

# Respiration (physiology)

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In physiology, **respiration** (often mistaken with breathing) is defined as the transport of oxygen from the outside air to the cells within tissues, and the transport of carbon dioxide in the opposite direction. This is in contrast to the biochemical definition of respiration, which refers to **cellular respiration**: the metabolic process by which an organism obtains energy by reacting oxygen with glucose to give water, carbon dioxide and ATP (energy). Although physiologic respiration is necessary to sustain cellular respiration and thus life in animals, the processes are distinct: cellular respiration takes place in individual cells of the animal, while physiologic respiration concerns the bulk flow and transport of metabolites between the organism and the external environment.

In unicellular organisms, simple diffusion is sufficient for gas exchange: every cell is constantly bathed in the external environment, with only a short distance for gases to flow across. In contrast, complex multicellular animals such as humans have a much greater distance between the environment and their innermost cells, thus, a respiratory system is needed for effective gas exchange. The respiratory system works in concert with a circulatory system to carry gases to and from the tissues.

In air-breathing vertebrates such as humans, respiration of oxygen includes four stages:

- **Ventilation**, moving of the ambient air into and out of the alveoli of the lungs.
- **Pulmonary gas exchange**, exchange of gases between the alveoli and the pulmonary capillaries.
- **Gas transport**, movement of gases within the pulmonary capillaries through the circulation to the peripheral capillaries in the organs, and then a movement of gases back to the lungs along the same circulatory route.

Organ	Oxygen consumption (ml O <sub>2</sub> /min per 100g) <sup>[1]</sup>
Heart (rest)	8
Heart (heavy exercise)	70
Brain	3
Kidney	5
Skin	0.2
Resting skeletal muscle	1
Contracting skeletal muscle	50

- **Peripheral gas exchange**, exchange of gases between the tissue capillaries and the tissues or organs, impacting the cells composing these and mitochondria within the cells.

Note that ventilation and gas transport require energy to power a mechanical pump (the heart) and the muscles of respiration, mainly the diaphragm. In heavy breathing, energy is also required to power additional respiratory muscles such as the intercostal muscles. The energy requirement for ventilation and gas transport is in contrast to the passive diffusion taking place in the gas exchange steps.

Respiratory behavior is correlated to the cardiovascular behavior to control the gaseous exchange between cells and blood. Both behaviors are intensified by exercise of the body. However, respiratory is highly voluntary compared to cardiovascular activity which is totally involuntary.

Respiratory physiology is the branch of human physiology concerned with respiration.

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## Classifications of respiration

There are several ways to classify the physiology of respiration:

### By species

- Aquatic respiration
- Buccal pumping

### By mechanism

- Respiration organ
- Gas exchange
- Arterial blood gas
- Control of respiration
- Apnea

### By experiments

- Huff and puff apparatus
- Spirometry
- Selected ion flow tube mass spectrometry
- Bell Jar Model Lung

### By disorders

- Sudden Infant Death Syndrome
- Myasthenia gravis
- Asthma
- Drowning
- Choking
- Dyspnea
- Anaphylaxis
- Pneumonia
- Severe acute respiratory syndrome
- Aspiration (medicine) - Pulmonary edema
- Death

### By medication

- Asthma medication

Respiration is the process by which oxygen is delivered from the external environment to the cells for cellular exchange. In its proper terminology, it includes the entire process. In terms of visibility, respiration is simply another term for breathing. Respiration includes the inhalation-exhalation process. As unwanted air is expelled from the body during exhalation, the chest 'falls' and a vacuum is created inside the lungs. As new air is then sucked into the body to fill in the vacuum, the chest 'rises'. We call this inhalation. In this process, the unwanted gas expelled is mainly carbon dioxide. This is then replaced during the inhalation breathing phase by the oxygen content within the air inhaled. During this process, via the sacs of the lungs, an exchange of gases first occurs as the blood exchanges carbon dioxide from the body with fresh oxygen. Oxygen attaches to the red blood cells in the blood, and later is diffused from the bloodstream into the intercellular spaces, and eventually diffuses into the cells for use by the cells. Therefore, "Respiration" refers to gas exchanged throughout the body with the point of transport of oxygen to the

cells for use.

"Cellular Respiration" refers to a specific type of metabolic process that allows an organism to gain energy by breaking down substances.

### **By intensive care and emergency medicine**

- CPR
- Mechanical ventilation
- Intubation
- Iron lung
- Intensive care medicine
- Liquid breathing
- ECMO
- Oxygen toxicity
- Medical ventilator
- Paramedic
- Life support
- General anaesthesia
- Laryngoscope

### **By other medical topics**

- Respiratory therapy
- Breathing gases
- Hyperbaric oxygen therapy
- Hypoxia
- Gas embolism
- Decompression sickness
- Barotrauma
- Oxygen toxicity
- Nitrogen narcosis
- Carbon dioxide poisoning
- Carbon monoxide poisoning
- HPNS
- Salt water aspiration syndrome

### **Further reading**

- Nilsson, Goran E. (2010). *Respiratory Physiology of Vertebrates*. Cambridge: Cambridge University Press. ISBN 978-0-521-70302-4.
- Randall, David (2002). *Eckert Animal Physiology*. New York: W.H. Freeman and CO. ISBN 0716738635 ,human biology 146149.

### **See also**

- Respiratory system
  - List of basic biology topics
  - Disorders and Diseases of the Respiratory System
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## References

- [1] Cardiovascular Physiology Concepts > Myocardial Oxygen Demand (<http://www.cvphysiology.com/CAD/CAD003.htm>) Richard E. Klabunde, PhD

# Article Sources and Contributors

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