

Respiratory System

Biology 2201

Respiratory System

- ▶ Most organisms on Earth are aerobic
- ▶ Meaning, it requires oxygen to survive. Why?

▶ Cellular Respiration

- ▶ $\text{Glucose} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{ENERGY}$

Respiratory System

- ▶ How does O_2 get delivered to cells?
- ▶ **The Respiratory System**
- ▶ It makes sure that gas exchange occurs
 - ensures oxygen can enter cells and CO_2 can leave

Respiration and Homeostatis

- ▶ The Respiratory System helps the body achieve homeostasis. How?
- ▶ Lungs control variable levels of CO_2 and O_2
- ▶ Our breathing rate is controlled by levels of CO_2
- ▶ If CO_2 levels increase in exercise, blood pH increases & thus you breathe quicker and deeper

Requirements

- ▶ Two requirements for every respiratory system:
 - ▶ 1) Respiratory surface must be big enough to meet metabolic need (a lot of SA)
 - ▶ 2) Respiration needs a moist environment so gases can dissolve (remember gas exchange)

The Lung

- ▶ Lung:
 - internal *moist respiratory surface*, connected to outside air by internal passageways.
- ▶ Meets all requirements of lung systems
 - Must have moist surface (How?)
 - Means of force to bring air to moist surface
 - Circulatory system to carry gases

4 Components of Human Respiration

Breathing

- inspiration: take air in lungs
- expiration: force air out of lungs

External Respiration

- Exchange of gases between air and blood

Internal Respiration

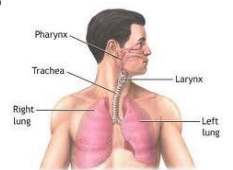
- exchange of gases between blood and cells

Cellular Respiration

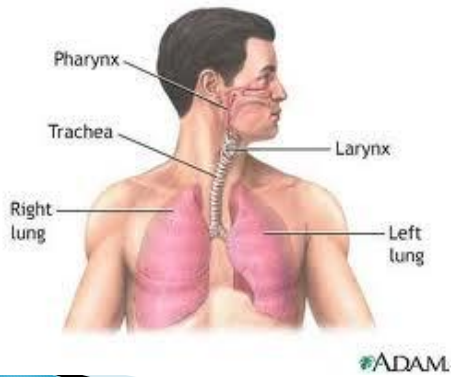
- reactions in the cell that make energy

Upper Respiratory Tract

- Air flow starts in Nostril (or Mouth)
- Goes to nasal cavity/passages where air is moistened by mucus and heated by blood (ever hurt to breathe?)
- Then goes through:
 - Trachea: aka 'windpipe'



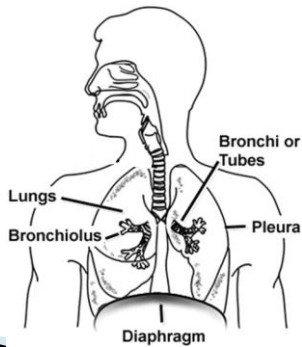
#ADAM



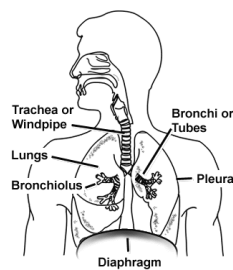
Upper Respiratory Tract

- ▶ The Upper Respiratory Tract has a lining
- ▶ Lined with cilia and mucous that cleans the air you breathe by trapping dust, and help expel dust when you cough
- ▶ *Catch a cold? Secrete more mucus (increases blowing of nose)

Lower Respiratory Tract



Lower Respiratory Tract



Bronchi (Bronchus)

- Two small passageways that branch off the trachea and enter lungs.

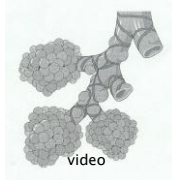
Bronchioles

- Fine tubes that branch off the bronchi
- Lined with cilia and mucus

Lower Respiratory Tract

Alveoli

- Tiny sacs (in grape-like clusters) at end of bronchioles
- Site of gas exchange

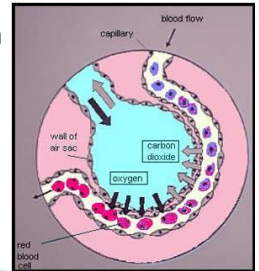


Pleura (Pleuron)

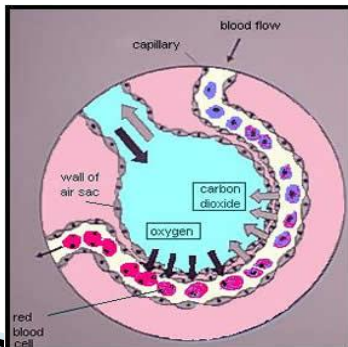
- Flexible membrane around lung

Gas Exchange

- ▶ Between air in alveoli and blood in capillaries
- ▶ Relies on concentration gradient (H to L)
- ▶ blood - high CO_2
Air - high O_2

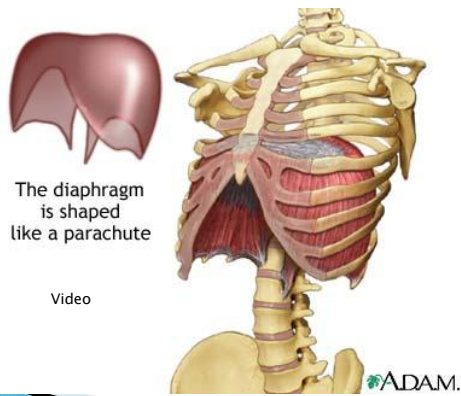


Gas Exchange



Mechanics of Breathing

- ▶ Gases move from areas of high to low pressure (all about air pressure)
- ▶ What controls this pressure? Two muscle structures:
 - **Intercostal muscles:** on ventral surface and ribcage
 - **Diaphragm:** muscle between thoracic and abdominal cavity

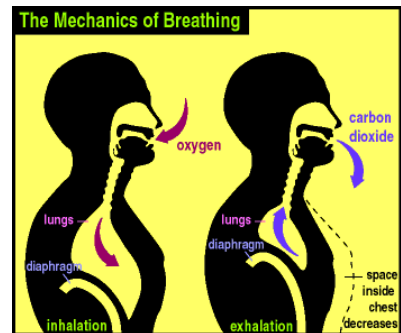


Inhalation

- Intercostals and diaphragm contract
 - Ribs expand up and out
 - Diaphragm lowers
- Volume increases and air pressure lowers
- Lungs expand, air moves in.

Expiration/Exhalation

- ▶ Diaphragm and intercostals relax.
 - Ribs lower
 - Diaphragm rises
- ▶ Volume decreases thus pressure increases
- ▶ Lungs shrink and air is forced out



Fun Facts

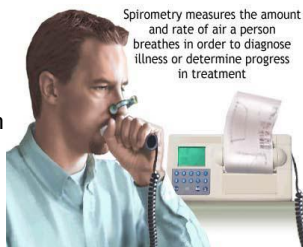
- ▶ In an average lifetime a person takes about $\frac{1}{2}$ billion breaths
- ▶ If all the different sized air tubes in the lungs could be joined end to end they would stretch more than 50 km
- ▶ In both lungs of an adult there are about 300 million alveoli

Lung Capacity

- ▶ Think about the difference between your normal breathing and a deep breath
 - *When and why do you breathe regularly or deeper?*
- Your lungs is able to hold only a certain amount of air.
- You usually do not completely fill your lungs with air in each breath.

Lung Capacity

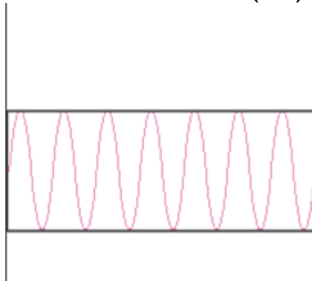
- ▶ Why is it important to have so much extra space in your lungs?
- ▶ How is it possible to explain the differences in our breathing pattern in terms and in a graph?



Lung Capacity (p. 340–341)

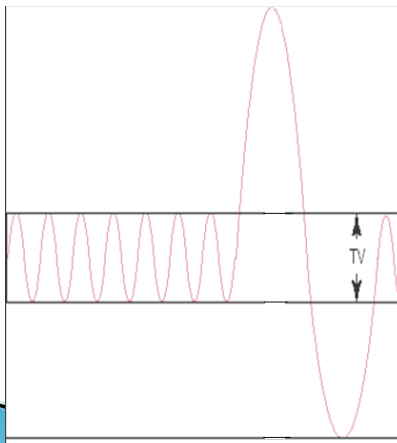
- ▶ **Tidal Volume (TV)**
volume of air inhaled and exhaled in normal breathing

Tidal Volume (TV)



Lung Capacity

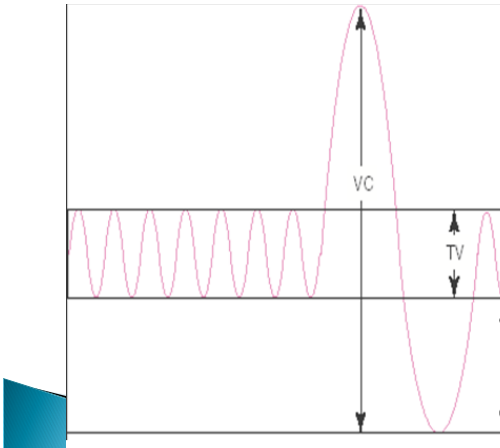
- ▶ **Tidal Volume (TV)**
volume of air inhaled and exhaled in normal breathing
- ▶ **Inspiratory reserve volume (IRV)**
additional vol. that can be inhaled after normal breath
- ▶ **Expiratory reserve volume (ERV)**
additional volume that can exhaled beyond normal breath



Lung Capacity

- ▶ **Vital Capacity (VC)**
total volume of air that can move in/out of lungs (has to be forced)

$$\begin{array}{r} \text{tidal volume} \\ \text{inspiratory reserve volume} \\ + \text{expiratory reserve volume} \\ \hline \text{vital capacity} \end{array}$$

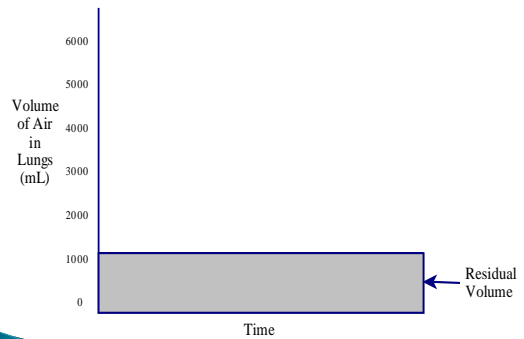
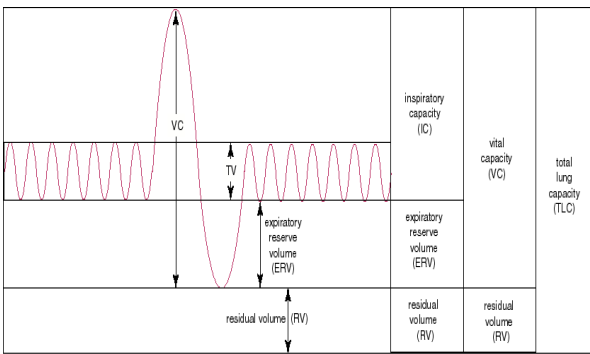


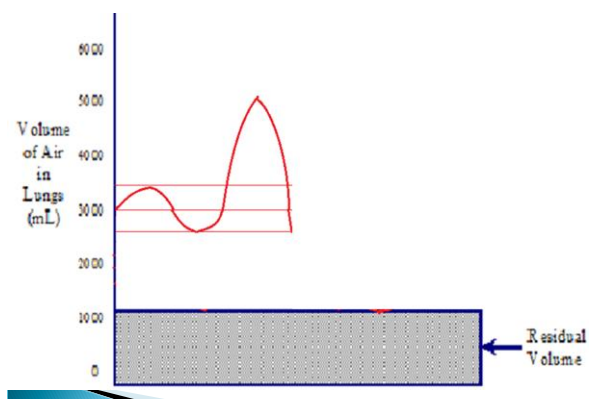
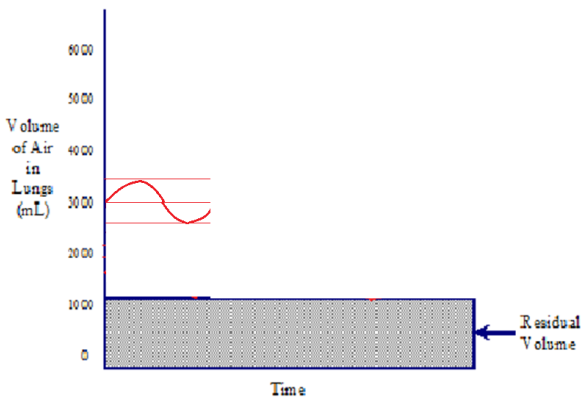
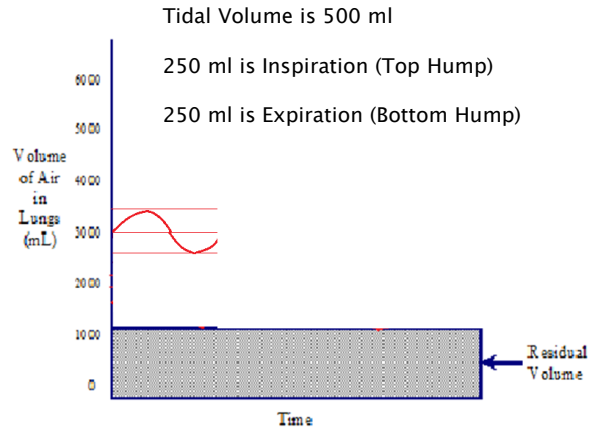
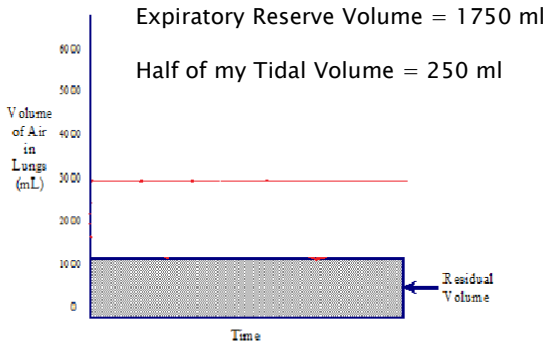
Lung Capacity

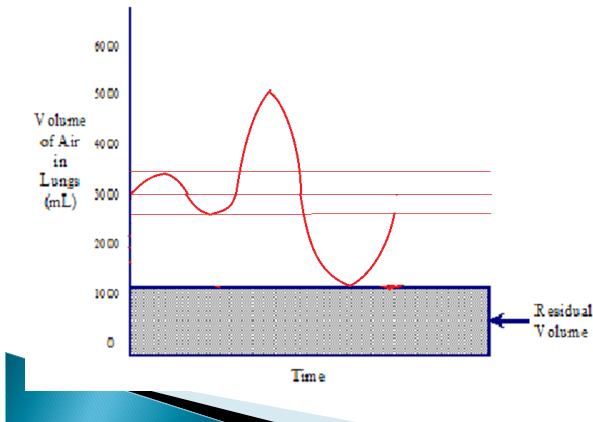
- ▶ **Residual Volume (RV)**
 - air that remains in lungs and passageways after full exhalation.
 - can't get rid of it; prevents lung collapse

- ▶ **Respiratory efficiency**
 - rate of oxygen transport to bloodstream from lungs.

- **Total Lung Capacity (TLC)**
 - total volume of air your lungs can hold







Lung Cancer Case Study

- ▶ Discussion Time

Diseases of the Lungs

- ▶ We'll look at the following diseases and how they affect homeostasis:
- ▶ Lung Cancer
- ▶ Asthma
- ▶ Pneumonia

Lung Cancer

[Video](#)

- Uncontrolled growth of abnormal lung cells
- Carcinoma is a malignant, spreading tumour; cells multiply and take over healthy tissue.
- The tumour can spread throughout the body if it enters the lymphatic system

Smoker's lungs



Non-smoker's lungs

- Black color could come from pollution or smoking (including 2nd hand)

Lung Cancer



Unhealthy Lung

Large white spots are cancer, while the black is caused by tar

What Causes Lung Cancer

- ▶ **Cigarette smoke** causes most cases of lung cancers. [Video](#)
- ▶ **Carcinogens** from the smoke damage DNA of lung cells and can form cancerous tumours
- ▶ **Radon** is a radioactive colorless, odorless gas from soil and radiotherapy
- ▶ Air pollution

Fun Facts (Health Canada)

- ▶ One cigarette contains over 4000 toxins (poisons)
- ▶ Carcinogens in cigarette smoke is 10 000X more concentrated than in the pollution at rush hour on a freeway.
- ▶ On average 1 pound of tar collects in a smoker's lung in 1 year

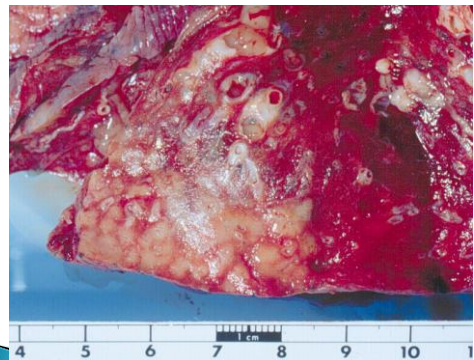
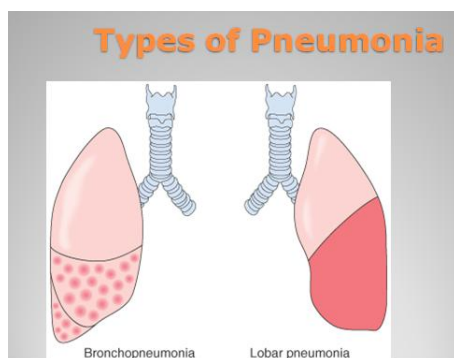
Treatment for Lung Cancer

- ▶ **Surgery**
 - remove cancer from lungs
- ▶ **Radiation:**
 - high energy x-ray that kills cancer cells
- ▶ **Chemotherapy:** [video](#)
 - preventing mitosis (cell division) of cancer cells

Pneumonia

[Video](#)

- Inflamed alveoli fill with fluid.
- lowers oxygen intake
- **Types:**
 - Lobar pneumonia: entire lobe
 - Bronchial pneumonia: patches of lung



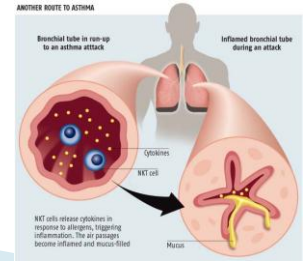
Causes of Pneumonia

- ▶ Bacterial infection causes lobar pneumonia
- ▶ Viral infection can cause either type but has shorter durations
- ▶ Parasitic infection is the hardest to fight off. Caused by small free-living agents.
- ▶ Both types of pneumonia can be treated by vaccines and antibiotics

Asthma

[Video](#)

- Inflammation of airways due to irritants
- Bronchioles constrict due to muscle spasms
- Mucous build ups
- Lowers oxygen intake.



Asthma Treatment

- ▶ Avoid triggers like
 - Cigarette smoke
 - Pets, Dust and Mould
 - Perfumes, petrochemical fumes
- ▶ Types of Medications:



- Broncho-dilators (puffers): reduce inflammation
- Anti-inflammatory drugs: prevent attacks

Air Quality and Asthma

- ▶ [Video](#) [Video](#)