
Definition

1. *Respiration* is the *sequence* of *events* that *results* in *gas exchange* between the body's cells and the environment.

Review of Respiration in Animal Kingdom

During our *tour of the phyla* of the *Animal Kingdom* at the beginning of this semester, we talked about several *different ways* that animals *respire*. In the Animal Kingdom, we see 4 *basic strategies* for respiration.

1. Respiration by *individual cells* is practiced by many *primitive invertebrates*

   - *many* of the individual *cells* of the body *exchange gases directly* with the environment.

   - This is a *strategy* used by *both aquatic* and *terrestrial species*. Examples include:

     • **Sponges** - Phylum *Porifera*
     • **Hydras** - Phylum *Coeleterata*
     • **Planarians** - Phylum *Platyhelminthes*
     • **Earthworms** - Phylum *Annelida*

2. Respiration by *gills* is practiced by both *invertebrate* and *vertebrate aquatic organisms*.

   - *Gills* are normally *finely divided*, highly *vascularized organs* that provide *surfaces* for *gas exchange*.

   - This is a *strategy* used by *aquatic species*. Examples include:

     • **Clams** and **mussels** - Phylum *Mollusca*
- *Crayfish* and *shrimp* - Phylum *Arthropoda*

- *Amphioxus, sea squirts,* and *fish* - Phylum *Chordata*

3. **Respiration** by a **network** of **tubes** called **tracheae** is found in **insects** and a **few** other **terrestrial arthropods**.

   - **Oxygen** enters the **tracheae** at **spiracles**, which are **openings** on each **side** of the insect's **body**

   - Note that the **tracheal system** of insects is **very effective** in delivering oxygen to the cells, so that the **circulatory system** plays **no role** in **gas transport in insects**.

   - This is a **strategy** used by **terrestrial species**

4. **Respiration** by **lungs** is practiced by **terrestrial vertebrates**

   - **Lungs** are **vascularized, saclike, internal organs** that provide **specialized surfaces** for **exchanging gases** with the **air** in the **environment**.

   - This is a **strategy** used by **terrestrial species**. Examples include:

   - **Amphibians, reptiles, birds, and mammals.**

**Human Respiratory System**

The human **respiratory system** includes **all structures** that **conduct air** in a continuous **pathway to** and **from** the **lungs**. The major components are:

1. **Major Components** *(see the handout of Figure 37.6 from page 674 of textbook)*

   a. Nostril

      - Opening where **air enters**

   b. Nasal Cavity

      - in the nasal cavity, **hairs and cilia** act to **filter** the air.

      - Air is also **warmed** and **humidified**
c. **Pharynx**

- The *throat*

- *Air* and *food* passages *cross* or *travel together* here.

- Creates *danger* of *chooking* if *food* goes the *wrong way*, that is down the *trachea* rather than down the *esophagus* that leads to the *stomach*

- However, this *arrangement* does *allow breathing* to *continue* through the *mouth* when the *nose* is *plugged* up.

d. **Epiglottis**

- A *flap of skin* that *closes* the *glottis* when *food* is being *swallowed*

- *Prevents food* from *entering* the *airways*. Directs food material into the *esophagus*

e. **Glottis**

- The *opening* from the *pharynx* to the *larynx*

- At the *edges* of the *glottis* are the *vocal cords*

f. **Larynx**

- The *voice box*

- The *larynx* is permanently *held open* by a group of *cartilages*, among them the *cartilage of the Adam's apple*.

g. **Trachea**

- The *wind pipe*

- Is *permanently* held *open* by *cartilages*

- *Divides* into 2 *bronchi*
h. Bronchi

- *Paired passages* that *lead* to the *right* and *left lung*
- Continue to *branch* into *smaller passages* called *bronchioles*

i. Bronchioles

- *Small passageways* that eventually *terminate* in an *elongated space* enclosed by many *air pockets*, or *sacs*, called *alveoli*

j. Alveoli

- Occur at the *end* of each *bronchiole*
- *Small grape-like air sacs* in the lungs where *internal respiration* (gaseous exchange) *occurs*.
- There are about *300 million alveoli* in a *human*.
- The *total surface area* of the *alveolar walls* in contact with *capillaries* in both lungs is *70 square meters* or *753.47 square feet*.

k. Lungs

- The *paired*, large *respiratory organs* that include the *bronchioles* and *alveoli*
- *Covered* by a *membrane* or tissue called the *pulmonary pleura*

l. Diaphragm

- The *muscular partition* between the *chest cavity* and *abdominal cavity*
- Plays a *significant role* in *breathing*

2. Path of Air

*Nostril - Nasal Cavity - Pharynx - Glottis - Larynx - Trachea - Bronchi - Bronchioles - Alveoli*
3. **External and Internal Respiration** *(see handout on External and Internal respiration)*.

- Remember - the *definition* of *respiration* is the *events* that lead to the *exchange of gases* between the *cells of the body* and the *environment*.

- **Gas exchange** takes place by a *process* called *diffusion*.

- *Diffusion* is defined as the *movement of molecules or ions* from a *region* of *higher concentration* to a *region of lower concentration*. It requires *no energy* and tends to lead to an equal distribution.

- Remember - the *important gases in respiration* are *oxygen* (O2) and *carbon dioxide* (CO2).

- *In* the bodies of *terrestrial vertebrates* there are *two places* where this exchange *occurs*; these are the *lungs* and in other *tissues* of the body, usually where there are *capillary beds*.

- So, *based on where it occurs* in the body there are *two types of respiration*.
  
  a. **External Respiration**
  b. **Internal Respiration**

- **External Respiration**
  
  a. Occurs in the *capillary networks* around the *alveoli* of the *lungs*
  
  b. Results in *oxygen* (O2) *entering* the *blood* by the process of *diffusion*.
  
  c. Results in *carbon dioxide* (CO2) *leaving* the *blood* by the process of *diffusion*.
  
  d. *Blood now high in oxygen and low in carbon dioxide* flows to the *capillary networks* of *tissues* of the *body* through the following *circulatory pathway*:

  *Pulmonary venules - Pulmonary veins - Heart - Aorta - Arteries - Artioles*
• **Internal Respiration**
  
  a. *Internal respiration* occurs in the many *capillary networks* in *tissues* in the *body*
  
  b. Results in *oxygen* (O2) *leaving* the *blood* by the process of *diffusion*
  
  c. Results in *carbon dioxide* (CO2) *entering* the *blood* by the process of *diffusion*
  
  d. *Blood* now *low* in *oxygen* and *high* in *carbon dioxide* flows to the *capillary networks* of *alveoli* of the *lungs* through the following *circulatory pathway*

  *Venules - Veins - Superior/Inferior vena cava - Heart - Pulmonary artery - Arterioles*

4. **Breathing** *(see handout on inspiration and expiration)*

  • *Breathing* is a *2 step* process.

  • The *2 steps* are called

    a. *inspiration* that involves *entrance* of *air* into the *lungs*

    b. *expiration* that involves *exit* of *air* from the *lungs*.

  • During *inspiration*

    a. *muscle contractions lower the diaphragm* and *raise the rib cage*

    b. *pressure in lungs* and *thoracic cavity decreases*

    c. results in *air* flowing *into lungs*

  • During *expiration*

    a. *muscles relax, diaphragm relaxes* and moves *up* and *rib cage* moves *down*

    b. *pressure in lungs* and *thoracic cavity increases*

    c. results in *air* being pushed *out of lungs*
5. Examples of diseases of the respiratory system

- The *entire* respiratory *tract* has a warm, wet, *mucous membrane* lining, which is constantly *exposed* to environmental *air*.

- The *quality* of the *air* can affect *respiratory health*.

- *Strep throat* is a bacterial infection that can lead to upper respiratory infection. Symptoms are severe sore throat, high fever, and white patches on a dark red throat.

- *Laryngitis* is an infection of the larynx with accompanying hoarseness.

- *Pneumonia* is a viral or bacterial infection of the lungs where the bronchi and alveoli fill with thick fluid.

- *Tuberculosis* is caused by bacteria that attack cells of the lung. To defend themselves, infected cells build a protective capsule around the bacteria to isolate them from healthy tissue. This process reduces lung capacity and in times past was fatal.

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