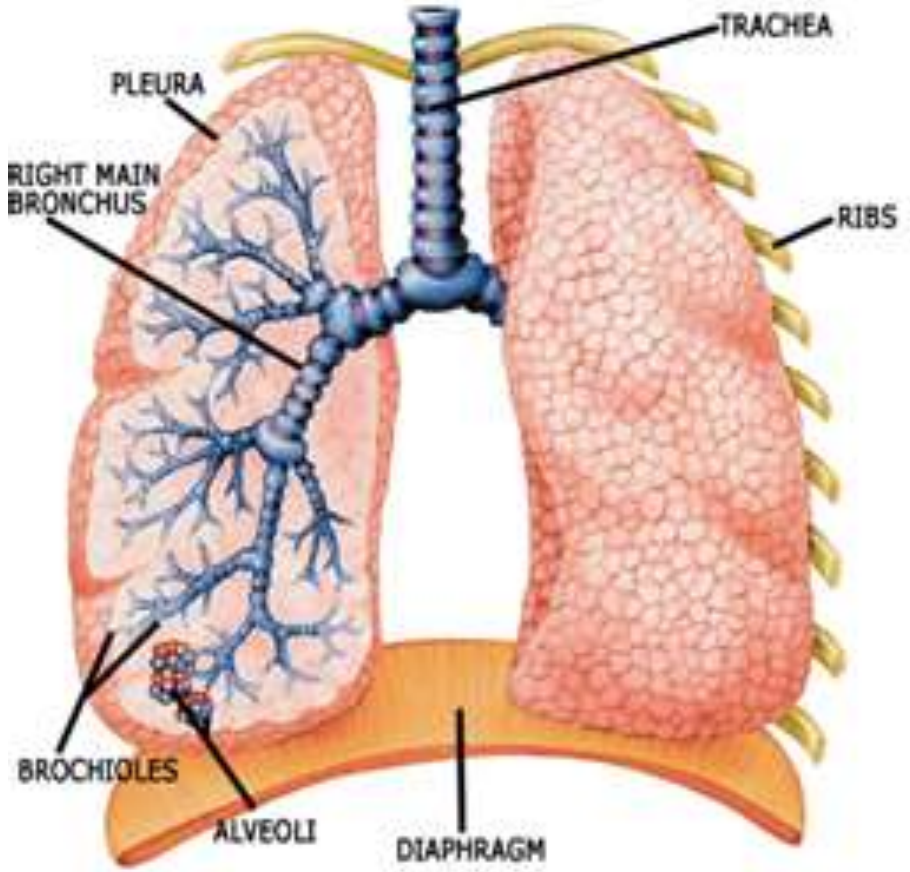
YOGIC BREATHING
Anatomy and Physiology of the Respiratory System



BREATHING

- Breath in, breath out. As long as you keep doing this you will never die!
- Breathing is an involuntary process. However unlike the heart we can control our breathing. We can stop it whenever we like, we can manipulate the rate, the depth and rhythm.
- Yogi breathing uses this voluntary aspect of breath control to promote physiologic changes which improve the function and performance of the body

Purpose of the Respiratory System

- **To supply oxygen to all cells**
- Without oxygen the cell dies. Starve enough cells within an organ of oxygen, an infarct will occur eventually the organ will fail
- **To remove the toxic waste product of metabolism namely carbon dioxide.**
- Build up of too much carbon dioxide and the body becomes acidic and respiratory failure happens

3 Levels of Respiration

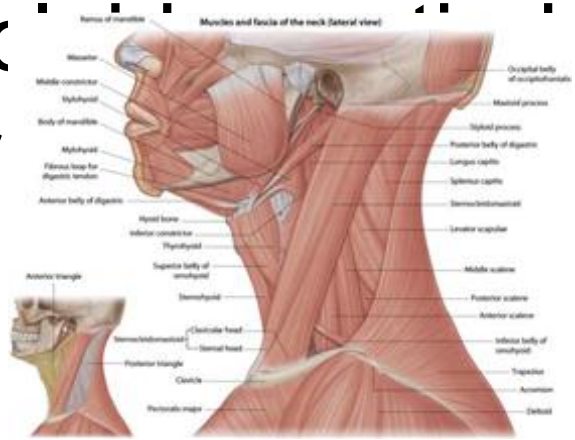
- Movement of air into and out of the lungs
- Exchange of gases between the air in the lungs and the blood
  - Oxygen moves into the blood
  - Carbon dioxide moved out the blood and into the air on expiration
- Exchanges of gases between the blood and the tissues
  - Oxygen moves into the tissue
  - Carbon dioxide moves into the blood to be returned to the lungs

Muscles of Breathing

- The main muscle of breathing is the diaphragm.
- Contraction of the diaphragm is responsible for 75% of the air coming into the lungs.
- The other 25% of the air coming into the lungs is a result of the expansion of the ribs. The main muscles responsible for movement of the ribs outward are the external intercostals

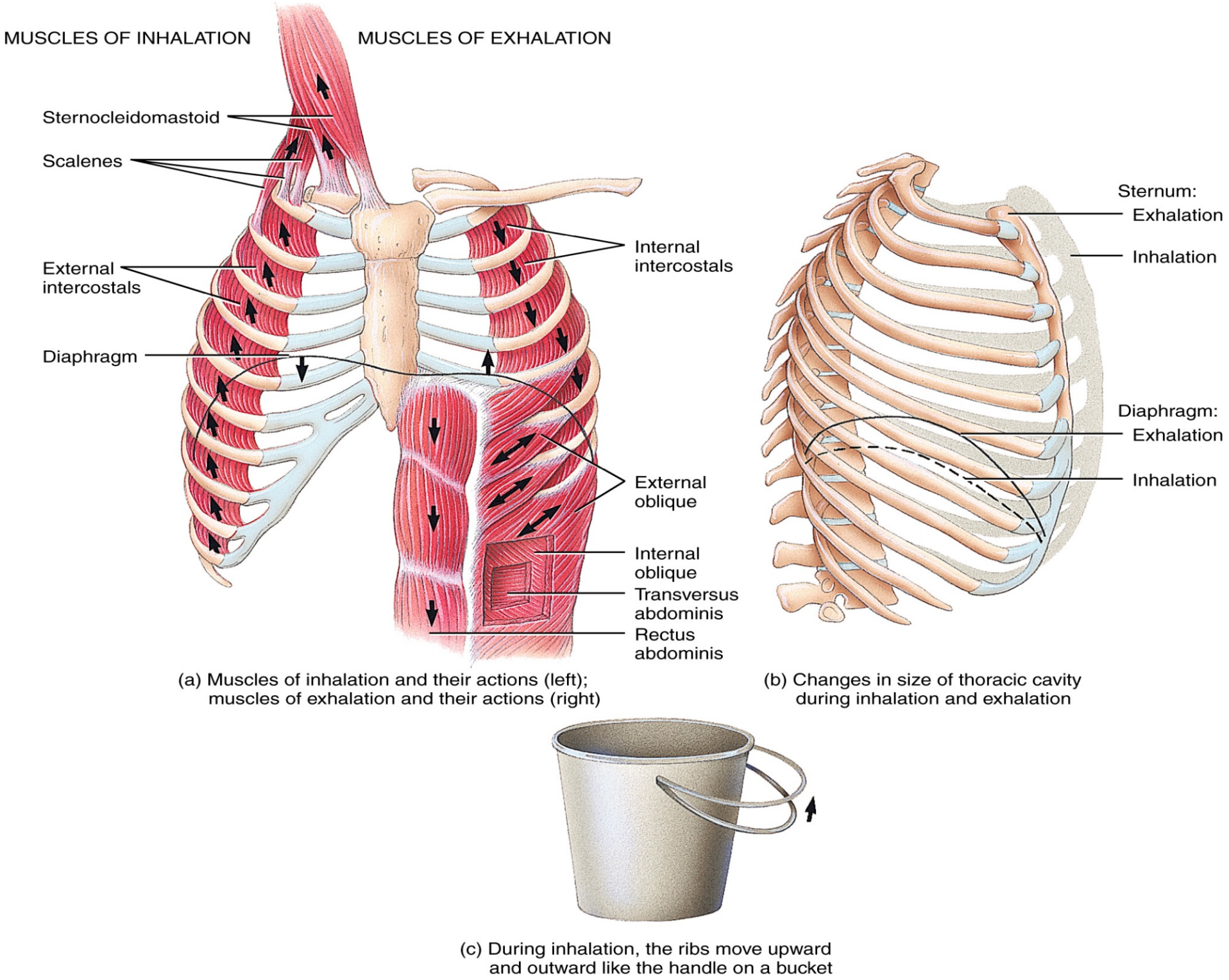
Accessory Muscles

- Additional muscles can also be recruited to assist in breathing especially during extreme conditions such as vigorous exercise, disease states, and respiratory attacks
- Scalene muscles, the sternoc
muscle, and pectoralis minor



Mechanics of Breathing

- Inhalation is voluntary and requires energy.
- In order for air to move from the atmosphere into the lungs the pressure must change. Air pressure inside lungs must drop to draw air into them
  - Lungs expand
  - Contractions of diaphragm and external intercostals; diaphragm drops
  - Thoracic cavity expands, and pleura and lungs are pulled outward



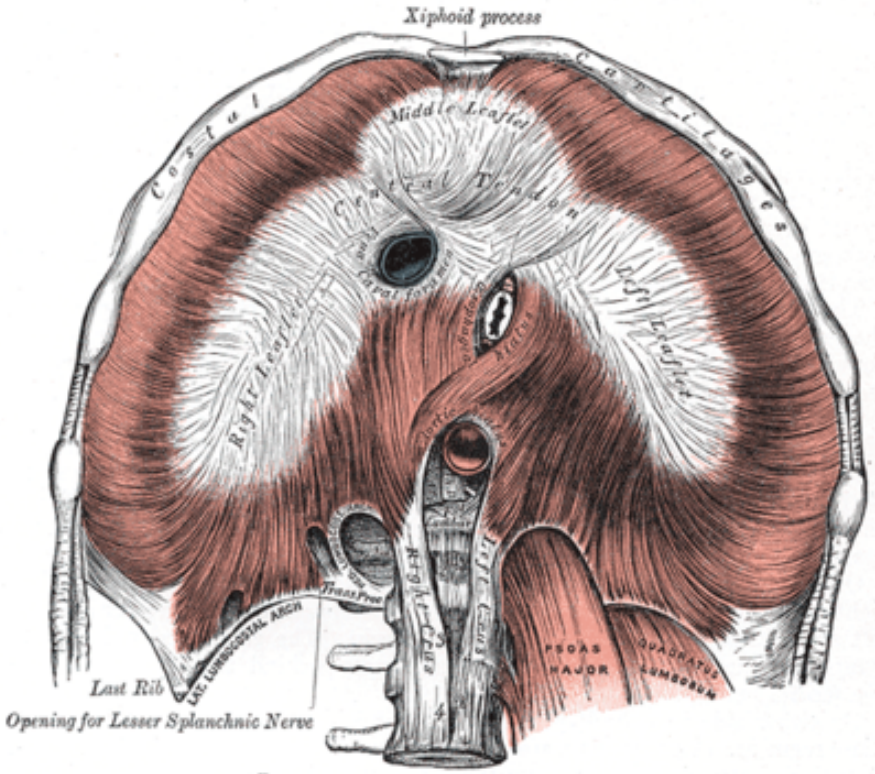
(a) Muscles of inhalation and their actions (left); muscles of exhalation and their actions (right)

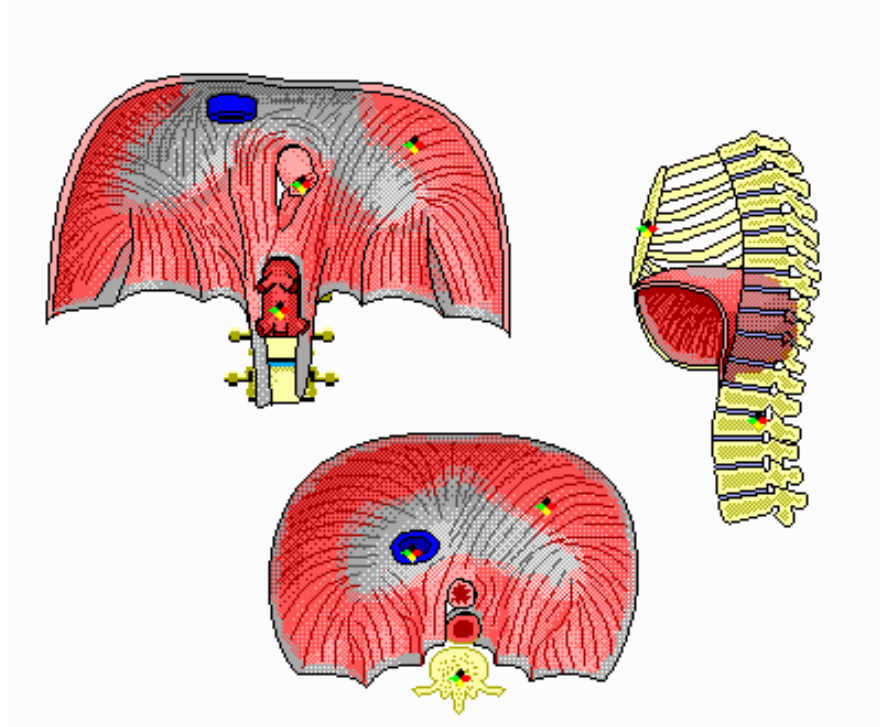
(b) Changes in size of thoracic cavity during inhalation and exhalation

(c) During inhalation, the ribs move upward and outward like the handle on a bucket

THE DIAPHRAGM

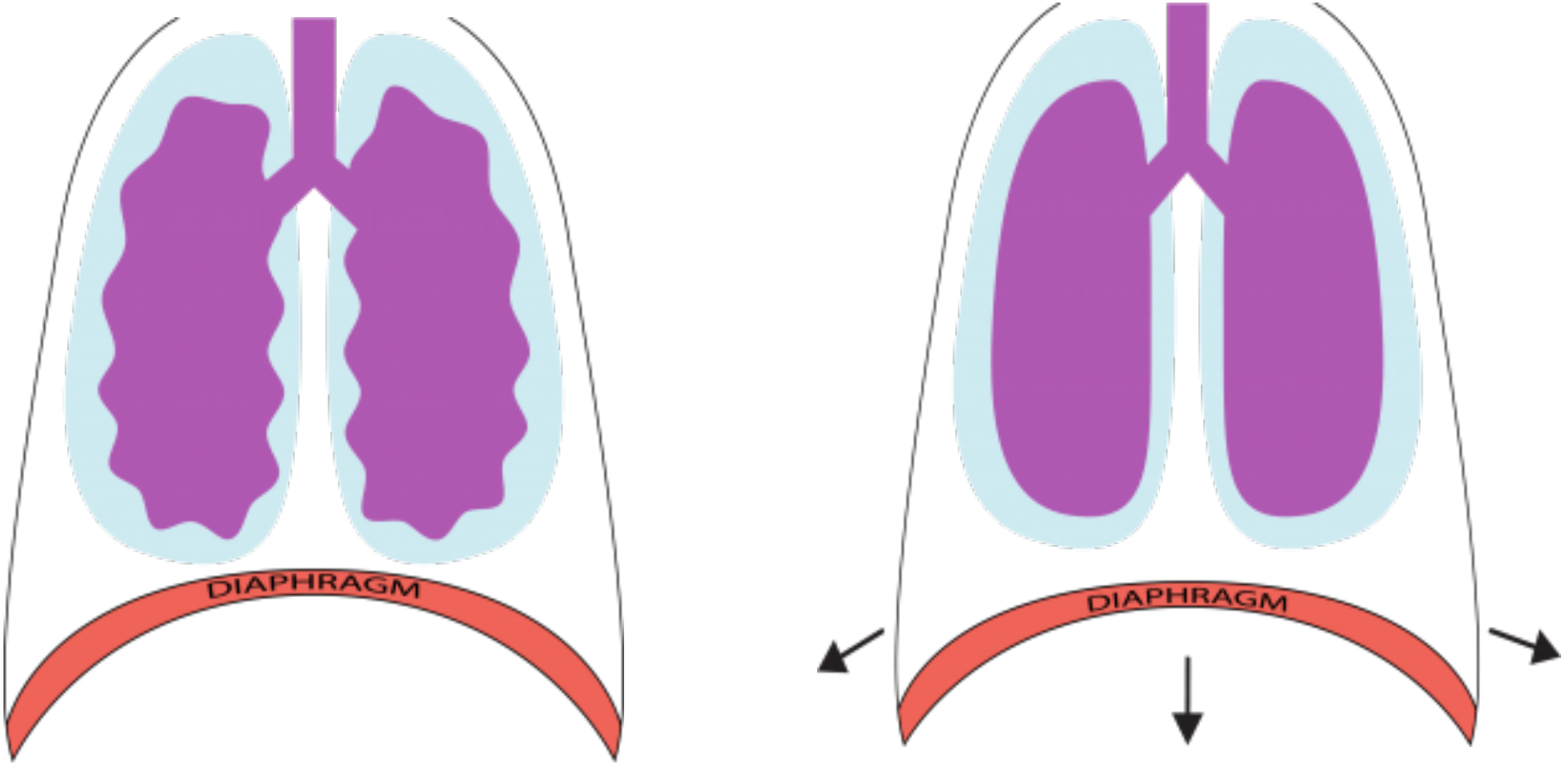
- The primary muscle of breathing
- After the heart it can be considered the most important muscle of the body.
- It has few proprioceptive nerve endings so there is very little voluntary control of this muscle.
- Can you train the diaphragm?


Xiphoid process
Costal Cartilages
Middle Leaflet
Central Tendon
Caval Foramen
Right Leaflet
Left Leaflet
Aortic Hiatus
Crus
Transversalis
Last Rib
Ant. Lumbocostal Arch
Opening for Lesser Splanchnic Nerve
PSOAS MAJOR
QUADRATUS LUMBORUM



EXHALATION

- Exhalation, for the most part, is passive and requires no energy.
- Normal exhalation
  - Relaxation of external intercostals
  - Recoil of elastic fibers in diaphrgam and within air passageways
  - Thoracic cavity becomes smaller
  - Pressure inside the thoracic cavity exceeds atmospheric pressure and air is forced out of the lungs
- Forced exhalation
  - Abdominal and internal intercostals are recruited when you control the exhalation


DIAPHRAGM
DIAPHRAGM

Breath Control

- Breathing can be controlled voluntarily, up to a point
- In yoga breath control is known as **pranayama**
- Internally the control of breathing is regulated by the level of carbon dioxide in the blood, not oxygen
- Too much CO_2 and H^+ will stimulate inspiratory area, phrenic and intercostal nerves
- There are sensors throughout the body, which detect the levels of CO_2 and send messages to the brain to start breathing

Disorders of the respiratory system

- The environment and lifestyle are the main culprits for the majority of lung diseases
- COPD – chronic obstructive pulmonary disease (emphysema, chronic bronchitis)
- Asthma*
- Cancer
- Cystic fibrosis (genetic disorder)
- Infections (pneumonia, TB, bronchitis)
- Allergies

Pranayama – Breath Control

- Prana – vital energy/life force
- Ayama – control
- Pranayama – “expansion of vital energy”
- Breath control (4 levels)
  - Inhalation (puraka)
  - Exhalation (rechaka)
  - Breath retention (kumbhaka)
    - Breath retention after inhalation (antara kumbhaka)
    - Breath retention after exhalation (bahir kumbhaka)

UJJAYI

- Contraction of the laryngeal muscles and partial closure of the glottis
- Mild airway resistance is maintained throughout inspiration and expiration
- A soft audible sound is created
- Sequence 4:4:6:2
  - Inhale for 4 seconds
  - Retention for 4 seconds
  - Exhale for 6 seconds
  - Retention for 2 seconds

Benefits of Yogic Breathing

- Slow breathing with prolonged expiration is associated with reduced physiologic and psychological arousal
- Slow breathing decreases chemoreflex sensitivity – can tolerate higher levels of CO_2
- Adaptation to the practice of deep, slow respiration increase vagal nerve signals to the brain which produces a calming effect
- Normalizes baroreflex sensitivity which helps maintain a normal blood pressure

Airway Resistance of Ujjayi

- Increased airway resistance improves breath control
- Provides a high level of vagus nerve stimulation which increases parasympathetic nervous system activity and reduces sympathetic activity.
- Heart rate slows and energy is conserved
- In animals, ujjayi-like breathing occurs under threat of danger and prepares the animal for self-protection
- Ujjayi breathing promotes a shift to parasympathetic dominance

Benefits of Kapalubhati

- Initially causes an excitation of the nervous systems which is followed by an emotional calming
- Produces a high level of mental activation and alterness
- Activated the cortex which prepares the body for stress
- May enhance sympathetic nervous system reserves and improve the capacity overtime to continue functioning effectively without becoming depleted

“OM” Chanting

- Has complex effects on the brain
- The verbal and vibrational component of the chant may contribute to activation of the Wernecke’s area of the brain (center for speech)
- Activation of the thalamus (found between the cerebral cortex and the midbrain) which regulates consciousness, sleep and alertness