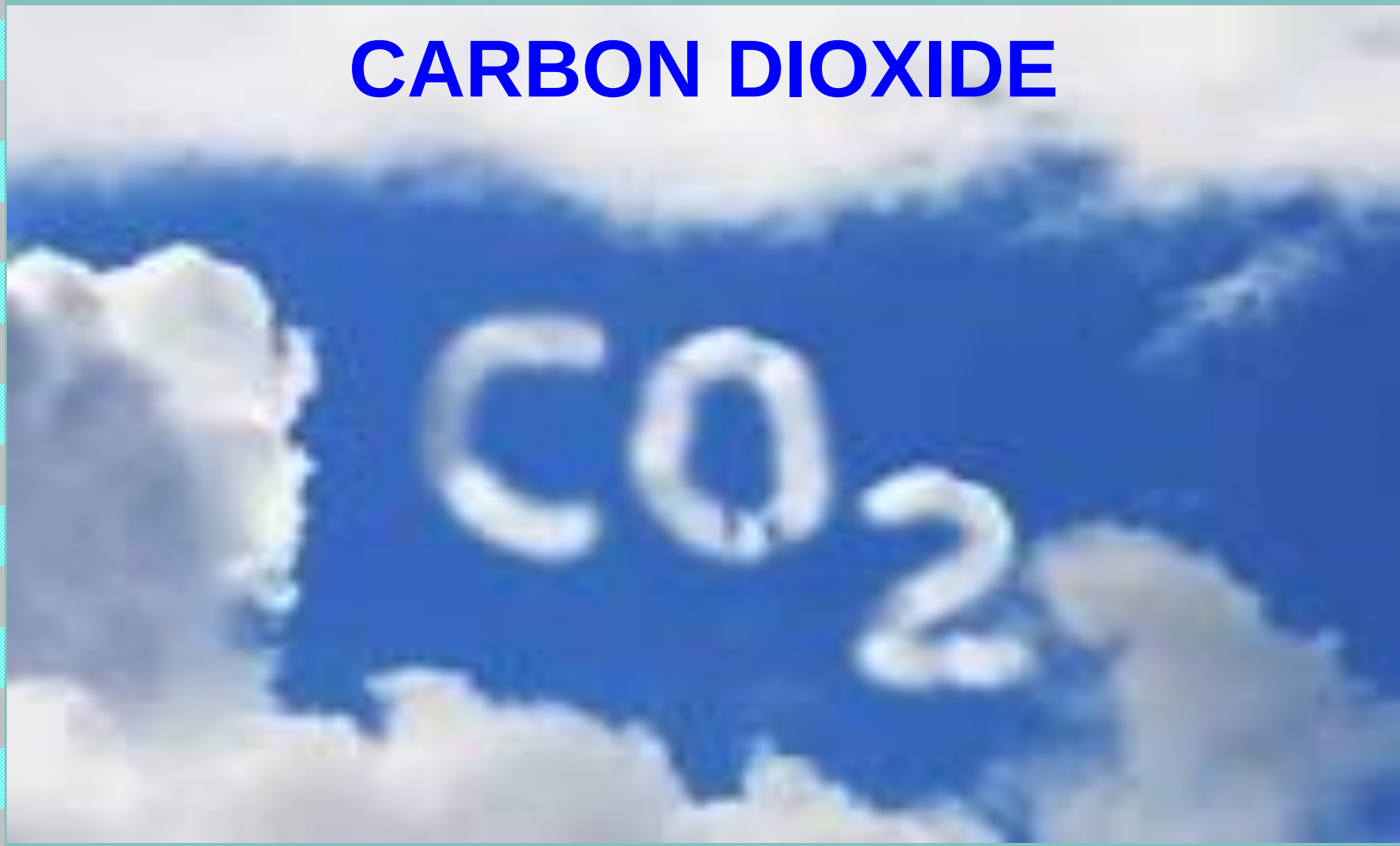
MEDICAL UNIVERSITY – PLEVEN
FACULTY OF PUBLIC HEALTH
CENTER FOR DISTANCE LEARNING

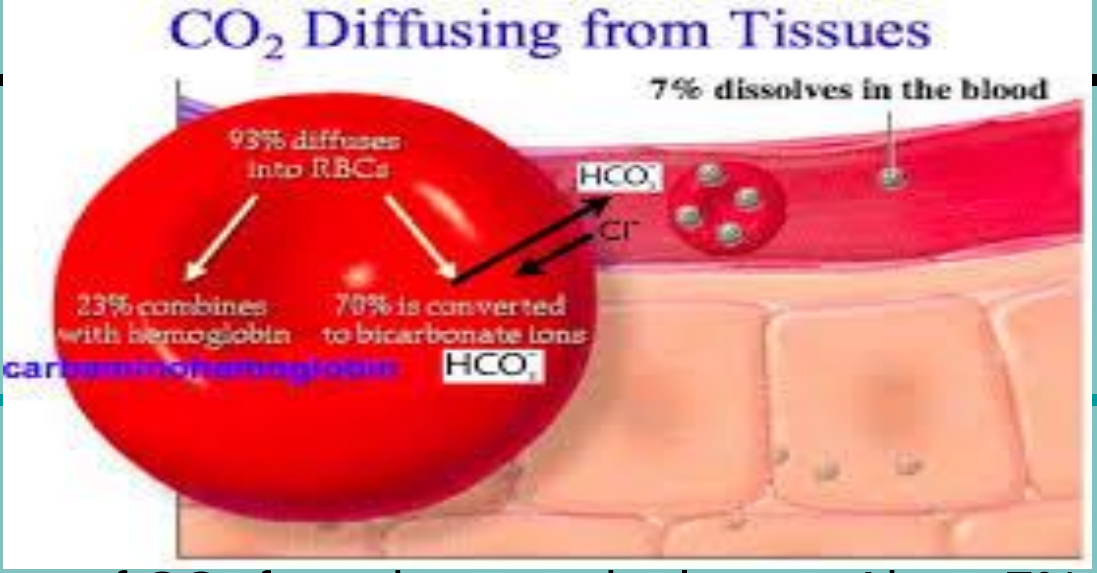
CARBON DIOXIDE



Лектор: доц. д-р В. Данчева, дм

Sources and uses

- Carbon dioxide (CO_2) is a **normal constituent** of the atmosphere, which occurs naturally in a concentration of 0,03% by volume. In the human body, it is a major **cellular buffer**.
- Carbon dioxide is one of the gases found in **mines, natural gas wells, silos, the holds**, where **fermentation** has occurred.
- Carbon dioxide is widely used in **industry** and **research laboratory**, mainly as a **refrigerant** and a **chilling agent**. Gaseous CO_2 is used in the **textile, leather** and **paint industries** and in the manufacture of **drugs** and **carbonated drinks**.



1.Transport of CO_2 from tissue to the lungs. About 7% of CO_2 is dissolved in plasma.

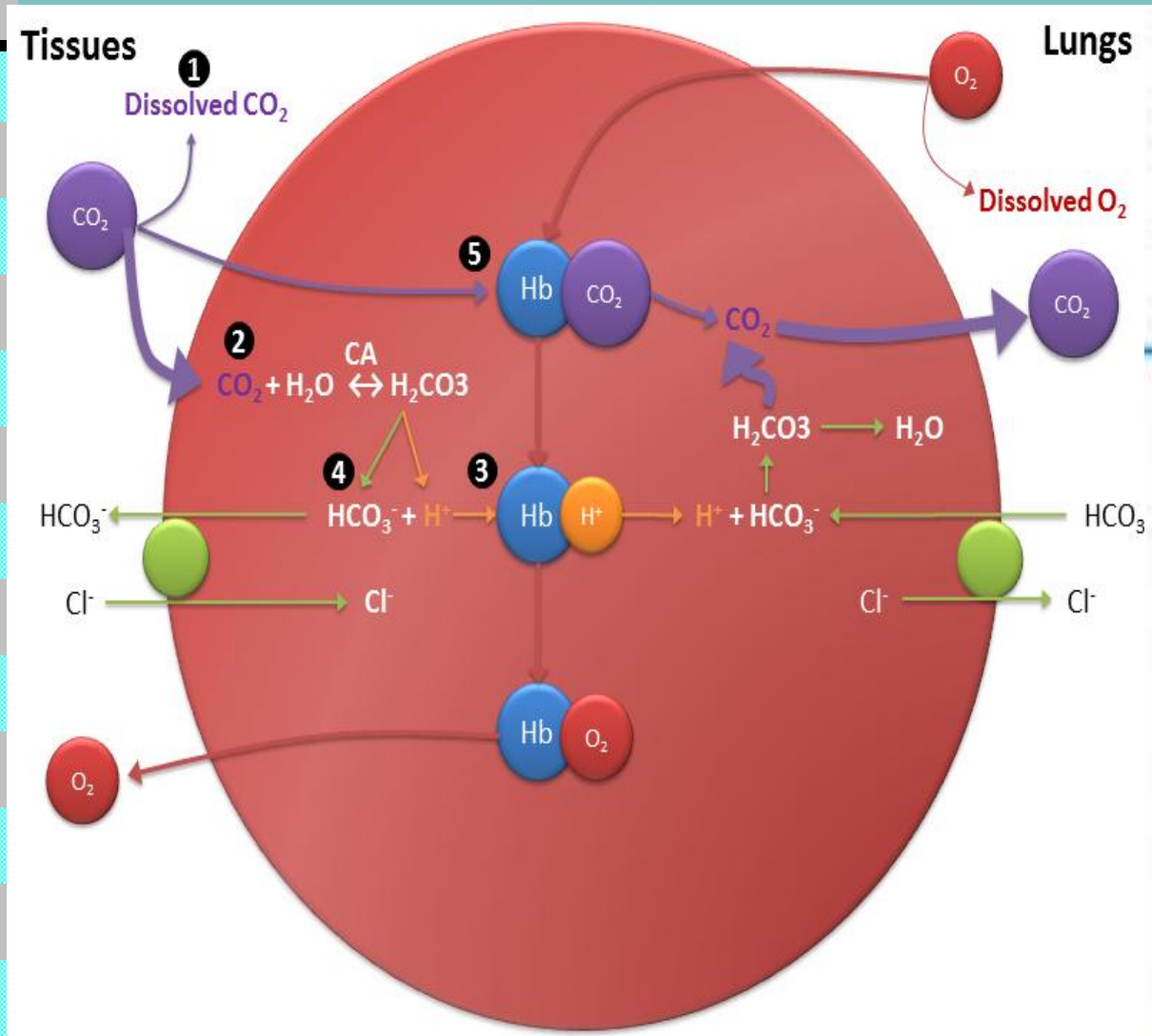
2. Most CO_2 (70%) is transported in the form of biocarbonate ion (HCO_3^-) After the reaction with water molecules to form carbonic acid ($H_2CO_{3)}$ is accelerated by **carbonic anhydrase** (**CA**).

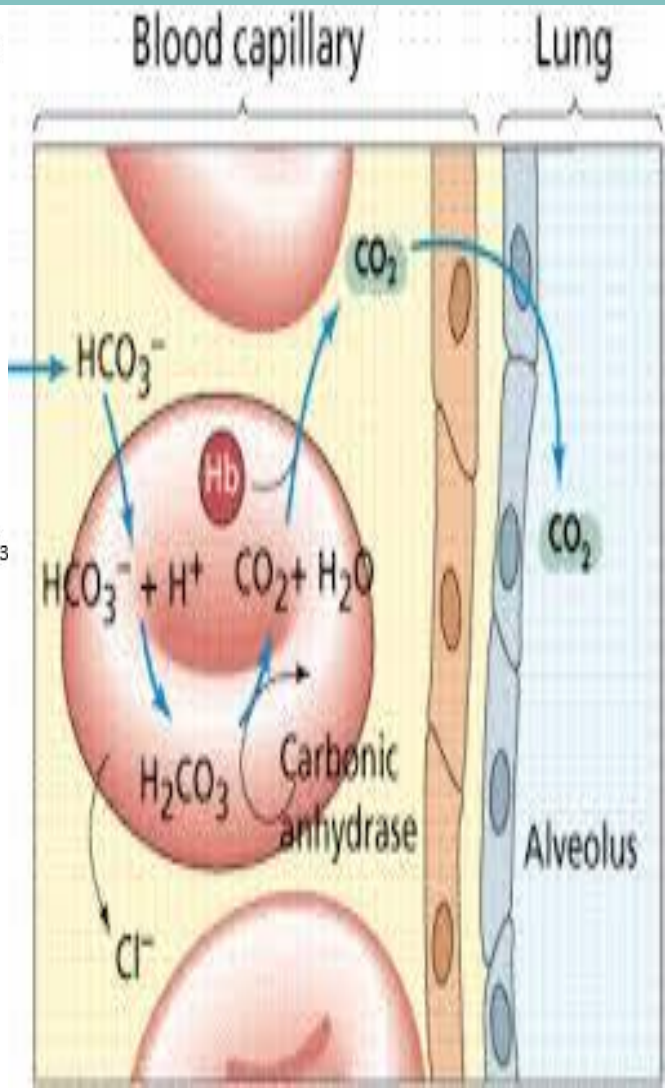
3. The reaction to form HCO_3^- is further accelerated by the removal of H^+ by deoxy-haemoglobin.

4. The $HC0_3^-$ produced by this reaction cannot pass through the cell membrane and is transported by the Cl^-/HCO_3^- exchanger.

5. The remaining 23% of CO_2 is transported as carbamino-haemoglobin. In the lungs, each process works in reverse leaving deoxy-haemoglobin free to bind to O_2.

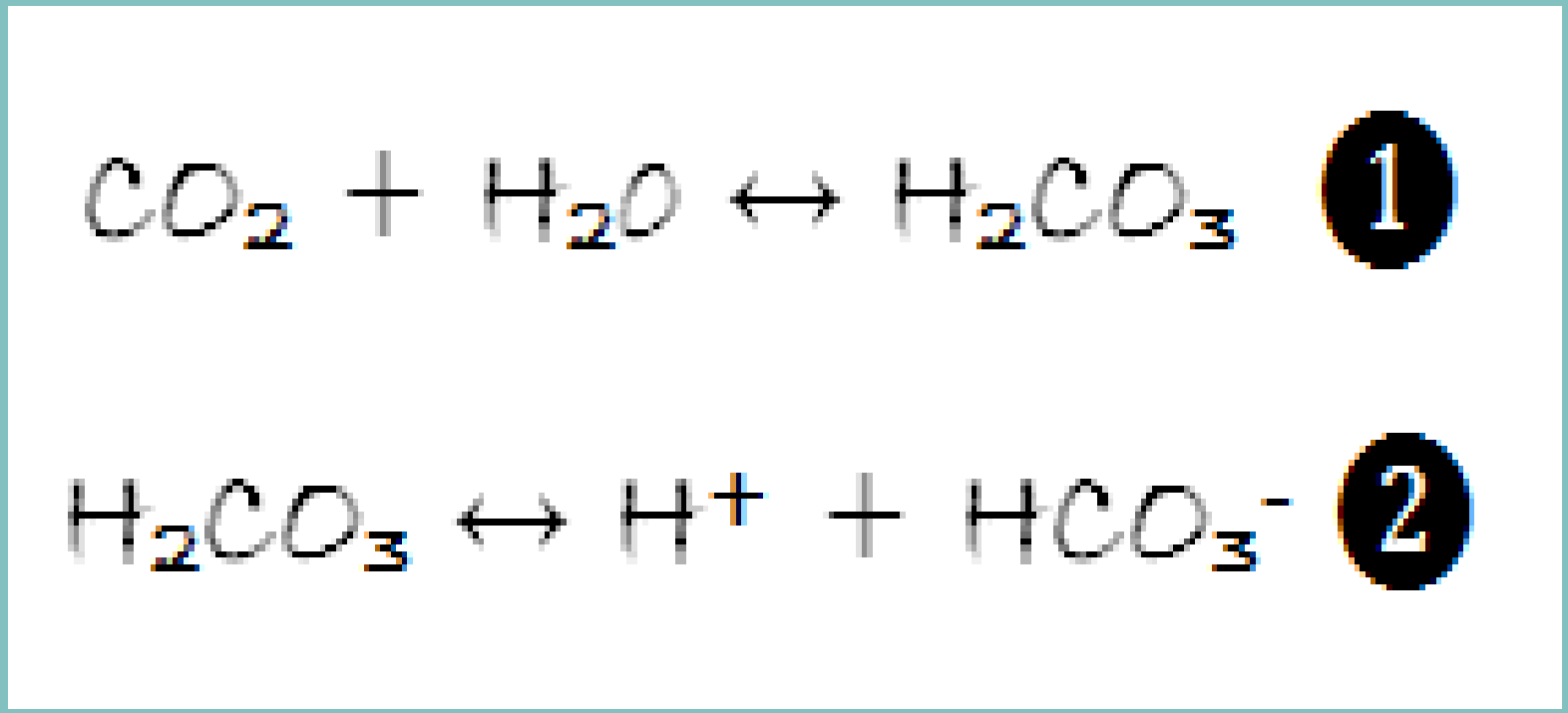
Transport of CO_2





Bicarbonate and blood pH

CO_2 reacts with water to produce H^+ and HCO_3 in a two-step process:



Acute and chronic effects

- There are **no symptoms** of toxicity if the carbon dioxide concentration is **below 3%.** When the CO_2 level **reaches 5%**, the **respiratory center is stimulated** and marked **dyspnea** becomes obvious. Dilation of peripheral arterioles and depression of myocardial contractility soon is followed by stimulation of the central nervous system by means of peripheral chemoreceptors. These reflexes invoke a **sympathoadrenal response** with increase in myocardial and vasomotor activity. The individual develops a **headache** and is observed to be **flushed**, **diaphoretic**, **tachycardic and hypertensive**.

- **Loss of consciousness** usually occurs when the concentration of the gas **reaches 10%. Coma, convulsions** and **death** occur when the CO_2 concentration is **about 25%**.

Lake Nyos: Carbon Dioxide

- A natural disaster in 1986 shows the toxicity of carbon dioxide in high concentrations. A massive release of CO_2 from Lake Nyos, Cameroon, a volcanic crater, killed 1700 people. Clinical findings were compatible with asphyxia rather than an irritant gases cause. Survivors experienced headache, weakness, malaise, limb swelling, and cough.

- **Prolonged (chronic)** exposure is improbable under most condition. **Respiratory acclimatization** to 3% carbon dioxide has been demonstrated by several investigators. Prolonged exposure to 1,5% CO_2 results in **respiratory acidosis.** **Sevel and Freedman** described **cerebral** and **retinal degeneration** in patients, who survived CO_2 asphyxia. Specifically, they reported **headache, photophobia, abnormalities of eye movements**, constriction of peripheral visual field, deficient dark adaptation, depression and irritability.

Main symptoms of

Carbon dioxide toxicity

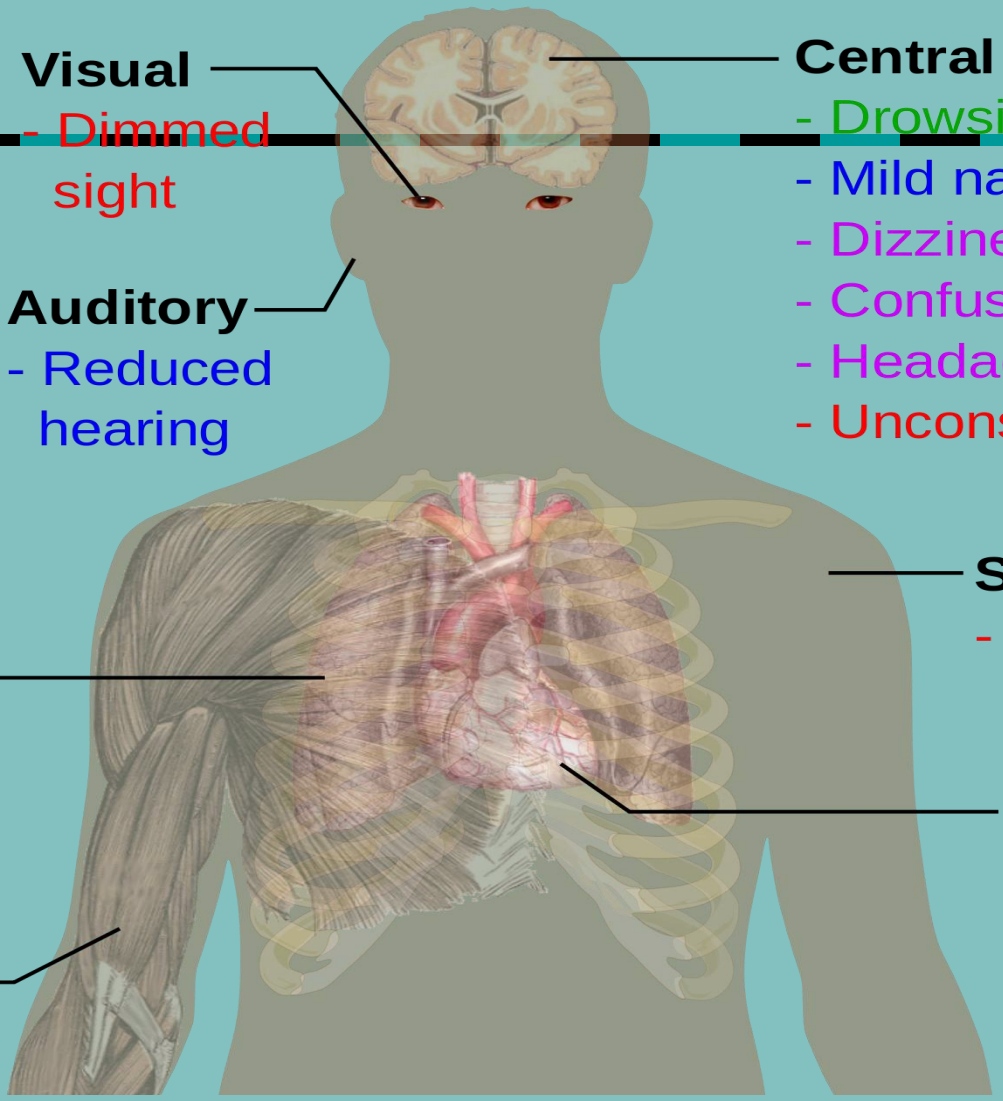
Volume % in air

- 1%
- 3%
- 5%
- 8%

Visual
- Dimmed sight

Auditory
- Reduced hearing

Central
- Drowsiness
- Mild narcosis
- Dizziness
- Confusion
- Headache
- Unconsciousness



Skin
- Sweating

Respiratory
- Shortness of breath

Heart
- Increased heart rate and blood pressure

Muscular
- Tremor

Treatment

- The treatment of overexposure to CO_2 consists of removing the patient from area and we have to ensure that the rescuers are not overexposed. Immediate administration of oxygen and cardiopulmonary life support are the basis of emergency care.