

- ❖ We have already learned that bacteria are prokaryotic organisms.
- ❖ Their cells are much smaller and more simply organized than those of eukaryotes, such as plants and animals.
- ❖ Viruses are *smaller and simpler still*, lacking the structure and most metabolic machinery in cells.
- ❖ Most viruses are little more than aggregates of nucleic acids and protein - *genes in a protein coat*.

A virus is a genome enclosed in a protective coat

- ❖ Viruses are not cells.
- ❖ They are infectious particles consisting of nucleic acid encased in a protein coat, and, in some cases, a membranous envelope.
- ❖ Viruses range in size from only 20nm in diameter to that barely resolvable with a light microscope.
- ❖ The genome of viruses includes other options than the double-stranded DNA that we have studied.
 - ✓ Viral genomes may consist of double-stranded DNA, single-stranded DNA, double-stranded RNA, or single-stranded RNA, depending on the specific type of virus.
- ❖ The viral genome is usually organized as a single linear or circular molecule of nucleic acid.
- ❖ The smallest viruses have only four genes, while the largest have several hundred.
- ❖ The **capsid** is a protein shell enclosing the viral genome (viral DNA or RNA).
- ❖ Capsids are built of a large number of protein subunits called *capsomeres*.
- ❖ Some viruses have **viral envelopes**, membranes covering their capsids.
- ❖ These envelopes are derived from the membrane of the *host cell*.
- ❖ They also contain some viral proteins and glycoproteins.
- ❖ The most complex capsids are found in viruses that infect bacteria, called **bacteriophages** or **phages**.
- ❖ The phages that infect *Escherichia coli* have a 20-sided capsid head that encloses their DNA and protein tail piece that attaches the phage to the host and injects the phage DNA inside.

Viruses can reproduce only within a host cell: *an overview*

- ❖ Viruses are obligate intracellular parasites.
- ❖ They can reproduce only within a host cell.
- ❖ An isolated virus is unable to reproduce - or do anything else, except infect an appropriate host.
- ❖ Viruses lack the enzymes for metabolism or ribosomes for protein synthesis.
- ❖ An isolated virus is merely a packaged set of genes in transit from one host cell to another.
- ❖ Each type of virus can infect and parasitize only a limited range of host cells, called its **host range**.
- ❖ Viruses identify host cells by a “lock-and-key” fit between proteins on the outside of the virus and specific receptor molecules on the host’s surface.
- ❖ Some viruses (like the rabies virus) have a broad enough host range to infect several species, while others infect only a single species.
- ❖ Most viruses of eukaryotes attack specific tissues.
 - ✓ Human cold viruses infect only the cells lining the upper respiratory tract.
 - ✓ The AIDS virus binds only to certain white blood cells.
- ❖ A viral infection begins when the genome of the virus enters the host cell.
- ❖ Once inside, the viral genome takes charge of its host, reprogramming the cell to copy viral nucleic acid and manufacture proteins from the viral genome.
- ❖ The nucleic acid molecules and capsomeres then self-assemble into viral particles and exit the cell.

Phages reproduce using lytic or lysogenic cycles

- ❖ While phages are the best understood of all viruses, some of them are also among the most complex.
- ❖ Research on phages led to the discovery that some double-stranded DNA viruses can reproduce by two alternative mechanisms: the lytic cycle and the lysogenic cycle.
- ❖ In the **lytic cycle**, the phage reproductive cycle culminates in the death of the host.
 - ✓ In the last stage, the bacterium lyses (breaks open) and releases the phages produced within the cell to infect others.
- ❖ **Virulent phages** reproduce only by a lytic cycle.

- ❖ In the **lysogenic cycle**, the phage genome replicates *without destroying the host cell*.
- ❖ **Temperate phages**, like phage lambda, use both lytic and lysogenic cycles.
- ❖ Within the host, the virus' circular DNA engages in either the lytic or lysogenic cycle.
- ❖ During a lytic cycle, the viral genes immediately turn the host cell into a virus-producing factory, and the cell soon lyses and releases its viral products.
- ❖ But during the lysogenic cycle, the viral DNA is incorporated by genetic recombination (crossing over) into a specific site on the host cell's chromosome.
- ❖ It is then known as a ***prophage***.
- ❖ Every time the host divides, it also copies the viral DNA (prophage) and passes the copies to daughter cells.
- ❖ Occasionally, the viral genome exits the bacterial chromosome and initiates a lytic cycle.
- ❖ This switch from lysogenic to lytic may be initiated by an environmental trigger.
- ❖ The lambda phage which infects *E. coli* demonstrates the cycles of a temperate phage.