Gaseous Exchange

## Movement of substances in and out of cells:

* Exchange of oxygen and carbon dioxide occurs by **diffusion**.
* Rate of diffusion depends on the **concentration gradients**.
* Gases can only diffuse across cell membranes in a solution, therefore **membranes must be moiste**.

## Specialized respiratory and circulatory systems:

* Respiratory system is specially adapted for gaseous exchange in the following ways:
  + Large surface area
  + Moiste
  + Rich blood supply
  + Very thin
  + Has a ventilating system

# Gaseous exchange in humans

# http://www.lung.ca/children/images/grades7_12/the_respitatory_system.gifPath of air into the lungs:

### Nasal Cavity

Air enters here and becomes **warm** and **moist**.

### Larynx (Voice box)

Contains vocal chords: Folds of epithelium that vibrate as air moves over them and produce sounds.

### Trachea

Takes the air down near to the lungs.

### Bronchi

The air branches out from the trachea into two brochi.

### Bronchioles

The bronchi branch out into smaller bronchioles.

### Alveoli

Tiny sacs with **one-cell thick walls** where gaseous echange takes place.

# Structures:

### Trachea and Bronchi

* Strengthened with C-shaped rings of cartilage which prevent the tubes from collapsing.
* Lining secretes mucus to trap dust and bacteria.
* Some cells have tiny projections called cilia which are always moving and waft mucus up to the throat where it is swallowed.

### Diaphragm

* A sheet of tissue made out of muscle and tendons.
* Seperates the chest cavity from the abdominal cavity.
* Contraction of the diaphragm results in breathing.

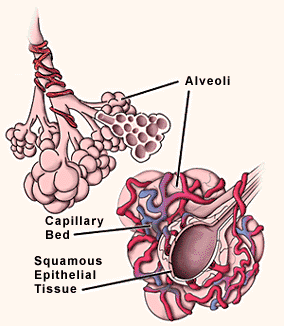
### Ribs

* Protects the lungs.
* Inside the ribs are pleural membranes with secrete a liquid to lubricate the movement of the lungs.

### Nasal cavity

* Has a mucous membrane that keeps the lungs clean by trapping dust and foreign matter in the mucus.
* The membrane also warms the air through the heat energy in its blood.

# Alveoli and gaseous exchange



### The following features make the alveoli an efficient exchange surface:

* **Large surface area** for gaseous exchange.
* A **single layer** of flattened epithelial cells forms the alveoli wall. Gases diffuse across this easily
* Surrounded by a **network of blood cappilaries** which provide an efficient transport system for the oxygen and carbon dioxide between tissues. This **maintains a concentration gradient**.
* Distance between the air in the lungs and the blood is tiny. The distance is the thickness of two cells (the alvolar epithelium and the cappilary epithelium).
* A **thin moist film** coats the wall which allows oxygen to diffuse into it.

# Gaseous exchange and diffusion gradients

### Diffusion gradient for oxygen:

* Atmospheric air in lungs contains 20% oxygen whereas blood in the lung capillaries contains 18% oxygen.
* Therefore the concentration of oxygen is higher in the lungs and will move into the blood.

### Diffusion gradient for carbon dioxide:

* Blood in lung capillaries contains 3% carbon dioxide whereas air in the lungs contains 0.04% carbon dioxide.
* Therefore the concentration of carbon dioxide is higher in the blood and will move into the lungs.

Ventilation

* The movement of air in and out of the lungs is called **ventilation**.
* The volume of he thorax must change to move air in and out of the lungs
* The supply of fresh air maintains the concentration gradient which allows gaseous exchange to continue.

# Volume-pressure changes during breathing

Air moves in and out of the lungs due to the pressure changes brought on by a change in volume of the chest cavity.

### These changes in volume are caused by the contraction and relaxation of:

* The muscles of the diaphragm
* The intercostal muscles between the ribs

# Volume

## Diaphragm

#### Inspiration (Increase in volume):

Diaphragm muscles **contract** and the diaphragm **flattens**.

#### Expiration (Decrease in volume:

Diaphragm muscles **relax** and the diaphragm is **curved (dome-shaped)**.

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## Ribs

#### Inspiration (Increase in volume):

Intercostal muscles **contract** and the ribs swing **upwards and outwards**.

#### Expiration (Decrease in volume):

Intercostal muscles **relax** and the ribs swing **downwards and inwards**.

# Pressure

#### Inspiration:

* **Volume increases**
* **Pressure decreases** and is lower than the atmospheric pressure
* Air moves into the lungs and **lungs inflate**

#### Expiration

* **Volume decreases**
* **Pressure increases** and is higher than atmospheric pressure
* Air moves out of the lungs and the **lungs deflate**.

Effects of tabacco smoke and pollution

# Tabacco smoke

Smoking tabacco is detrimental to one’s health. The following substances are in tobacco smoke:

* Nicotine
  + Is a **stimulant** and increases heart rate and blood pressure
    - This makes smokers more susceptible to heart disease.
  + Is **poisonous** and half of the intake remains in the blood
* Tar
  + Contains **carcinogens** and is absorbed by cells in the bronchi and bronchioles
    - This may cause lung cancer.
  + **Irritates** the linings of the respiratory passages
    - This causes inflammation and **chronic bronchitis**.
  + **Damages cilia linings**
    - This causes mucus to trickle down to the bottom of the lungs.
      * **Bacteria** breed in the mucus and cause infection.
      * The sufferer coughs to try and get rid of the mucus. This **damages the alveoli** and as a result, sufferers have a **lack of oxygen**. This is called **EMPHYSEMA**.
* Carbon monoxide
  + Combines rapidly and very strongly to haemoglobin to form **carboxyhaemoglobin**.
    - Oxygen cannot be absorbed by the red blood cells anymore.
      * Shortness of breath occurs.
    - Cells (especially brain cells) are less able to absorb oxygen and this causes damage.

# Air pollution

## Coal Fires

* Produce vast amounts of sulphur dioxide which cause **irritation** of the air passages.
* People who are allergic to sulphur dioxide may respond with **hay fever** or **asthma**.

Coal-powered power stations are the main contributor of sulphur dioxide.

## Allergic reactions

* People who are sensitive to substances such as pollen in the air’s natural defence system overreacts when in contact with these substances and produce **histamine** which causes sneezing, a runny nose, itching and watery eyes.
* Air pollution makes the symptons of allergic reactions far worse. This is due to **low-level ozone** and **pollutants** that damage the linings of the nose and make a substance trigger an allergic reactions much faster than normal.

## Asthma

* Caused by many factors such as tobacco smoke, pollen and poor air quality.
* During an asthma attack, a **sticky mucus** is produced and the muscles around the **airways contract** and make the airways very narrow. The sufferer becomes breathless and wheezy.