Dehydration in Southwestern Arizona: An Educational Approach to Vulnerable Populations

Lily McNair
Arizona Western College - Honors Capstone
Fall 2018

INTRODUCTION

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2. There was little scientific research specific to Yuma County, AZ
3. In my project, I wanted to research dehydration and its effects, an important problem locally in this rural community
4. I planned to raise awareness through health education in the community

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2. Look at Dehydration's Effects on Human Health

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5. Use "The Educational Approach" for Helping Ensure Healthy Hydration

What is Dehydration?

Dehydration

Clinical consequences of negative fluid balance (i.e., of fluid intake that fails to match fluid loss).

Dehydration is marked by thirst, orthostatic hypotension, tachycardia, elevated plasma sodium levels, hyperosmolality, and in severe instances, cellular disruption, renal failure, or death.

Dehydration. (2005). In *Taber's cyclopedic medical dictionary* (20th ed., pg. 548) Philadelphia, PA: F.A. Davis Company.

Dehydration

Excessive loss of water from the body or from an organ or bodily part.

(Dehydration. In *New college edition, the american heritage dictionary,* 1976)

Dehydration

Clinically defined as fluid loss, either the loss of water or the loss of water and solutes together.

(Hoehn & Marieb, 2017).

Dehydration

Dehydration is a serious human health issue that occurs when the body's fluid intake does not match the fluid losses.

It creates a homeostatic imbalance in which the body cannot properly preform its physiological functions and may cause organ damage, an increased risk of disease, and cognitive/physical impairment.

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Three Types of Dehydration

- isotonic: resulting from proportionate loss of water and sodium, and results in normal serum sodium concentrations
- hypotonic: occurs when the proportion of sodium lost is greater than proportion of water lost
- hypertonic: occurs when proportionately more water than sodium is lost from the extracellular fluid compartment

(El-Sharkawy, Lobo, & Sahota, 2015, p. 97)

Acute vs Chronic Dehydration

Acute Dehydration

Acute dehydration occurs at certain times when the loss of fluid is suddenly greater than what the body needs for normal functions.

(Kleiner, 1999, pg. 200)

Chronic Dehydration

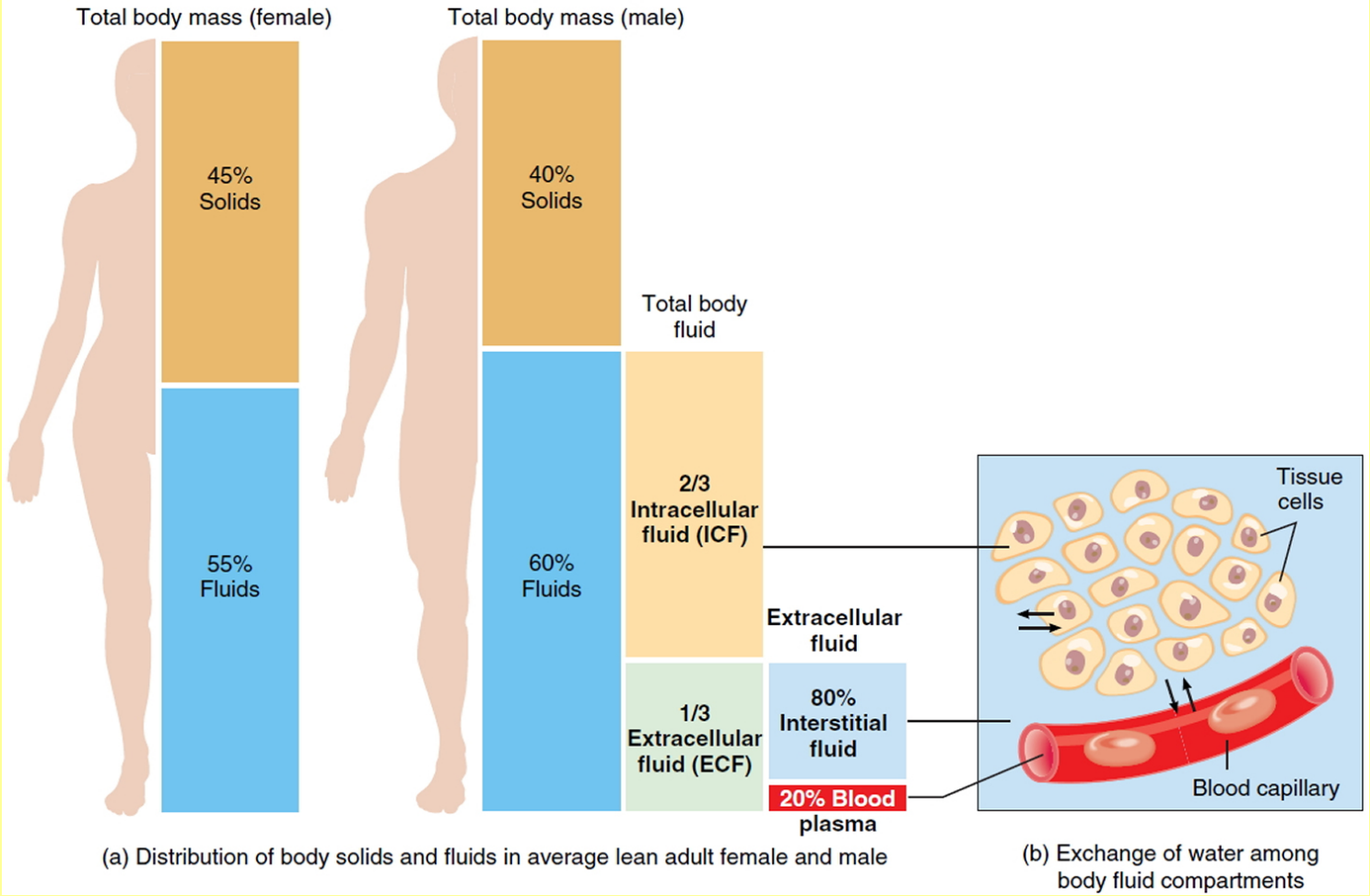
Dehydration resulting from less than adequate rehydration of water losses over a period of time.

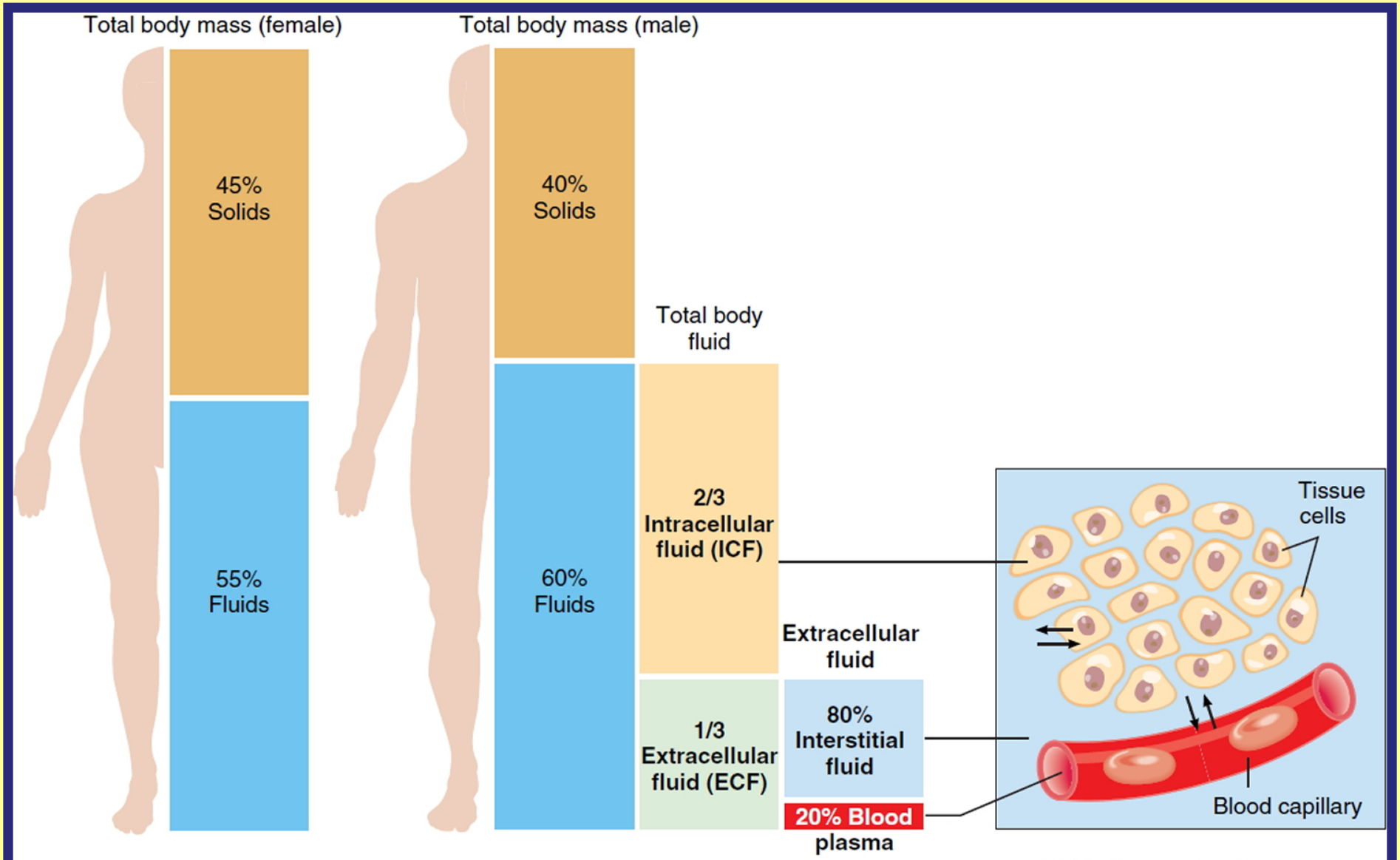
(Kleiner, 1999, pg. 200)

Physiology

Fluids in the Body

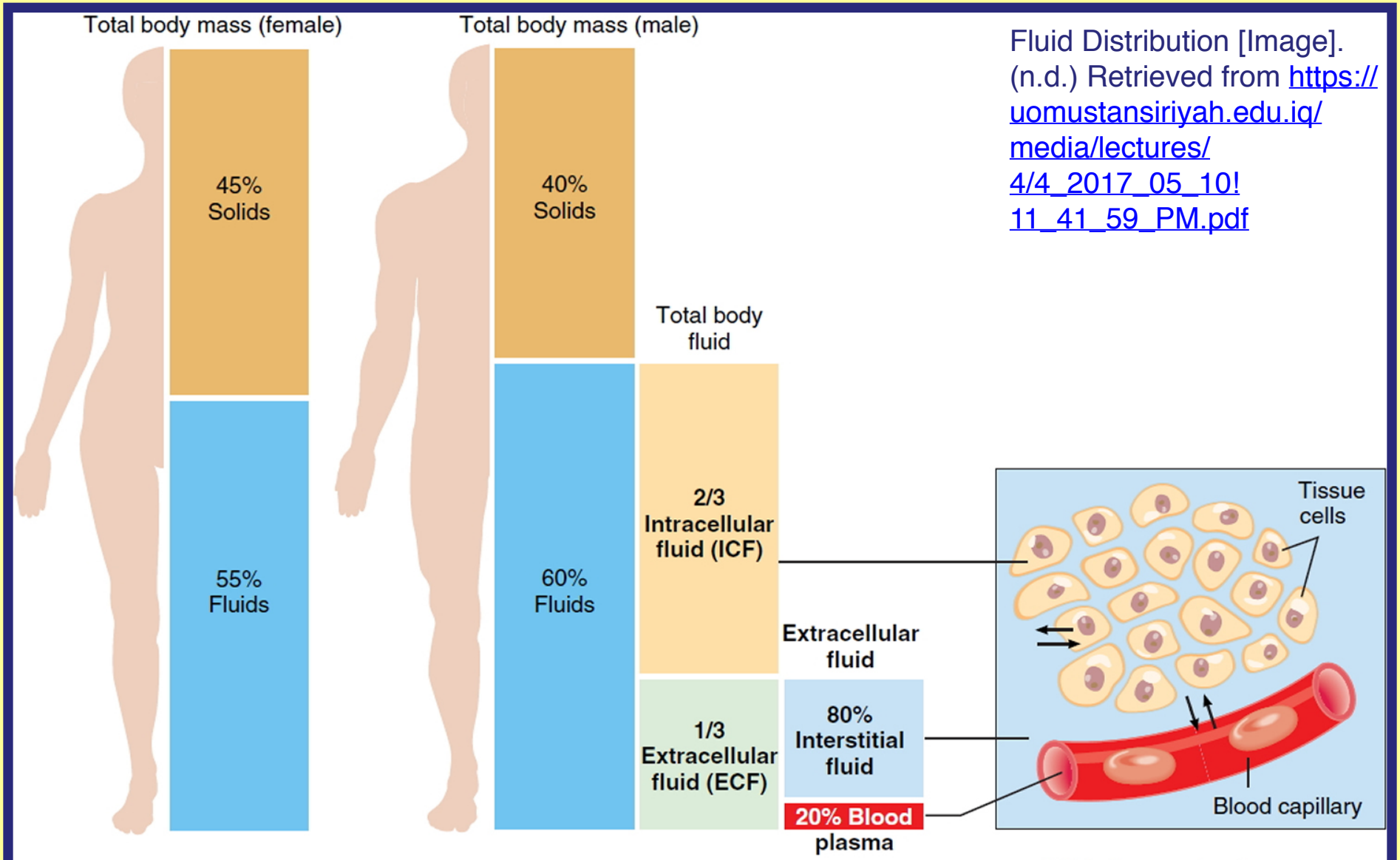
Fluids in the Body





(a) Distribution of body solids and fluids in average lean adult female and male

(b) Exchange of water among



Fluid Distribution [Image]. (n.d.) Retrieved from https://uomustansiriyah.edu.iq/media/lectures/4/4_2017_05_10!11_41_59_PM.pdf

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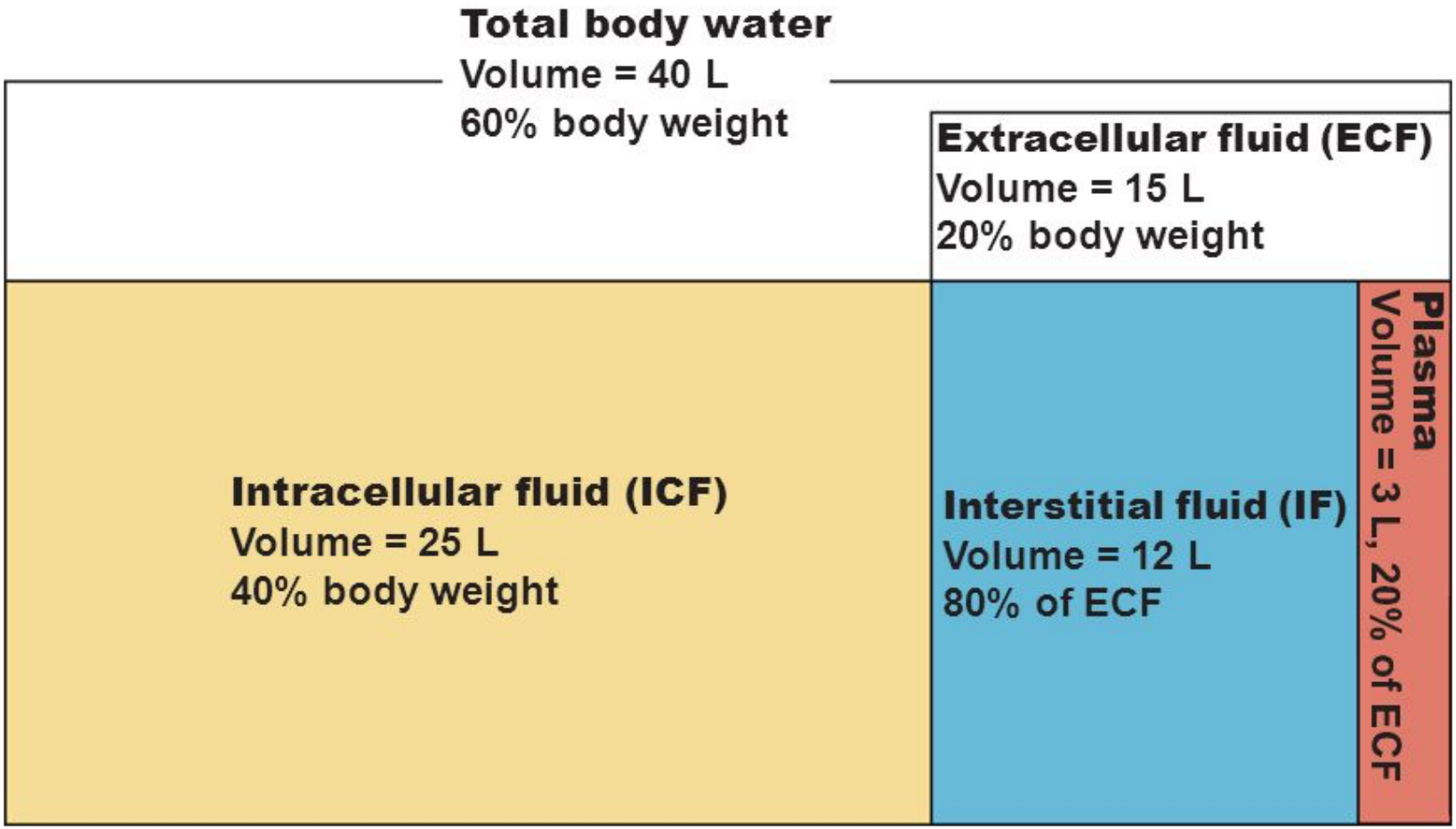

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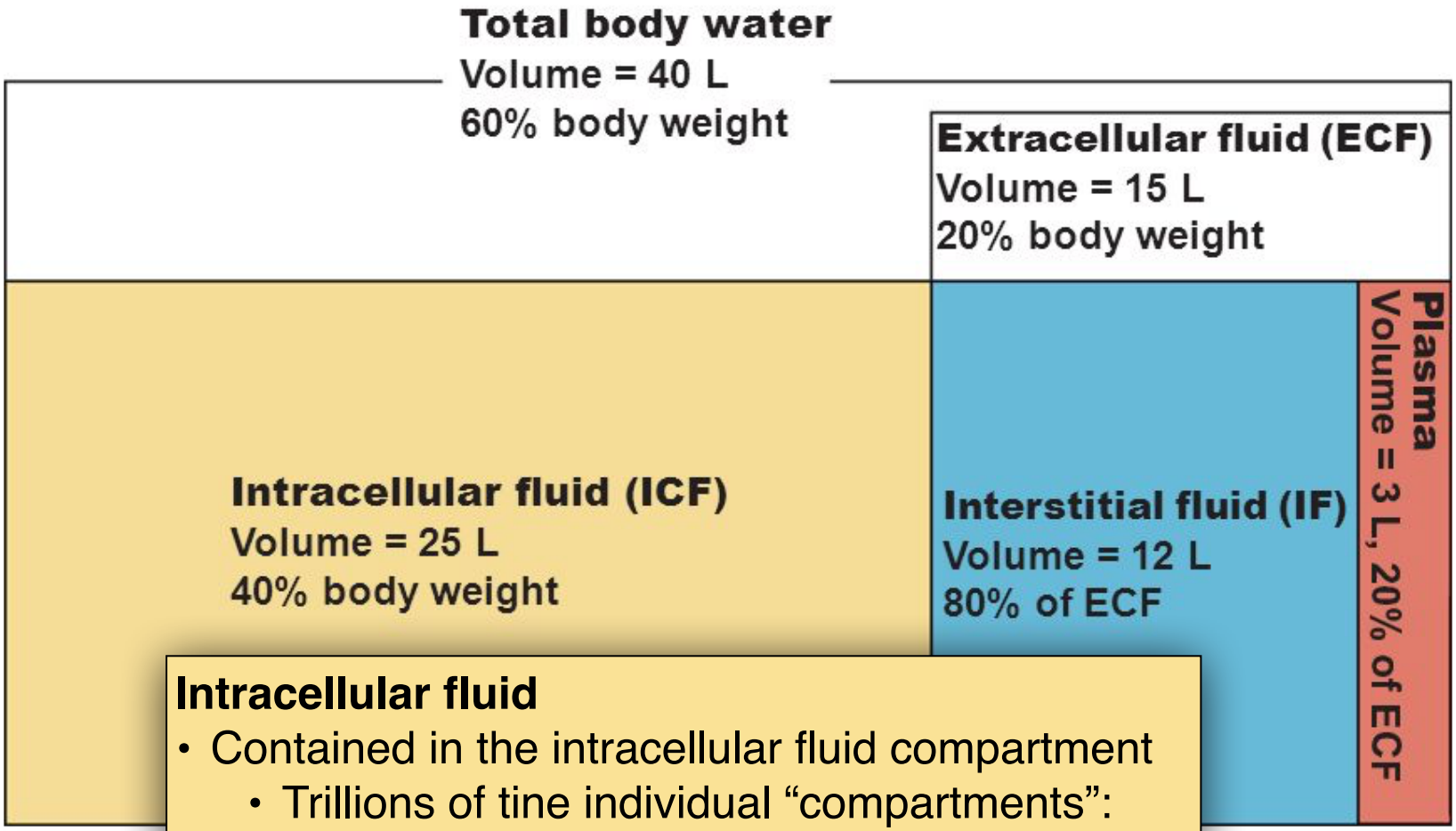

Intracellular fluid

- Contained in the intracellular fluid compartment
  - Trillions of tine individual "compartments": cells
- About 25 L of the 40 L of body water
- Amounts for ~ 2/3 by volume of water that is taken in

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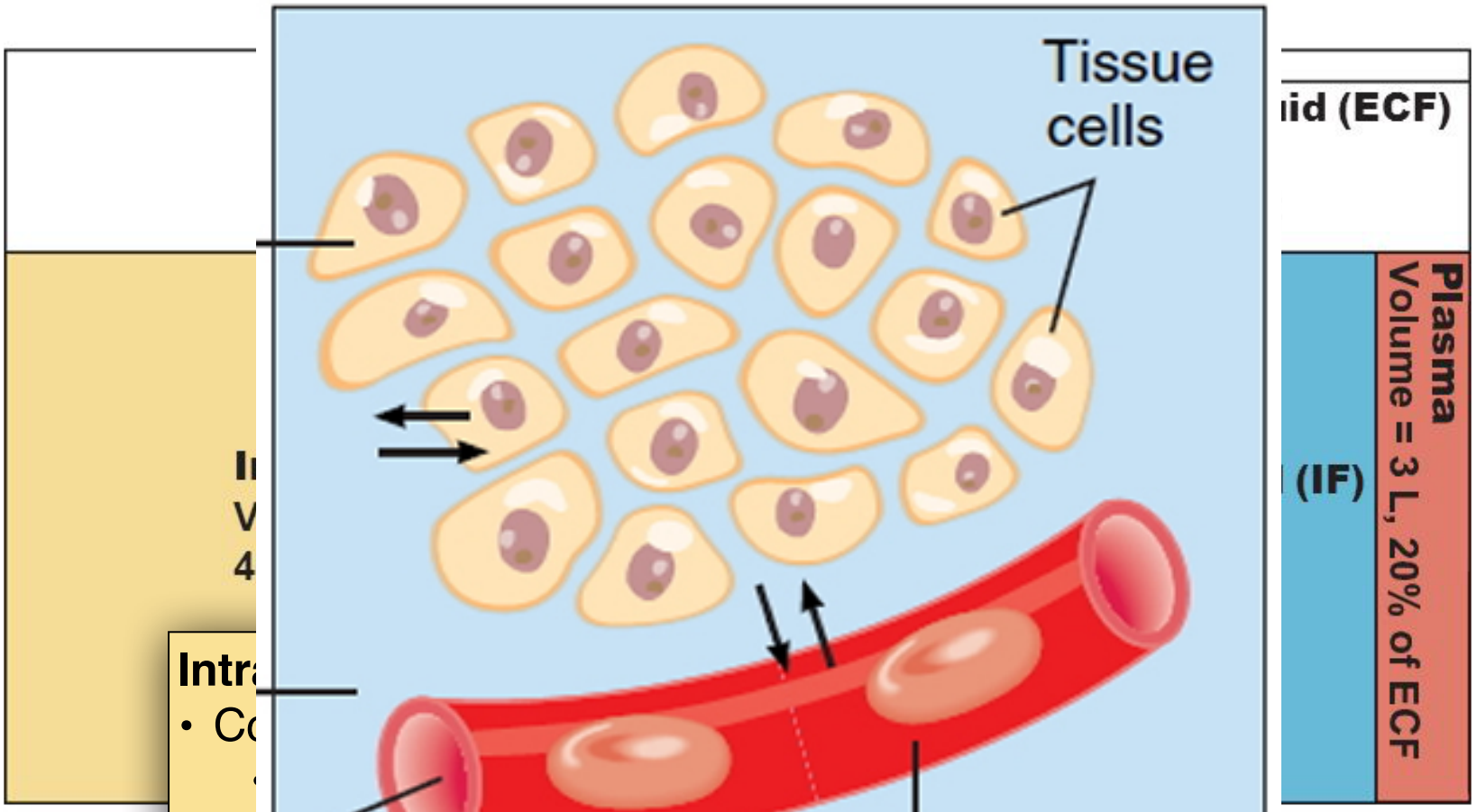

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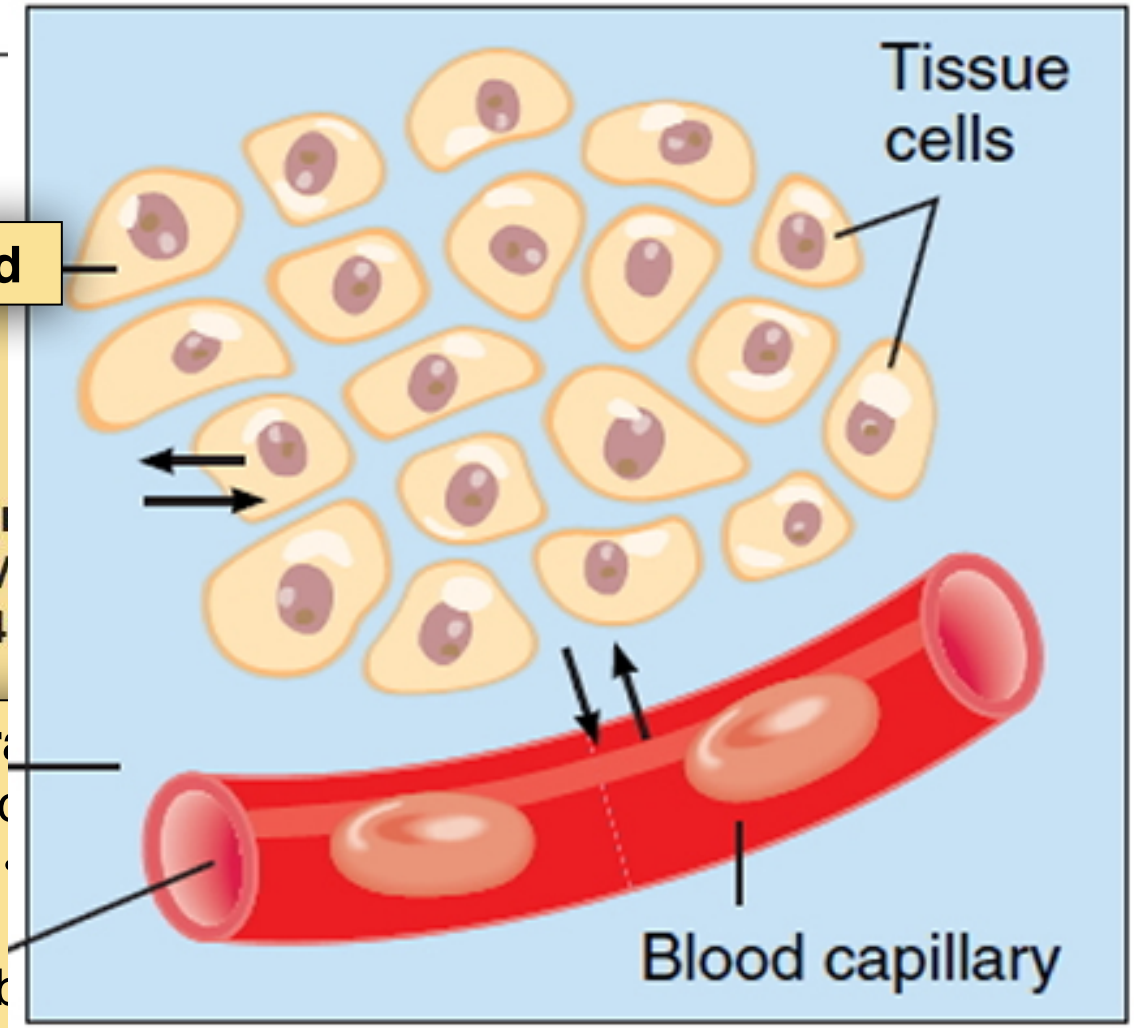


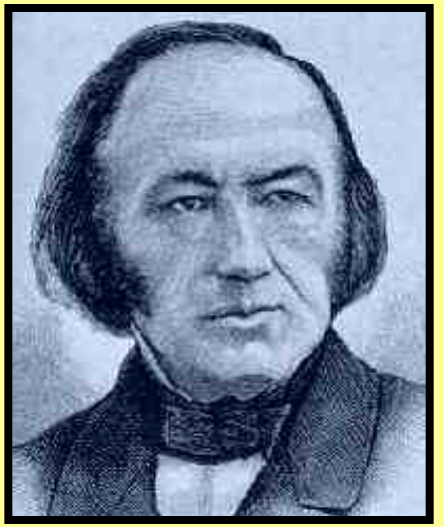
Intracellular fluid

- Amounts for ~ 2/3 by volume of water that is taken in

Figure 26.1

Importance of Extracellular Fluid

"The living body, though it has need of the surrounding environment, is nevertheless relatively independent of it. This independence which the organism has of its external environment, derives from the fact that in the living being, the tissues are in fact withdrawn from direct external influences and are protected by a veritable internal environment which is constituted, in particular, by the fluids circulating in the body."



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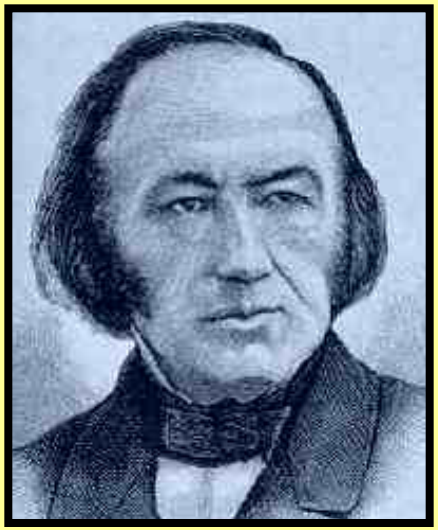

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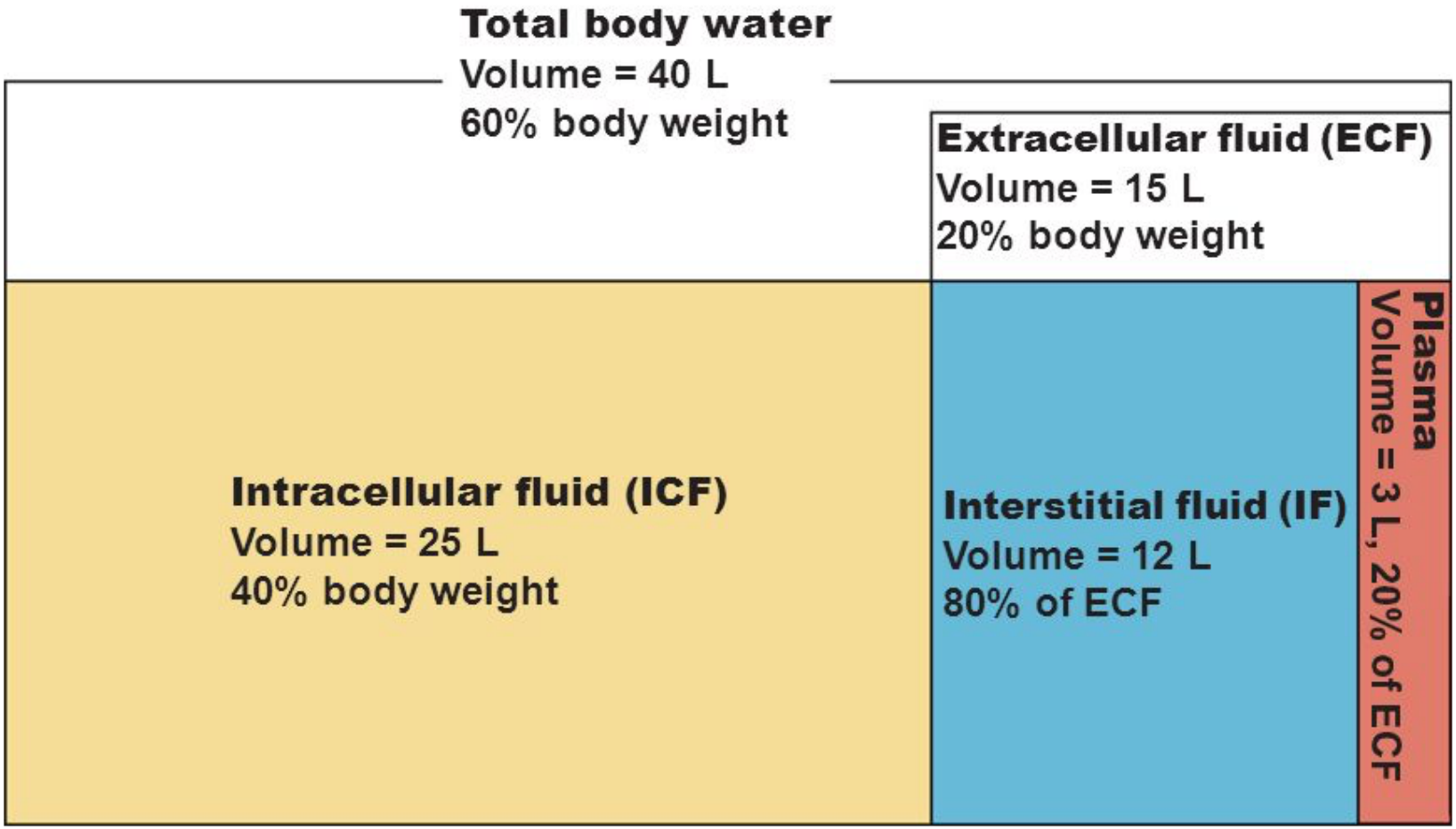

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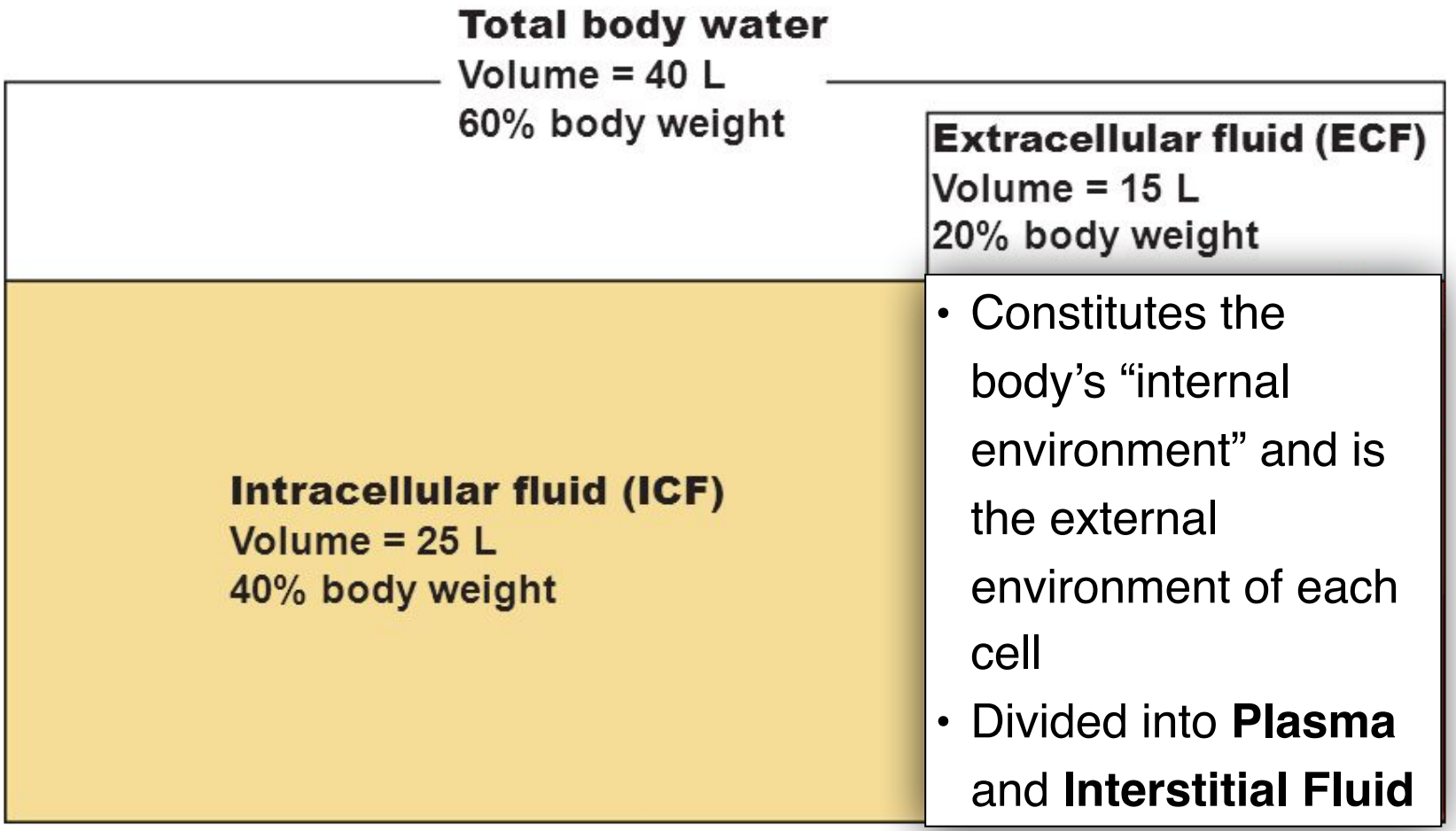

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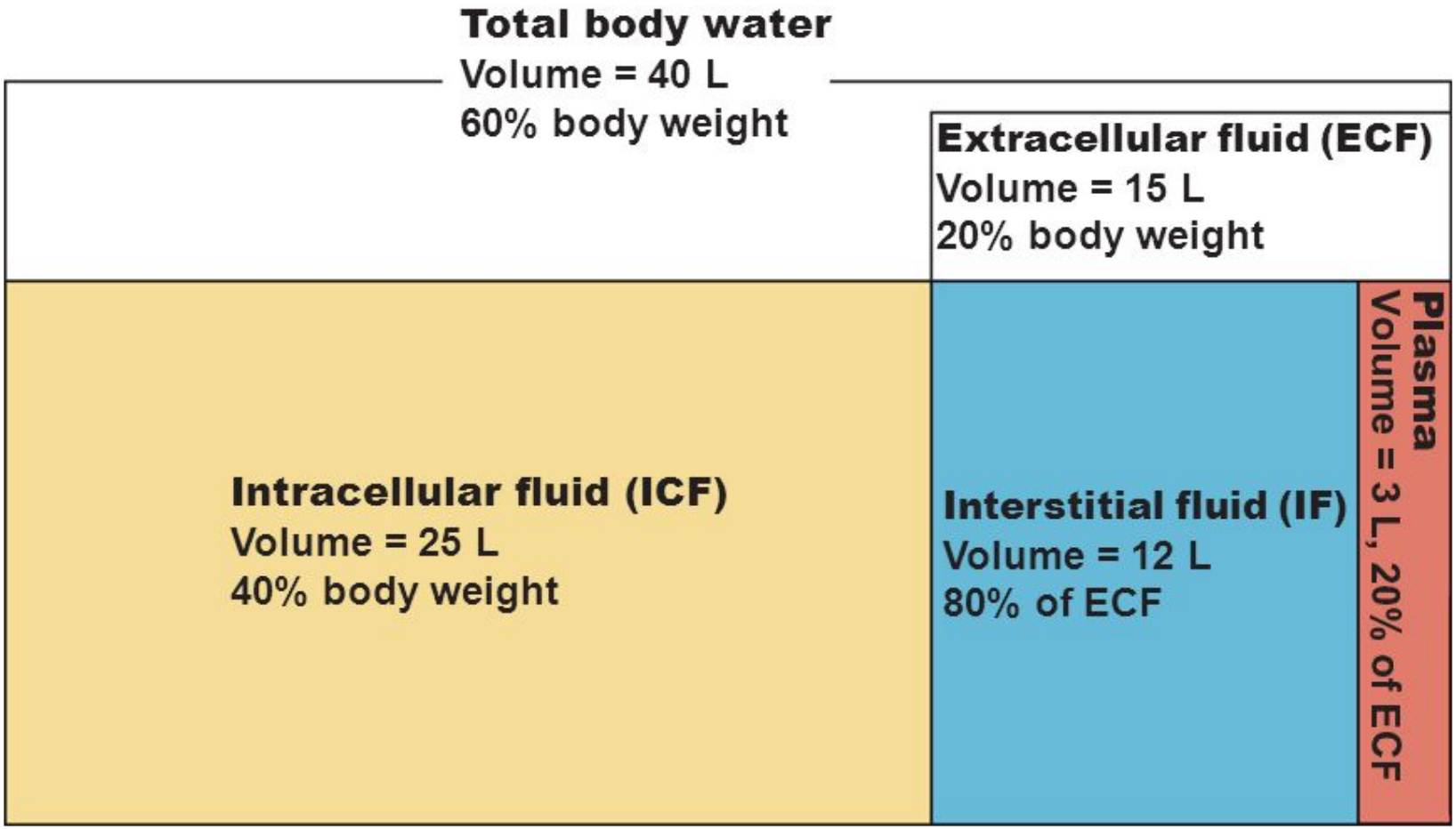

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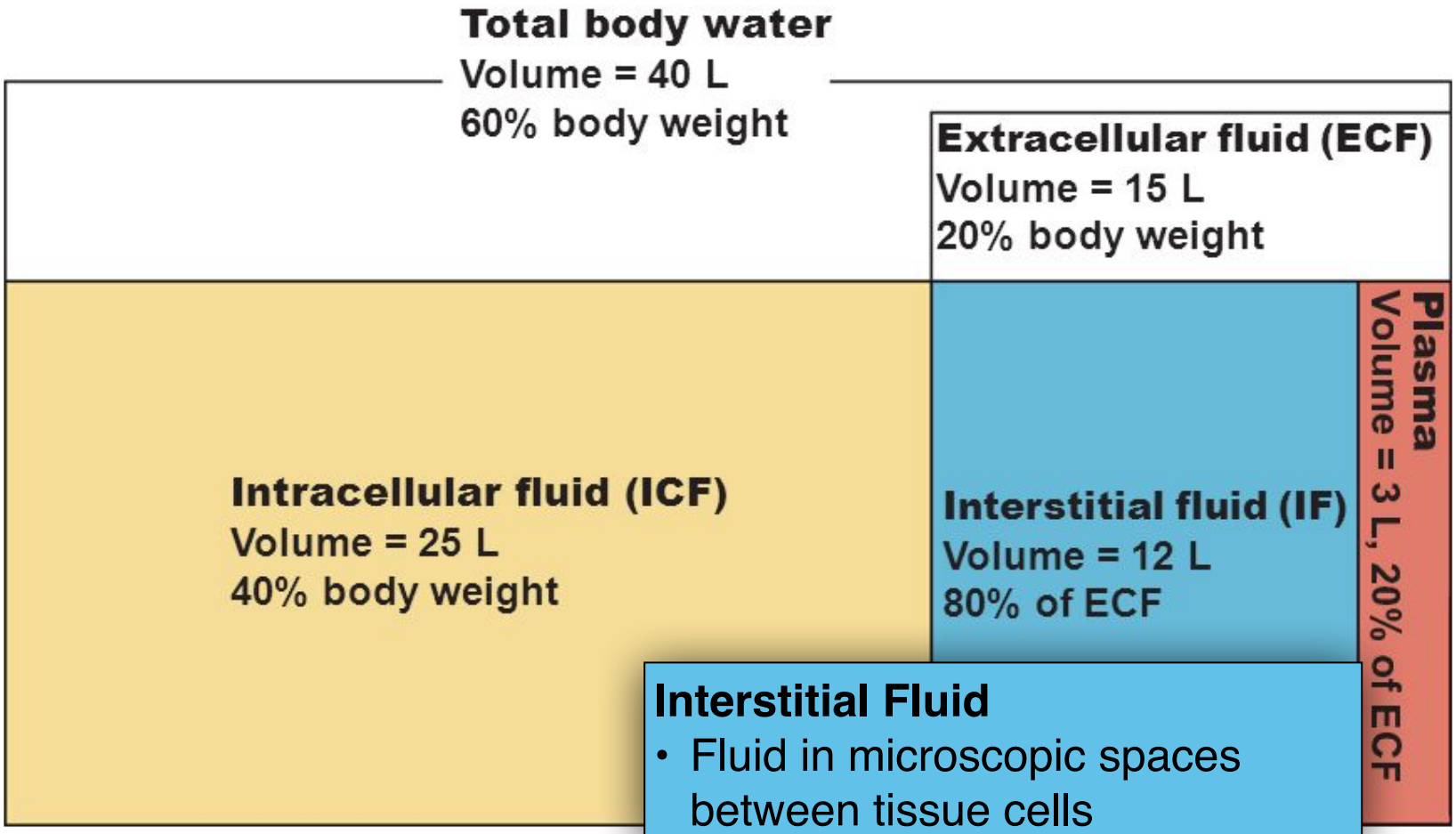

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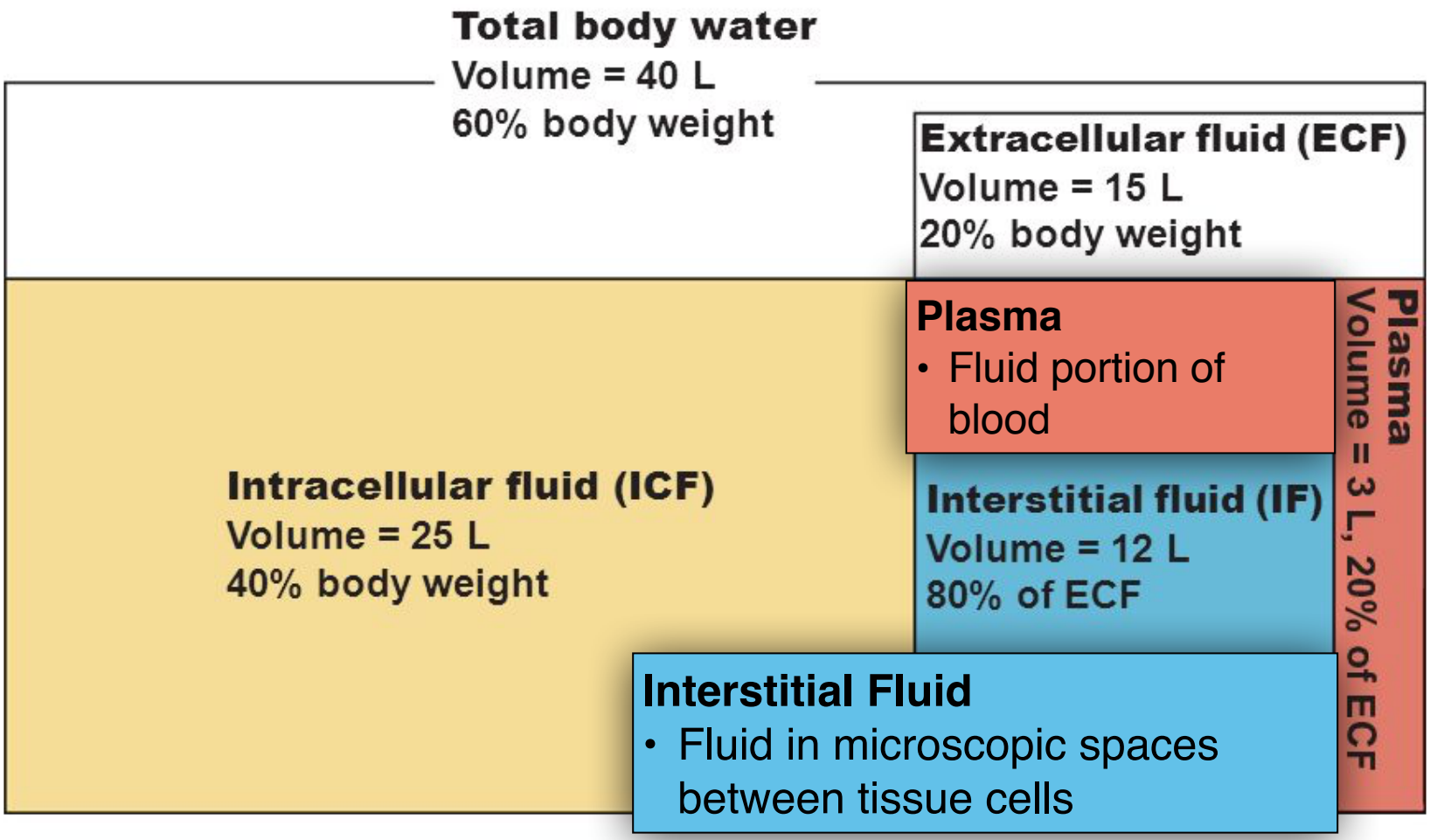

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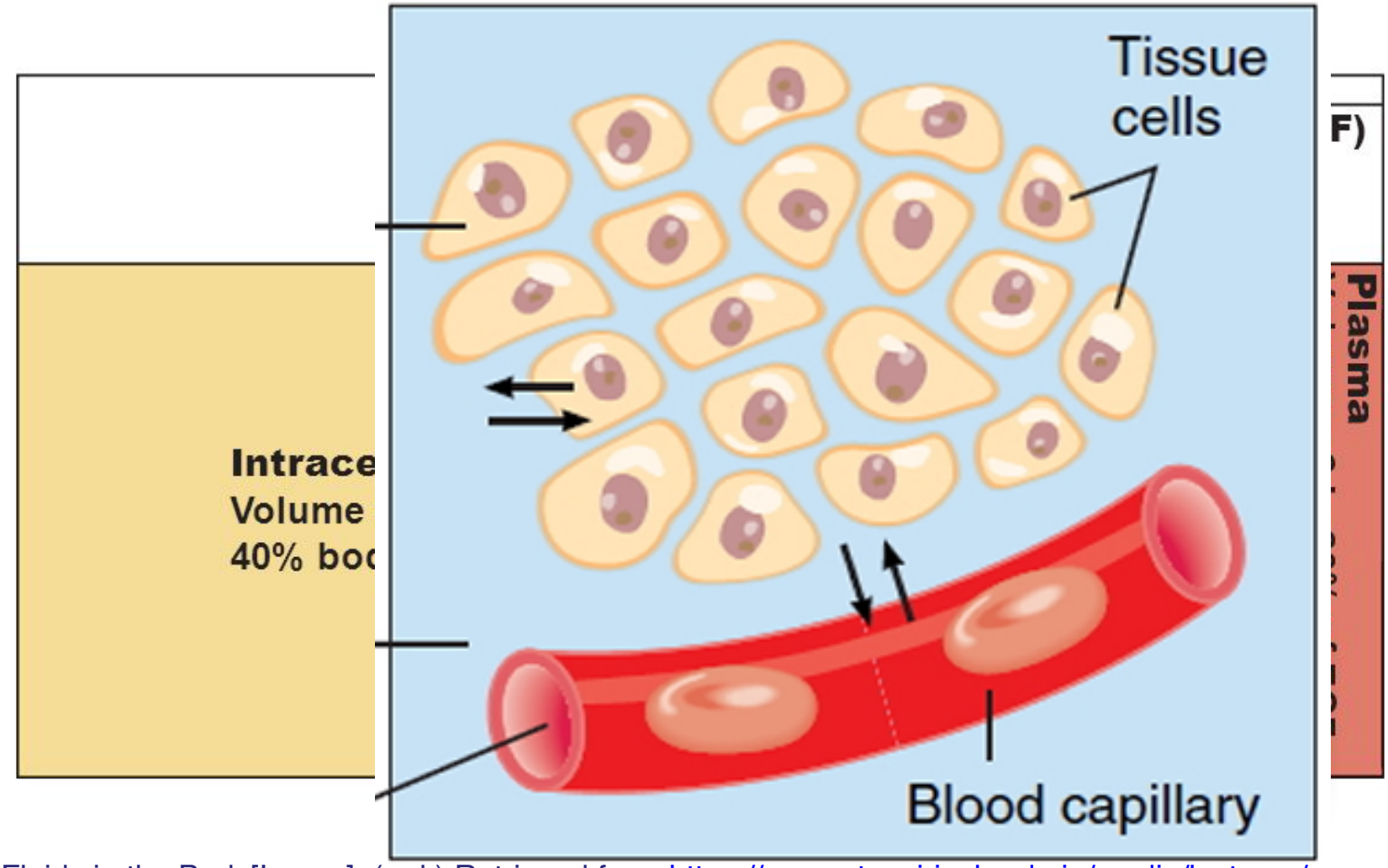

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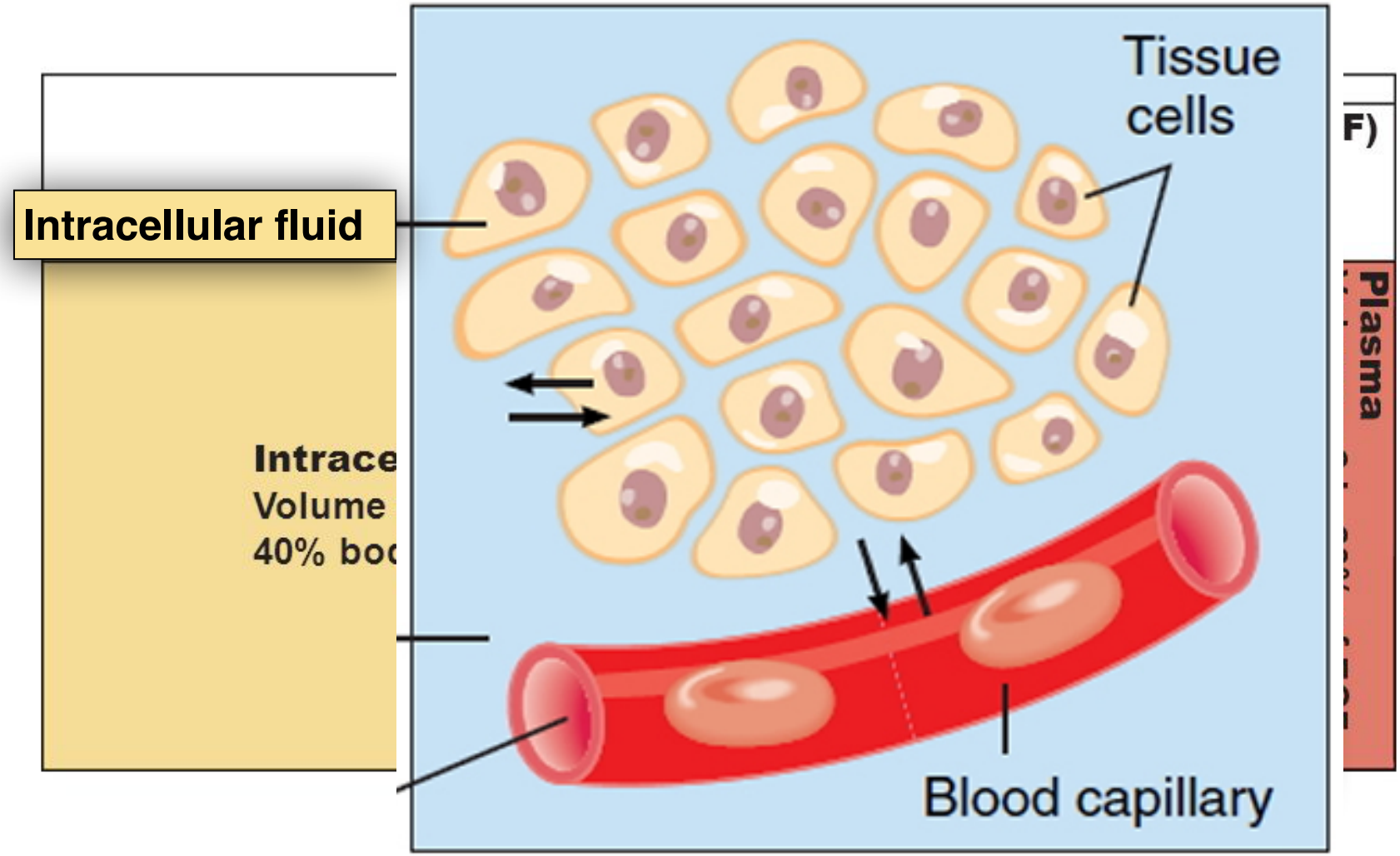

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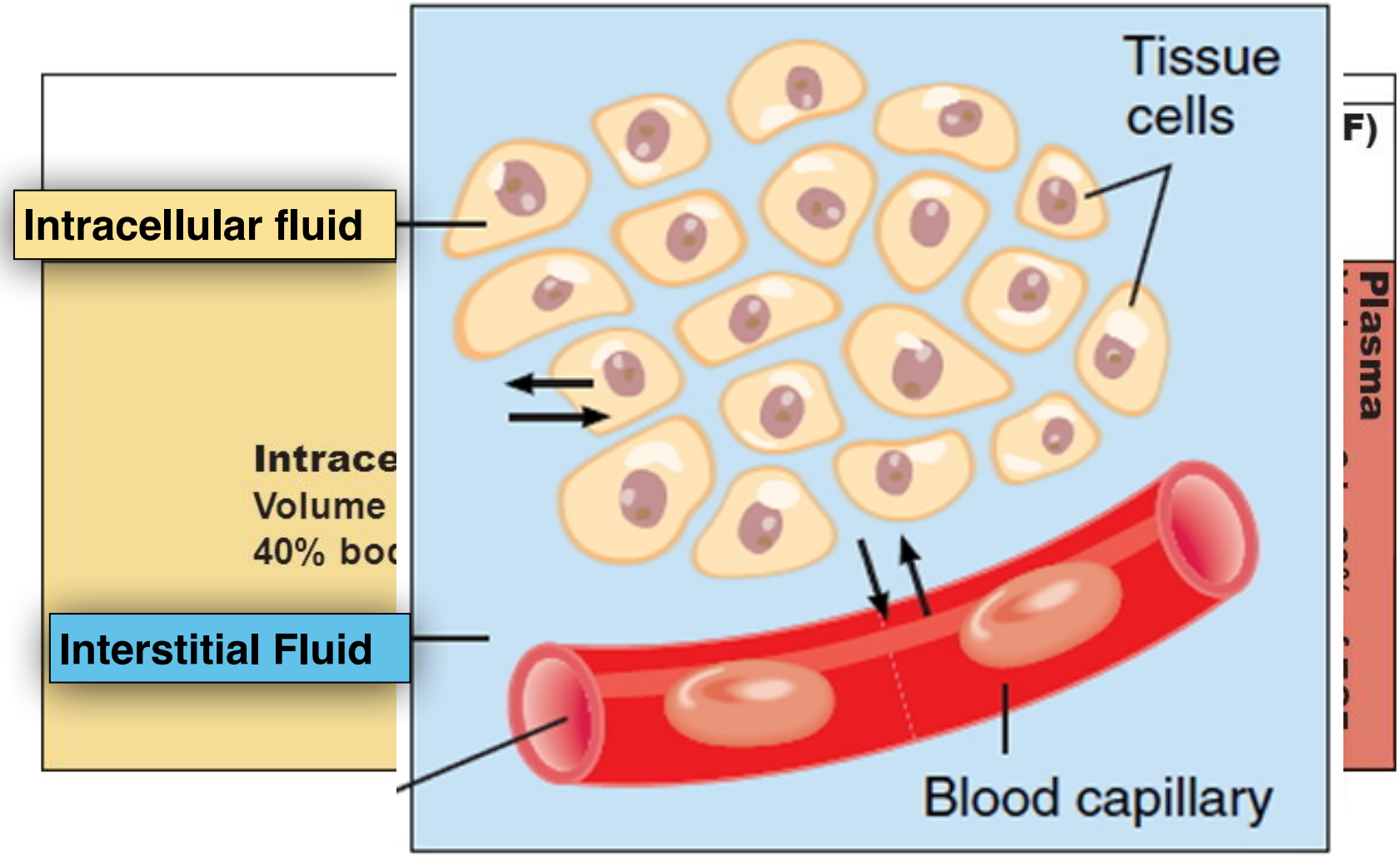

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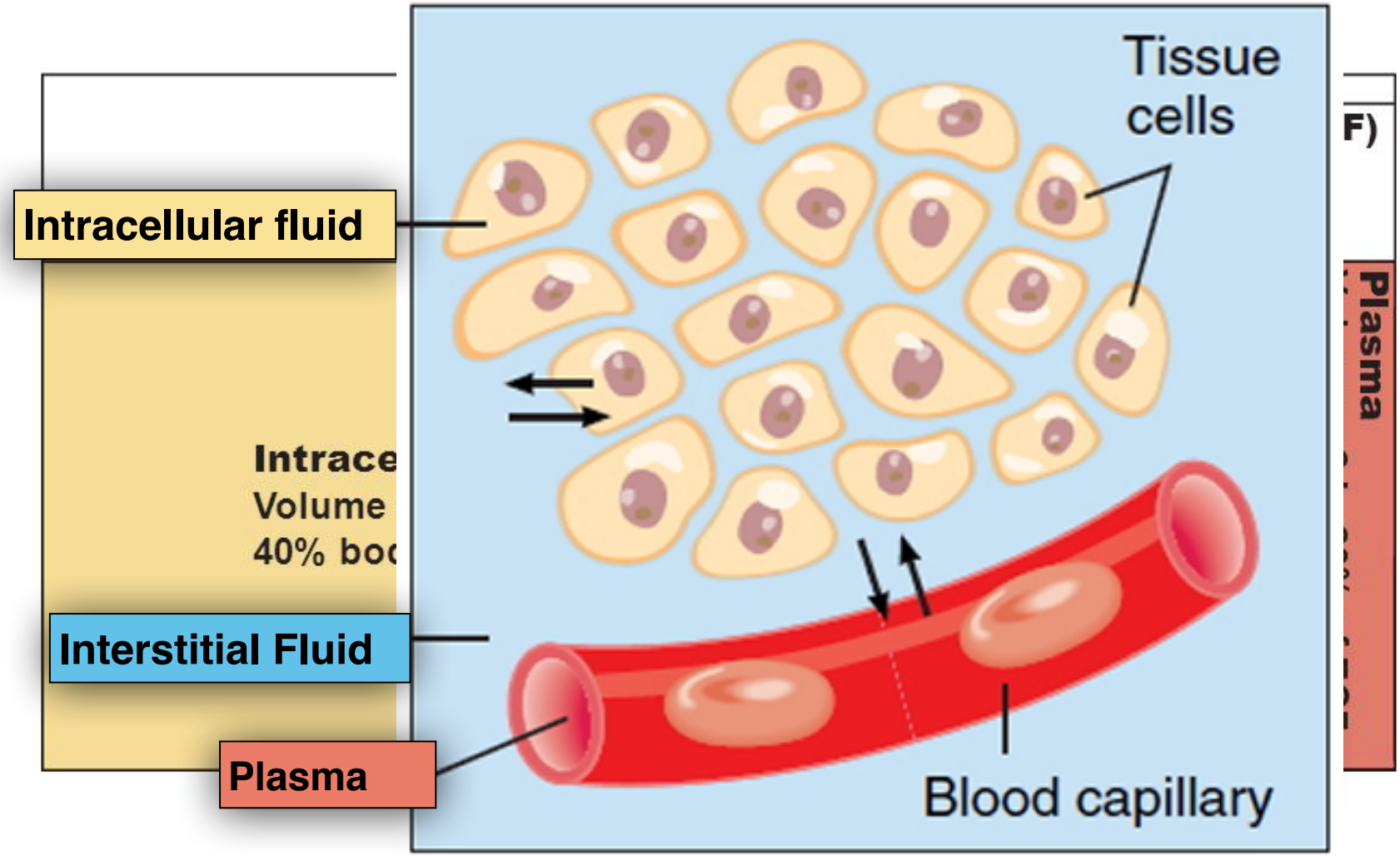

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Intake of Fluids

- Varies per person, habits have a strong influence
- Most water that is ingested in the body comes from liquids and solid foods
- A small percentage is produced from cellular metabolism, also called metabolic water

(Hoehn & Marieb, 2017).

Intake of Fluids

- Varies per person, habits have a strong influence

Glucose + Oxygen → Carbon Dioxide + Water + ATP

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + ATP$

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Cellular Respiration Equation [Image]. (2018). Retrieved from https://study.com/academy/lesson/what-is-the-chemical-equation-for-cellular-respiration.html

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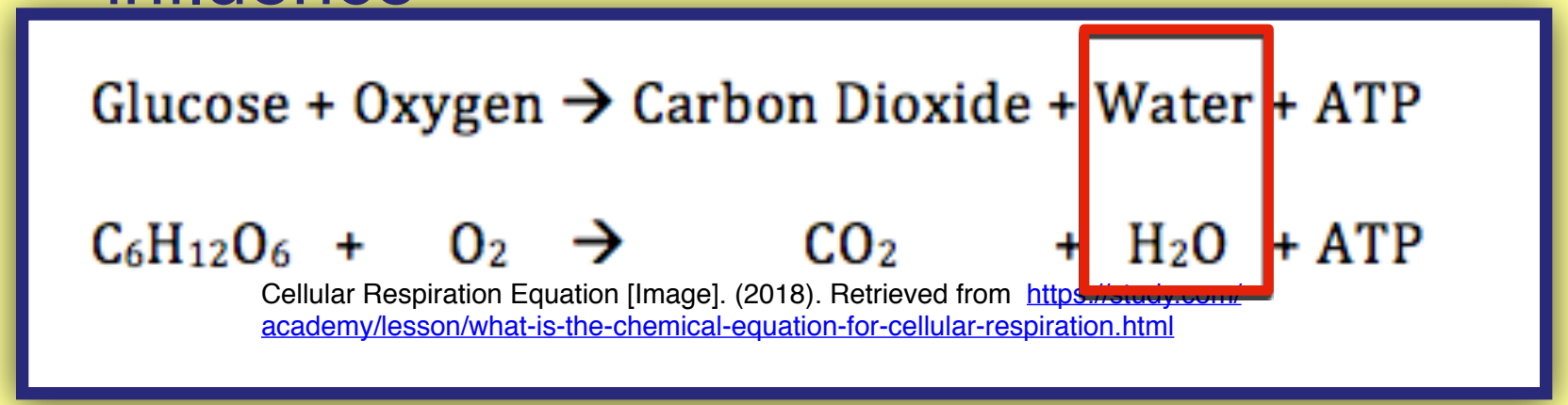

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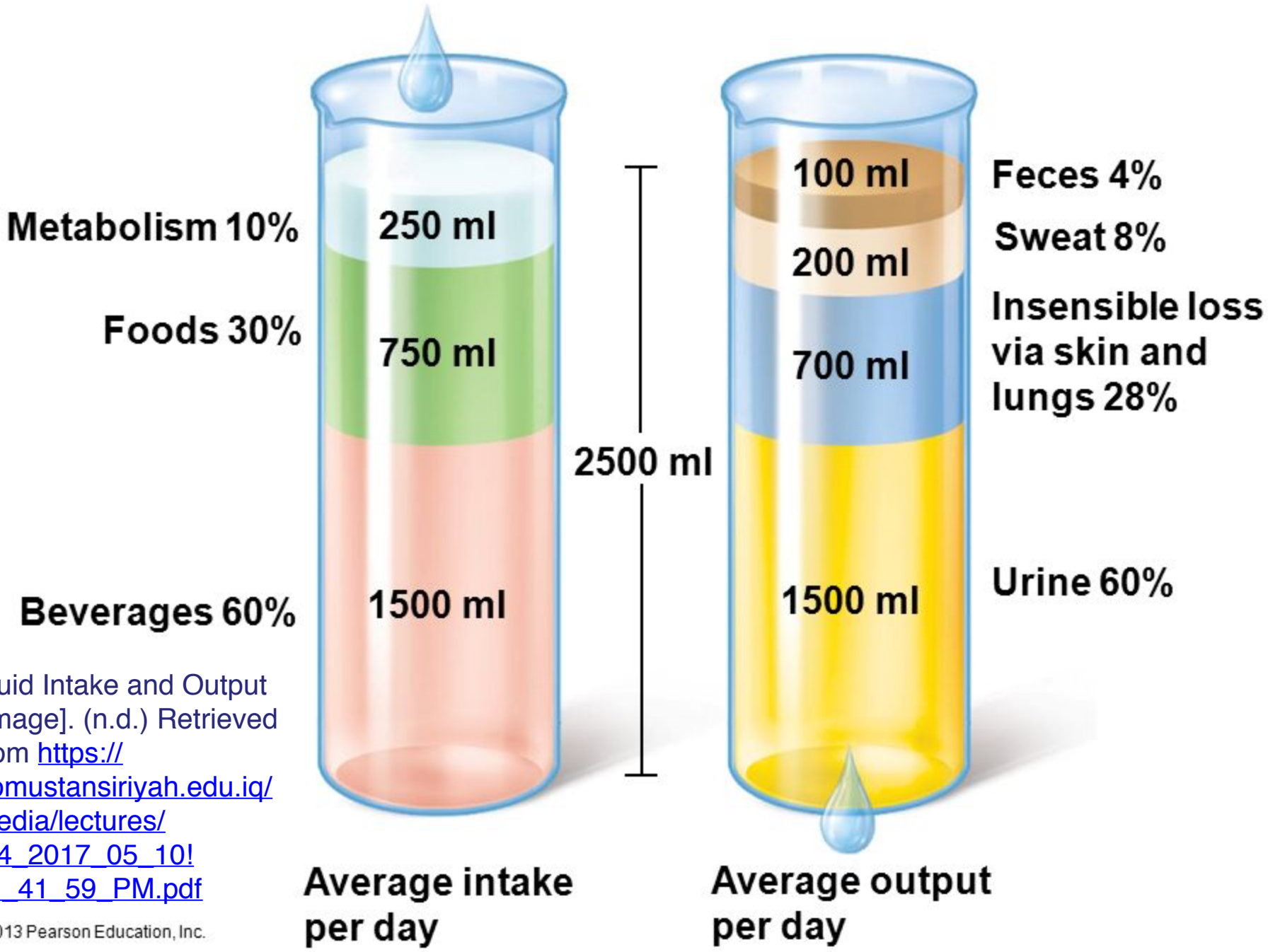
Output of Fluids

- **Obligatory Water Loss** - unavoidable water loss
  - **Insensible Water Loss:** unnoticed
    - Skin and Lungs
  - **Sensible Water Loss:** observable
    - Urine and Fecal Matter
    - Sweat
- Rest depends on fluid intake, diet, and other activities like exercising

(Hoehn & Marieb, 2017).

Figure 26.4 Major sources of water intake and output.



Fluid Intake and Output [Image]. (n.d.) Retrieved from https://uomustansiriyah.edu.iq/media/lectures/4/4_2017_05_10!11_41_59_PM.pdf

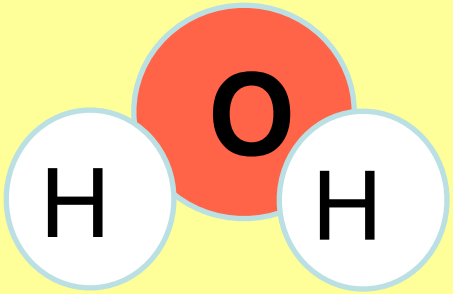
Water

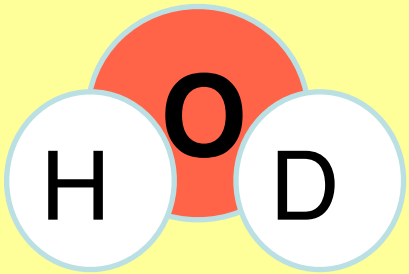
- Water is an essential and often overlooked nutrient
- Its absence from the human body is lethal within days
- Water is one of the six nutrients essential for life (water, fat, carbohydrates, protein, vitamins, and minerals).
- Chemical Formula: H2O
- All water is not equal

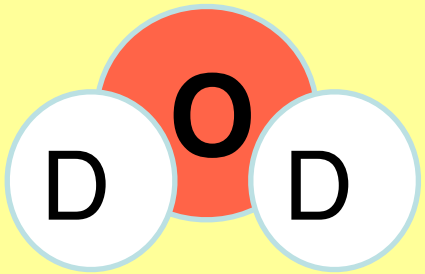
(Kleiner, 1999)

All Water is Not Equal

- There are isotopes of Hydrogen
  - Protitium (1 p+, 0 n), Deutrium (1 p+, 1 n), Tritium (1 p+, 2 n)
  - H2O vs D2O (Heavy Water)
- Kinetic Isotope Effect
- The human body is perfectly formed for H2O







(Waltham, 2011; Knowles, R., 2005; Donnelly, S., personal communication, Sept. 2018)

Role of Water in the Body

- **Structural**
- Fill space and help form the structures of macromolecules such as proteins and glycogens
- **Kidney Function**
- Solvent for minerals, vitamin, amino acids, glucose, and many other nutrients
- Medium for safe elimination of toxins and waste products and reabsorption of nutrients

(Kleiner, 1999; Texas Health and Human Services, n.d.)

Role of Water in the Body

- **Gastrointestinal Function**
- Digestion, absorption, and use of nutrients
- Water helps convert food into energy
- **Circulatory**
- Thermoregulation - regulates body temperature
- Water is the main property of blood, which carries nutrients to cells and carries wastes out of the body.

(Kleiner, 1999; Texas Health and Human Services, n.d.)

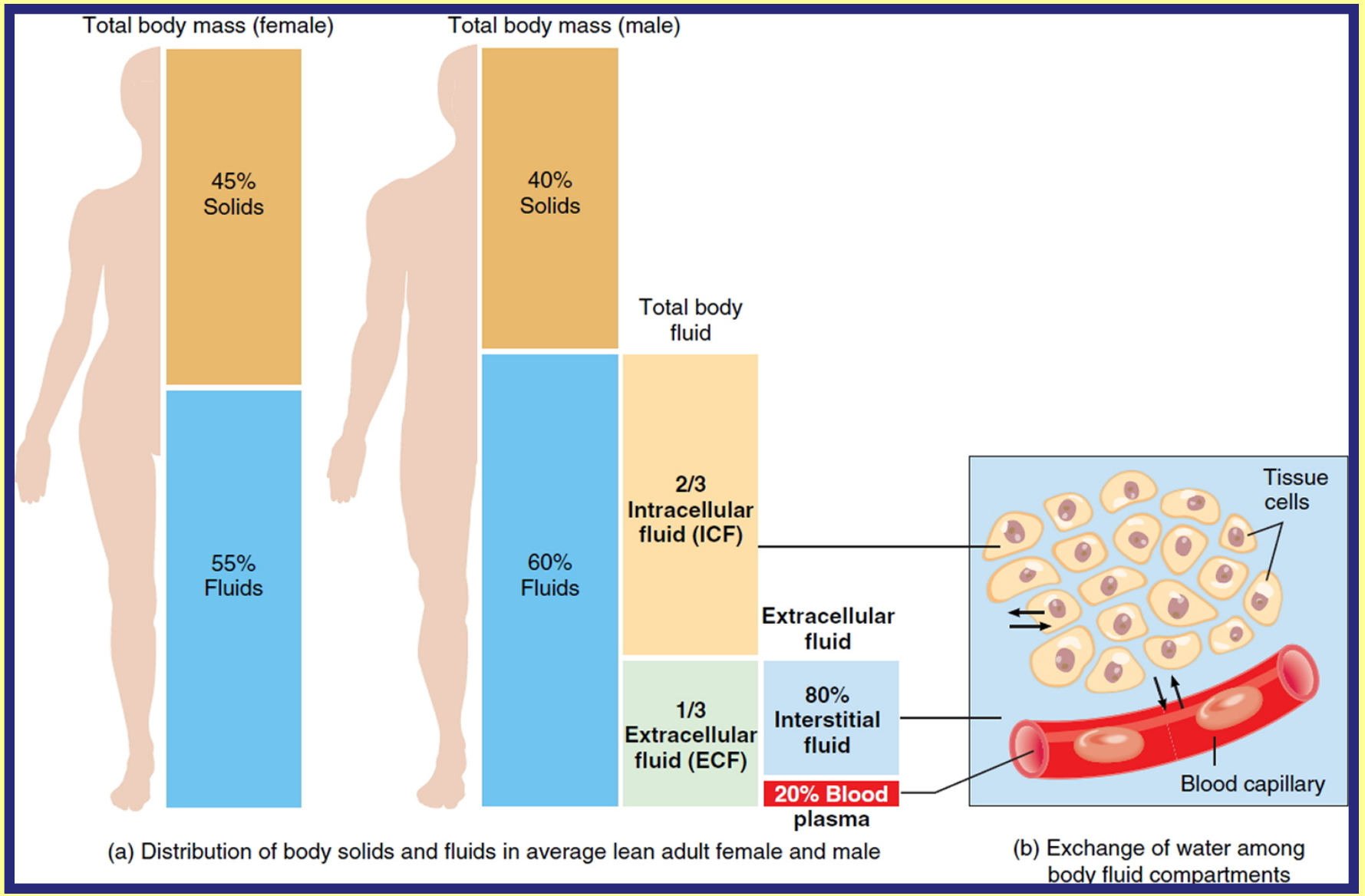
Role of Water in the Body

- **Musculoskeletal**
- Water protects and cushions vital organs.
- Water lubricates joints.
- **Respiratory**
- Water moistens oxygen for breathing. Water is essential for our senses to work properly.
- **Nervous System**
- Hearing waves are transmitted through fluids in the ear, light is reflected through fluids in the eye, and food and odors must be dissolved in water for taste and smell.

(Kleiner, 1999; Texas Health and Human Services, n.d.)

Water fills space

Water fills space



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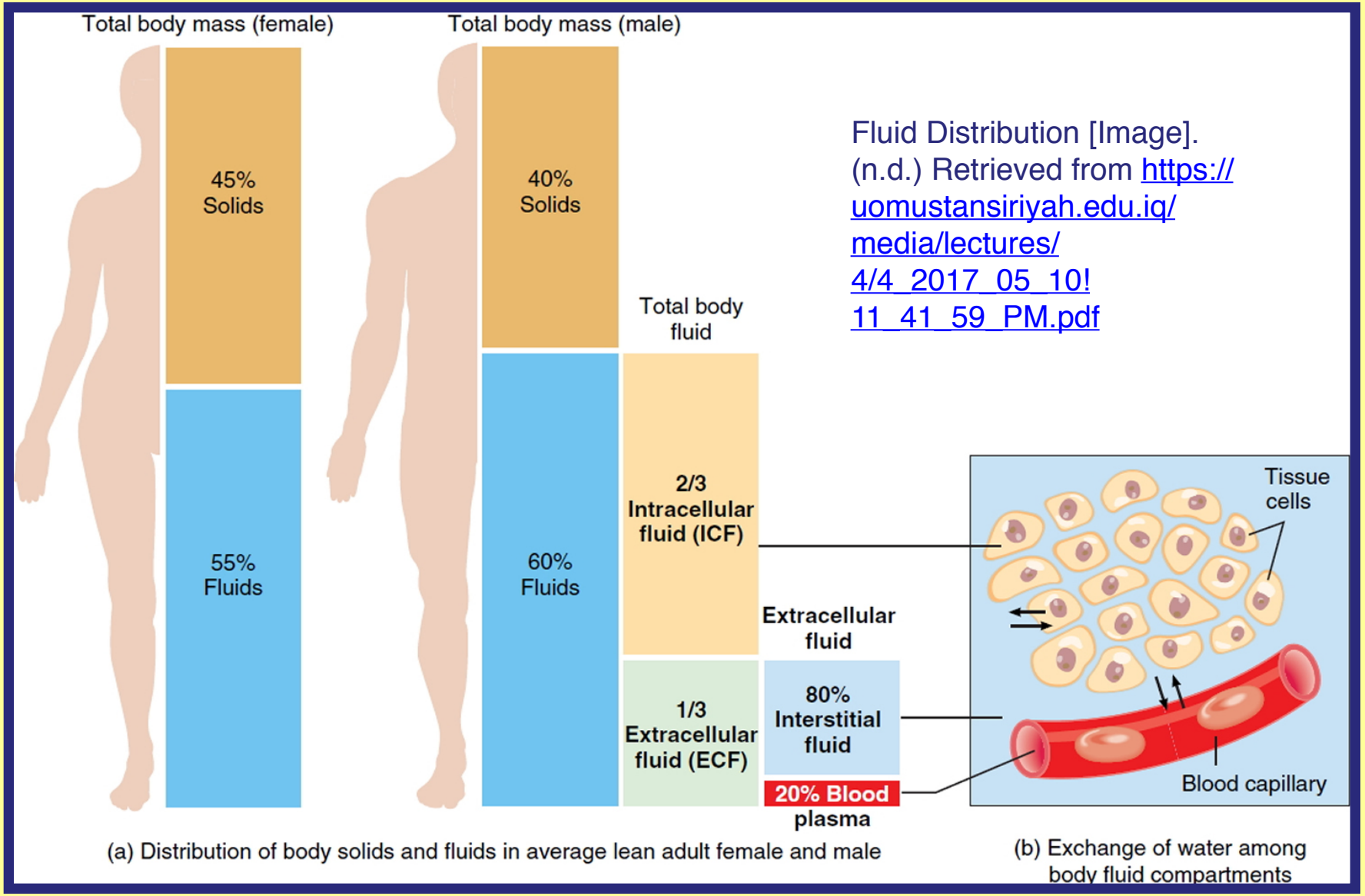

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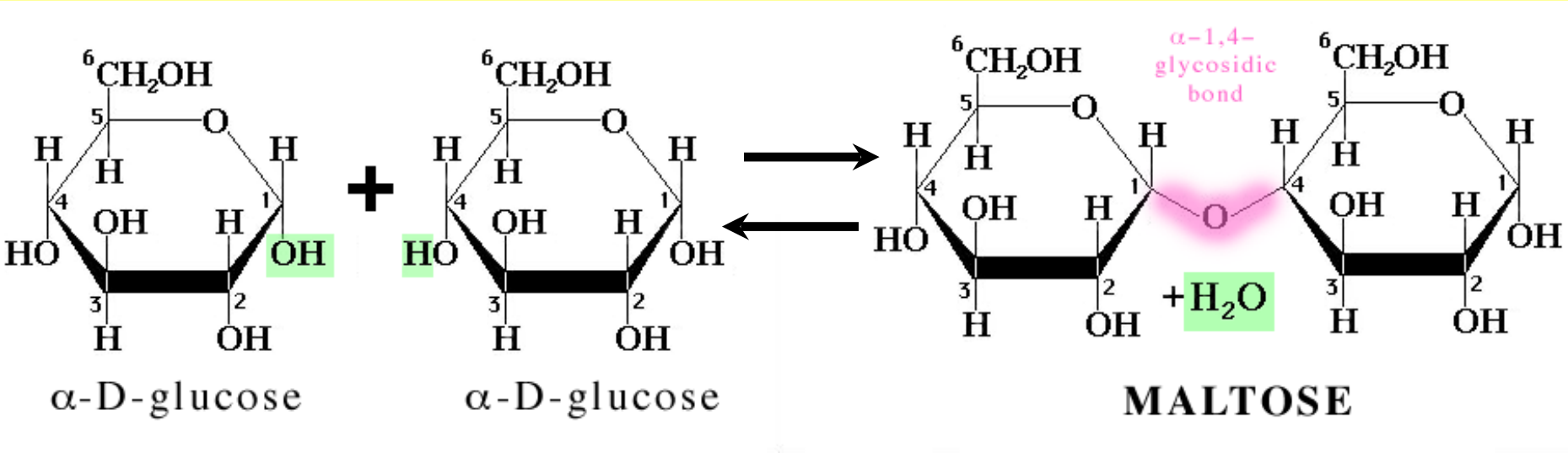
Water helps form the structures of macromolecules such as proteins and glycogens

- **Dehydration Synthesis and Hydrolysis**



Dehydration Synthesis of Glucose [Image]. (2012.) Retrieved from https://socratic.org/questions/what-are-dehydration-synthesis-reactions

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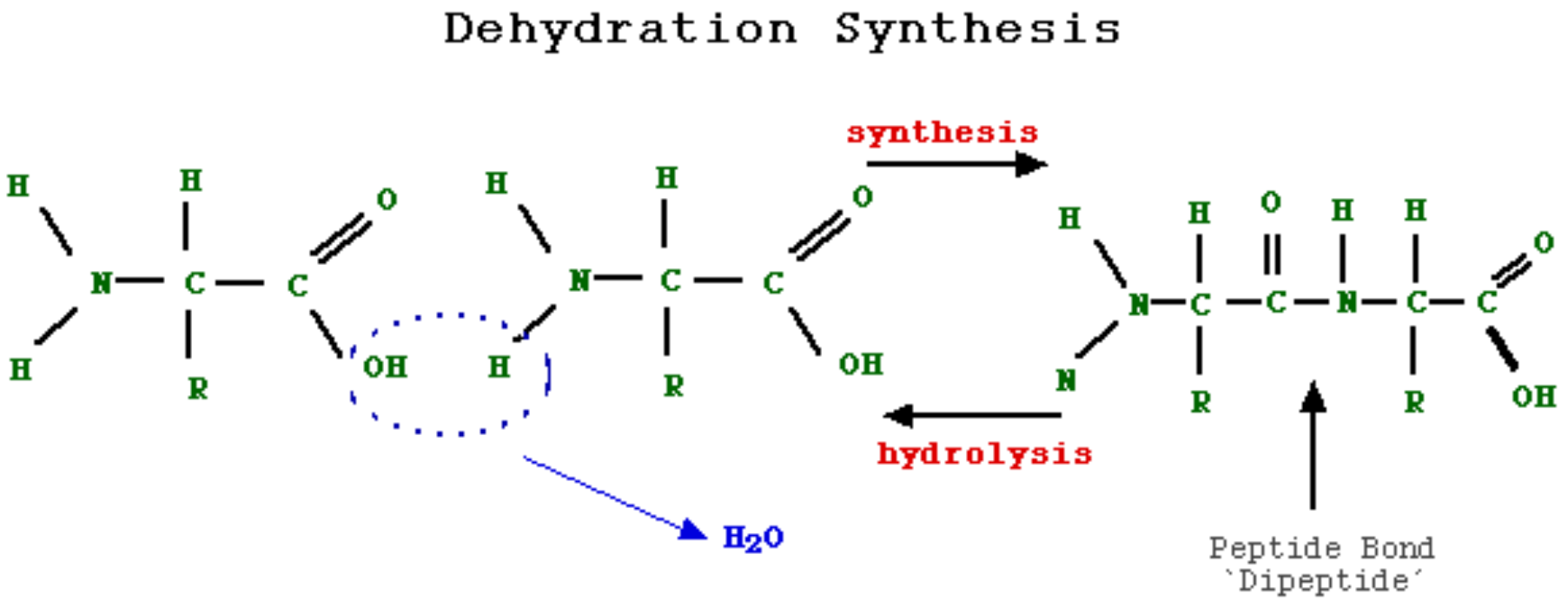
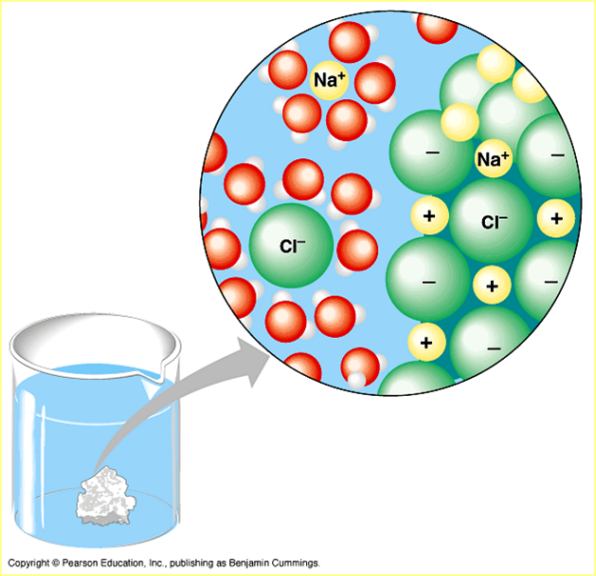


Dehydration Synthesis of Protein [Image]. (2012.) Retrieved from https://quintenrene.wordpress.com/2012/10/26/present-workout-wears-supplements-fuel-protein-dehydration-synthesis/

Water is a Solvent

Water is the Universal Solvent

- Solvent for minerals, vitamin, amino acids, glucose, and many other nutrients
- (Texas Health and Human Services, n.d.)



Salt dissolved in Water [Image]. (n.d.) Retrieved from http://vsbasicchem.weebly.com/solvent.html

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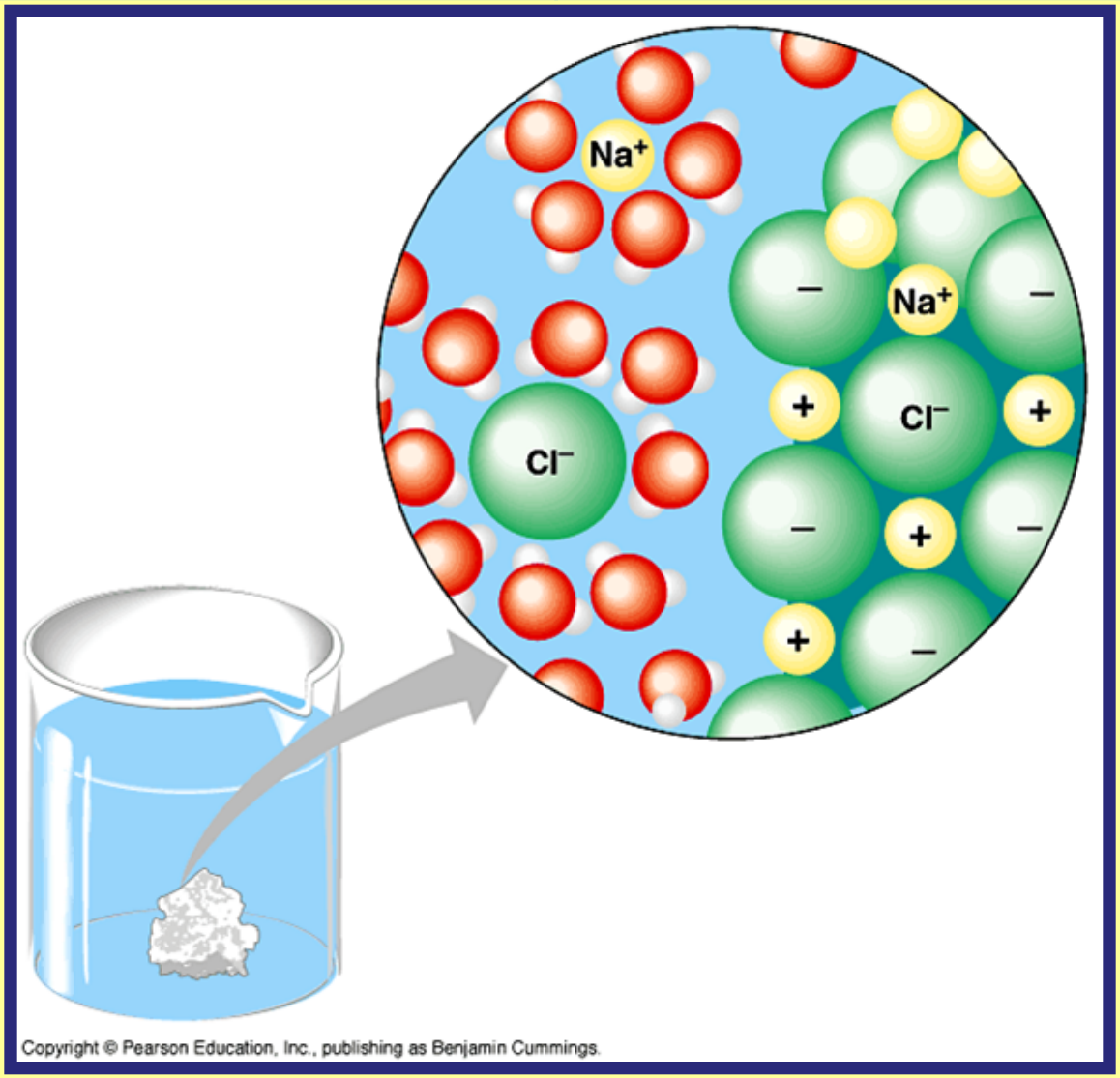

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Water is a Medium for Safe Elimination and Reabsorption of Nutrients

Kidney: Urine Formation

- Filtrate
  - Blood plasma minus large proteins
- Reclaim Water, Nutrients, and Ions in Nephron
- Kidney processes 47 gallons/day
  - < 1% if total filtrate is urine
    - metabolic waste and unneeded substances

(Hoehn & Marieb, 2017; Chang, J., 2017)

Water is a Medium for Safe Elimination and Reabsorption of Nutrients

Kidney: Urine Formation

- 3 Steps to Urine Formation
  - Glomerular Filtration
  - Tubular Reabsorption
  - Tubular Secretion

(Hoehn & Marieb, 2017; Chang, J., 2017)

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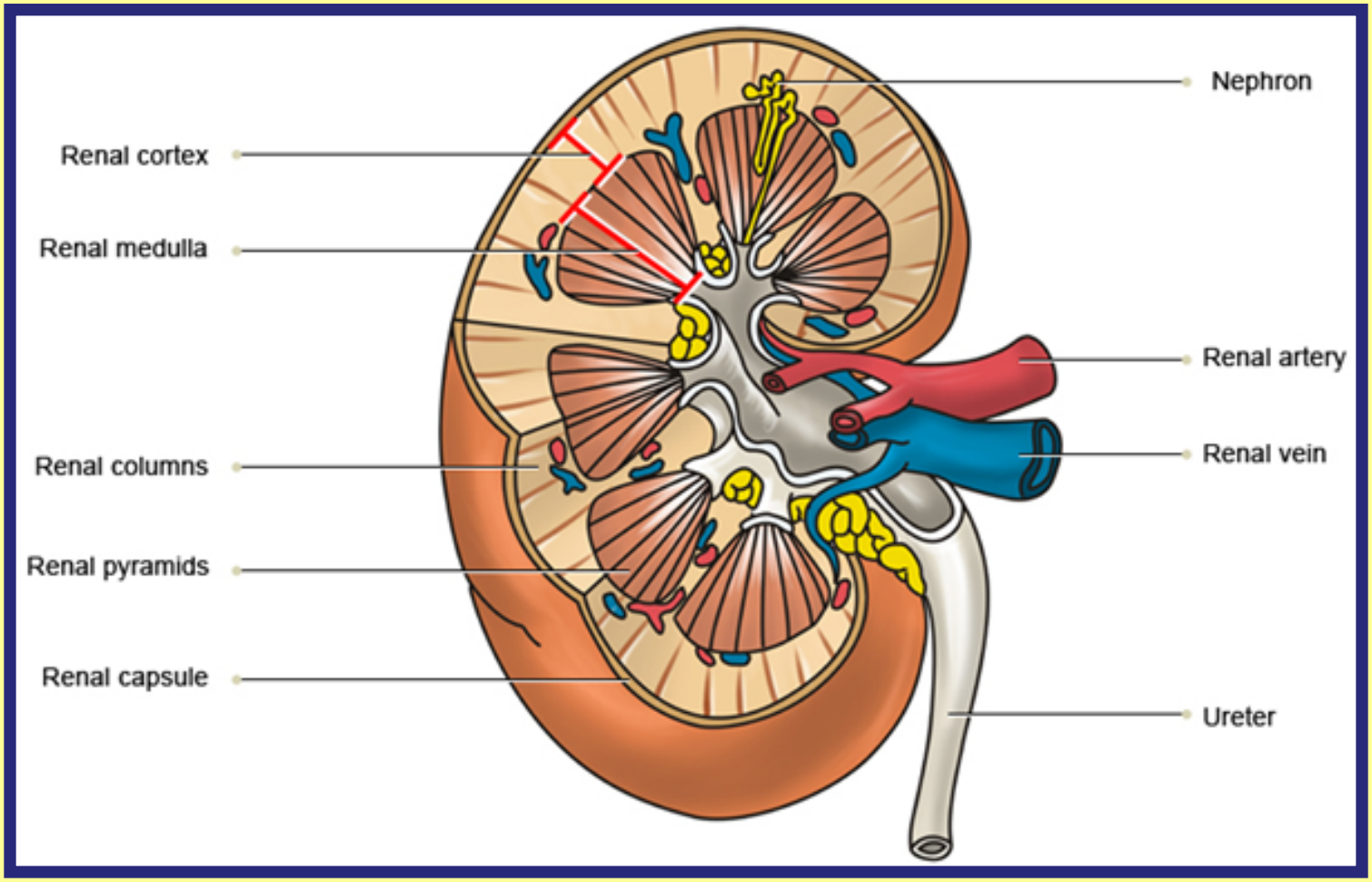
Kidney



Kidney [Image]. (2016). Retrieved from http://www.biyanicolleges.org/kidney-structure/

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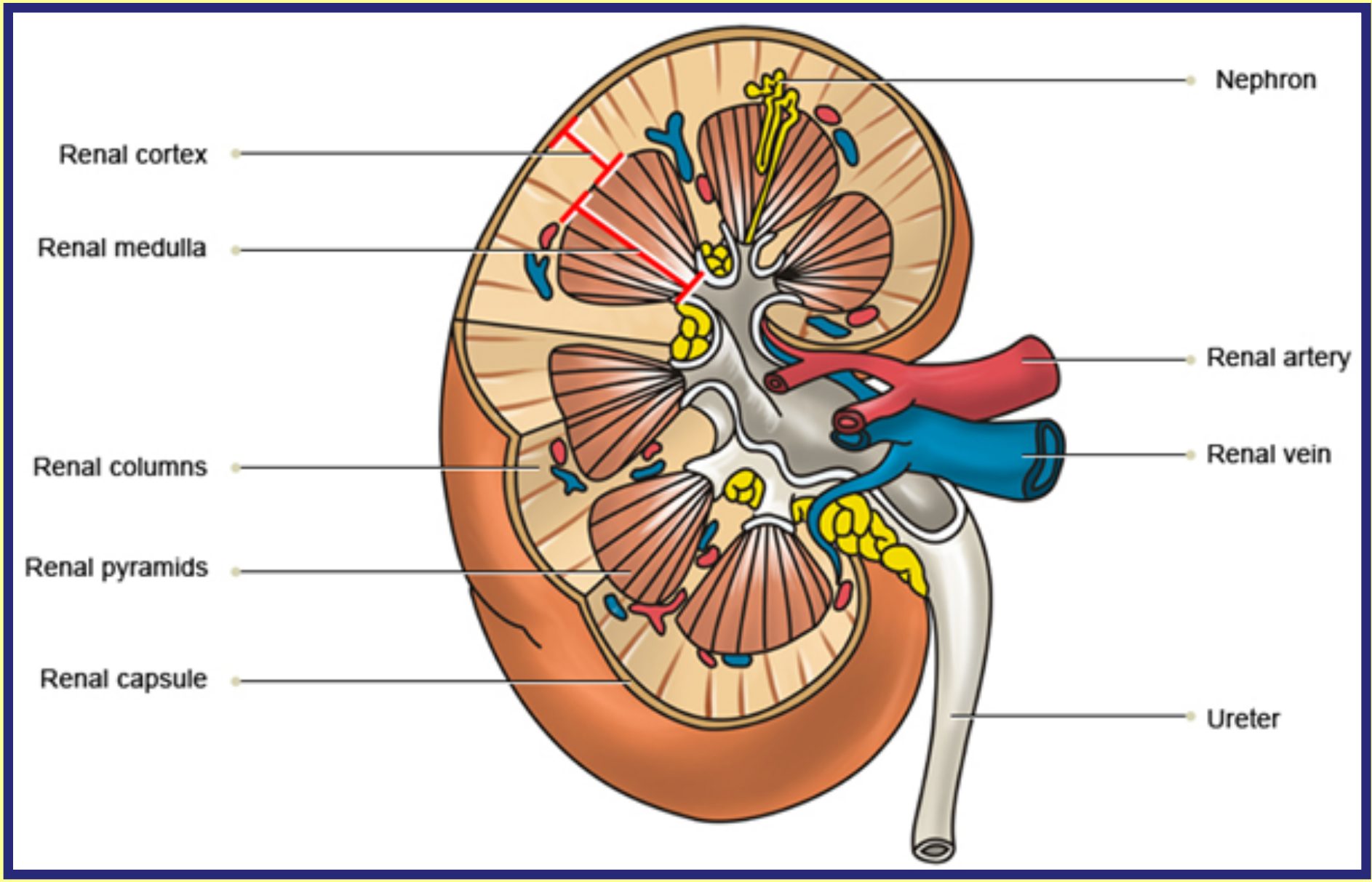
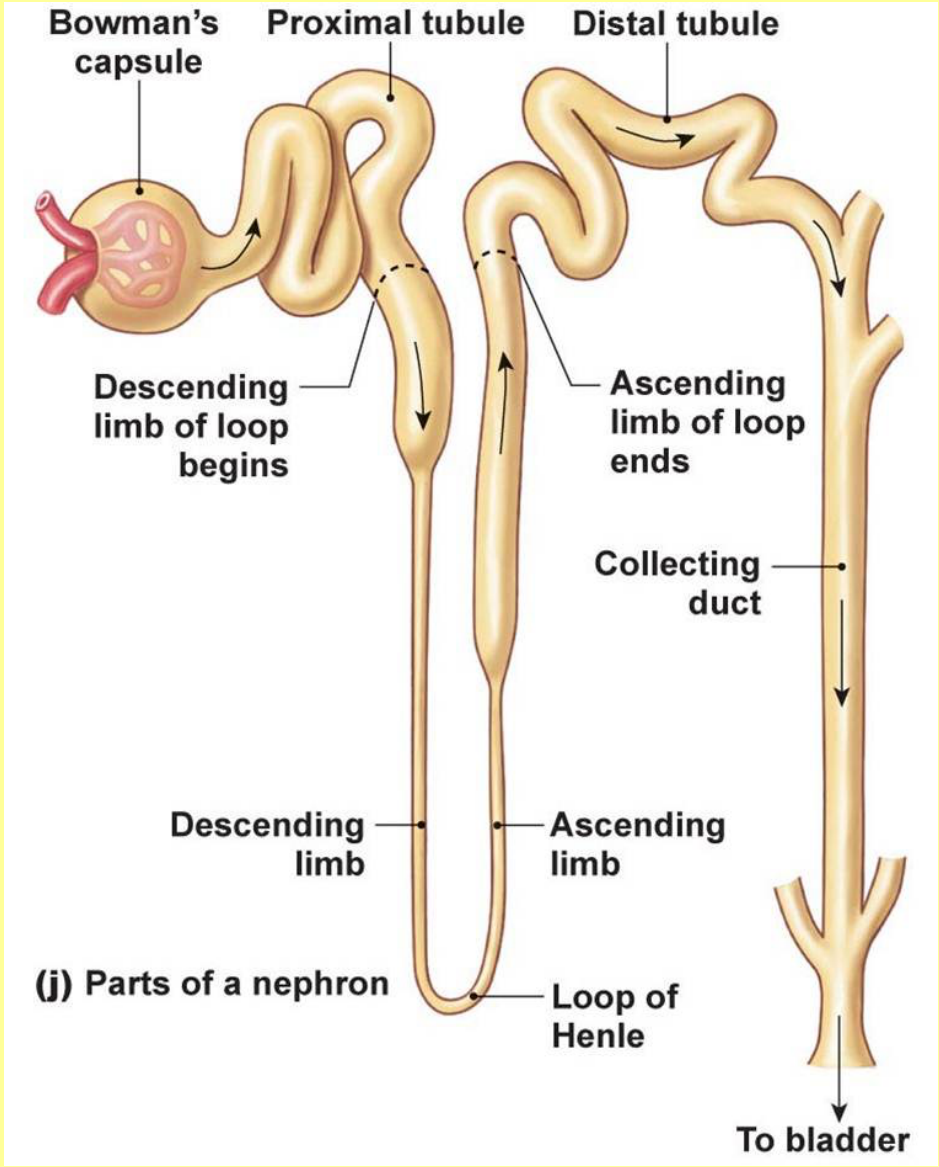


Water is a Medium for Safe Elimination and Reabsorption of Nutrients

Kidney: Glomerulus and Renal Tubule



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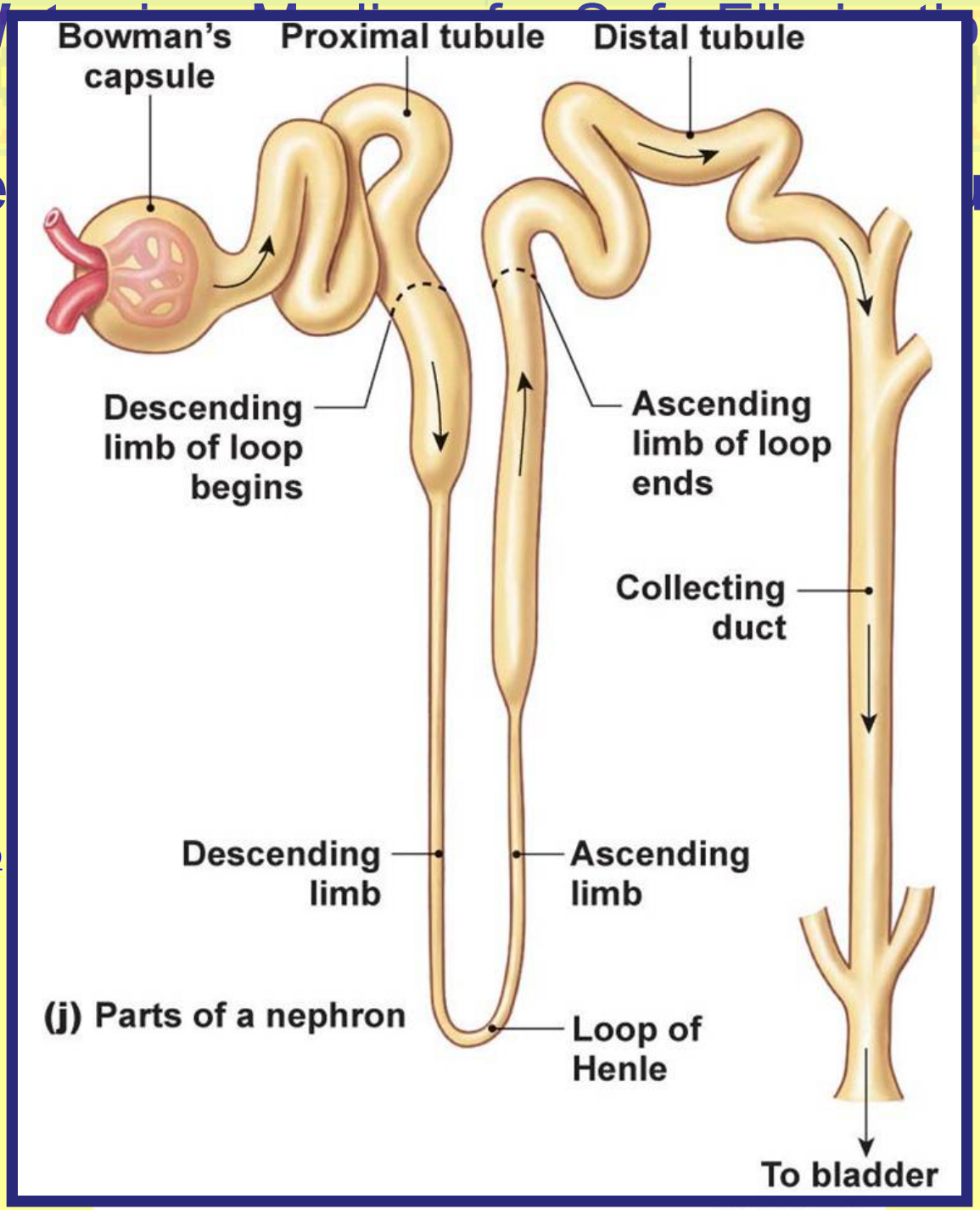
Kidne ule



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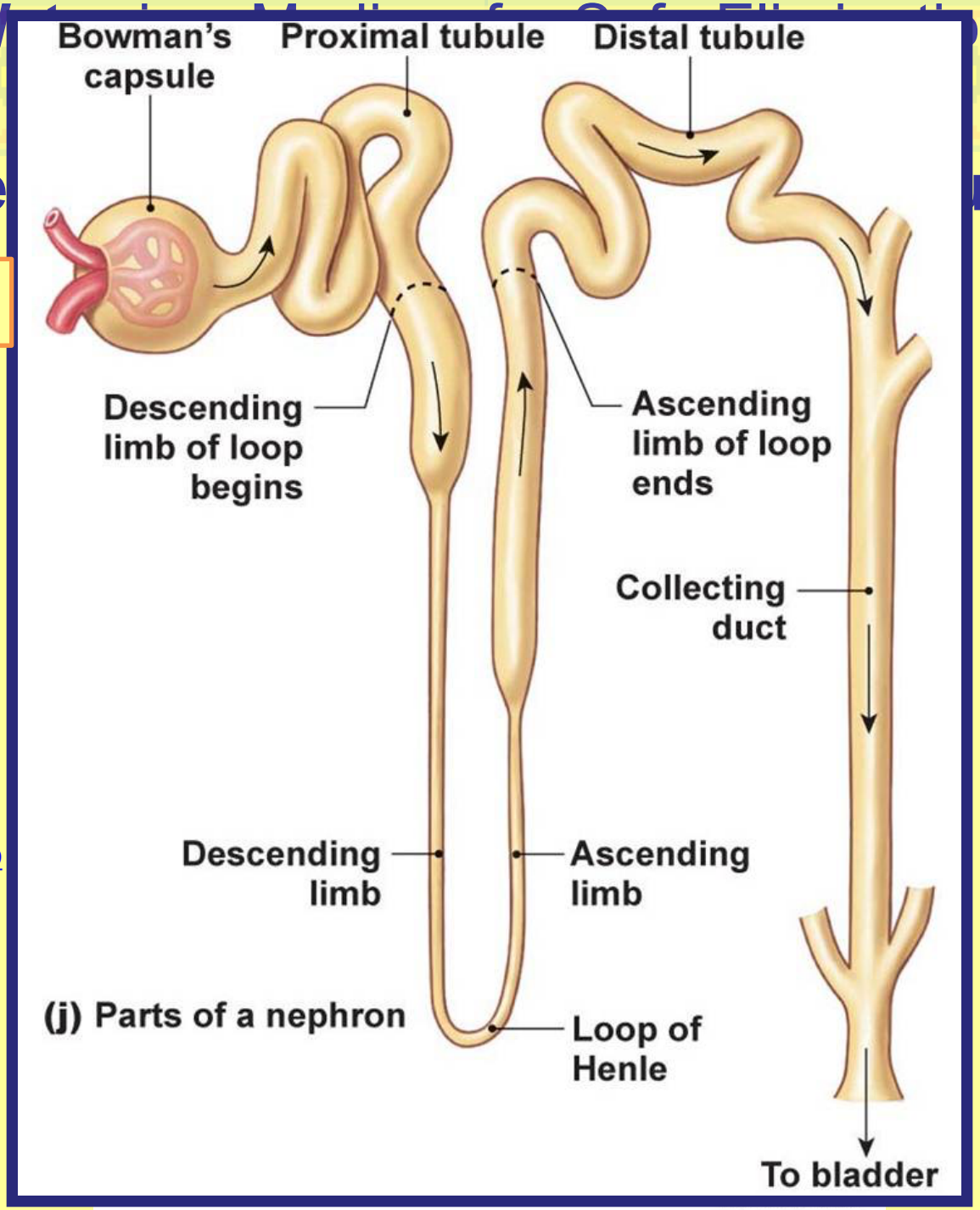
Glomerulus



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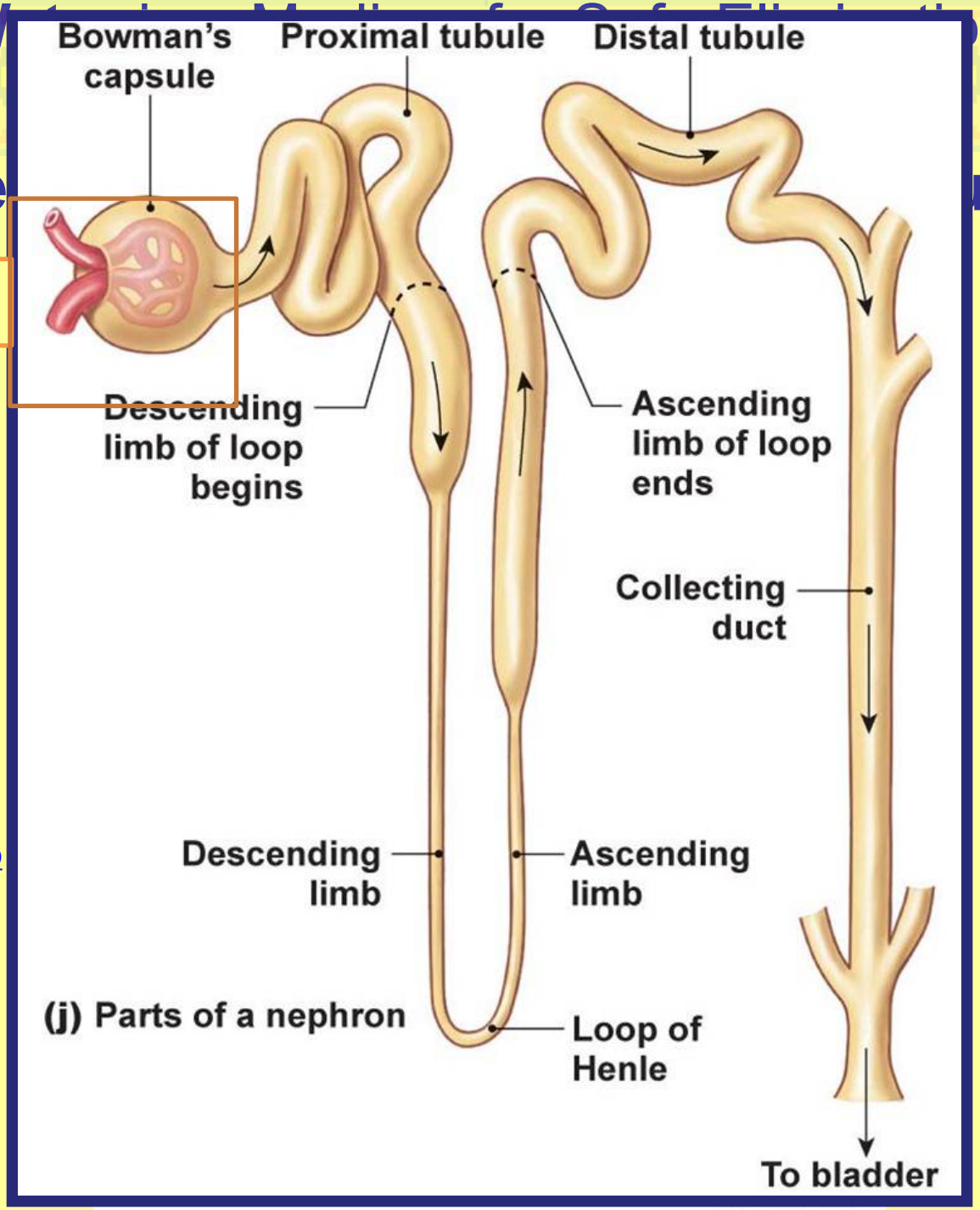

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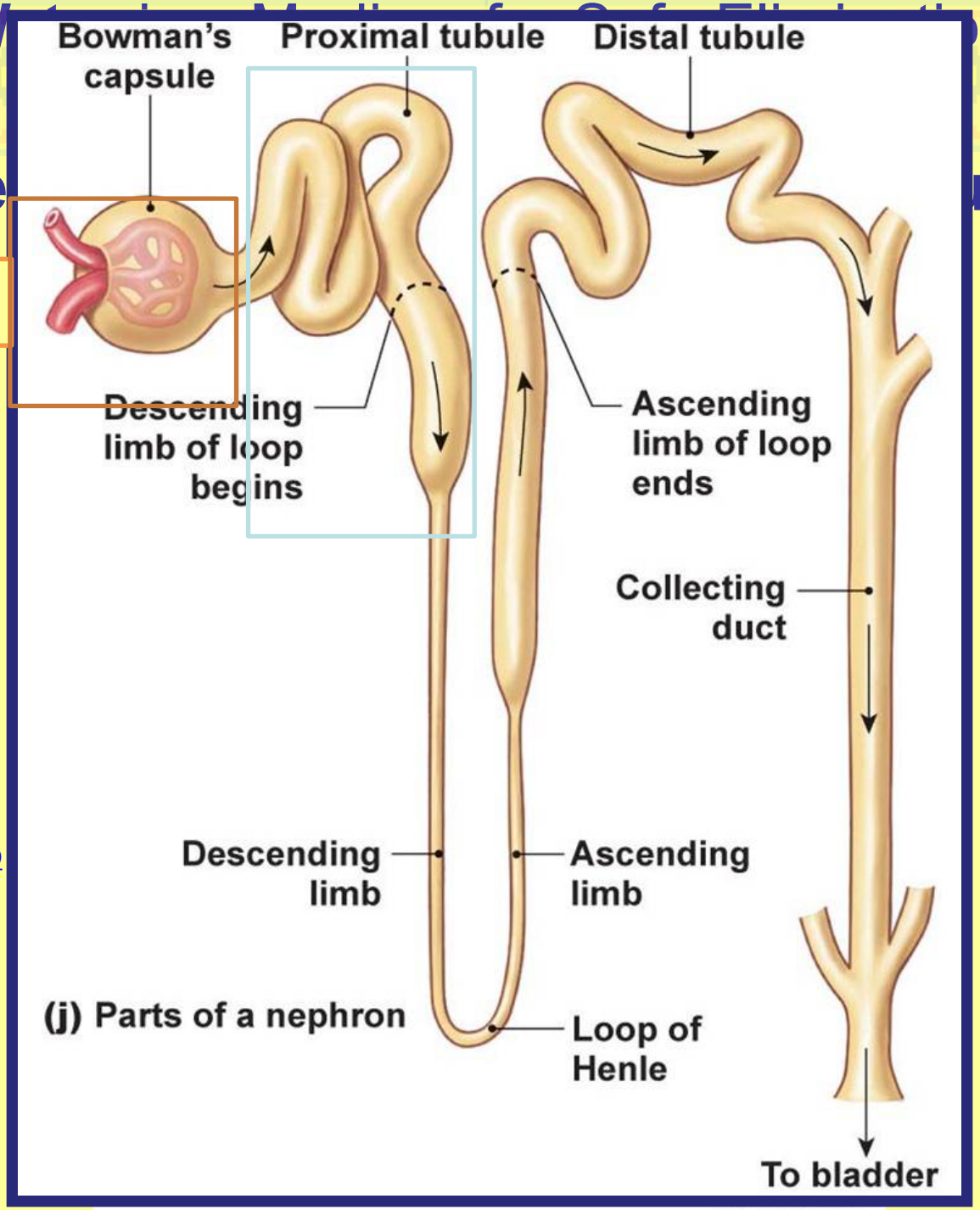

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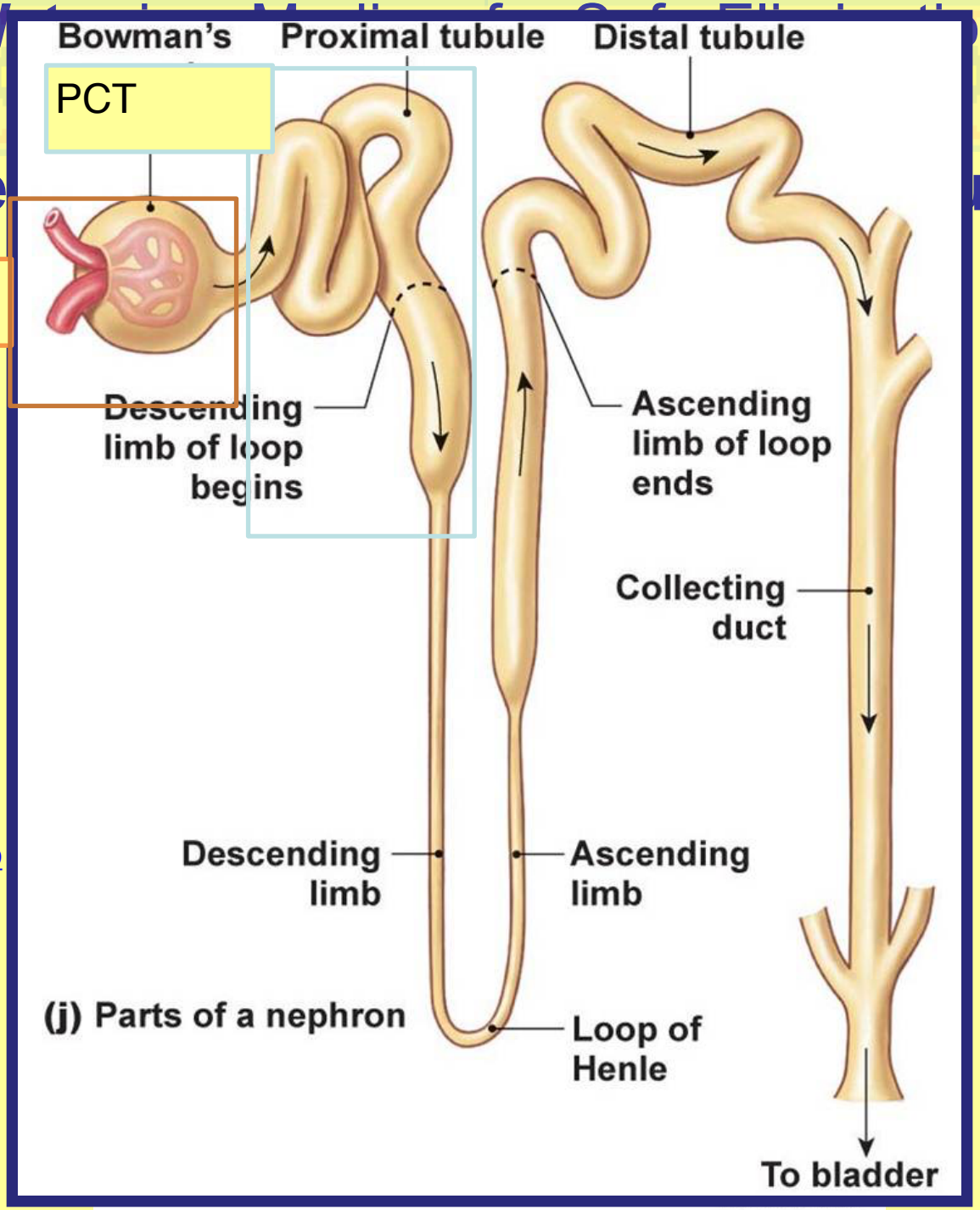

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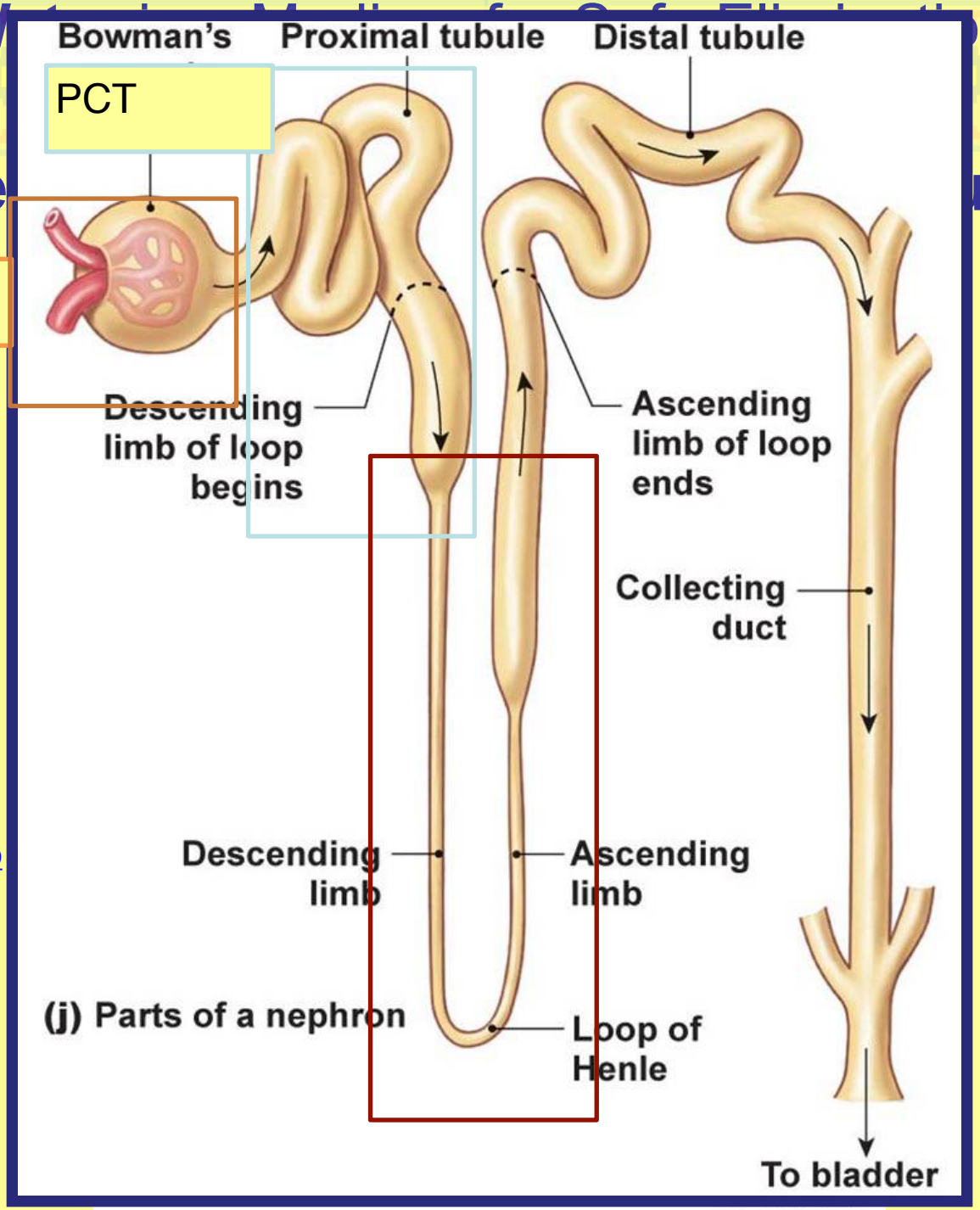

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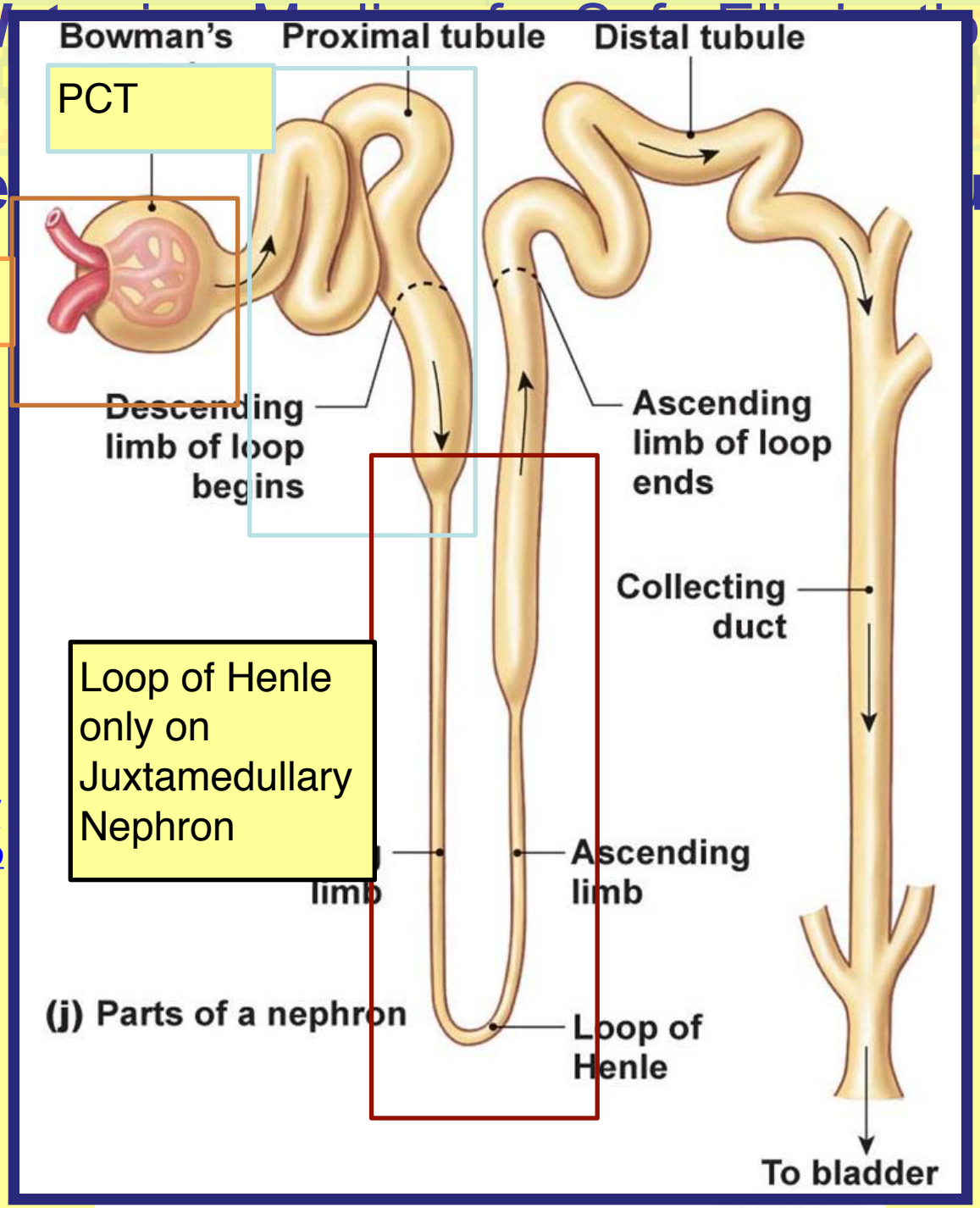

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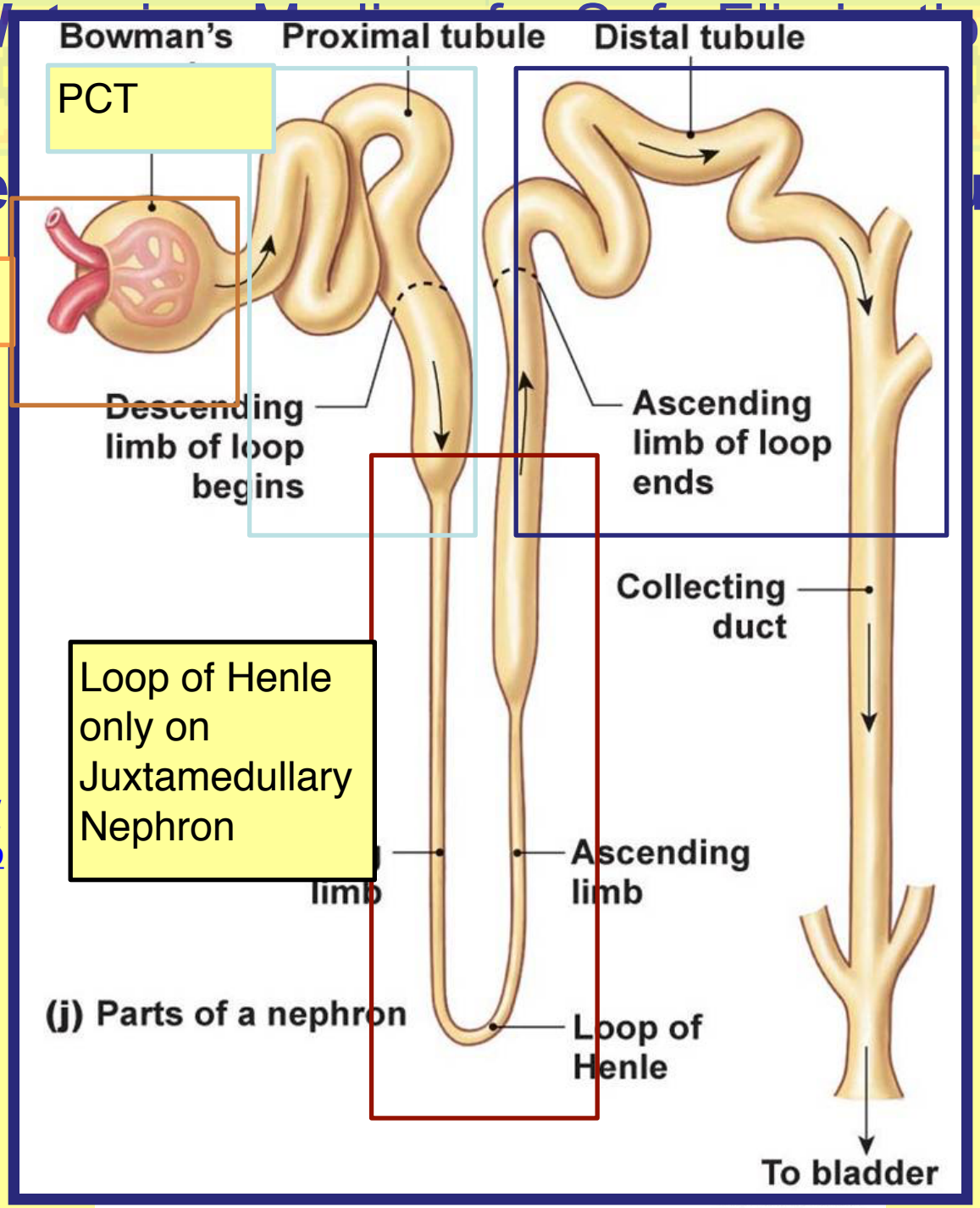

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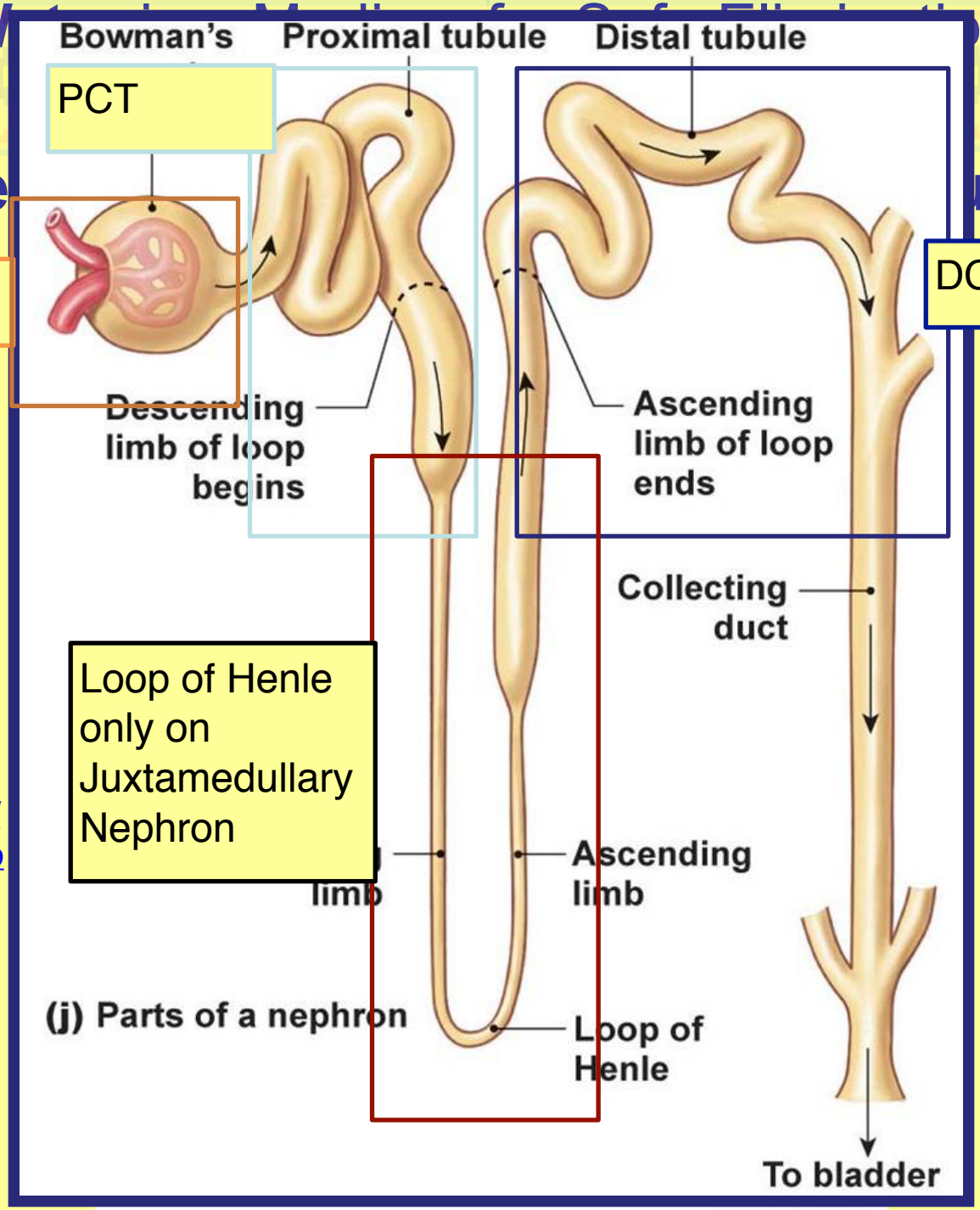

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Water is a Medium for Safe Elimination and Reabsorption of Nutrients

Glomerular Filtration

- Passive Process
- Filter out plasma through fenestrated capillaries
- In the Glomerular Capsule (Bowman's Capsule)
- Rate is based on Myogenic Controls, Ion Concentration, and Hormones

(Hoehn & Marieb, 2017; Chang, J., 2017)

Water is a Medium for Safe Elimination and Reabsorption of Nutrients

Tubular Reabsorption

- Selective Transepithelial Process
- Returns all organic nutrients, 99% of water, ions, and other components to the blood

(Hoehn & Marieb, 2017; Chang, J., 2017)

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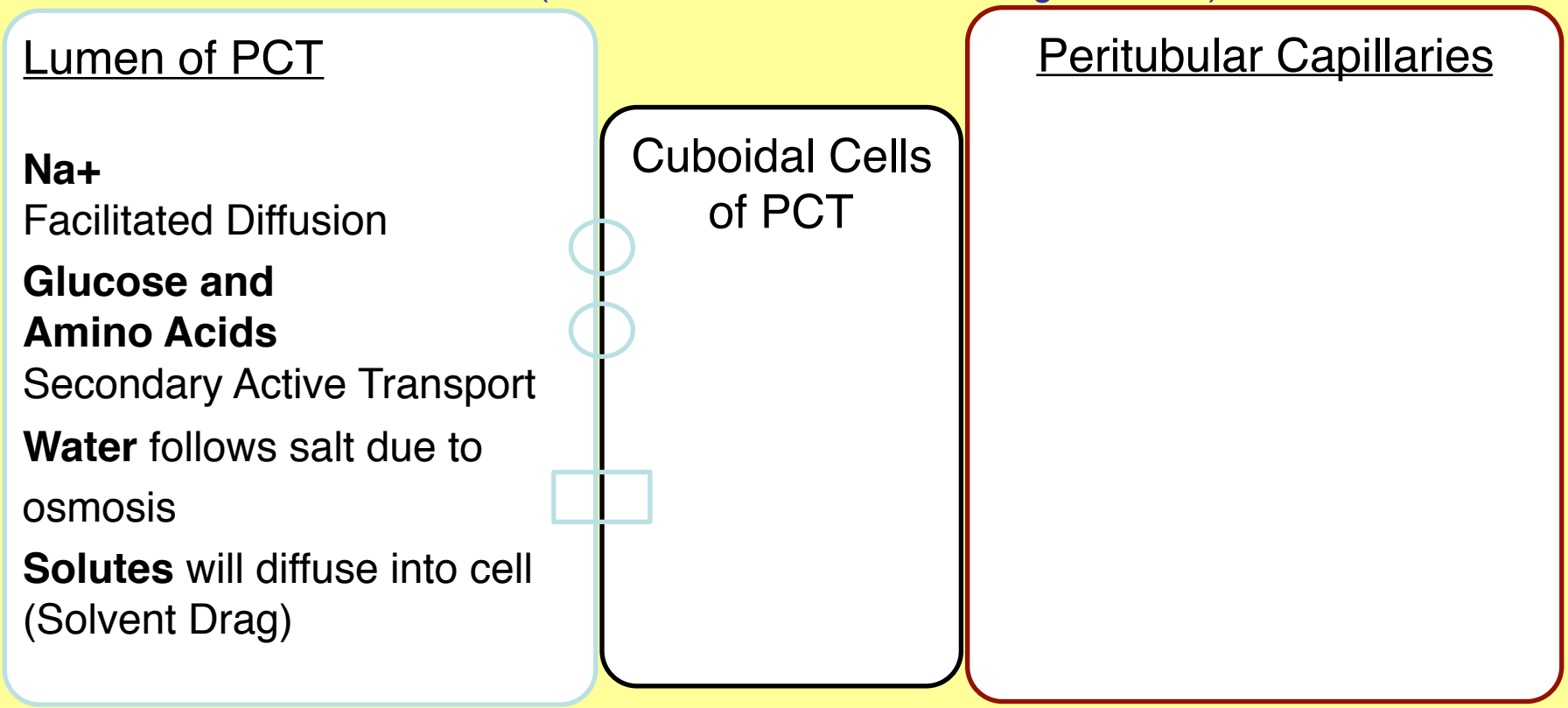

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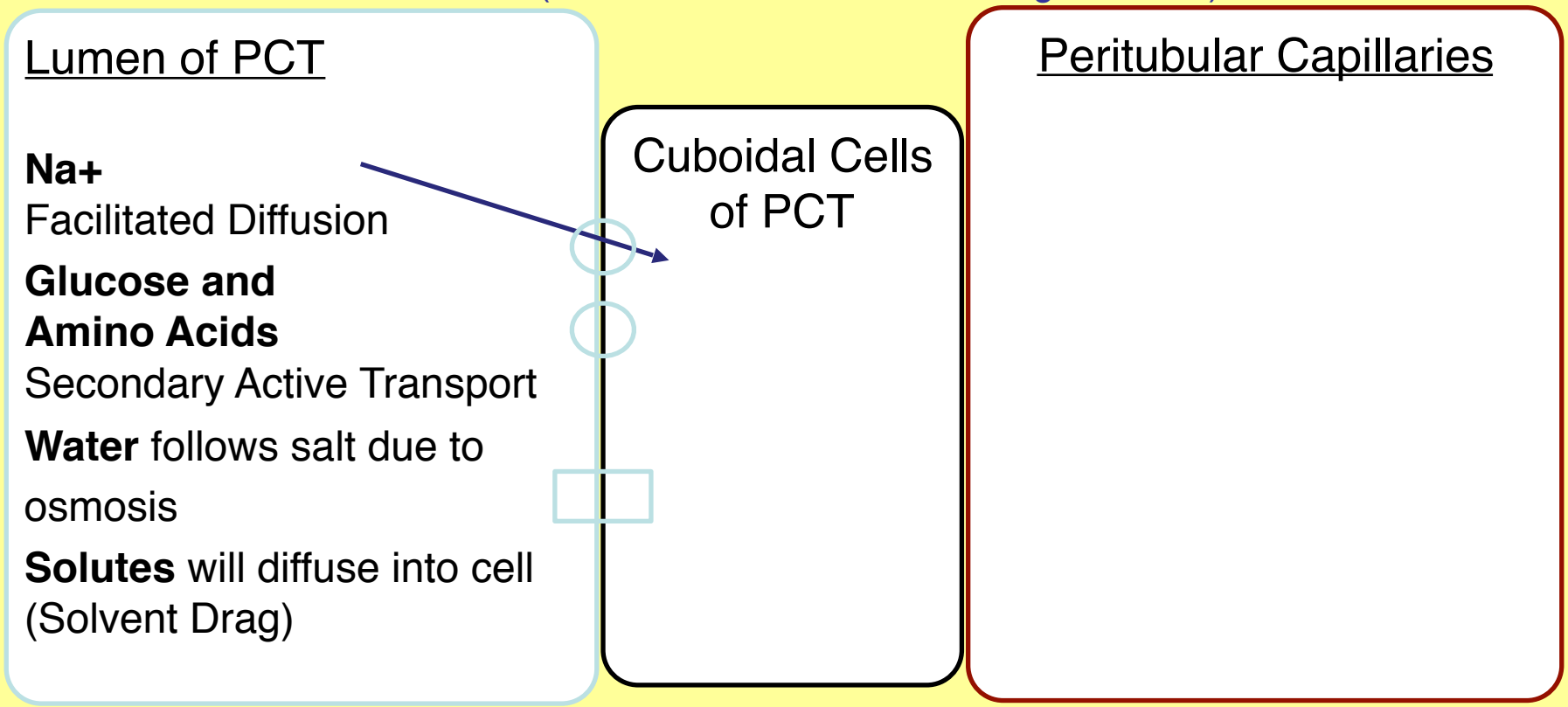

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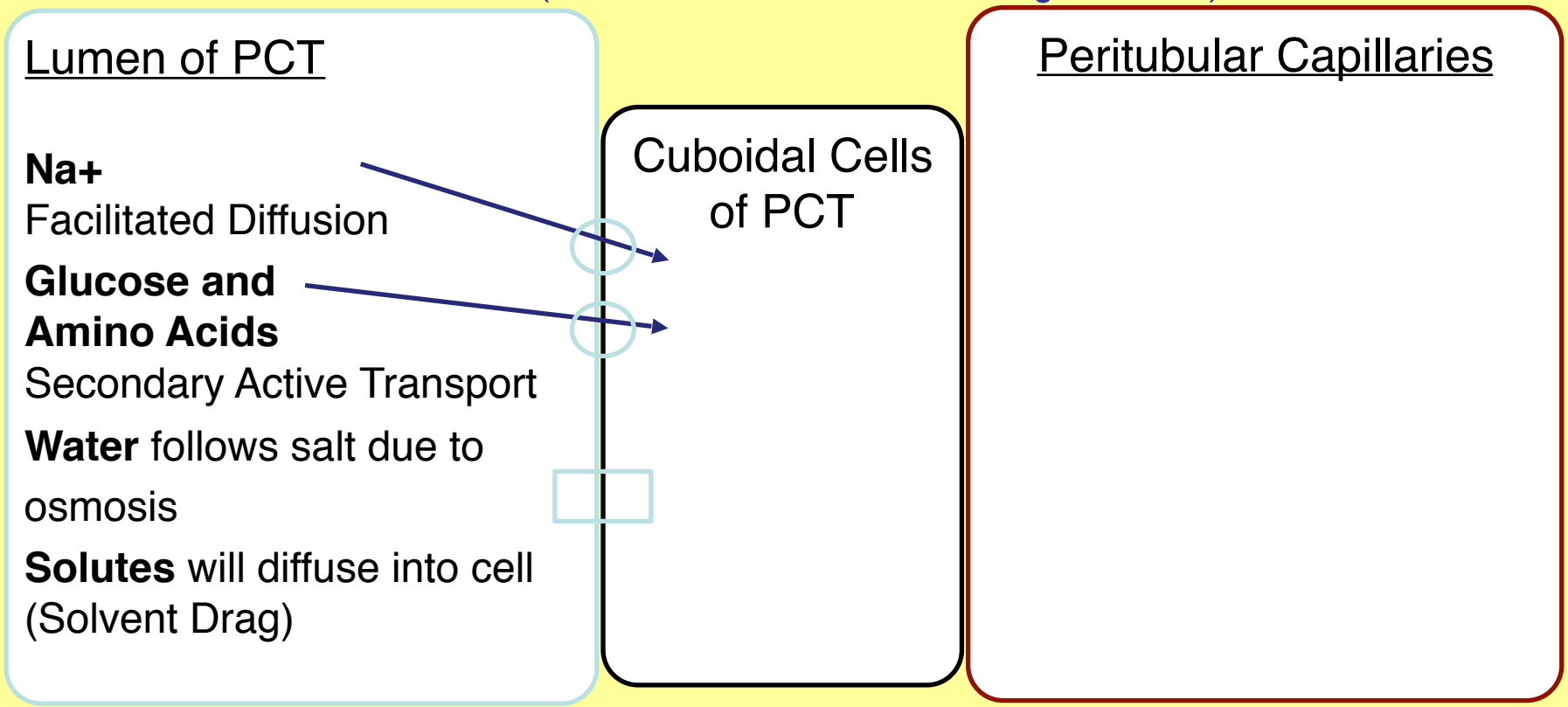

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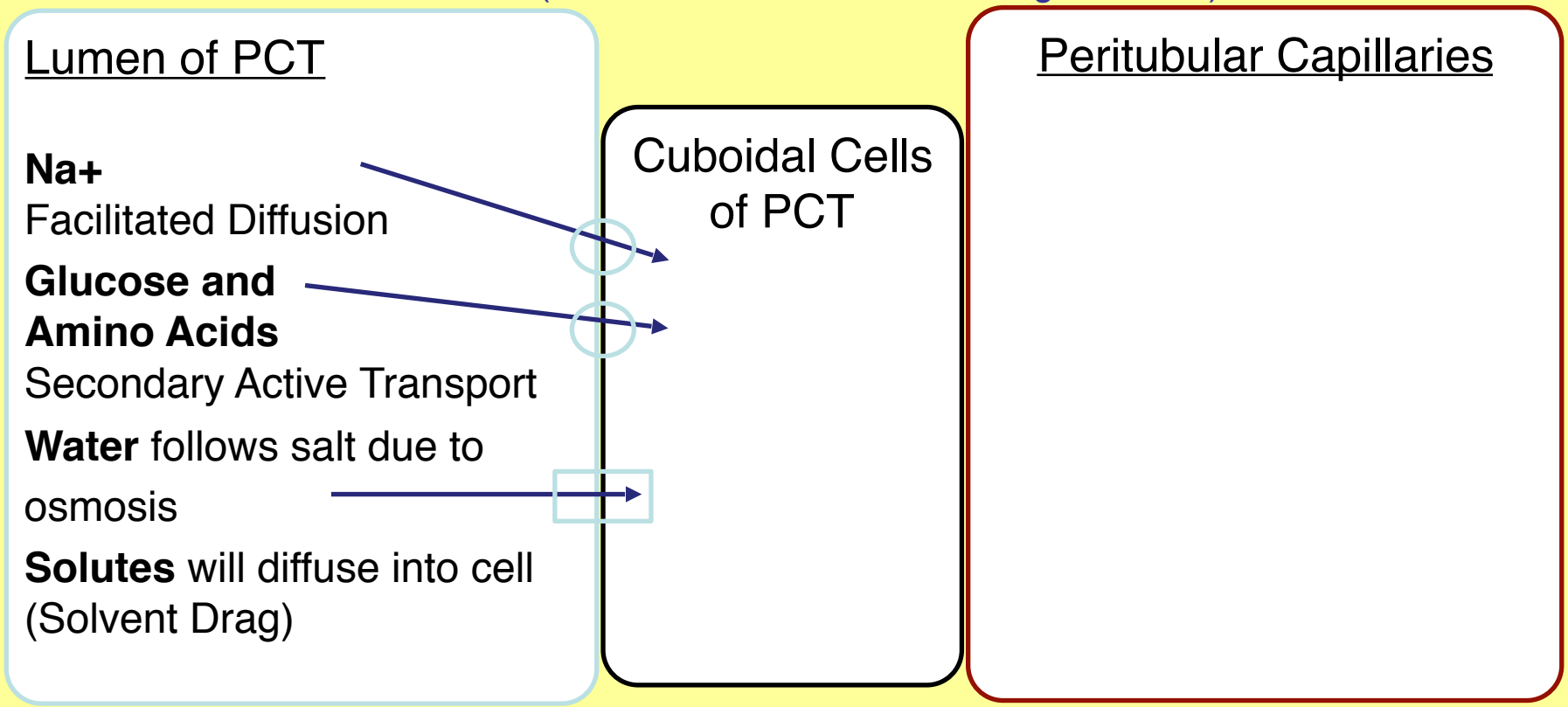

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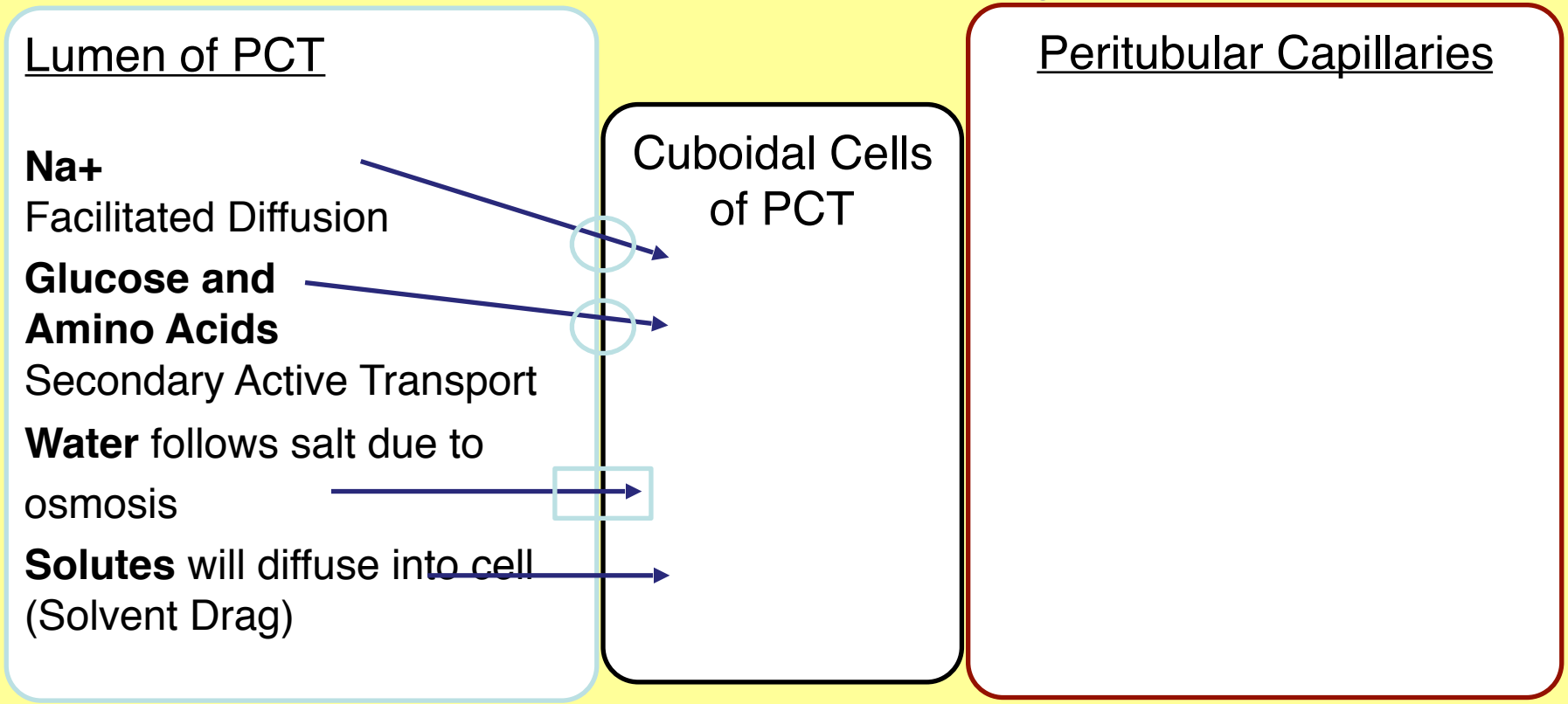

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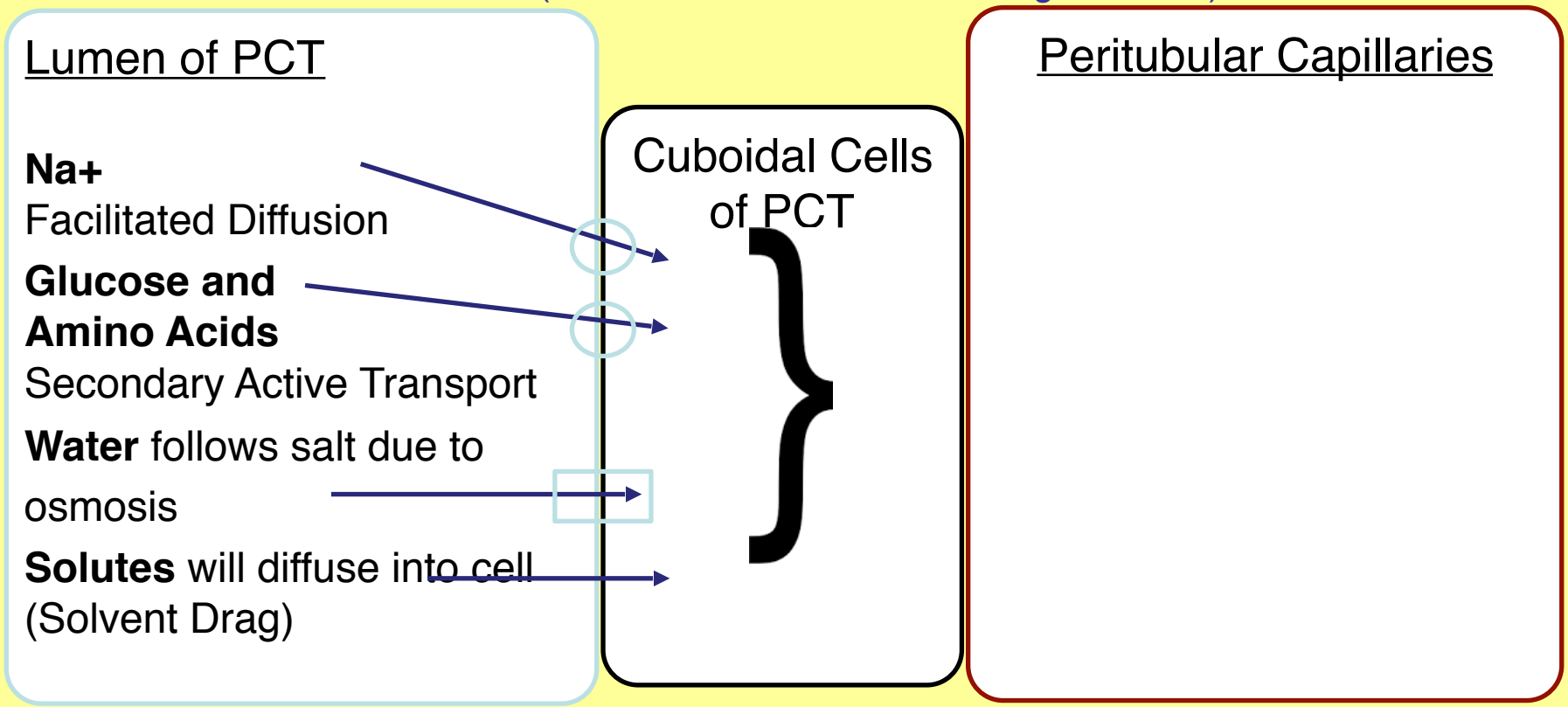

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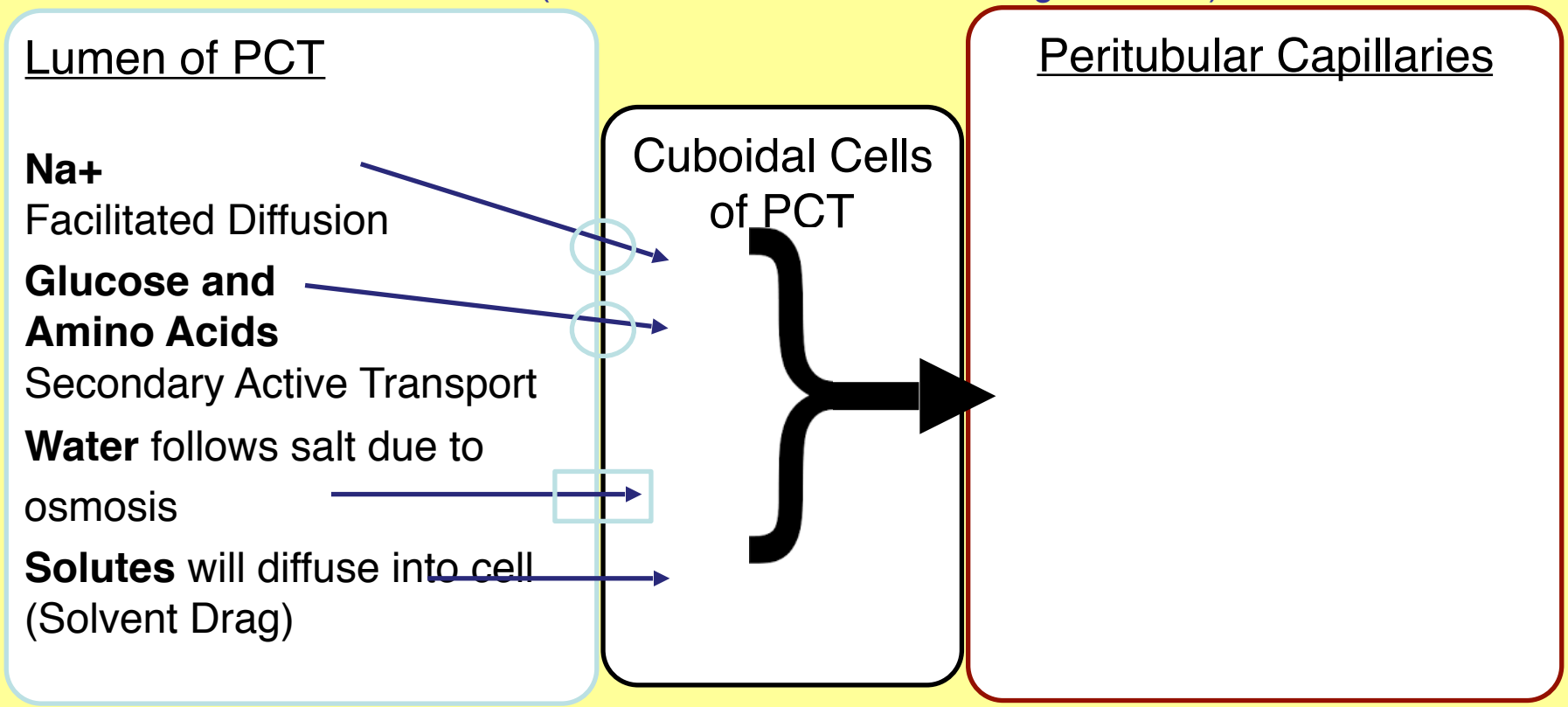

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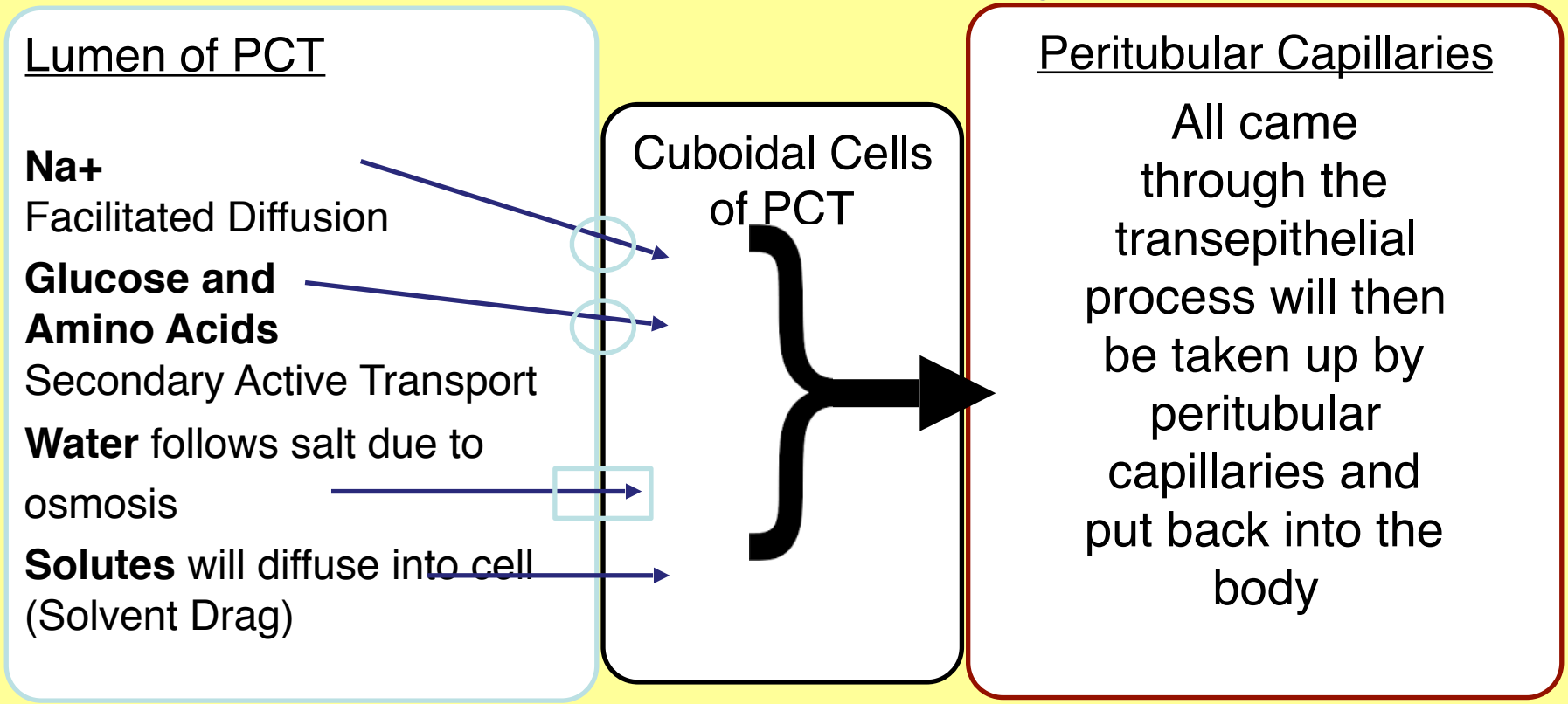


Water is a Medium for Safe Elimination and Reabsorption of Nutrients

Tubular Secretion

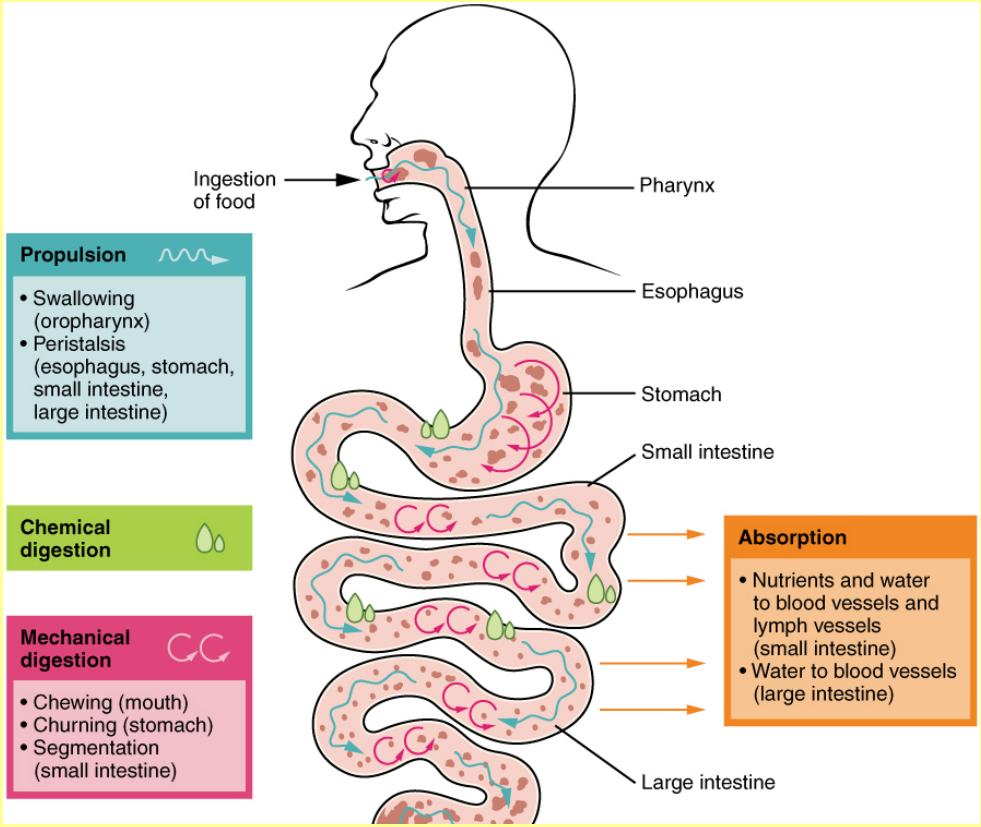
- Selective adds wastes to filtrate and urinated out
- Between DCT and peritubular capillaries
  - Gets ride of waste: K+, H+, NH4+, Creatine, and Organic Acids
- Dispose of Substances bound to Plasma Protein
  - Drugs and metabolites
  - Controls Blood pH by altering H+ and HCO3- in urine

(Hoehn & Marieb, 2017; Chang, J., 2017)

Water Aids in Digestion and Absorption

Absorption

- Water absorbed in stomach, small intestine, and large intestine
- Aids in Solute Absorption
  - Sodium, specifically, creates osmotic gradient that allows water to diffuse into intracellular space
- Helps in reabsorption of other nutrients

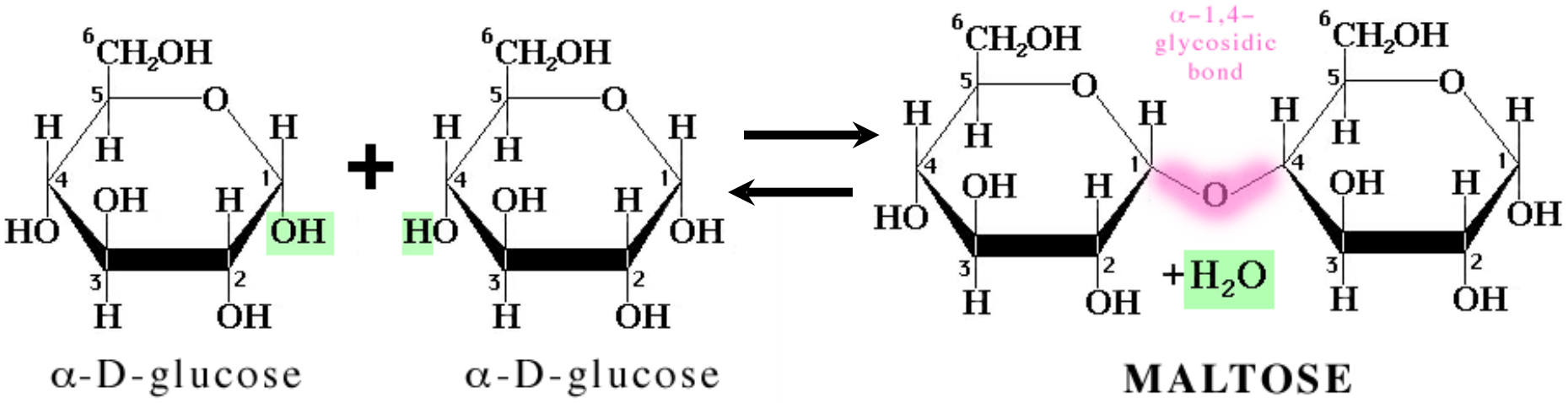


Digestion and Absorption [Image]. (n.d.). Retrieved from https://opentextbc.ca/anatomyandphysiology/chapter/23-2-digestive-system-processes-and-regulation/

Water Aids in Digestion and Absorption

Chemical Digestion

- Hydrolysis - Adding Water to Break Bonds



Dehydration Synthesis of Glucose [Image]. (2012.) Retrieved from https://socratic.org/questions/what-are-dehydration-synthesis-reactions

Water Helps Convert Food into Energy

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Glucose + Oxygen → Carbon Dioxide + Water + ATP

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + ATP$

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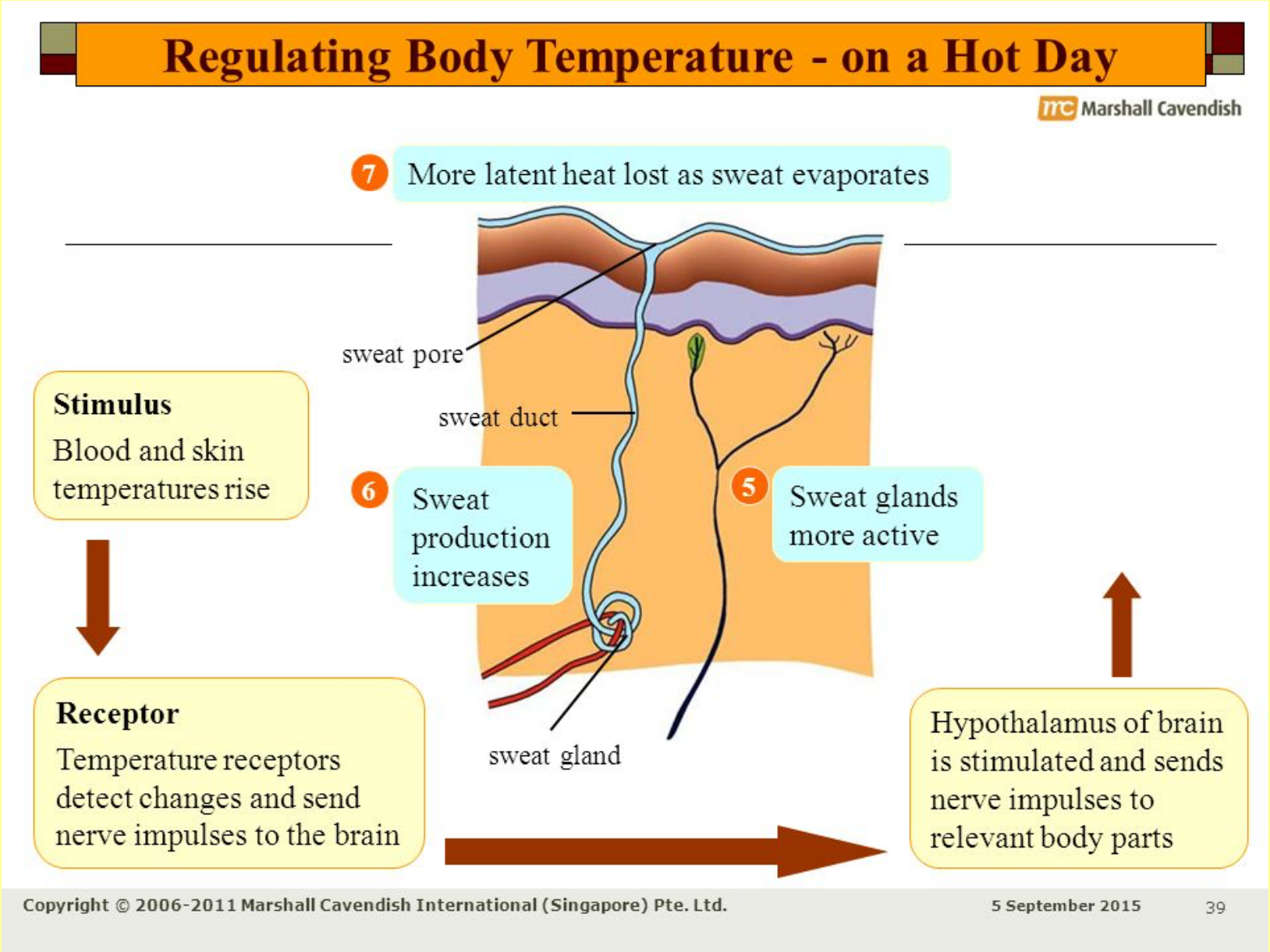
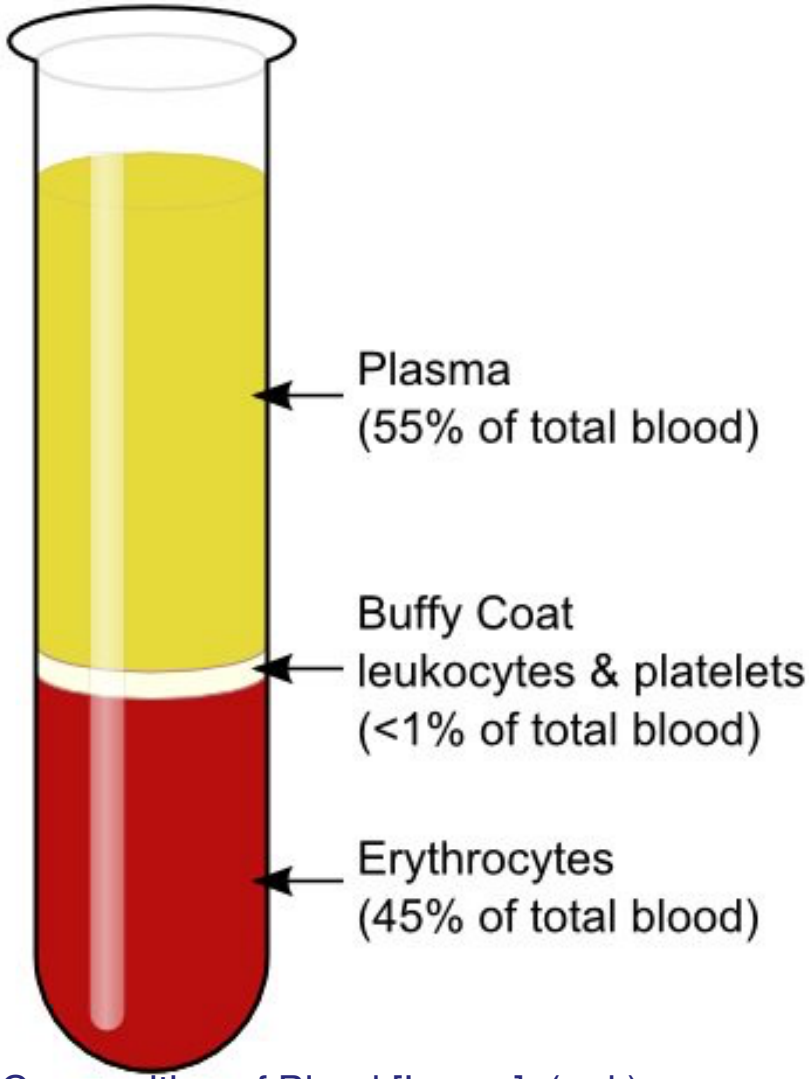
Cellular Respiration Equation [Image]. (2018). Retrieved from https://study.com/academy/lesson/what-is-the-chemical-equation-for-cellular-respiration.html

Water Regulates Blood Temperature



Regulating Body Temperature on a Hot Day [Image]. (n.d.). Retrieved from https://slideplayer.com/slide/6424155/

Water is the Main Component of Blood



Composition of Blood [Image]. (n.d.). Retrieved from https://biologydictionary.net/blood/

Blood Plasma - 55%

- 90% Water
- 10% solutes

(Hoehn & Marieb, 2017; Chang, J., 2017)

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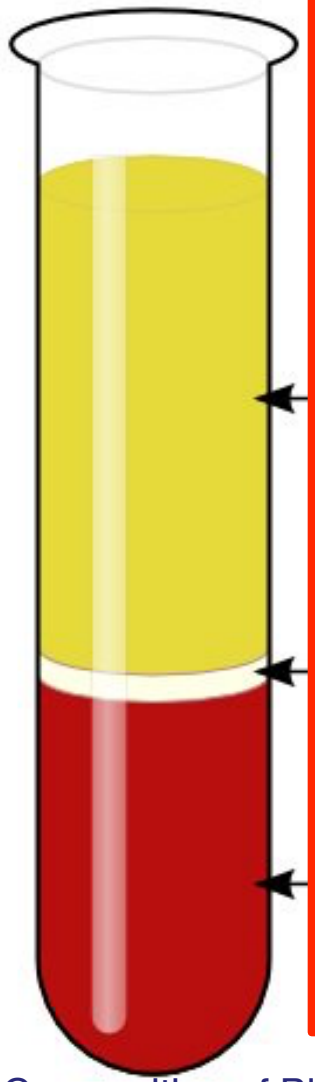

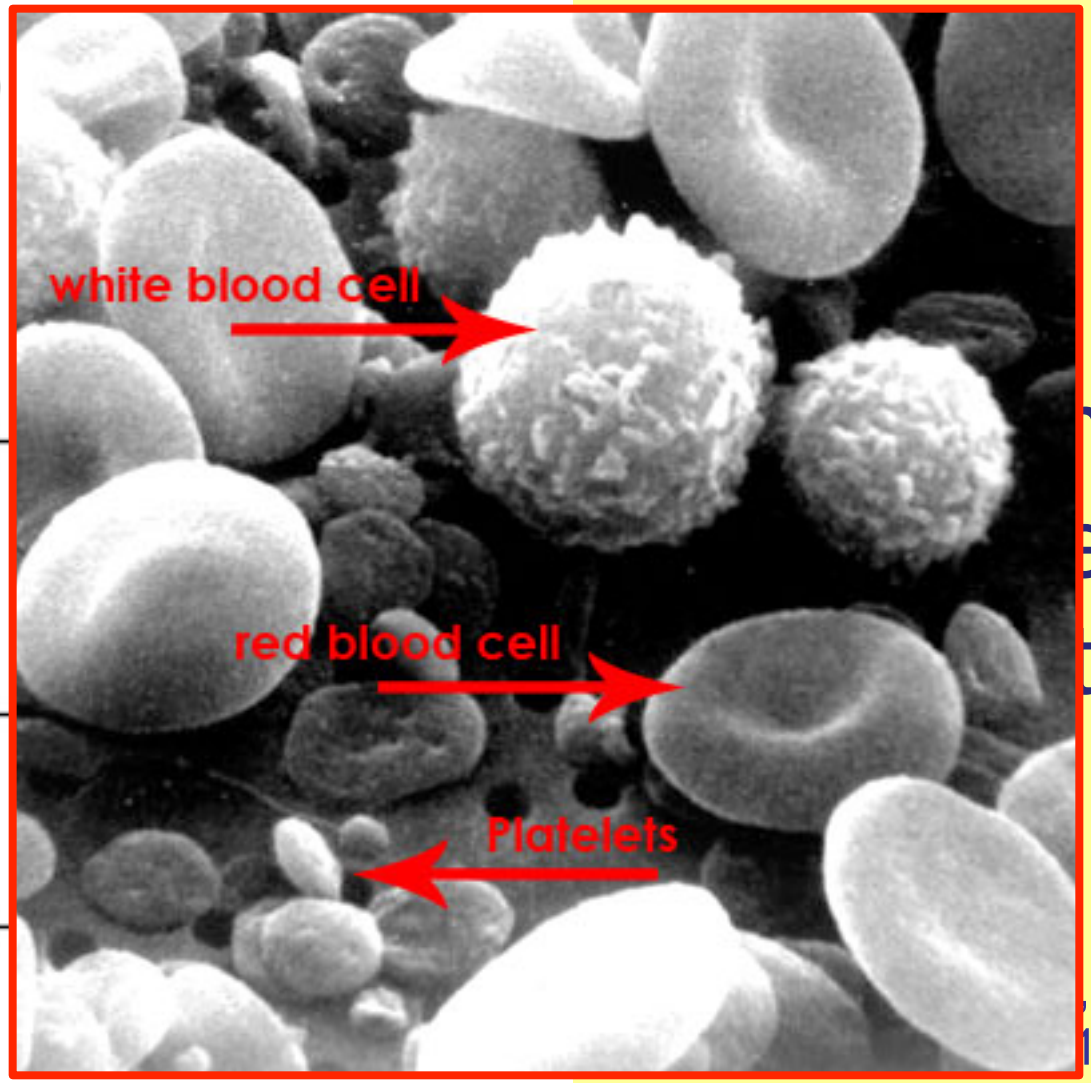

ma - 55%
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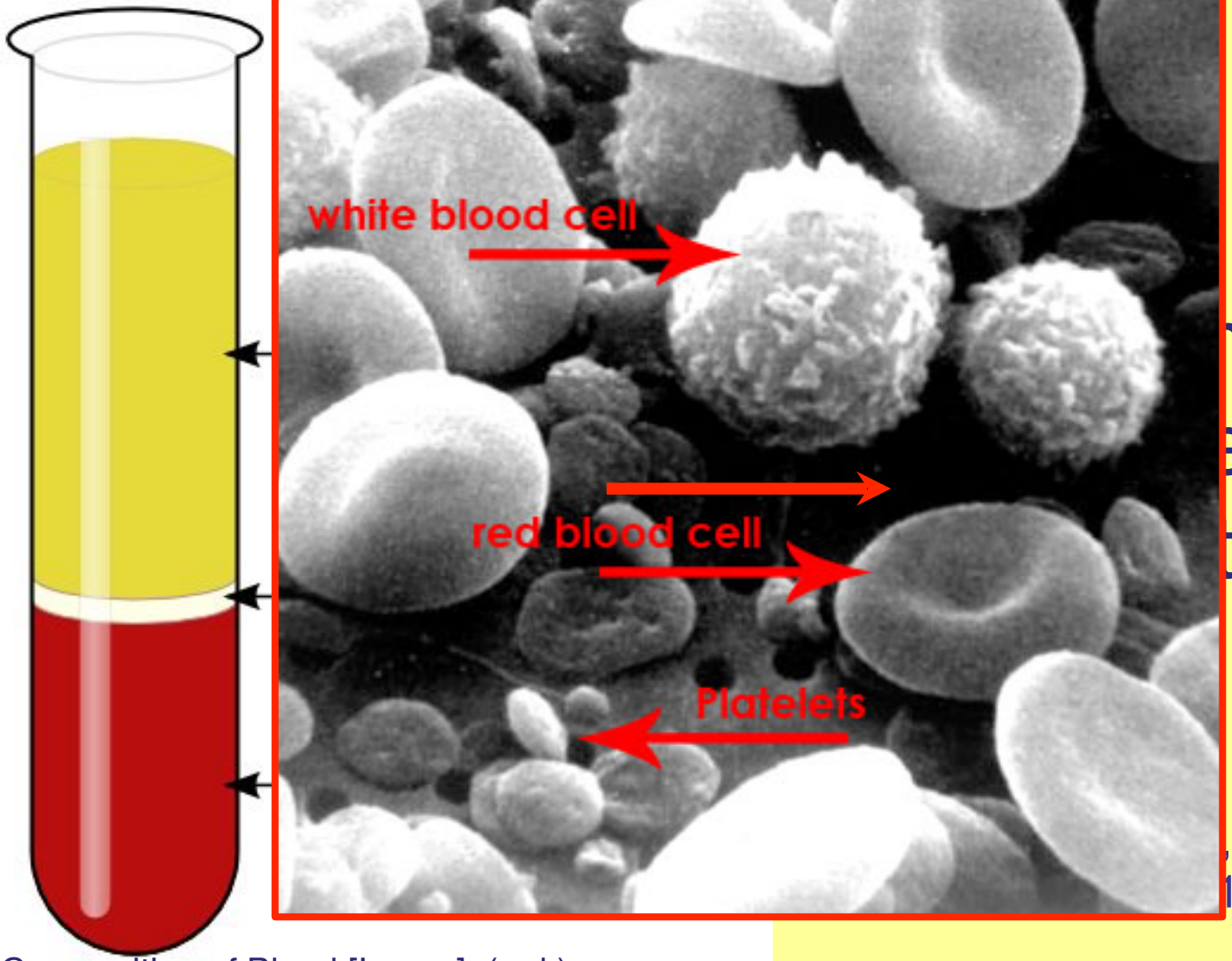

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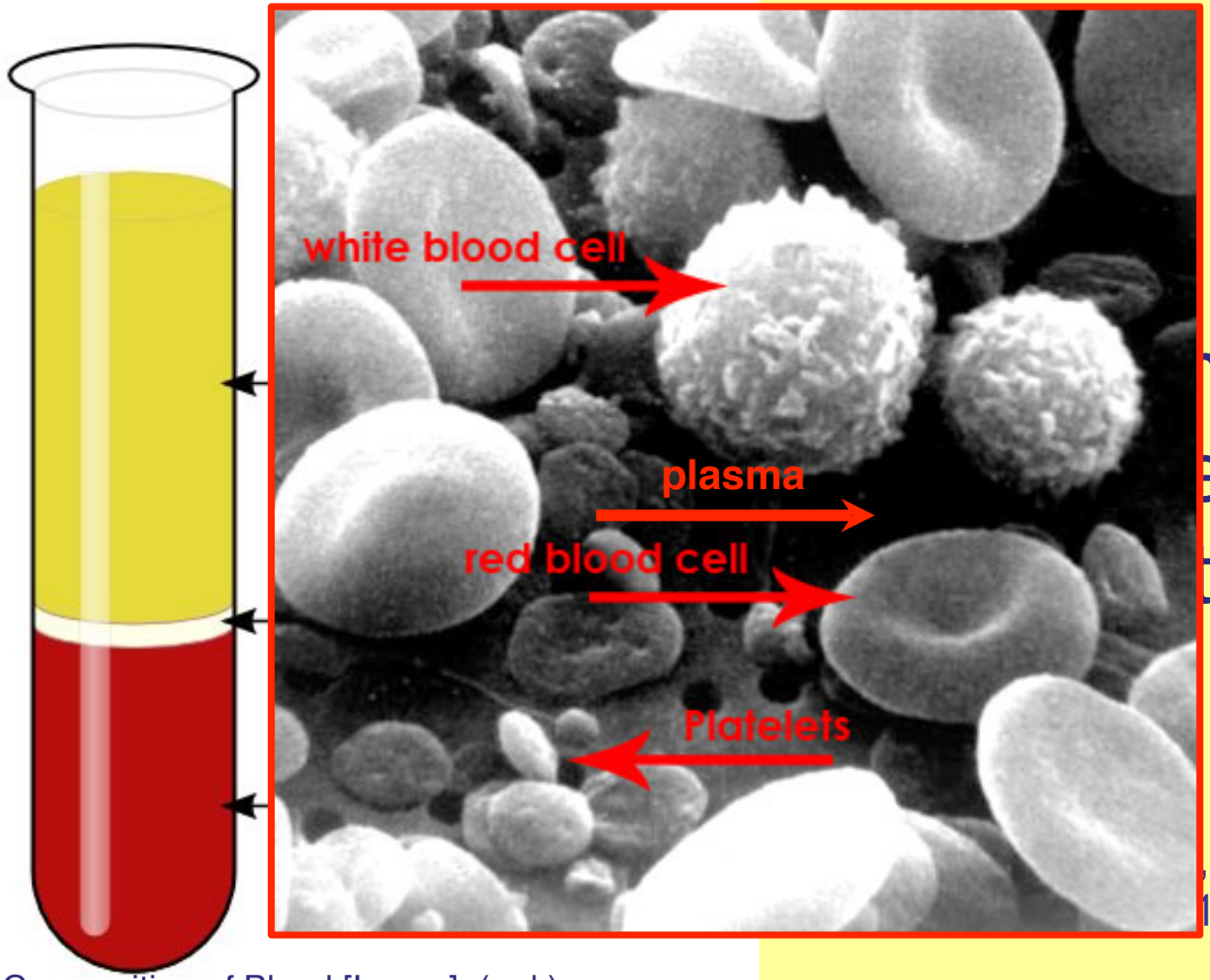

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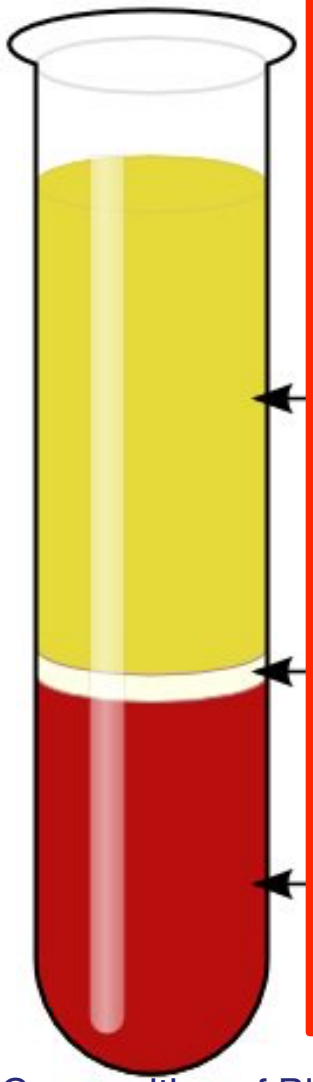

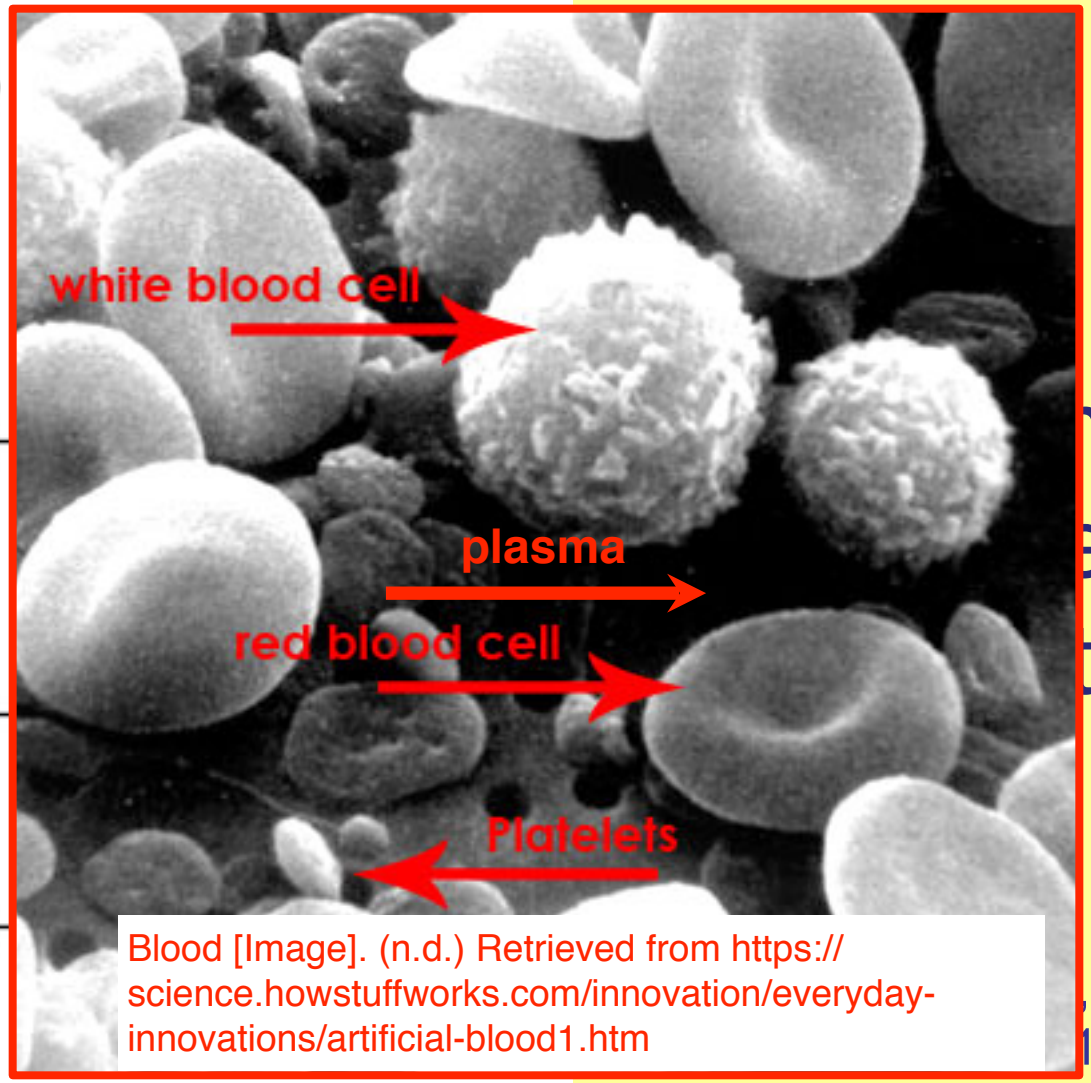

Blood [Image]. (n.d.) Retrieved from https://science.howstuffworks.com/innovation/everyday-innovations/artificial-blood1.htm

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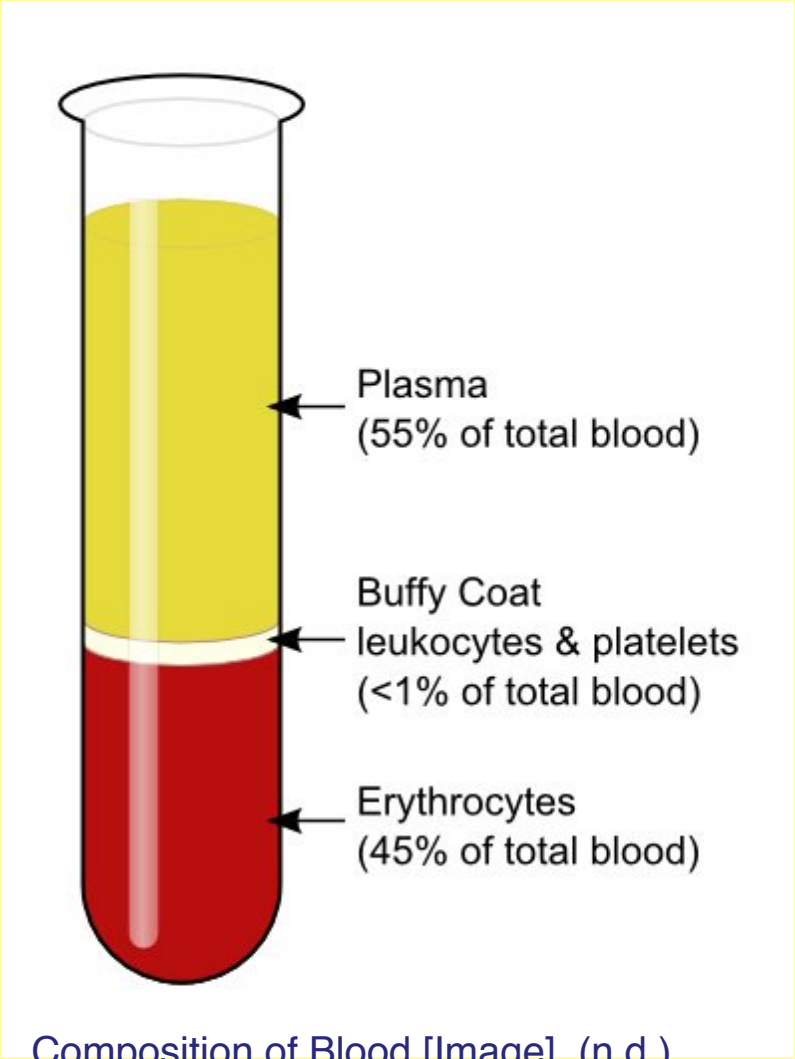
Water is the Main Component of Blood and Regulates Blood Volume



Composition of Blood [Image]. (n.d.). Retrieved from https://biologydictionary.net/blood/

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  - 10% solutes
    - 60% Albumin
      - maintains colloid osmotic pressure
    - 36% Blogulin
    - 4% Fibrinogen

(Hoehn & Marieb, 2017; Chang, J., 2017)

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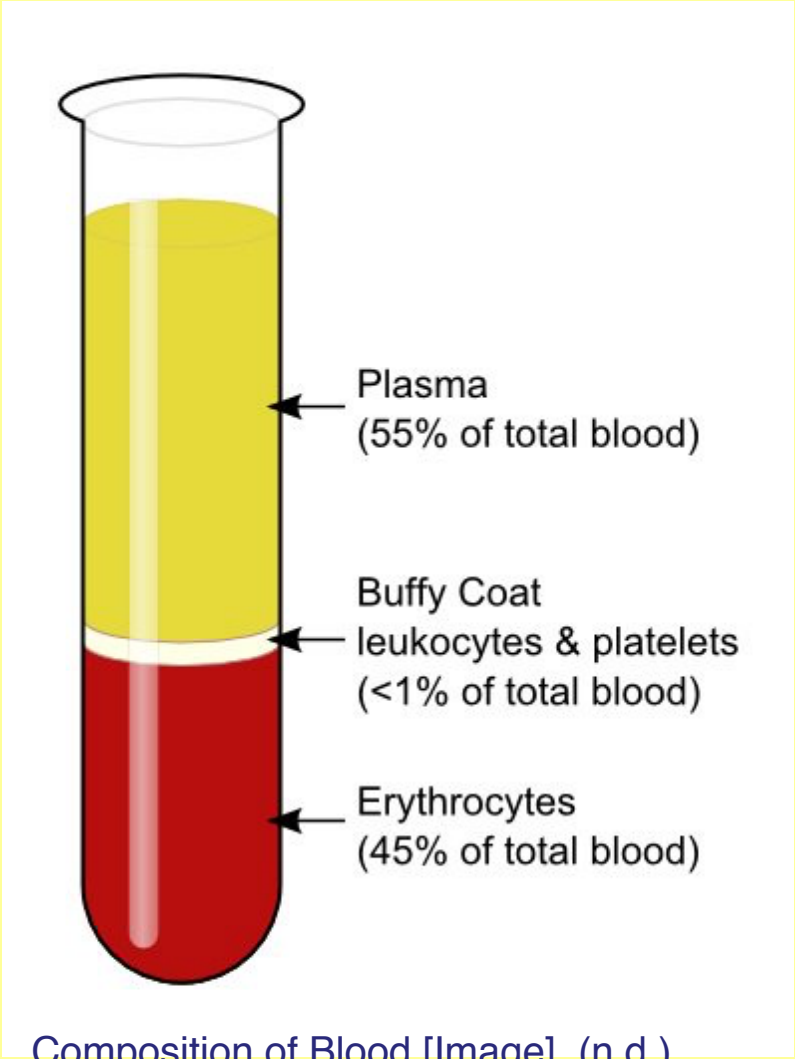

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Water is the Main Component of Blood and Transports Nutrients

Blood:

- Plasma - 55%
- Buffy Coat - 1%
- Erythrocytes - 45%

Blood Transports:

- O2 and CO2
- Hormones
- Nutrients
- Wastes

(Hoehn & Marieb, 2017; Chang, J., 2017)

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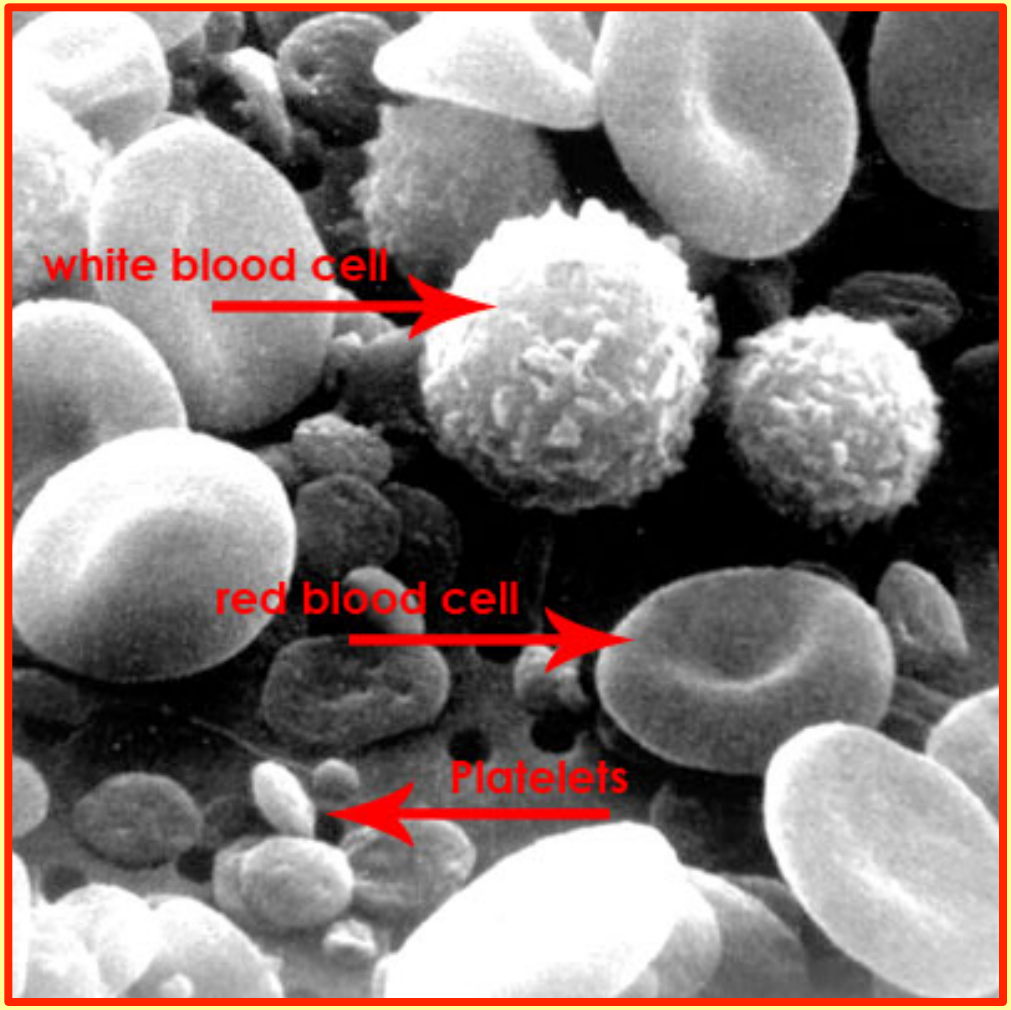

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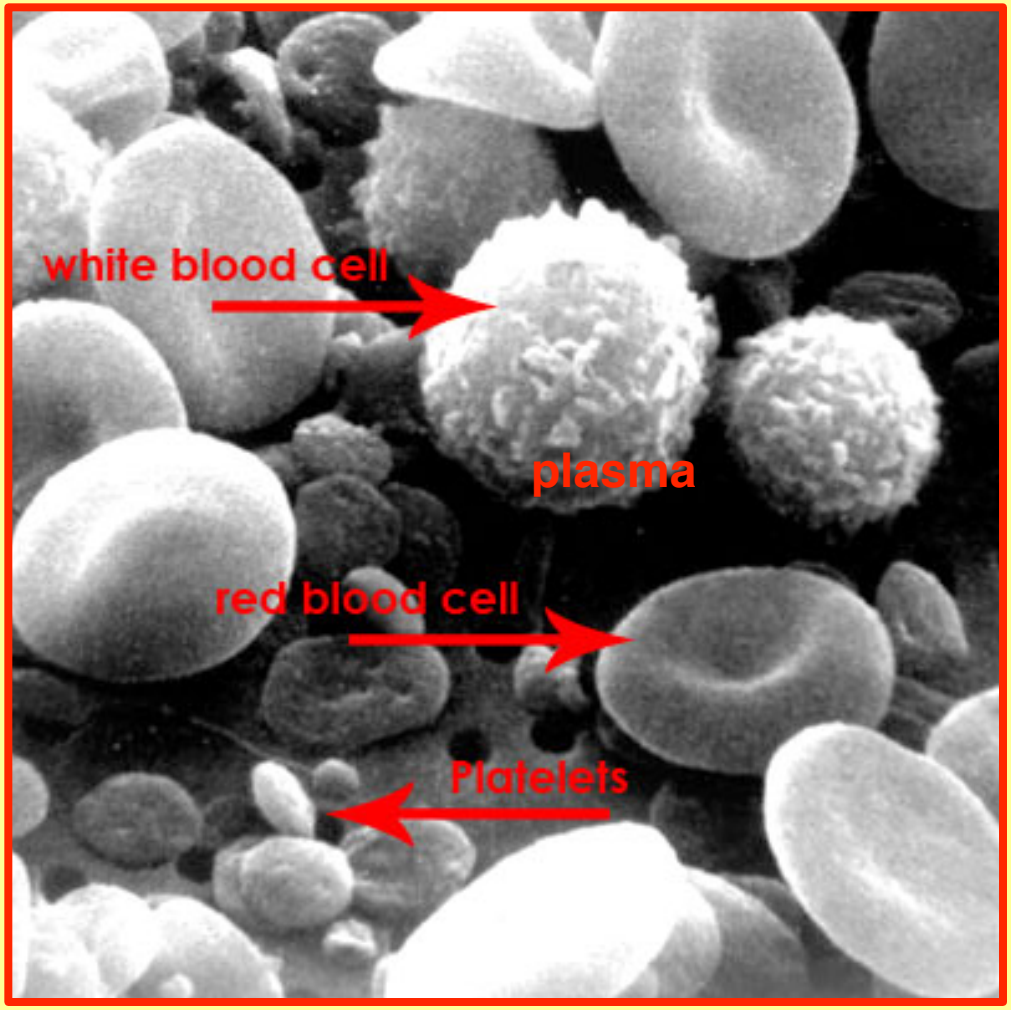

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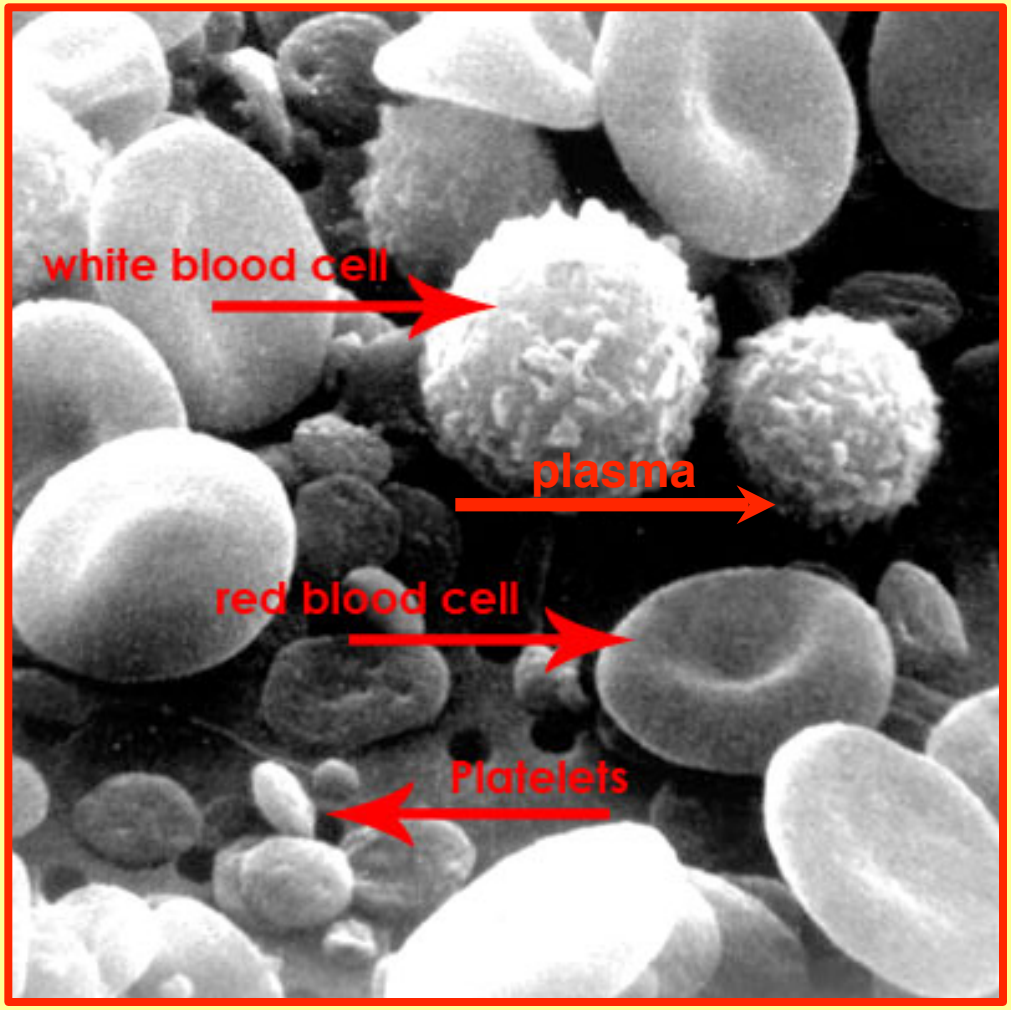

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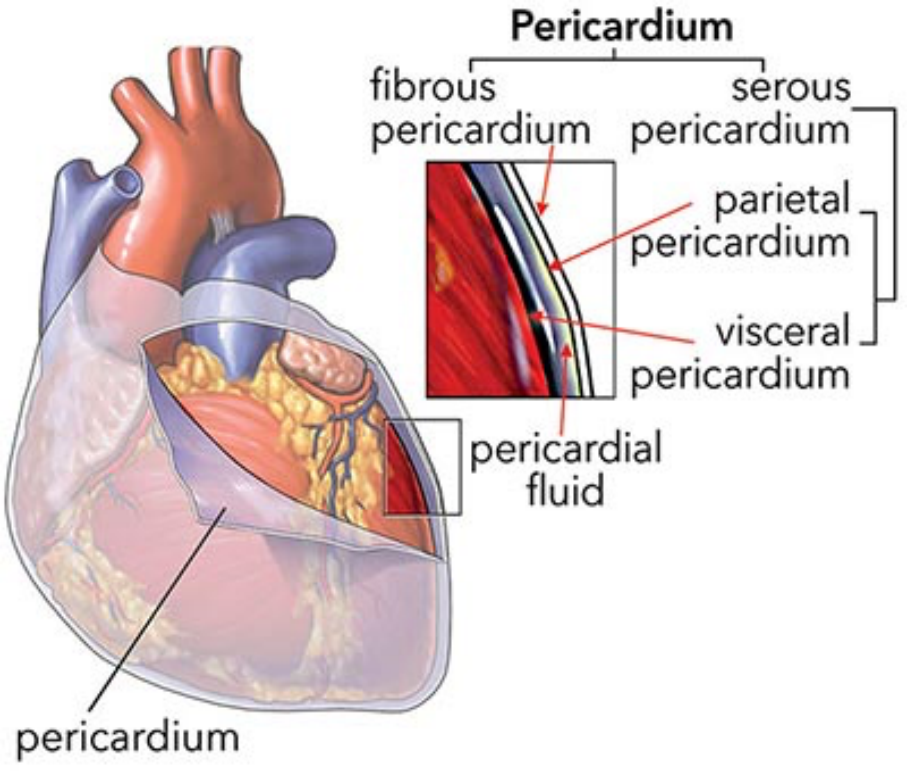
Water Protects and Cushions Vital Organs

Heart



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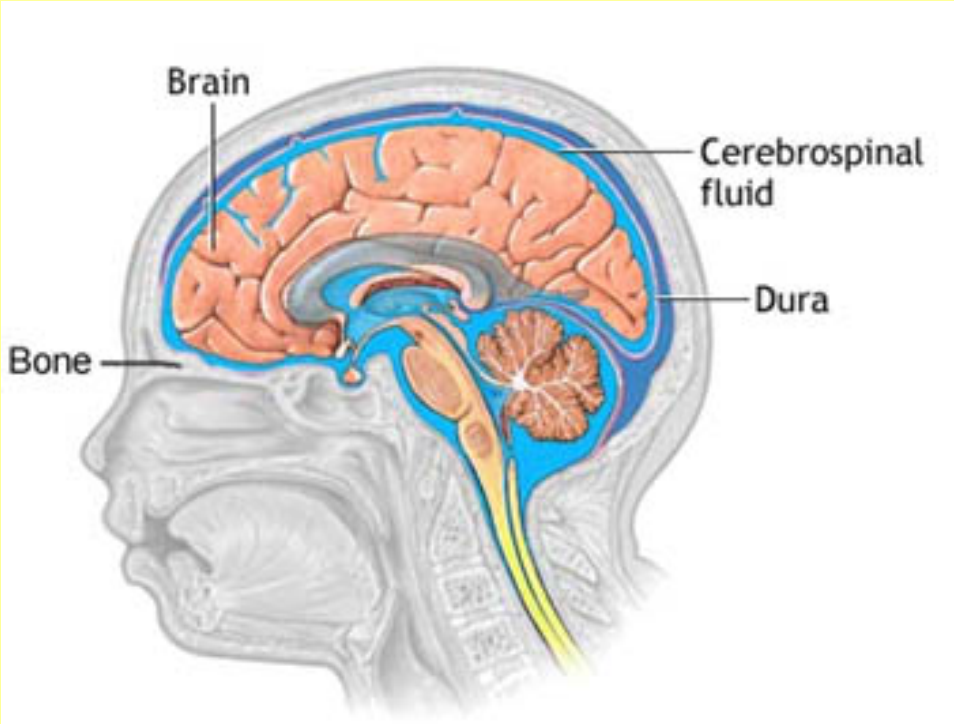
Brain



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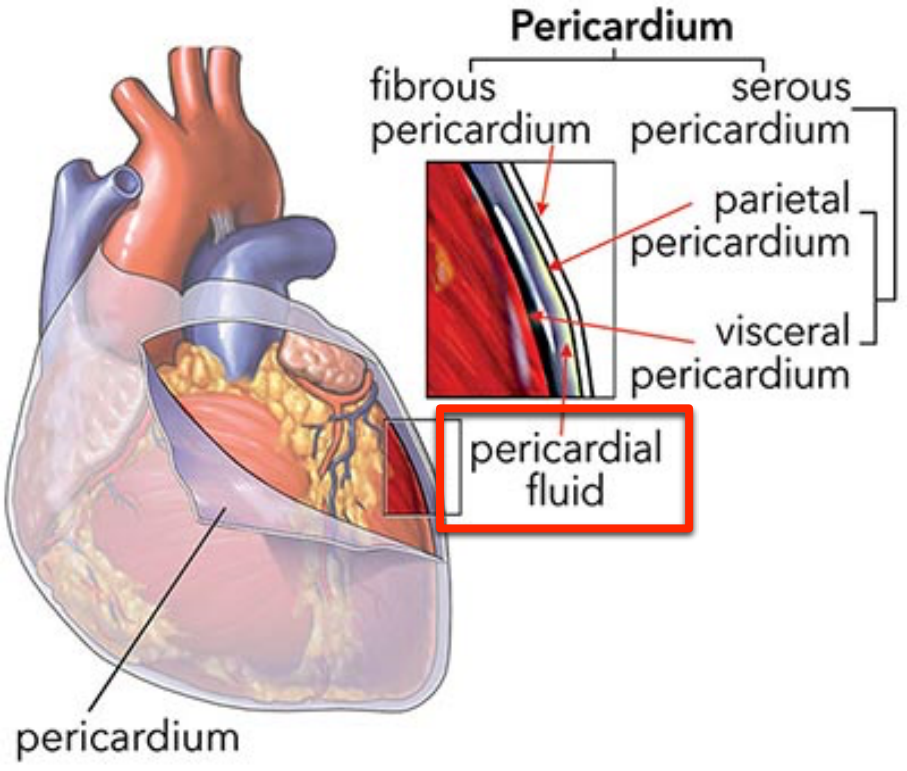

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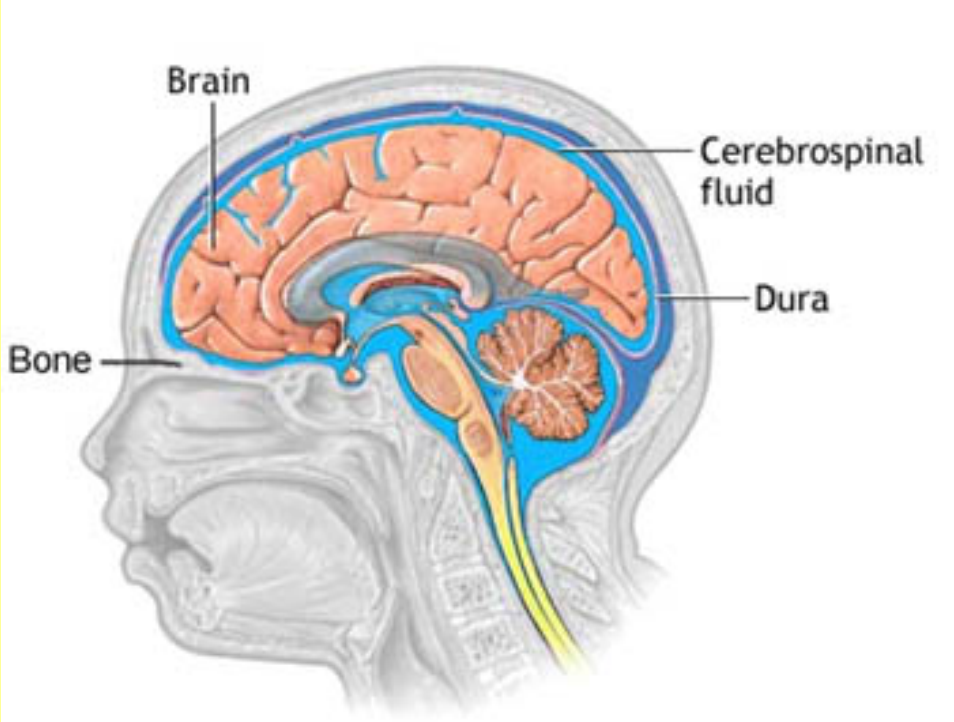

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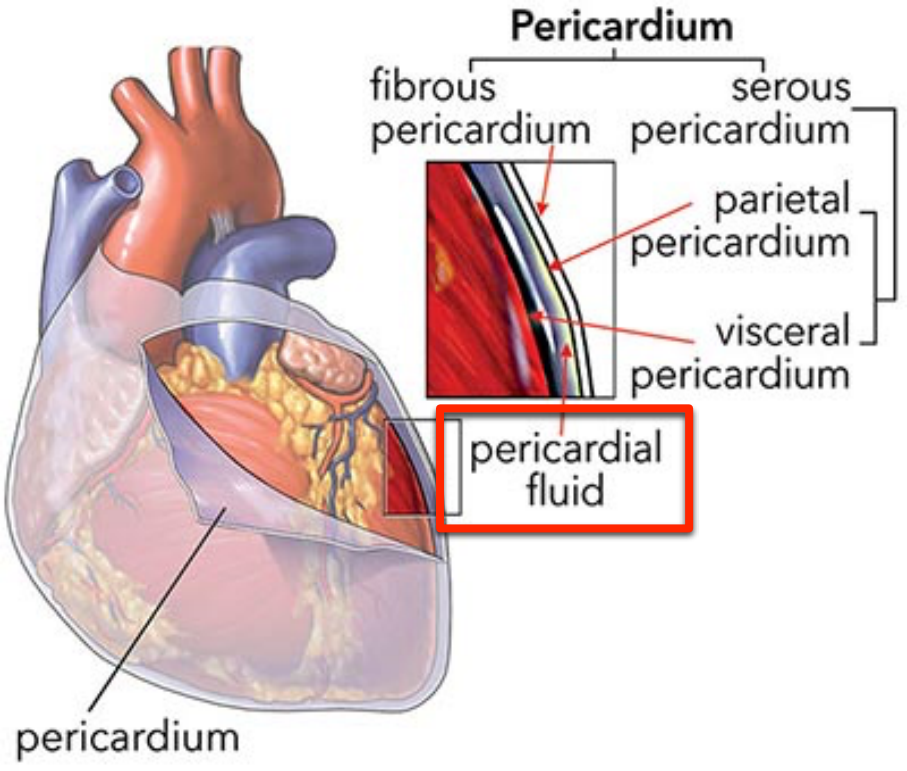

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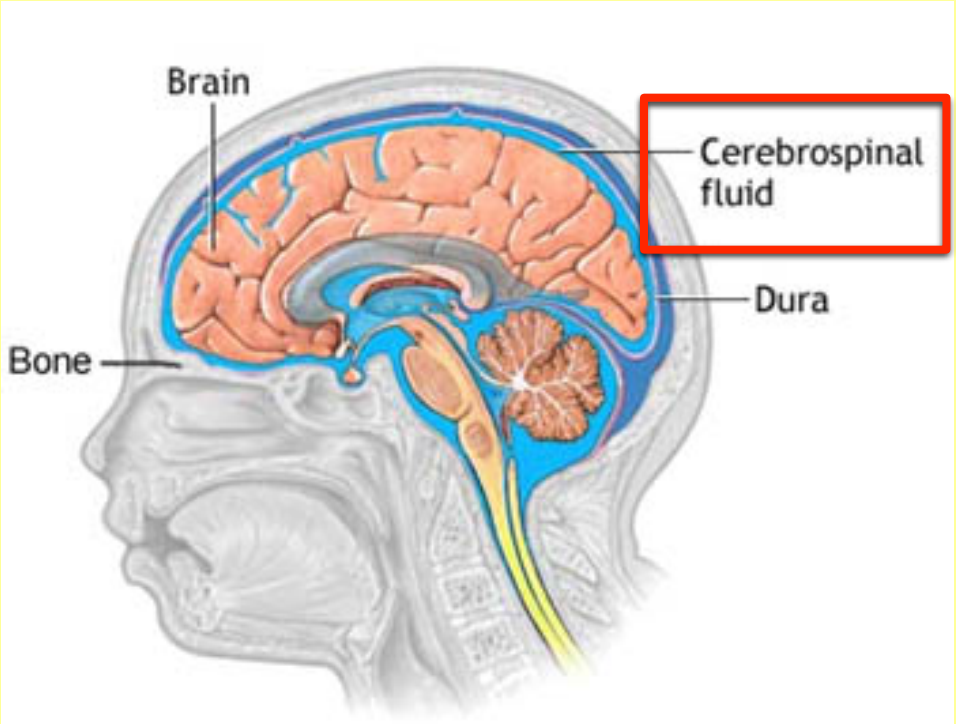

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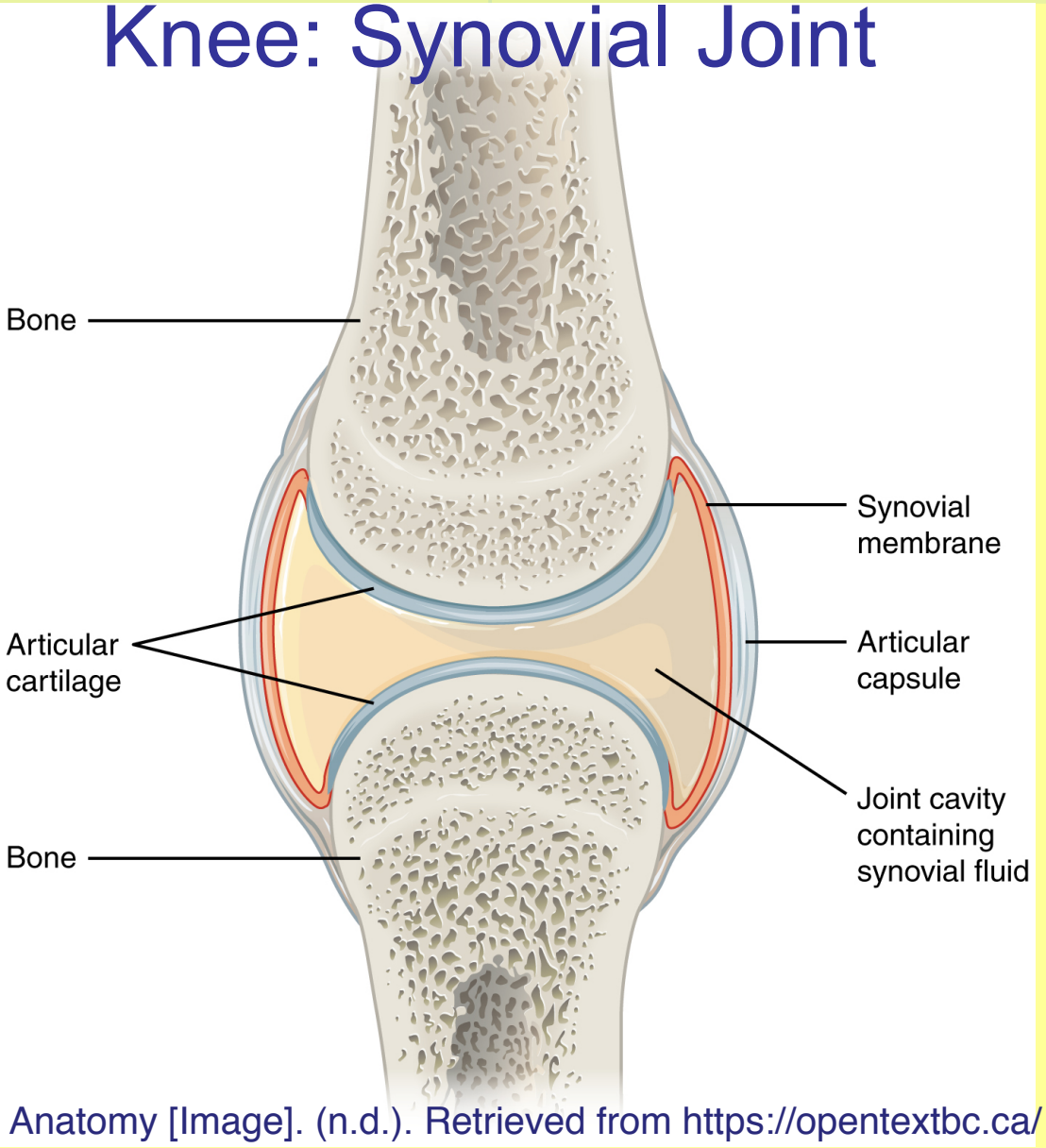
Water Lubricates Joints

Knee: Synovial Joint



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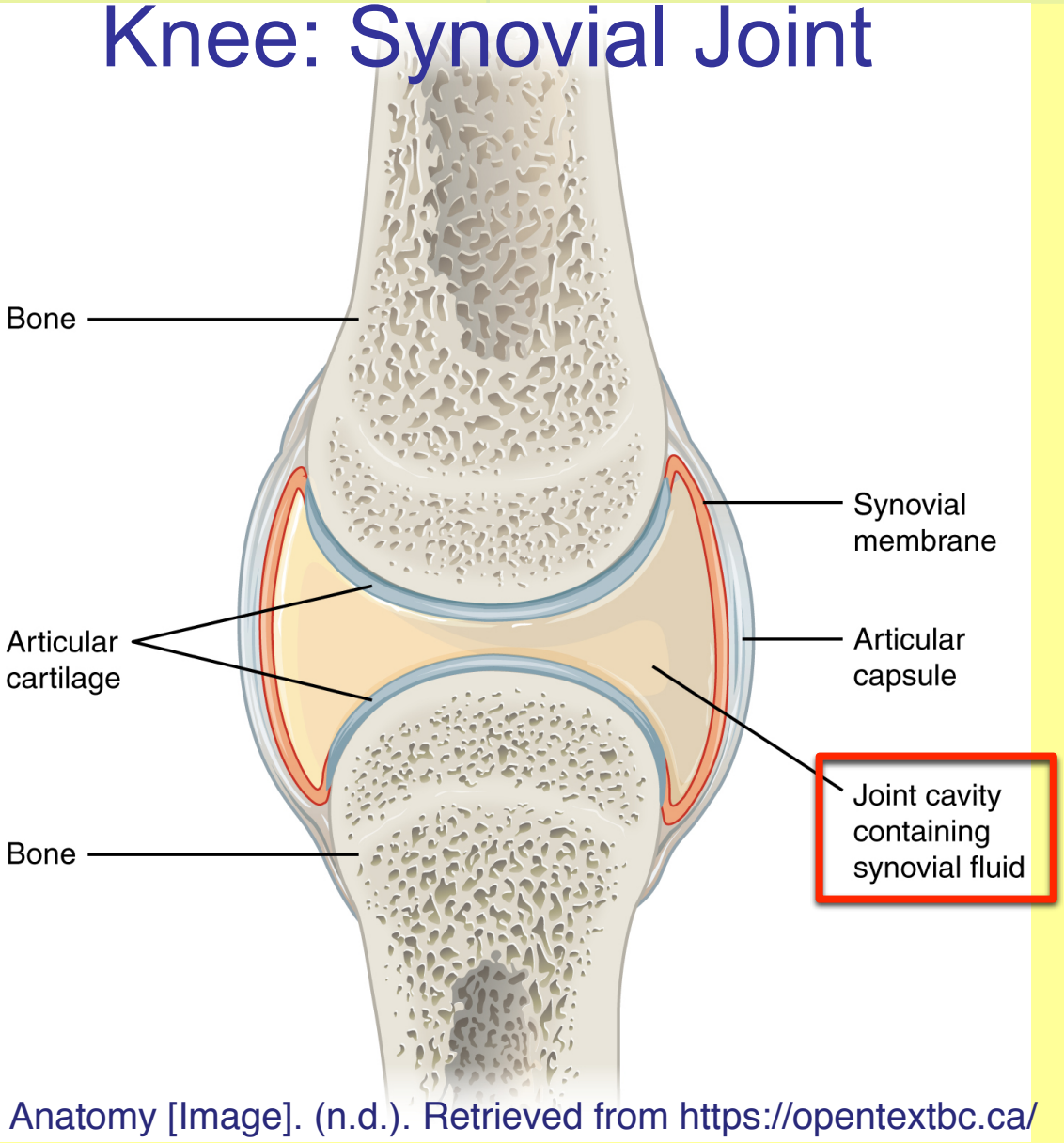

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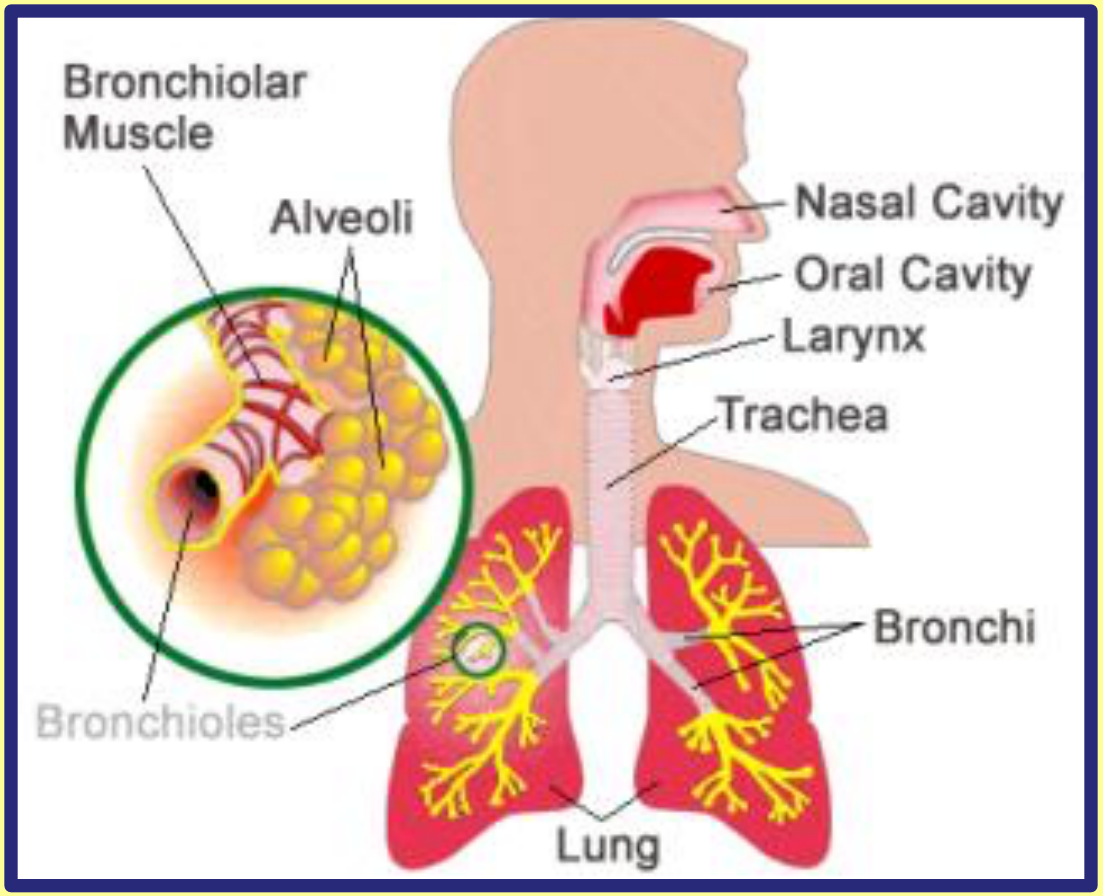
Water Moistens Air for Breathing

- Occurs in Nasal Cavity and Paranasal Sinuses



Lung Anatomy [Image]. (n.d.). Retrieved from http://leavingbio.net/respiratory-system/

- Nasal Cavity has cilia that secrete mucous to warm and humidify air
- Increases water vapor inhaled, to prevent damage to lung and other respiratory structures

(Hoehn & Marieb, 2017; Chang, J., 2017)

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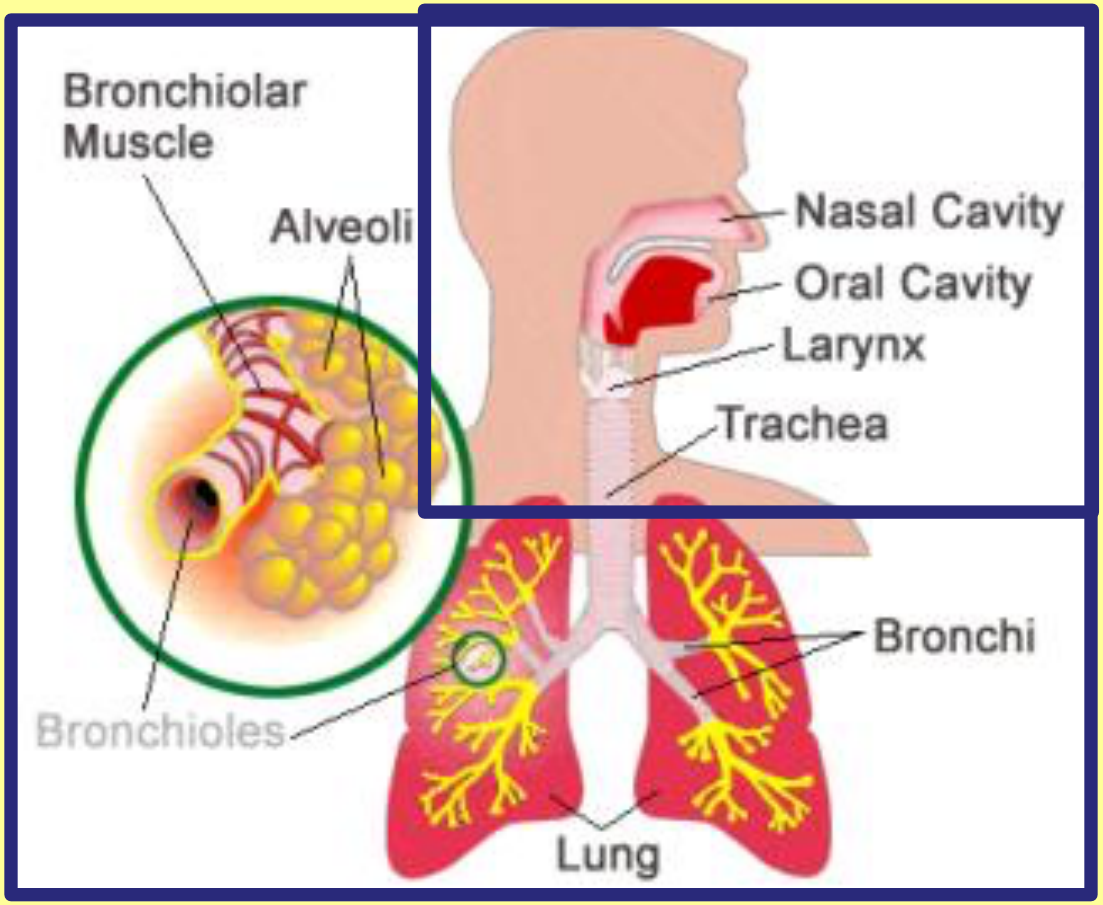

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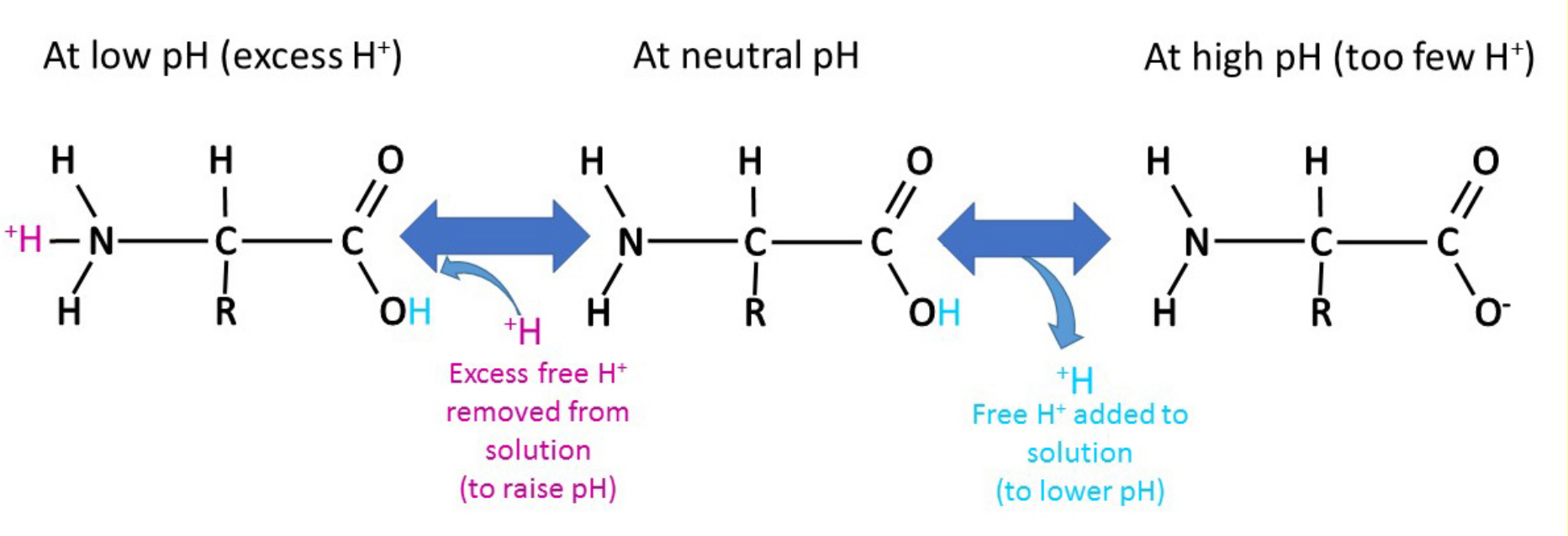
Water Helps Modulate Acid/Base Balance

Buffer Systems

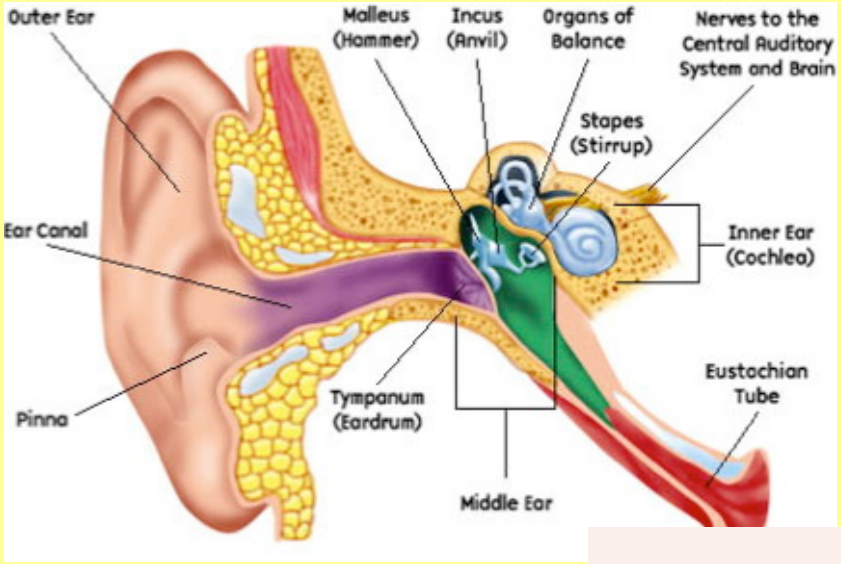
- Hemoglobin
- Phosphate
- Bicarbonate-Carbonic
- Renal Regulation
- Protein



Protein Buffer System [Image]. (n.d.). Retrieved from https://courses.lumenlearning.com/cuny-kbcc-ap2/chapter/acid-base-balance-no-content/

Water transmits Sound, Light, and Sense of Odor

Ear: Sound



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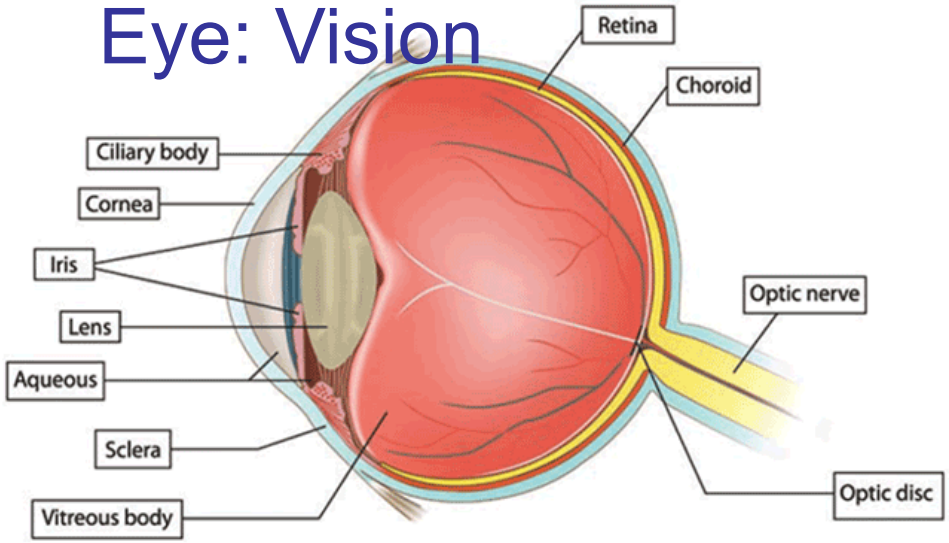
Eye: Vision



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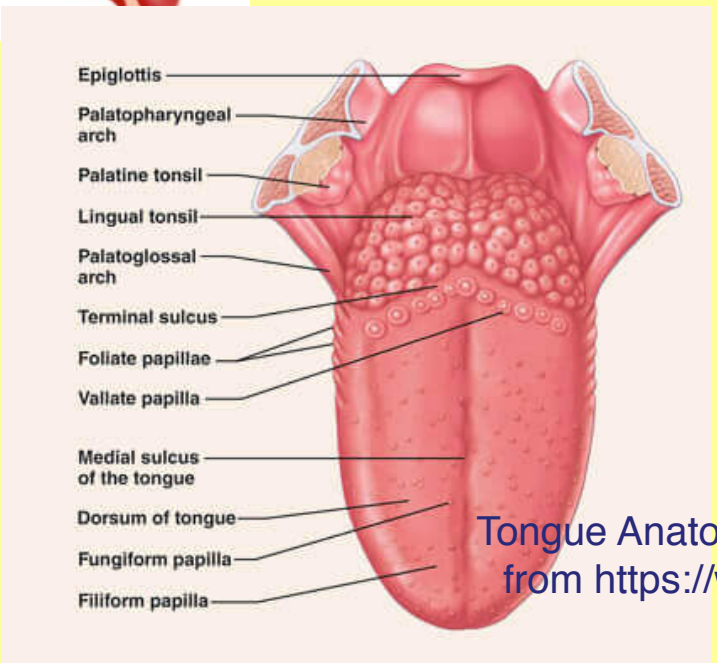

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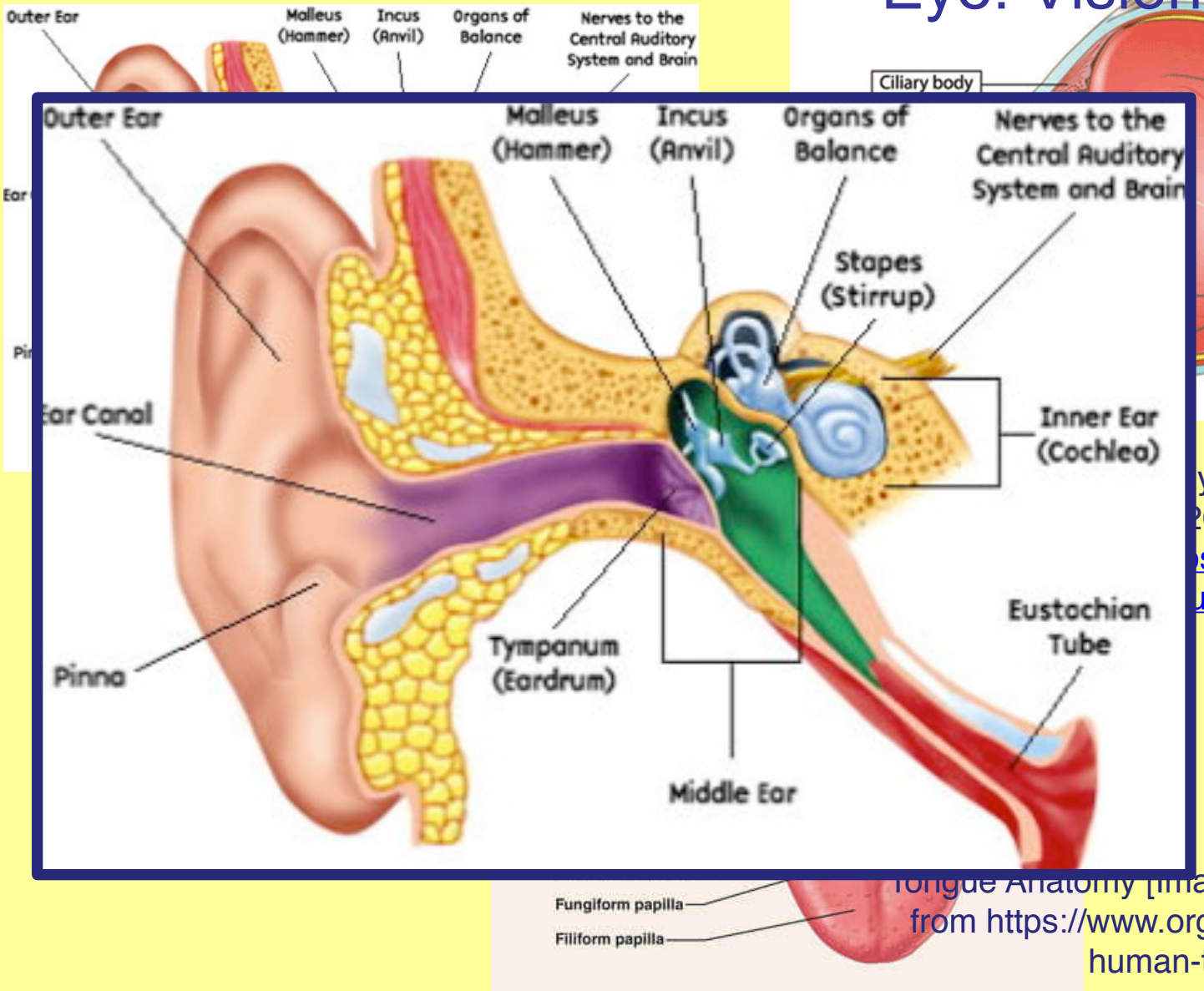

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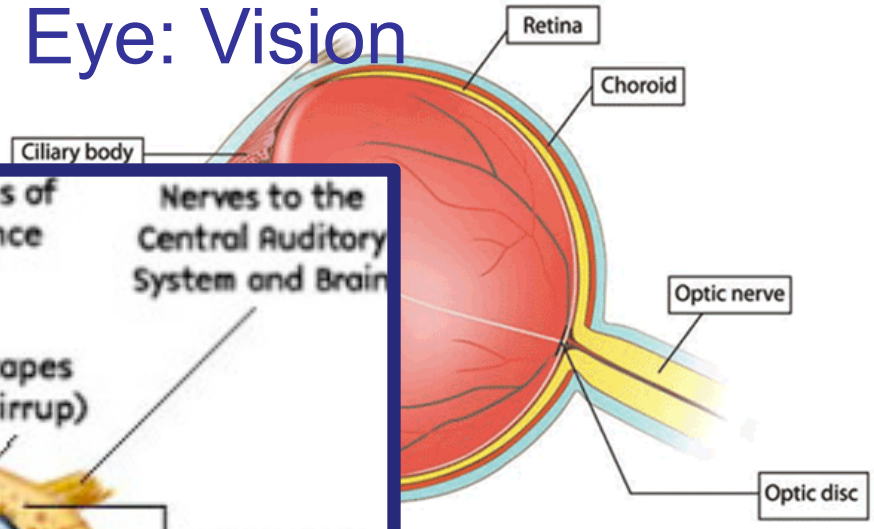

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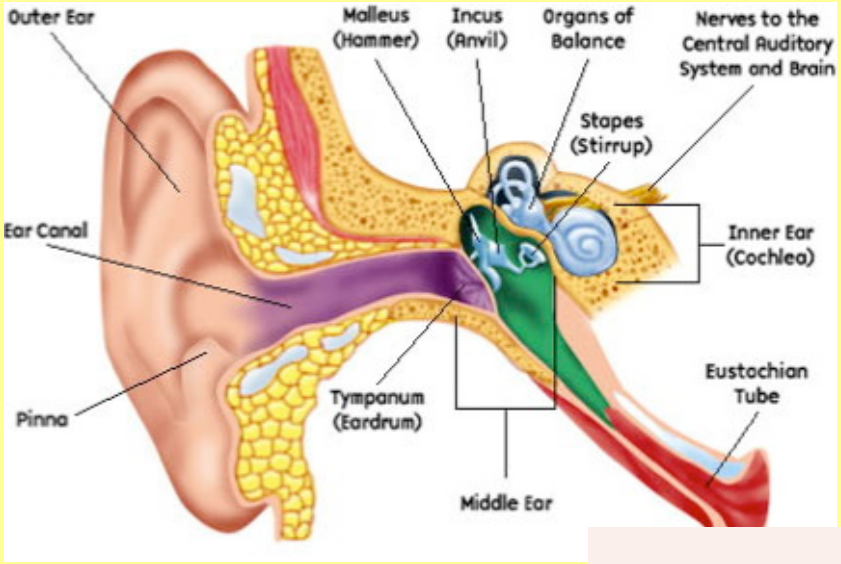

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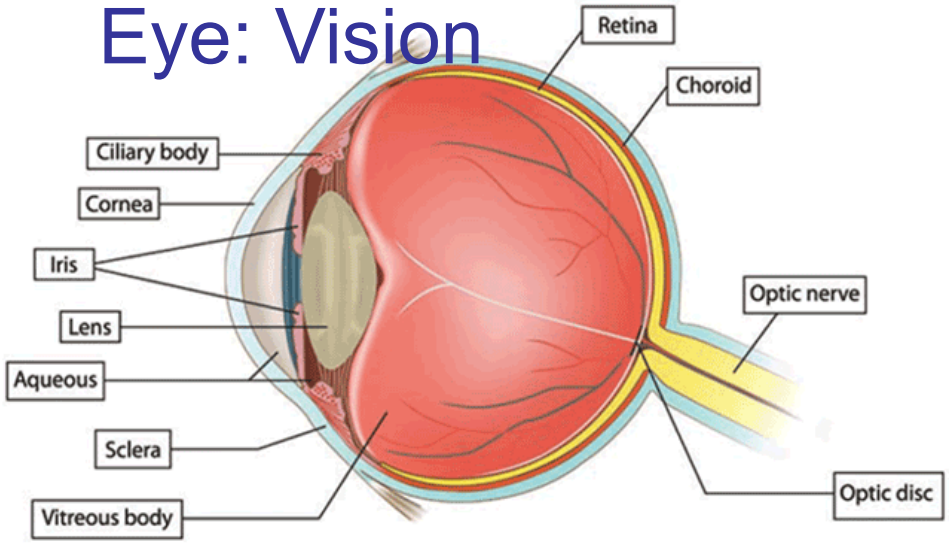

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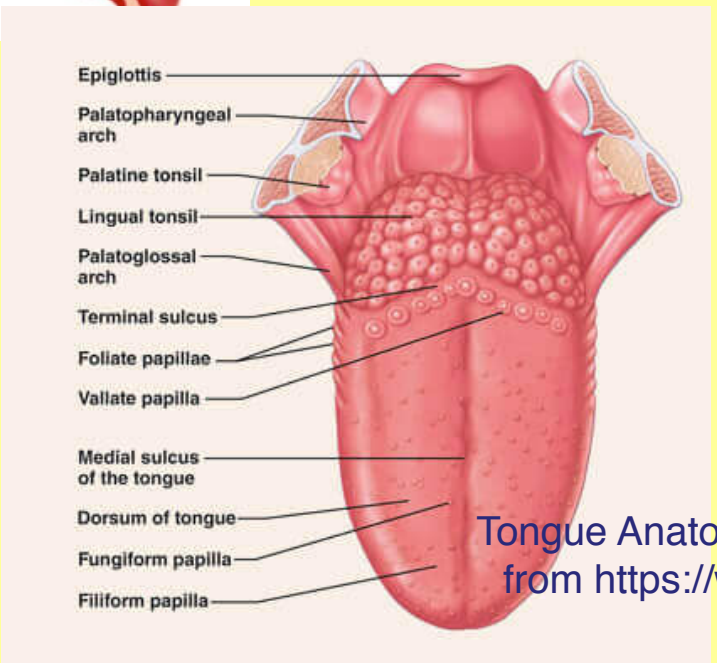

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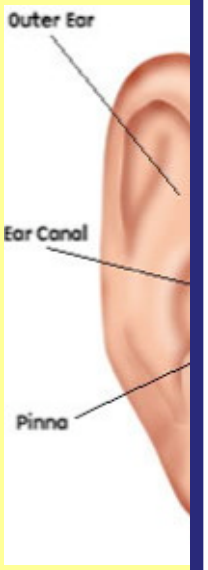

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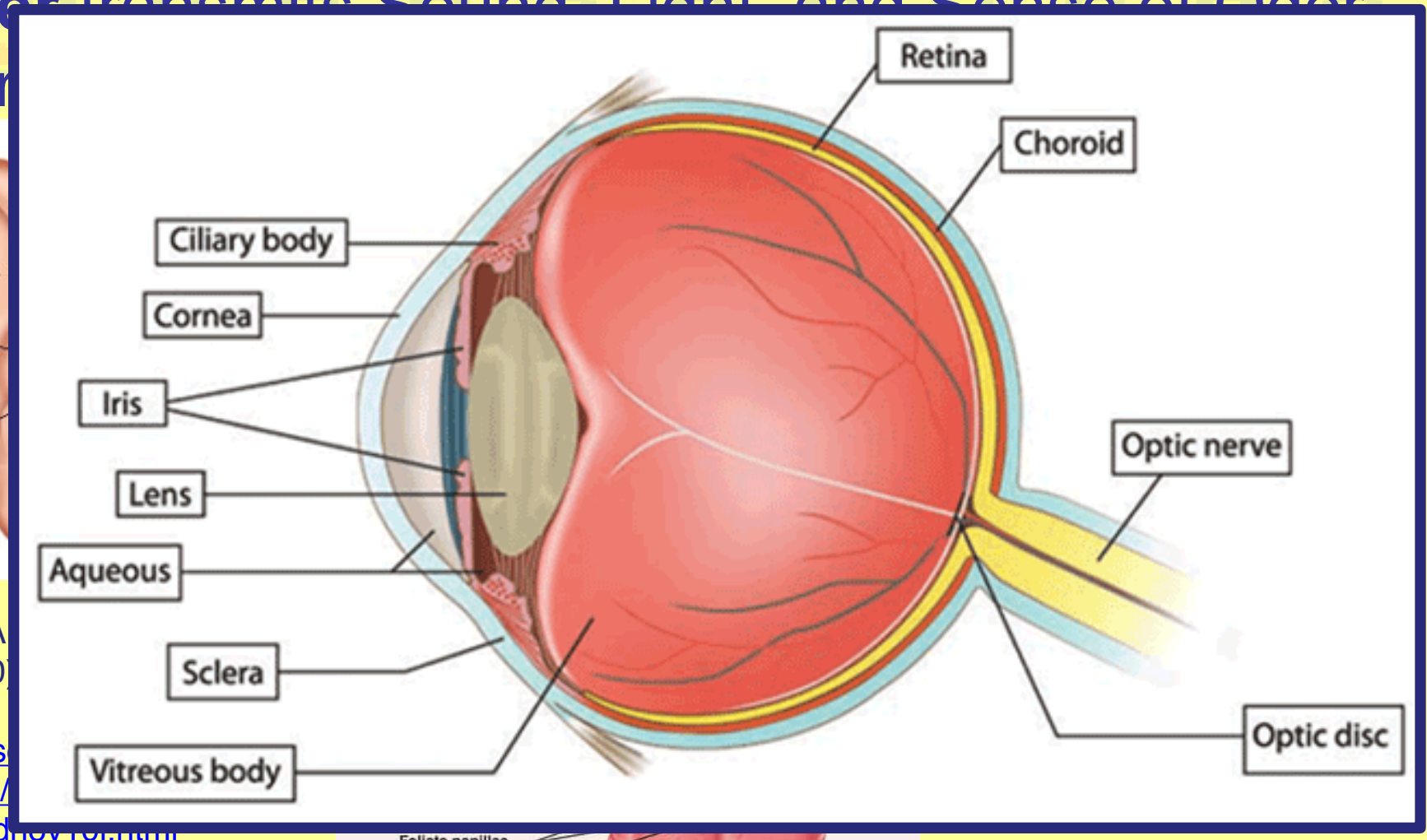

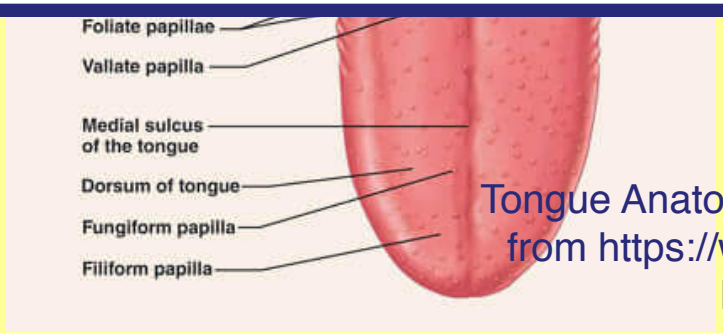

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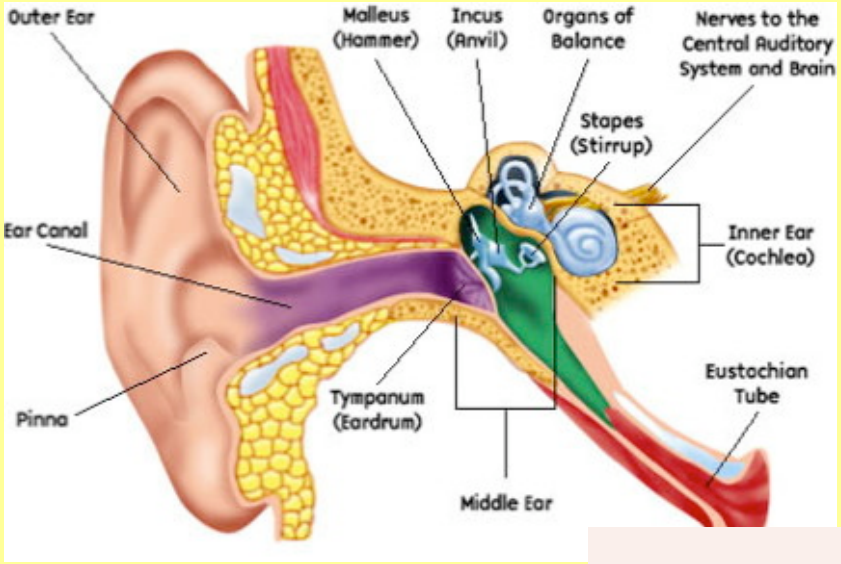

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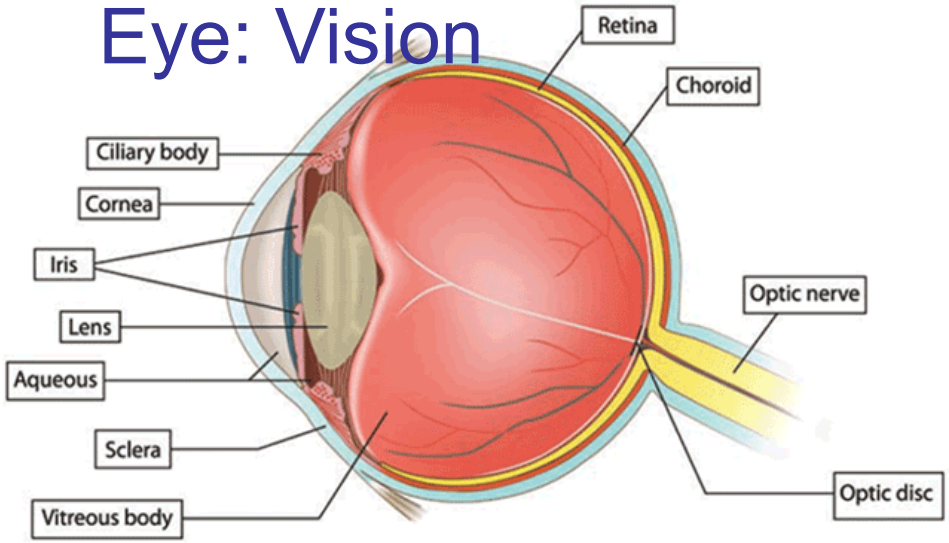

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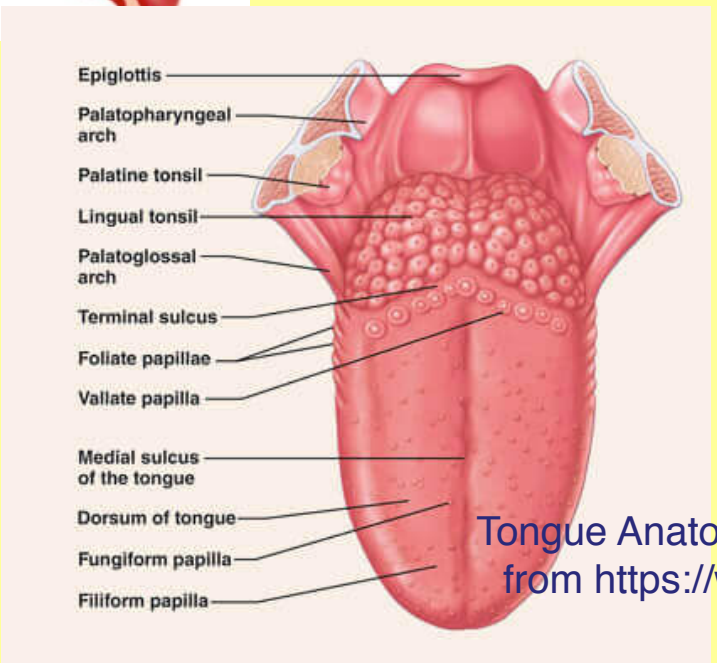

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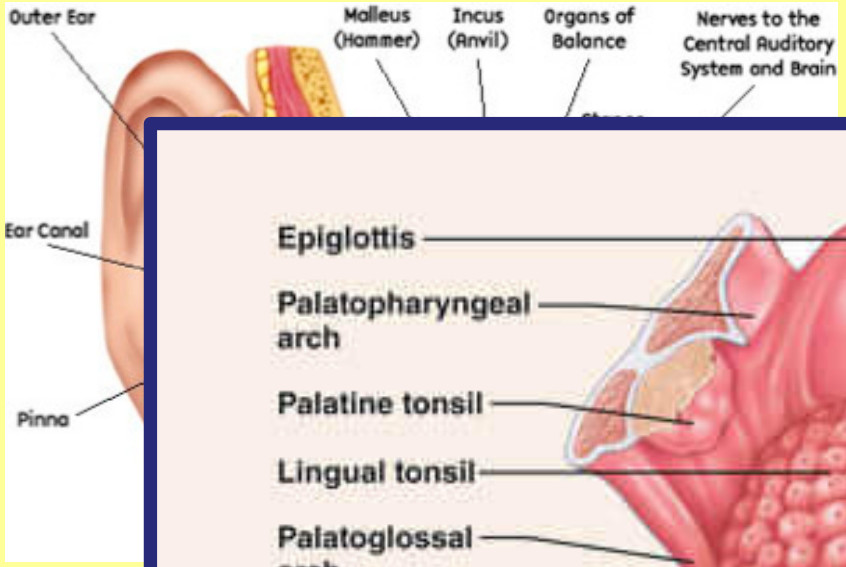

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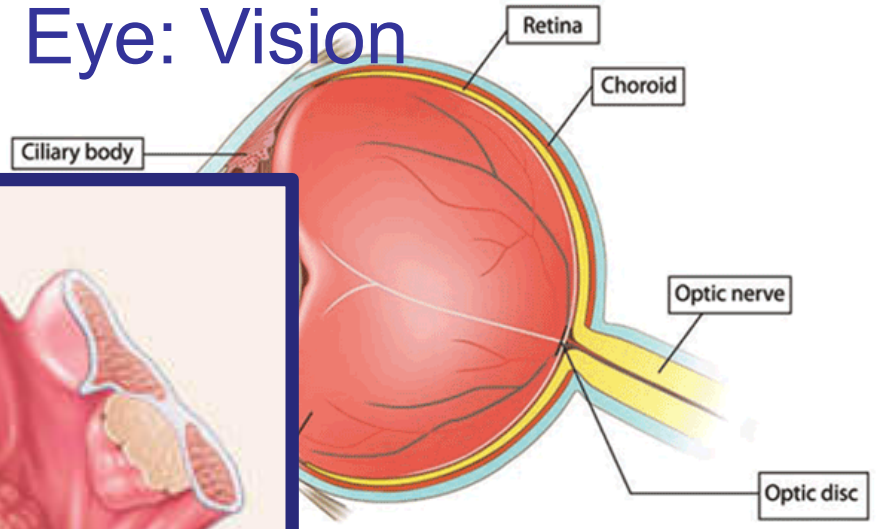

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ny [Image]. (n.d.). Retrieved
ww.organsofthebody.com/
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Physiology of Thirst

Factors Affecting Hydration

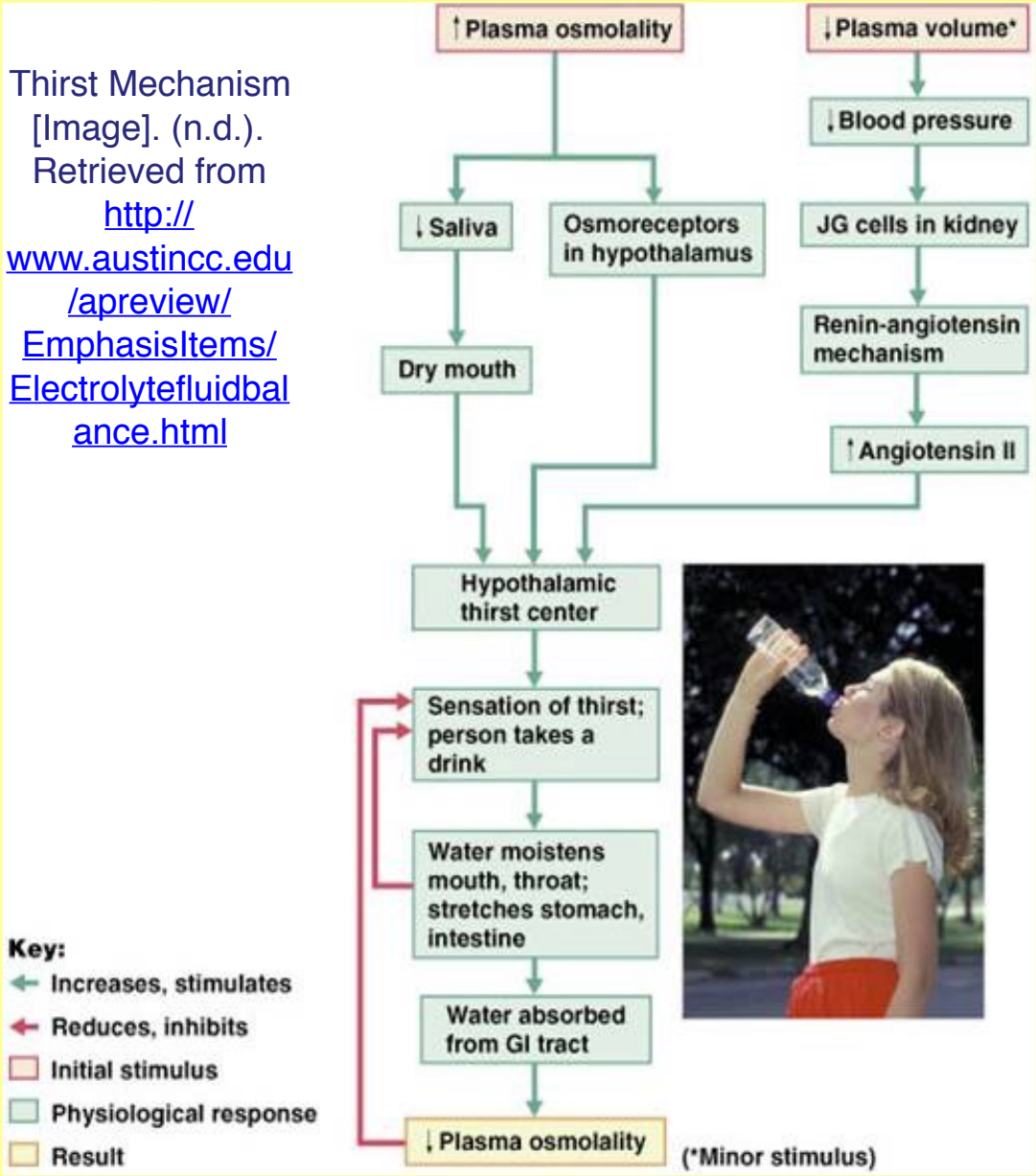
- Demographic - including Educational and Cultural Background
- Physiological
  - Disease
  - Excretion Rate
- Environmental
  - Altitude, temperature, and weather
- Age
- Varying types of fluid that are drunk

(Kleiner, 1999; D'Anci, Popkin, & Rosenberg, 2015)

Thirst Mechanism

- Controlled by **osmoreceptors** and **decrease in volume**
- **Osmoreceptors** detect change in ECF Osmolality
  - Activated by 1% - 2% change
- **Decrease in volume**
  - Activated by 5% - 10% change

Thirst Mechanism [Image]. (n.d.). Retrieved from http://www.austincc.edu/apreview/EmphasisItems/Electrolytefluidbalance.html



(Kleiner, 1999; Hoehn & Marieb, 2017)

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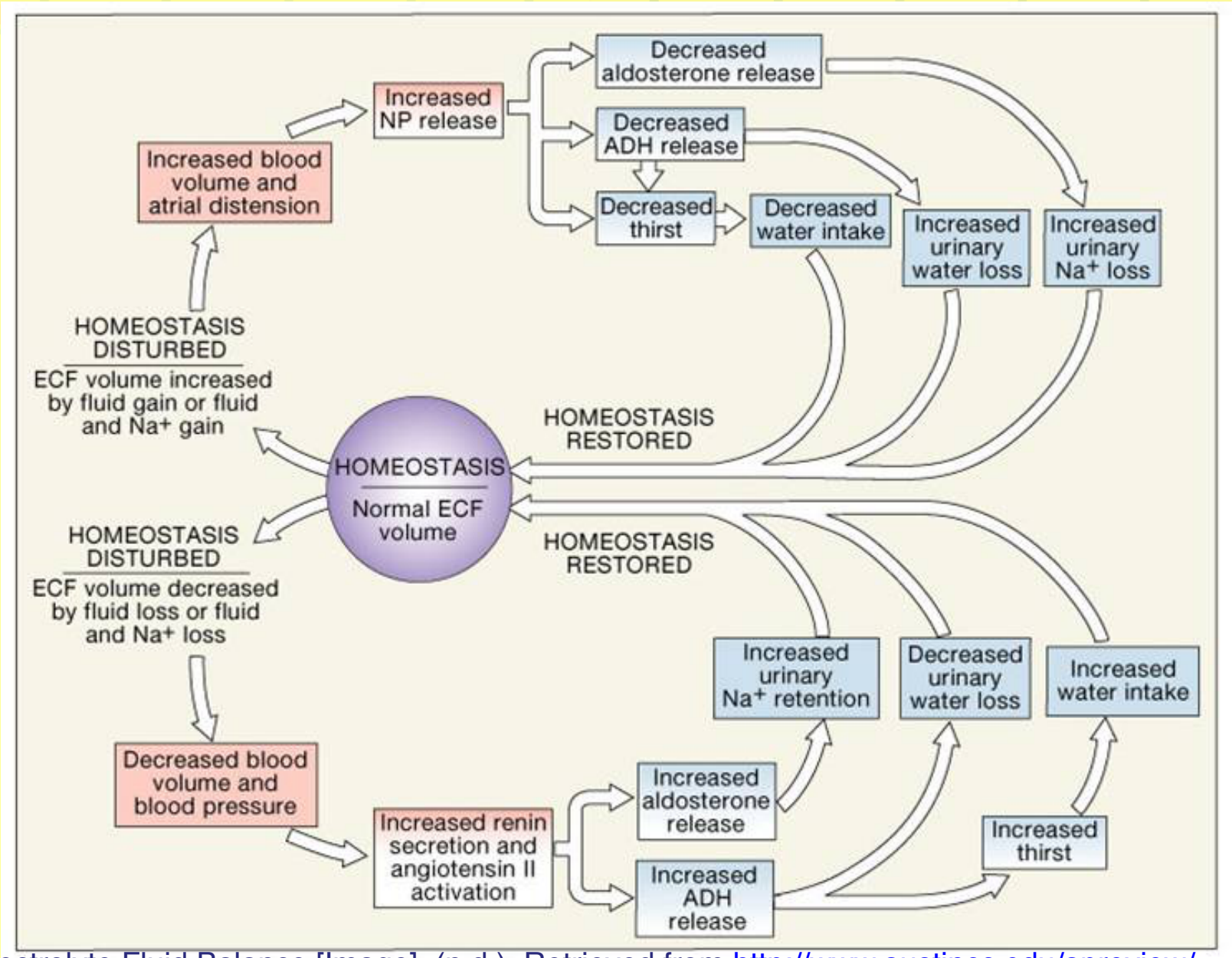

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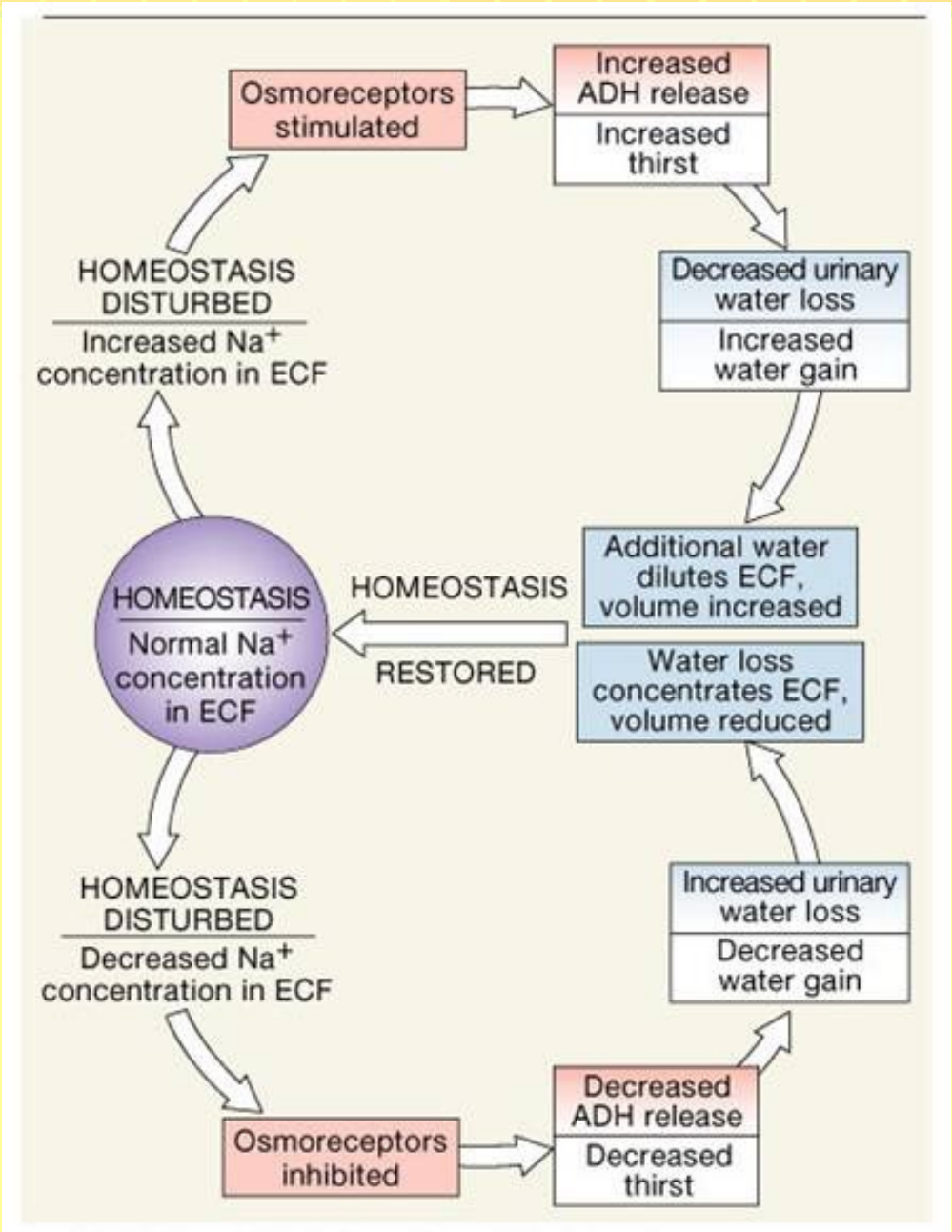

Sodium Balance [Image]. (n.d.). Retrieved from http://www.austincc.edu/apreview/EmphasisItems/Electrolytefluidbalance.html

Detriments of Not Intaking Enough Fluids

- The issues with not drinking enough fluids are numerous.
- Studies have shown correlation with:
  - Increase Risk of Disease or Illness
  - Organ Damage
  - Physical and Cognitive Impairment

Table 2 **Summary of the evidence linking dehydration and overhydration to health disorders**

Health disorder	Summary of findings	Level of evidence[a]
Urological		
UTIs	Inconsistent findings; however, evidence largely favors the positive effects of "adequate" fluid intake on UTIs	IIb
Urolithiasis	Evidence largely from epidemiological studies and RCTs reporting beneficial effects of increased fluid consumption in preventing urolithiasis recurrence	Ib
Chronic kidney disease	One population-based cross-sectional study showed reduced risk of developing chronic kidney disease associated with increased fluid consumption	IV
Bladder cancer	Conflicting evidence on the link between chronic dehydration and bladder cancer	III
Gastrointestinal		
Functional constipation	Some evidence to suggest dehydration is a cause of functional constipation. The strongest evidence favors increased fluid consumption to treat constipation during a state of dehydration and as an adjunct to a high-fiber diet	III
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Circulatory		
DVT	Limited number of studies. Serum hyperosmolality associated with increased risk of DVT in hospitalized patients with stroke	III
Cerebral infarct	Limited evidence directly linking dehydration as a cause of cerebral infarct; however, some evidence linking serum hyperosmolality to poor outcome following stroke	III
CHD	Strongest evidence from a large prospective cohort study that reported that increased water consumption was inversely associated with reduced risk of fatal CHD events	IIb
Orthostatic hypotension	Good evidence linking dehydration and orthostatic hypotension, particularly in severe cases that result in significant hypovolemia	IIb
MVP	Limited evidence showing that acute mild dehydration induced MVP in healthy individuals and resolved with rehydration	III
Neurological		
Delirium	Evidence linking dehydration to cognitive impairment is inconsistent. An inverse relationship has been reported between increased water consumption and delirium in residents of long-term care facilities	III
Headache	No direct link between dehydration as a cause of headache. Evidence supports increased water consumption to help limit the intensity of migraines	IIb

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Metabolic disorders		
Diabetes mellitus	Evidence from a cohort study suggests an inverse relationship between increased water consumption and type II diabetes. Strongest evidence supports the link between dehydration and poor clinical outcome with diabetic ketoacidosis	III
Obesity	Inconsistent evidence linking increased water consumption in relation to meals to treat obesity. Some evidence supports the effects of consuming cold water on increased basal metabolic rate	III
Respiratory disorders	Evidence suggests that dehydration in the airways may result in bronchoconstriction, and inspiration of humidified air has been shown to be beneficial in obstructive airway disease. However, no link between total body fluid balance and bronchoconstriction has been found	III
Pregnancy, labor, and breastfeeding		
Oligohydramnios	Good evidence from multiple RCTs and systematic reviews concluding that dehydration results in a reduced amniotic fluid index, which increases with rehydration	Ib
Labor	Good evidence from multiple RCTs and systematic reviews concluding that 250 mL/h of intravenous fluid results in reduced frequency of prolonged labor in fasted women. However, when patients ate and drank liberally, no clear differences were observed	IIb
Breastfeeding	Limited evidence suggesting that dehydration does not affect the quality or quantity of breast milk	IV
Other conditions		
Dental disorders, hypertension, gallstones, and breast cancer	Limited evidence to suggest that dehydration can predispose to dental disorders, hypertension, gallstones, and breast cancer	IV

Evidence Linking Dehydration [Table] (2015). El-Sharkawy, Lobo, & Sahoto,

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Respiratory disorders	Evidence suggests that dehydration in the airways may result in bronchoconstriction, and inspiration of humidified air has been shown to be beneficial in obstructive airway disease. However, no link between total body fluid balance and bronchoconstriction has been found	III
Pregnancy, labor, and breastfeeding		
Oligohydramnios	Good evidence from multiple RCTs and systematic reviews concluding that dehydration results in a reduced amniotic fluid index, which increases with rehydration	Ib
Labor	Good evidence from multiple RCTs and systematic reviews concluding that 250 mL/h of intravenous fluid results in reduced frequency of prolonged labor in fasted women. However, when patients ate and drank liberally, no clear differences were observed	IIb
Breastfeeding	Limited evidence suggesting that dehydration does not affect the quality or quantity of breast milk	IV
Other conditions		
Dental disorders, hypertension, gallstones, and breast cancer	Limited evidence to suggest that dehydration can predispose to dental disorders, hypertension, gallstones, and breast cancer	IV

Evidence Linking Dehydration [Table] (2015). El-Sharkawy, Lobo, & Sahoto,

Metabolic disorders		
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Circulatory Disorders

Fatal Congestive/Coronary Heart Disease

- Congestive Heart Disease occurs when the heart cannot pump the blood adequately due to a weakened heart or stiff heart
- Coronary Heart Disease - narrowed arteries around the heart that don't allow the heart to beat as well
- Some evidence that increased fluid intake decreases the risk of fatal events due to Congestive/Coronary Heart Disease

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010)

Circulatory Disorders

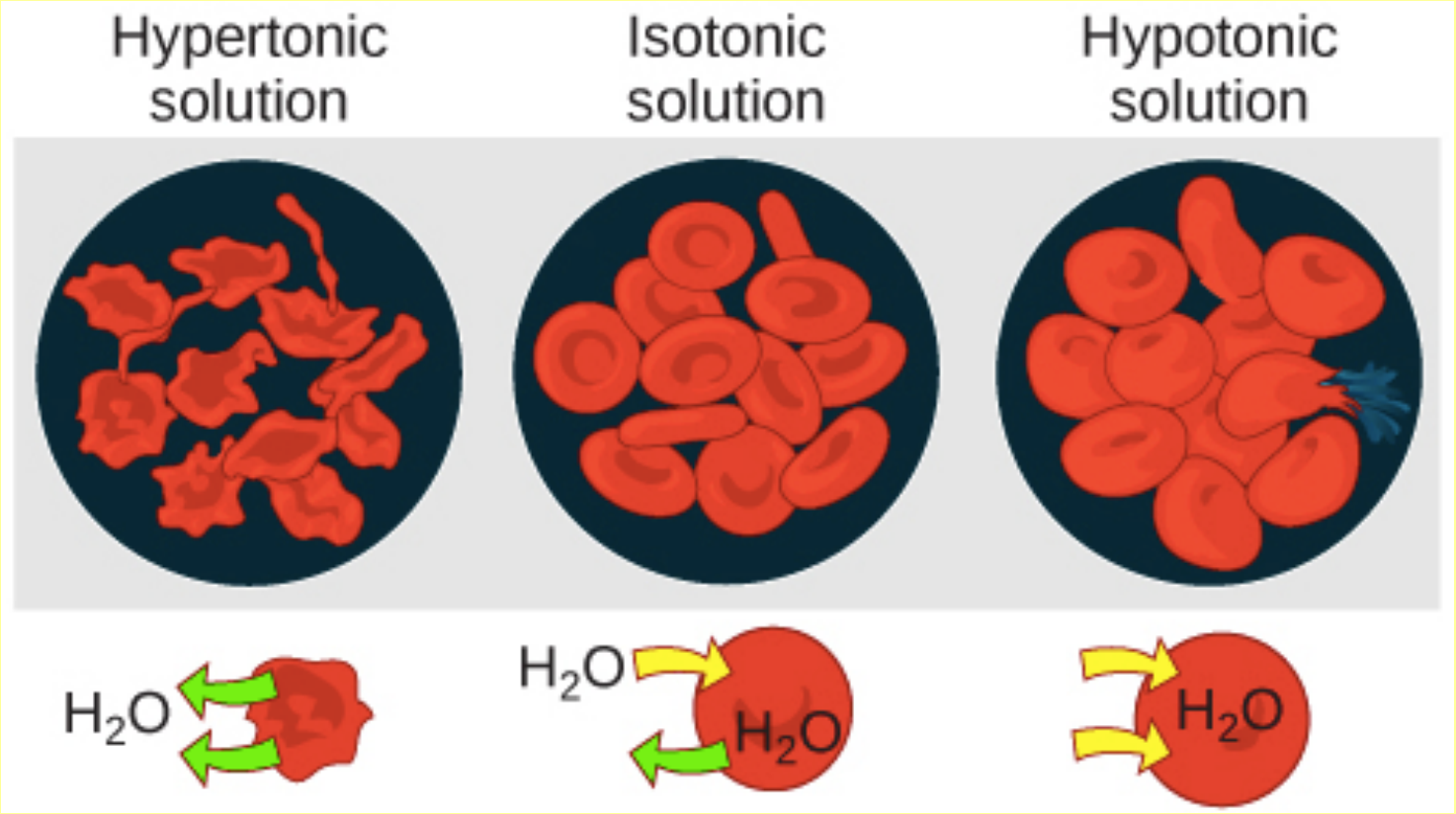
Orthostatic Hypotension

- Decrease in systolic blood pressure by 20 mmHg or a decrease of diastolic blood pressure by 10 mmHg, 3 minutes after standing from the blood pressure of sitting position or supine position
- Dehydration is directly linked to orthostatic hypotension

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010; Clay, E.C., Lanier, J.B., & Mote, M.B., 2011)

Circulatory Disorders

Cellular Disruption



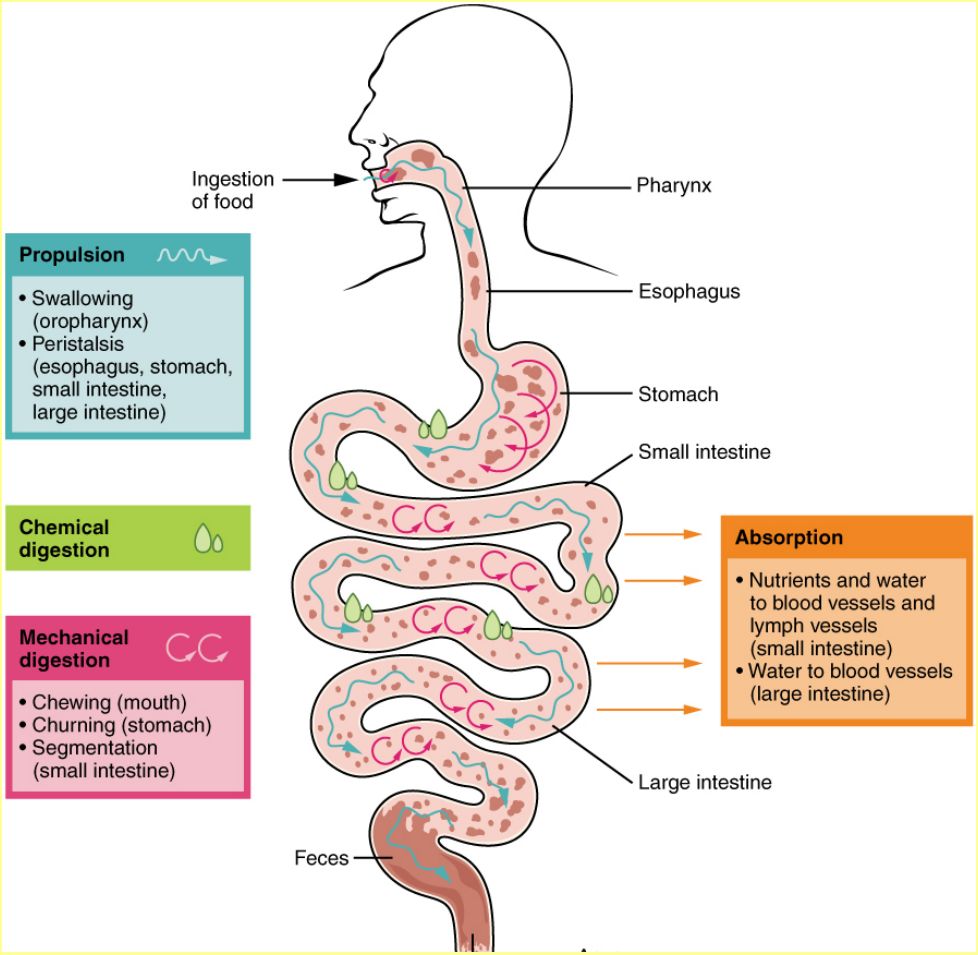
RBC's in Solutions [Image]. (n.d.). Retrieved from https://www.khanacademy.org/science/high-school-biology/hs-energy-and-transport/hs-osmosis-and-tonicity/v/hypotonic-isotonic-and-hypertonic-solutions-tonicity

Gastrointestinal Disorders

Constipation

- Infrequent bowel movements or difficulty in passing stools
- Dehydration is a cause of constipation

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010)



Digestion and Absorption [Image]. (n.d.). Retrieved from https://opentextbc.ca/anatomyandphysiology/chapter/23-2-digestive-system-processes-and-regulation/

Metabolic Disorders

Hyperglycemia

- High blood sugar or glucose values in the blood
- Often associated with diabetes mellitus
- Possible protective effect in increasing fluid consumption in the development of hyperglycemia

(El-Sharkawy, Lobo, & Sahoto, 2015)

Metabolic Disorders

Hyperglyce

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- Often a…ellitus
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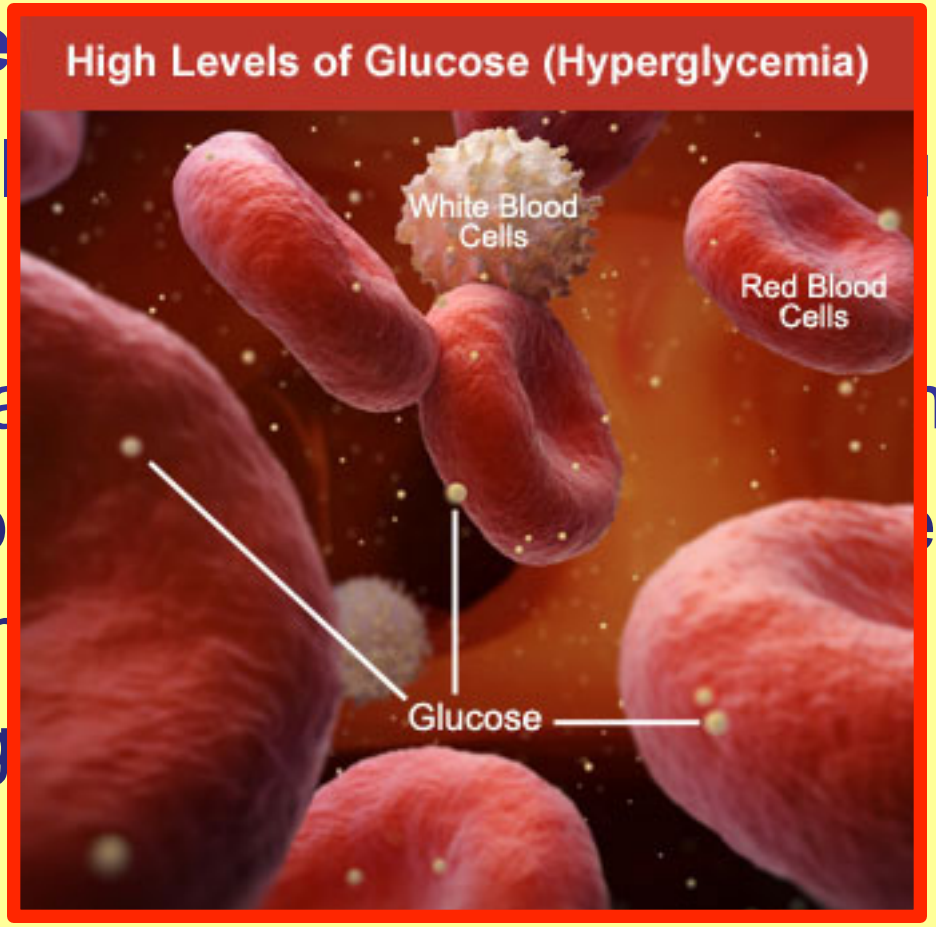

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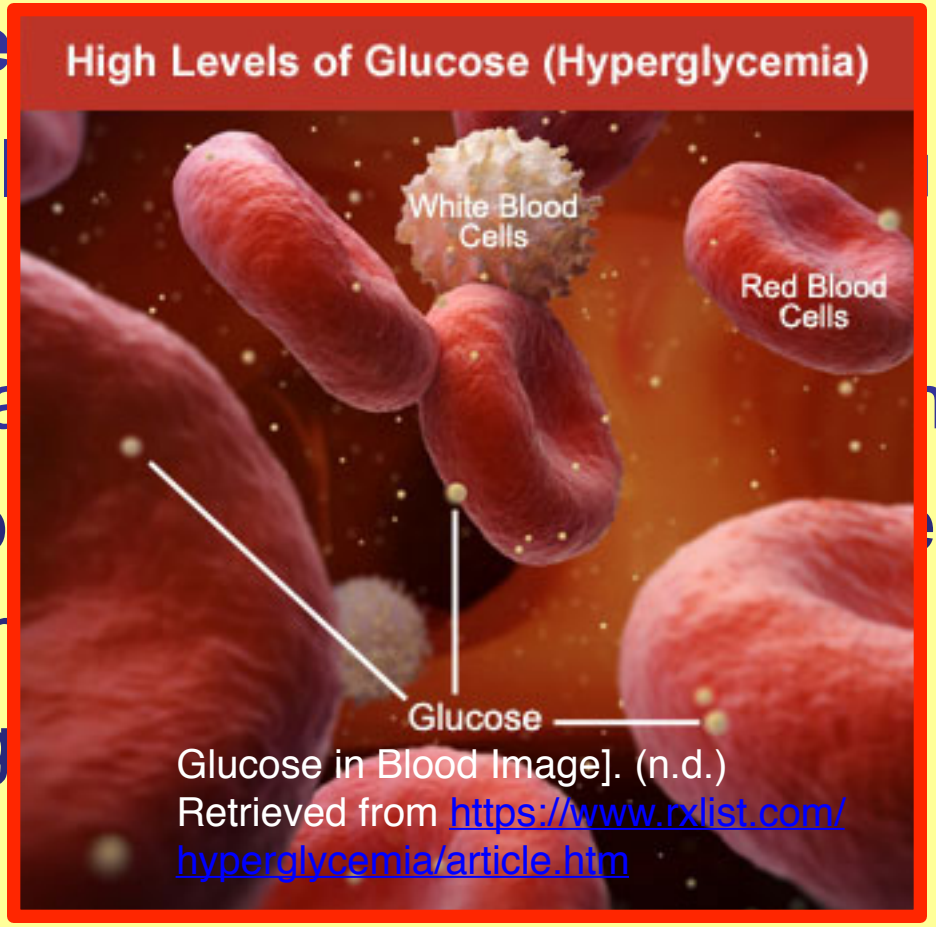

Glucose in Blood Image]. (n.d.) Retrieved from https://www.rxlist.com/hyperglycemia/article.htm

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(El-Sharkawy, Lobo, & Sahoto, 2015)

Urological

Urinary Tract Infection (UTI)

- Infection in the Urinary System
- Proper hydration has been shown to decrease the risk of UTI's
- Some evidence that an increased water consumption may help treat a UTI

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010)

Urological

Urolithiasis

- Formation of stones formed in urinary system, including the kidneys and bladder
- Increased water consumption lowers the risk of urolithiasis

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010)

Urological - Kidney

Chronic Kidney Disease

- Permanent damage to the kidney that prevents it from filtrating and eventually leads to kidney failure
- Increased water consumption may lower the risk of developing chronic kidney disease

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010)

Urological - Kidney

Kidney Disease

- Some evidence shows that “sustained high urine volumes with urine osmolalities below plasma osmolality accelerate the decline of glomerular filtration rate” (D’Anci, Popkin, & Rosenberg, 2010).
- Glomerular Filtration Rate - how much blood passes through the glomeruli each minute
  - 120-125 ml/min
- Causes a decline in the function of kidney
- May increase risks of chronic renal failure, diabetes mellitus, and salt-sensitive hypertension

(Chang, J., 2017; El-Sharkawy, Lobo, & Sahoto, 2015; D’Anci, Popkin, & Rosenberg, 2010; Hoehn & Marieb, 2017)

Respiratory Disorders

Exercise Related Asthma

- Narrowing of the lung airways in response to exercise
- Good evidence that "exercise related asthma is linked with fluid intake" (D'Anci, Popkin, & Rosenberg, 2010).

Obstructive Airway Disorder

- Due to lung damage and/or narrowing of lung airways, causing airway resistance
- Inspiration of humidified air has been shown to be beneficial in obstructive airway disease" (El-Sharkawy, Lobo, & Sahoto, 2015).

(Chang, J., 2017; El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010; Hoehn & Marieb, 2017)

Pregnancy and Labor

Amniotic Fluid Index

- Estimate of amniotic fluid, good indicator for assessing fluid status and well being
- Evidence that dehydration causes reduced amniotic fluid index

Labor

- Good evidence that 250 mL/h of intravenous fluid in women who have fasted has been shown to reduce the frequency of prolonged labor

(El-Sharkawy, Lobo, & Sahoto, 2015; D'Anci, Popkin, & Rosenberg, 2010)

Neurological

Delirium

- Disturbance in mental awareness: confusion and reduced awareness
- Dehydration is “a risk factor for delirium and delirium presenting as dementia in the elderly and the very ill” (D’Anci, Popkin, & Rosenberg, 2010).

(El-Sharkawy, Lobo, & Sahoto, 2015; D’Anci, Popkin, & Rosenberg, 2010)

Neurological

Headache

- “Water deprivation can lead to the development of headache” (D’Anci, Popkin, & Rosenberg, 2010).
- The strongest evidence linking headache and lack of water is “increased water consumption help[s] limit the intensity of migraines” (El-Sharkawy, Lobo, & Sahoto, 2015; D’Anci, Popkin, & Rosenberg, 2010).

(El-Sharkawy, Lobo, & Sahoto, 2015; D’Anci, Popkin, & Rosenberg, 2010)

Physical Performance and Exercise

- Big issue is that people who are participating in physical performance do not remember to drink fluids.
- As they are already losing fluid in sweat, “it is no uncommon for them to lost 6% - 10% in body weight” D’Anci, Popkin, & Rosenberg, 2010).
- Physical activity (exercise or work-related activities) especially in a hot climate, coupled with inadequate fluid replacement, “is associated with hyperthermia, reduced stroke volume, and cardiac output, decreases in blood pressure, and reduced blood flow to muscle” (D’Anci, Popkin, & Rosenberg, 2010)

Cognitive/Mental Performance

- Dehydration has been shown to influence cognitive abilities and performance
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- Mild to moderate dehydration has also been shown to affect “short term memory, perceptual discrimination, arithmetic ability, visumotor tracking, and psychomotor skills” (D’Anci, Popkin, & Rosenberg, 2010).

Identify/Diagnosing Dehydration

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Symptoms **May Include**:

- “Extreme Thirst,
- Less frequent Urination,
- Dark-colored Urine,

Identify/Diagnosing Dehydration

Symptoms **May Include**:

- "Extreme Thirst,
- Less frequent Urination,
- Dark-colored Urine,
- Fatigue,
- Dizziness,
- Confusion"

(Mayo Clinic, n.d.)

Identify/Diagnosing Dehydration

- Urine Specific Gravity
  - Density of substance/Density of Water
  - 1.002-1.030 - Normal Range
- Urine Osmolality
  - Number of Dissolved Particles/Unit of Water
  - 500-800 mOsm/kg of water - Normal Range
- Plasma Osmolality
  - Concentration of all chemical particles found in the fluid part of blood.
  - 275-299 mmoles/kilogram.

(Kleiner, 1999; MedlinePlus, n.d.; Stephens, C. 2018; Wilczynski, C., 2014)

Identify/Diagnosing Dehydration

- Plasma Sodium
  - Regulation in salinity of ECF
  - 135-142 mmol/L
- Hematocrit Level
  - Test that measures proportion of human blood
  - Dehydration can cause a high hematocrit
- Urine Color
- Formation of Concentrated Urine

(Chang, J., 2018, Kleiner, 1999; Hoehn & Marieb, 2017; Sterns, R.H., 2015)

Formation of Concentrated Urine

- Formed in the presence of ADH due to dehydration
- Medullary osmotic gradient formed
- More water is reabsorbed
- Urine is voided with greater most than water
- Up to 99% water can be reabsorbed

(Hoehn & Marieb, 2017; Chang, J., 2017)

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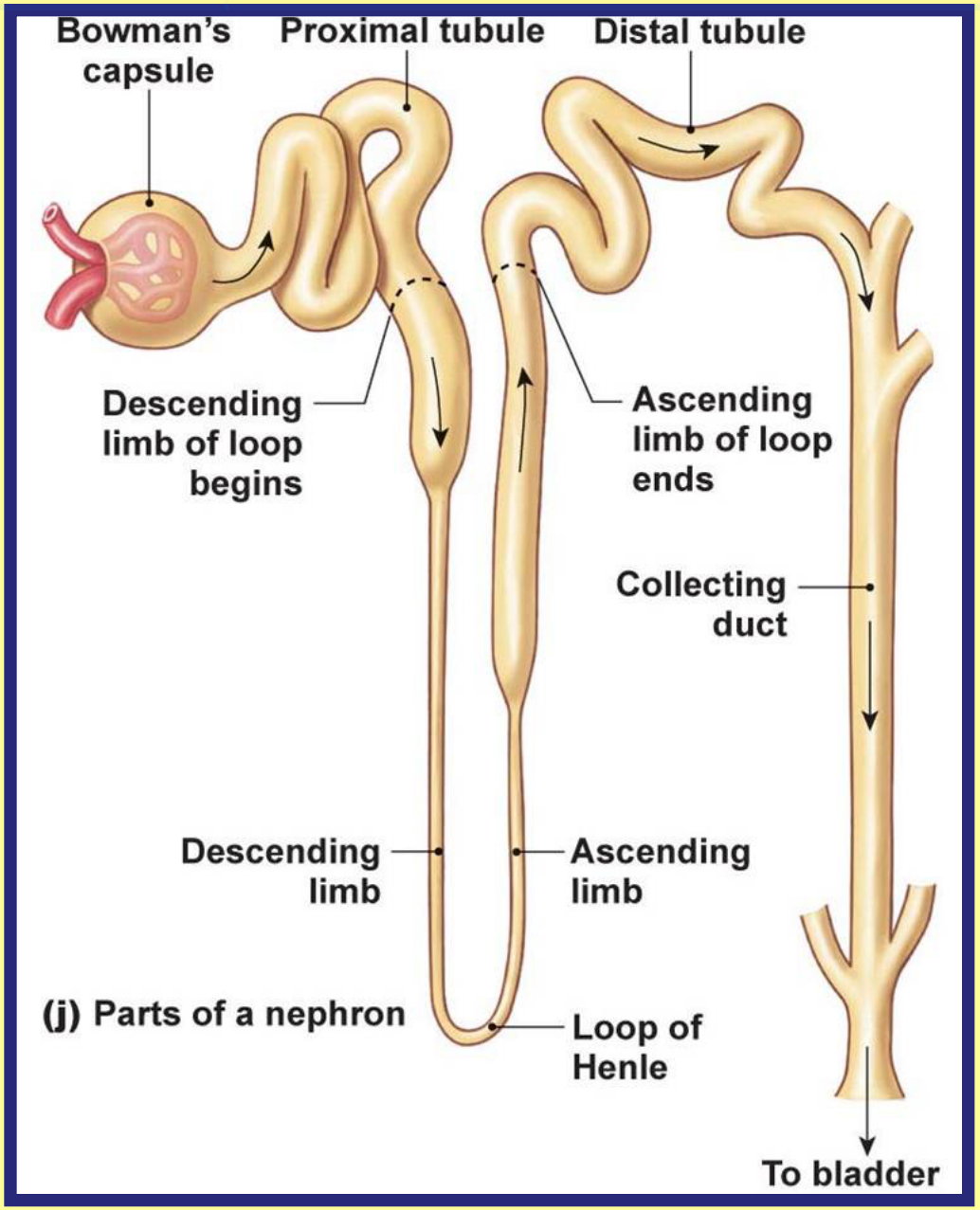

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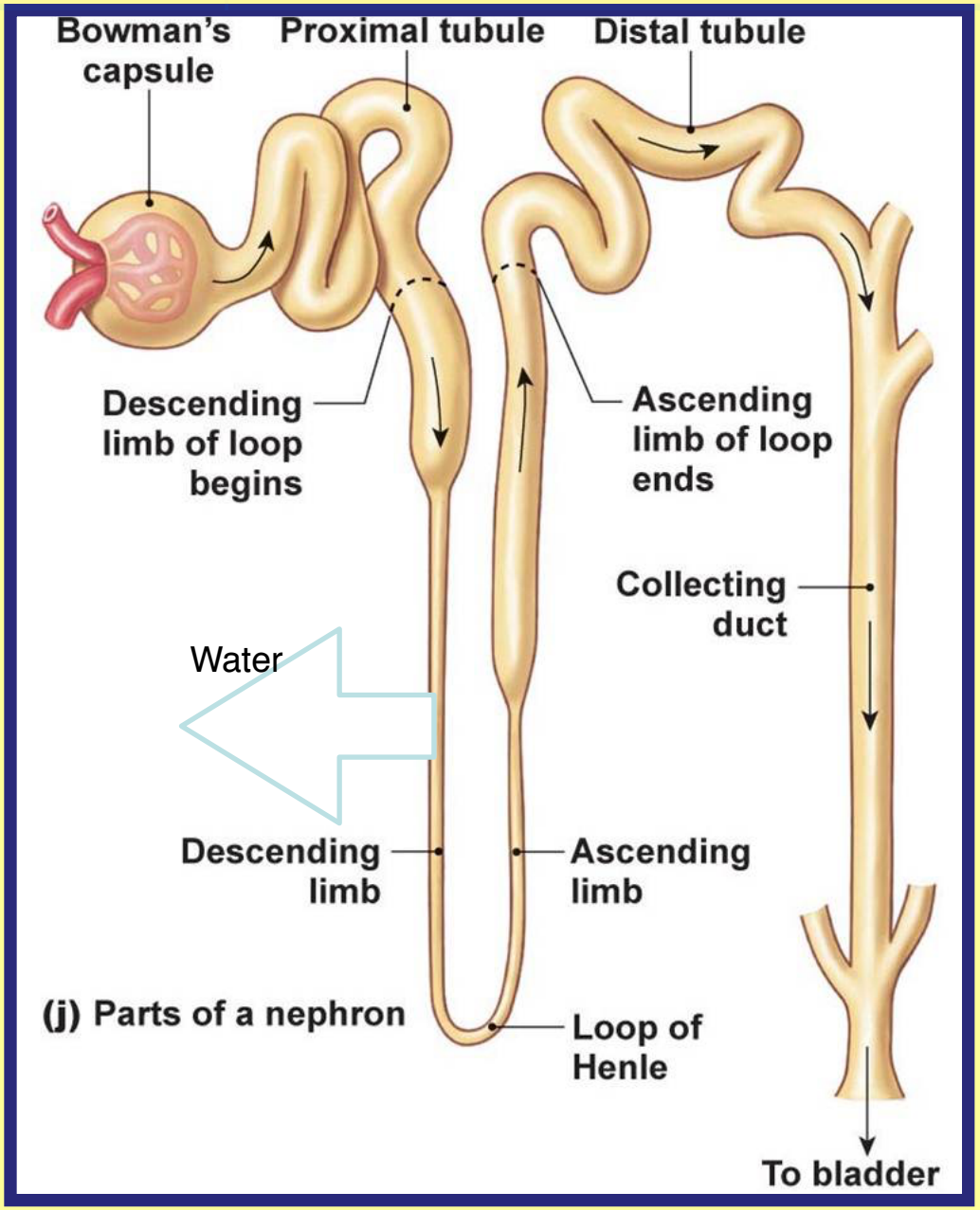

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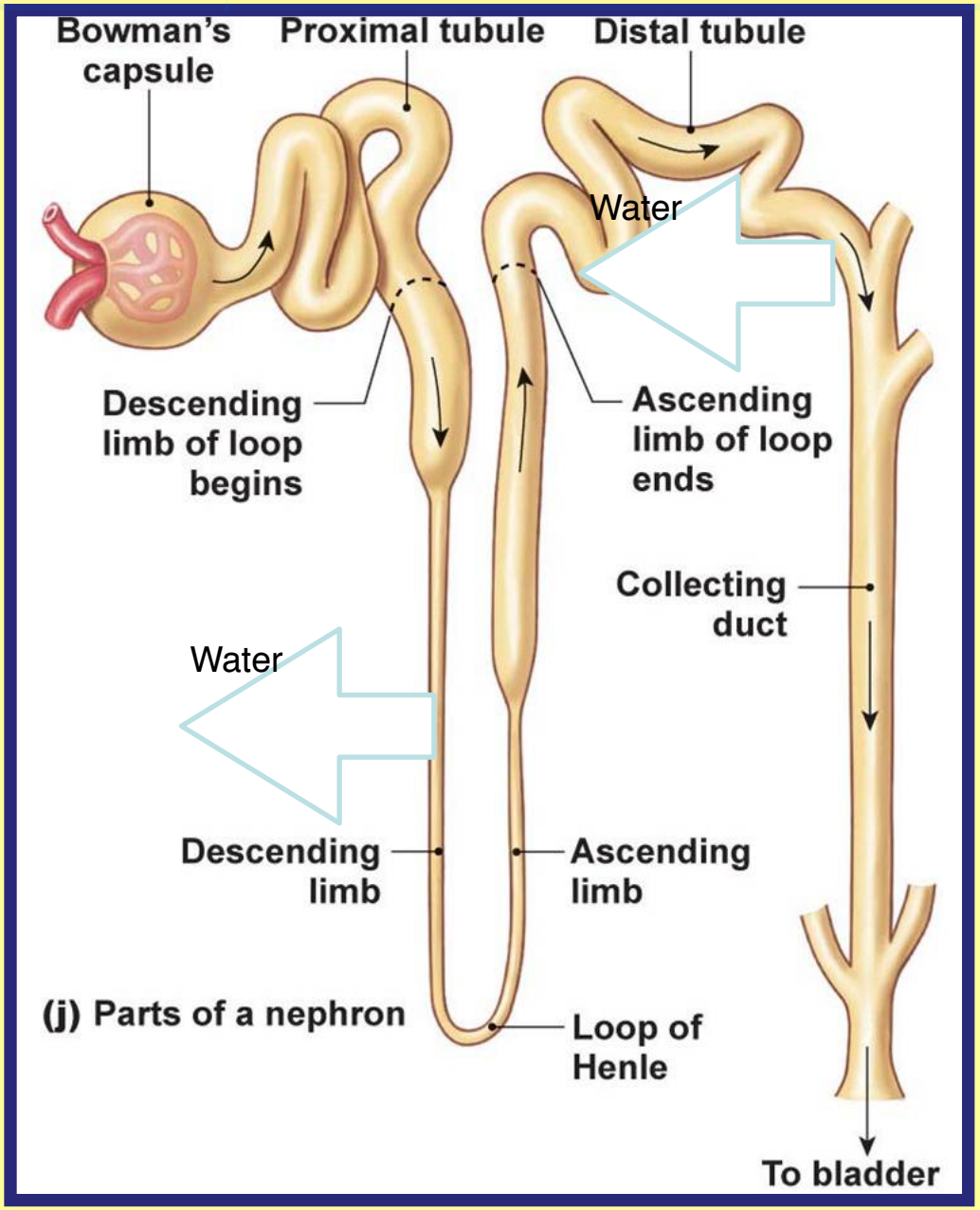

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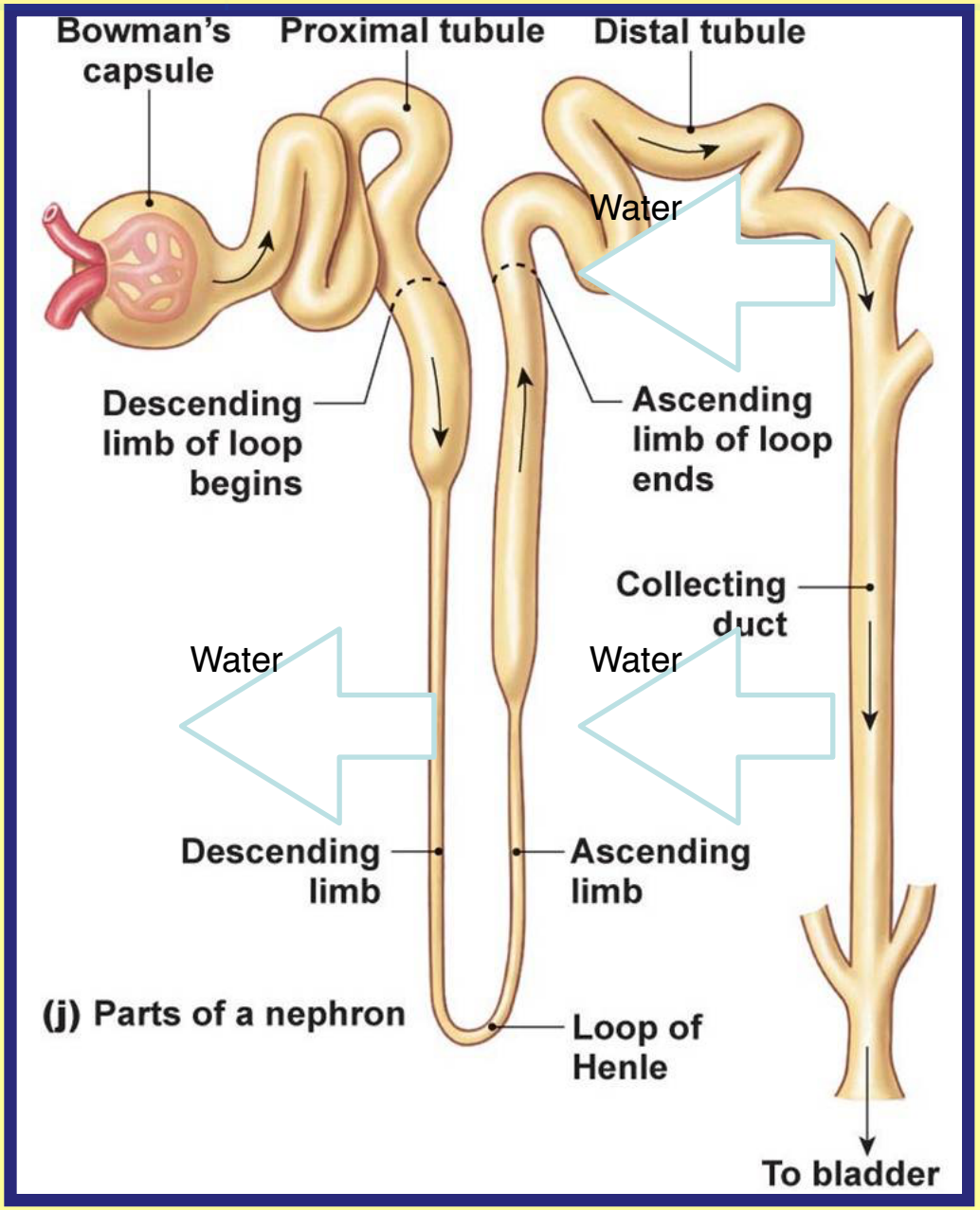

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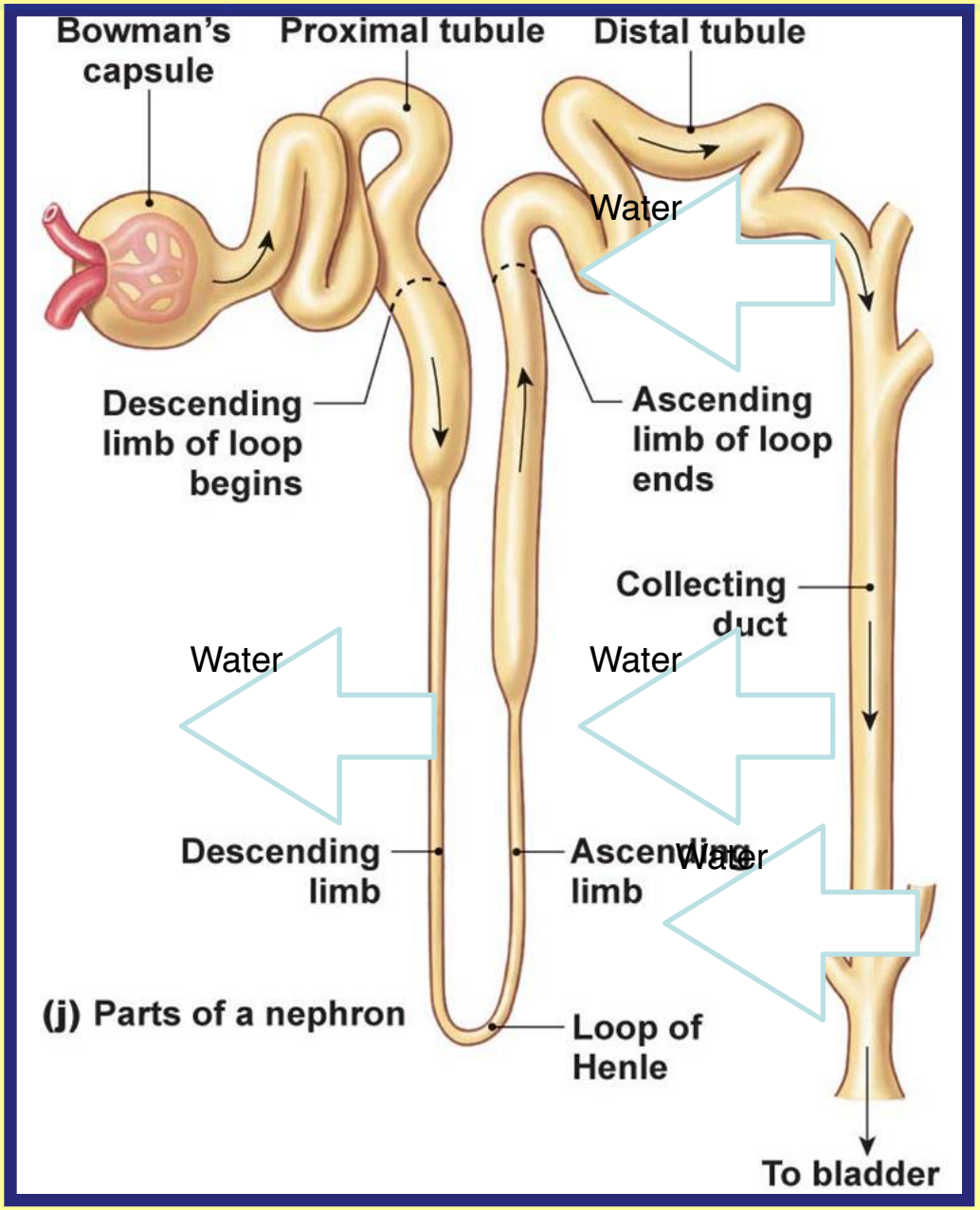

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Fluid Intake Recommendations Per Day

Calculation

Your Weight X 0.5 = Ounces of Water per Day

Calculation when Exercising

Previous Result + (Minutes of Exercise / 30 minutes X 12 oz)

= Ounces of Water per Day

Average Fluid Intake Recommendations Per Day

	Females	Males
4-8 years	7 cups	7 cups
9-13 years	8 cups	9 cups
14 -18 years	9 cups	12 cups
Adult	9 cups	12 cups
Pregnant	10 cups	N/A
Breastfeeding	13 cups	N/A

(Adapted from Academy of Nutrition and Dietetics, 2018; Adapted from Mayo Clinic, n.d.) .

Dehydration is an Important Health Issue

Dehydration as a Global Health Issue

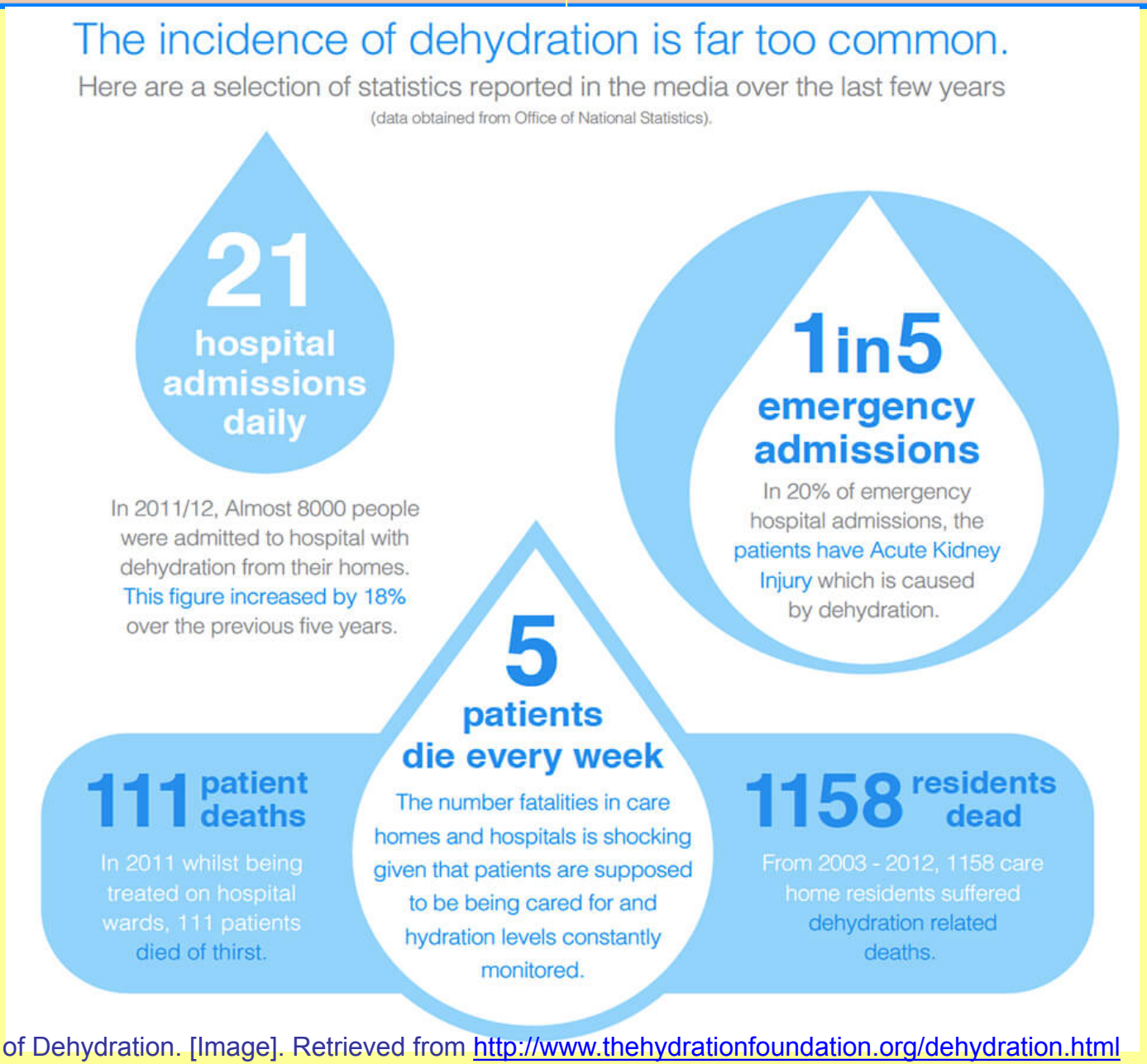
- The World Health Organization (WHO) estimate that a little over 2 billion people do not have access to safe drinking water (2018).
- Of those 2 billion, “423 million people tak[e] water from unprotected wells and springs” (WHO, 2018) and “159 million people collect untreated surface water from lakes, ponds, rivers and streams” (WHO, 2018).

Dehydration as a Global Health Issue

- The choice is to become dehydrated or drink the polluted, contaminated water.
- “Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhoea [sic], dysentery, hepatitis A, typhoid, and polio” (WHO, 2018).
- Dehydration can increase risk of disease, lead to organ failure, and cause physical and cognitive impairment

Dehydration as a National and Local Health Issue

- 75% of the population in the United States is estimated to be chronically dehydrated (Waterlogic, 2017).
- A family nurse practitioner at a local rural health clinic, estimates that around 1 in 5 patients seen are dehydrated.
- “Safe water” may be easily accessible, it may be full of minerals and salts that can potentially cause health issues leading to less drinking.



Incidence of Dehydration. [Image]. Retrieved from http://www.thehydrationfoundation.org/dehydration.html

National Trends for Fluid Intake

- “In 2005-2010, U.S. youth drank an average of 15 ounces of water and U.S. adults drank an average of 39 ounces of water on a given day.
- Among U.S. youth, plain water intake is lower in younger children, non-Hispanic black, Mexican-American.
- Among U.S. adults, plain water intake is lower in older adults, lower-income adults, and those with lower education.
- U.S. adolescents who drink less water tended to drink less milk, eat less fruits and vegetables, drink more sugar-sweetened beverages, eat more fast food, and get less physical activity.”

(Center for Disease Control, 2016)

Dehydration in Rural Southwestern Arizona

The EDUCATE Model

E – Enhance comprehension and retention
D – Deliver patient-centered education
U – Understand the learner
C – Communicate clearly and effectively
A – Address health literacy and cultural competence
T E – Teaching and educational goals

(Marcus, C., 2013).

The EDUCATE Model

E – Enhance comprehension and retention

- Portray information in an educational handout that was easy to read and comprehend, highlighting important information with the use of font, font size, and color.
- Present in elementary and middle schools in the local Yuma County area

D – Deliver patient-centered education

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The EDUCATE Model

E – Enhance comprehension and retention

- Portray information in an educational handout that was easy to read and comprehend, highlighting important information with the use of font, font size, and color.
    - Distributed at local school and at Arizona Western College through Honors Department and Student Health and Wellness

The EDUCATE Model

E – Enhance comprehension and retention

- Present in elementary and middle schools in the local Yuma County area with follow up questions for comprehension

The EDUCATE Model

E – Enhance comprehension and retention

D – Deliver patient-centered education

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Six Vulnerable Populations

(Kleiner, 1999; D'Anci, Popkin, & Rosenberg, 2015)

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- Youth (0-18 years)
- Older Adults (65+ years)
- Pregnant Women

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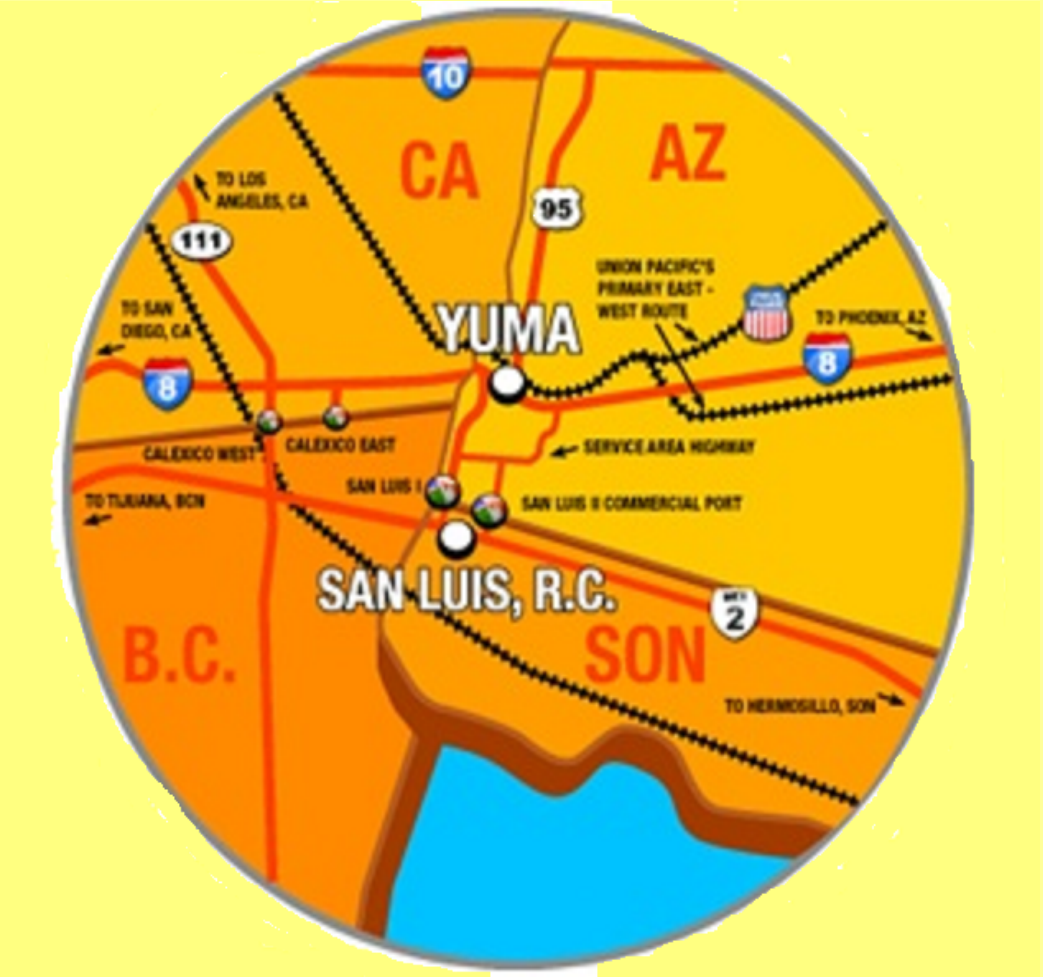
The EDUCATE Model

E – Enhance comprehension and retention
D – Deliver patient-centered education
U – Understand the learner

- Examine demographics: geographical, socio-economic levels and education.

C – Communicate clearly and effectively
A – Address health literacy and cultural competence
T E – Teaching and educational goals

Yuma Area Map



Yuma, Arizona's "Four Corners" Border Region:

USA

S.W. Arizona and S.E. California

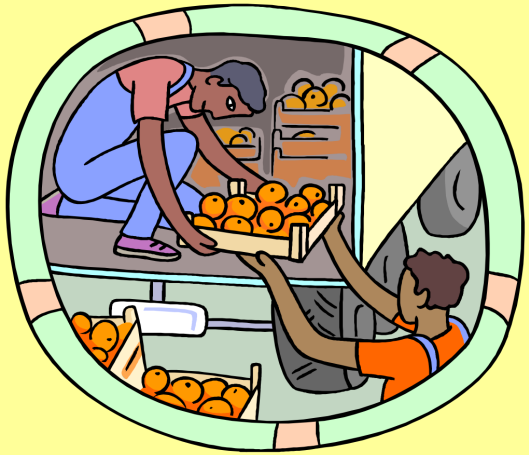
+

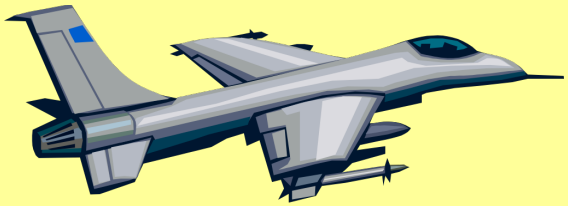
Mexico

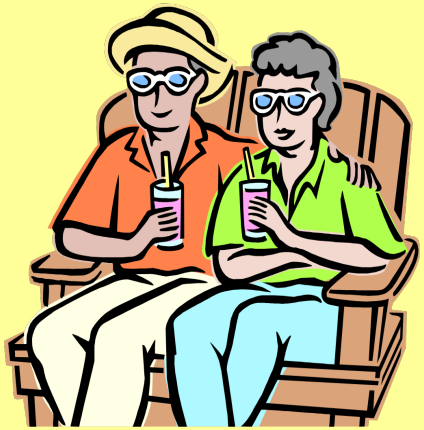
N.E. Baja California Norte and N.W. Sonora

Yuma Area Principal Occupations

Agricultural, Trucking, Military, Border Patrol, Transient and Unemployed, “Snow Birds”







The EDUCATE Model

Understand the Learner

Geographical

- In 2017 Yuma County's Population was estimated to be 207, 534. (United States Census Bureau, 2017)

- The weather in the area is very hot and arid.

- The yearly temperature average from 1981-2010 in Yuma, Arizona, was a high of 88.2 degrees Fahrenheit and a low of 63.4 degrees Fahrenheit (National Ocean and Atmospheric Administration, 2018).

The EDUCATE Model

Understand the Learner

Socioeconomic

- 7.3% of the population was under 5 years, 25.4% were under 18 years, and 18.3% of the population was over 60 years

- 63.9% of the population were Hispanic or Latino, 30.8% were White, not Hispanic (United States Census Bureau, 2017).

The EDUCATE Model

Understand the Learner

Socioeconomic and Education Level

•From 2012-2016, 71.7% of the population over 25 years had a high school diploma or higher, while only 14.4% had a bachelor's degree or higher (United States Census Bureau, 2017)

•The poverty level in Yuma County was 19.3% (United States Census Bureau, 2017), which is 7% higher than the national poverty level at 12.7% (United States Census Bureau, 2017).

The Educate Model

E – Enhance comprehension and retention
D – Deliver patient-centered education
U – Understand the learner
C – Communicate clearly and effectively

- A readability calculator was used on the education handouts to ensure that the information was communicated clearly and effectively.

A – Address health literacy and cultural competence
T E – Teaching and educational goals

The Educate Model

E – Enhance comprehension and retention

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- The handouts were also reviewed by practicing providers in the local region, to ensure that the handouts were presented in a manner that was easily digestible and kept true to healthcare standards.
- The handouts were translated into Spanish to ensure cultural competence as well as spreading awareness to a broad range of populations in the community.

T E – Teaching and educational goals

The Educate Model

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- The Educational Approach

The Educational Approach

Provide information in an easily digestible way to different people, of different ages, that will aid in the maintenance of health.

Specifically, to create an educational handout that targets six vulnerable populations of Southwestern Arizona to:

- Increase Awareness of Dehydration
- Its Effects
- Ways of Prevention

Treating Dehydration

- Replacement fluid therapy may treat acute dehydration. “The goal of replacement fluid therapy is to correct existing abnormalities in volume status and/or serum electrolytes” (Sterns, R.H., 2017)
- Maintenance therapy is used “to preserve water and electrolyte balance and to provide nutrition” (Sterns, R.H., 2017)
- Treating may consist of replacement fluid there in the clinic and is followed up by educational awareness about dehydration (personal communication, November 8, 2018).

Dehydration Matters

Survey

Dehydration Matters Survey

Objectives

Survey respondent's answers were examined for relationships between fluid intake

- Age
- Education Level
- Years Residing in or near Yuma County, AZ
- Knowledge that Dehydration is More Common in Hot, Dry Climates
- Previous Diagnosis of Dehydration or Advised to Intake More Fluids
- Previous Experience of Dehydration's Symptoms

Dehydration Matters Survey

Limitations

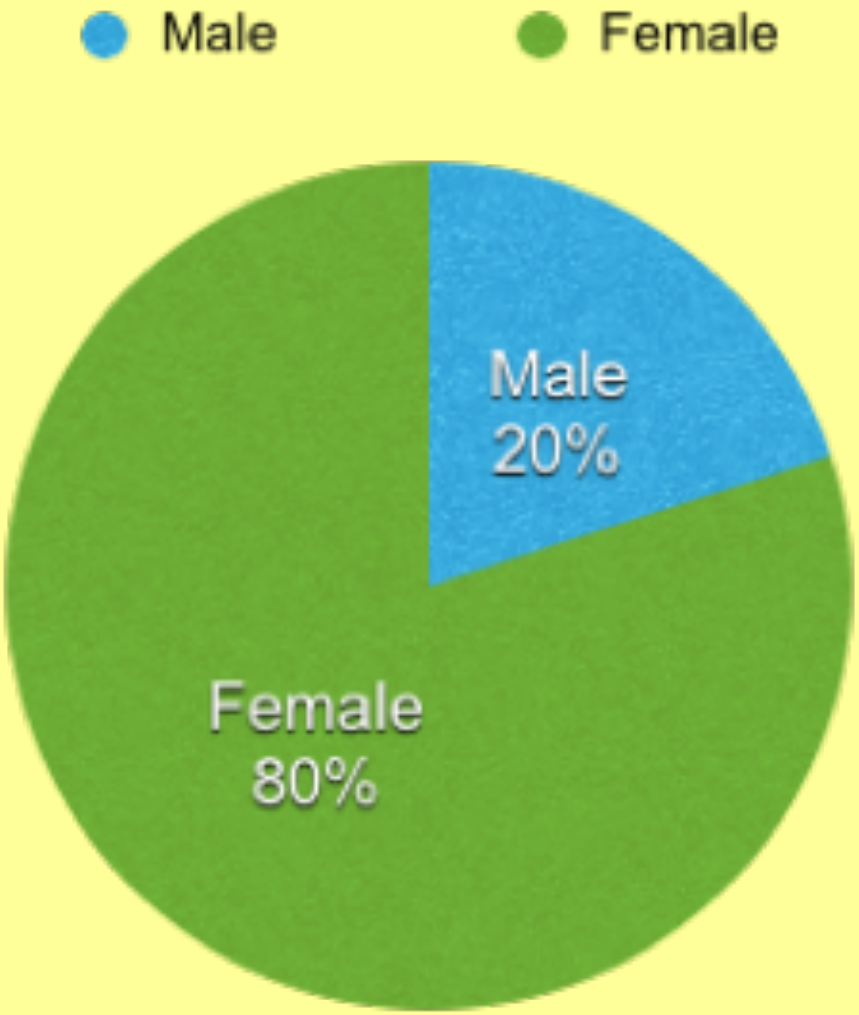
- The sample size is not large enough to obtain the most accurate view of dehydration in Yuma County, AZ.
- There were no male respondents from the age range of 30-45 years.
- The overwhelming majority of respondents were females. Respondents with education levels higher than an obtained master's degree, or currently seeking, were few, making up only 19% of the respondents' surveys.

Dehydration Matters Survey

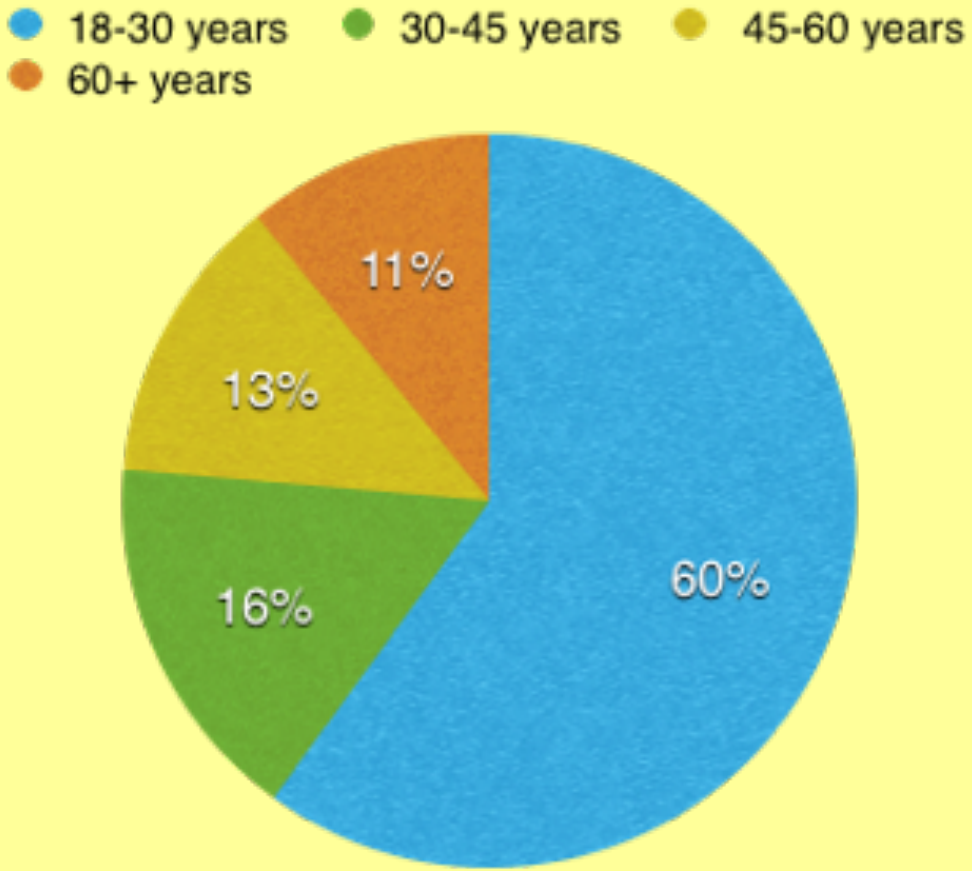
Limitations

- Respondents were mainly 18-30 years old, those older only made up 24% of the respondents. Although some possible correlations may be gained, the sample size was not large enough accurately predict them.
- This study also only ran from September 2018 to November 2018, so there may be bias due to time.

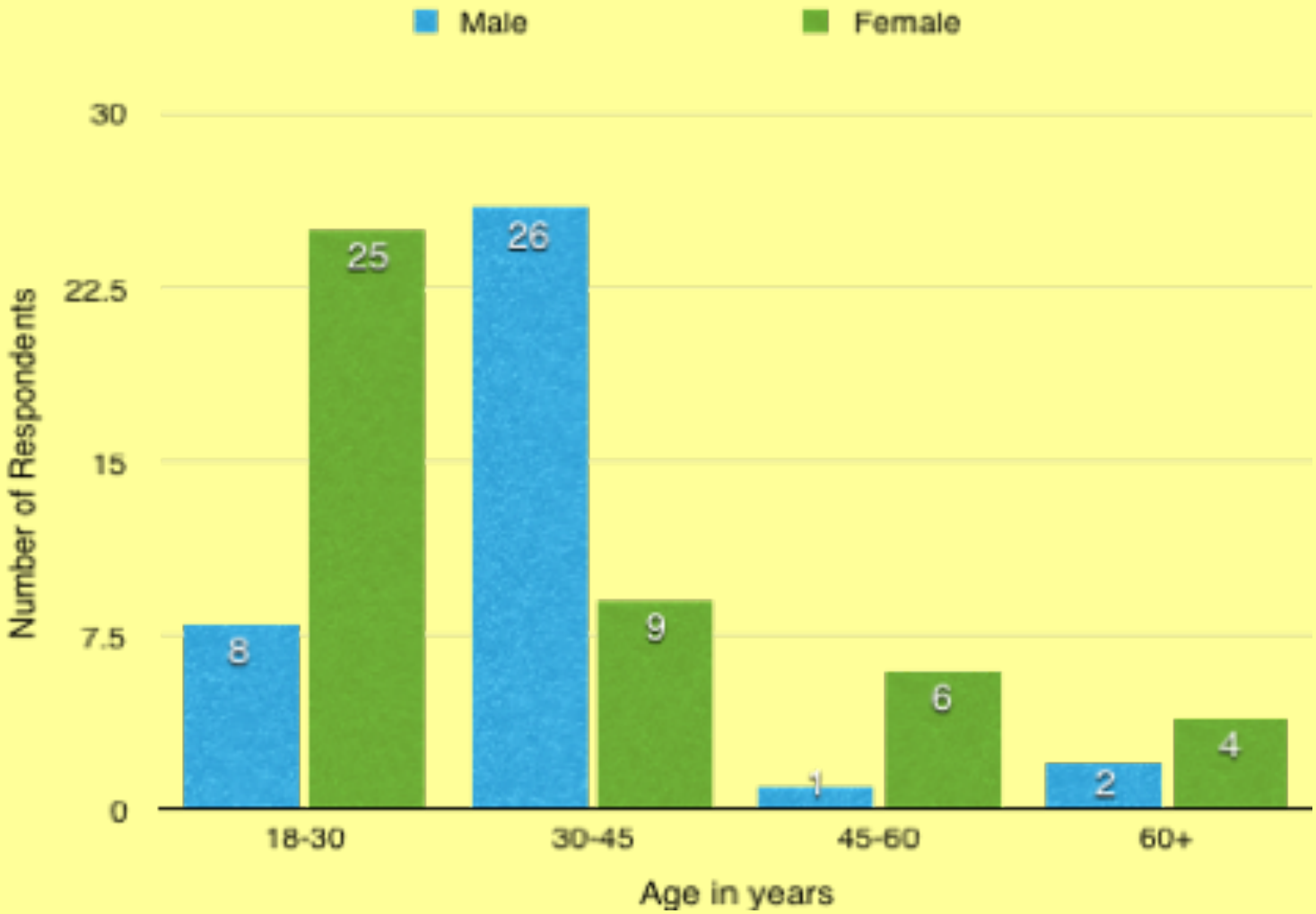
Gender of Survey Respondents



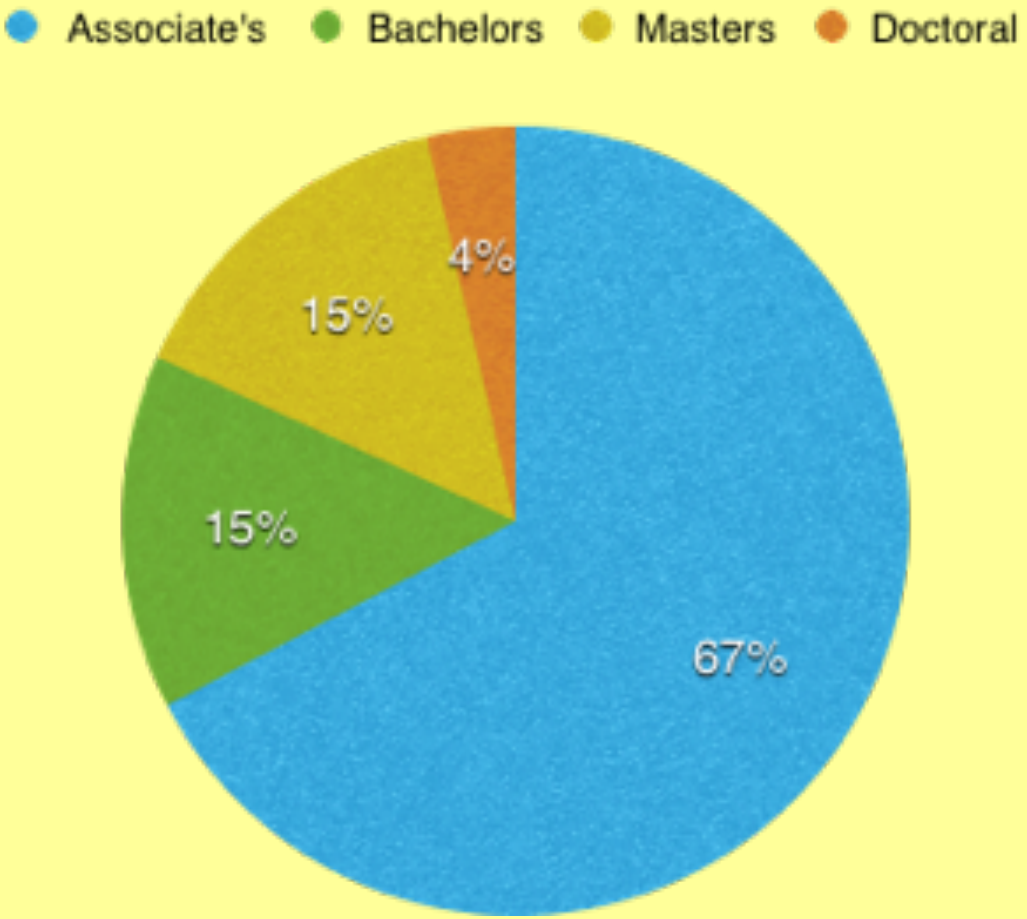
Age of Survey Respondents



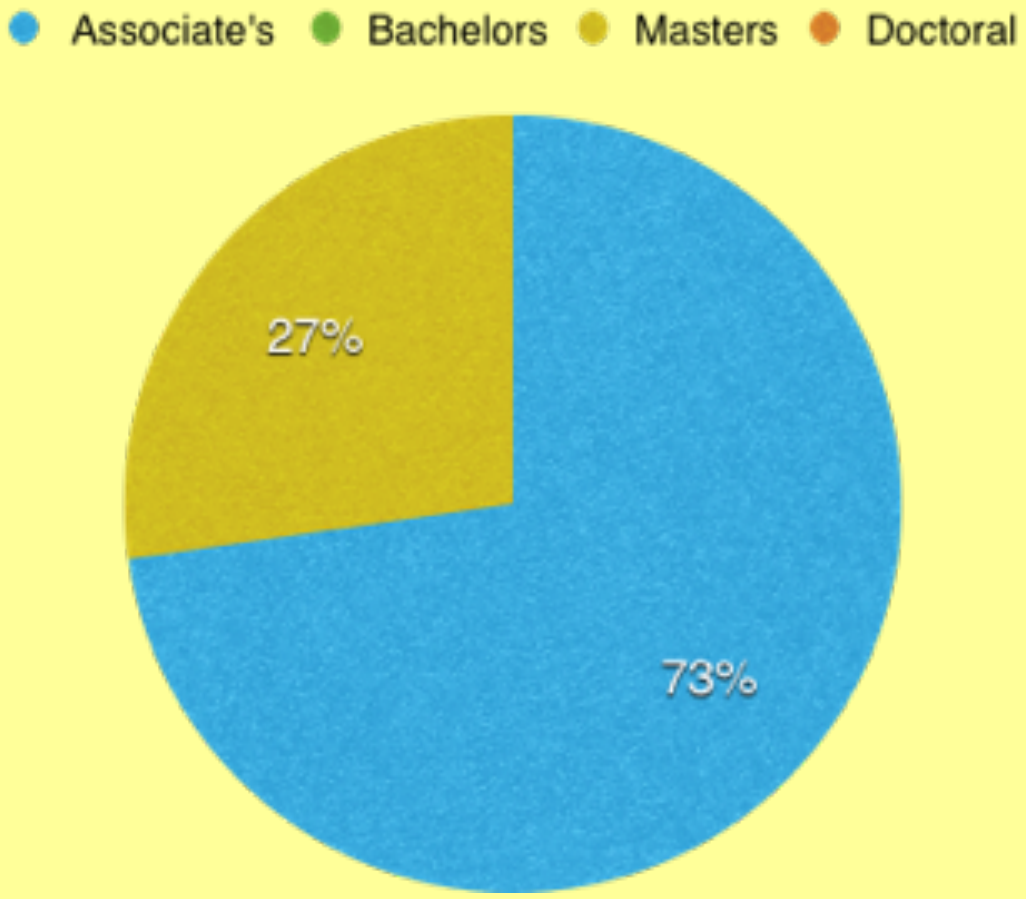
Gender of Survey Respondents by Age



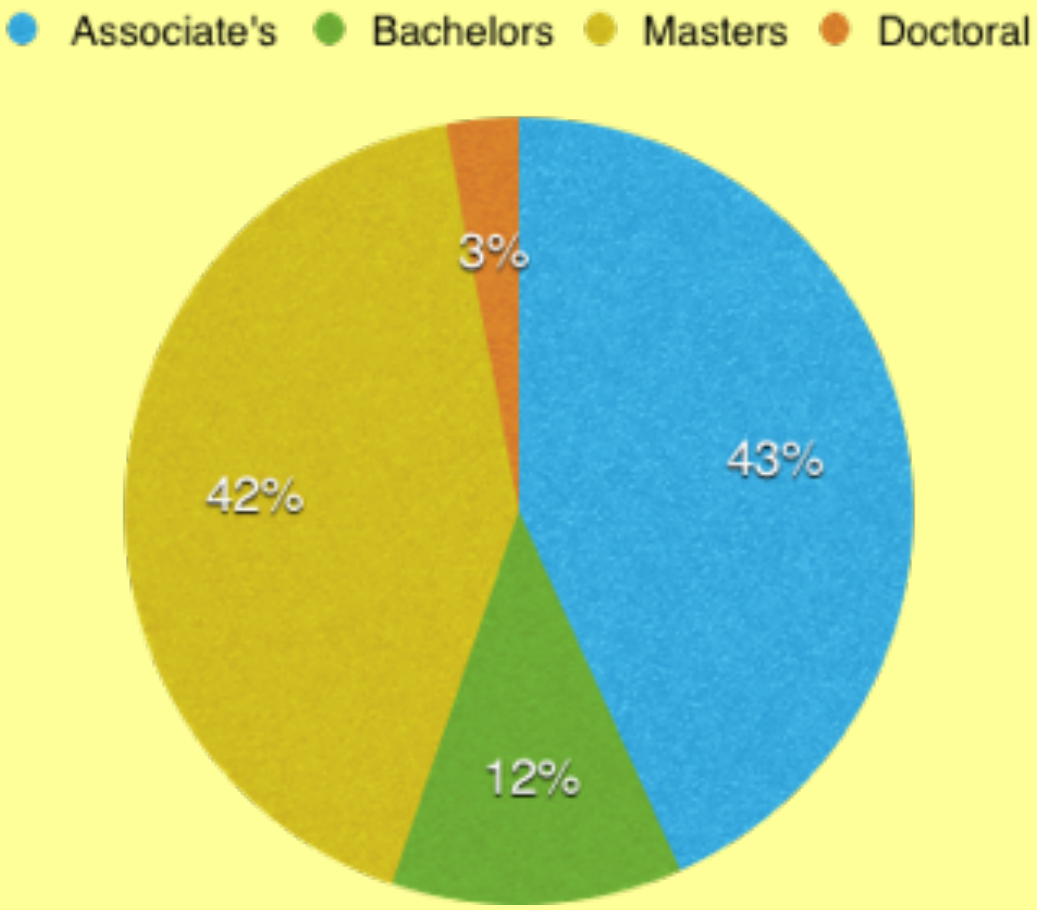
Male and Female Respondents' Educational Level



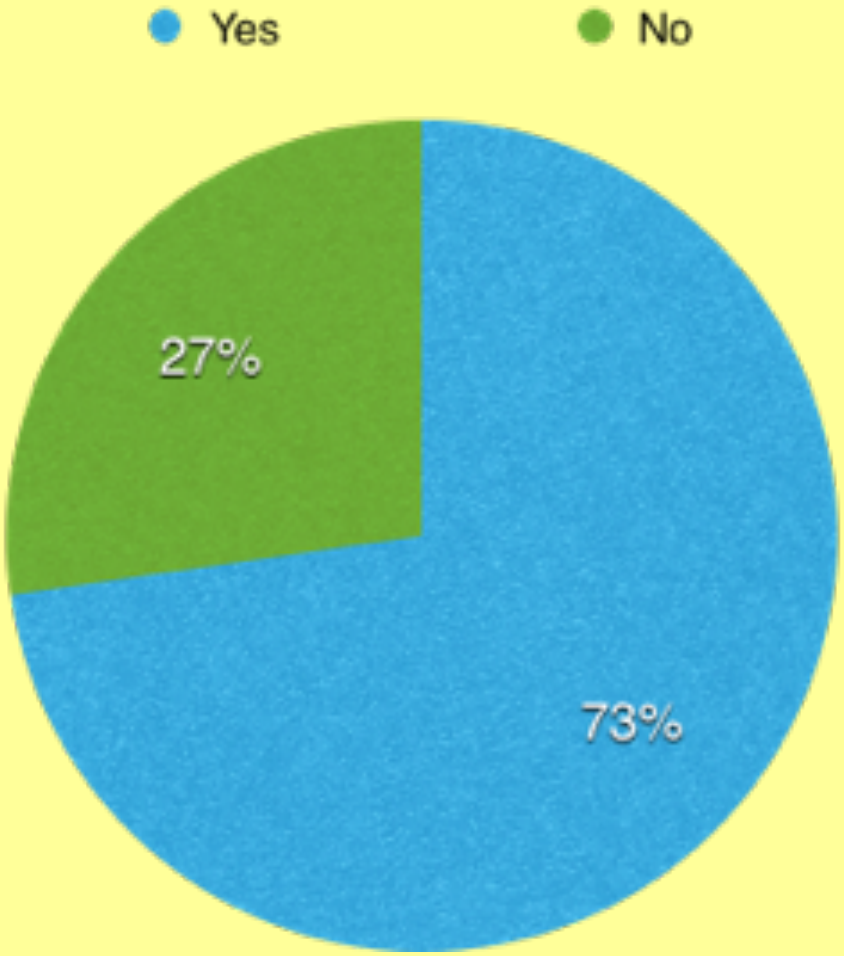
Male Respondents' Educational Level



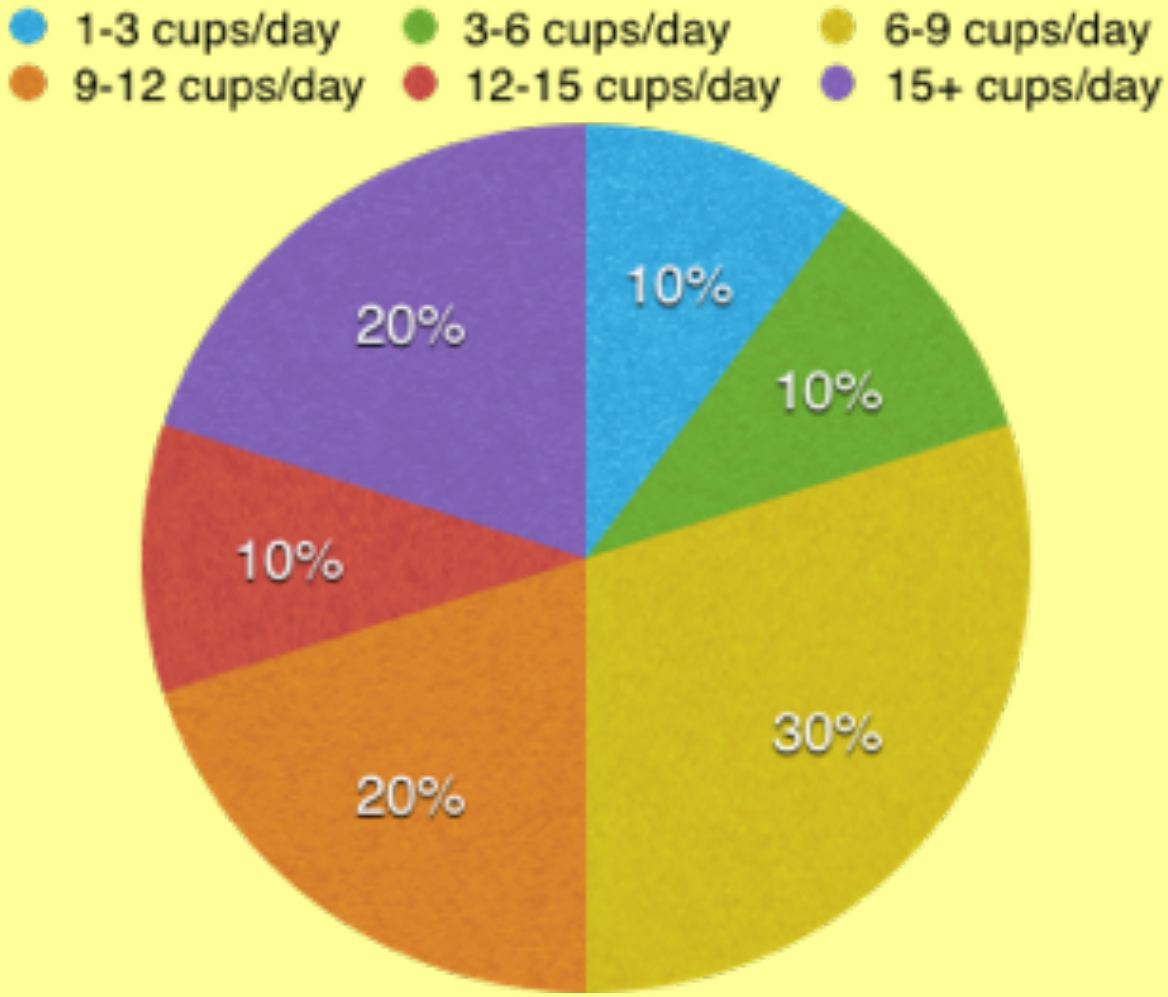
Female Respondents' Educational Level



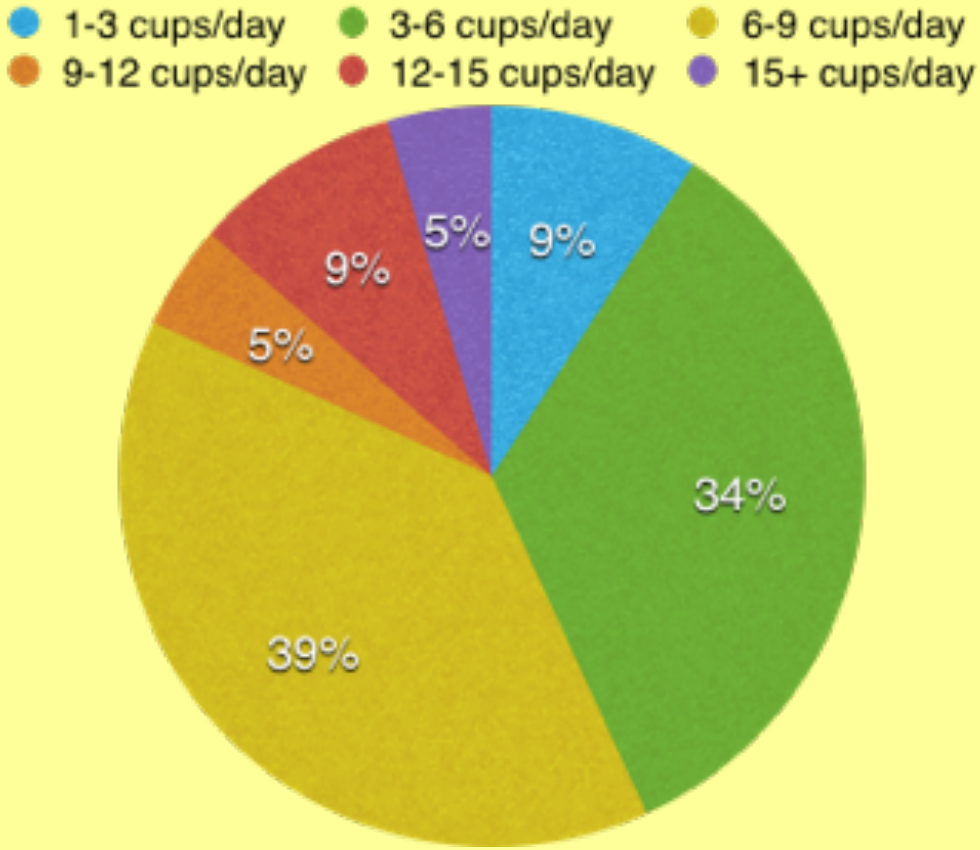
Respondents Meeting Risk Factors



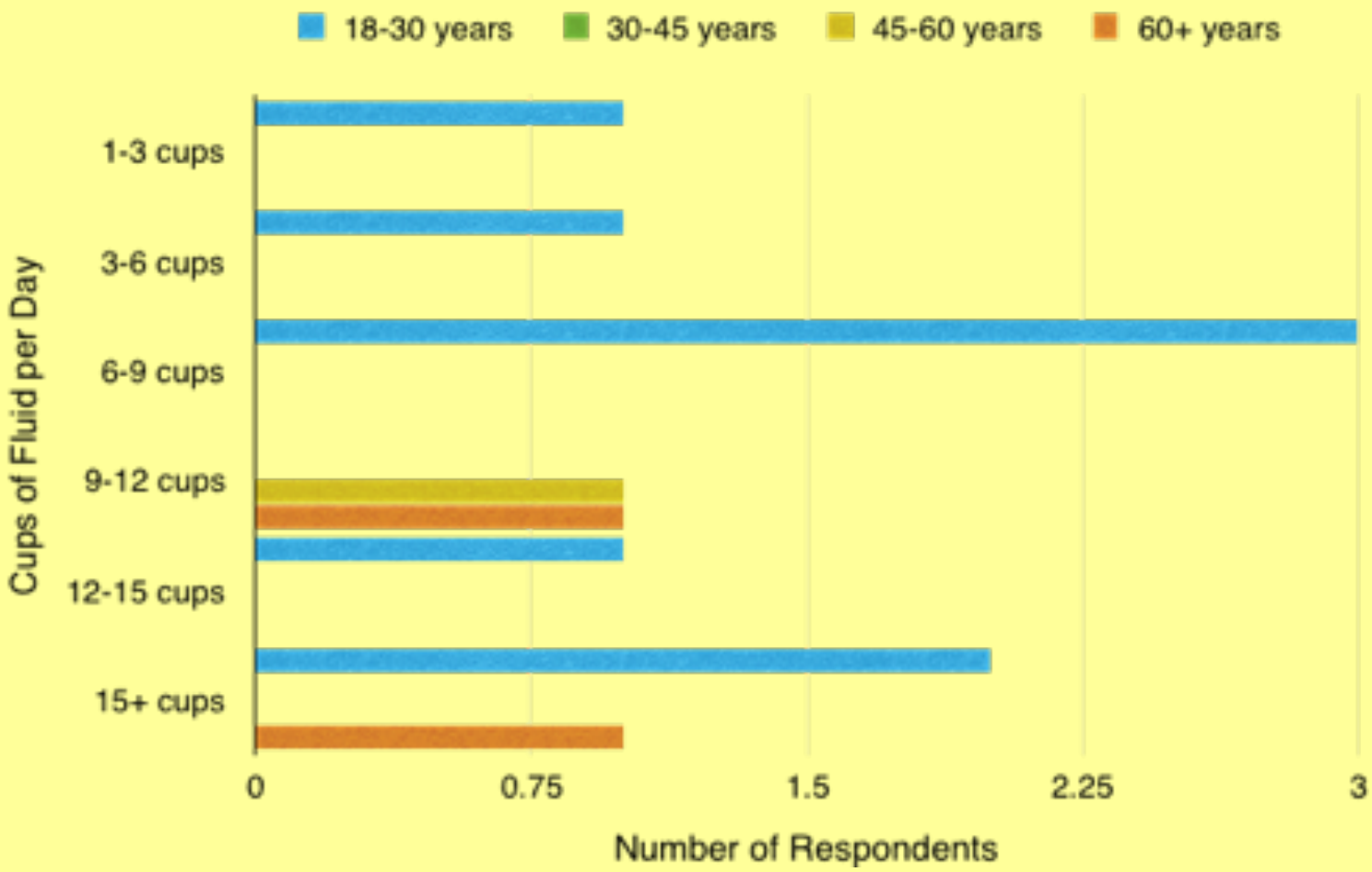
Male Respondents' Fluid Intake Level



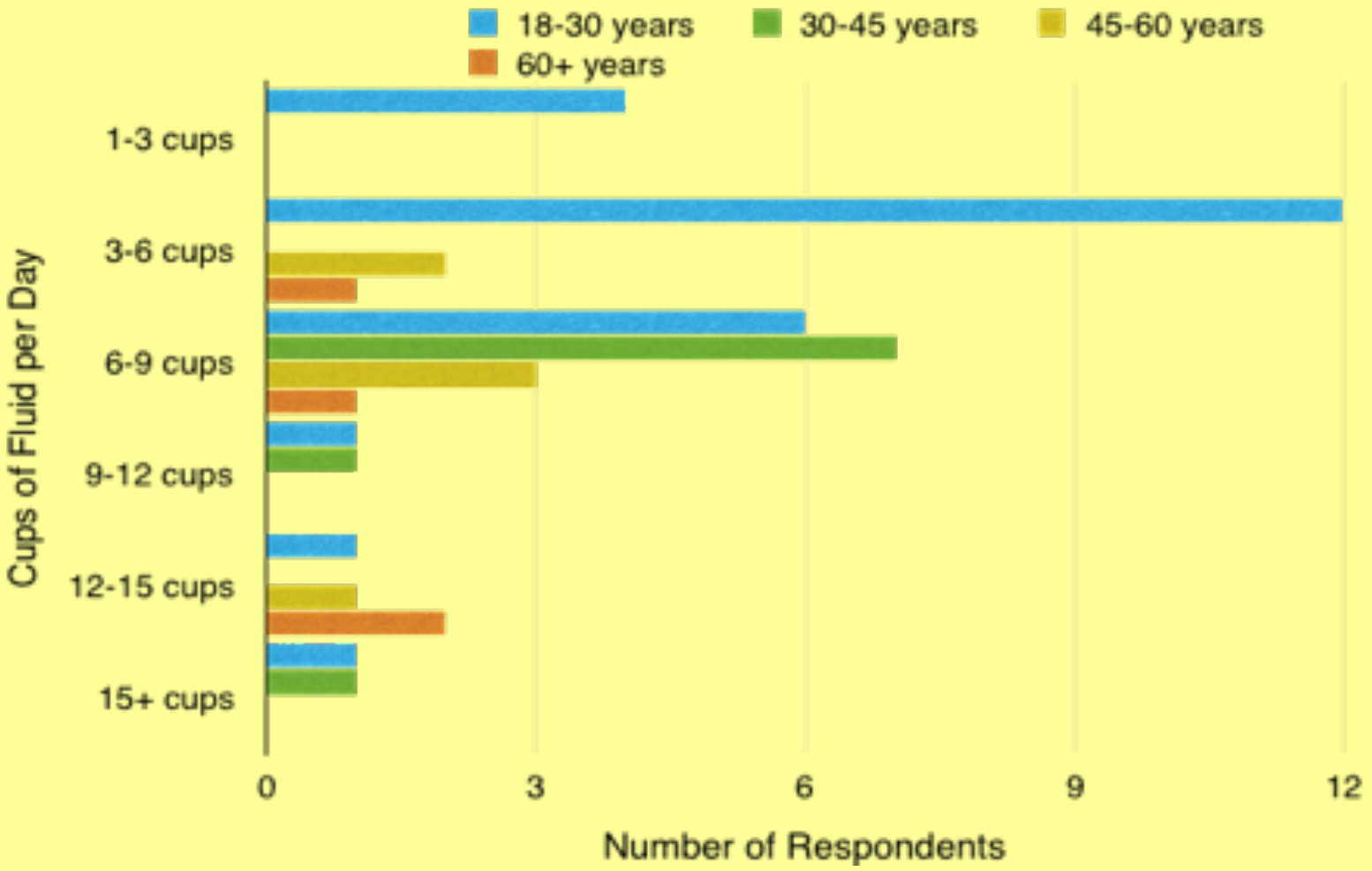
Female Respondents' Fluid Intake Level



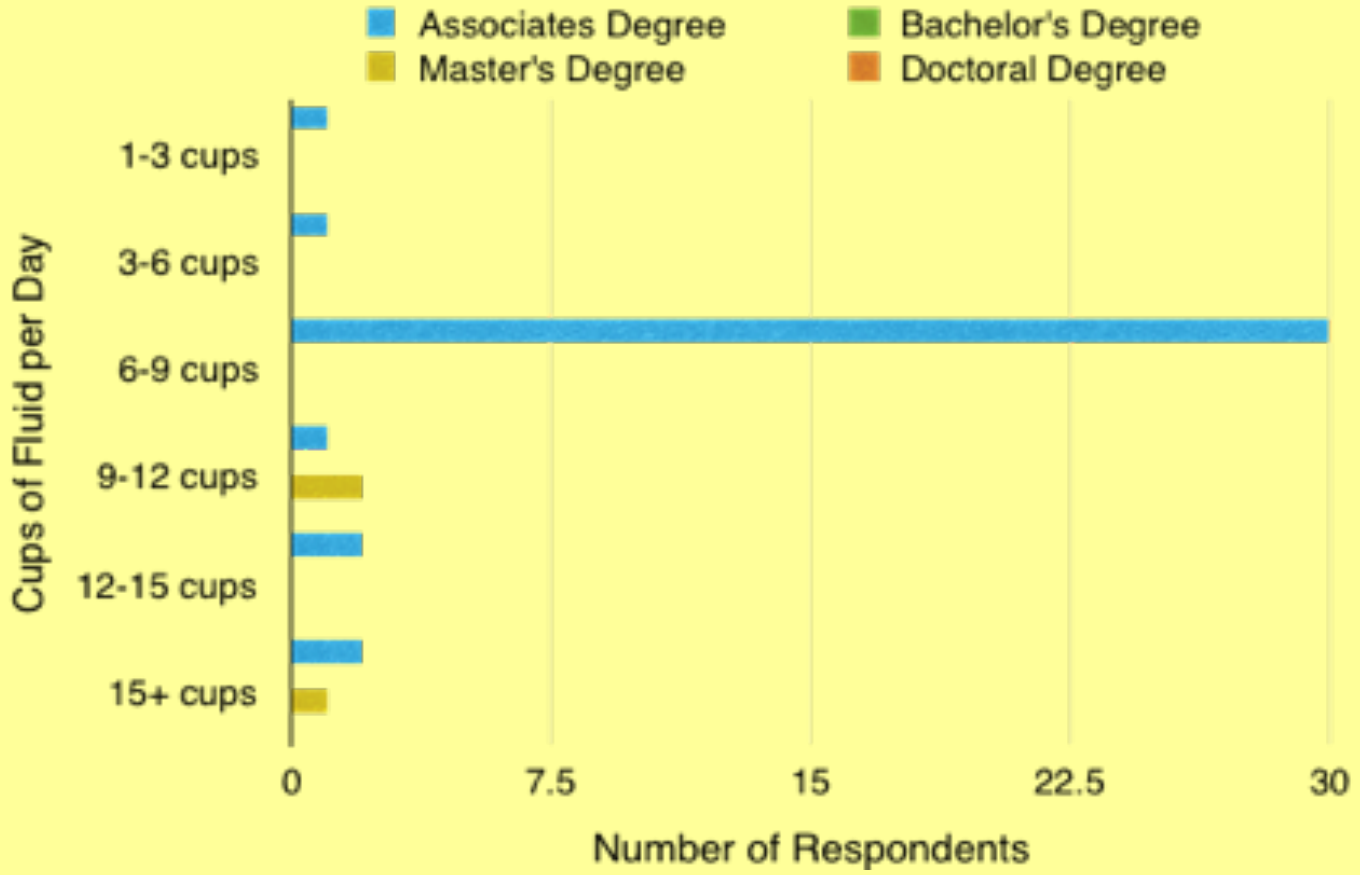
Male Respondents' Fluid Intake Level by Age



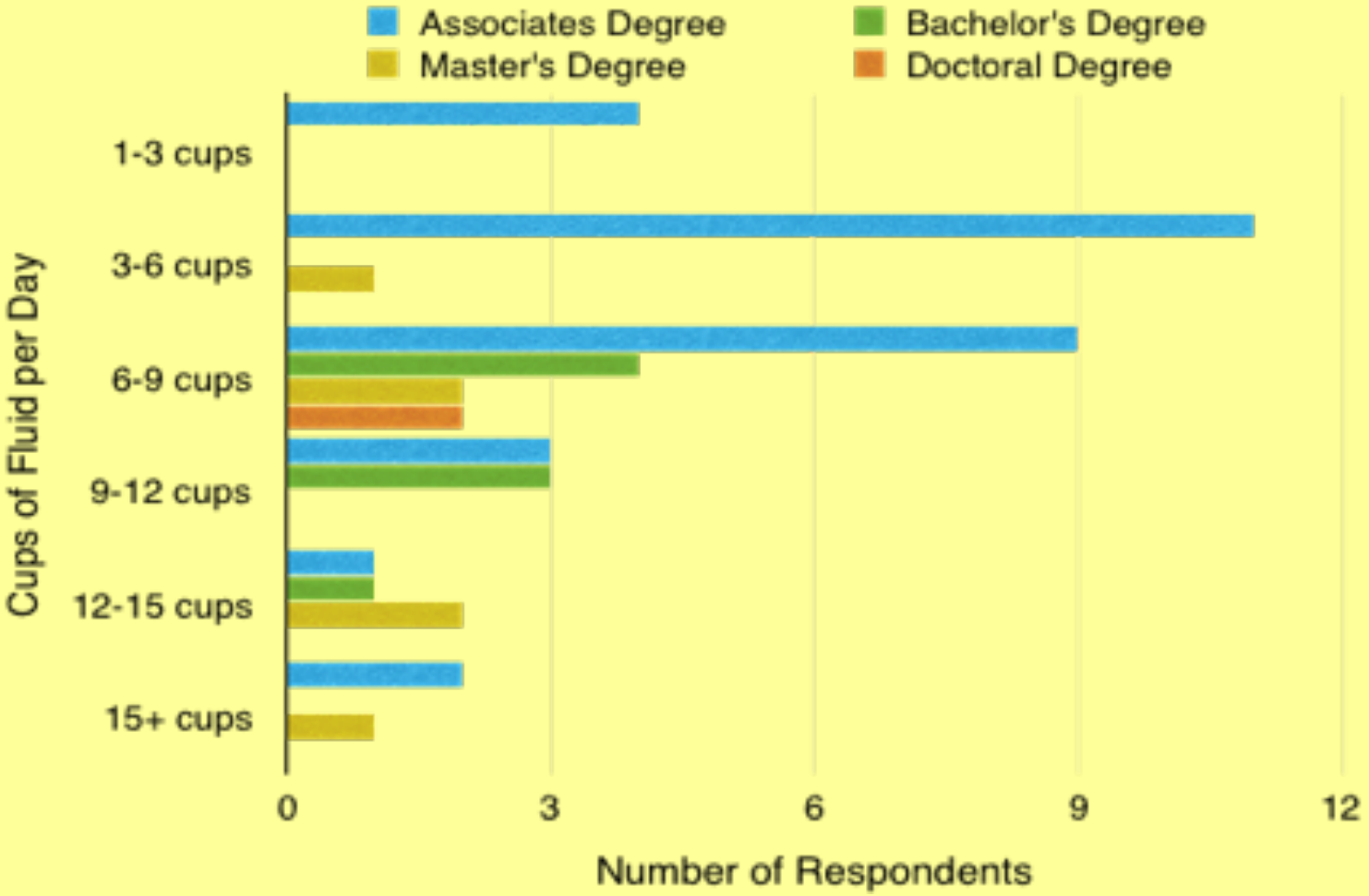
Female Respondents' Fluid Intake Level by Age



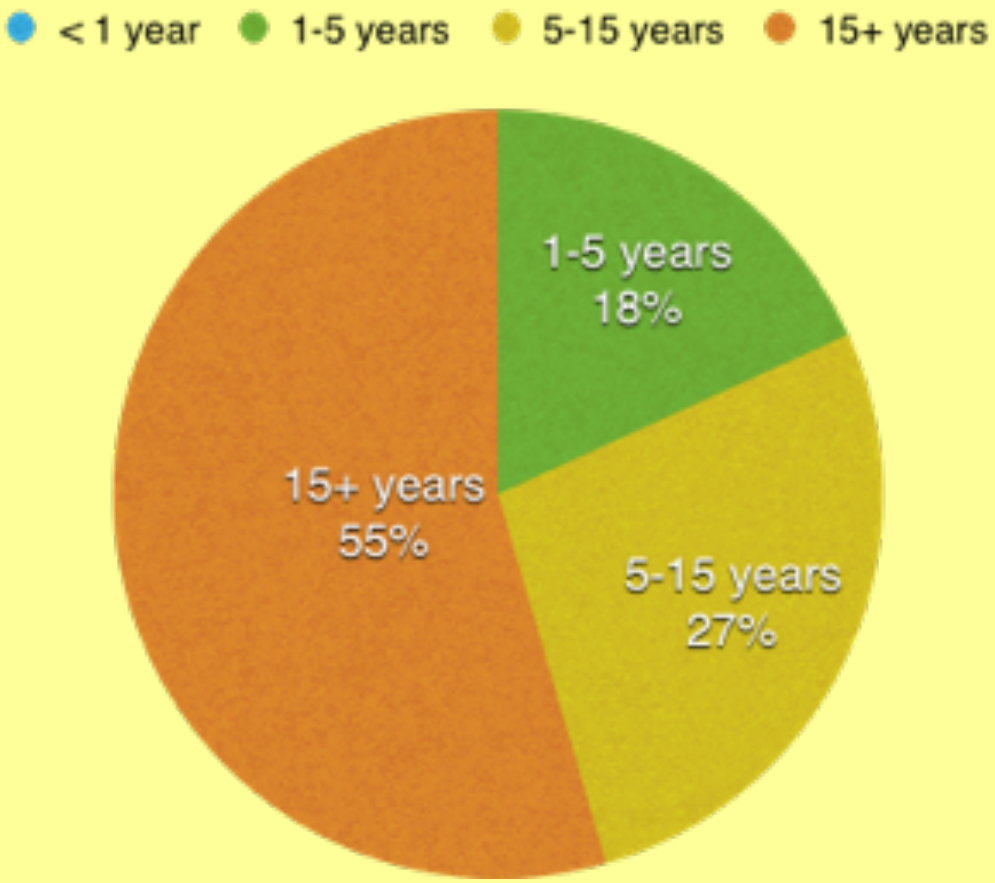
Male Respondents' Fluid Intake by Degree



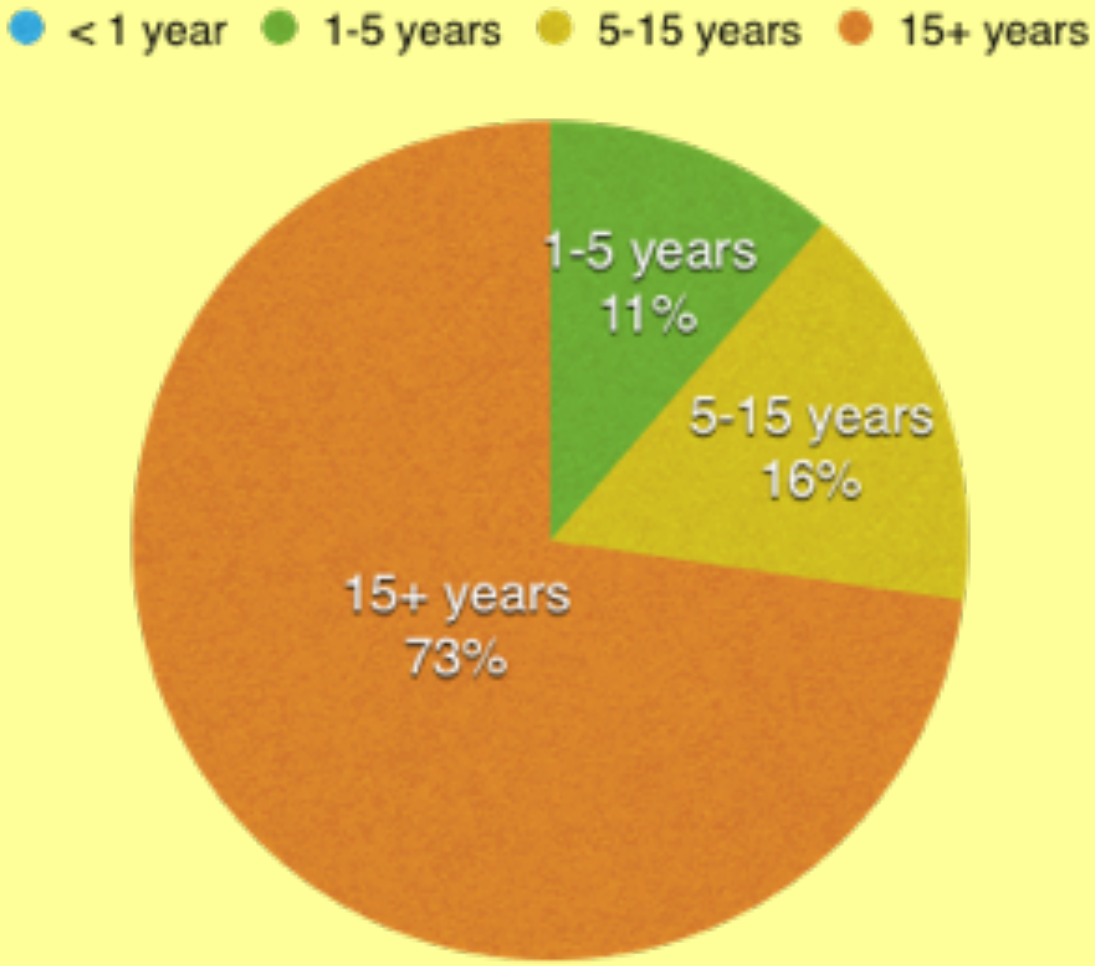
Female Respondents' Fluid Intake by Degree



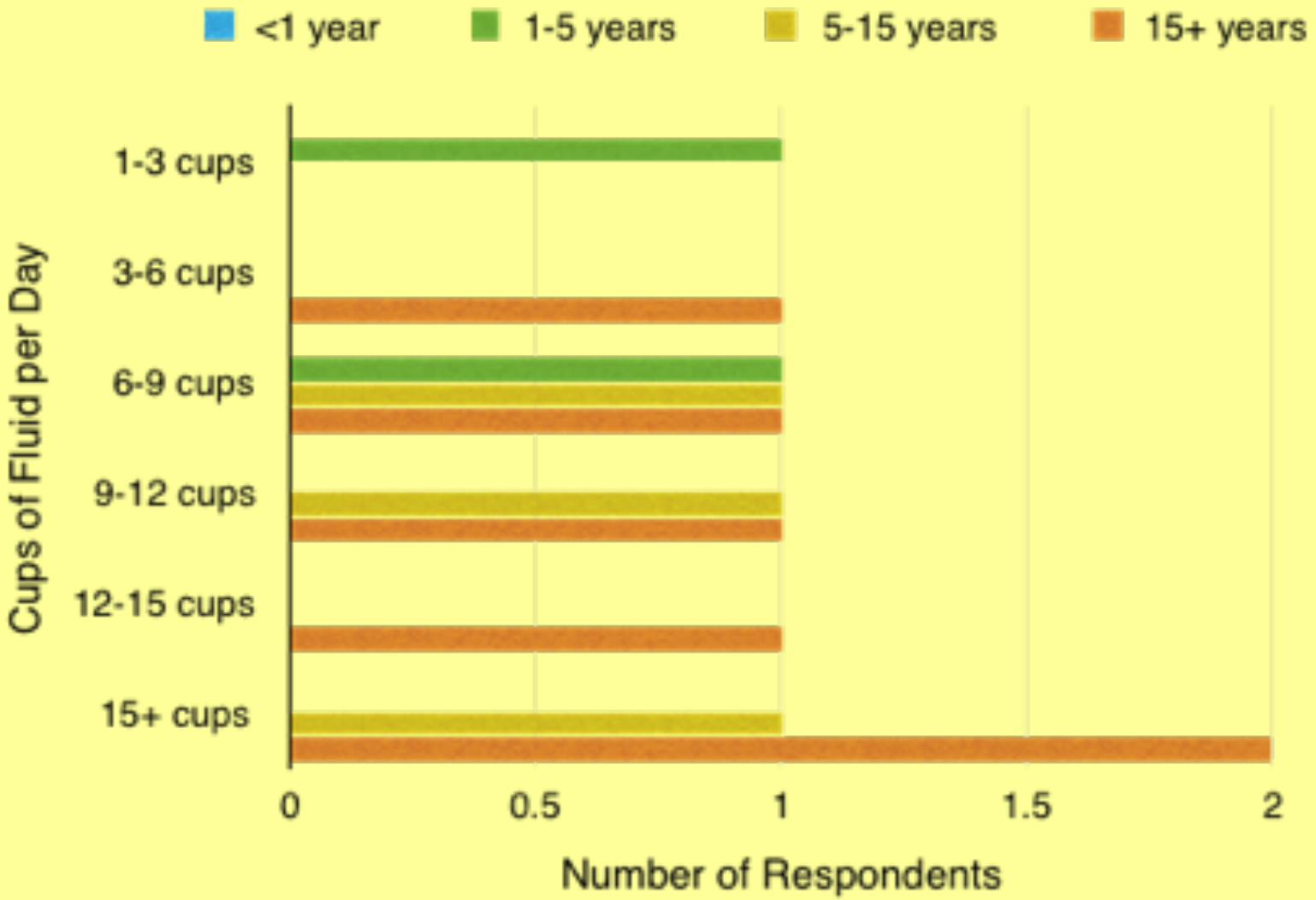
Male Respondents - Years Lived in Yuma County



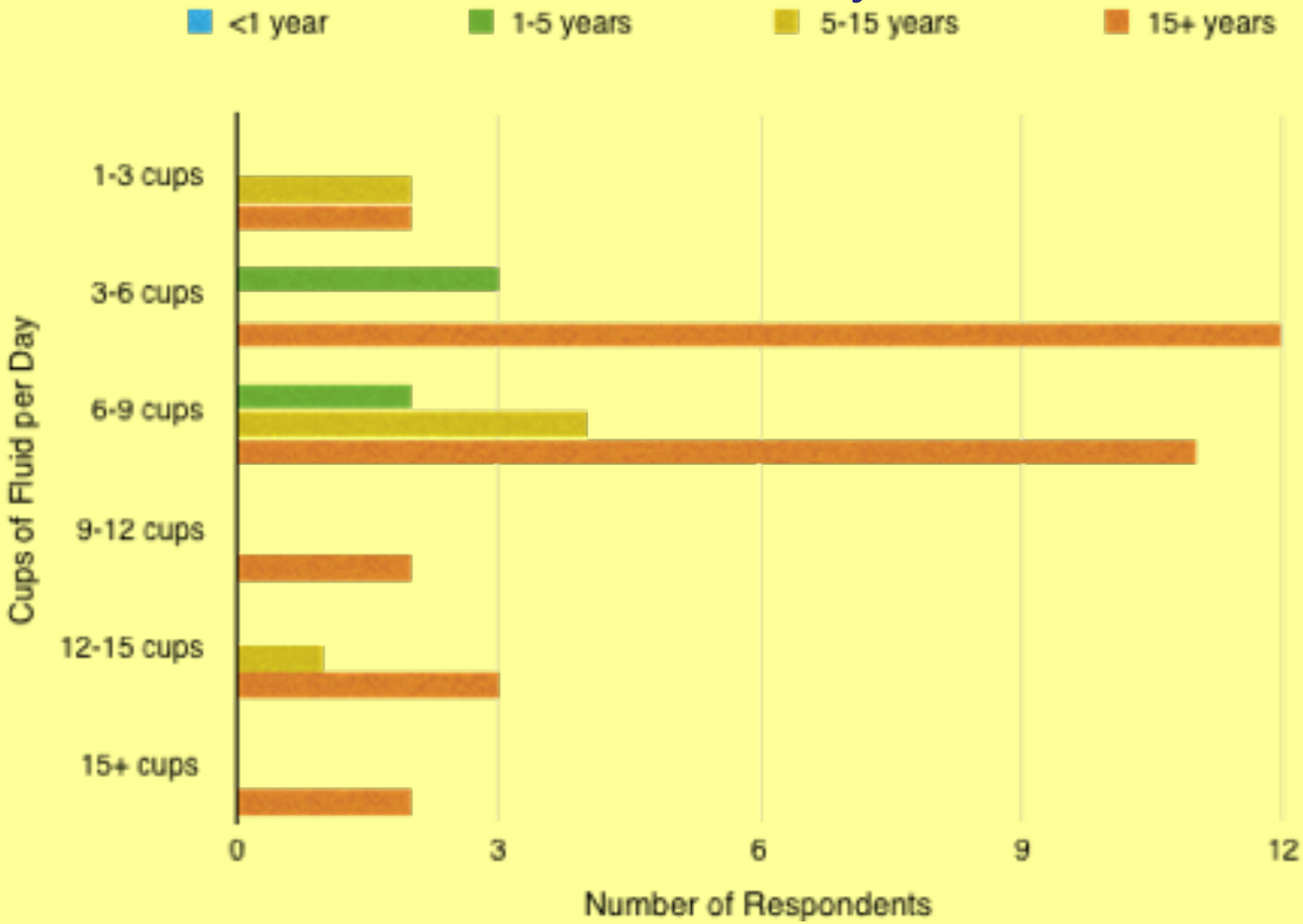
Female Respondents - Years Lived in Yuma County



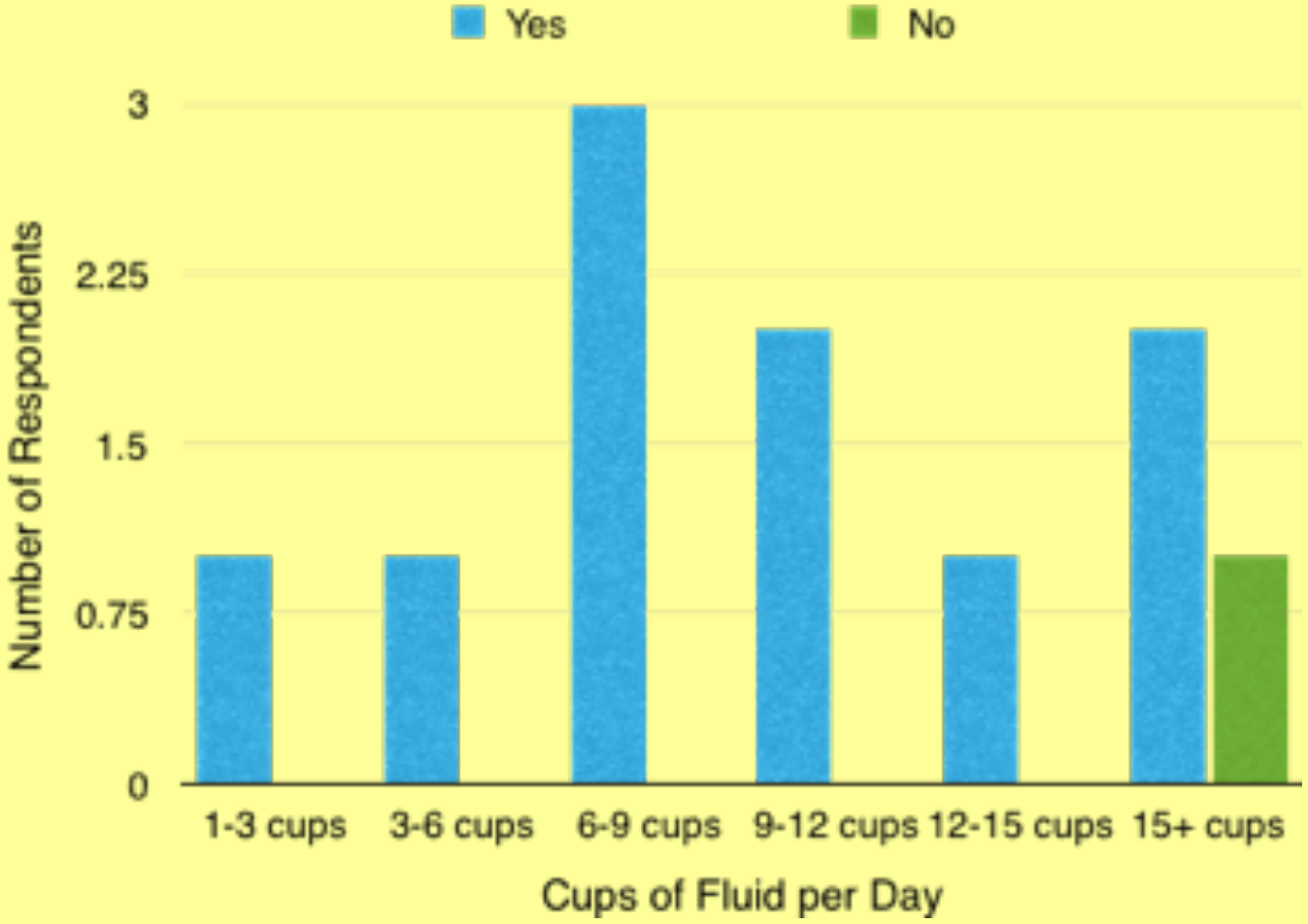
Male Respondents – Fluid Intake and Years Lived in Yuma County



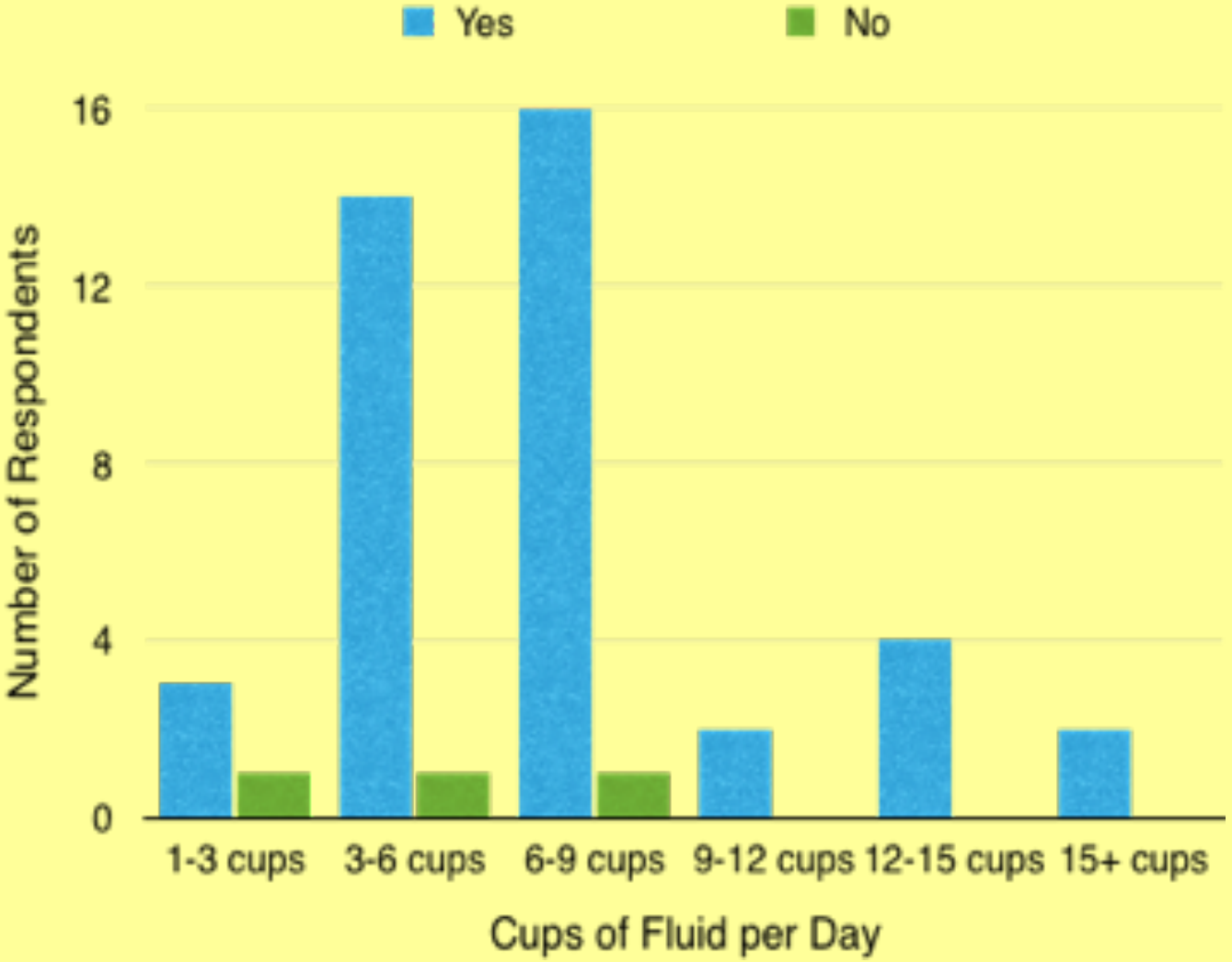
Female Respondents – Fluid Intake and Years Lived in Yuma County



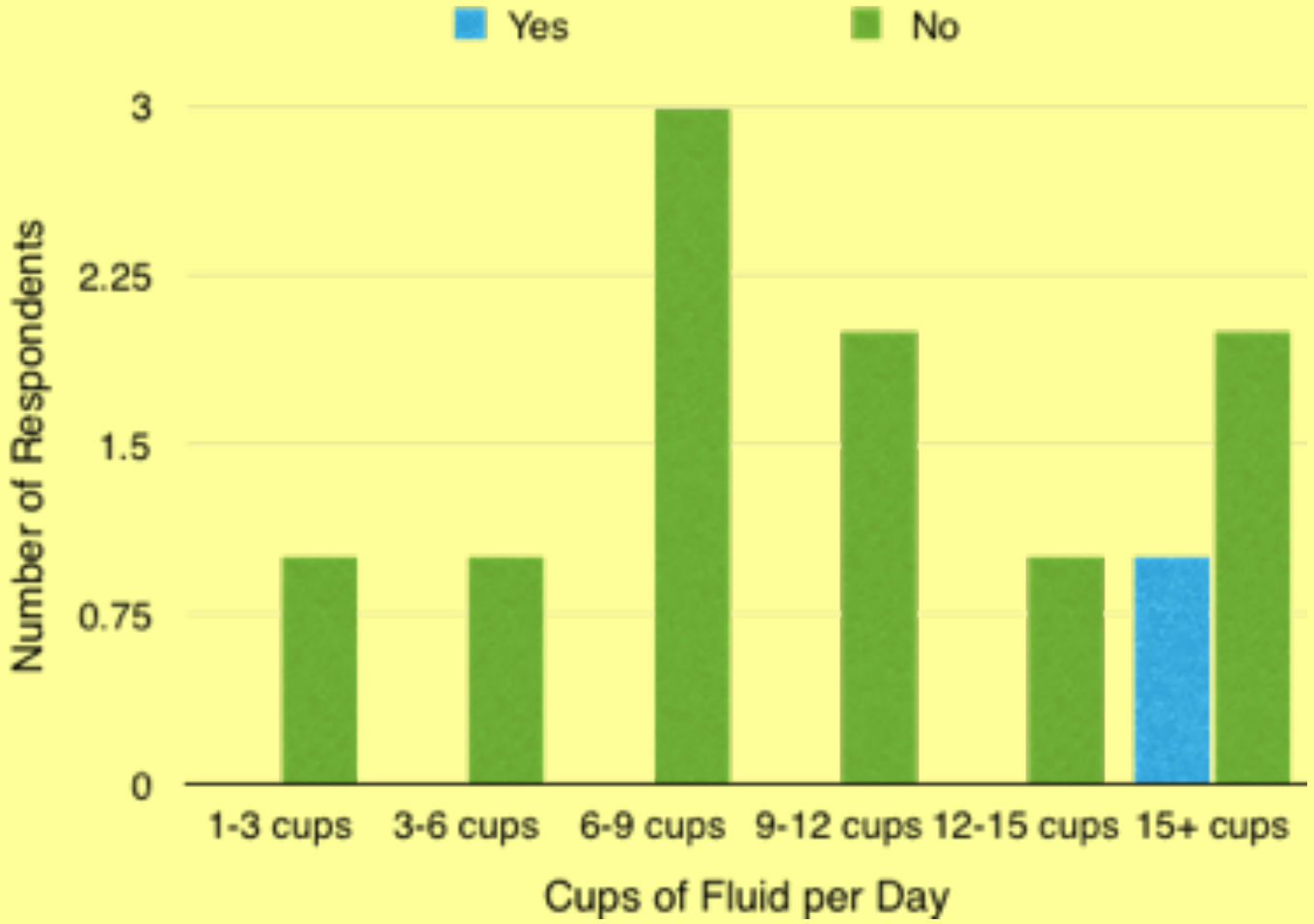
Male Respondents – Fluid Intake and Knowledge about Dehydration with regard to Climate and Time



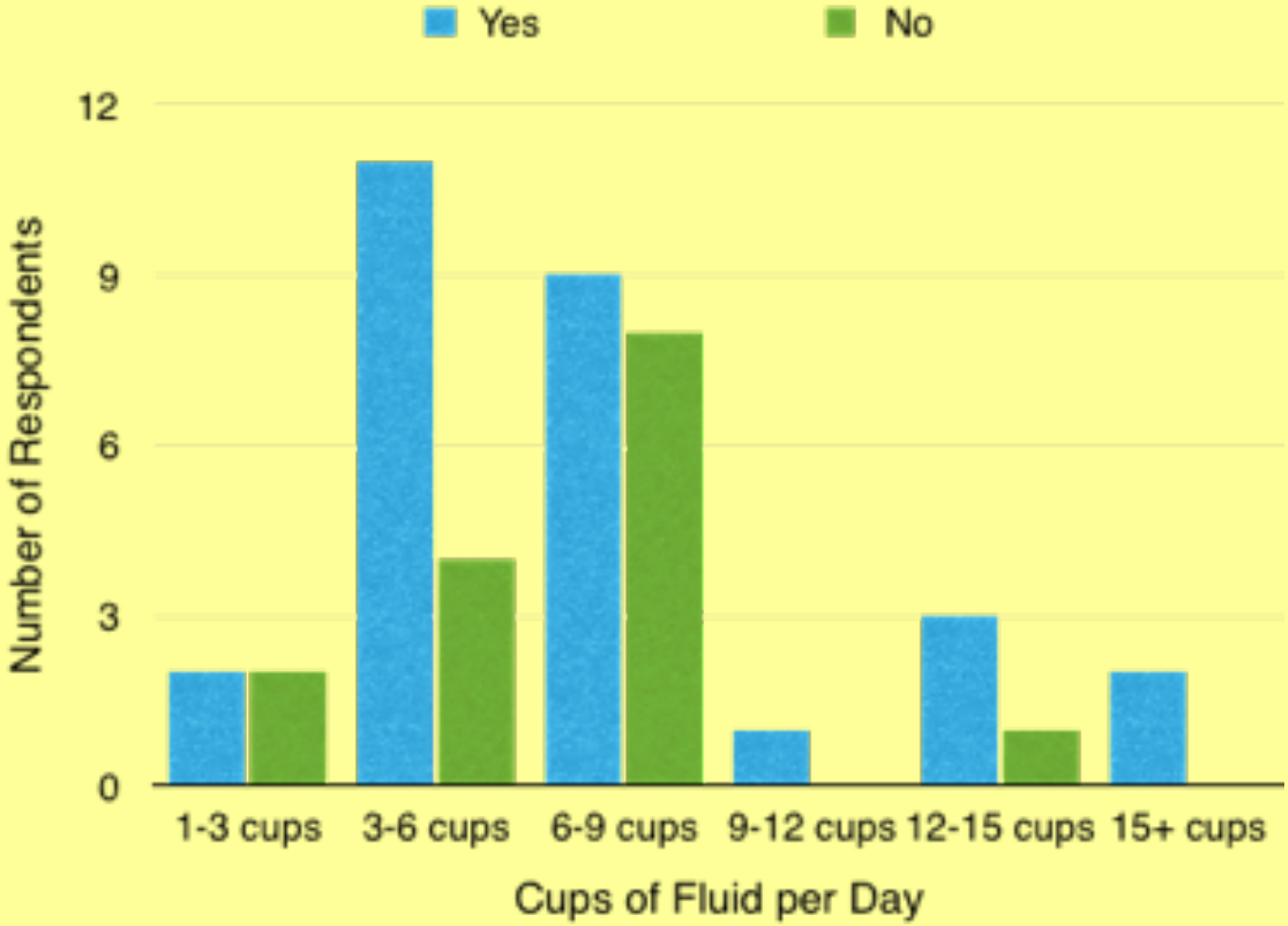
Female Respondents – Fluid Intake and Knowledge about Dehydration with regard to Climate and Time



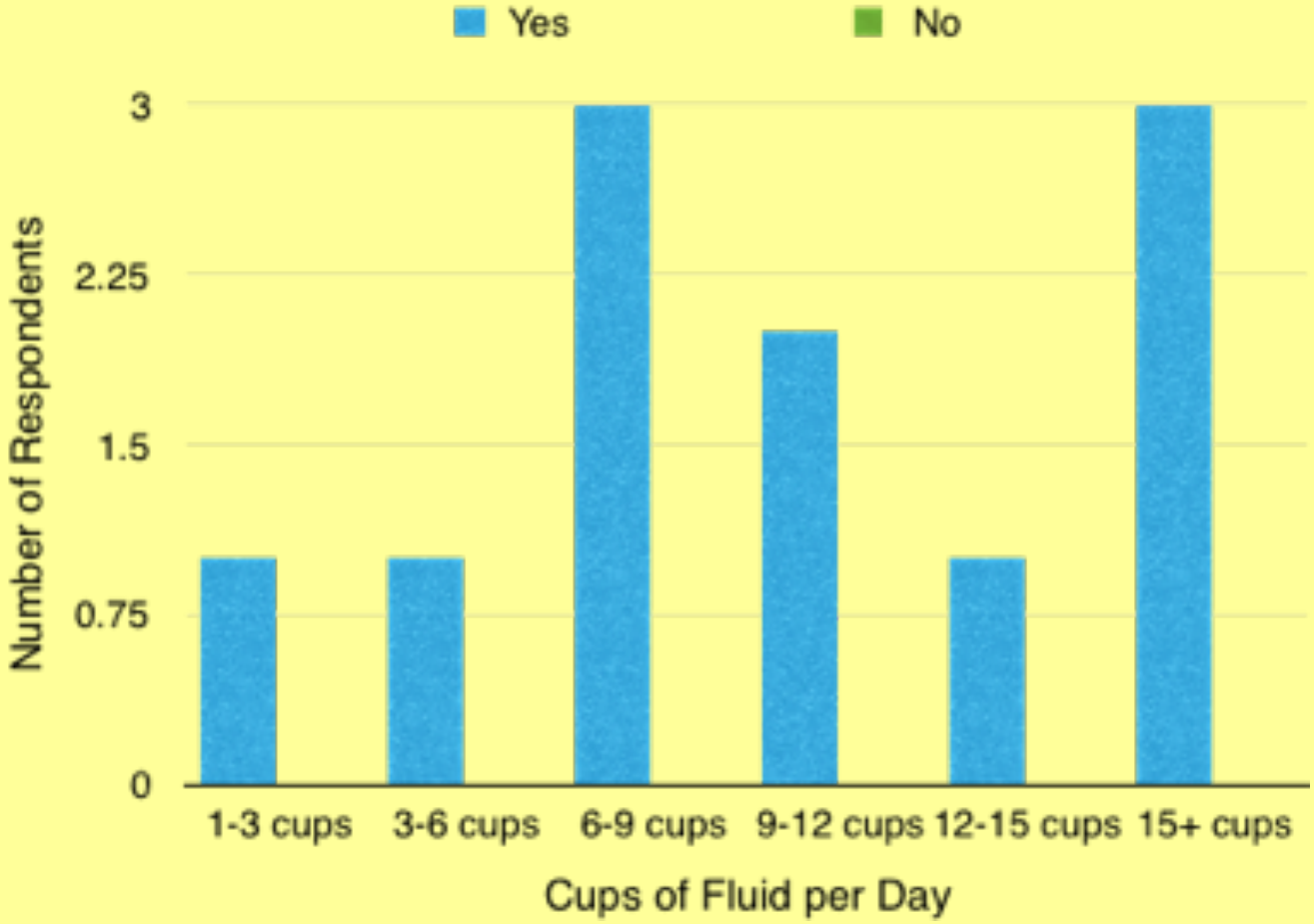
Male Respondents – Fluid Intake and Diagnosis of Dehydration or Advice to Drink More Fluids



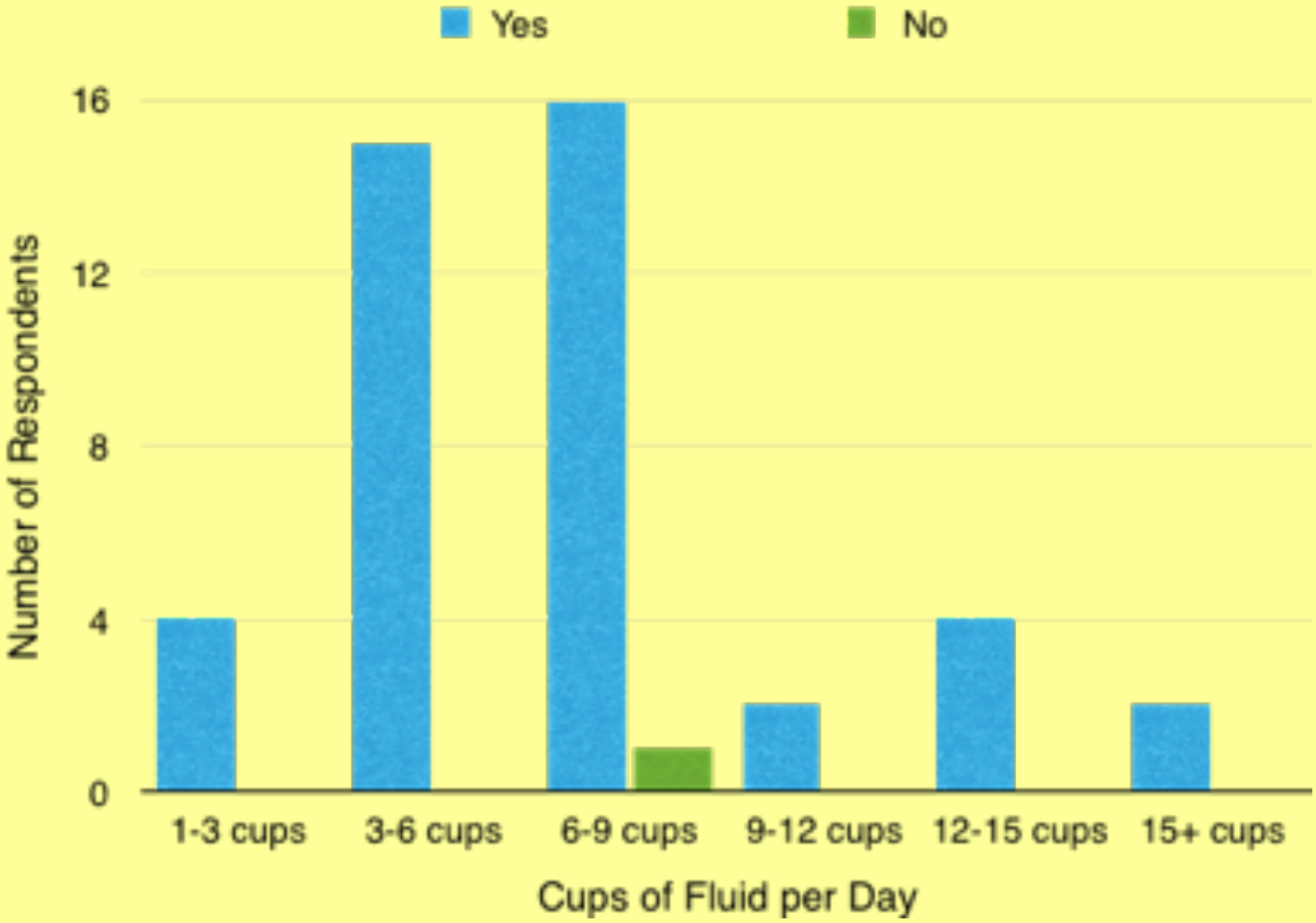
Female Respondents – Fluid Intake and Diagnosis of Dehydration or Advice to Drink More Fluids



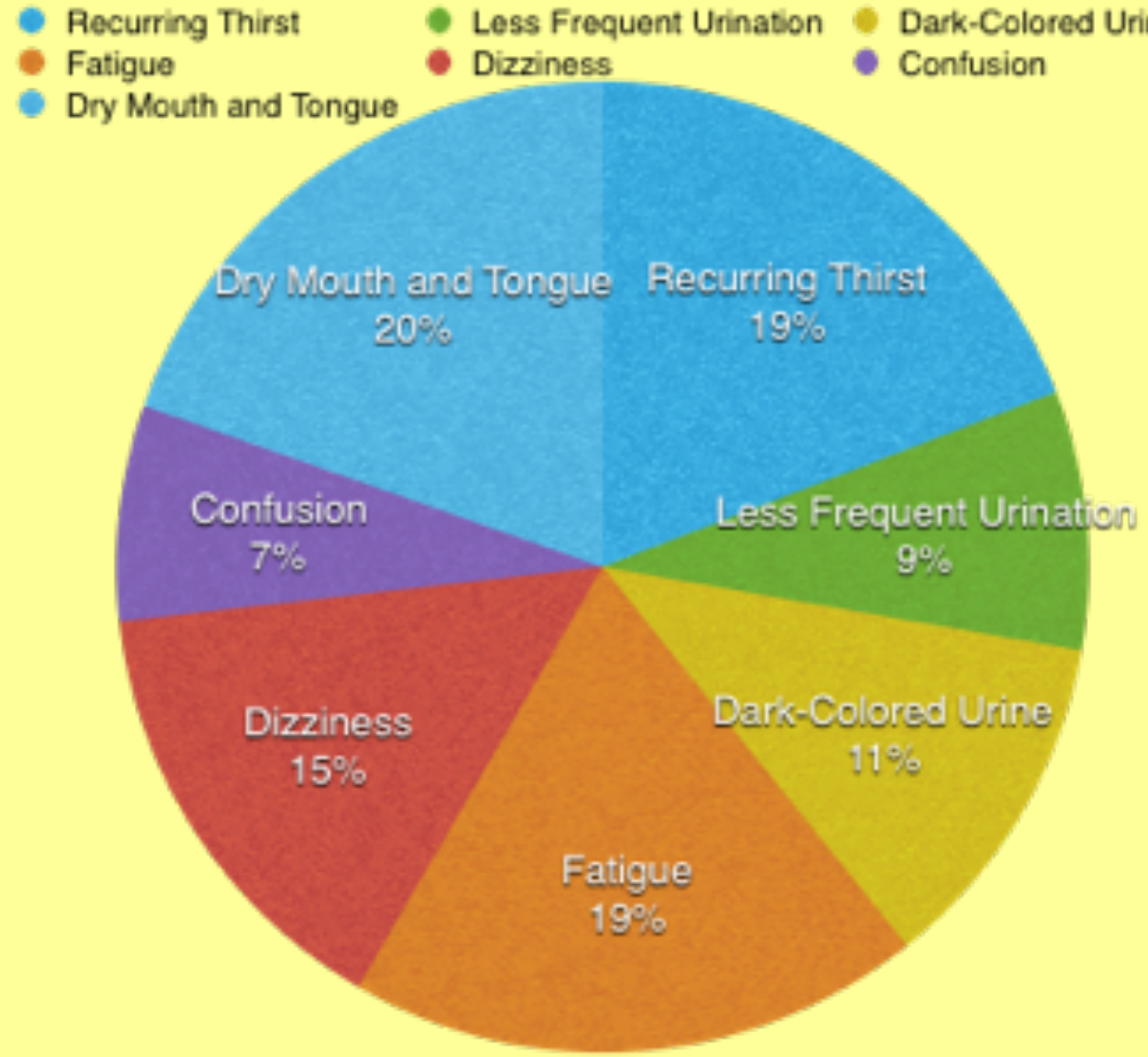
Male Respondents – Fluid Intake and Experience of Symptoms of Dehydration



Female Respondents – Fluid Intake and Experience of Symptoms of Dehydration



Respondents' Experienced Symptoms of Dehydration



Conclusions

- There were possible correlations between fluid intake and:
  - Age
  - Education level
  - Years Lived In or Near Yuma County, AZ,
  - Knowledge that Dehydration is More Common in Hot, Dry Climates and could Cause Damage to Human Health.

Conclusions

- There was insufficient data to show correlation between
  - Fluid Intake
  - Previous Experience of Dehydration's Symptoms or Diagnosis of Dehydration or Advice to Intake More Fluids.

Recommendations for Decreasing the Occurrence of Dehydration

Recommendations for Decreasing the Occurrence of Dehydration

- Recommendations after the conclusion of this study are that for those who meet any of the risk factors should raise the recommended daily fluid intake by one unit.
  - For instance, instead of 9-12 cups of fluid per day, males should try for 12-15 cups of fluid per day. Females should aim for a daily fluid intake of 9-12 cups of fluid per day, instead of 6-9 cups of fluid per day.

Recommendations for Decreasing the Occurrence of Dehydration

- Also recommended is that awareness of dehydration and its effect on human health be increased
  - through means of distribution of educational flyers/handout, presentations at schools or health fairs,
  - partnerships with local clinics and health departments; awareness should specifically target vulnerable, at-risk populations.

Conclusion

- Further research is necessary to show significant or definite trends among fluid intake and age, education level, years residing in or near Yuma County, AZ, knowledge that dehydration previous diagnosis of dehydration or to intake more fluids, and previous experience of dehydration's symptoms.
- Further studies are also imperative for a better understanding of the influence of fluids and human health.

Conclusion

- Continuing educational awareness in or near Yuma County, AZ, about dehydration is critical for maintaining a population of healthy humans.

Questions?

Thank you!

Soli Deo Gloria!

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