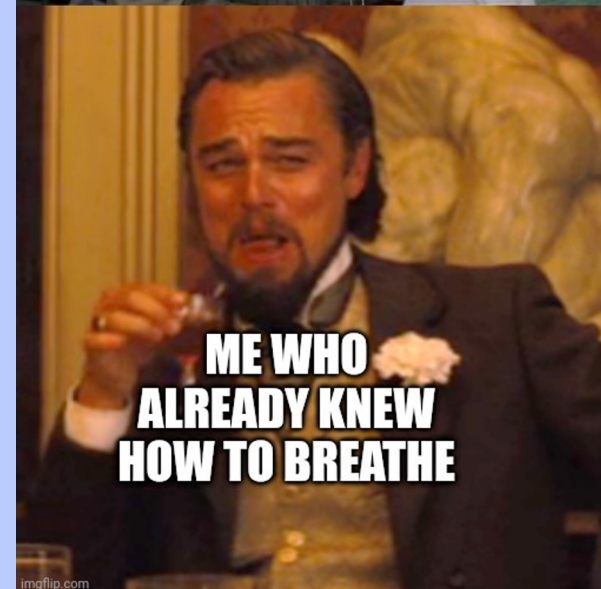
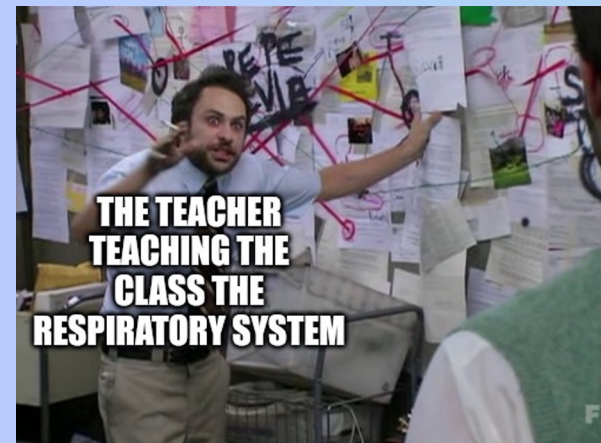




Respiratory Control

By Michelle Kaminski

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- Overview of Involuntary vs Voluntary
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 - Pons
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- Voluntary Breathing

Involuntary vs Voluntary

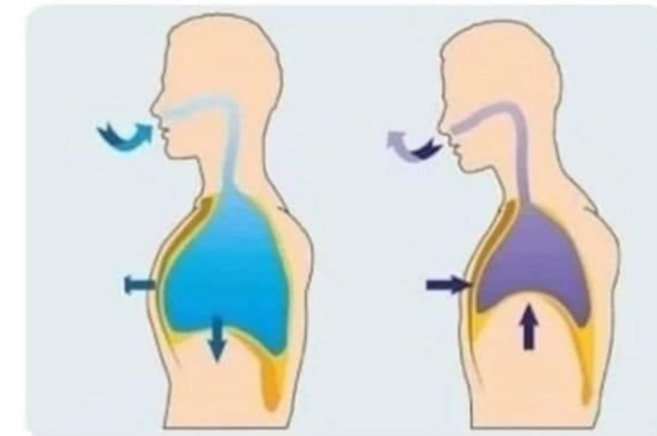
Involuntary breathing

- Unconscious breathing
- Actively inhale
- Passively exhale
- Chemoreceptors
 - Central
 - Within CNS monitor pH within CSF
 - Peripheral
 - Outside CNS

Voluntary breathing

- “Thinking about it”
- Actively use muscles to inhale as well as exhale

You haven't lived if
you haven't done this



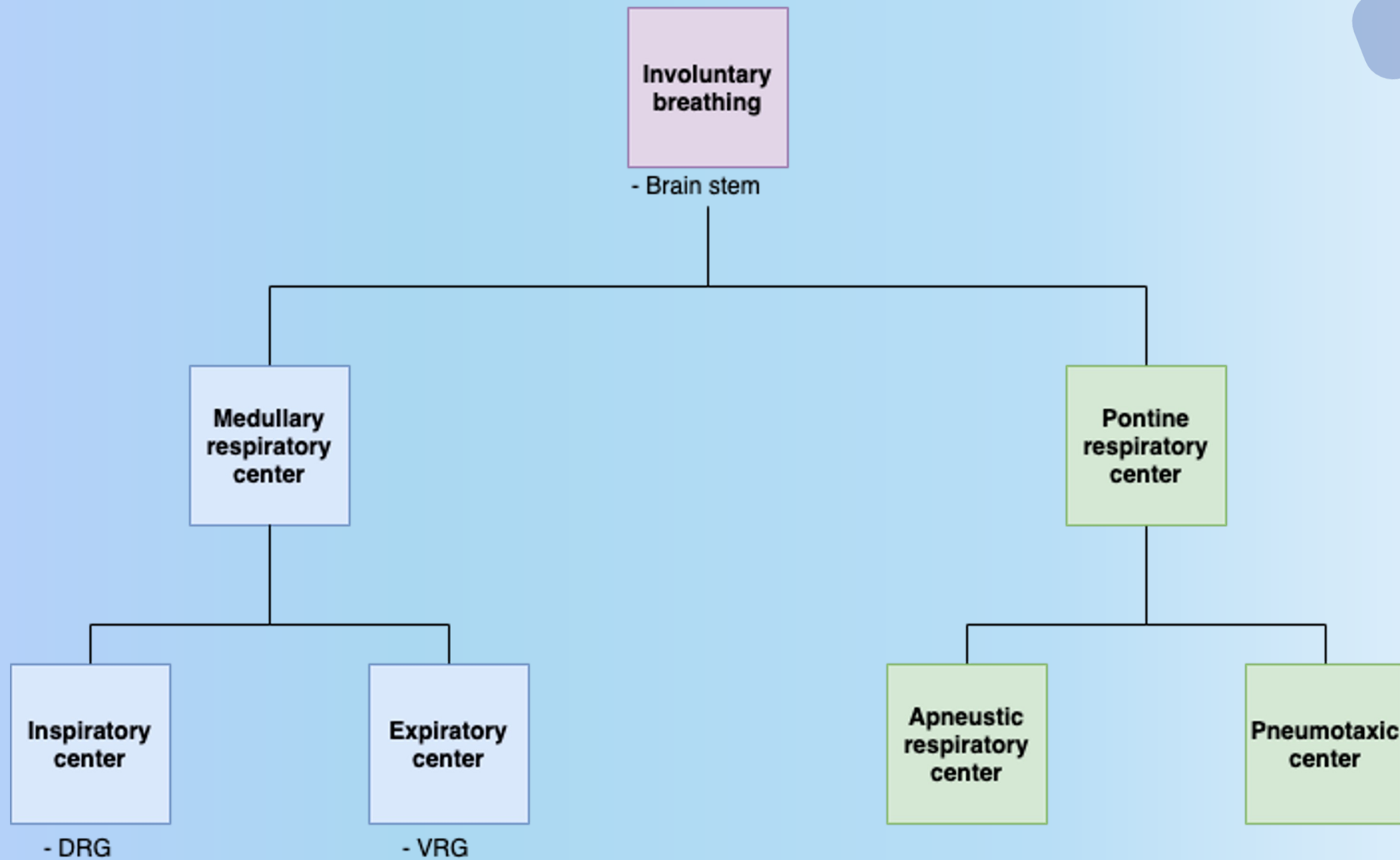


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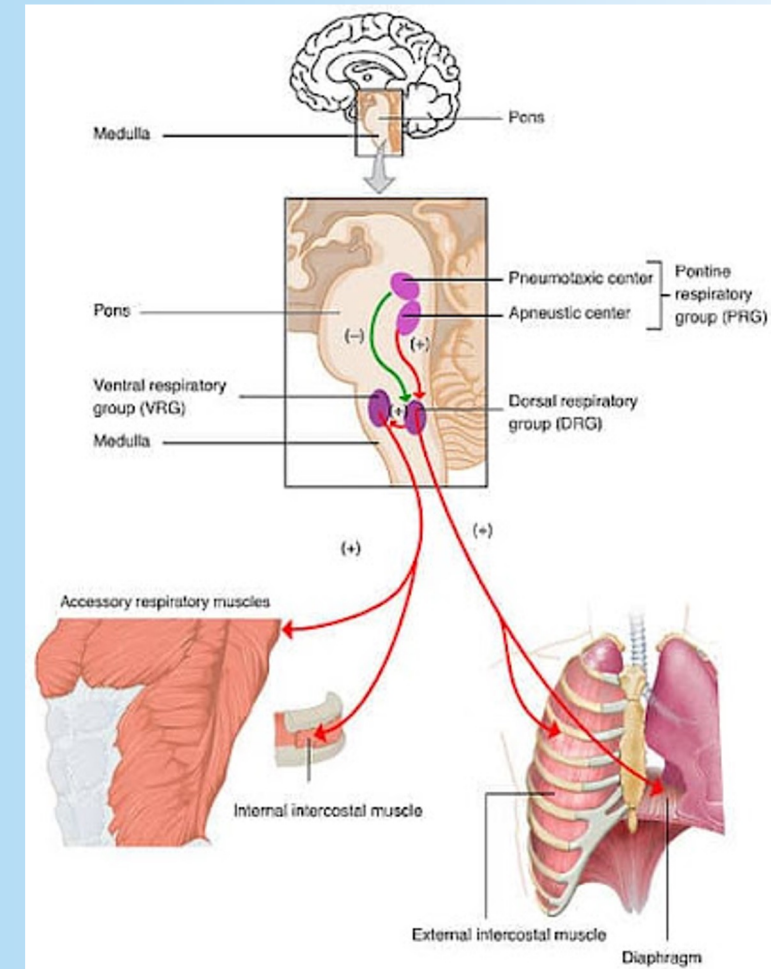
Respiratory Control Centers

Medullary Centers

- Controls the natural rhythm of breathing
- Two divisions
 - **Dorsal respiratory group (DRG)**
 - Inspiration
 - **Ventral respiratory group (VRG)**
 - Expiration

Pontine centers

- “Fine-tuning” of medullary center
- Two divisions
 - **Pneumotaxic center**
 - Regulating respiratory rate
 - **Apneustic Center**
 - Regulates depth



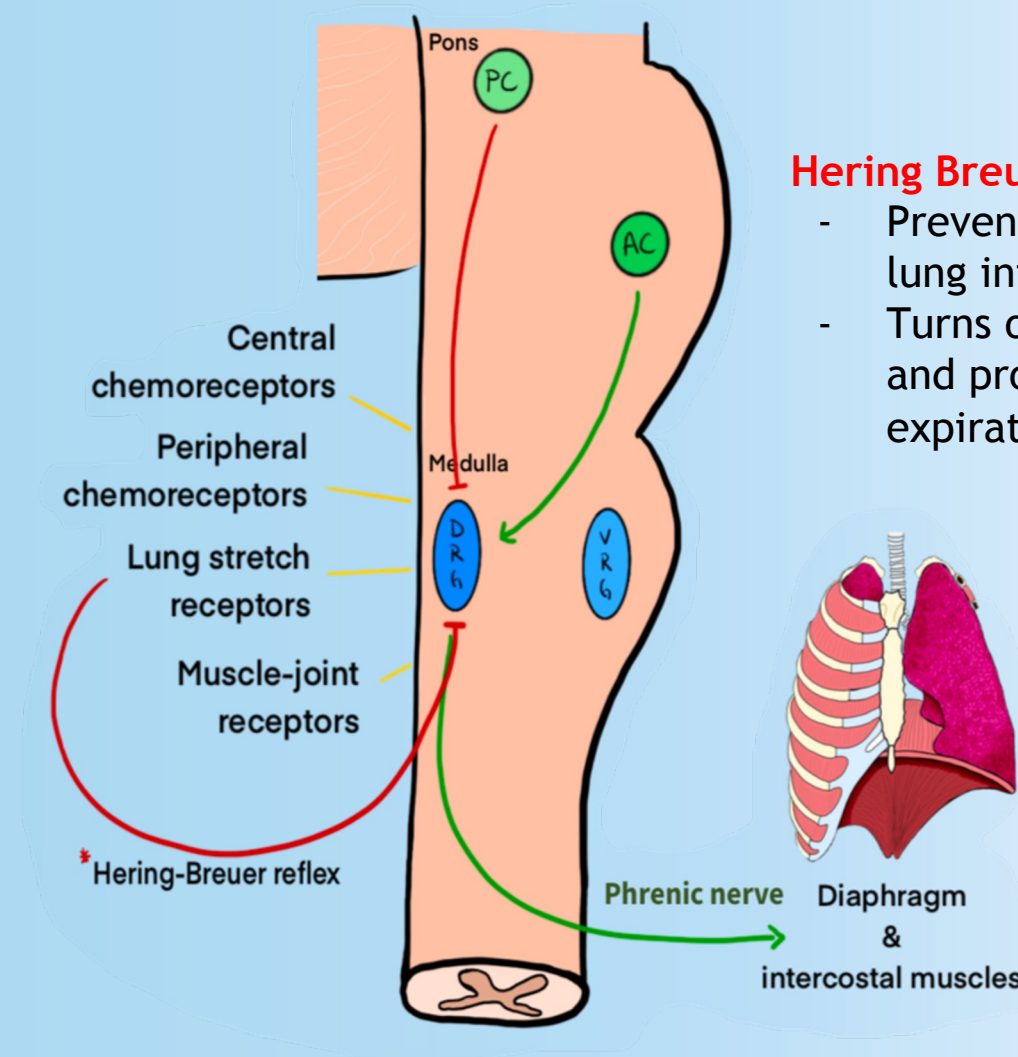
Medullary Centers

Inspiratory Center (DRG)

- Maintains rate of normal, quiet inspiration
- Input
 - Peripheral (CN9) and central chemoreceptors
 - Lung stretch receptors (CN10)
 - Muscle-joint receptors (proprioceptors)
- Output
 - Phrenic nerve
 - C3, C4, C5 keep the diaphragm alive

Inhibited by:

- Pneumotaxic center in the pons
- The Hering-Breuer reflex



Hering Breuer Reflex

- Prevents excessive lung inflation
- Turns off inspiration and prolongs expiratory time

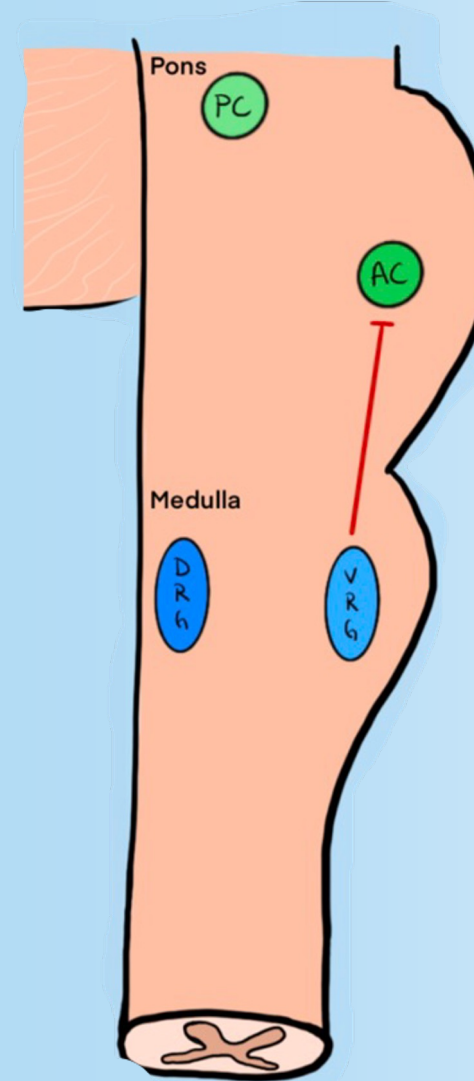
Medullary Centers

Expiration Center (VRG)

- Inactive
 - Normal quiet breathing (a month before exam no stress)
- Active
 - Vigorous breathing (a day before the test)

Inhibits

- Apneustic center



Month before exam
feeling goood and
stronk



Day before realizing
there's a whole anki
you haven't done and
everyone else has



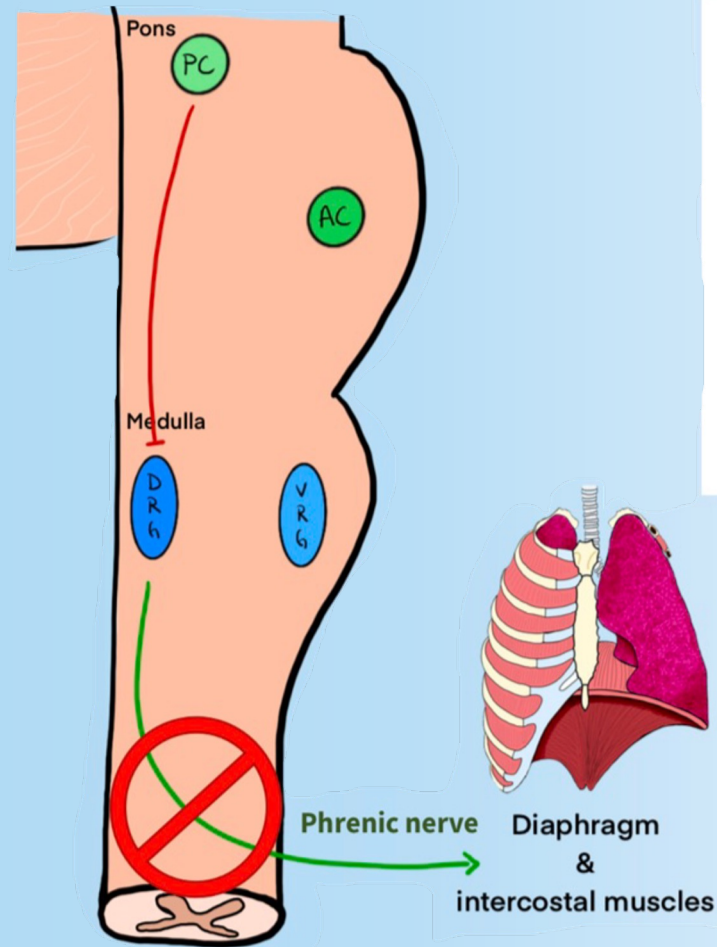
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Pontine Centers

Pneumotaxic Center (Upper Pons)

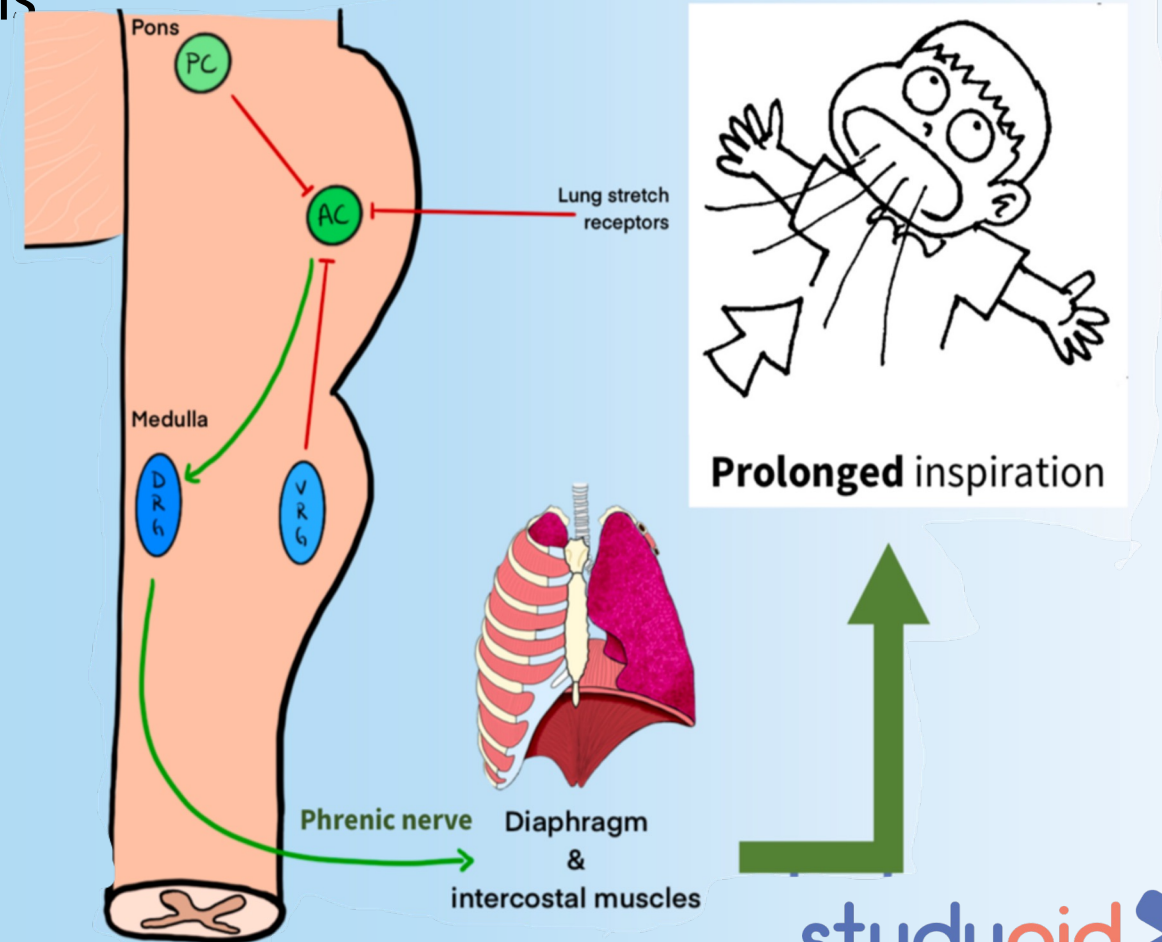
- Regulates respiratory Rate
 - Limiting or delaying inspiration
- Inhibits DRG
 - To be able to control respiratory rate finely
 - It's signals limit the activity of the phrenic nerve
- Inhibits signals to Apneustic Center



Pontine Centers

Apneustic Center (Lower Pons)

- Regulates intensity and depth of breaths
 - Send signals to inspire long and deep breaths (apneusis)
- Stimulates Inspiratory Center (DRG)
 - ↑↑ depth of inspiration by sending actions potentials by the phrenic nerve to the inspiratory muscles
- Inhibited by
 - Lung Stretch receptors
 - Expiratory center (VRG)
 - Pneumotaxic center
 - Work antagonistically to control the respiratory rate



Review

Brain stem center	Inspiration	Expiration	Main action
Pneumotaxic center		X <i>passive</i>	Control of respiratory rate and pattern
Apneustic center	X		Triggers prolonged inspiration
Inspiratory center = Dorsal respiratory group	X		Generation of the basic rhythm of breathing
Expiratory center = Ventral respiratory group		X <i>active</i>	Generation of the basic rhythm of breathing <i>Active during exercise</i>

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Chemoreceptors

Central Chemoreceptors

- Located on ventral surface of medulla
 - Main drive of normal ventilation
- Monitor CO₂ levels and pH in Cerebrospinal fluid

Example:

↑Paco₂

↑ H⁺ in CSF

↓pH in CSF

Central chemoreceptor
detect ↓pH in CSF

They Stimulate Inspiratory
center (DRG)

↑ respiratory rate to
get rid of excess CO₂

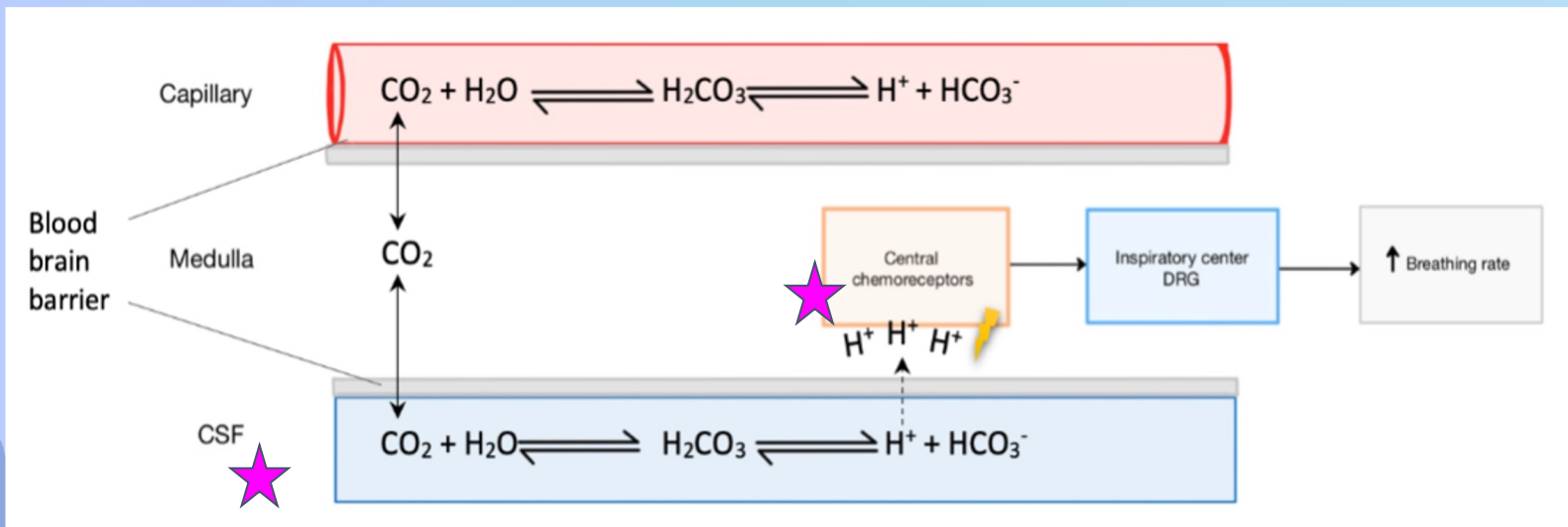


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Chemoreceptors

Peripheral Chemoreceptors

- Detects changes in PaO_2 , PaCO_2 , or arterial pH
 - If change is detected
 - Stimulate inspiratory center DRG
 - Increase Inspiration
 - If Acidosis is detected
 - Compensatory mechanism = **Hyperventilation**
- Two bodies
 - Aortic bodies
 - Located in aortic arch
 - Stimulated by $\downarrow \text{PaO}_2$ or $\uparrow \text{PaCO}_2$
 - Carotid bodies
 - Located in bifurcation of common carotid arteries
 - Stimulated by $\downarrow \text{PaO}_2$ (<60 mmHg), $\uparrow \text{PaCO}_2$, $\downarrow$ arterial pH

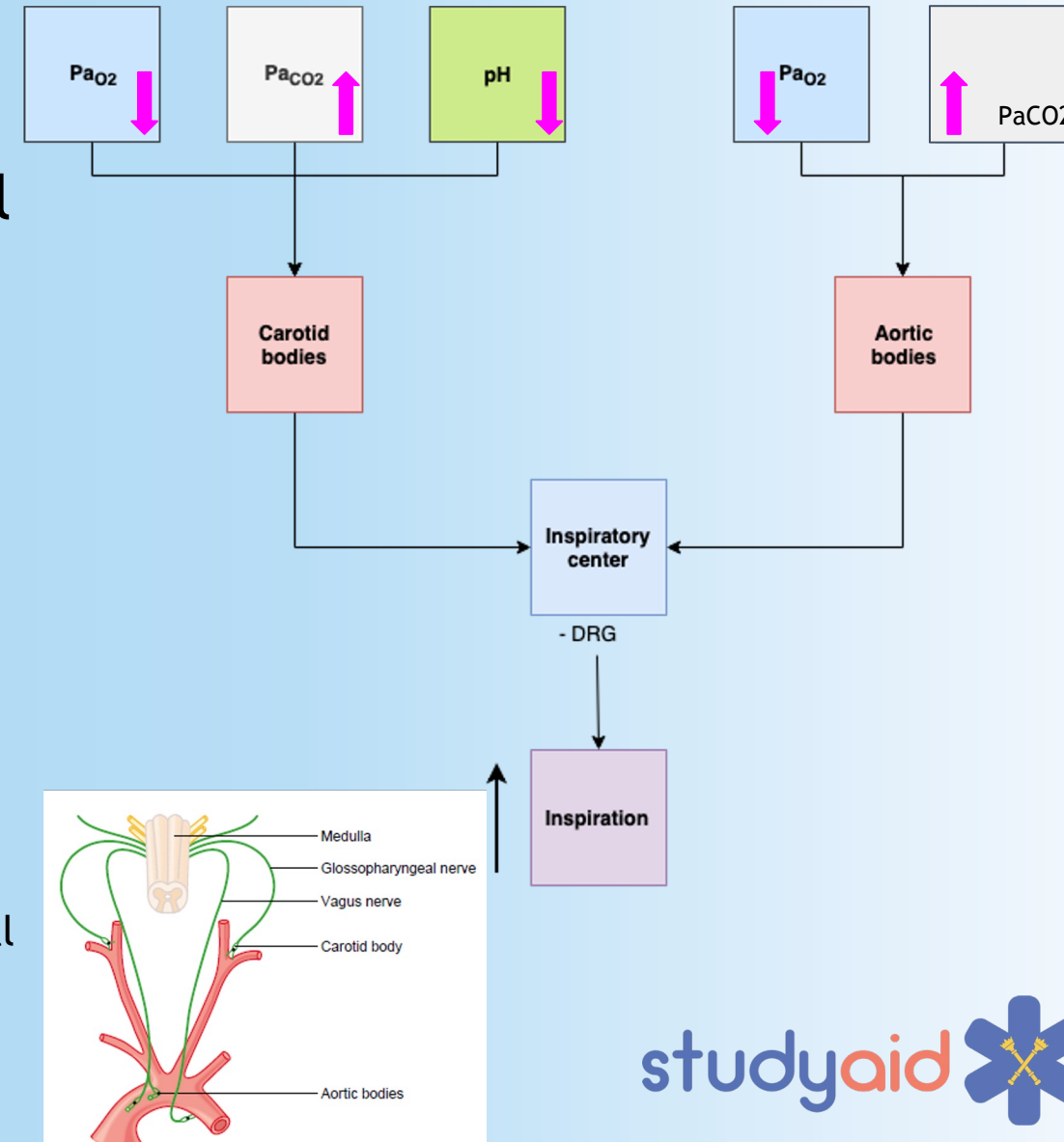


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Review of Other Chemoreceptors

	Lung stretch receptors	Joint and muscle receptors	Irritant receptors	Juxtacapillary ² receptors
Type	Mechanoreceptor	Mechanoreceptor	Rapidly adapting receptors	Sensory nerve endings
Location	Airway smooth muscle	Joints and muscles	Between airway epithelial cells	Alveolar walls
Stimulation	Distension of the lungs	Movement of limbs during exercise	Noxious chemicals and particles	- ↑ Blood volume - ↑ Interstitial fluid volume
Effect on respiratory rate	↓	↑	↑	↑
Reflexes	Hering-Breuer reflex		Coughing reflex ¹	

¹Caused by constriction of bronchial smooth muscle

²Juxta means close to/near; juxtacapillaries = close to capillaries, they are also called pulmonary **C-fiber receptors**

Hering Breuer Reflex

- Prevents excessive lung inflation
- Turns off inspiration and prolongs expiratory time

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Voluntary Breathing



Mindful conscious breathing

- Controlled by Cerebral cortex
 - Sends impulses through the corticospinal tract to the respiratory motor neurons
 - Activates muscles of inspiration
- Hypoventilation
 - Respiratory Rate below 12
- Hyperventilation
 - respiratory rate above 20

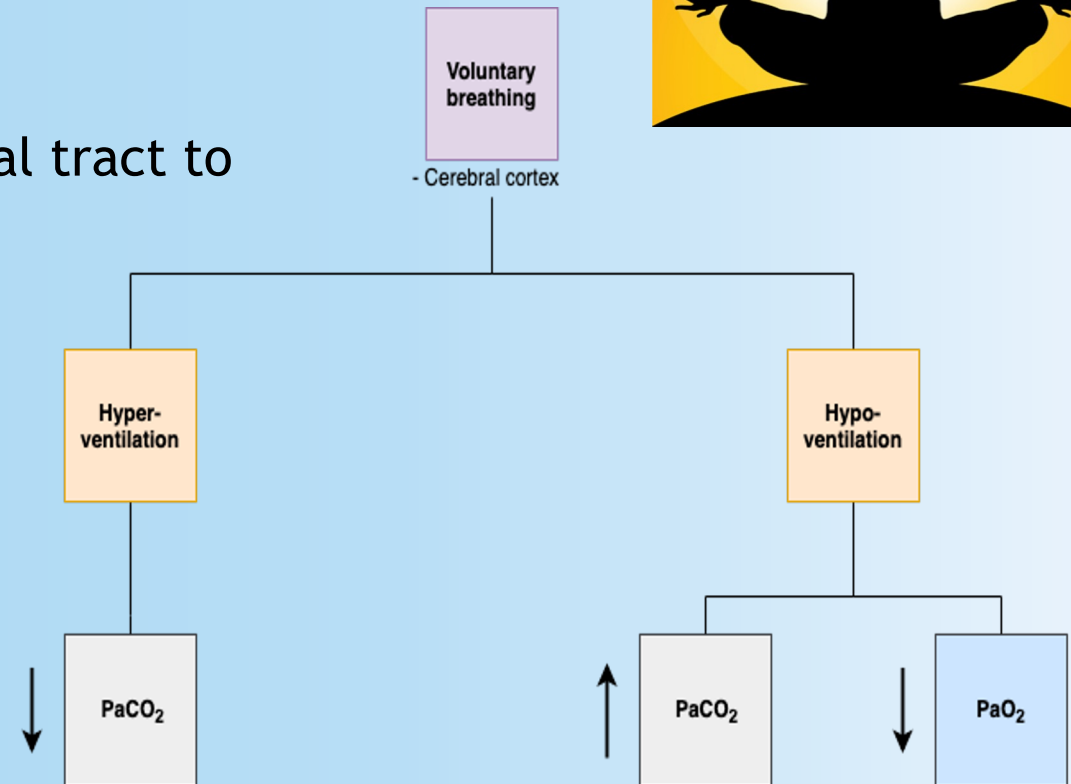


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WooClap!