Homeostasis & Control Mechanisms (L1)
Homeostasis: The maintenance of a relatively stable internal environment. Essential for the survival of each cell (hence the individual). A system will always lead to a response.
Requires Pathways:

- **Sensor**: Detect changes/fluctuation outside of comfortable 'normal' range.
- **Afferent pathway**: To the integrating centre. [Message to integrator].
- **Controller/integrator** (e.g. brain): Compare to set point (translates the change). Signals output to effector/target.
- **Efferent pathway**: From the integrating centre. [Message to effector].
- **Response**: Return to within desired range (Negative Feedback).
- Sensor recognises change has disappeared, signals integrating system to 'tell' everything is normal.

Integration involves: Response alleviates the signal from the receptors.

- **Endocrine**: Hormones (released into bloodstream, communicate with every cell in the body with a receptor for that hormone; slow acting).
- **Neural**:
  - Advantage: Nerve from point A to B. Sends an electrical signal. Nerves are **very** fast ('urgent').
  - Disadvantage: **Short** acting. Only target nerve/s activated. Not 'global' signal throughout body (not efficient).
- **Negative feedback**: Constant monitoring & adjustment: response in opposite direction to re-gain homeostasis.
- **Positive Feedback:** Reinforces the stimulus & escalates the response. Rare but important e.g. birth, ovulation, Na channels in action potential.

Diffusion

Passive & spontaneous process ('flowing downhill'). No net movement once equilibrium is reached (get rid of concentration gradient, move until there is none). Must have a driving force to move **down** a concentration gradient.
Cell Membrane

- Separates cell from environment so that intracellular different from extracellular.
- Need **control.** Energy needed to maintain differences.
- **Pass**: Lipid soluble e.g. uncharged, Small e.g. lipids, *water*, O_2, CO_2
- **Stopped**: Lipid insoluble e.g. charged, Large, e.g. ions, proteins
- Facilitated diffusion & Active transport

RBCs respond to solutions of different solutions of different tonicity (A: isotonic B: hypertonic C: hypotonic solutions).
Osmolarity & Tonicity

- **Osmolarity**: Total concentration of solutes (particles in solution) penetrating & non-penetrating. Normal cell osmolarity is ~300 mOsm. Absolute measurement.
- **Tonicity:** Concentration non-penetrating solutes (extracellular compared to cell). A solution can be isotonic, hypertonic or hypotonic in the cell. Relative measurement (relative no. solutes outside compared to inside cell).
- **Hypertonic:** Higher concentration of solutes outside the cell than inside the cell. If particles cannot move, water will via osmosis out of the cell to dilute the high concentration of particles. Cell will **shrivel up/shrink**.
- **Isotonic**: Same concentrations on both sides of the cell. Water doesn't need to move, same concentration of non-penetrating solutes on either side of the membrane.
- **Hypotonic**: More non-penetrating solutes inside the cell rather than outside the cell. Water will move from outside into the cell to the area with a higher concentration of particles to dilute them, causing the **cell to swell**. IV drip in hospital **must** put isotonic saline rather than water otherwise cells would swell & explode.

Fick's Law

- The rate of diffusion will increase by surface area, concentration gradient (cause things to move faster, greater force to move down a concentration gradient), membrane permeability **(important**, membranes can control that for non-penetrating solutes: how easily can these particles move through the membrane e.g. sodium: determined by lipid solubility & molecular size; & channels)**.**
- The rate of diffusion will decrease with membrane thickness.

Osmotic Equilibrium:

- Body is in osmotic equilibrium.
- Water moves between intra & extracellular space (same total no. of particles across the membrane).
- Dilutes more concentrated solution: osmosis
- Net movement stops when at equilibrium
- Osmolarity usually 300 mOsm
  - The solutes on either side of the membrane are completely different
  - Water wants to stay the same but still have concentration gradients
- Does **not** mean an even distribution of different types of particle e.g. Na^+ higher outside than inside
  - Chemical disequilibrium

Extracellular fluid is split into plasma & intercellular fluid.

- Na^+ has a much higher concentration in the ECF than it does in the ICF which means that despite having the same number of particles on both sides of the membrane: more Na^+ on outside than in. Na^+ wants to move down its concentration gradient, building **potential**.