**KEY CONCEPTS FOR CONTROL OF BREATHING**

Breathing can be controlled both **voluntarily** and i**nvoluntary**.

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| **Voluntary Breathing** – Conscious Control | **Involuntary Breathing** – Unconscious Control |
| * Involves connections from the **cerebral cortex** to the descending tracts in the spinal cord. * Used as a **protective device** by allowing us to:   + Hold our breath (prevent inhalation) underwater   + Hold our breath (prevent inhalation) if exposed to dangerous gases (or farts in elevators)   + Speak * Involuntary control will override voluntary control if the chemoreceptors detect significant changes in gas concentrations | * **Chemoreceptors** (peripheral and central) detect changes in gas concentrations (CO2, H+, O2) and stimulate respiratory muscles to change the rate and depth of breathing. * Important to ensure constant supply of oxygen for cellular respiration and remove carbon dioxide, a by -product of cellular respiration. |

**HYPERVENTILATION**

This process can be voluntary or involuntary (anxiety attack) and is described as rapid (deep or shallow) ventilation/breathing.

Due rapid breaths, hyperventilation causes **CO2 levels to drop significantly**, and **O2 levels to rise slightly**.

* Context: there is a larger concentration difference (diffusion gradient) between the amount of CO2 in air in the alveoli than in the blood, therefore C02 diffuses more rapidly out of the blood.
* Opposed to O2, where the concentration difference between the air in the alveoli and blood is less significant, therefore less of a diffusion gradient.

This can be very dangerous if someone were to hyperventilate before diving/swimming. The following mechanisms take place:

* Initially CO2 drops significantly, O2 rises slightly – no stimulus to breathe, therefore the person can hold their breath.
* Cellular respiration continues to occur – increasing C02 levels and reducing O2 levels.
* The reduction in O2 caused the person to become unconscious (black out). Person is still holding their breath.
* Continued cellular respiration causes the CO2 levels to increase, chemoreceptors detect change and stimulate breathing (person is still underwater).
* Person breathes underwater and brings water into their lungs 🡪 causing them to drown.