Cheatography

# APBioChap7 Osmosis, Water Potential, etc. Cheat Sheet

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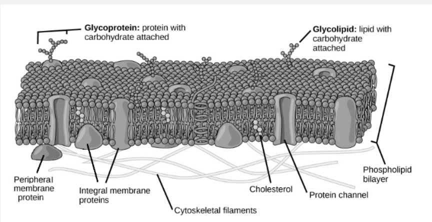
## Major Formulas

| | |
|---|---|
| **Calculating Water Potential** | $\Psi = \Psi^s + \Psi^p$ |
| **Calculating Solute Potential** | $\Psi^s = -iRCT$ |

| Key | |
|---|---|
| **$\Psi^s$** | Solute Potential |
| **$\Psi^p$** | Pressure Potential |
| **i** | The # of particles the molecule will make in water |
| **C** | Molar Conentration (from experimental data) |
| **R** | Pressure Constant = 0.0831 liter bar/mole K |
| **T** | Temperature in degrees Kelvin = 273 + C° of solution |

## Membrane Structure




**Principal components:**
➋Lipids (*phospholipids, cholesterol*), proteins, carbohydrate groups.

**Phospholipids**
➋Made of glycerol, two fatty acid tails, and a phosphate-linked head group.
→A phospholipid bilayer involves two layers of phospholipids with their tails pointing inward

**Cholesterol**
➋Lipid composed of four fused carbon rings
→Found alongside phospholipids in the core of the membrane.

## Active Transport

## Active Transport (cont)

➋ Uses an electrochemical gradient – generated by active transport – as an energy source to move molecules against their gradient
→Does not directly require a chemical source of energy such as ATP

**The Sodium-Potassium Pump Cycle**

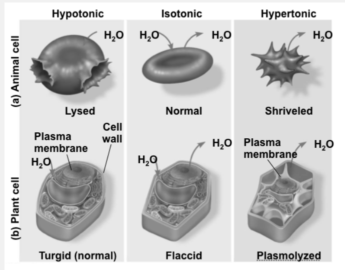
➋ Moves $Na^+$ out of cells and $K^+$ into them
➋ Electrogenic pump
➋ 1. The pump is open to the inside of the cell and binds/takes up 3 $Na^+$ ions
➋ 2. Once the $Na^+$ ions bind, the pump is triggered to hydrolize ATP. One P-group is attached to the pump, and then phosphorylated. ADP is released as a by-product.
➋ 3. Phosphorylation causes the pump to change form so that it then faces the exterior of the cell. Like this, the pump no longer has an affinity for $Na^+$ ions, and 3 are released.
➋ 4. Facing this direction, the pump now has an affinity for $K^+$ ions. It binds 2 of them which triggers the release of the P-group attached to the pump.
➋ 5. With the P-group gone, the cell once again changes form and then faces towards the interior of the cell.
➋ 6. The pump is now back to step 1, and the cycle repeats.

The sodium-potassium pump acts primarily by building up a high concentration of potassium ions inside the cell, which makes potassium's concentration gradient very steep. The gradient is steep enough that potassium ions will move out of the cell (via channels), despite a growing negative charge on the interior. This process continues until the voltage across the membrane is large enough to counterbalance potassium's concentration gradient. At this balance point, the inside of the membrane is negative relative to the outside. This voltage will be maintained as long as $K^+$concentration in the cell stays high

## Apoptosis

| Apoptosis |
|---|
| may be engulfed when no longer needed |
| cells with genetic damage are replaced |
| defense against infection |
| signals trigger caspases to carry out apoptosis |

## Hypotonic vs Isotonic vs Hypertonic



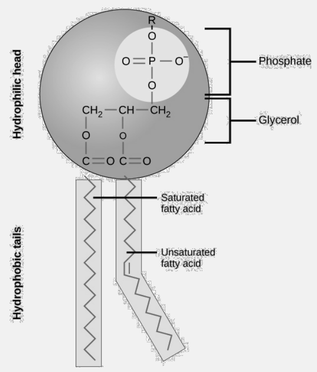

**Isotonic solution:** Solute concentration is the same as that inside the cell; no net water movement across the plasma membrane

**Hypertonic solution:** Solute concentration is greater than that inside the cell; cell loses water

**Hypotonic solution:** Solute concentration is less than that inside the cell; cell gains water

Cells without cell walls will shrivel in hypertonic solution and lyse (burst) in a hypotonic solution

## Phospholipid




Phospholipids are **ampipathic** because of their hydrophilic, polar heads and hydrophobic, nonpolar tails.

**Primary Active Transport**

- Directly uses a source of chemical energy (e.g., ATP) to move molecules across a membrane against their gradient

**Secondary Active Transport**

The hydrophilic **heads of phospholipids in a membrane bilayer face outward**, contacting the watery fluid both inside and outside the cell. Since water is a polar molecule, it readily forms electrostatic interactions with the phospholipid heads.

Phospholipids tuck their fatty acid tails away in the interior of the membrane, where they are shielded from the surrounding water.

## Selective Permeability

- The hydrophobic core of the plasma membrane helps some materials move through the membrane, while it blocks the movement of others
- Polar molecules can easily interact with the outer face of the membrane, where the negatively charged head groups are found, but they have difficulty passing through its hydrophobic core
- While small ions are the right size to slip through the membrane, their charge prevents them from doing so. Instead, they must be transported by special proteins.
- Larger charged and polar molecules, like sugars and amino acids, also need help from proteins

## Organelles

| | |
|---|---|
| **Nucleolus** | where rRNA & ribosomes are synthesized |
| **Ribosomes** | protein factories |
| **Endomembrane System** | regulates protein traffic+metabolic functions |
| **Nucleus** | holds chromatin, surrounded by nuclear envelope |
| **ER** | Rough: makes proteins Smooth: synthesizes lipids, stores Ca++, detoxifies drugs/poisons |
| **Golgi Appara tus** | processes, packages, & secretes substances |
| **Lysosomes** | intracellular digestion |
| **Mitochondria** | powerhouse of the cell |
| **Vacuoles** | storage & pumping out water |
| **Chloroplast** | absorbs light & synthesize sugar |
| **Cytoskeleton** | maintains cell shape, flow, positioning |

## Organelles (cont)

| | |
|---|---|
| **Centrioles Centrosomes MTOCs** | organize spindle fibers (cell division) |
| **Cell Wall** | protects, maintains shape, regulates water intake |
| **Peroxisomes** | break down fatty acids to be used for forming membranes and as fuel for respiration, transfer hydrogen from compounds to oxygen to create hydrogen peroxide and then convert hydrogen peroxide into water |

## Osmosis & Tonicity

### Osmosis

- Osmosis is the movement of water through a semi-permeable membrane from a region of high concentration to a region of low concentration, tending to equalise the concentrations of the water.
- Osmosis is passive transport, meaning it does not require energy to be applied.

### Tonicity

- The ability of an extracellular solution to make water move into or out of a cell by osmosis is know as its tonicity.
- A solution's tonicity is related to its osmolarity, which is the total concentration of all solutes in the solution.

## Passive Transport

### Diffusion

- A substance moves from an area of high concentration to low concentration until its concentration becomes equal throughout a space

### Facilitated Diffusion

## Passive Transport (cont)

- Molecules diffuse across the plasma membrane with assistance from membrane proteins, such as channels and carriers
- A concentration gradient exists for these molecules, so they have the potential to diffuse into (or out of) the cell by moving down it. However, because they are charged or polar, they can't cross the phospholipid part of the membrane without help. Facilitated transport proteins shield these molecules from the hydrophobic core of the membrane, providing a route by which they can cross.

### Channels

- Channel proteins span the membrane and make hydrophilic tunnels across it, allowing their target molecules to pass through by diffusion
- Very selective and will accept only one type of molecule for transport
- *Aquaporins* are channel proteins that allow water to cross the membrane very quickly, and they play important roles in plant cells, red blood cells, and certain parts of the kidney
- Play an important role in electrical transmission along membranes (in nerve cells) and in muscle contraction (in muscle cells)

### Carrier Proteins

- Change their shape to move a target molecule from one side of the membrane to the other
- Will change shape in response to binding of their target molecule, with the shape change moving the molecule to the opposite side of the membrane
- Provide hydrophilic molecules with a way to move down an existing concentration gradient (rather than acting as pumps)

## Types of Cell Communication

| | |
|---|---|
| **Quorum Sensing** | monitors bacteria population density & controls gene expression |
| **Auto-crine Signals** | produced & used by same cell |
| **Juxt-acrine Signals** | physically touching cells (gap junctions, plasmodesmata) |

### Types of Cell Communication (cont)

| | |
|---|---|
| **Paracrine Signals** | adjacent (not touching) cells (synapses, growth factors) |
| **Endocrine Signals** | for all tissues, long distance (hormones) |

### Prokaryote vs Eukaryote

| Prokaryotes | Eukaryotes |
|---|---|
| no internal membranes/organelles | membrane-bound organelles |
| circular DNA | DNA forms chromosomes |
| smaller ribosomes | larger ribosomes |
| anaerobic or aerobic metabolism | aerobic metabolism |
| no cytoskeleton present | cytoskeleton present |
| mainly unicellular | mainly multicellular |
| small | large |