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## *Respiratory System*

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**At the end of this section you will understand and appreciate:**

- Structure and function of the respiratory system
- External and Internal respiration.
- Nervous control of respiration
- Conditions affecting the respiratory system
- How massage affects the respiratory system

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# The Respiratory System

## FUNCTION OF THE RESPIRATORY SYSTEM

The energy needed by the body to perform given tasks is derived from chemical processes which require the presence of **oxygen** (**AEROBIC RESPIRATION**).

The Respiratory System provides a route through which oxygen in the atmosphere is taken into the body and a pathway for the excretion of waste products such carbon dioxide into the atmosphere.

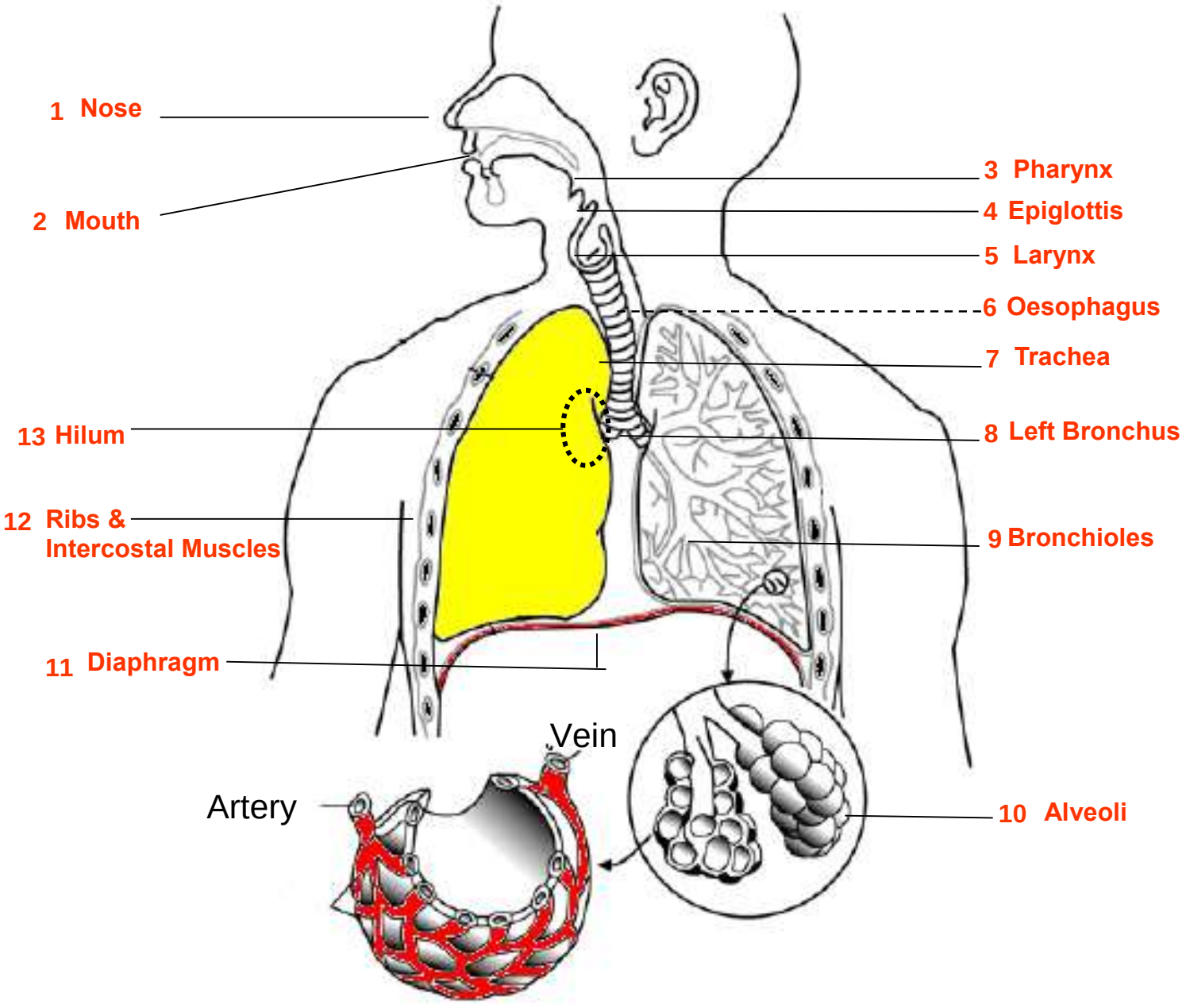


**Diagram of the organs of respiration**

| Name | Structure | Function |
|---|---|---|
| **Nose** | Is made of cartilage and two nasal bones.<br><br>It is lined with skin both inside and out and has a **mucous** membrane that is ciliated (hairs). The two nostrils lead into a bony nasal cavity. This connects to the paranasal sinuses – hollow spaces inside the bones surrounding the nose which are also lined with mucous membrane | Air enter nose first. It:<br>• Works as an organ of **olfaction**<br>• Moistens + warms air entering nostrils<br>• **filters** dust, bacteria etc. using mucous membranes and hairs. Mucous collects and prevents foreign material to enter the lungs |
| **Pharynx** | From the nose the air travels into the pharynx. This is about 12 cm long<br>This then divides into the larynx anteriorly and oesophagus posteriorly.<br>It works as part of both the digestive system and the respiratory system.<br>At the back section of the pharynx which connects to the nose are small masses of lymphoid tissue – adenoids. These help filter bacteria | • Acts as an air passage and also moistens and warms air |
| **Larynx** | Also known as the "voice box"<br>It is made of rings of **cartilage** attached to each other by membranes and ligaments.<br><br>The thyroid cartilage is found at the top of the larynx and is commonly known as the "**adam's apple**"<br><br>It is larger in men compared to women | • Filters bacteria<br>• Helps **voice** production.<br>• Warms and moistens air |

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|---|---|---|
| **Trachea**  | Continuation of the larynx.<br>Is about 10cm long and continues along the front of the chest where it divides into 2 bronchi.<br><br>Is made of **incomplete** rings of hyaline cartilage anteriorly and involuntary **muscle** and **connective** tissue posteriorly.<br><br>Is lined with **cilliated** epithelium which contains mucus secreting goblet cells. | • Connects **larynx** to **bronchi**<br><br>• **goblet** secretary cells secrete mucous which collects foreign matter or bacteria.<br>**cilia** then push this collection towards the larynx.<br><br>This is then swallowed or spat out. |
| **Bronchi**  | These are tubes which transport air into each lung.<br>Each **bronchus** enters the lung at the **hilum** which is a depression where the bronchus subdivides into different branches for the different lobes of the lung.<br>They are like the trachea in structure. | • Connects **trachea** to **bronchioles** |
| **Bronchioles**  | These are fine tubes.<br>They become progressively smaller as they spread further into the lungs until they are no more that a **single** layer thick. | • Take air to **alveoli** of lungs |

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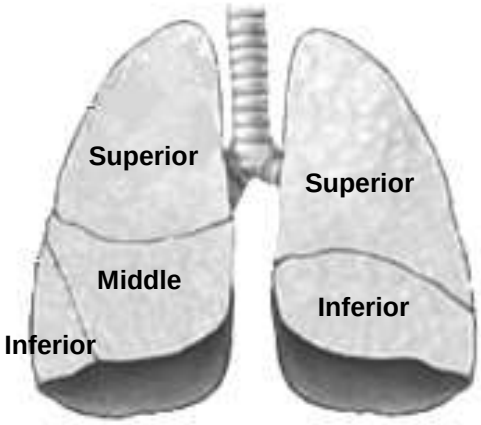
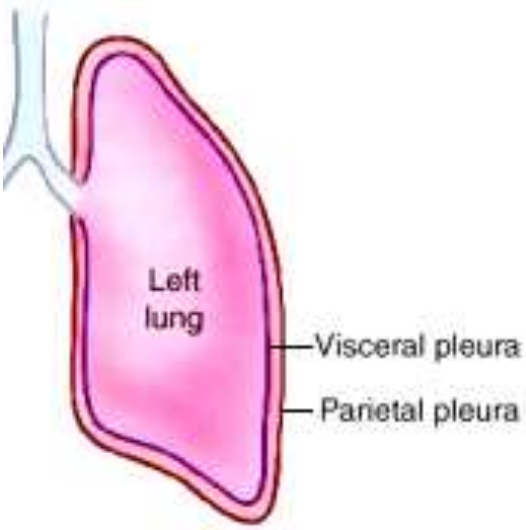
|---|---|---|
| **Lungs** | Positioned on either side of the heart.<br>Left divided into 2 and right divided into 3 lobes.<br>Lung tissue is made up of:<br>• **BLOOD VESSELS**<br>• **NERVES**<br>• **BRONCHIOLES**<br>• **ALVEOLI**<br>• **CONNECTIVE TISSUE**<br>• **ELASTIC TISSUE**<br><br>Lung are covered in a special membrane called the **pleura** | • Allows an area where **gaseous** exchange can take place.<br>(cross reference to pulmonary circulation)?"\|""""\<br>]<br>  <br><br>**Right Lung** **Left Lung** |
| **Pleura** | The pleura is a double membrane that surrounds each lung.<br><br>The inner layer is called the **VISCERAL LAYER**<br><br>The outer layer is called the **PARIETAL LAYER**<br><br>The two layers are separated by a space called the **Pleural Cavity**<br><br>The pleural membrane is a serous membrane and functions to **prevent friction.** |  <br> |
| **Alveoli** | These are tiny sacs where gaseous exchange takes place.<br>They are made up of a thin layer of squamous cells and surrounded by a **capillary** network | • Allows an area where **GASEOUS EXCHAGE** can take place through the process of **diffusion** |

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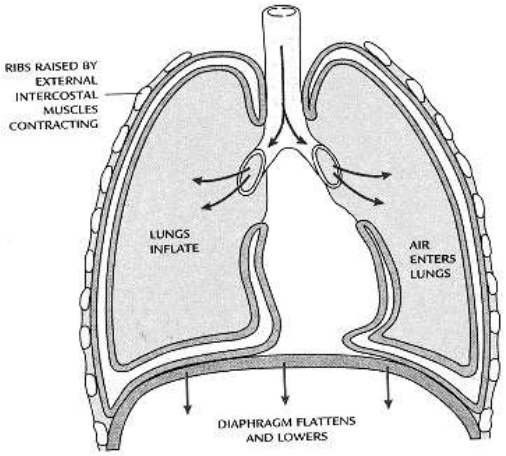
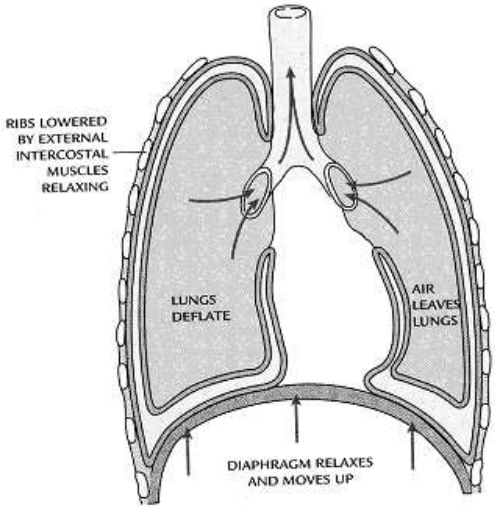
|---|---|---|
| **Diaphragm** | This is a sheet of muscle that is positioned between the abdomen and the chest.<br><br>It has a central tendon with muscle fibres towards the edges.<br><br>When it relaxes, the diaphragm is **dome** shaped<br><br>  <br><br><br>  <br> | ▪ **Inspiration / Inhalation**<br>Diaphragm contracts and **flattens**. This increases the size and volume of the<br>chest cavity, but **decreases** the pressure. Air is consequently sucked in.<br><br>• **Expiration / Exhalation**<br>When the diaphragm relaxes it becomes **dome** shaped and pushes up into the chest cavity.<br><br>This reduces the size and volume, but **increases** the pressure. Air consequently rushes out because the pressure is lower outside compared to inside.<br><br>The diaphragm also help with expulsive body actions:<br>1. **MICTURITION**<br>2. **DEFAECATION**<br>3. **PARTURITION**<br>4. Coughing, Sneezing, Vomiting etc. |

## BREATHING

**Inspiration**: External intercostal muscles **contract** at the same time as the diaphragm which lifts the rib cage up and outwards. This increases the size of the chest cavity.

**Expiration**: The external intercostals relax allowing the ribs to drop down helping to decrease the size of the chest cavity.

Nerve impulses received from the **intercostal nerve** tell the muscles when to contract and relax.

## EXTERNAL RESPIRATION

***This is the mechanism which enables the entrance and exit of air into the body as well as exchange of gases between the BLOOD and the ALVEOLI.***

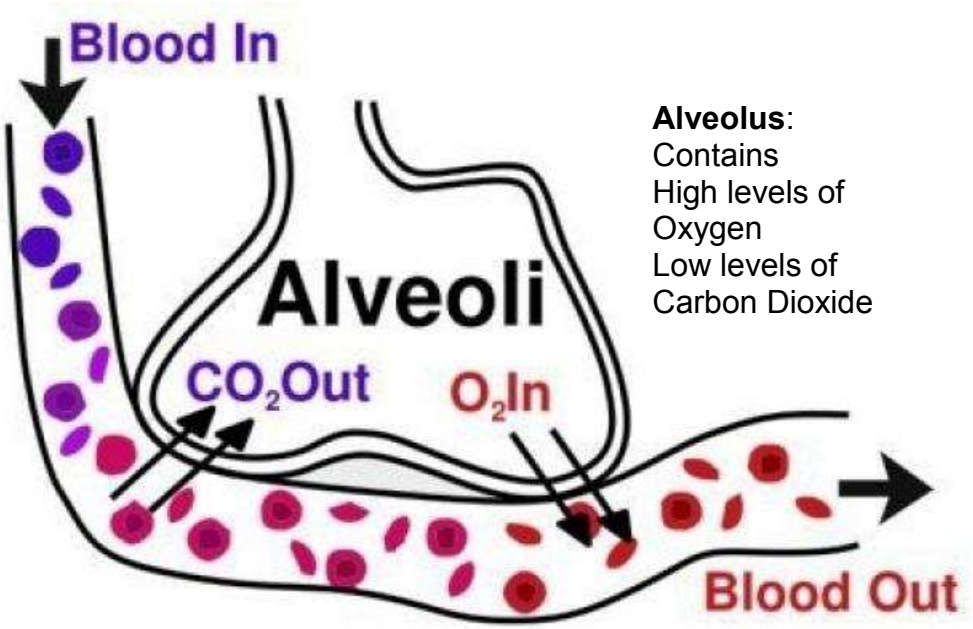
This exchange of gases occurs due to **DIFFUSION** (see below).

Although the diaphragm is the principle muscle involved, the **EXTERNAL INTERCOSTAL** muscles also assist in breathing.

***External Respiration at Cellular Level***

**Deoxygenated Blood:**
Contains:

Low levels of Oxygen
High levels of Carbon Dioxide

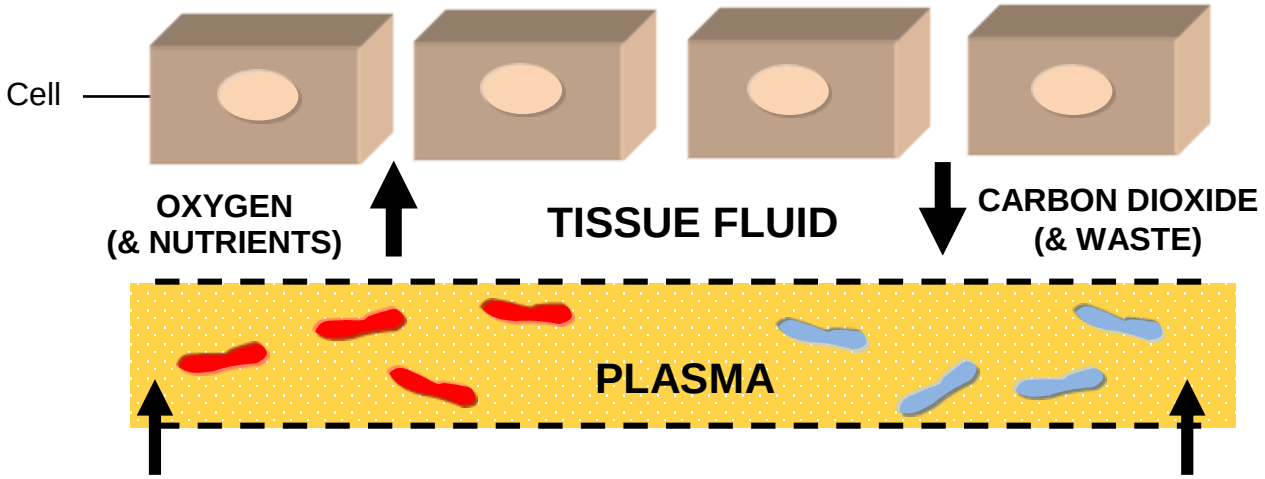



**Alveolus**:
Contains
High levels of Oxygen
Low levels of Carbon Dioxide

Gases move by process of **DIFFUSION**

## INTERNAL RESPIRATION

This is the process of gaseous exchange that happens at cellular level once the heart has pumped the oxygenated blood to areas which require oxygen. The process of gaseous exchange is based on the same principle as above.




Arterial end of blood capillary has:

3. High pressure
4. Oxygen & Nutrients diffuse into the tissues

Note: Blood cells are too big to exit the capillary

Venous end of blood capillary has:

1. Low pressure
2. Waste Material e.g. $CO^2$ have diffused into the vessel

***Diagram showing exchange of gases at tissue level***

## CHEMICAL & NERVOUS CONTROL OF OXYGEN LEVELS

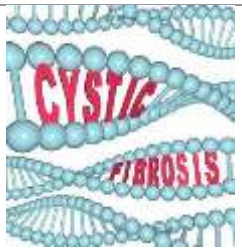
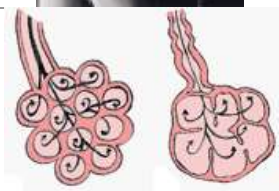
There are nerve cells **(CHEMORECEPTORS)** in the **AORTA** and **CAROTID** arteries which send information to the **RESPIRATORY CENTRE** in the **medulla oblongata** in the brain.

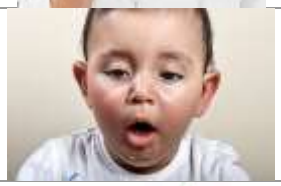
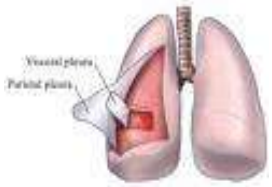
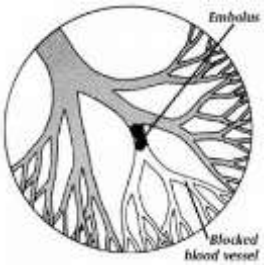
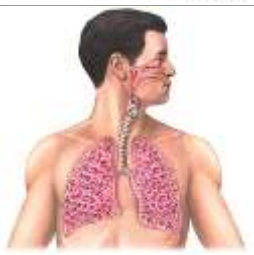
The **RESPIRATORY CENTRE *stimulates* DIAPHRAGM** and controls the **DEPTH** of breathing and it's **REGULARITY**

When the levels of **CARBON DIOXIDE** are too high and the levels of **OXYGEN** are too low a nerve impulse is sent to the diaphragm telling it contract, thus causing **INSPIRATION / INHALATION.**

The other centre involved in breathing is the **pons varolii**. This has the effect of ***stopping*** inspiration thus provoking expiration.

## DISORDER AND DISEASES OF THE RESPIRATORY SYSTEM

| Condition | Description | Picture |
|---|---|---|
| ***Asthma **** | Difficulty in exhalation, coughing and wheezing. Often caused by allergies. |  |
| ***Bronchitis **** | Inflammation of the bronchial tubes causing cough, shortness of breath and fatigue. Causes include smoking and infections. |  |
| ***Cor Pulmonale*** | Enlargement of the right ventricle of the heart due to disease of the lungs or of the pulmonary blood vessels. |  |
| ***Chronic Obstructive Airways Disease (COPD)*** | Refers to chronic bronchitis and emphysema, a pair of two commonly co-existing diseases of the lungs in which the airways become narrowed. | |
| ***Cystic Fibrosis*** | The most common congenital disease; the child's lungs, intestines and pancreas become clogged with thick mucus; caused by a defect in a single gene; no cure is known. |  |
| ***Common Cold*** | A mild viral infection involving the respiratory passages (but not the lung). |  |
| ***Emphysema **** | Alveoli stretch and lose their elasticity. This prevents effective breathing, causing cough, shortness of breath and wheezing |  |
| ***Hay Fever **** | Allergic rhinitis; caused by allergy to certain pollens; symptoms include sneezing, runny nose and eyes and sometimes swelling and itching. |  |

| | | |
|---|---|---|
| ***Hyperventilation*** | An increased depth and rate of breathing, greater than is demanded by the body's needs; can cause dizziness and tingling of the fingers and toes and chest pain if continued. |  |
| ***Laryngitis*** | An inflammation of the mucous membrane of the larynx; characterised by hoarseness or loss of voice and coughing. |  |
| ***Pertussis "Whooping Cough"*** | A disease of the respiratory mucous membranes. |  |
| ***Pleurisy **** | Inflammation of the pleural lining; fluid may develop in pleura. Causes localised chest pain, shortness of breath, cough. |  |
| ***Pharyngitis*** | A sore throat; inflammation of the pharynx. |  |
| ***Pneumonia**** | Inflammation of lung tissue caused by infection. The lung fills with fluid. Causes cough, fever, fatigue, headache and chest pain. Can be fatal. |  |
| ***Pulmonary Embolism**** | A blockage of the pulmonary artery caused by foreign matter or by a blood clot. |  |
| ***Pulmonary Fibrosis*** | A chronic lung inflammation with progressive scarring of the alveolar walls that can lead to death. |  |

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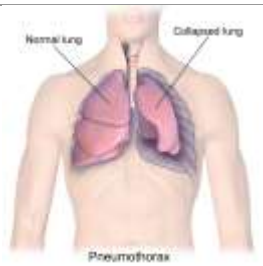
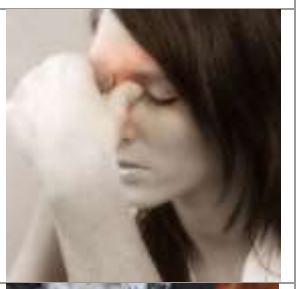
|---|---|---|
| ***Pneumothorax*** | An abnormal presence of air in the plural cavity resulting in the collapse of the lung; may be spontaneous (due to injury) or induced (as a treatment for tuberculosis. |   |
| ***Rhinitis **** | Stuffy, congested nose and sinuses. Caused by cold, flu, hay fever and sinus infections. |  |
| ***Sarcoidosis*** | A chronic disease of unknown cause marked by the formation of nodules in the lungs, liver, lymph glands and salivary glands. |  |
| ***Severe Acute Respiratory Syndrome (SARS)*** | A respiratory disease of unknown cause that apparently originated in mainland China in 2003; characterised by fever and coughing what difficulty breathing or hypoxia; can be fatal. |  |
| ***Sinusitis **** | Inflammation of sinuses, often following respiratory infection; causes headaches and facial pain. |  |
| ***Smoking*** | There are over 60 known cancer-causing chemicals in tobacco smoke. Smoking harms nearly every organ in the body, causing many diseases and reducing health in general. |  |
| ***Stress **** | Can cause an increase in the breathing rate. |  |

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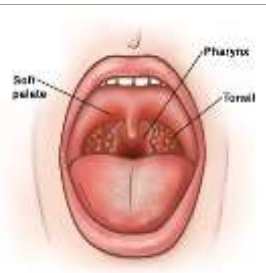
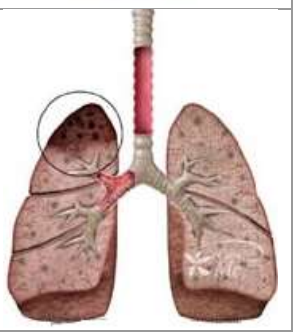
| ***Tonsillitis*** | Tonsillitis is a disorder involving inflammation of the tonsils.<br><br>Causes can be viral or bacterial. |  |
| ***Tuberculosis (TB)**** | Disease caused by bacteria, inhaled or eaten (in infected meat or milk). **Symptoms include cough, night sweats and fever**.<br><br>BCG injections are used to vaccinate against it. |  |

## INTERRELATIONSHIP OF RESPIRATORY SYSTEM WITH OTHER BODY SYSTEMS

| | |
|---|---|
| **Circulatory** | The circulation transports oxygen from the respiratory system to every cell of the body and transports carbon dioxide to the respiratory system to be exhaled. |
| **Nervous** | Respiration is closely controlled by the nervous system, which indicates when inhalation or exhalation should happen.<br>Chemoreceptors in the main arteries stimulate the nervous response of the respiratory system to begin the process of inhaling oxygen when required. |
| **Muscular** | The intercostals muscles and the diaphragm are fundamental to process of respiration |

## EFFECTS OF MASSAGE ON THE RESPIRATORY SYSTEM

1. Induces deep breathing
2. Decreases rate of external and internal respiration
3. Helps clears nasal passages
4. Helps in moving phlegm up the respiratory tract (cupping)

## SYMPTOMS OF THE RESPIRATORY SYSTEM

- Chest pain
- Shortness of breath
- Cough – dry or productive of phlegm
- Wheezing
- Relate to the CVS as you can do both systems together in the case history.