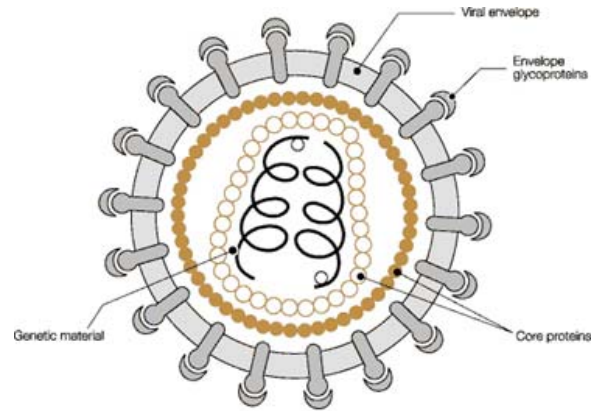


Biology Lecture 3 – Microbiology

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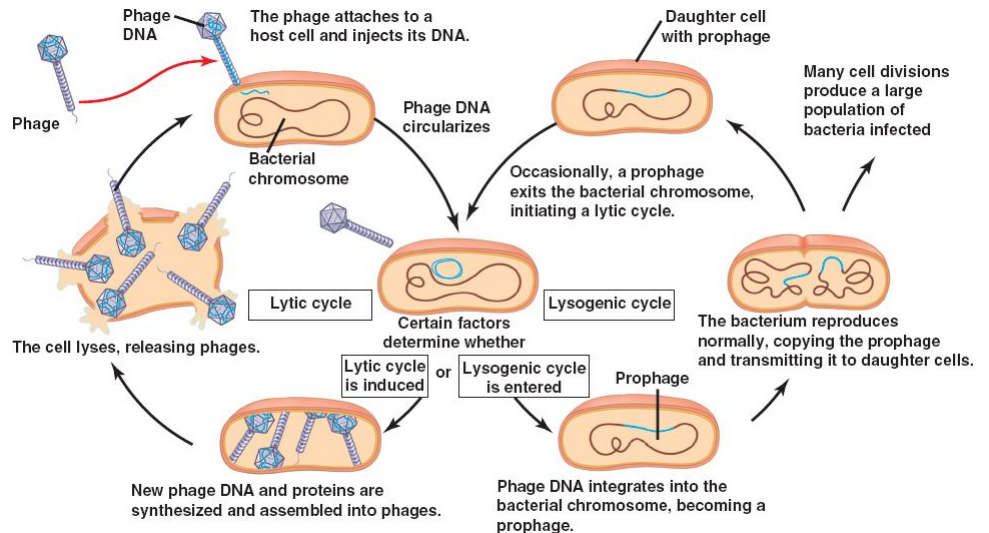
Viruses

- **Genetic material** inside capsid (protein coat) and sometimes inside envelope (lipids)
 - DNA or RNA, single- or double-stranded (never both)
 - *Plus-strand RNA*: proteins can be directly translated from RNA
 - *Minus-strand RNA*: must be transcribed to plus-RNA before translation
- Enters host cell via chemical receptor
 - Usually via *endocytosis*
 - *Bacteriophages*: enzymes digest a hole in the cell wall, then nucleic acid injected thru tail
- Requires host cell's machinery/energy in order to reproduce



Viral life cycles:

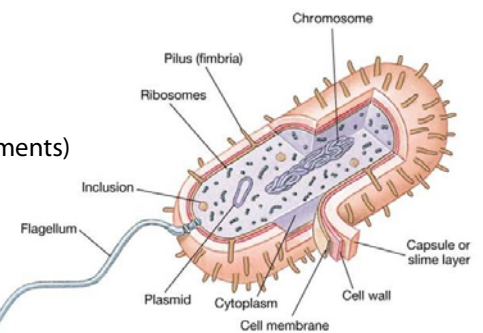
- *Lytic cycle*: virus produces new viruses, cell lyses to release them (virulent)
- *Lysogenic cycle*: viral genetic material added to host genome, reproduces (temperate)
 - RNA virus uses *reverse transcriptase* to convert it to DNA
 - Virus in host genome called dormant/latent/provirus/prophage
 - Usually leaves cycle due to stress/UV light/carcinogens

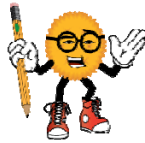


- Immune system attacks viruses with antibodies or cytotoxic T cells
- *Vaccines* involve injecting antibodies/non-pathogenic viruses with the same capsid
- Viruses can exist in *carrier populations* (non-human animals) so eradication is difficult

Prokaryotes

- **Organelles**:
 - No membrane-bound nucleus, no membrane-bound organelles
 - Single, circular double stranded DNA molecule forming the nucleoid
 - Have ribosomes which are smaller than eukaryotic ones
- Two domains: Bacteria and Archaea (more similar to eukaryotes, extreme environments)
- **Trophs**: carbon source, energy source
 - *Autotrophs*: organisms that can use CO₂ as only source of carbon
 - *Heterotrophs*: organisms that must use organic molecules for carbon
 - *Phototrophs*: organisms that use light as source of energy
 - *Chemotrophs*: organisms that oxidize organic matter for energy
- *Nitrogen fixation*: how some bacteria can convert nitrogen gas to ammonia
- **Shapes**: cocci (round), bacilli (rod), spirilla (helical, rigid), spirochetes (helical, non rigid)





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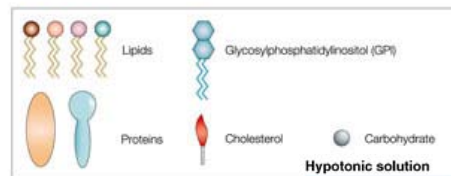
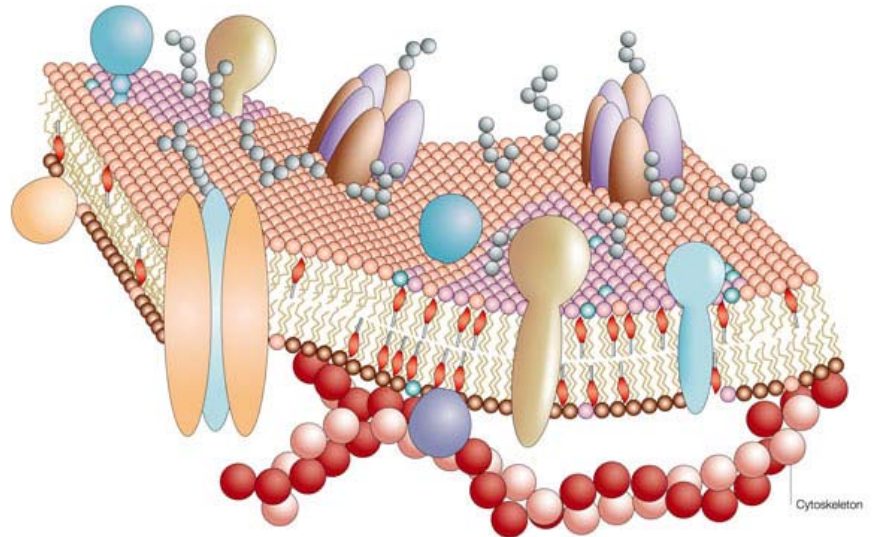
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Plasma Membrane

- Surrounds cytosol

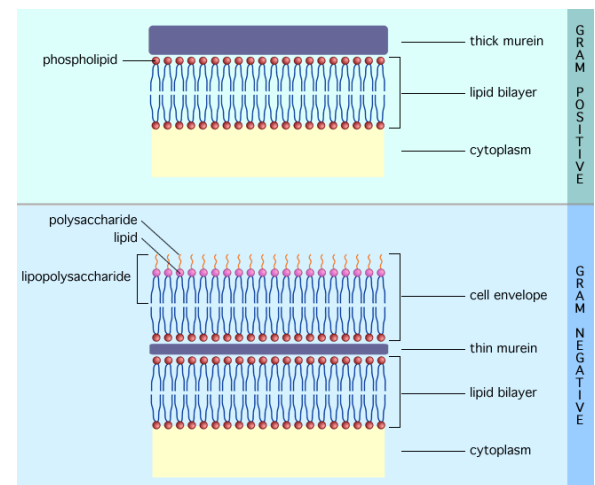
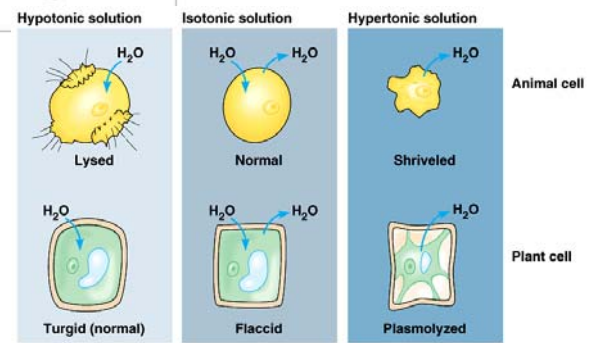
Structure

- **Phospholipid bilayer:** phosphate + two fatty acids + glycerol
 - **Amphipathic** = has both polar/nonpolar side
 - Forms spherical **micelles** in solution
- **Glycolipids** help attach to extracellular matrix
- **Cholesterol** (hopanoids in prokaryotes) help with fluidity
- **Integral/intrinsic** proteins: amphipathic proteins that go through entire membrane
- **Peripheral/extrinsic** proteins: proteins that are only on one surface
- **Fluid mosaic model:** parts of membrane can move laterally



Function

- Makes barrier between solutions with different compositions
- **Diffusion:** random movement of something from higher to lower concentration
- **Concentration gradient:** gradual change in concentration over a distance
- **Electrical gradient:** gradual change in electrical charge over a distance
- **Electrochemical gradient:** conc + elec gradients, tells us where particles will move
 - For ions usually creates an **equilibrium**
- **Semipermeable:** characteristic of membrane that allows only certain molecules to pass through
 - Only small or uncharged/nonpolar molecules can diffuse thru plasma membrane
- Polar/charged molecules can cross the membrane through:
 - Cracks next to integral proteins (passive diffusion)
 - Transport/carrier proteins (facilitated diffusion) - **DOWN** electrochemical gradient
 - Forced across **AGAINST** electrochemical gradient using ATP (active transport)
- **Hypertonic:** cytosol more concentrated than surroundings
- **Isotonic:** cytosol has same concentration as surroundings
- **Hypotonic:** cytosol less concentrated than surroundings





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- *Osmosis*: movement of water from lower to higher solute concentration
- Bacteria are kept stiff/turgid by their peptidoglycan cell walls (targeted by some antibiotics)
 - Balance of hydrostatic pressure (stiffness of cell wall) and osmotic pressure
- *Gram staining*: positive = thick cell walls, negative = thin cell wall
- *Flagella*: long cylinders of flagellin which propel bacteria forward (9+2 microtubules)

Prokaryote Reproduction

- *Binary fission*: 2x DNA polymerase start at origin of replication going opposite directions → duplicates circular DNA molecule, then bacterial splits in half
- *Genetic recombination*: three types to promote genetic variation
 - *Conjugation*: bacteria with F/fertility factor plasmid (F+) grows sex pilus (hollow tube) which connects to another bacteria (F-); other plasmids can transfer along with part of chromosome thru pilus
 - *Transformation*: bacteria incorporate DNA in external environment into genome
 - *Transduction*: virus capsid encapsulates bacterial DNA, transferred during next infection
- *Endospores*: gram-positive bacteria can form hard shells that are VERY tough + resistant

Fungi

- Kingdom divided into divisions, not phyla (similar to plants)
- Eukaryotic heterotrophs – absorb food after secreting digestive enzymes
- Most are *saprophytic* or eat dead matter
- Have cell walls (*septa*) made of chitin which have holes to allow cytoplasm to flow between cells
- Can do both asexual and sexual reproduction
 - Usually asexual; only sexual when times are tough (why?)
- Alternates between haploid and diploid stages; haploid stage is dominant, is most visible
 - Haploid stage has a huge mass called a *mycelium* of multinucleate threads called *hyphae*
 - Hyphae can release haploid *spores* which divide asexually to form new mycelia
- Sexual reproduction
 - Two types of hyphae + and - join
 - Haploid gametes combine creating diploid zygote
 - Diploid zygote can form spores via meiosis when conditions are favorable
- Yeasts: *budding* occurs where a small cell pinches off a larger cell

