**Control of Respiration**

* Done in 1 ways: 1. Neural control 2. Non-neural factors that affect respiration

**Neural Regulation: Setting the Basic Rhythm**

* Respiration rate is controlled by nerve impulses sent to the phrenic nerve and intercostals nerves
* Medulla and pons are areas of the brain that regulate respiration rhythm and depth
  + **Medulla**- sets basic rhythm of breathing, contains pacemaker 🡪 **self-exciting inspiratory center**; also has an expiratory center 🡪 feedback between the two sets a baseline rhythm of 12-15 breaths/min
    - Causes neurons to send a signal through the phrenic (moves the diaphragm) and intercostals nerves (moves the external intercostals muscles—ribs)
  + **Pons**- assists medulla with respiratory control
* **Eupnea-** normal respiratory rate; 12-15 respirations/min
* Stretch receptors in the bronchioles and alveoli respond to overinflation and cause a reflexive reaction 🡪 stretch receptors send message to the medulla via the vagus nerve that ends inspiration allowing expiration to occur
* There are times when the baseline rhythm is altered by the medulla such as exercise
  + Body needs to meet the cellular demand of oxygen 🡪 inc nerve impulse to stimulate the diaphragm and intercostals so more respiration can occur both externally and internally
  + Medulla’s inc. stimuli may elevate respiration rate but also stimulates active expiration (causes abdominal and internal intercostals to contract to help push air out of the lungs)
* **Hyperpnea**- when breathing becomes deeper and respiration rate is elevated

\*\*\* If you suppress the ability of the medulla to function by overdosing on meds such as morphine or antidepressants, sleeping pills, or alcohol respiration ceases and you die\*\*\*

**Non-neural Factors that Influence Respiration Rate & Depth**

* Physical Factors
  + Talking, coughing, exercising, inc body temp
* Volition
  + Conscious control of breathing
  + Holding breath, singing, swallowing, swimming
  + Length for which you can control your breathing is limited b/c medulla and pons can override conscious control when blood oxygen is too low or the pH is decreasing
* Emotional Factors
  + Fear, stress, temperature shock (jump into a cold pool) can change breathing rate and depth b/c they’re emotional reflexes stimulated by the hypothalamus
* Chemical Factors \*\*\*most important factor affects resp rate and depth
  + Inc CO2 in blood 🡪 dec pH 🡪 inc resp rate
    - A change in CO2 levels are detected by chemoreceptors in the aortic arch and common carotid artery which send a message to the medulla which changes the pH of cerebrospinal fluid (dec CSF pH)

\*\*\* most important feedback factor in breathing isn’t getting O2 in the body (unless O2 levels become dangerously low) it’s getting CO2 out

\*\*\* people with respiratory conditions that cause them to retain CO2 due to an impaired ability to take in or release air do not have CO2 –regulated respiration. Their resp. rate is regulated by low O2 levels (why they breath low-oxygen gas, if breath too much O2 their medulla won’t regulate respiration properly because the stimulus to which they now respond, low O2, is gone)

* Hyperventilation- a situation where respirations increase causing excess CO2 (carbonic acid in the blood plasma) to be released lowering the blood pH🡪 causes people to pass out b/c blood vessels in brain constrict
* Hypoventilation- slow breathing, causes an inc in blood pH b/c CO2 isn’t being released (blood is holding onto the carbonic acid)
* Blood can compensate & keep the pH within a normal range for a period but eventually experiences a pH change causing acidosis (dec in pH🡪 blood gets more acidic) or alkalosis (inc in pH--) blood gets more basic)
* After hyperventilation apnea (lack of breathing) sets in to allow time for carbonic acid levels to rise
* If breathing stops for an extended period of time the body may begin to appear blue (cyanosis) due to insufficient oxygen in the blood