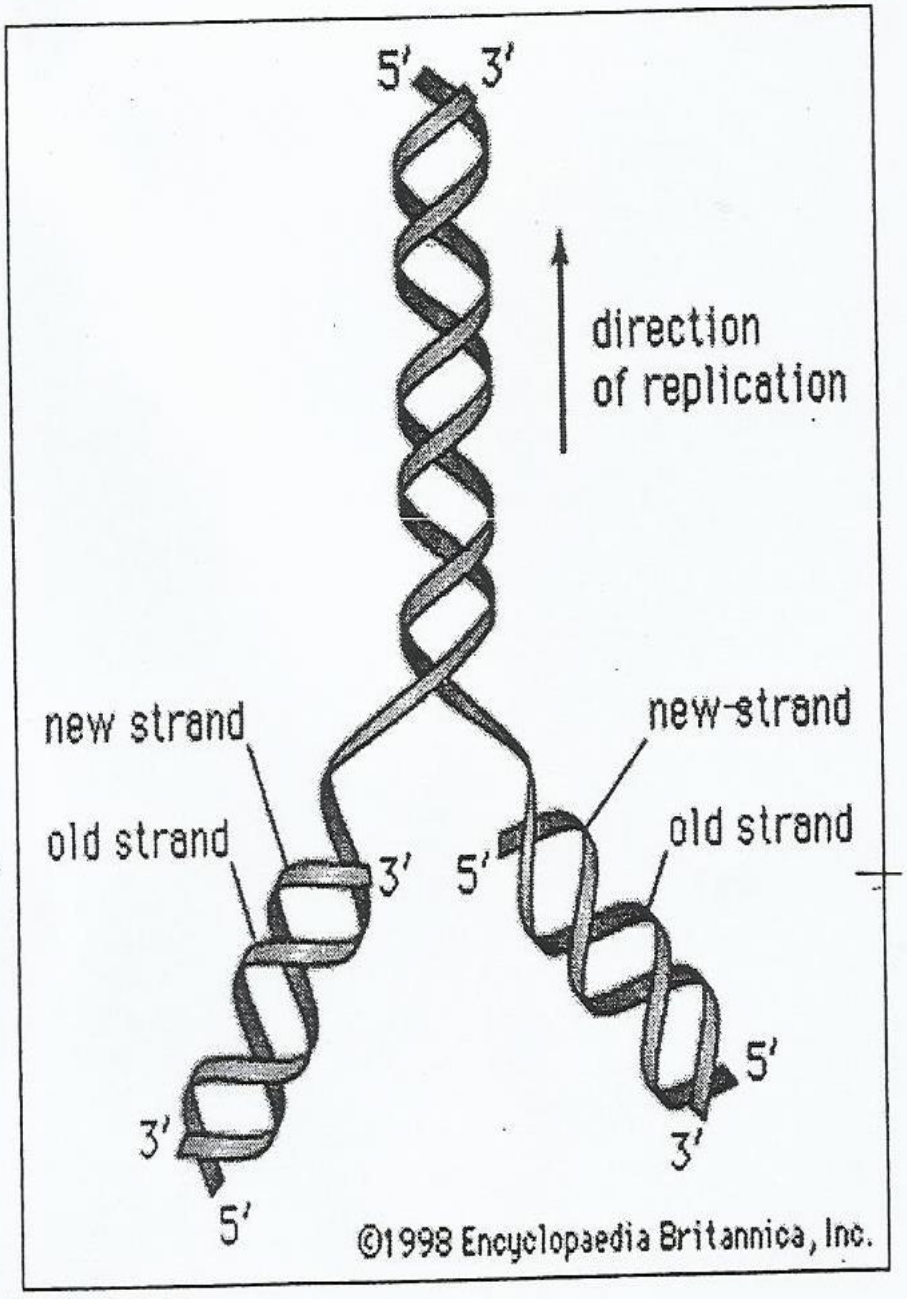
When the two parent strands of DNA are separated to begin replication, one strand is oriented in the 5’ to 3’ direction while the other strand is oriented in the 3’ to 5’ direction. During DNA replication, each DNA strand is used as a template to synthesize the second DNA strand. Replication always progresses from the 5’ end of the DNA backbone to the 3’ end. With new nucleotides being added onto the 3’ site. DNA replication is termed **semi conservation replication** because each newly formed molecule of DNA has one strand conserved from the parent molecule and one newly synthesized strand. Semi conservative replication would produce two copies that each contain one of the original strands and one new strand.



Antiparallel strands

The enzymes needed for DNA replication and their roles

1. **Helicase:** unwinds the double stranded DNA by breaking the hydrogen bonds between base pairs.
2. **RNA primase:** start off replication by adding nucleotides from 5’ to 3’ on the new DNA strand.
3. **DNA polymerase III:** adds nucleotides one by one to the new and growing DNA strand.
4. **DNA polymerase I :**removes the RNA primers and replaces them with DNA.
5. **DNA ligase:** joins the small unattached DNA segments to create a continuous strand.


5′
3′
direction
of replication
new strand
old strand
3′
5′
new-strand
old strand
5′
3′
3′
5′
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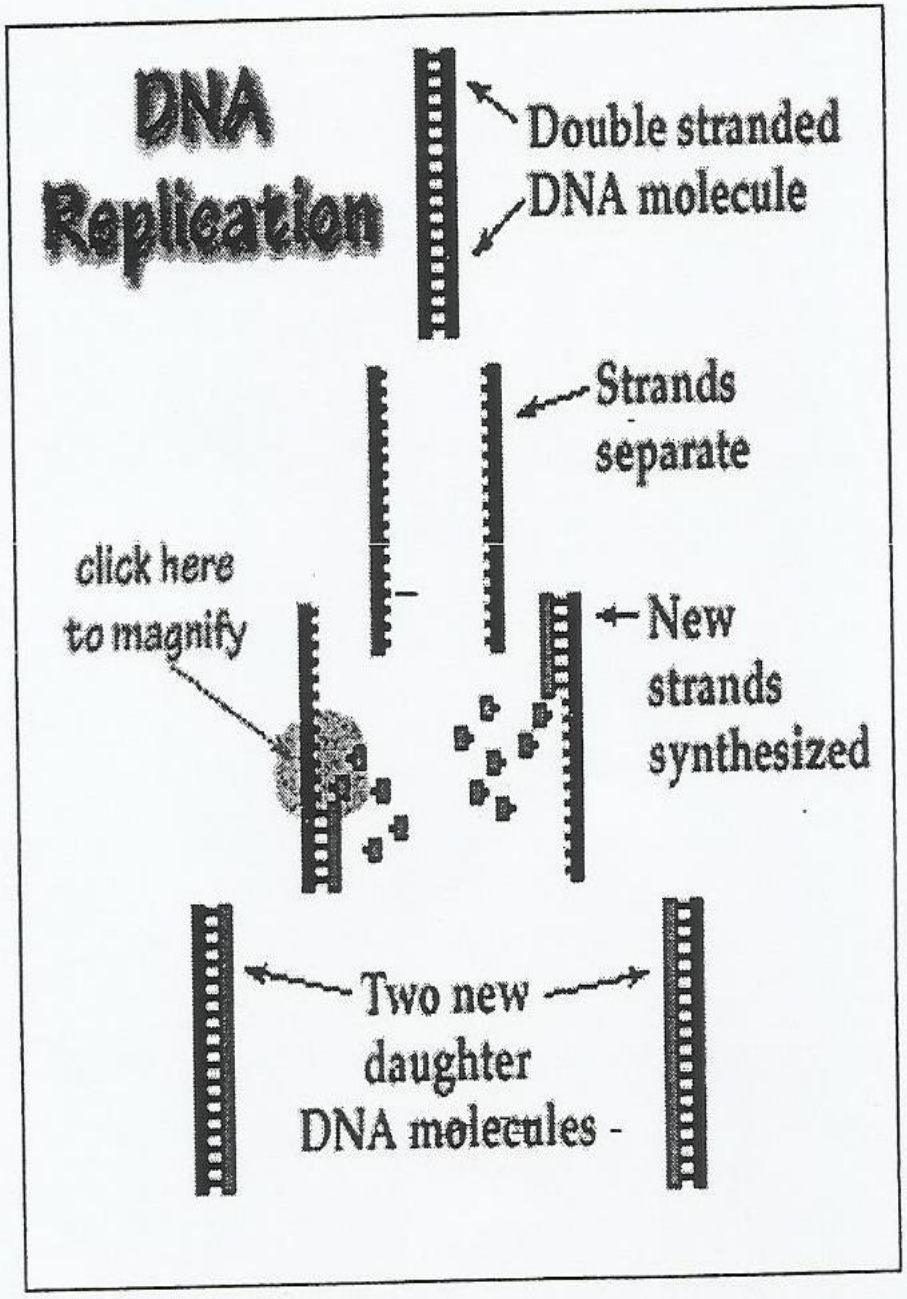

DNA
Replication
Double stranded
DNA molecule
Strands
separate
click here
to magnify
New
strands
synthesized
Two new
daughter
DNA molecules

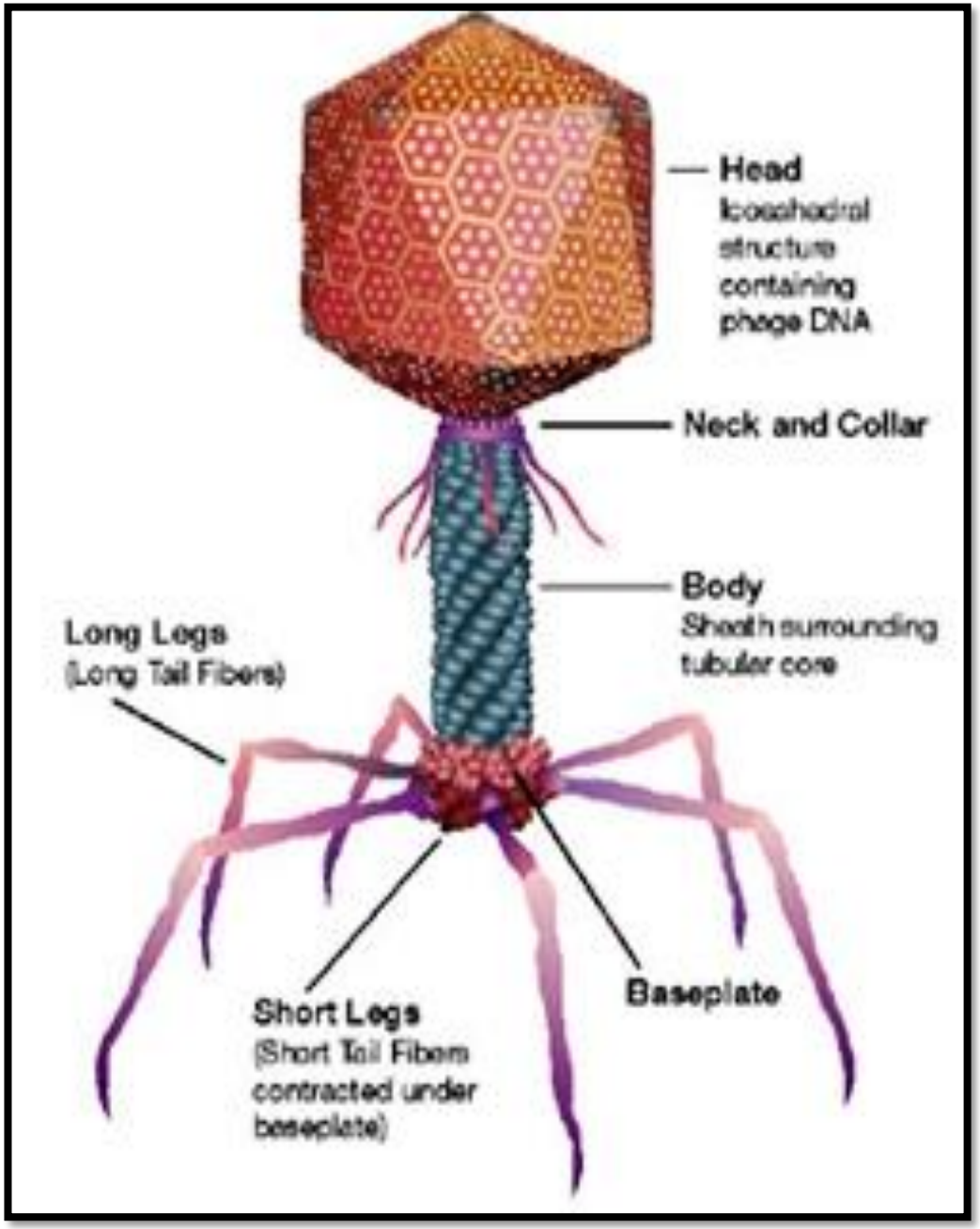
Viruses:

Viruses are small obligate intracellular parasites which means that they cannot replicate or express their genes without the help of a living cell. Viruses do not contain enzymes for energy production or protein synthesis. For a virus to multiply , it must invade a host cell and direct the host's metabolic machinery to produce viral enzymes and components. In its infective form , outside the cell, a virus particle is called a Virion .

The basic structure of a virus is made up of a genetic information molecule and a protein layer that protects that information molecule. The arrangement of the protein layer and the genetic information comes in a variety of presentations.

All viruses contain nucleic acid, either DNA or RNA (but not both), and a protein coat, which encloses the nucleic acid. The capsid is the protein shell that encloses the nucleic acid; with its enclosed nucleic acid, it is called the nucleocapsid.

All viruses have a capsid or head region that contains its genetic material. In addition to the head region, some viruses, mostly those that infect bacteria (bacteriophages) have a tail aids in binding to the surface of the host cell and in the introduction of virus genetic material to the host cell.


Head
Icosahedral structure containing phage DNA
Neck and Collar
Body
Sheath surrounding tubular core
Long Legs
(Long Tail Fibers)
Short Legs
(Short Tail Fibers contracted under baseplate)
Baseplate

Virus Multiplication Cycle

The virus multiplication cycle may be divided into the following stages:

1. **Attachment (Adsorption)**

   Attachment is a specific binding between viral surface proteins and their receptors on the host cellular surface.

1. **Penetration**

   Following attachment, viruses may enter the host cell through receptor mediated endocytosis or other mechanisms.

1. **Replication**

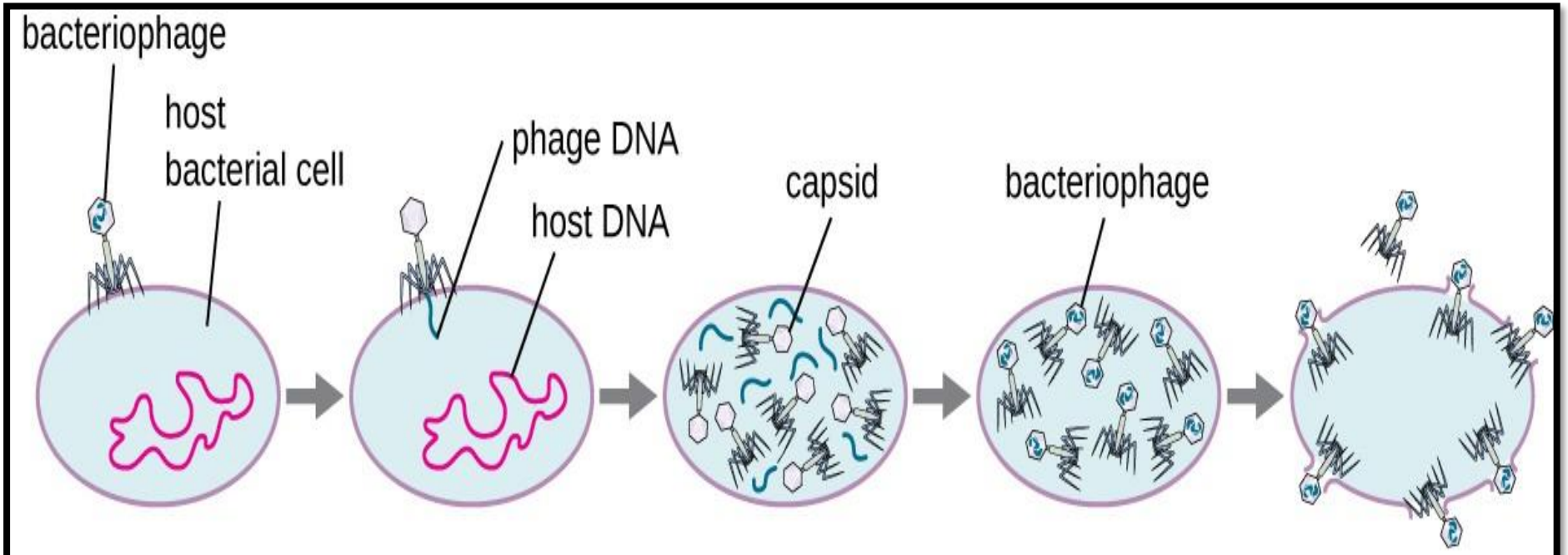
   The virus' nucleic acid uses the host cell's machinery to make large amounts of viral components, both the viral genetic material (DNA or RNA) and the viral proteins that comprise the structural parts of the virus.

1. **Assembly**

   Assembly involves bringing together newly formed viral nucleic acid and structural proteins to form the nucleocapsid of the virus.

1. **Release**

Viruses may escape from the host cell by causing cell rupture (Lysis)



1 Attachment
The phage attaches to the surface of the host.

2 Penetration
The viral DNA enters the host cell.

3 Biosynthesis
Phage DNA replicates and phage proteins are made.

4 Maturation
New phage particles are assembled.

5 Lysis
The cell lyses, releasing the newly made phages.