The Respiratory System

The nose
Nostrils = external nares
Nasal cavity is divided in half by the nasal septum
Olfactory receptors are located in superior part of nasal cavity, near ethmoid bone
Respiratory mucosa is lined by 100s of veins, to warm air
Cilia on respiratory mucosa trap bacteria and other debris; allowing us to swallow it to get destroyed in the stomach

Nasal conchae
Increase nasal
Increase surface
Increases “trapping” of debris on mucus-covered surfaces
Increases efficiency of air warming

Nasal cavity anatomy

Pharynx
= your “throat”
Continuous with nasal cavity via the internal nares
Divided into nasopharynx, oropharynx, and laryngopharynx, which enters the larynx
Pharyngotympanic tubes empty into nasopharynx
Pharynx is the side of several clusters of lymphatic tissue (= tonsils)

Larynx
Inferior to pharynx
Formed of 8 rigid hyaline cartilages and the epiglottis (elastic cartilage)
Thyroid cartilage protudes anteriorly, forming the “Adam’s Apple”
Epiglottis closes over the trachea when we swallow, preventing anything but air going into the airways
Folds in mucus membrane form the vocal folds, which vibrate, allowing us to speak
Trachea
Extends from pharynx to about mid-chest (5th thoracic vertebrae)
Reinforced by C-shaped rings of **hyaline cartilage**
abut the esophagus, allowing it to expand
keep the airway **patent** (= open)
Lined with cilia that beat **away** from the lungs, further filtering out debris, etc.

Respiratory zone structures
*Respiratory zone* is the only site of gas exchange in the lungs; all other structures are part of **conducting zone**

Respiratory membrane
Pulmonary ventilation
= breathing
Process depends on pressure changes in the thoracic cavity
Gas particles always fill their container
  if there are few gas particles, pressure is low
  If there are many gas particles, pressure will be high
Breathing consists of two phases: inspiration, and expiration

Inspiration
Diaphragm and external intercostal muscles contract, increasing size of thoracic cavity
Lungs increase volume with the thorax
Interpulmonary volume increases, decreasing gas pressure within the lungs
This partial vacuum sucks air into the lungs from the outside
Air moves into lungs until pressure inside and outside of lungs is equal

Expiration
Inspiratory muscles relax
Intrapulmonary volume decreases, pressure increases
Gases equalize pressures
Intrapleural pressure is always negative--prevents lungs from collapsing

Respiratory volumes and capacities
Gas exchange

Respiratory influences

Physical factors
Talking, coughing, exercising all modify the rate and depth of our breaths; increased body temperature also increases the rate of breathing

Emotional factors
Gasping, laughing, crying

Pulmonary surfactants

Essential for proper functioning of the lungs
Lowers surface tension of the film of water lining alveoli, keeping them from collapsing
Not present until babies are 28-30 weeks old

Control of respiration
Respiratory muscles are controlled by the phrenic and intercostal nerves
The medulla sets the basic breathing rhythm, and contains the self-exciting inspiratory center
The pons is responsible for smoothing that basic breathing pattern
Normal respiratory rate (12-15 resps/min) = eupnea

Respiratory influences

Volition (conscious control)
We can control the rate of breathing to some control (i.e. holding our breath), but respiratory centers will eventually ignore messages from the cortex
Chemicals
Levels of CO\(_2\) (medulla) and O\(_2\) (carotid body and arch) in the blood affect respiratory rate. Decreased pH.