**POE #2: The Calcium Disruption**

**Topic**

Unit 2- Histology, Integumentary, Bone (Bones, Blood Calcium, Calcium and Muscle/Nerve Function)

The scenario below has been simplified for the purposes of this introductory anatomy and physiology course. As you progress in your academic and professional careers you may learn more extensive details related to this scenario.

**Introduction to the Scenario**

*As you read through the scenario below underline specific facts and information you find important to the situation*

Amara was abruptly awoken in the middle of the night due to extreme muscle cramping and spasming. She was also experiencing tingling and burning in her fingertips, toes, and lips. Due to the pain and muscle spasming, she was unable to drive herself to the hospital, so she called 911 for an ambulance. Upon arrival the medics immediately began running tests on Amara to determine why she was experiencing these symptoms. After running some tests on her blood, vitals, and hormones, they determined she has hypoparathyroidism. This is a rare condition where the body produces abnormally low levels of parathyroid hormone (PTH), which is vital in maintaining blood calcium levels.

**Driving Question(s)**

Why would hypoparathyroidism cause muscle cramps, muscle spasms, and tingling/burning sensations within Amara’s body?

**Initial Hypotheses/Predictions**

*In the box below, please provide your initial ideas about a possible answer to the driving question above.*

**Relevant Data & Analysis Questions**

***ALL analysis questions are italicized in the pages below***

**Amara’s Demographics & Health**

Gender: Female

Age: 34

Height: 5’6”

Weight: 127lbs.

Average Blood Pressure: 114/74

Average Resting HR: 72bpm

**Amara’s Test Results (The night she called 911)**

Amara- Denotes Amara’s levels

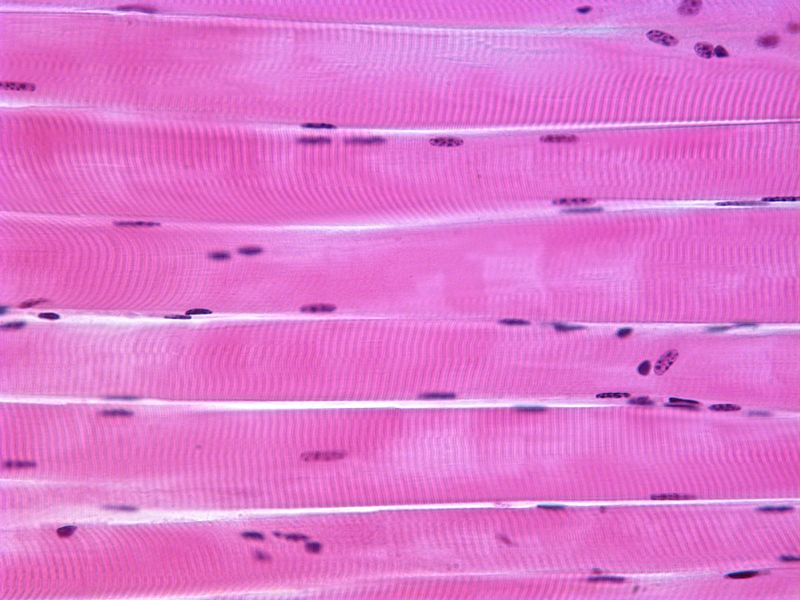
Normal- Are normal/average ranges for an adult female

|  |  |  |  |
| --- | --- | --- | --- |
| **Blood Work:** | **Calcium**  Amara: 5mg/dL  Normal:  9-11mg/dL | **Parathyroid Hormone (PTH)**  Amara: 5.5ng/L  Normal:  10-55ng/L | **Calcitonin**  Amara: 50pg/ml  Normal: <5.0pg/ml |
| **Vitals:** | **Resting Heart Rate**  Amara:  140bpm  Normal:  60-100bpm | **Blood Pressure**  Amara:  130/82  Normal:  ≤120/80 | **Body Temperature**  Amara:  99.4℉  Normal:  98.6℉ |

*Complete the table below to understand how Amara’s vitals and bloodwork are abnormal.*

|  |  |  |  |
| --- | --- | --- | --- |
|  | For each health marker below write the normal average values for females/Amara | Write Amara’s values the night she called 911 | Are Amara’s values higher or lower than normal (circle one) |
| Blood Pressure |  |  | HIGHER / LOWER |
| Resting Heart Rate |  |  | HIGHER / LOWER |
| Body Temperature |  |  | HIGHER / LOWER |
| Calcium |  |  | HIGHER / LOWER |
| PTH |  |  | HIGHER / LOWER |
| Calcitonin |  |  | HIGHER / LOWER |

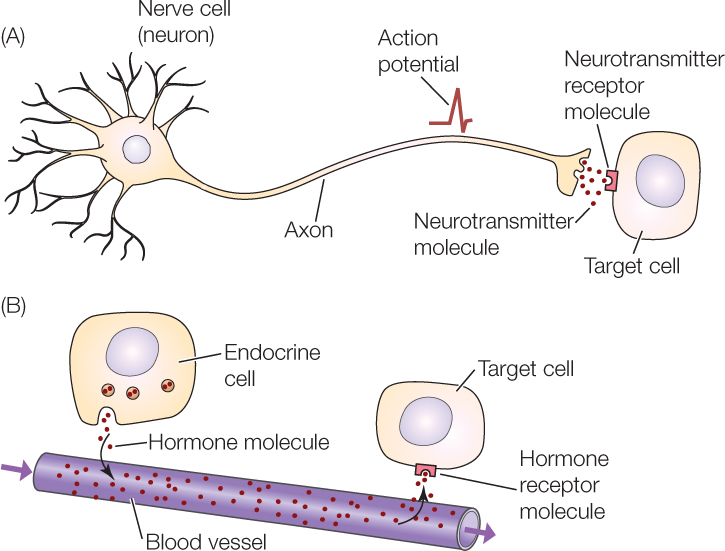
**Calcium’s Role in Muscle Contraction**

Skeletal Muscle Histology:

In muscle, Ca2+ binds to proteins located in the striations and initiates muscle contraction

Without Ca2+ the muscles are unable to contract because the proteins cannot interact

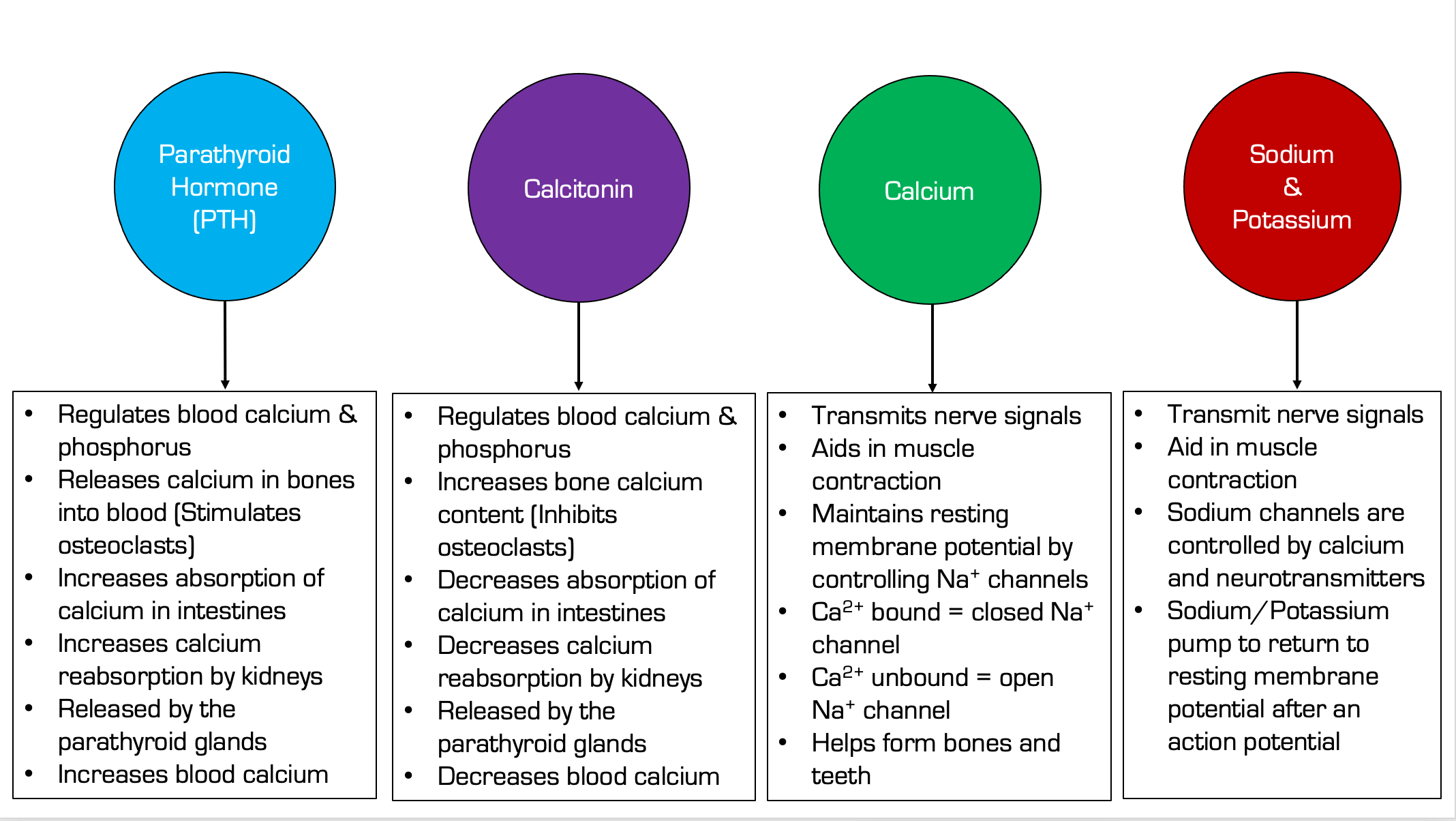
**Calcium’s Role in Nerve Function/Signaling**



* In the nerve cell (neuron), Ca2+ stimulates the release of neurotransmitters
* Neurotransmitters stimulate other neurons or target cells (i.e. muscle cells)
* Stimulation of other neurons can lead to sensory or motor responses
* Stimulation of muscle cells can lead to muscle contractions
* Without Ca2+, target neurons and muscle cells wouldn’t receive important messages and signals

*Without calcium, would nerves and muscles be able to communicate? Why or Why Not?*

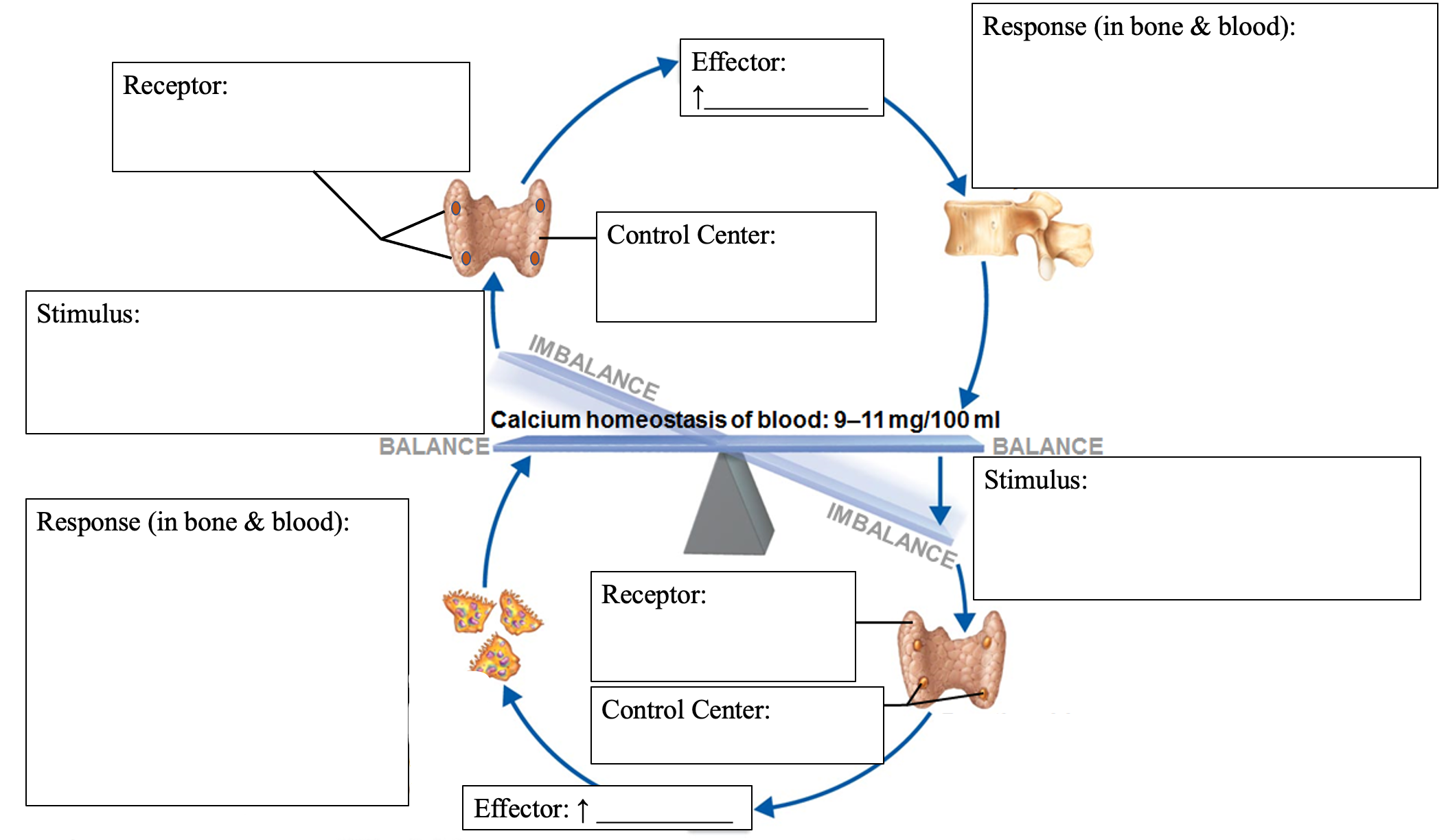
*Without calcium would muscles be able to contract properly? Why or Why Not?*

**Hormones & Ions Graphic**

*How would low levels of PTH affect the body?*

*How does calcium influence sodium channels? Would low blood calcium lead to more sodium or less sodium entering the muscle cell?*

*If resting membrane potential (the voltage across plasma membranes at rest) is increased by the movement of sodium down its concentration gradient into the cell, an action potential (electrical signal used in nerve communication and muscle contraction) will occur, what would happen if there was continual diffusion of sodium into the muscle cell?*

*Complete the blood calcium homeostasis graphic below using your knowledge from lecture as well as the relevant data above:*

*How would the above blood calcium homeostasis be affected by Amara’s hypoparathyroidism?*

*How would low blood calcium affect bone growth? Would we expect there to be an increase or decrease in bone growth? Explain.*

*How could regular sun exposure and a calcium rich diet aid in preventing osteoporosis?*

**Observations**

*After examining the data and answering the analysis questions above, describe interesting observations and patterns you believe are relevant to explaining the scenario. You can include both textual and visual observations in order to help organize the data from above. (Include at least 10 important pieces of data and evidence that will aid in your final explanation of the scenario below)*

**Explanation**

*Based on the data and analysis questions above, please provide an answer to the driving question(s) in the box below. Remember to include data from above as evidence, important ideas from previous units, and the concept of homeostasis in your response.*

**Driving Question(s)**

*Why would hypoparathyroidism cause muscle cramps, muscle spasms, and tingling/burning sensations within Amara’s body? Discuss how blood calcium homeostasis and muscle/nerve function are affected by Amara’s condition.*