

## Respiratory Anatomy

“...in yoga we train ourselves to breathe deeply, and in a variety of unusual patterns, but this is only for the purpose of exploring the full potential of our breathing mechanisms, and to uncover and dismantle habits that obstruct normal function. In other words, the end goal of practicing pranayama (unusual breathing patterns) in a Yoga therapy breathing intervention is to achieve “normal” breathing. Normal breathing, in the physiological sense, means that our everyday, moment-to-moment respiratory activity is consistent with our metabolic requirements.” –Leslie Kaminoff

Breathing is defined as taking air into and expelling it from the lungs, which is caused by a three-dimensional changing in shape of the thoracic and abdominal cavities (kaminoff). The diaphragm is the principle muscle that causes the shape change in the two cavities. The diaphragm is the strong wall of muscle that separates the chest cavity from the abdominal cavity. By moving downward, it creates suction in the chest to draw in air and expand the lungs.

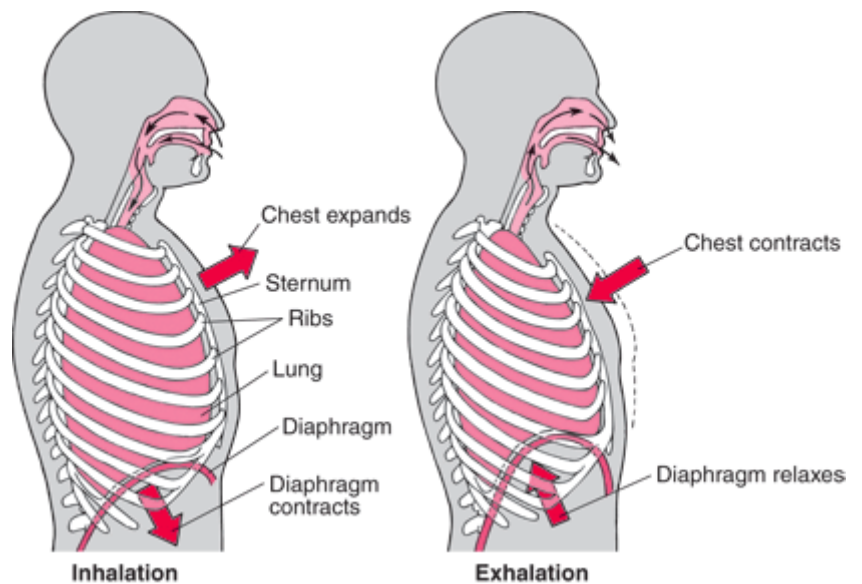


Figure 1: Inhalation vs. Exhalation

Items to note:

- Abdomen changes shape but not volume
- Thoracic cavity changes both shape and volume
- Boyle's Law: Inverse relation between volume and pressure. Increasing volume in thoracic cavity causes a decrease in pressure (air flowing in: inhalation). Inhalation is not pulling air into the body; this is caused by atmospheric pressure.

## Primary and Assisting Muscles

The ribcage plays a major role in breathing. Not only does it protect the lungs, but also moves (up and down, sideways and front to back) with the help of the assisting muscles of respiration:

- **Intercostals:** These muscles act as a unit to expand and contract the chest.
  - **Internal:** The muscles assist with exhalation. The muscles run down and medially to the rib cage. They originate on ribs 1-11 and have their insertions on ribs 2-12. They are responsible for the depression of the ribs decreasing the transverse dimensions of the thoracic cavity.
  - **External:** These muscles assist with inhalation. They originate on ribs 1-11 and have their insertion on ribs 2-12. The external intercostals are responsible for the elevation of the ribs, and expanding the transverse dimensions of the thoracic cavity
- **Obliques:**
  - **Internal:** acts as an antagonist (opponent) to the diaphragm, helping to reduce the volume of the thoracic (chest) cavity during exhalation. When the internal obliques contract they compress the organs of the abdomen, pushing them up into the diaphragm which intrudes back into the chest cavity reducing the volume of the air filled lungs, producing an exhalation. Secondly, its contraction rotates and laterally flexes the trunk by pulling the rib cage and midline towards the hip and lower back, of the same side.
  - **External:** The external oblique functions to pull the chest downwards and compress the abdominal cavity, which increases the intra-abdominal pressure. It also has limited actions in both flexion and rotation of the vertebral column.
- **Rectus abdominus:** The abdominal muscles function to help with deep, forceful exhalations. When they contract they press the thoracic cavity upward forcing air out.
- **Transverse abdominis:** The transversus abdominis is the innermost of the flat muscles of the abdomen that wraps around the entire waist forming a stable-like girdle. It assists with exhalation by bringing the bottom of the ribcage closer to the spine, which forces air out of the lungs.
- **Bucket Handle Muscles (Clavicular Breathing)**
  - **Pectoral Minor:** The pectoralis minor muscles are located on the front of the chest, originating on ribs two through five and inserting on the coracoid process of the scapula. When we stabilize the scapula so that the insertion can't move, contracting the pectoralis minor lifts the ribcage.
  - **Rhomboids:** When the rhomboids contract, they cause the scapula to retract, pulling the shoulders back and opening the front of the chest.

- **Scalenes:** The scalene muscles are a group of three pairs of muscles in the lateral neck, namely the scalenus anterior, scalenus medius, and scalenus posterior. They lift the first and second rib during inhalation.
- **Sternocleidomastoid:** Anterior muscles in the neck that act to flex and rotate the head. They work with the scalenes to lift the ribcage during inhalation.
- **Serratus Anterior:** The serratus anterior is a muscle that originates on the surface of the upper eight ribs at the side of the chest and inserts along the entire anterior length of the medial border of the scapula. It helps with forced inhalation by lifting the rib cage.

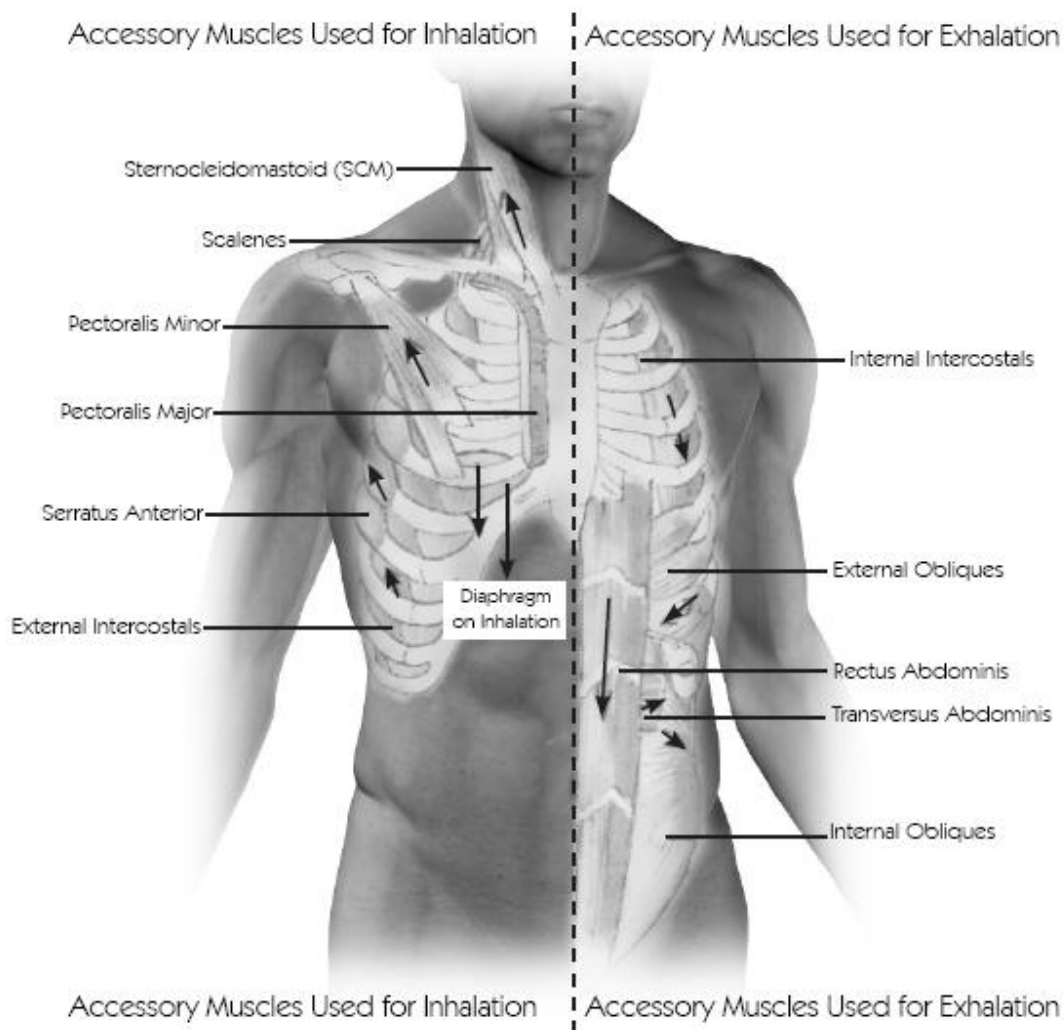


Figure 2: Muscles of Breathing

## **Breathing and Stress**

The goal of breathing in yoga is to arrive at a natural state, one in which the diaphragm is active. When the diaphragm is underactive, the assisting muscles of respiration take over. They are meant to *assist* us in breathing, but they are not designed for the 24-7 work of the breath. Their *overuse* is most often defined as '**chest breathing**,' which is in turn considered to be a stressful pattern of 'overbreathing.' Constant activation of these muscles triggers the flight or fight response and leads to excessive tension in the neck and shoulders. It also is associated with elevated cortisol levels (the stress hormone produced by the adrenals).

## **Effects of Breathing on Yoga Postures**

- Inhales function to lift the body further (the hips and the ribcage)
- Exhales (relax the ribcage and promote sinking)