TERM 3 Exam REVIEW

Chapter 12-14

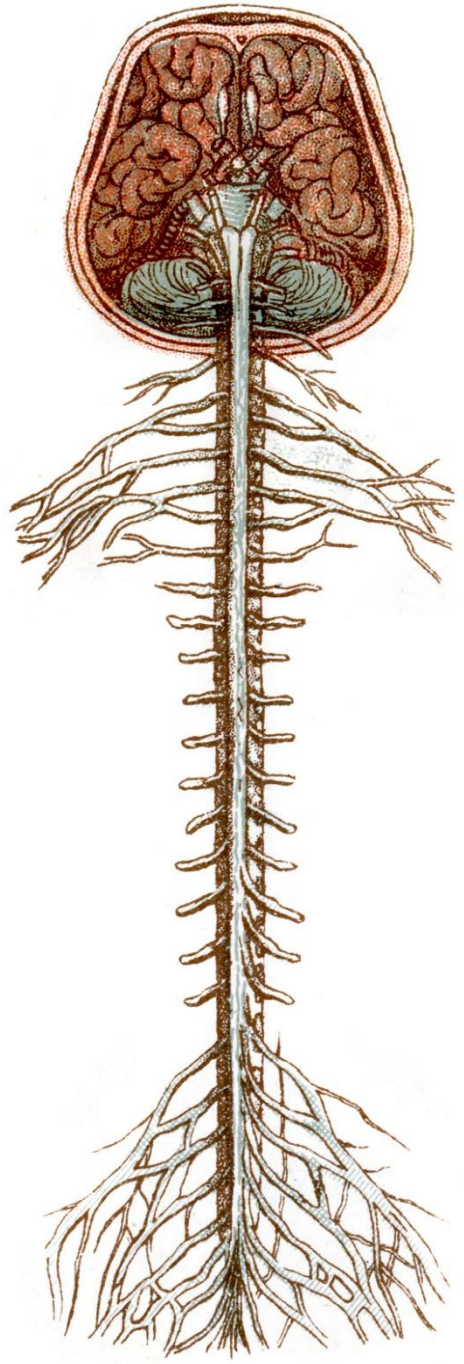
CHAPTER 12: NERVOUS SYSTEM

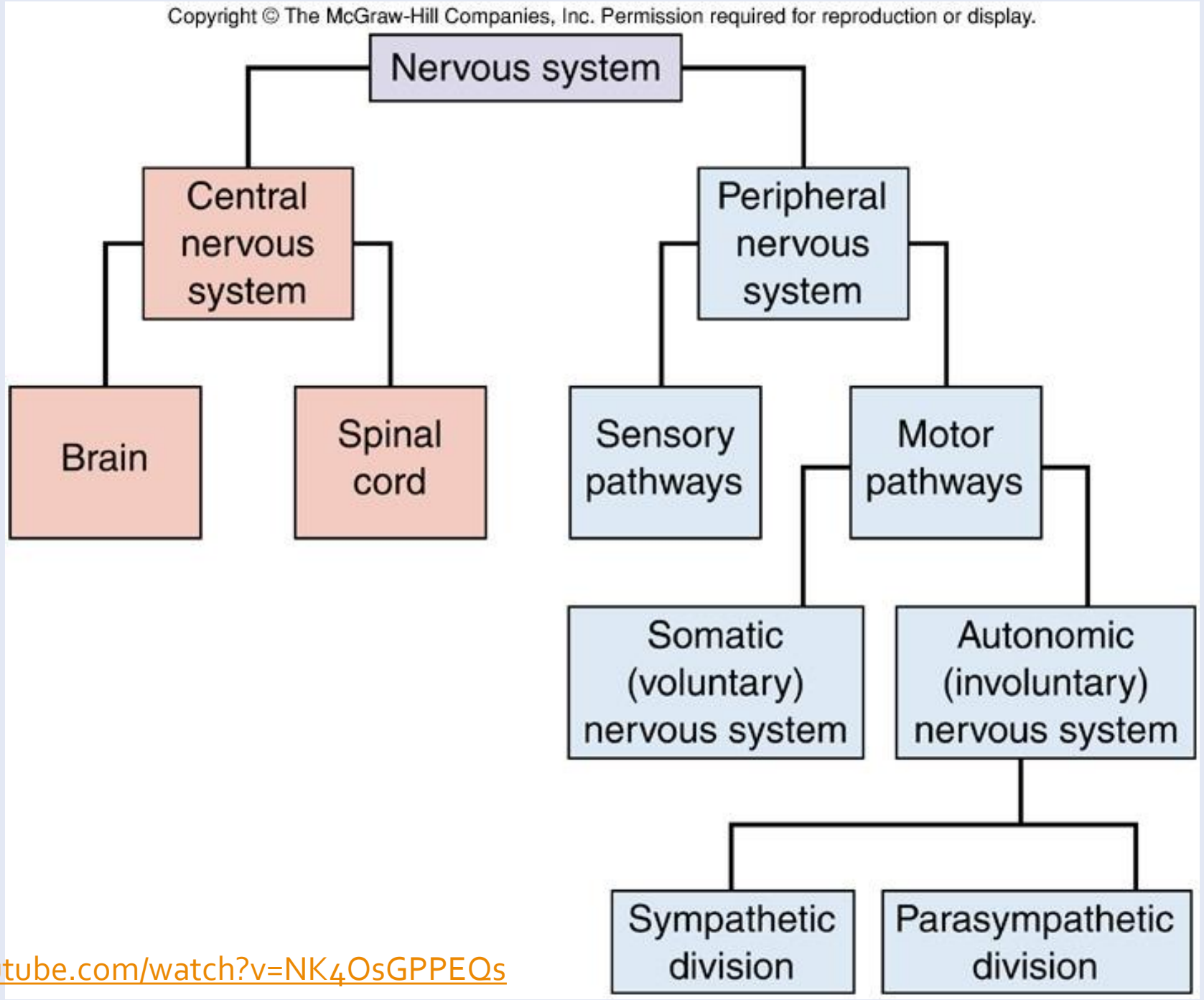
The Nervous System

- The nervous system consists of the 2 parts
  - The Central Nervous System (CNS) consists of the brain and spinal cord
  - The Peripheral Nervous System (PNS) consists of the nerves extending from the brain and spinal cord → cranial nerves and spinal nerves respectively

- The CNS and PNS are formed from tiny nerve cells called neurons

https://www.youtube.com/watch?v=x8DjPqdlUbg





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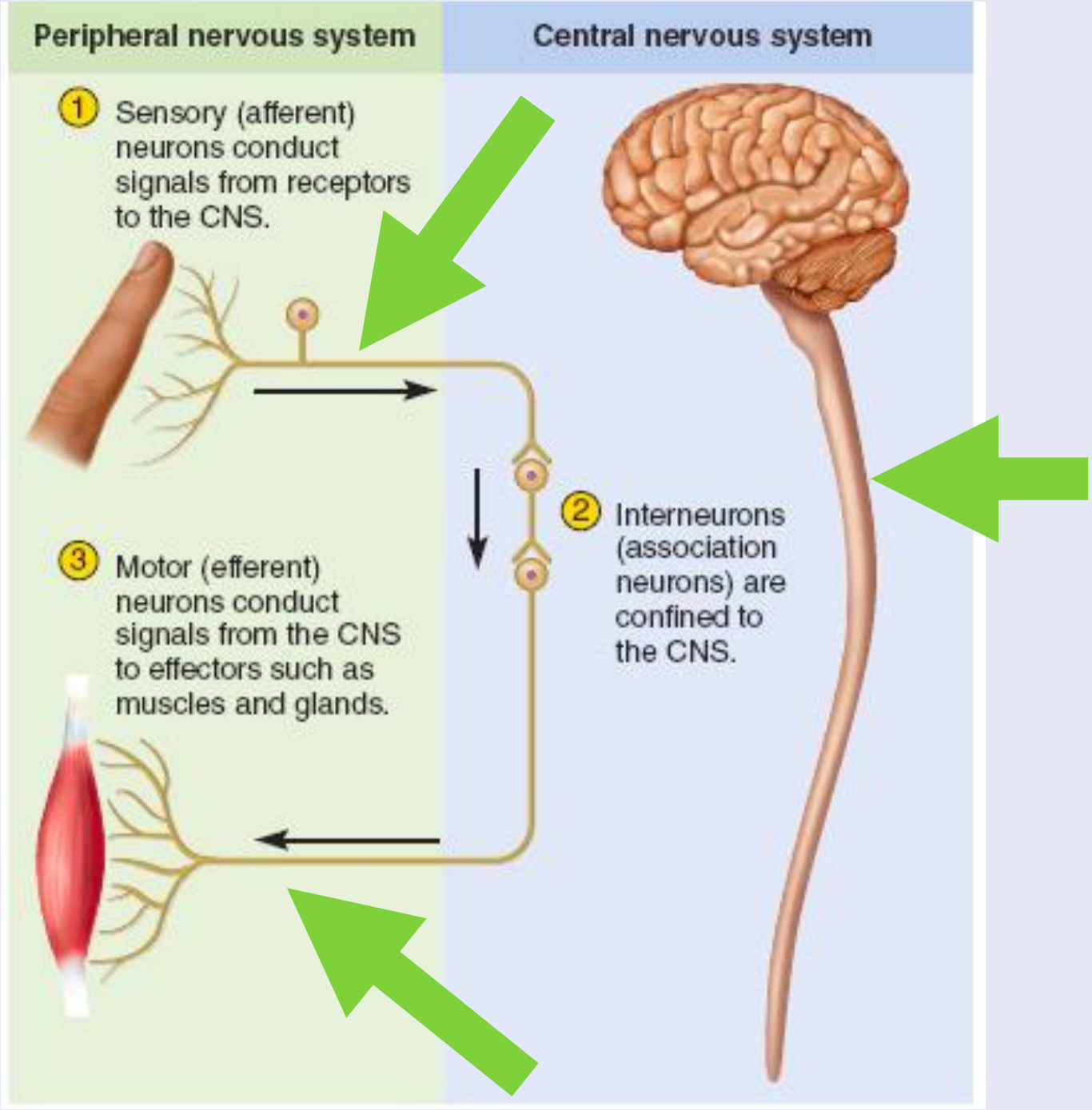
How does it work?



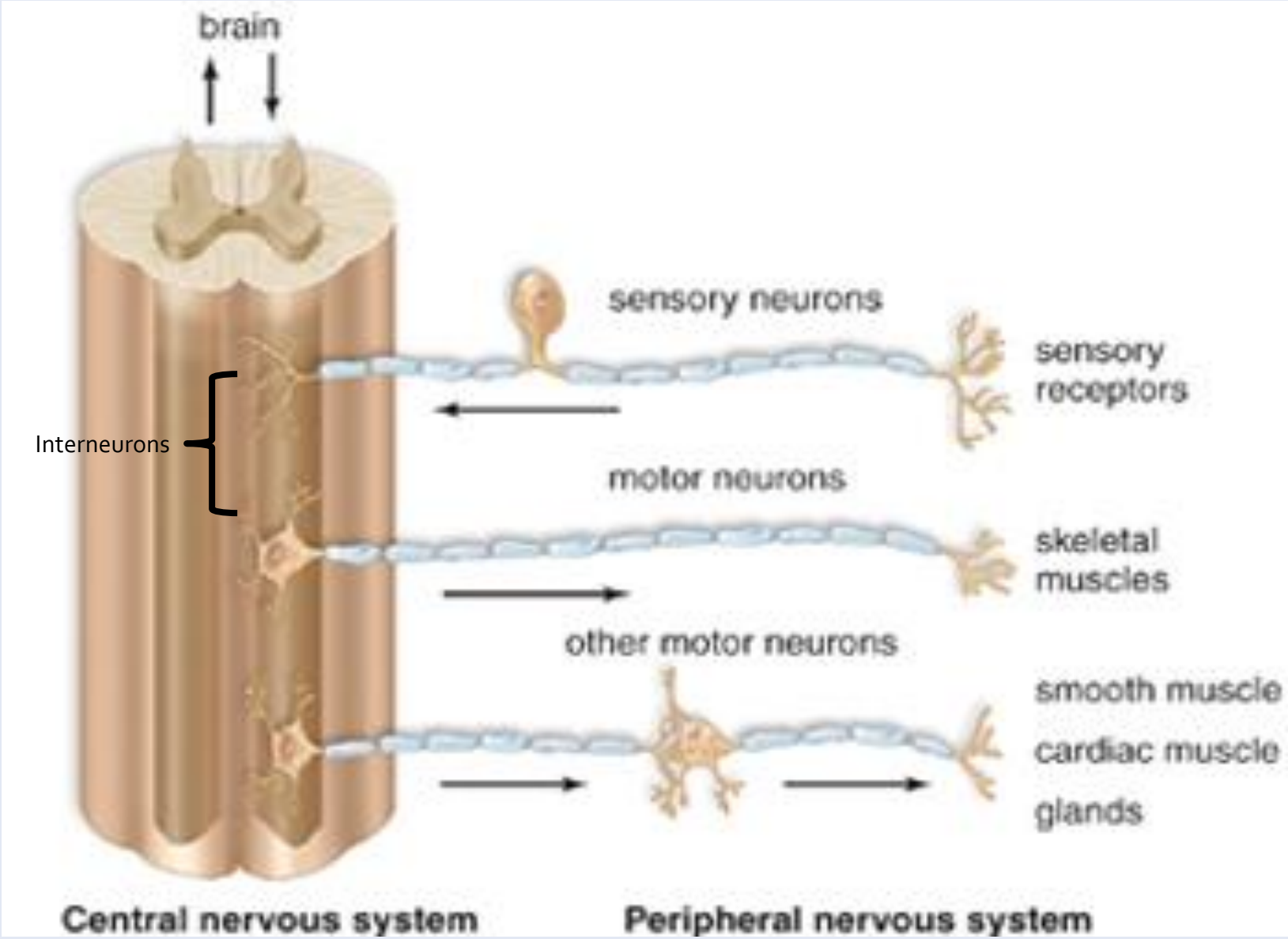
Neurons = 3 Types make up the Nervous System

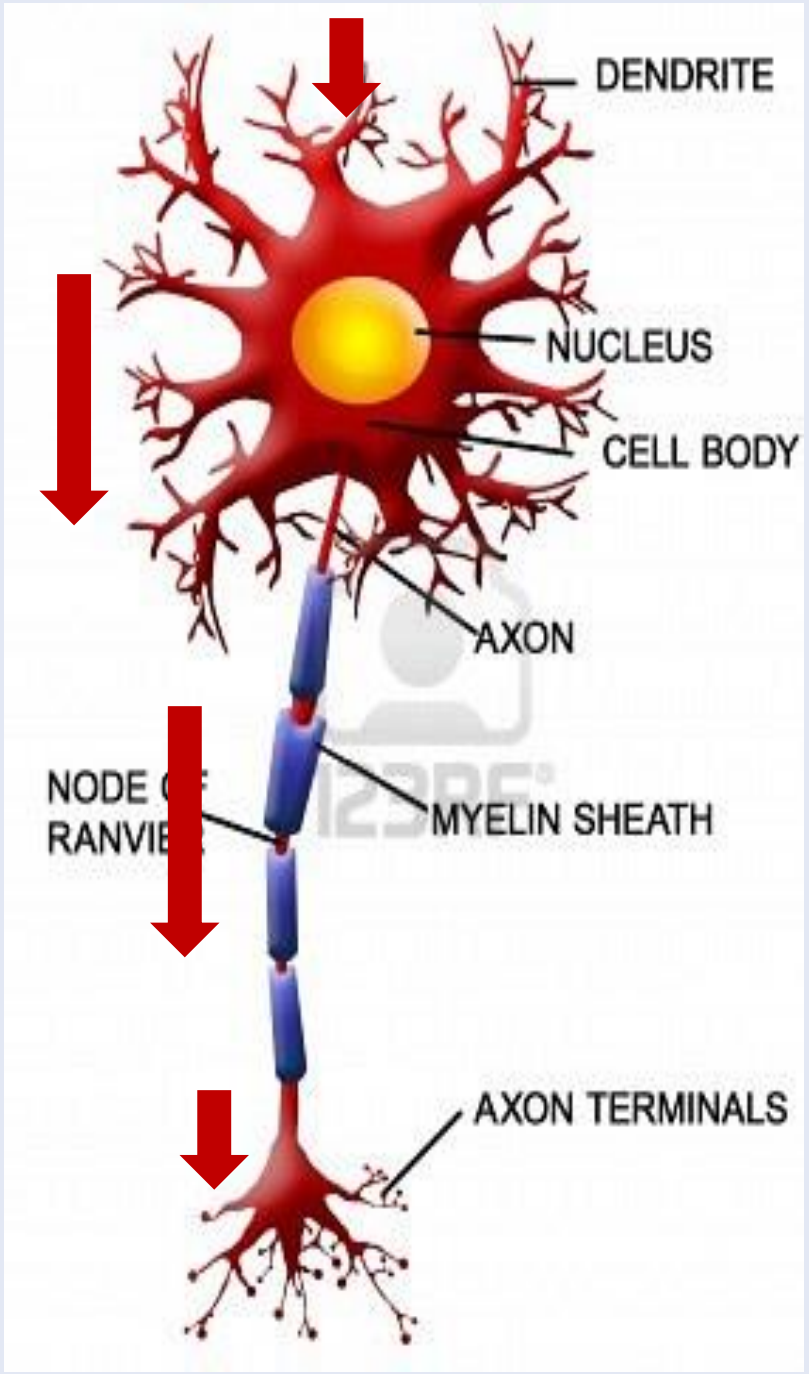
Part of PNS:

1. **Sensory neurons** carry messages/action potentials towards the CNS
2. **Motor neurons** carry messages/action potentials away from the CNS

Part of CNS:

3. **Interneurons** carry message/action potentials inside the CNS and between the sensory and motor neurons





Each neuron consists of three parts

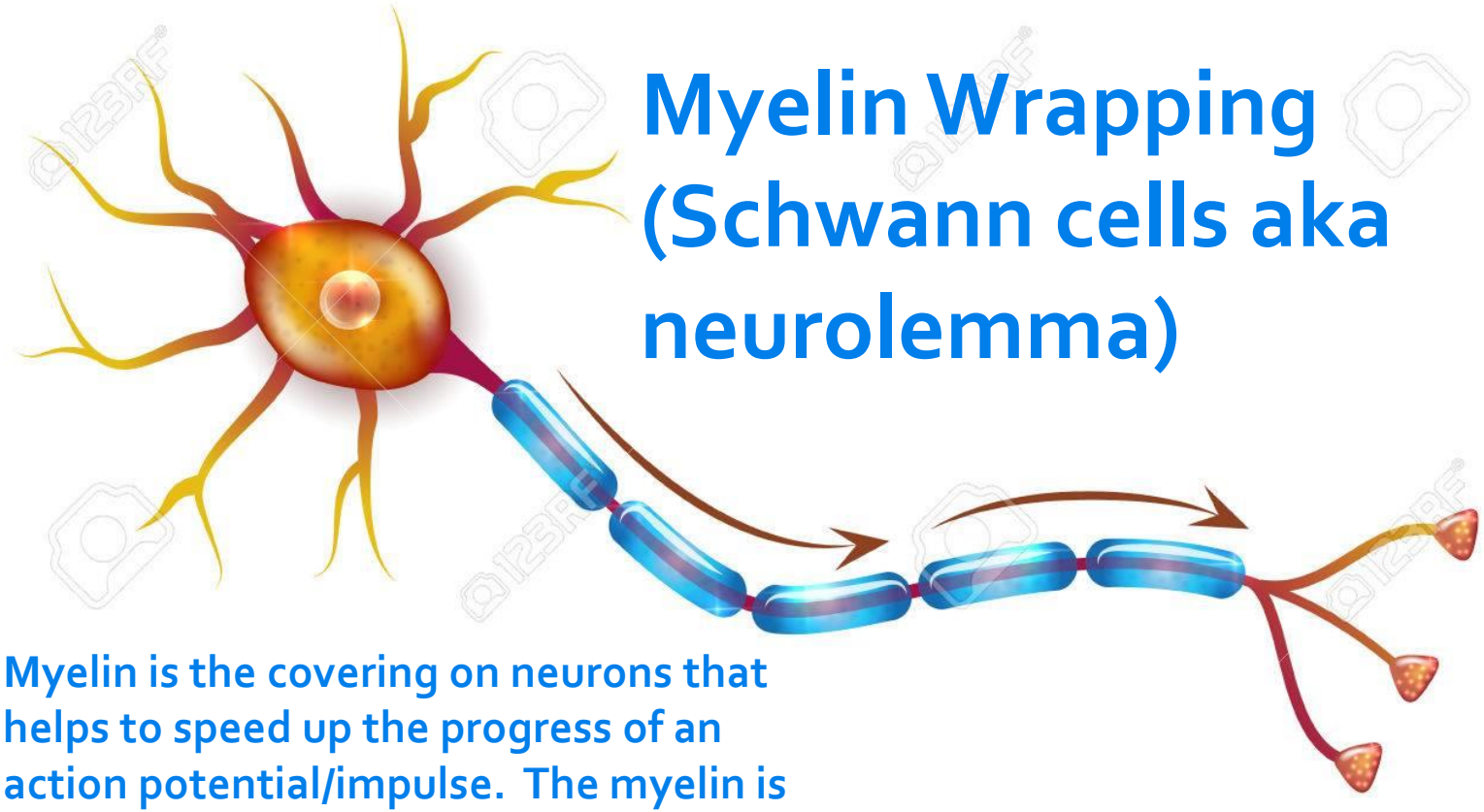
1. **Dendrite** = carries impulses towards the cell body
2. **Cell body** = location of the nucleus
3. **Axon** = carries impulses away from the cell body

Myelin sheath= is the fatty substance surrounding parts of the neuron

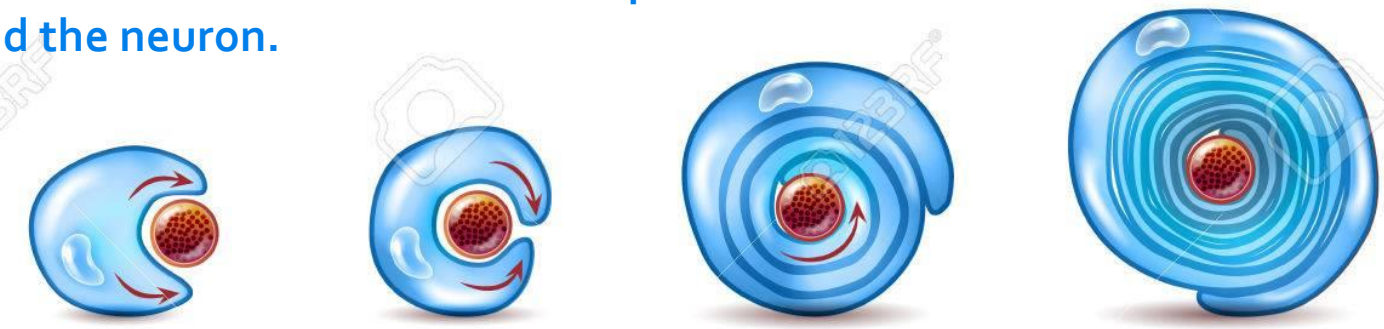
Nodes of Ranvier= gapes where there is no myelin sheath

Schwann cells= make the myelin sheath

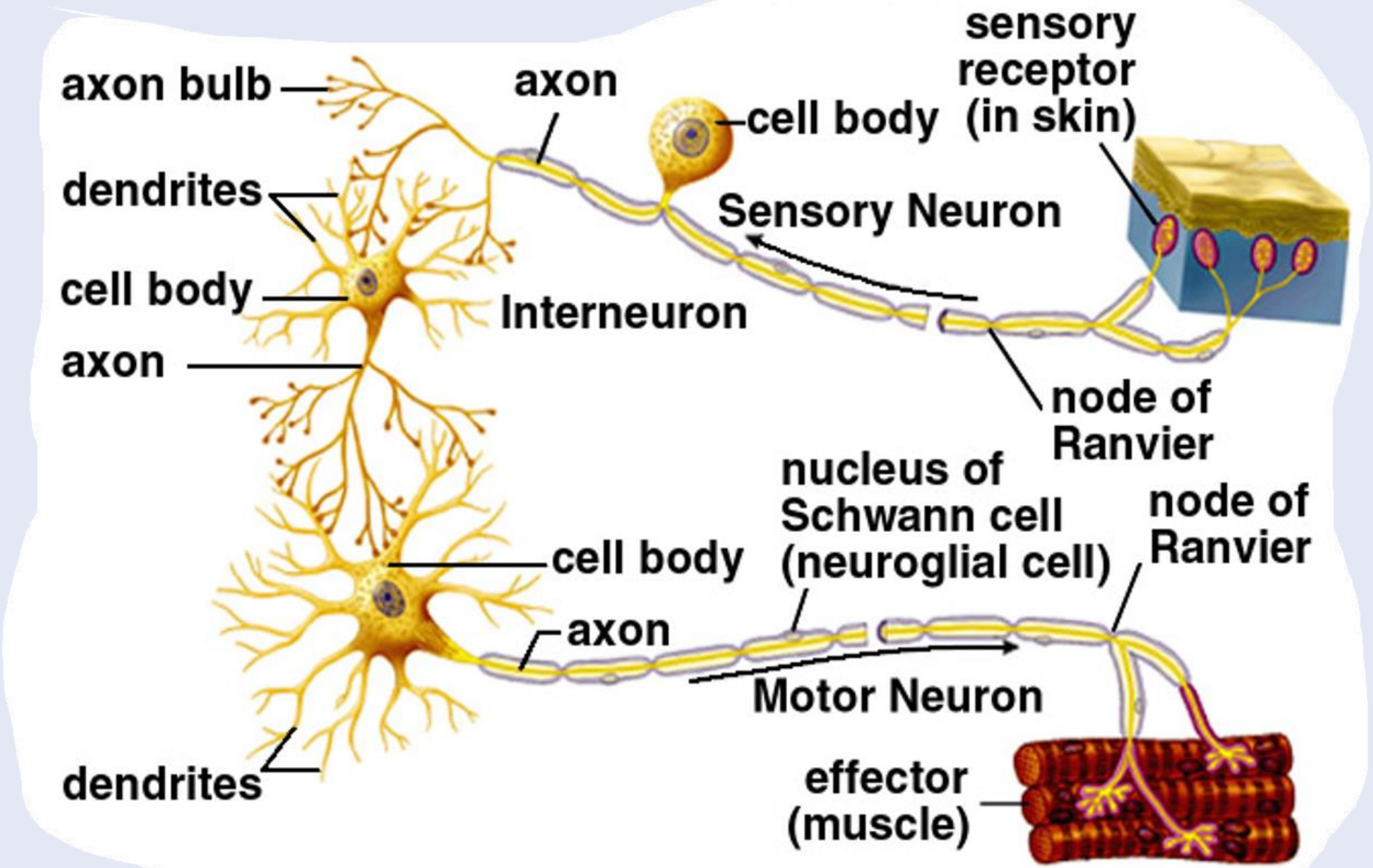
Myelin Wrapping (Schwann cells aka neurolemma)

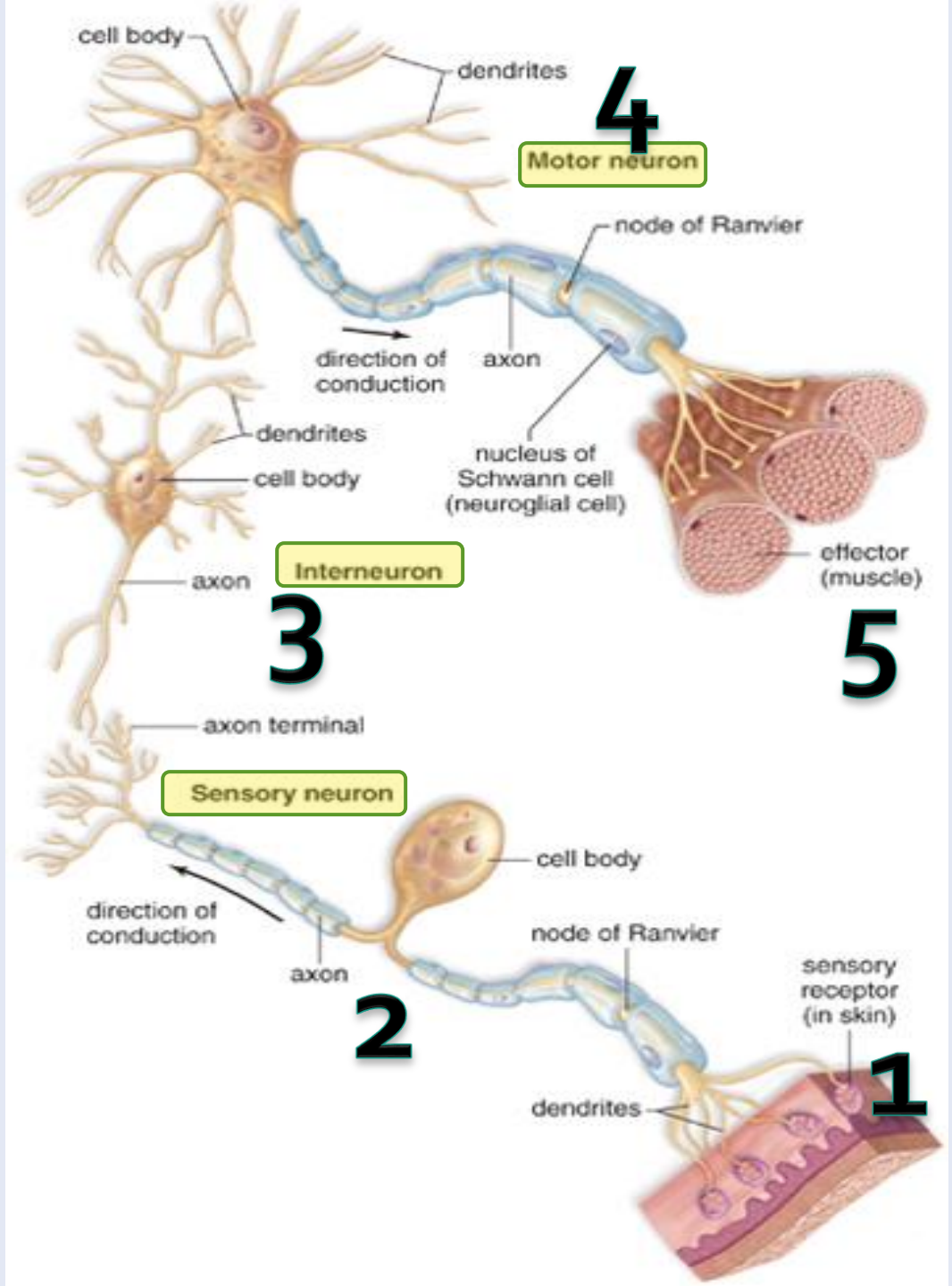


Myelin is the covering on neurons that helps to speed up the progress of an action potential/impulse. The myelin is made from Schwann cells which wrap around the neuron.



1. 2. 3. 4.

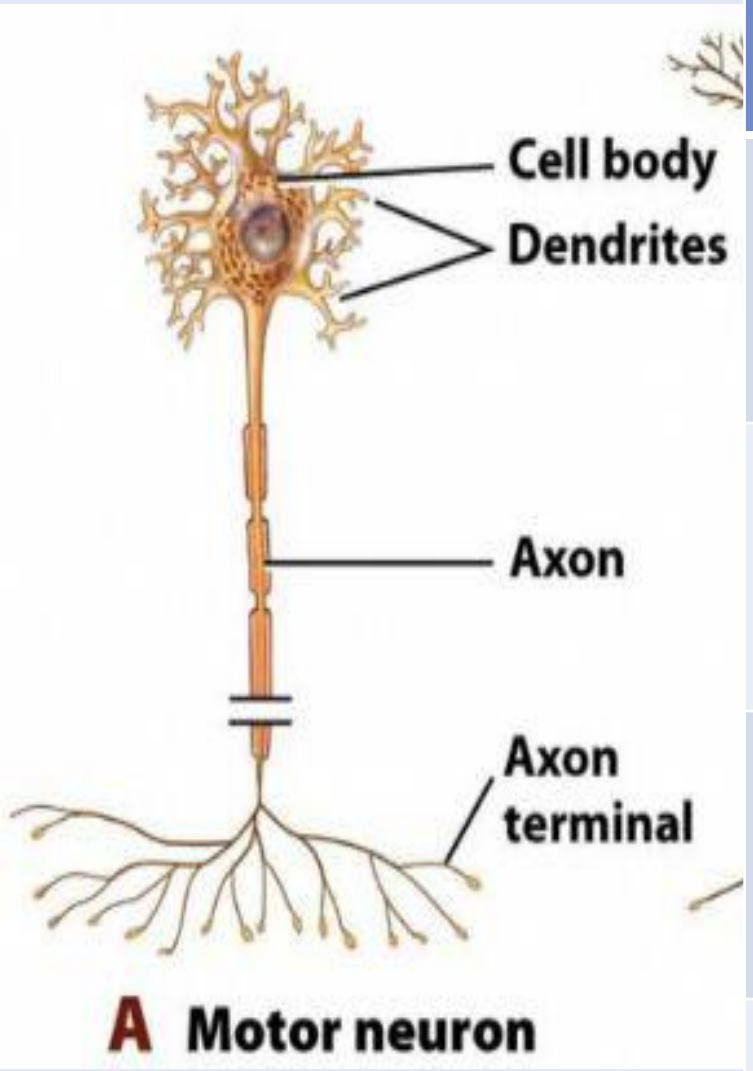

axon bulb
dendrites
cell body
axon
Interneuron
axon
cell body
sensory receptor (in skin)
Sensory Neuron
node of Ranvier
nucleus of Schwann cell (neuroglial cell)
node of Ranvier
cell body
axon
Motor Neuron
dendrites
effector (muscle)



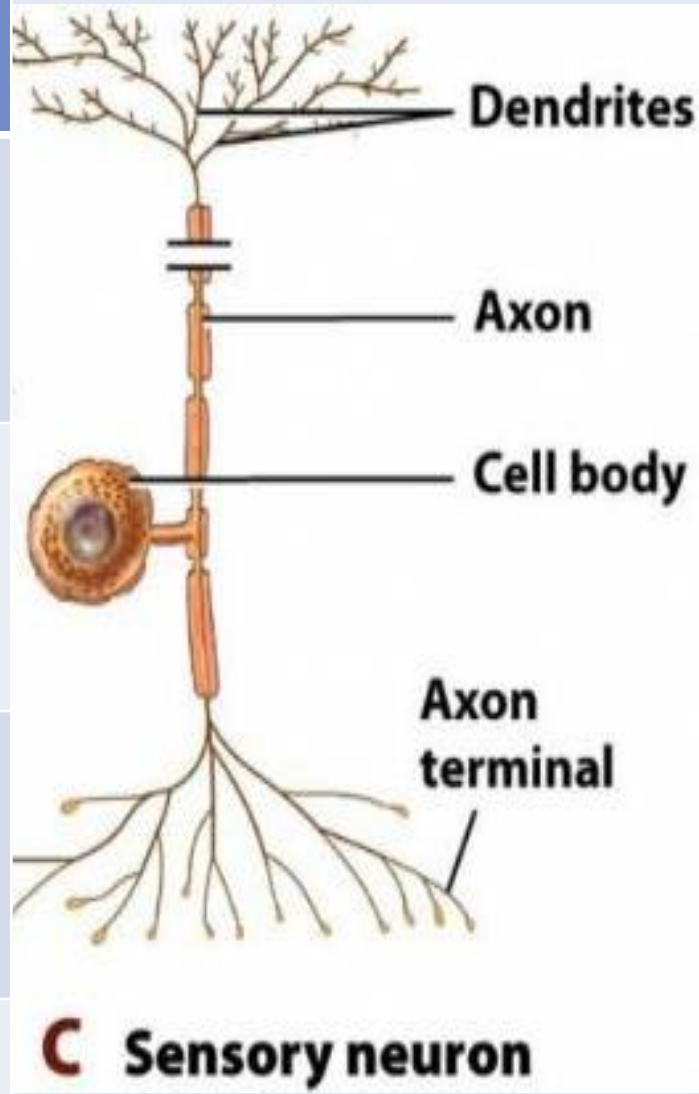
The ***sensory receptor*** detects changes in the environment and initiates the signal at the sensory neuron dendrite

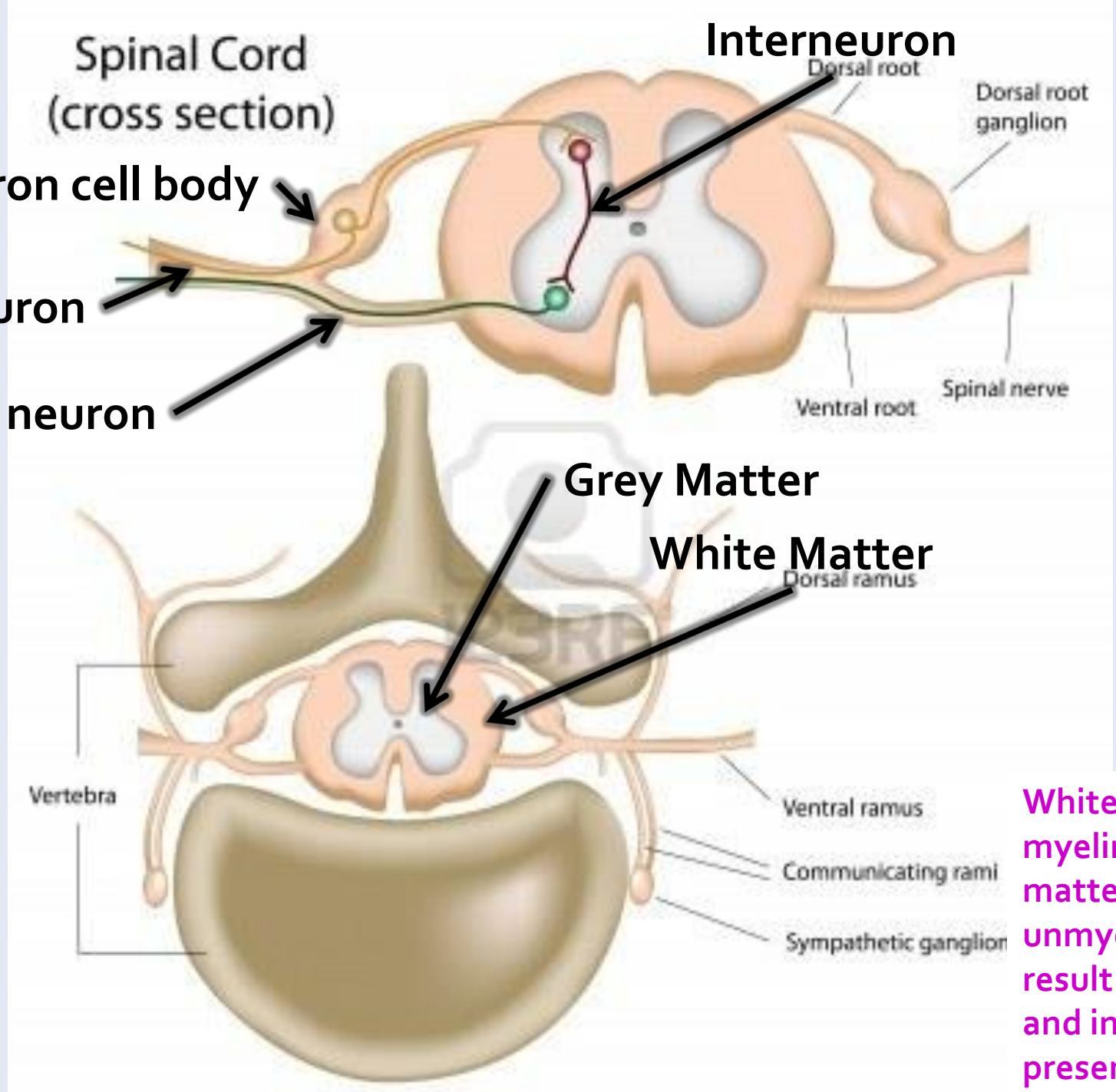
The ***effector*** is at the end of the motor neuron and is stimulated by the neurotransmitters released by the motor neuron axon endings (bulbs)

The effector can be a voluntary (like skeletal muscle) or involuntary (like a gland, cardiac muscle or smooth muscle)

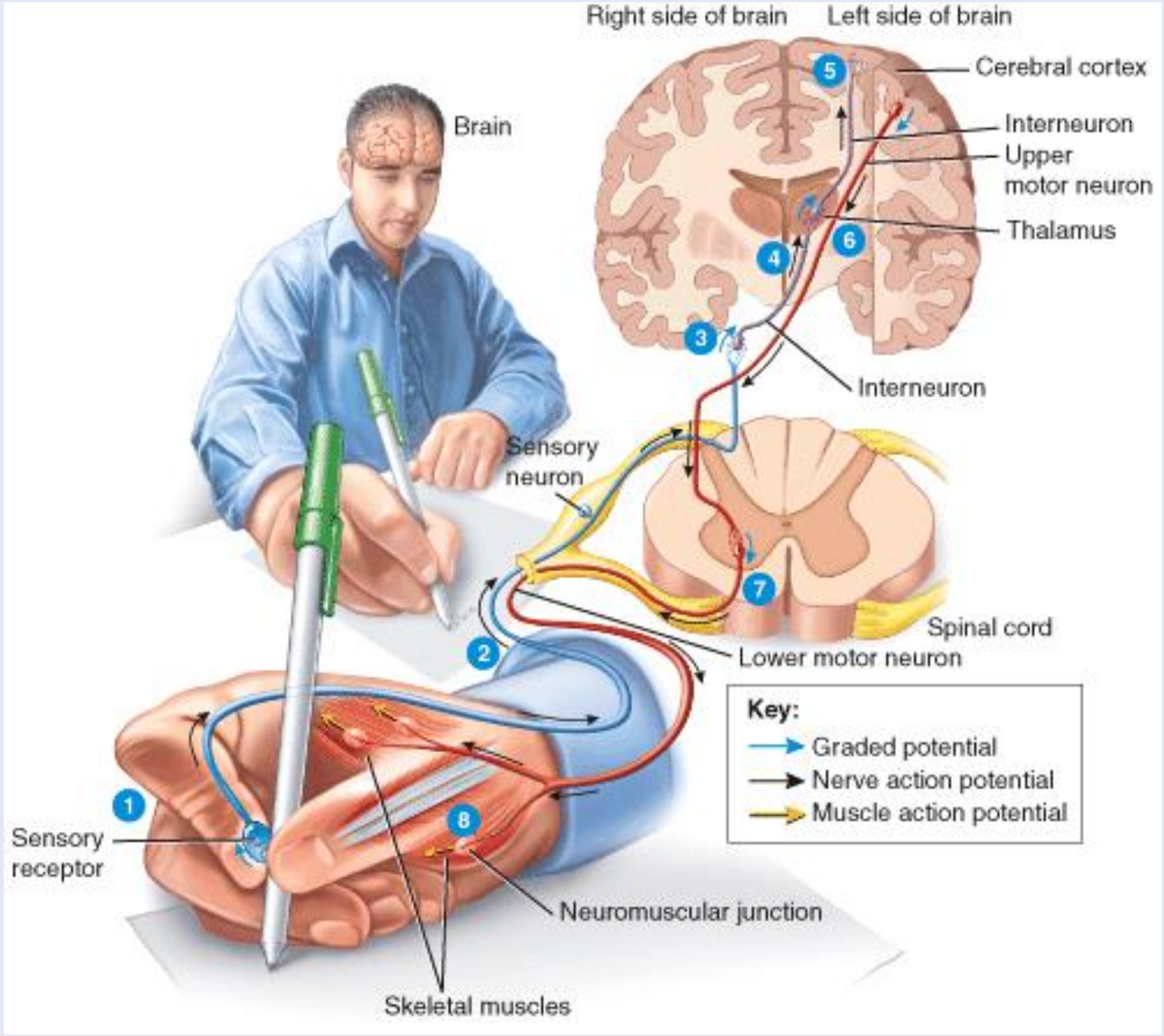


Motor Neuron	Sensory Neuron
Carry impulse away from CNS	Carry impulse towards CNS
Cell body inside CNS	Cell body outside CNS
Short, unmyelinated dendrites	Long, myelinated dendrite
Long, myelinated axon	Short, partially myelinated axon



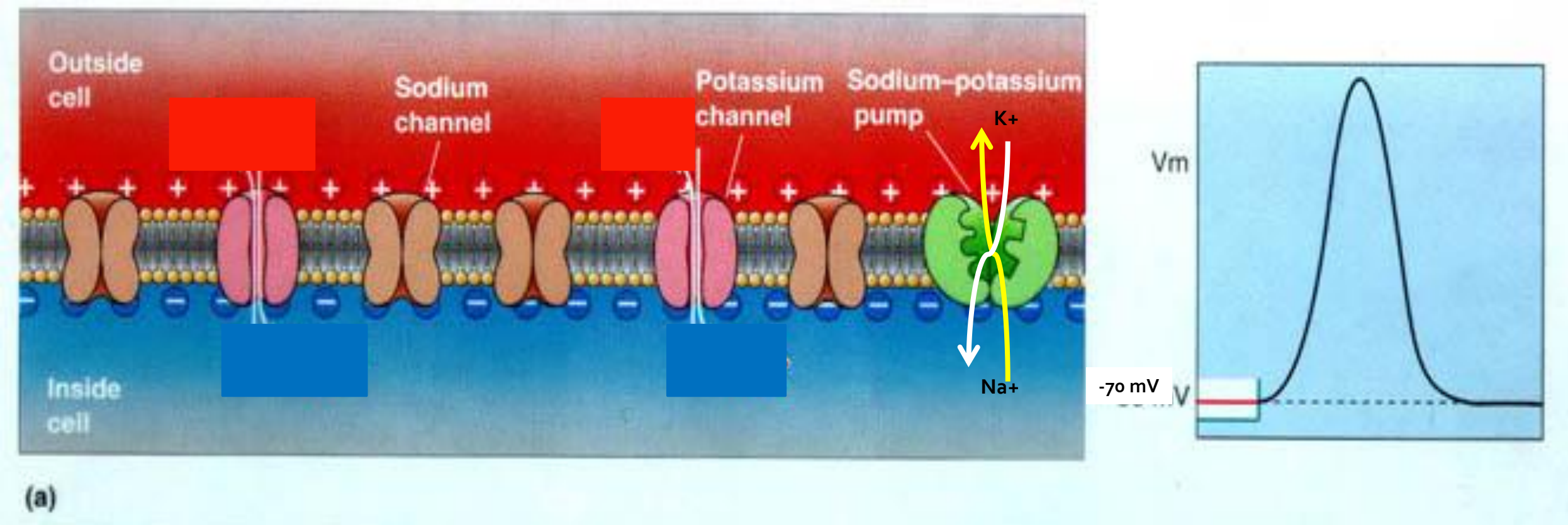


White matter consists of myelinated neurons and Grey matter consists of unmyelinated neurons. As a result the PNS is myelinated and inside the CNS both are present.


Right side of brain
Left side of brain
Cerebral cortex
Brain
Interneuron
Upper motor neuron
Thalamus
Interneuron
Sensory neuron
Spinal cord
Lower motor neuron
Key:
Graded potential
Nerve action potential
Muscle action potential
Sensory receptor
Neuromuscular junction
Skeletal muscles
1
2
3
4
5
6
7
8

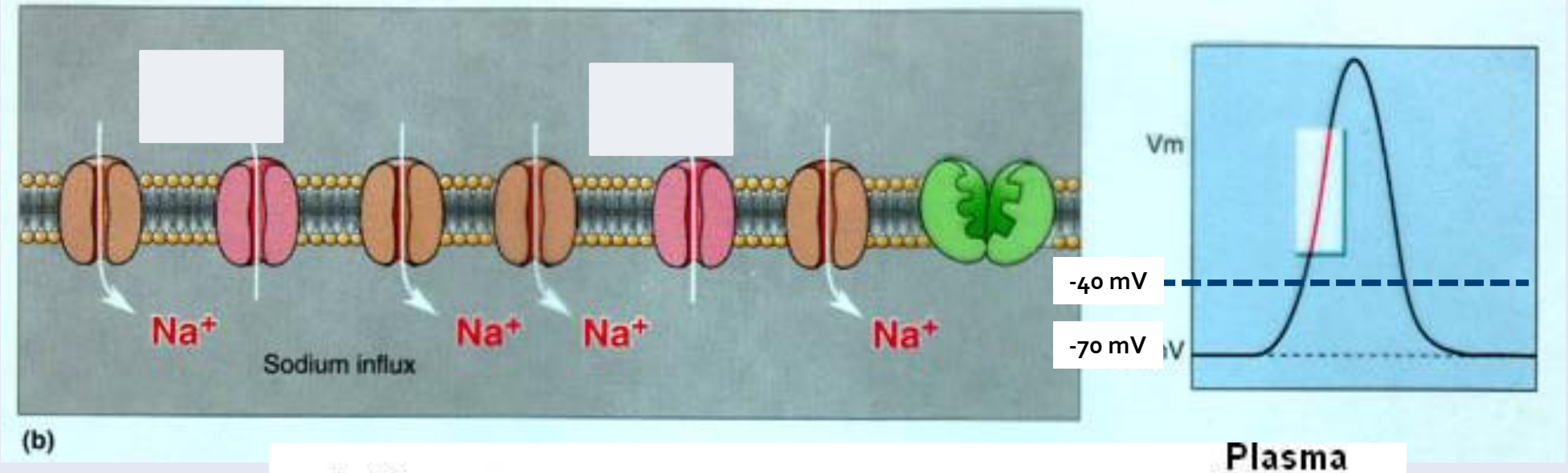
Neuron at Resting Potential

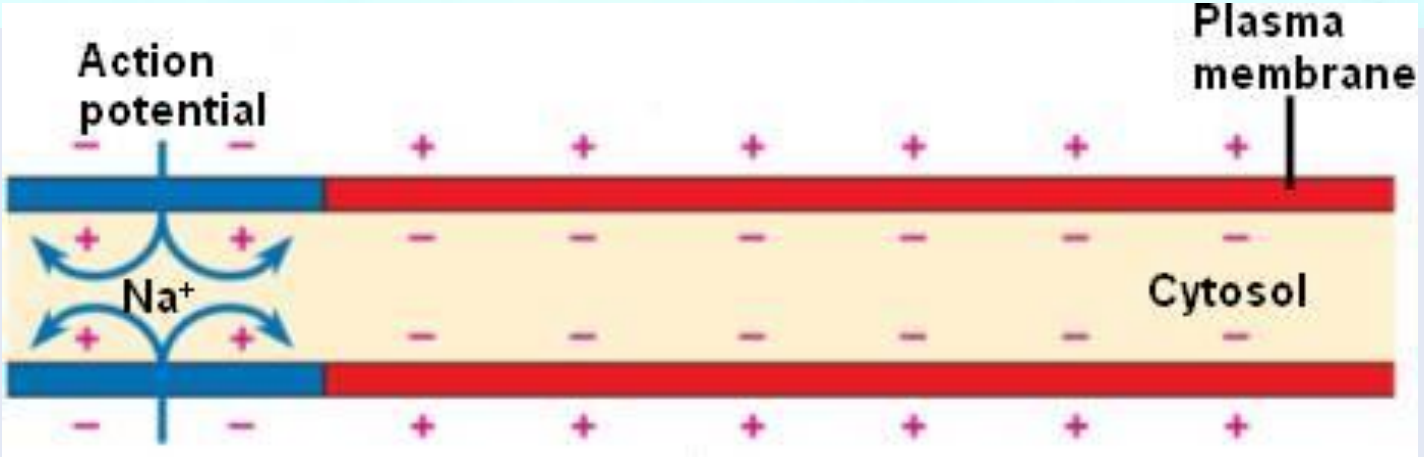
- Resting Potential = The inside of the neuron is negative compare to the outside at -70mV. This is maintained by the sodium-potassium pump which pumps Na+ out of the neuron and K+ into the neuron (more Na+ on outside of neuron and K+ on inside of neuron)



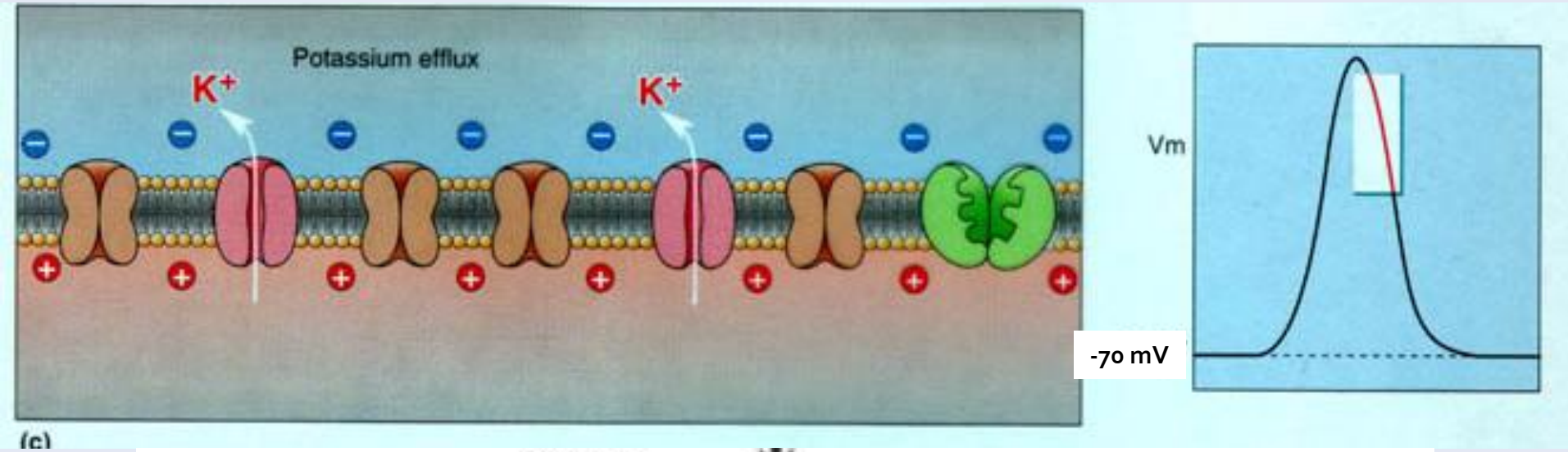
The Action Potential

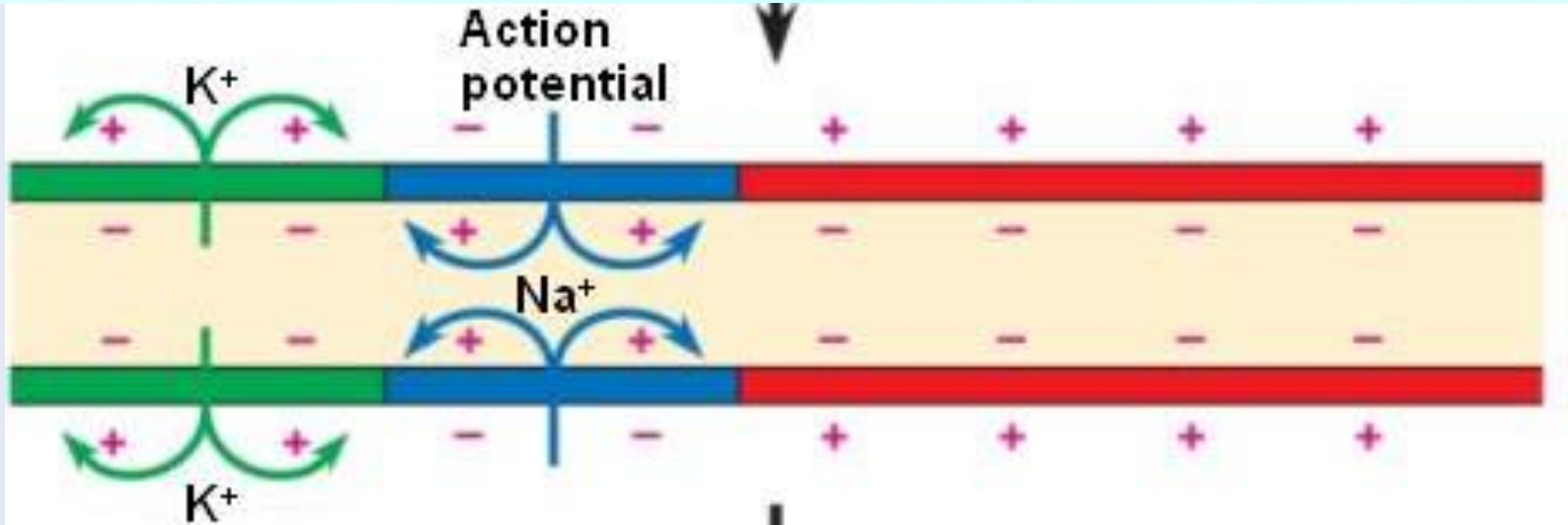
Depolarization = When the membrane stimulated to cause Na+ gates to open, Na+ rushes into the neuron. If enough Na+ rushes into increase neuron potential to approximately -40 mV, then a full depolarization to +30 mV occurs



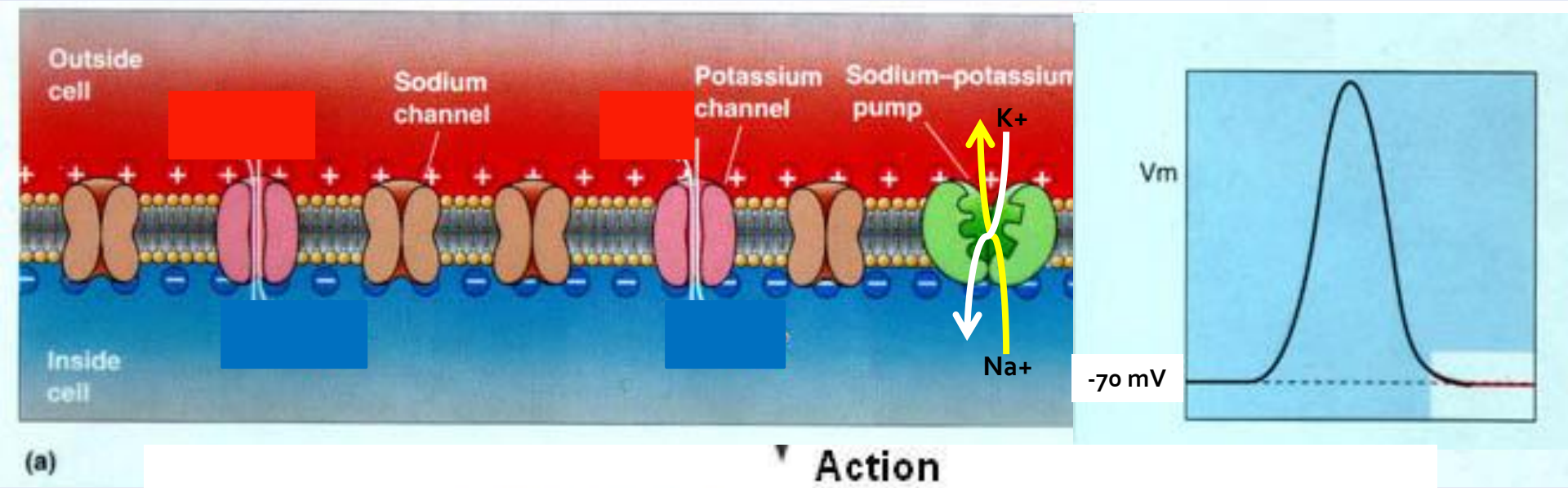


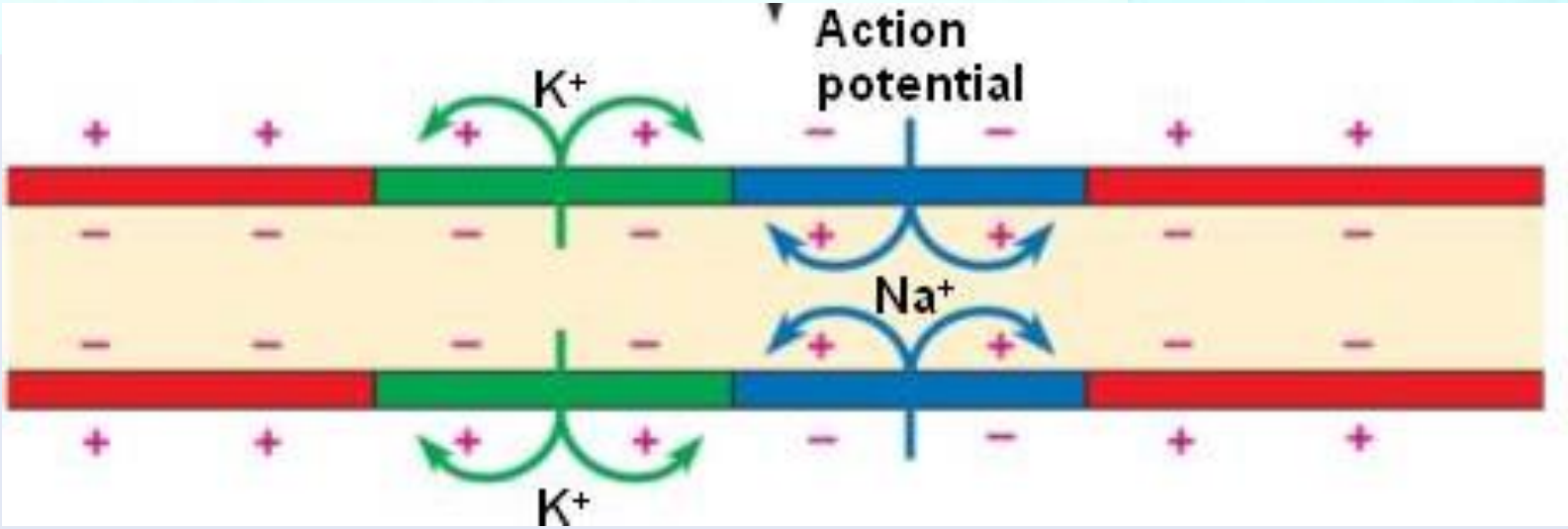
Repolarization = When the potential reaches +30 mV, the sodium gates close and the potassium gates open. K+ rush out of the neuron returning the neuron potential to -70mV. There is a slight overshoot (hyperpolarization) to approximately -90mV.

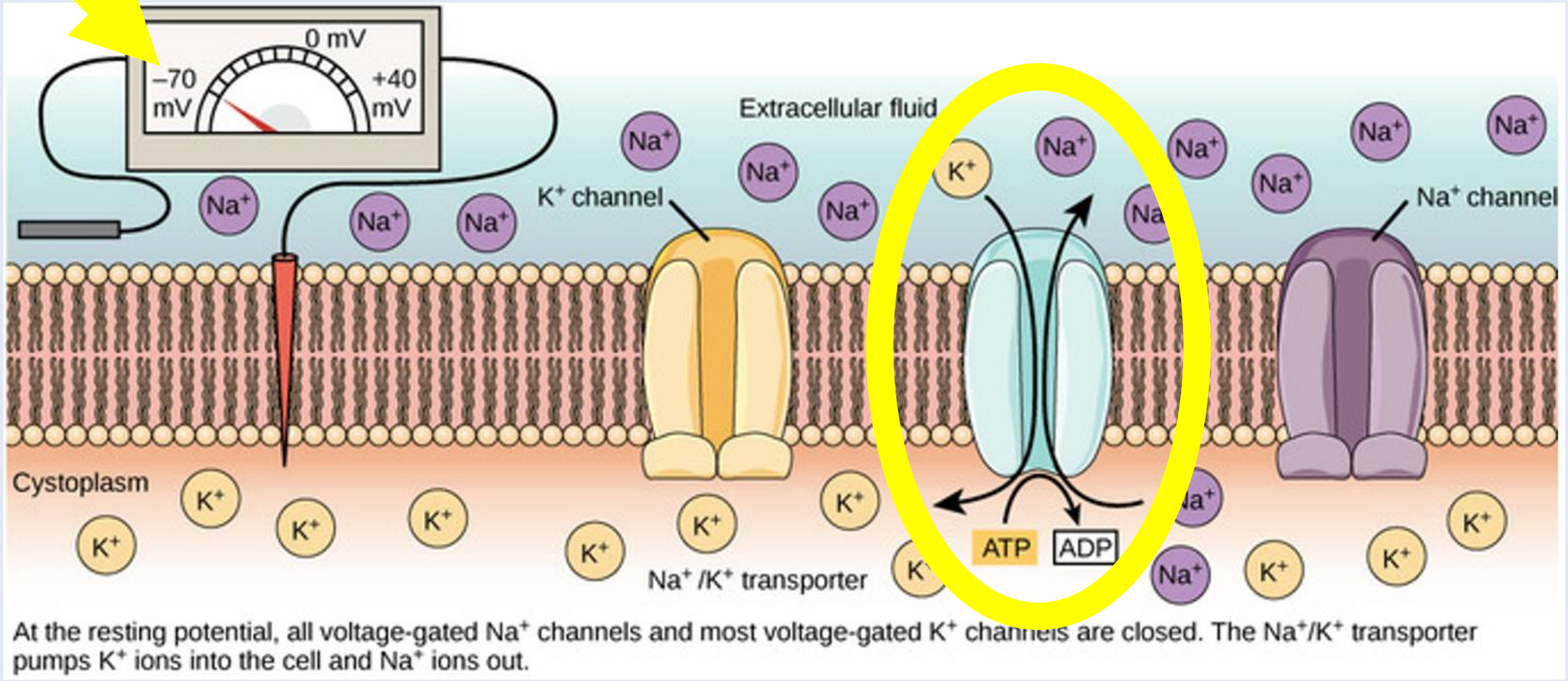




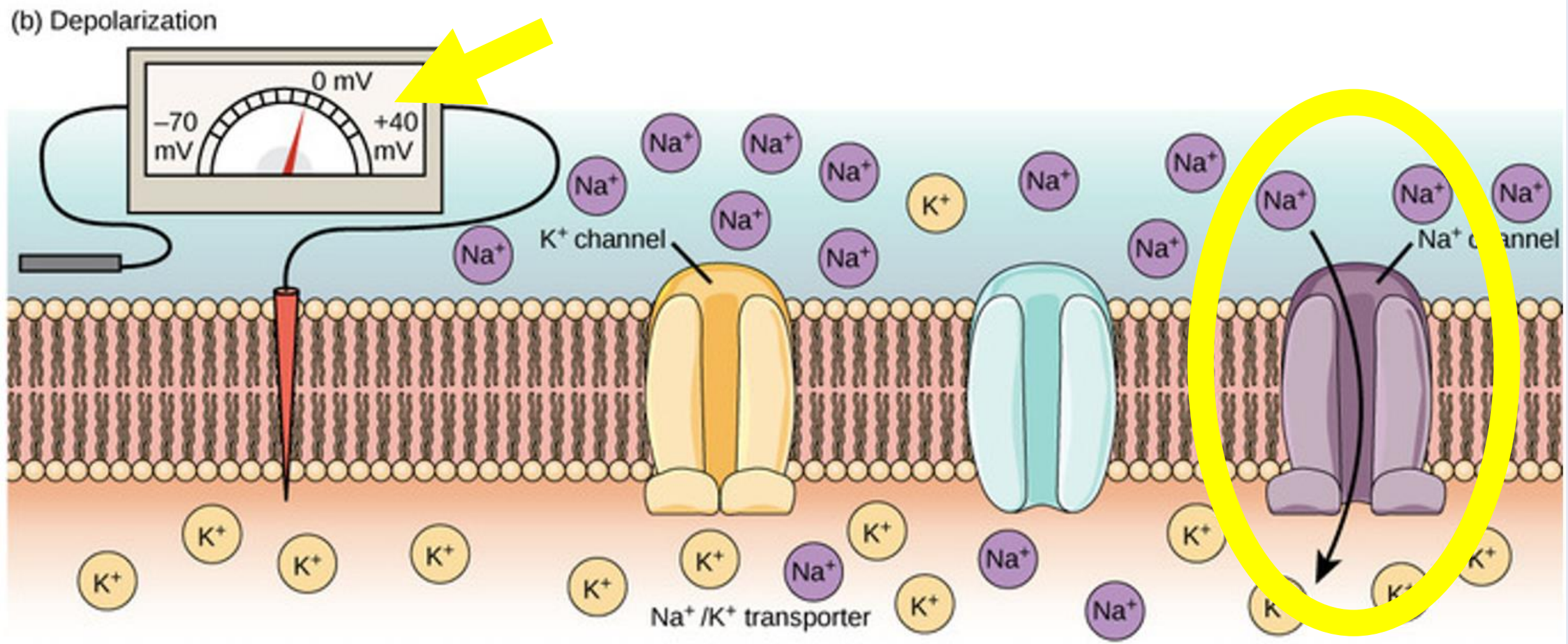
Refractory Period = Due to the overshoot/hyperpolarization, the sodium-potassium pump is actively pumping the Na+ out and the K+ into the neuron to restore distribution of ions and to return to resting potential.



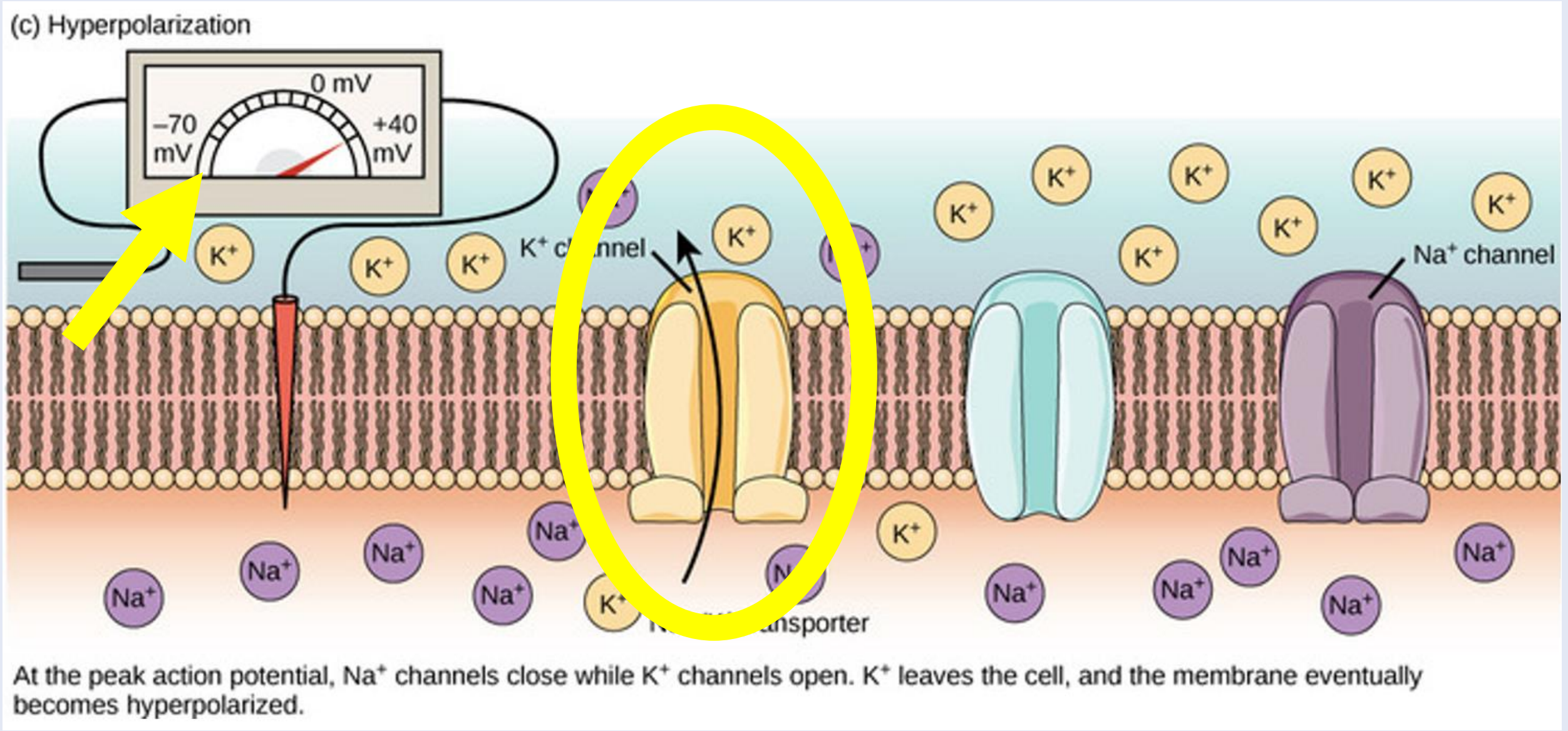




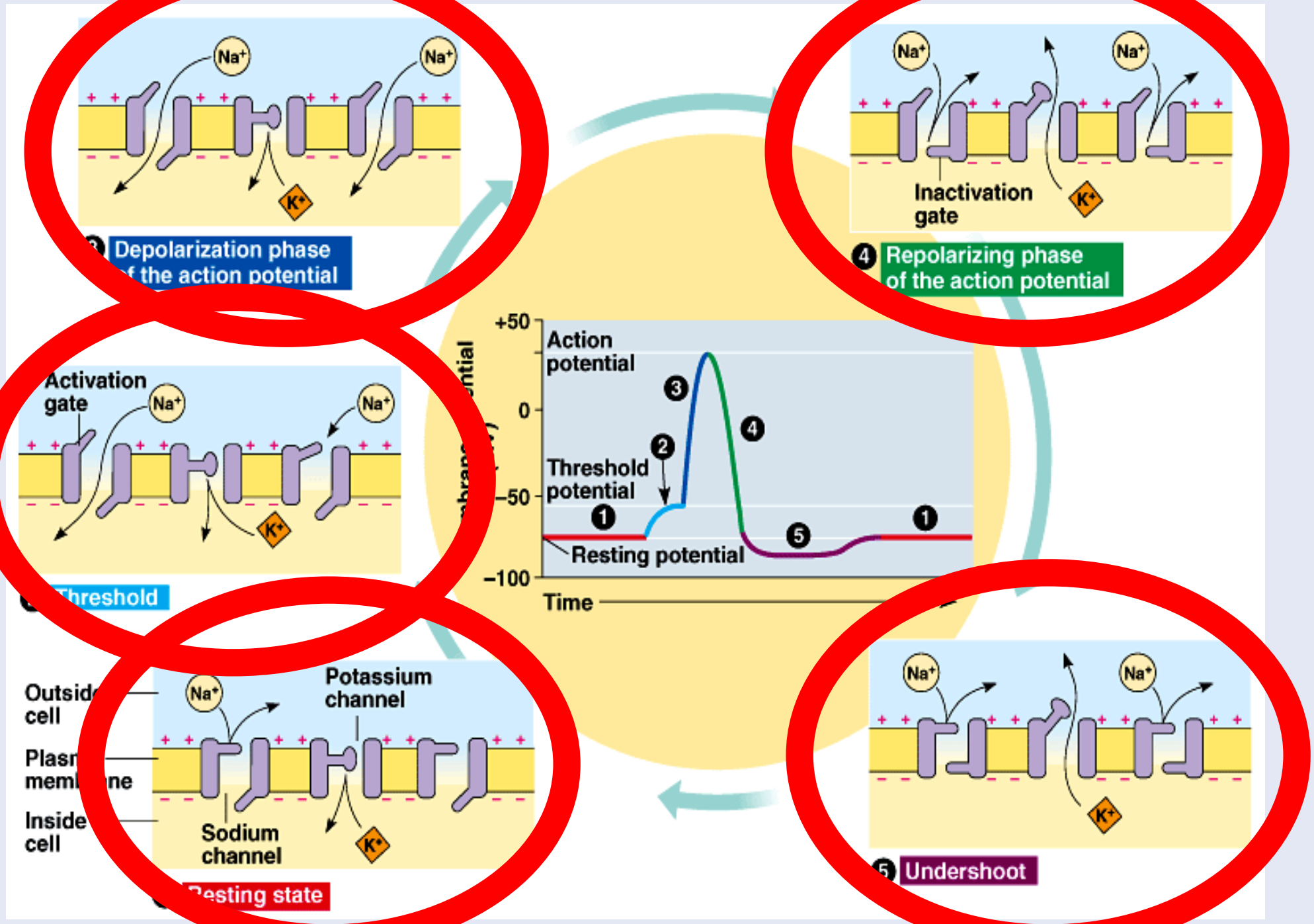
At the resting potential, all voltage-gated Na^+ channels and most voltage-gated K^+ channels are closed. The Na^+/K^+ transporter pumps K^+ ions into the cell and Na^+ ions out.



In response to a depolarization, some Na^+ channels open, allowing Na^+ ions to enter the cell. The membrane starts to depolarize (the charge across the membrane lessens). If the threshold of excitation is reached, all the Na^+ channels open.



At the peak action potential, Na^+ channels close while K^+ channels open. K^+ leaves the cell, and the membrane eventually becomes hyperpolarized.

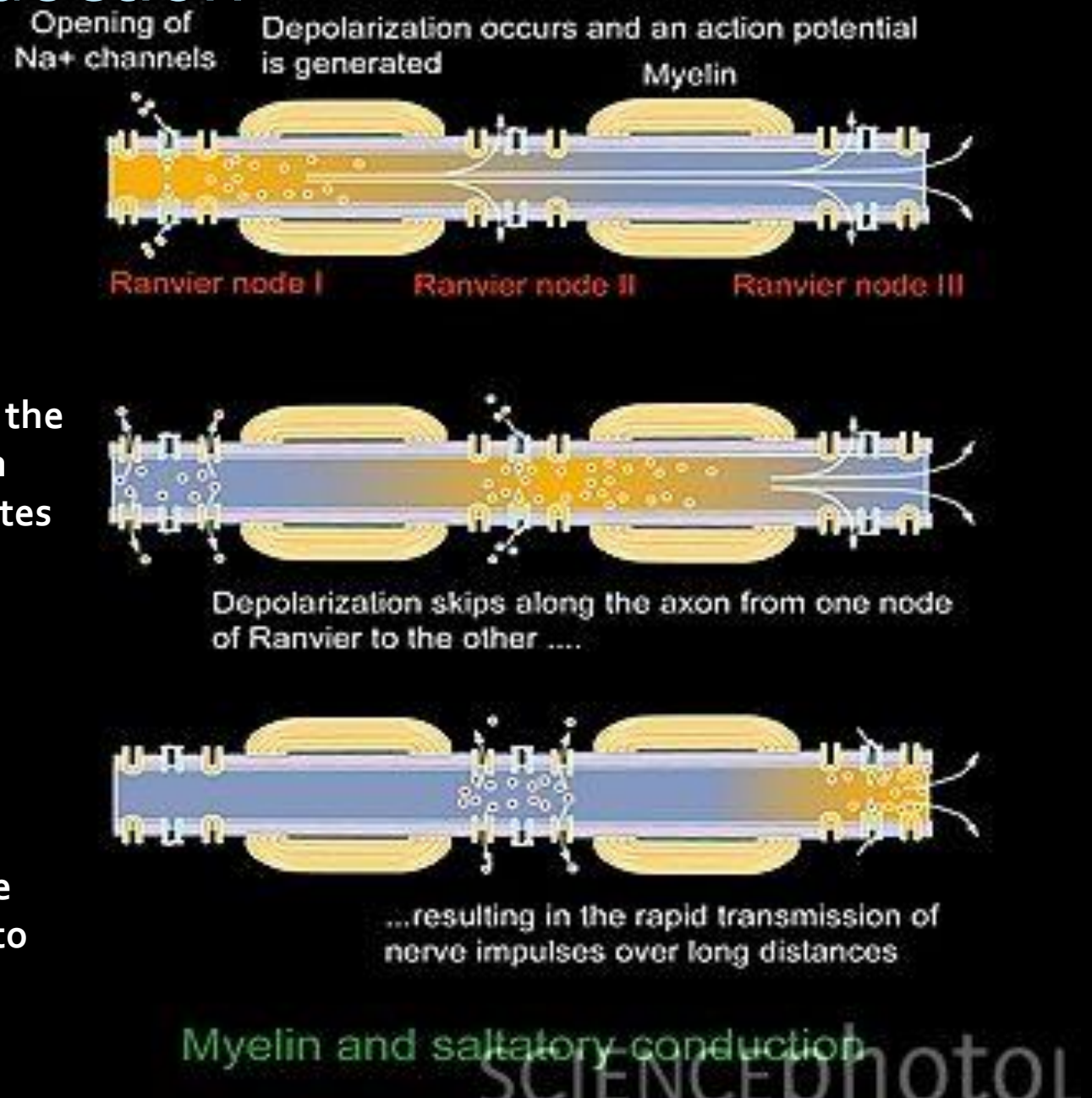

Na+
Na+
K+
Depolarization phase
of the action potential
Na+
Na+
Inactivation
gate
K+
Repolarizing phase
of the action potential
Activation
gate
Na+
Na+
K+
Threshold
+50
0
−50
−100
Action
potential
Threshold
potential
Resting potential
Time
1
2
3
4
5
Outside
cell
Plasma
membrane
Inside
cell
Na+
Potassium
channel
Sodium
channel
K+
Resting state
Na+
Na+
K+
Undershoot

Saltatory Conduction

1. Depolarization occurs on the neuron to begin the action potential – Na+ gates open and Na+ rushes into neuron

2. Repolarization occurs on the neuron after depolarization has moved forward – K+ gates open and K+ rushes out of neuron

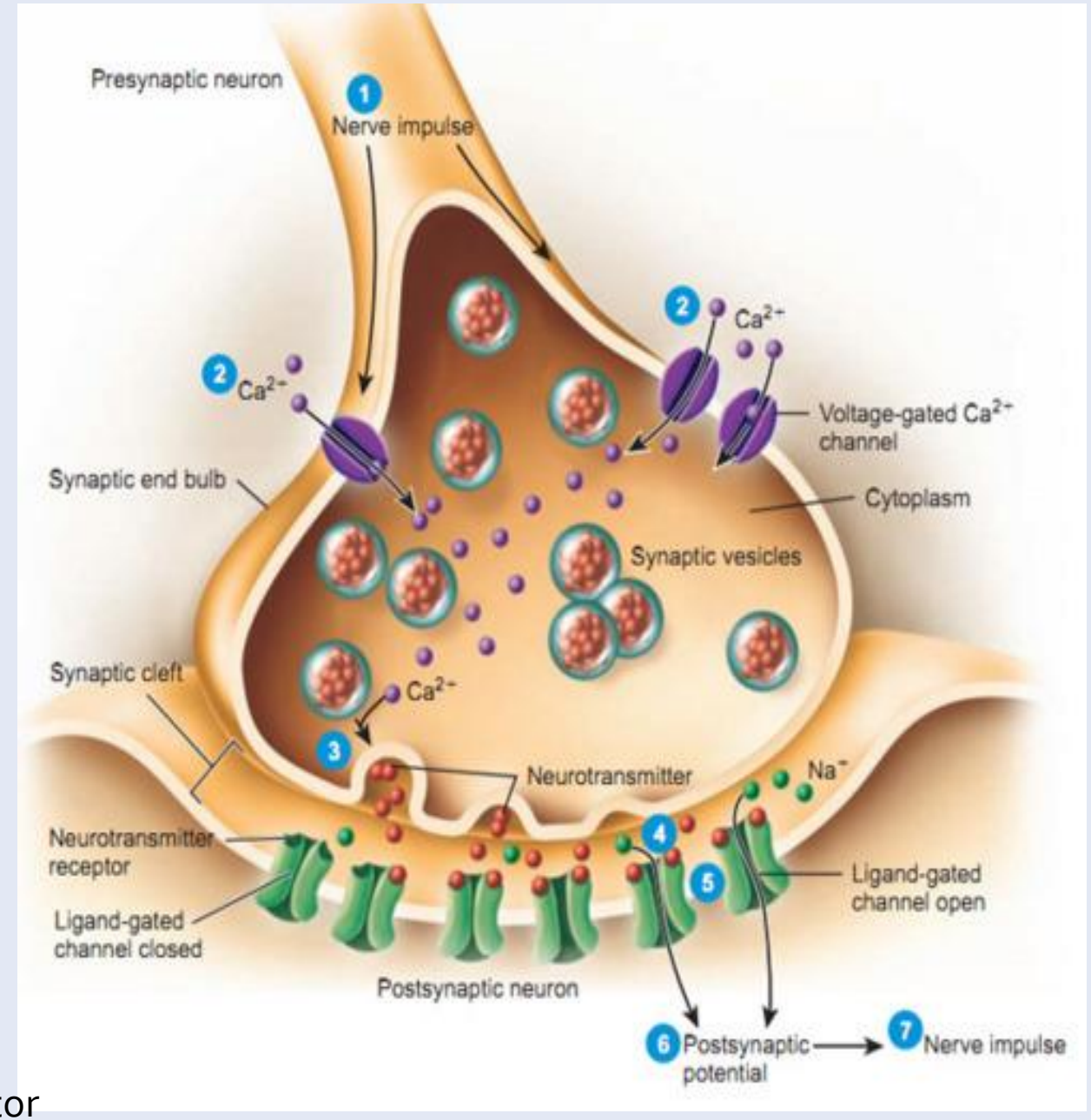
3. The refractory period occurs after repolarization has moved forward. The Na+ is pumped out and the K+ is pumped in to return to resting potential



Steps for Synaptic Transmission

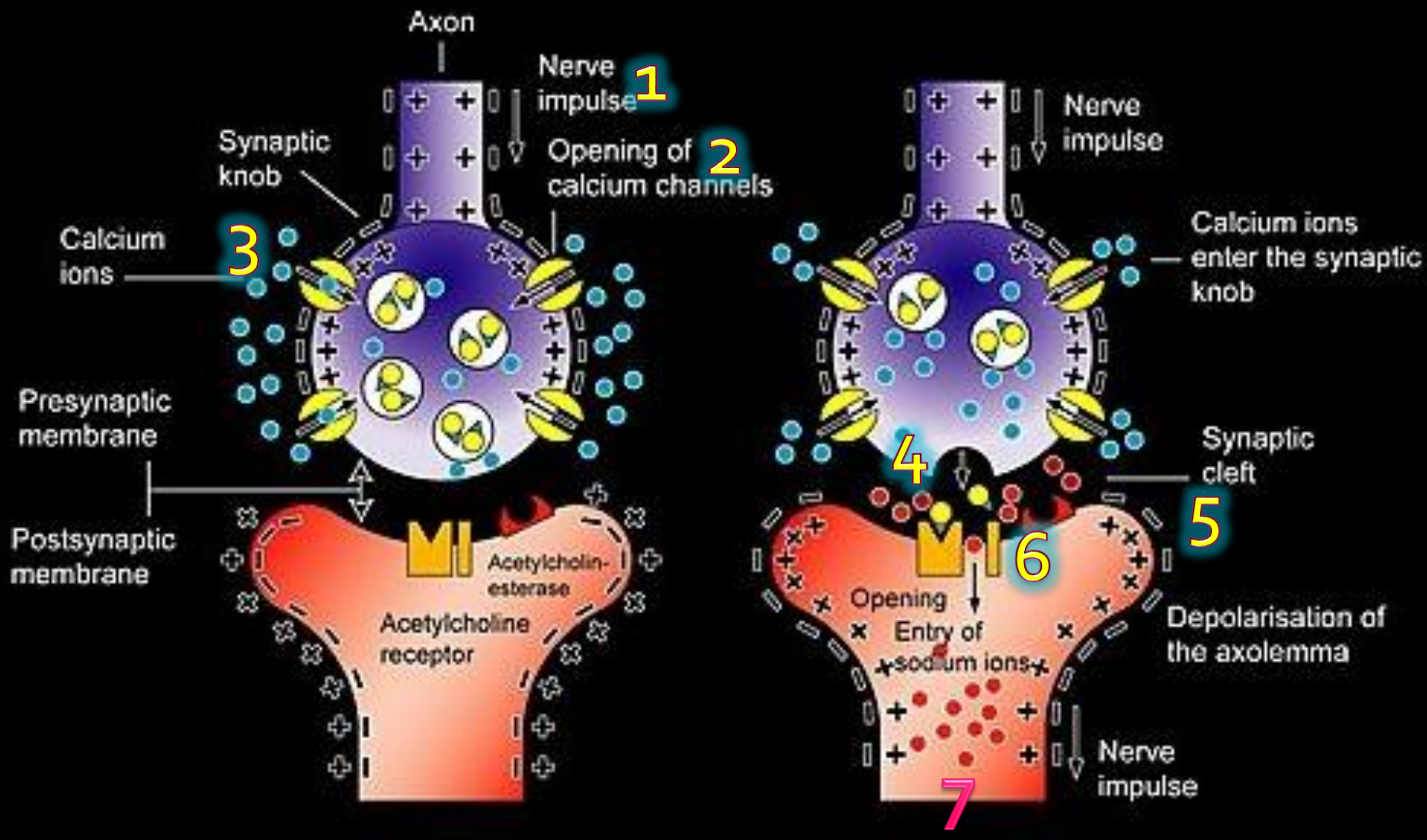
1. Impulse reaches the end of the axon at the axon bulb
2. Calcium gates open and Ca2+ rushes into bulb
3. In the presence of calcium, the vesicles carrying neurotransmitter (NT) are pulled towards the pre-synaptic membrane. By exocytosis the NT is released into the synaptic cleft
4. The NT diffuses across the cleft and attached to Na+ gate receptors on the post-synaptic membrane
5. The Na+ gates open and Na+ rushed into the neuron
6. If enough Na+ enters the neuron to pass the -40 mV threshold, a full depolarization will begin
7. The action potential moves down the next neuron.

Note: if the axon bulb is at the end of a motor neuron, the NT stimulates or inhibits the effector



Synaptic Transmission =

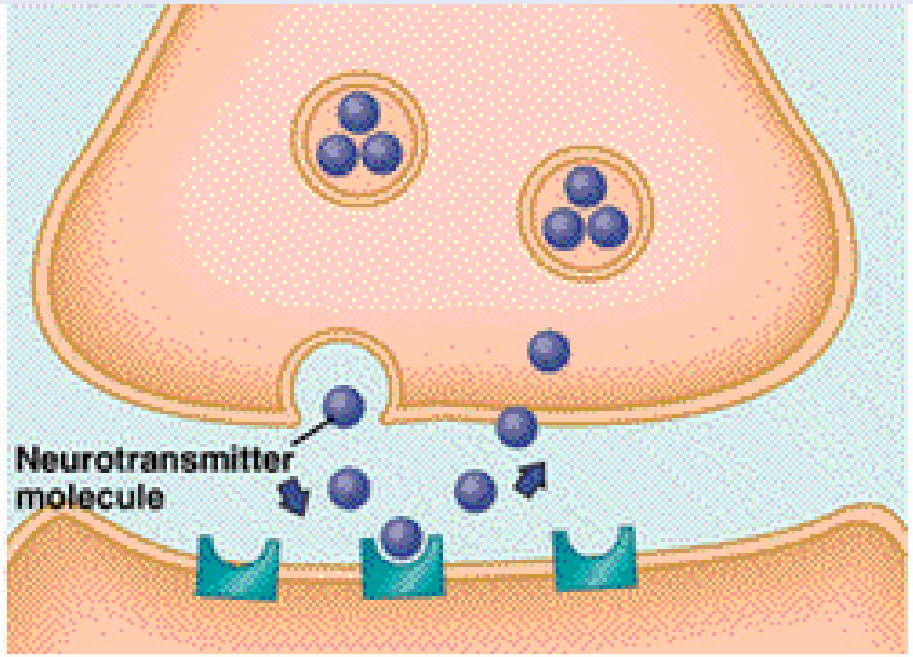
transmitting the action potential between neurons



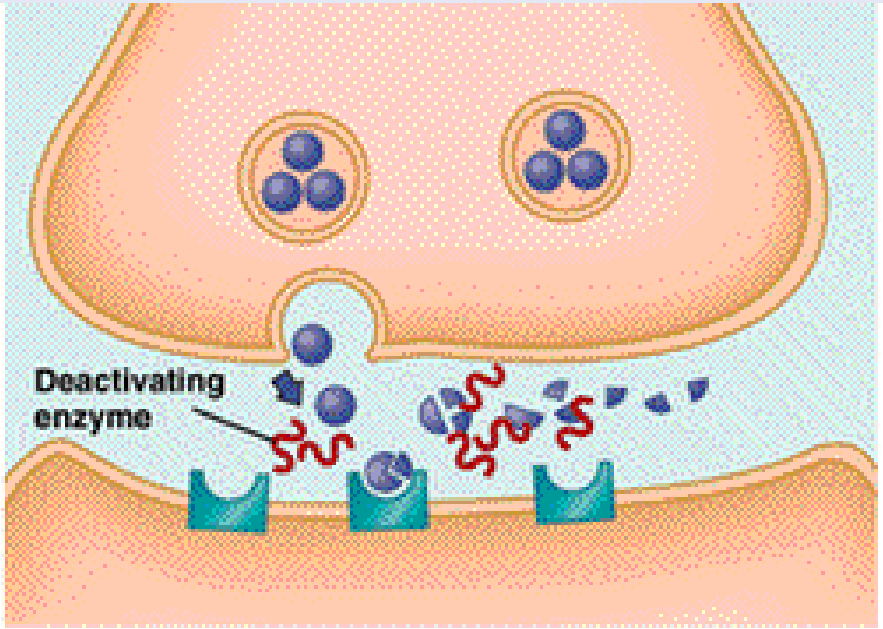
Neurotransmitters in the synaptic cleft can be removed in two ways.

By reuptake = the NT is taken back into axon bulb by endocytosis into vesicles.

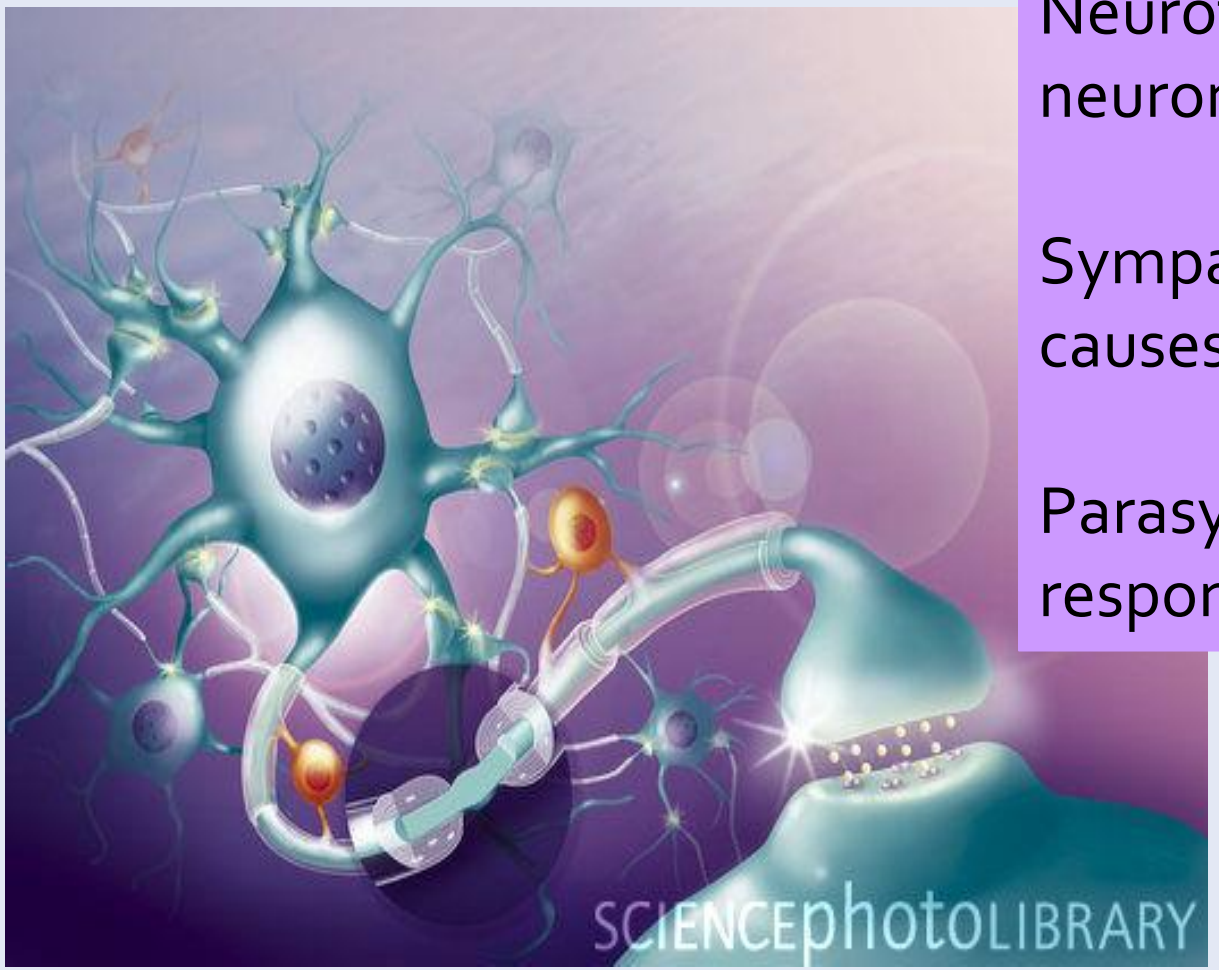
By enzymes = the NT can be broken down in the cleft by enzymes. The enzyme that degrades acetylcholine is **acetylcholinesterase.**



Reuptake



Deactivating Enzymes

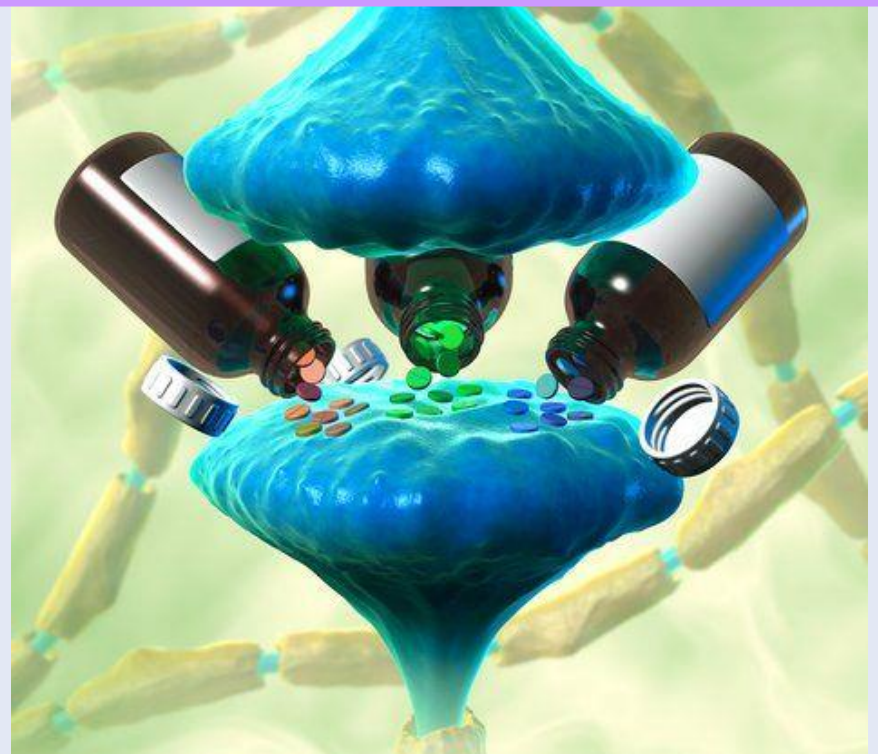


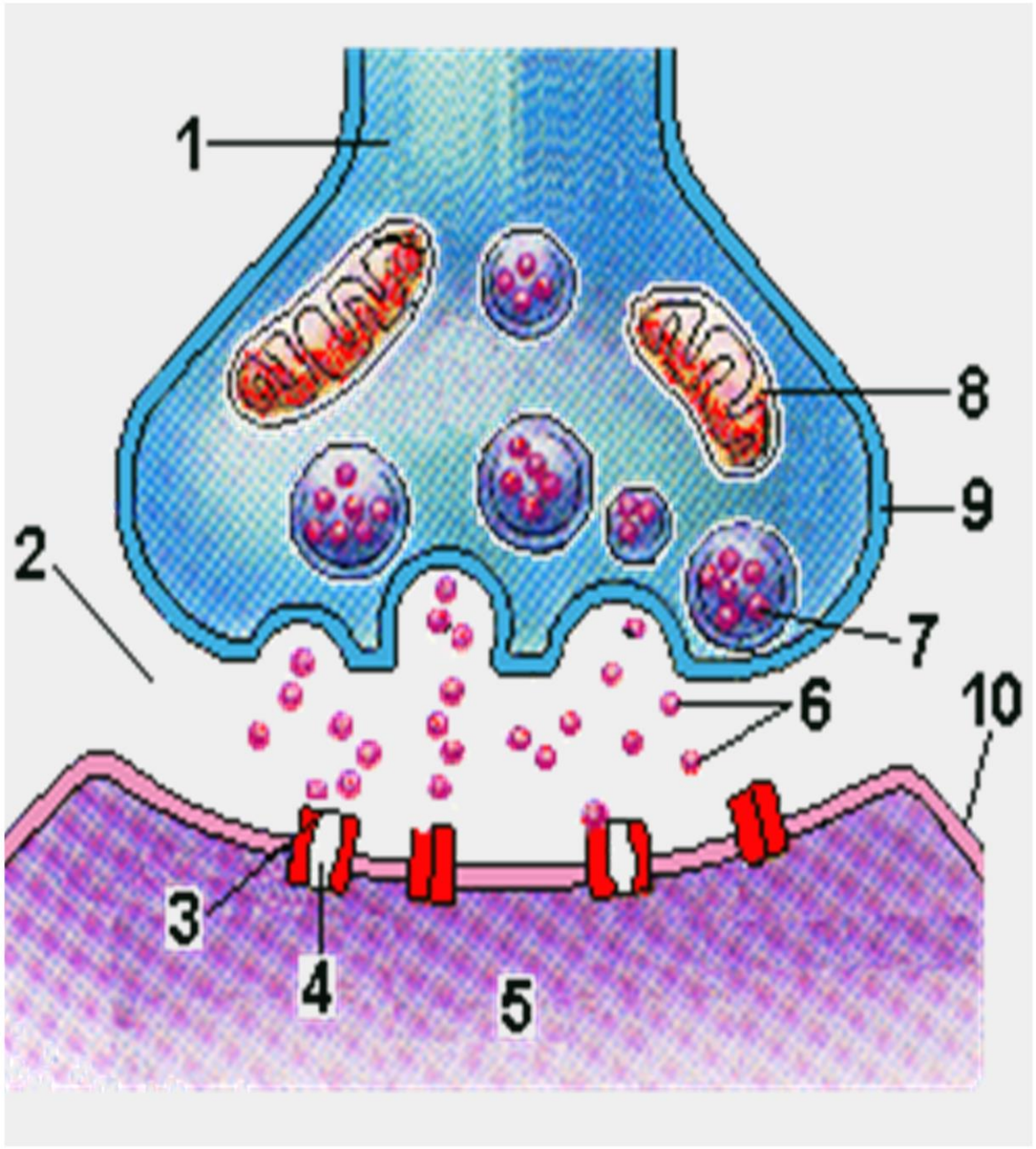
Neurotransmitters can stimulate or inhibit other neurons

Sympathetic NT = **epinephrine** or adrenalin and causes responses consistent with fight-or-flight

Parasympathetic NT = **acetylcholine** and causes responses consistent with relaxed state

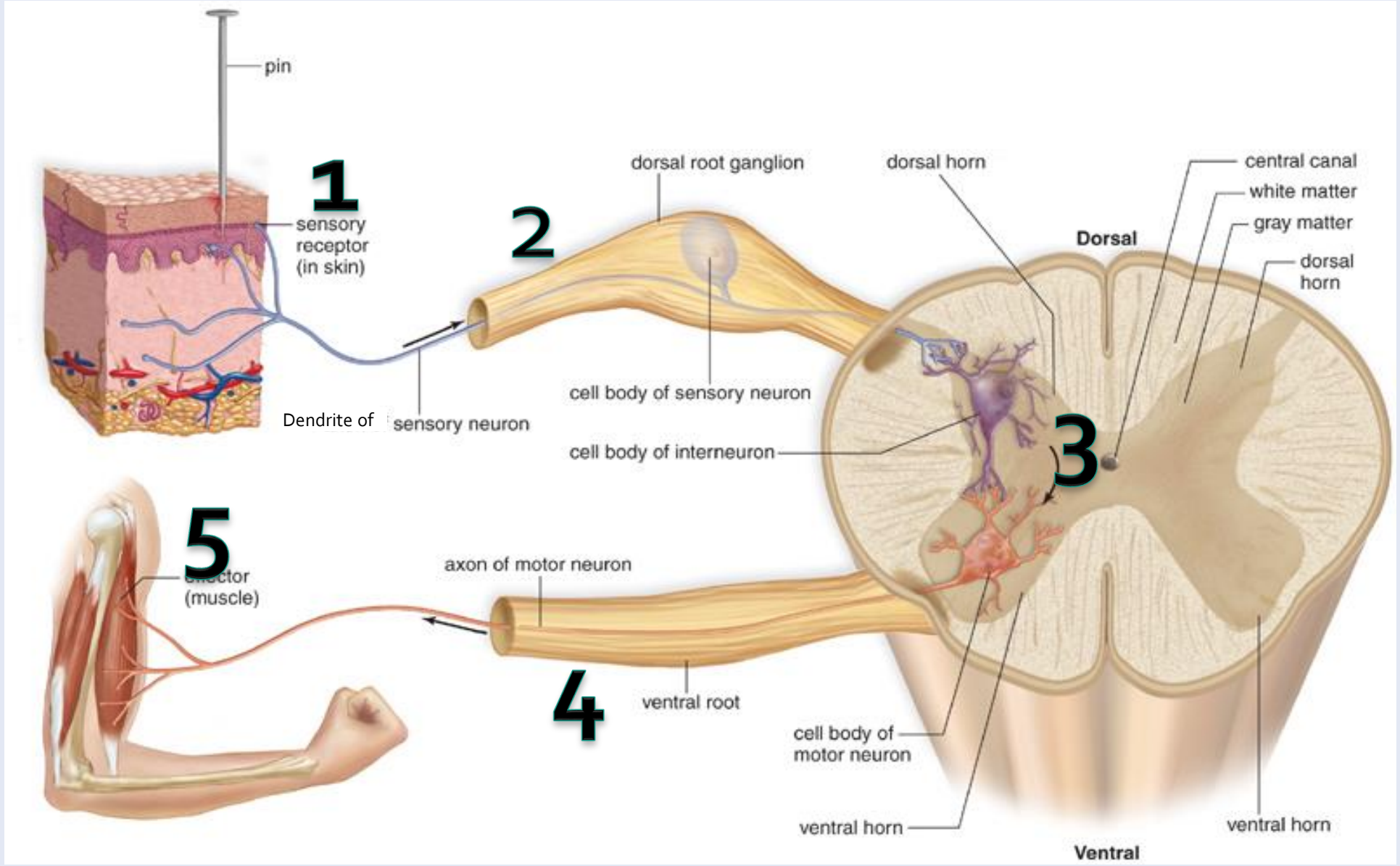
Drugs can mimic, enhance or inhibit certain NT's to obtain a desired effect.

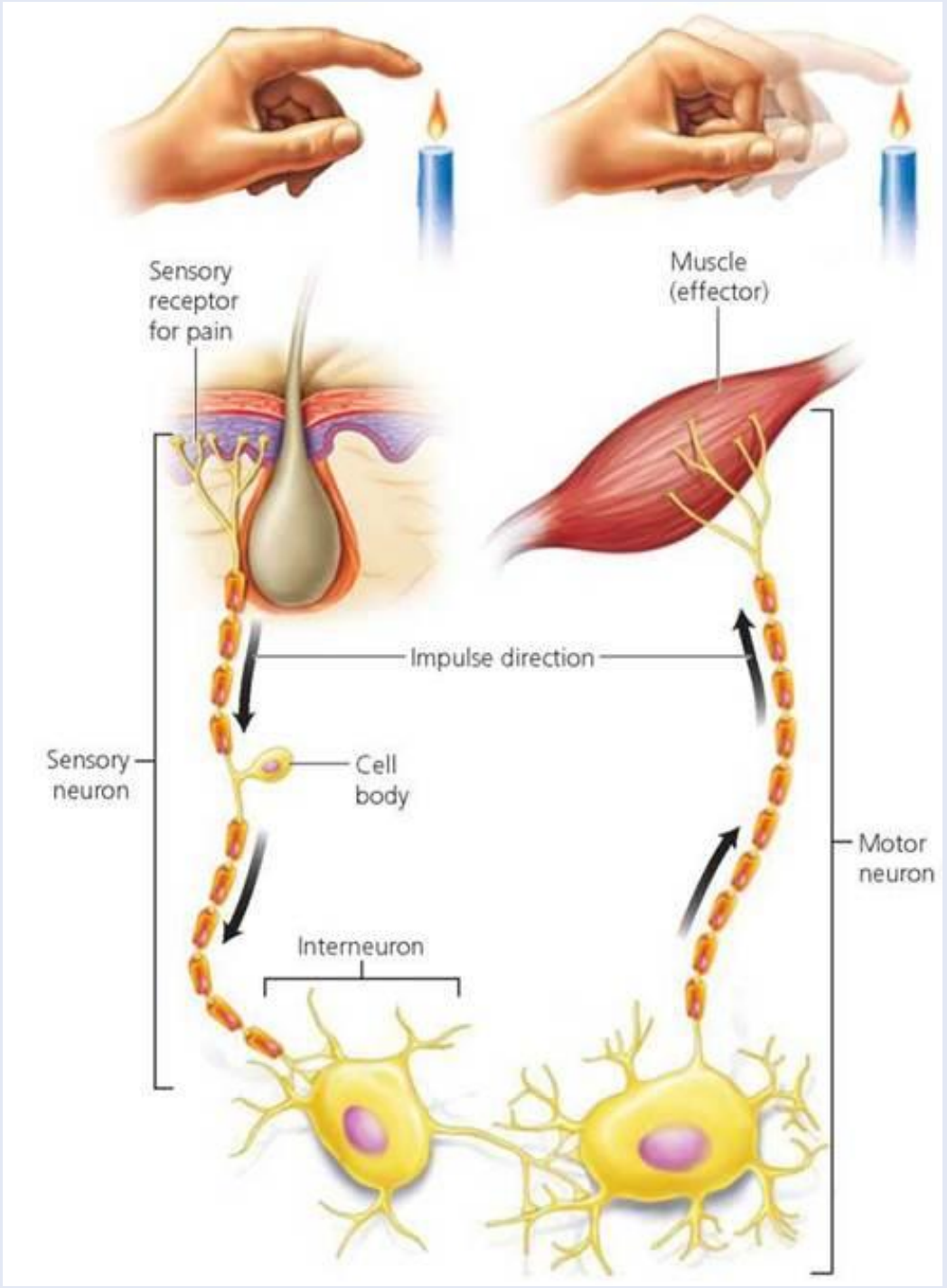




	Function
	Provided energy in the form of ATP for active transport
	Neurotransmitter diffuses across cleft
	NT attaches to receptor on Na+ gate
	Synaptic Cleft
	Post-synaptic Neuron
	Axon
	Vesicles carrying NT
	Na+ gates open and sodium rushes into neuron
	Action potential would continue down next dendrite
	Axon bulb

The Reflex Arc

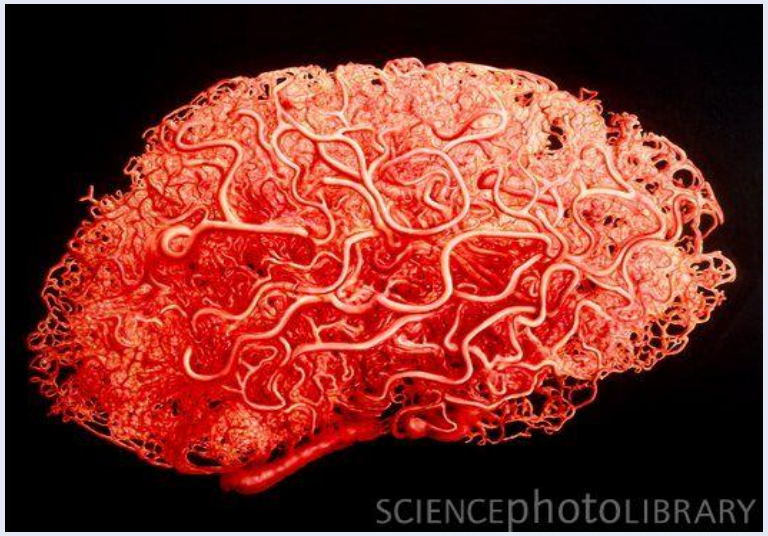


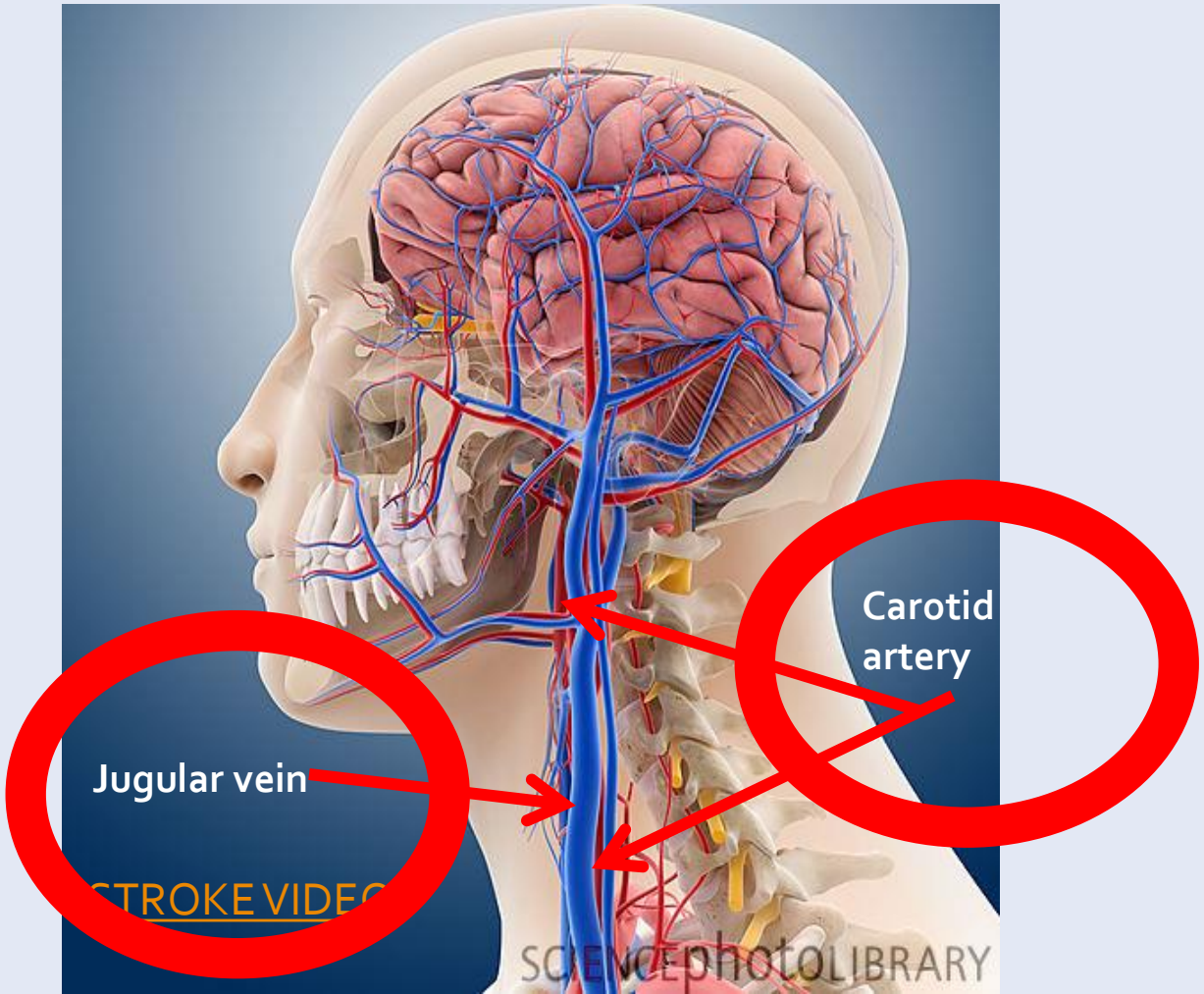

Sensory receptor for pain
Muscle (effector)
Impulse direction
Sensory neuron
Cell body
Motor neuron
Interneuron

The Brain

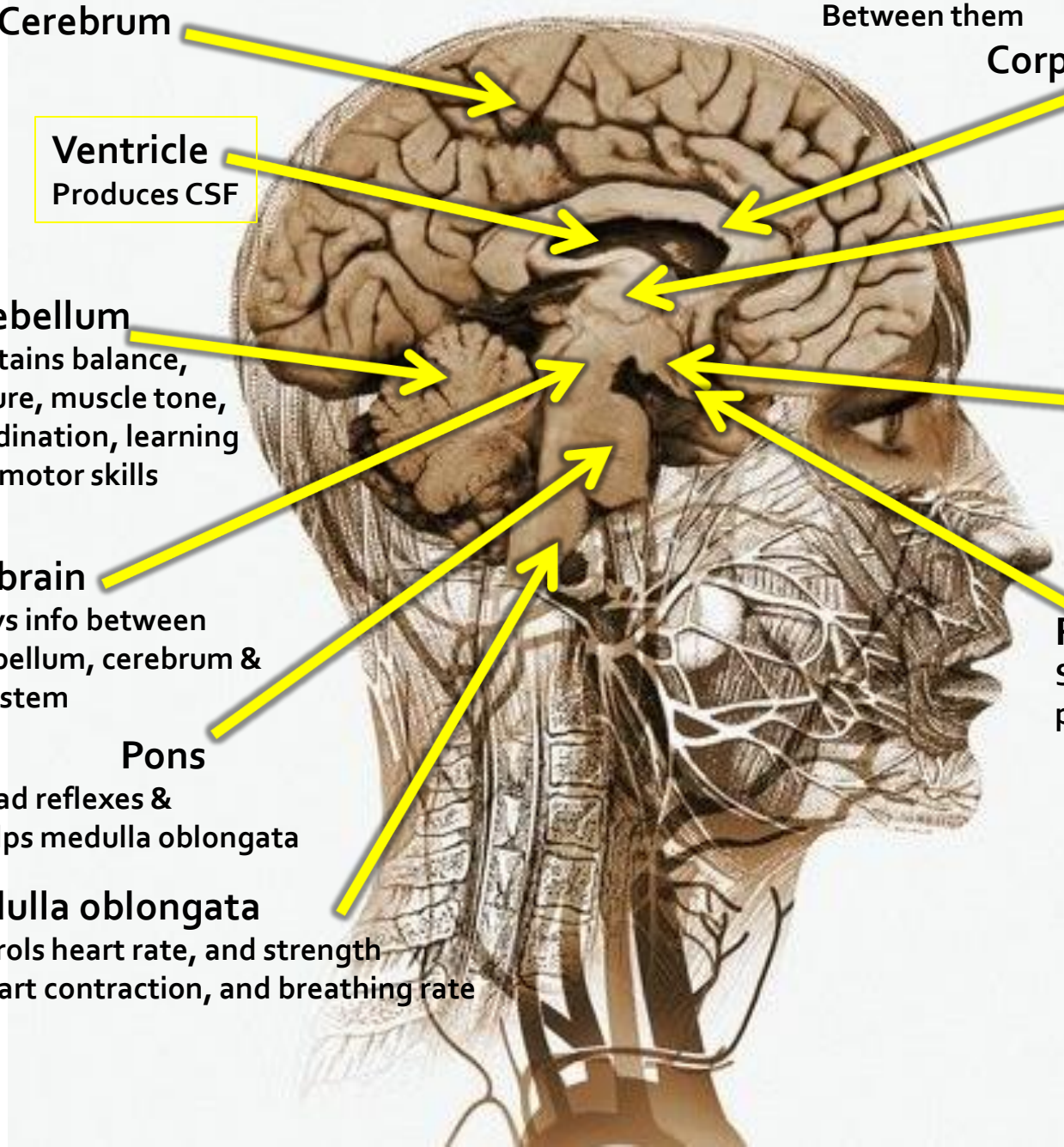
The brain is housed in the **skull** which protects it from injury. It is also surrounded by **meninges** for protection and cushioning. The **cerebrospinal fluid** help provide some cushioning and lubrication but also helps to circulated nutrients around the brain and spinal cord.

The **carotid artery** supplies the O_2 and nutrients (glucose) to the brain and the **jugular vein** carries wastes and CO_2 away from the brain to the heart.
Notice the extensive vasculature of the brain.





The outer layer of the brain (cerebral cortex) is made of grey matter - short unmyelinated neurons for higher processing and mental functions. The neurons going up through the brain are mostly myelinated neurons making up the white matter.



Thinking, personality, problem solving,
Decision making, emotions, memory, movement

Cerebrum

Connects the right and left cerebral
Hemispheres and transmits messages
Between them

Corpus callosum

Ventricle

Produces CSF

Thalamus

Sorts incoming sensory stimuli to cerebrum, participates in memory and emotions

Cerebellum

Maintains balance,
Posture, muscle tone,
Coordination, learning
New motor skills

Hypothalamus

Controls/maintains
Homeostasis; ie. Thirst,
Hunger, water balance,
Body temperature.

Midbrain

Relays info between
Cerebellum, cerebrum &
brainstem

Pituitary gland

Secretes hormones that are produced by hypothalamus

Pons

Head reflexes &
Helps medulla oblongata

Medulla oblongata

Controls heart rate, and strength
of heart contraction, and breathing rate

Concussion Video

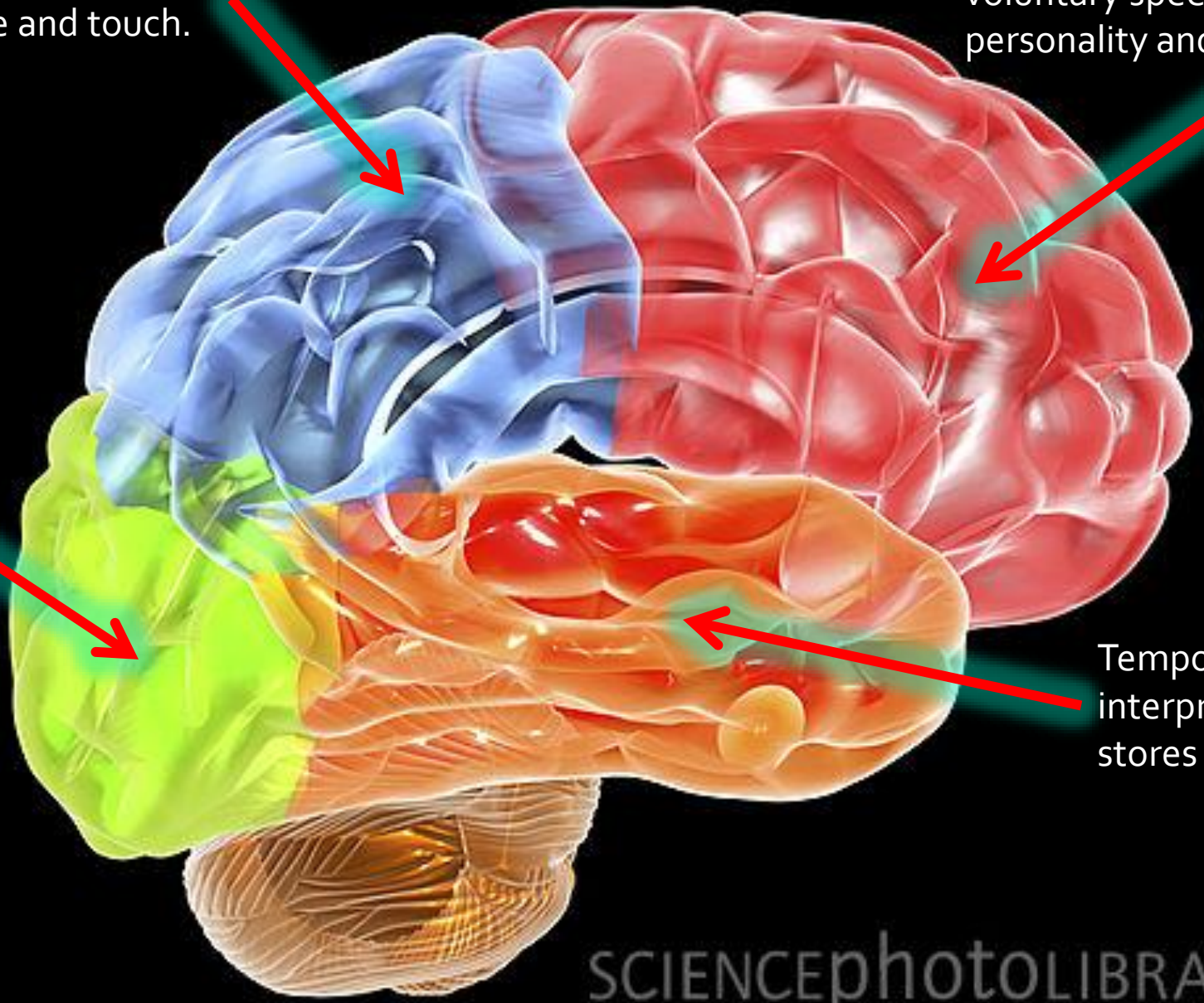
Lobes of the Cerebrum

Parietal Lobe = sensory interpretation like taste and touch.

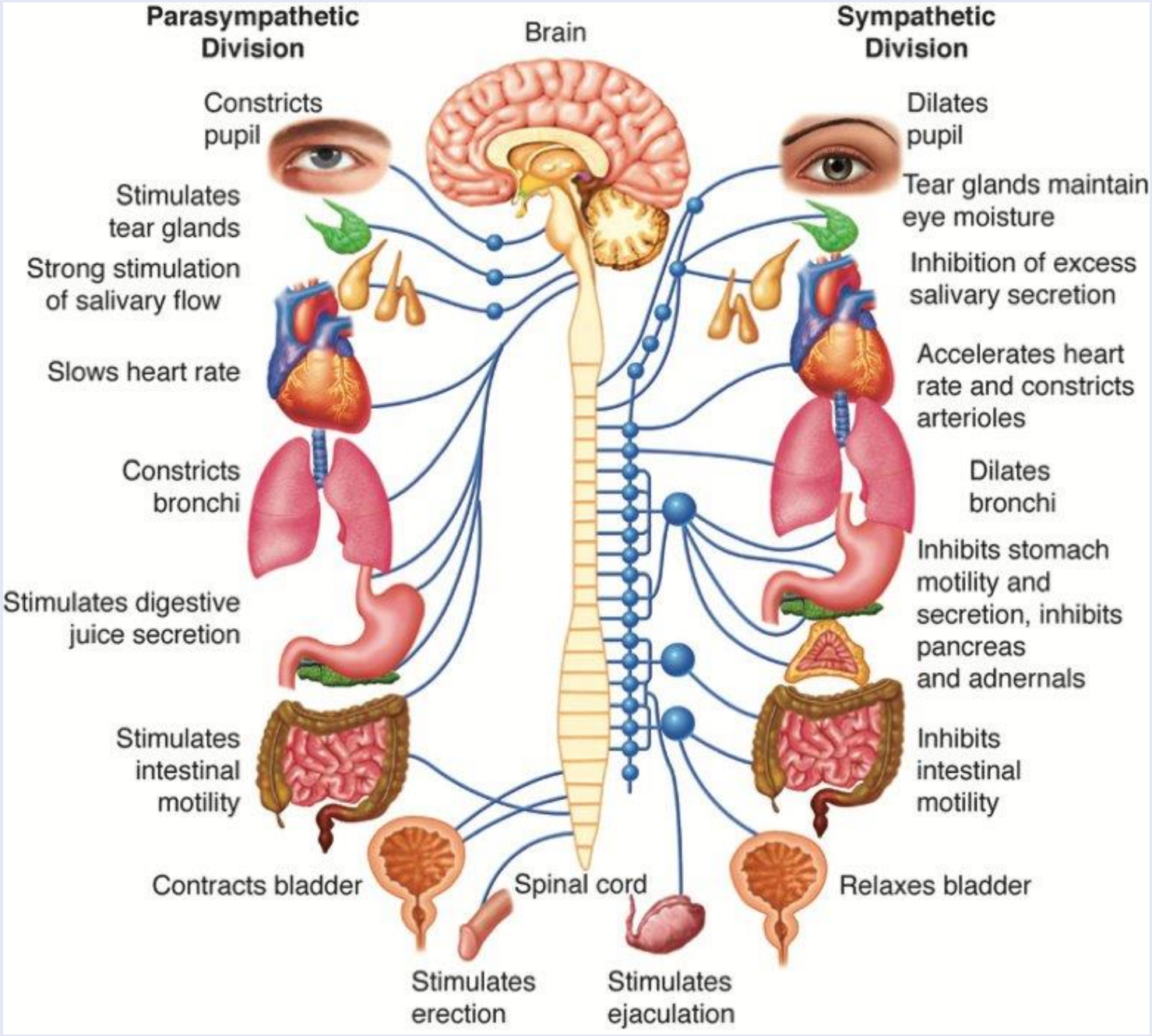
Frontal Lobe = problem solving, voluntary speech and muscle, and personality and emotions

Occipital Lobe = interpret vision

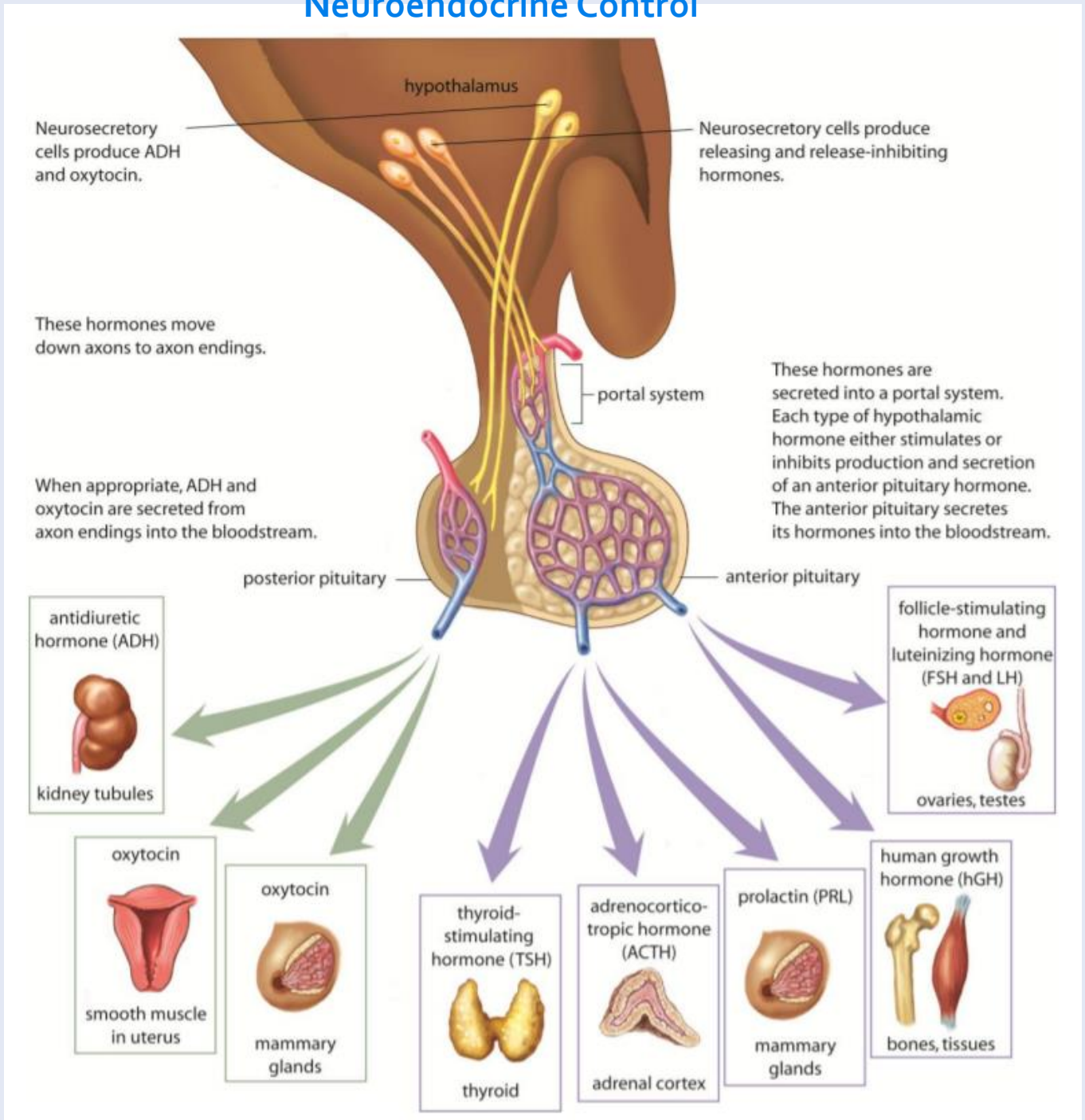
Temporal Lobe = interpret sounds and stores some memories

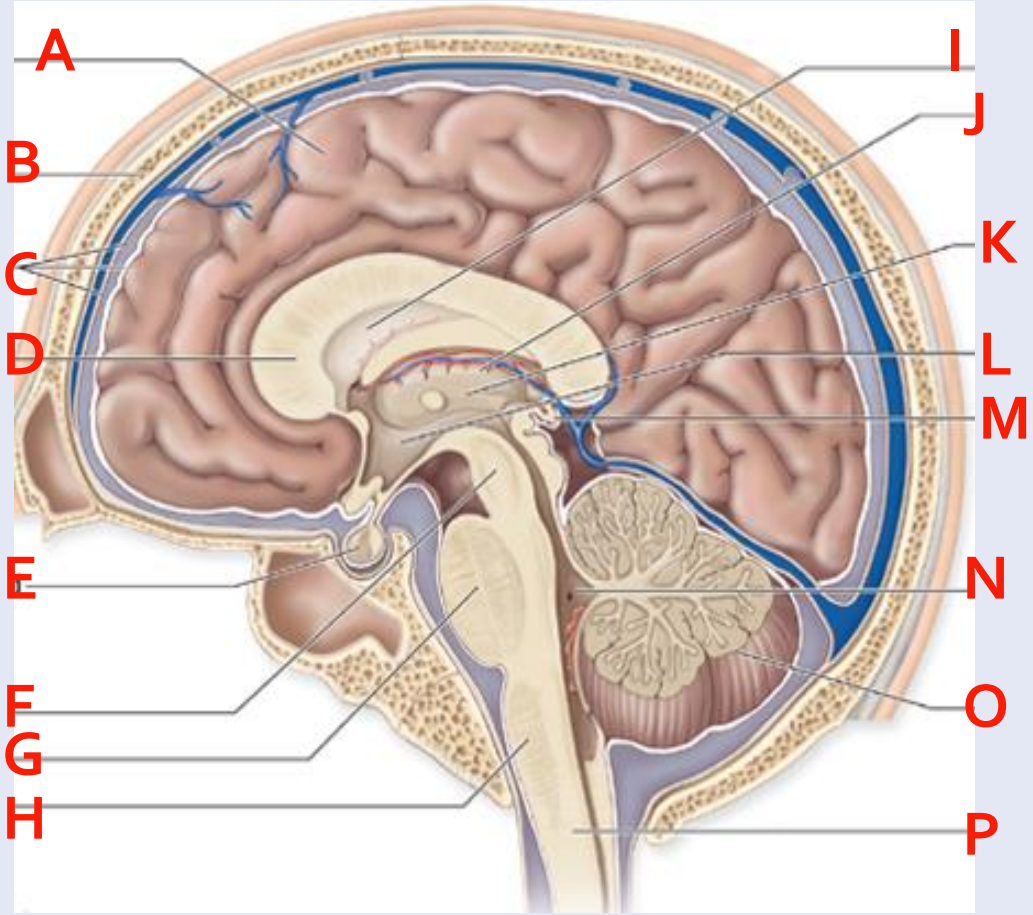


[Parasympathetic and Sympathetic Systems Video]



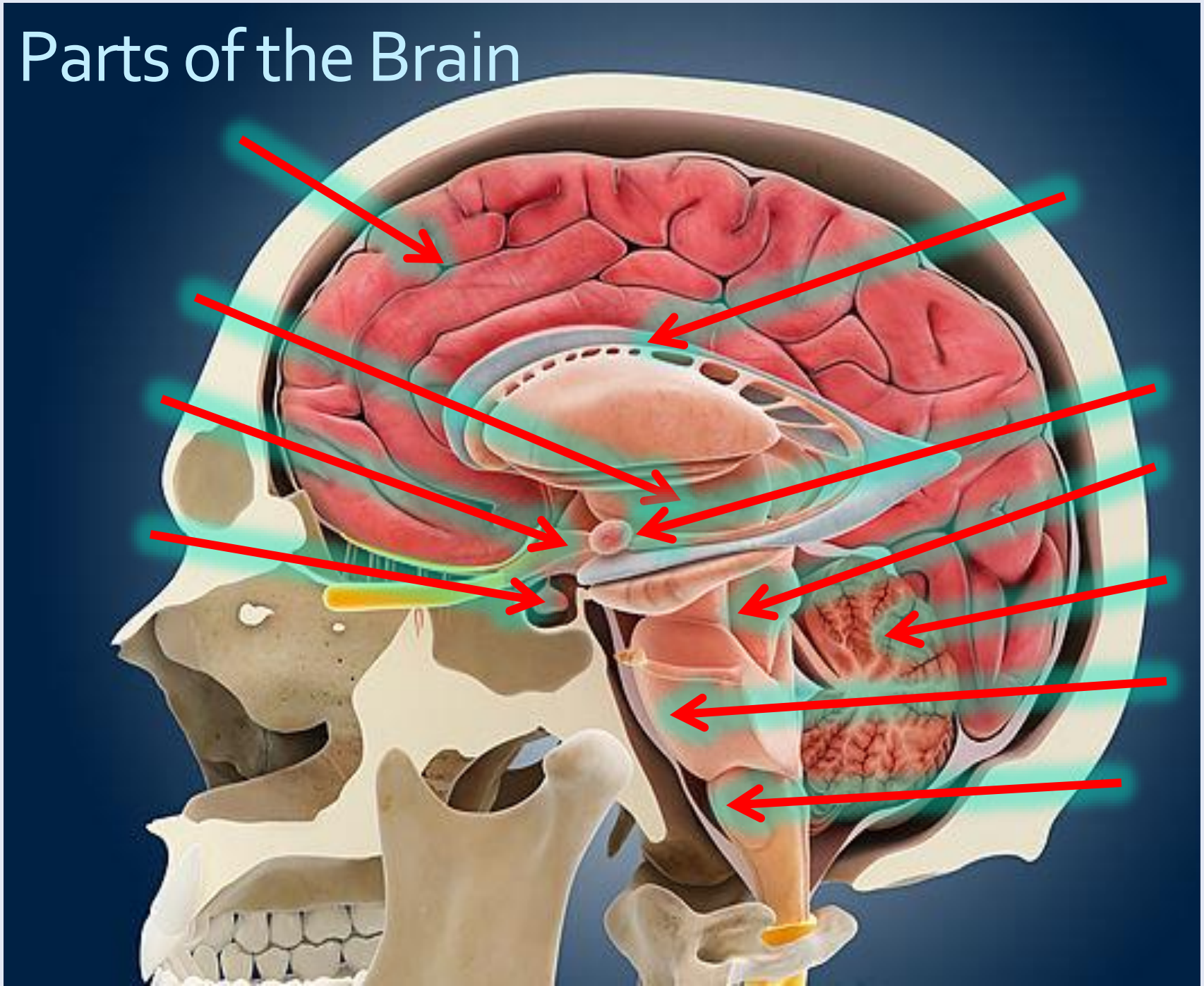
Neuroendocrine Control





	Function
	Joins the cerebral hemispheres together
	Sort sensory stimuli to cerebrum
	Responsible for coordination and balance
	Secretes ADH, oxytocin, LH and FSH
	Ventricles that produce cerebrospinal fluid (CSF)
	Help regulated heart rate, strength of contraction and breathing
	Controls homeostasis like hunger, water balance, body temp., and reproduction
	Visual and auditory reflexes along with providing communication between all parts of the brain
	Involved with head reflexes and helps with heart rate and breathing control

Parts of the Brain



CHAPTER 13: EXCRETORY SYSTEM (URINARY SYSTEM)

EXCRETION

Kidneys:

- Filter blood of wastes & produces urine
- Maintains water & salt balance
- Maintains blood pH
- Produces hormones

Ureters:

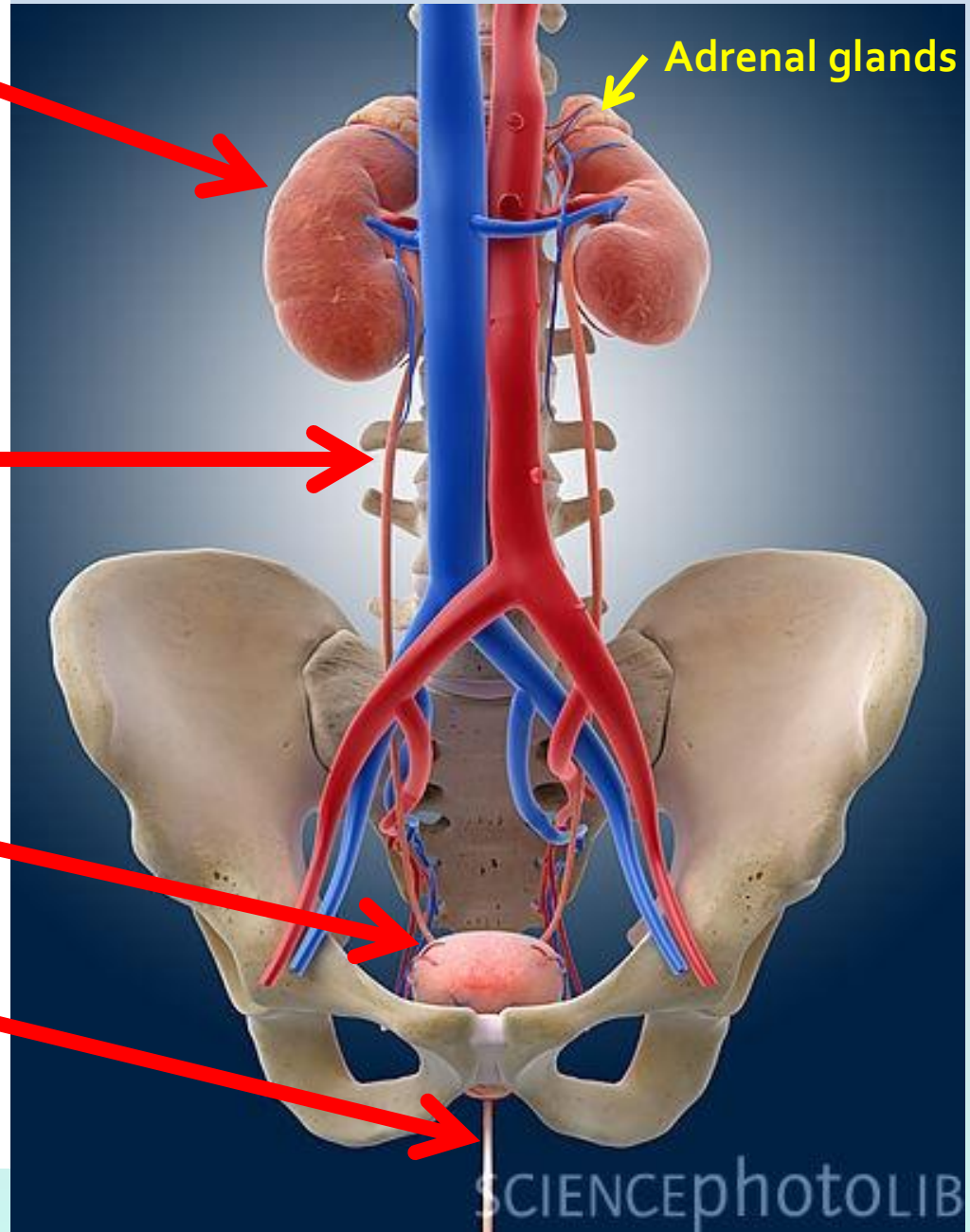
- Transports urine from kidney to bladder by peristalsis

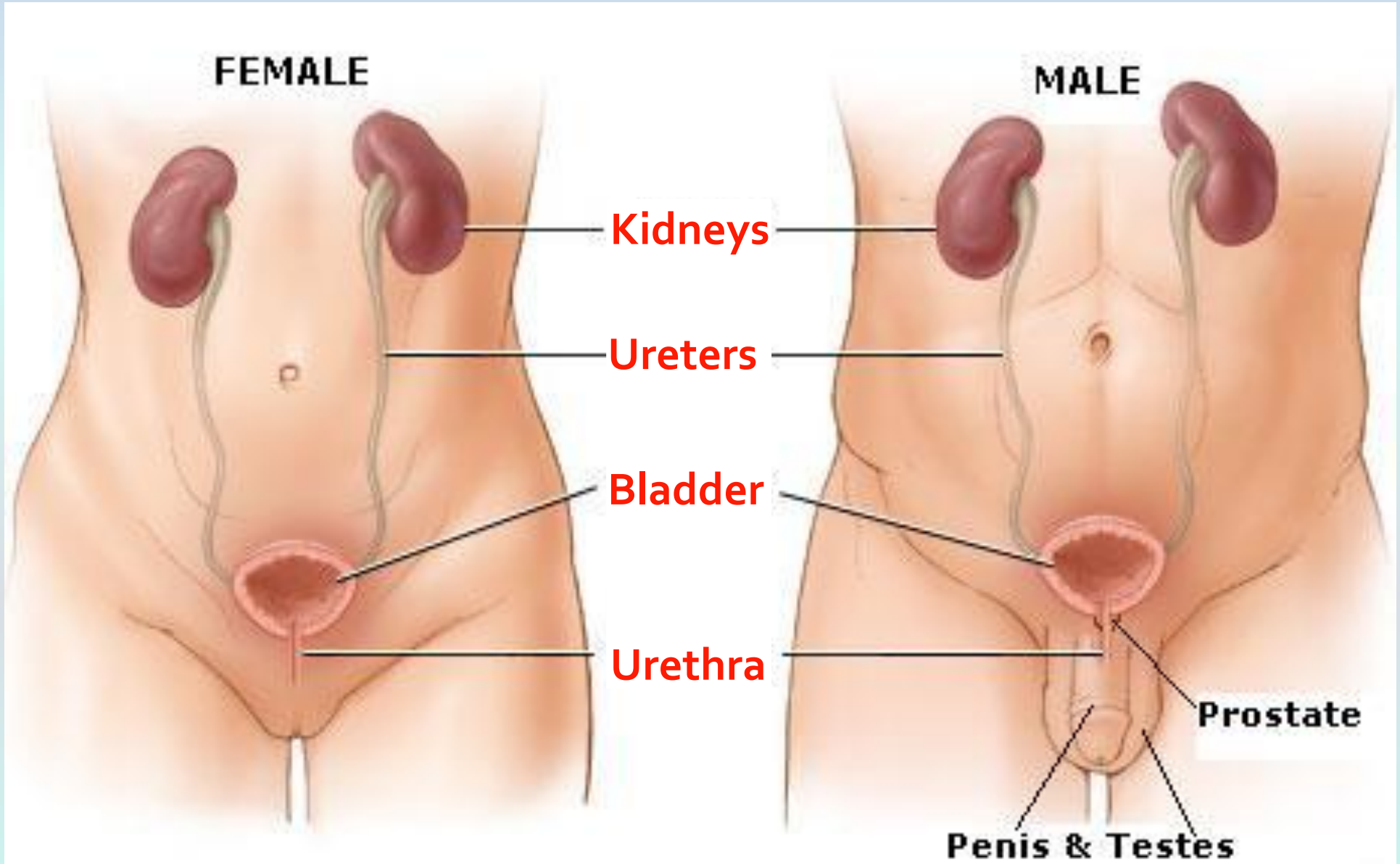
Bladder:

- Stores urine until urination

Urethra:

- Transports urine from bladder out of body during urination

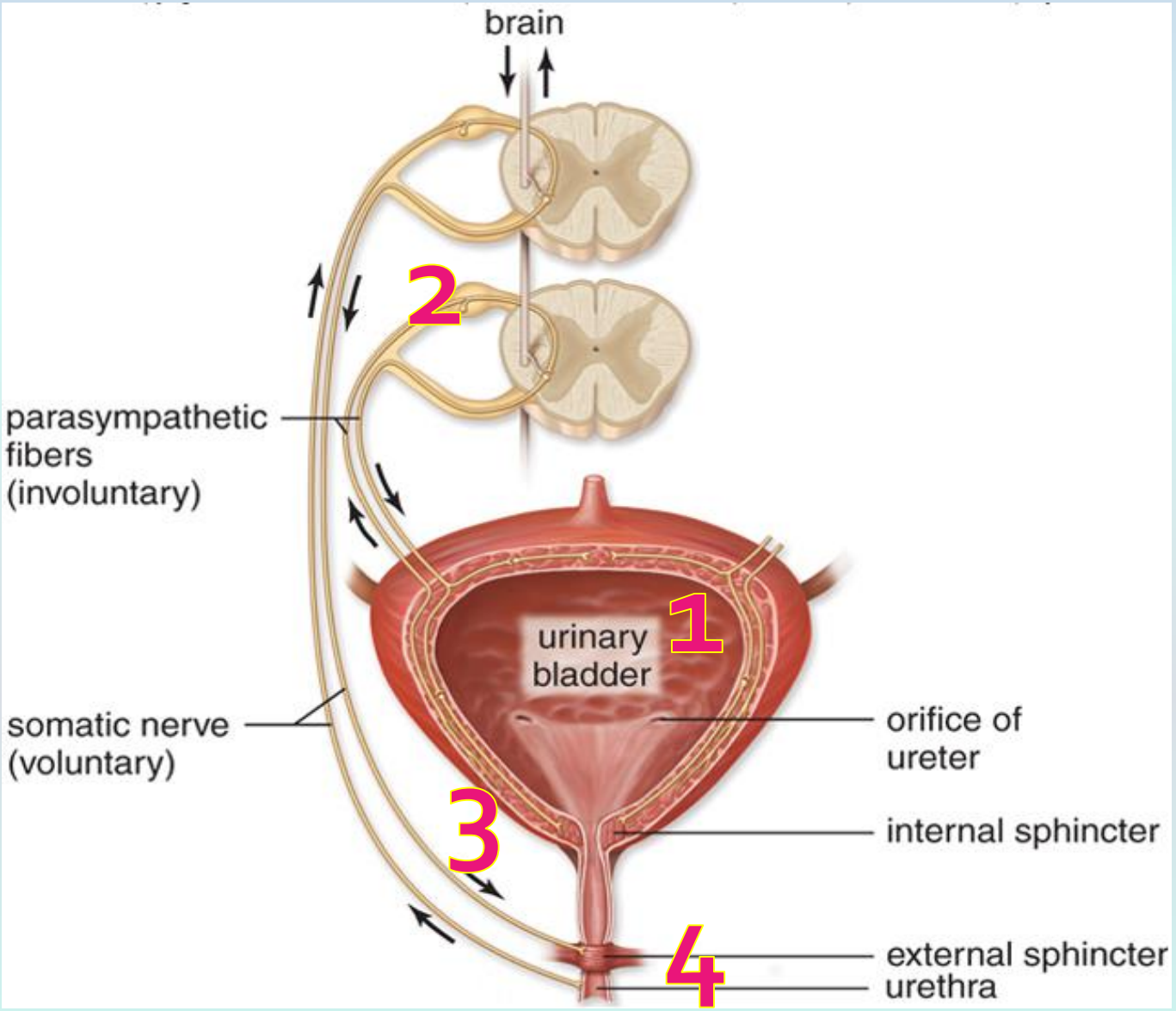



FEMALE
MALE
Kidneys
Ureters
Bladder
Urethra
Prostate
Penis & Testes

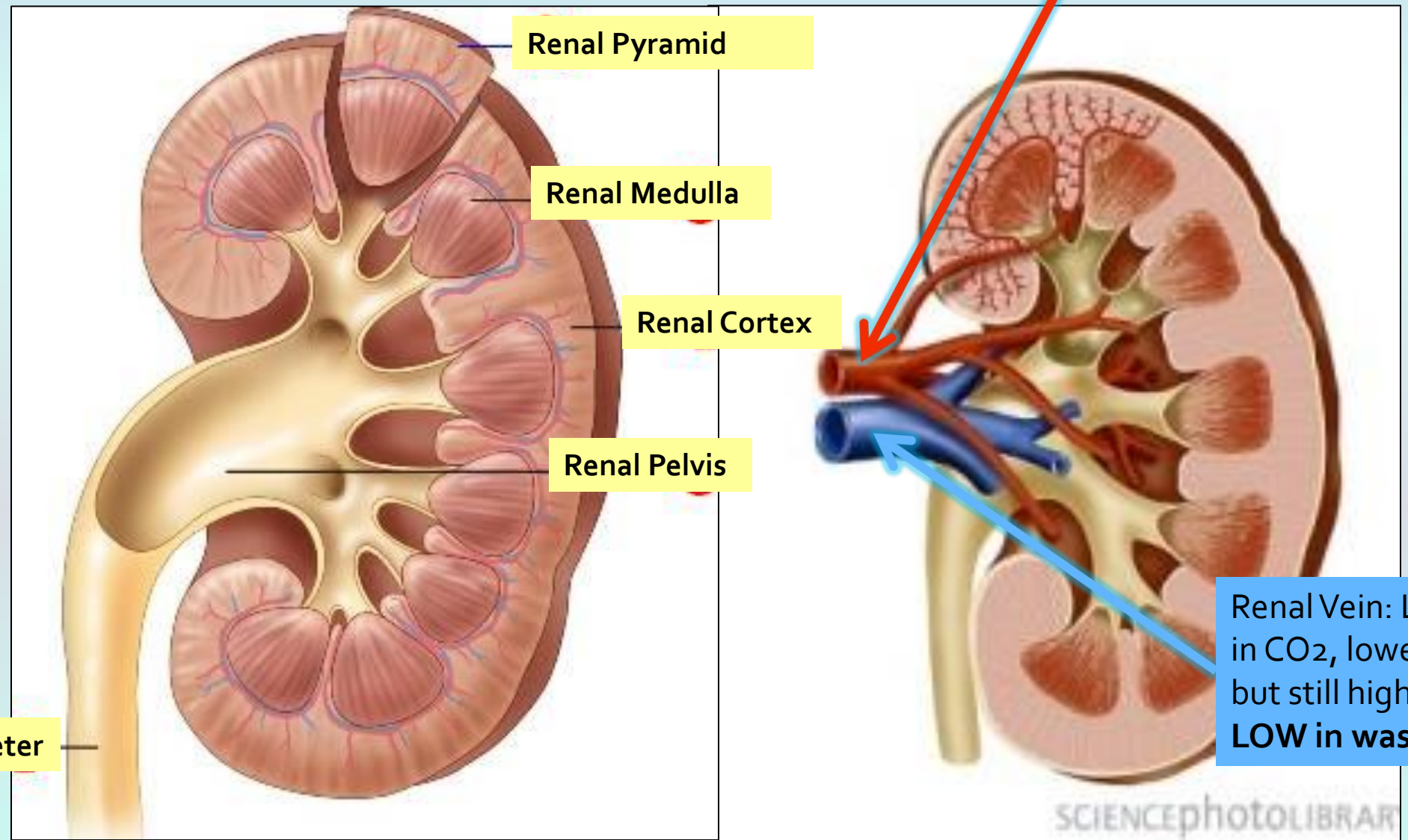
Urination Reflex = Micturition Reflex

1. Bladder fills with urine and stretches.
2. Stretch receptors send impulse to spinal cord and back as a reflex
3. Bladder contracts and internal sphincter relaxes
4. External sphincter is voluntary and you relax it during a convenient time to urinate

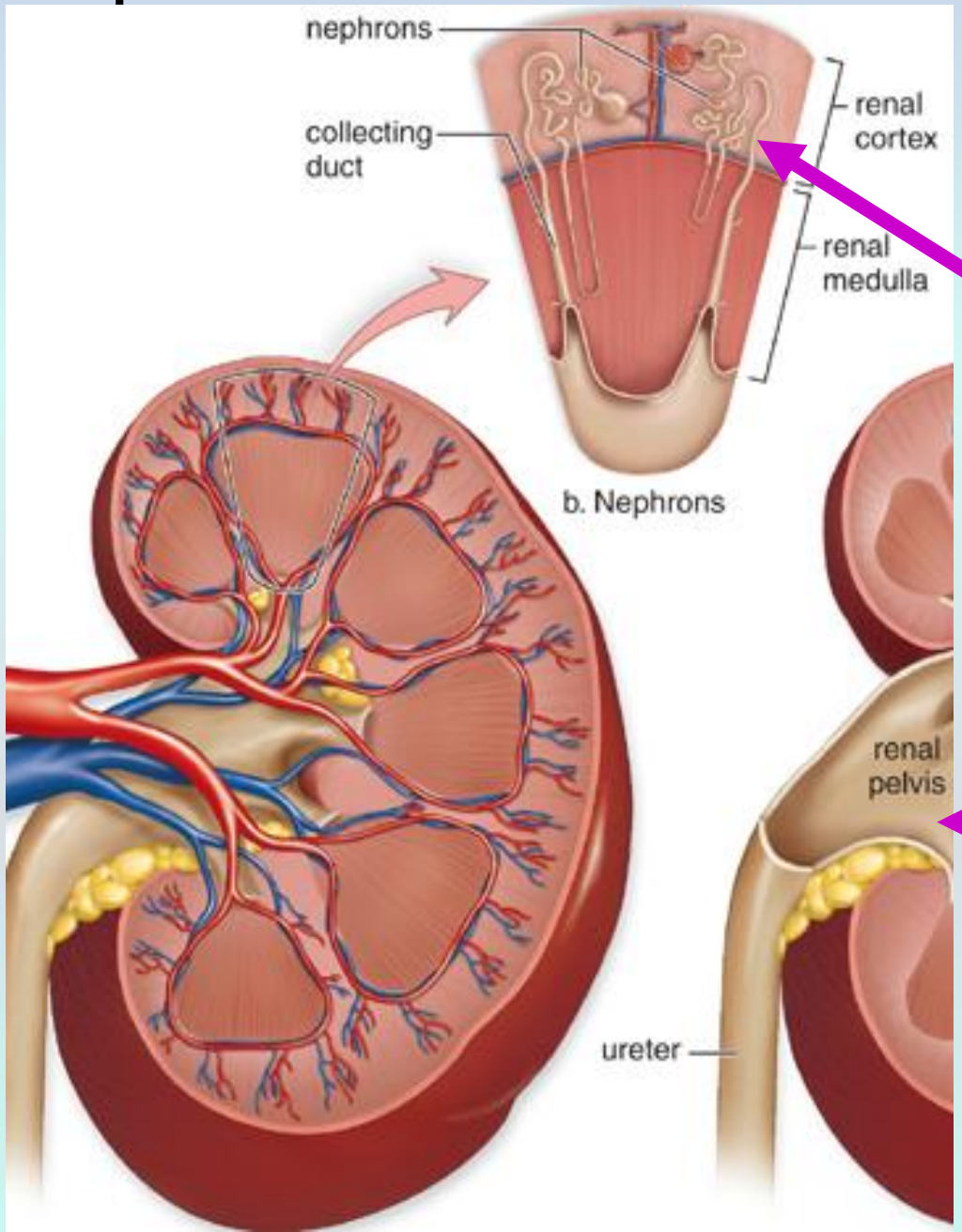
Micturition Reflex



Kidney Anatomy



Nephrons = kidney tubules for urine formation

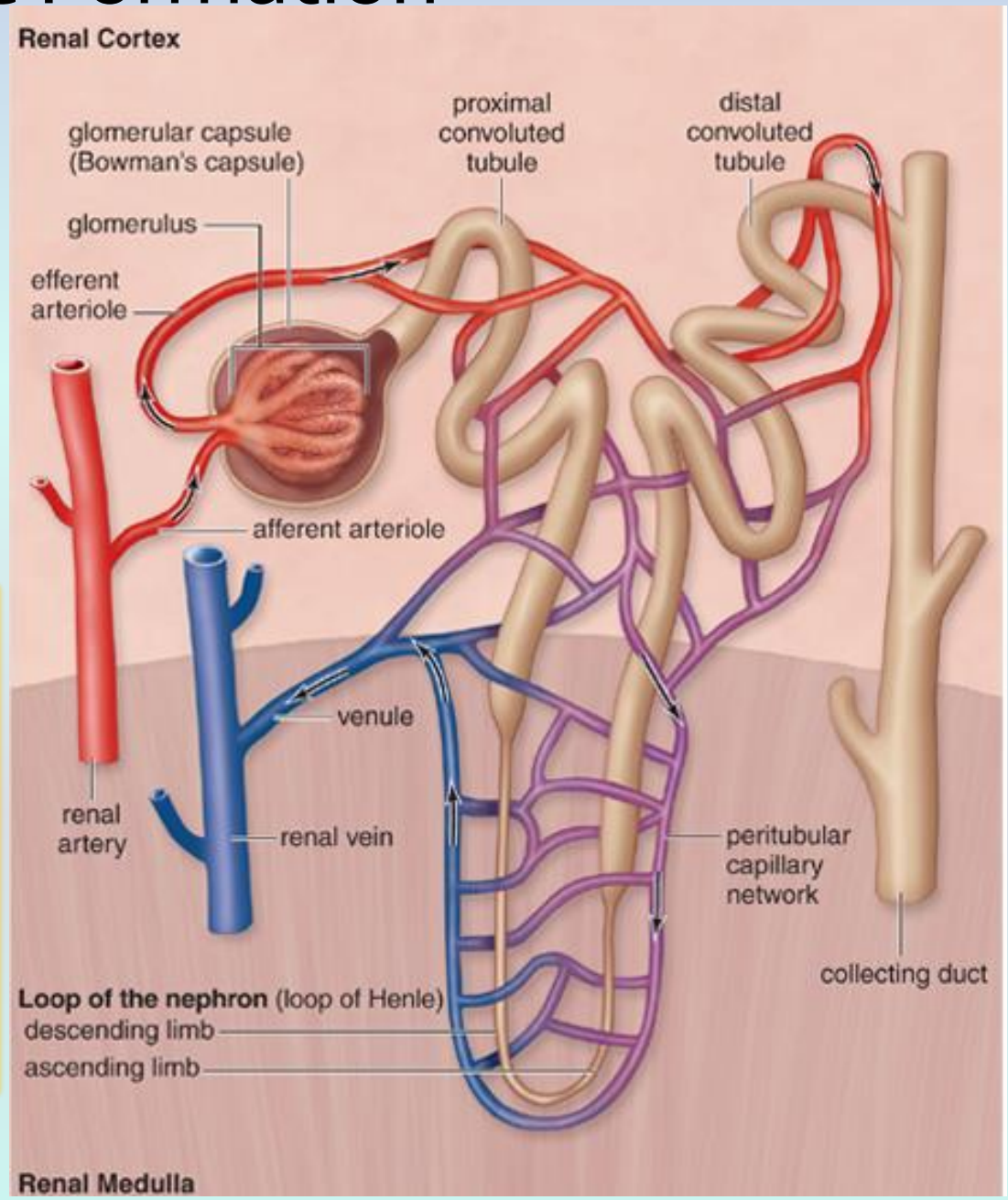


- The renal artery carries blood high in wastes to the kidney.
- Filtration of the blood occurs at the nephron
- Wastes are excreted while nutrients are reabsorbed back into the blood
- Urine is formed and excreted from the kidney via the renal pelvis into the ureters
- Blood leaving the renal vein is low in wastes

Nephron Anatomy & Urine Formation

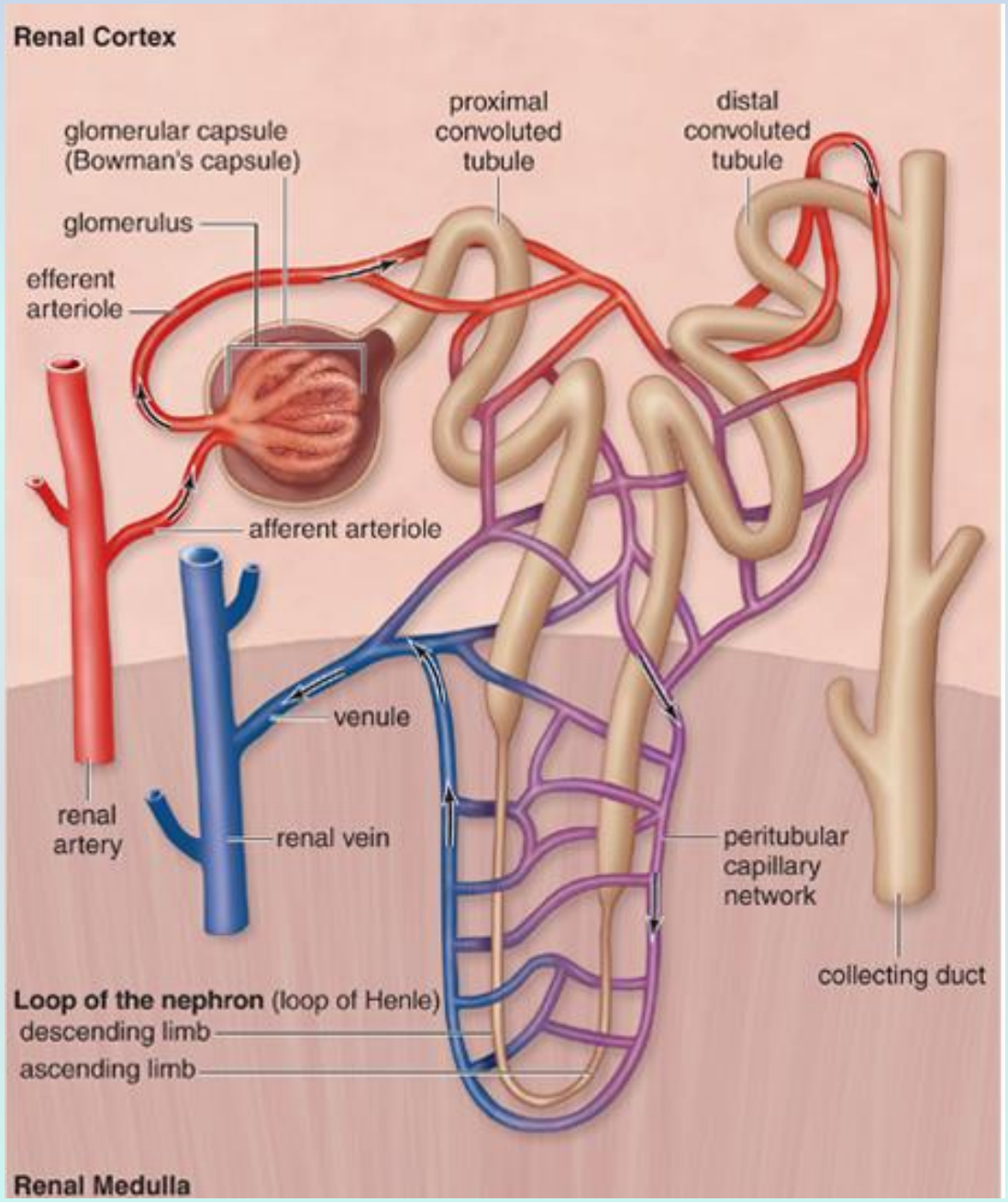
1. ***Pressure Filtration*** - occurs at the glomerulus where blood is filtered. Only small molecules leave blood (plasma) but large molecules like the formed elements (RBCs, WBCs, platelets) and proteins are not filtered.

Filterable Blood Components	Non-filterable Blood Components
• Water • Nitrogenous wastes • Nutrients • Salts (ions)	• Formed elements (blood cells and platelets) • Plasma proteins



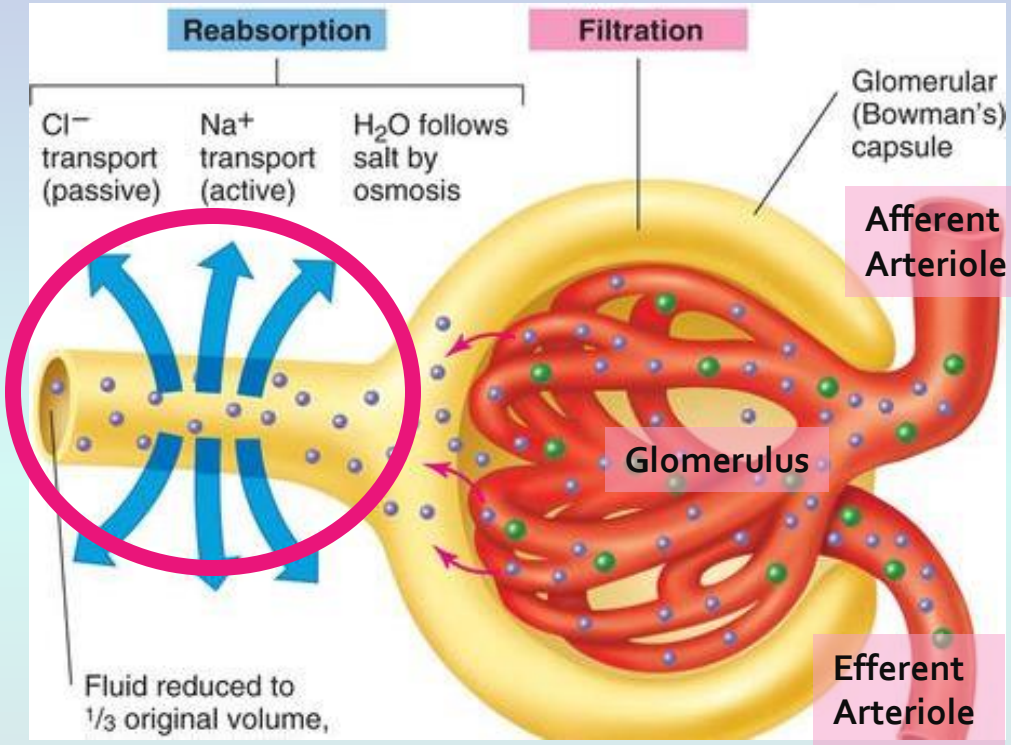
Nephron Anatomy & Urine Formation

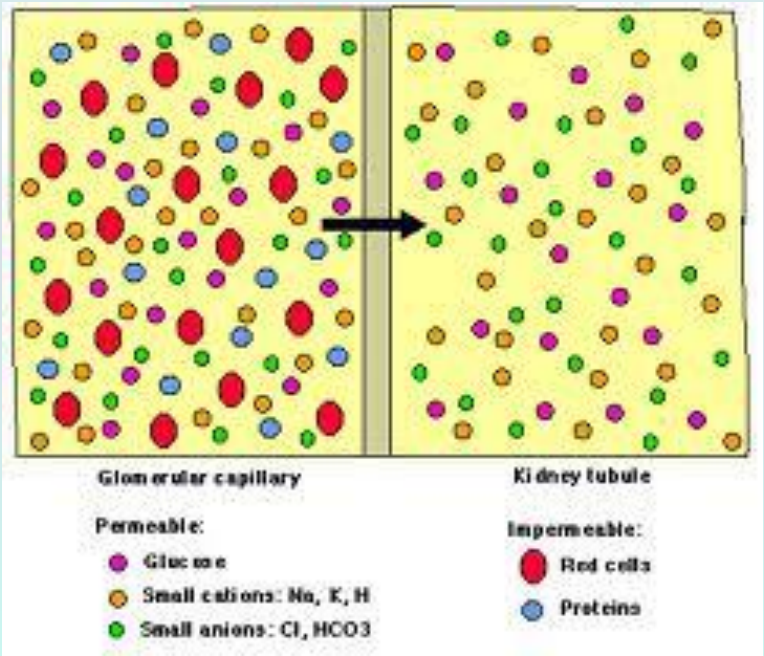
2. ***Reabsorption*** – where molecules are reabsorbed from the filtrate inside the tubule back into the blood capillary.
3. ***Excretion or Secretion*** – additional wastes, drugs and hydrogen ions (H+) can be excreted from blood into the nephron tubule to become a part of urine.



Urine Formation

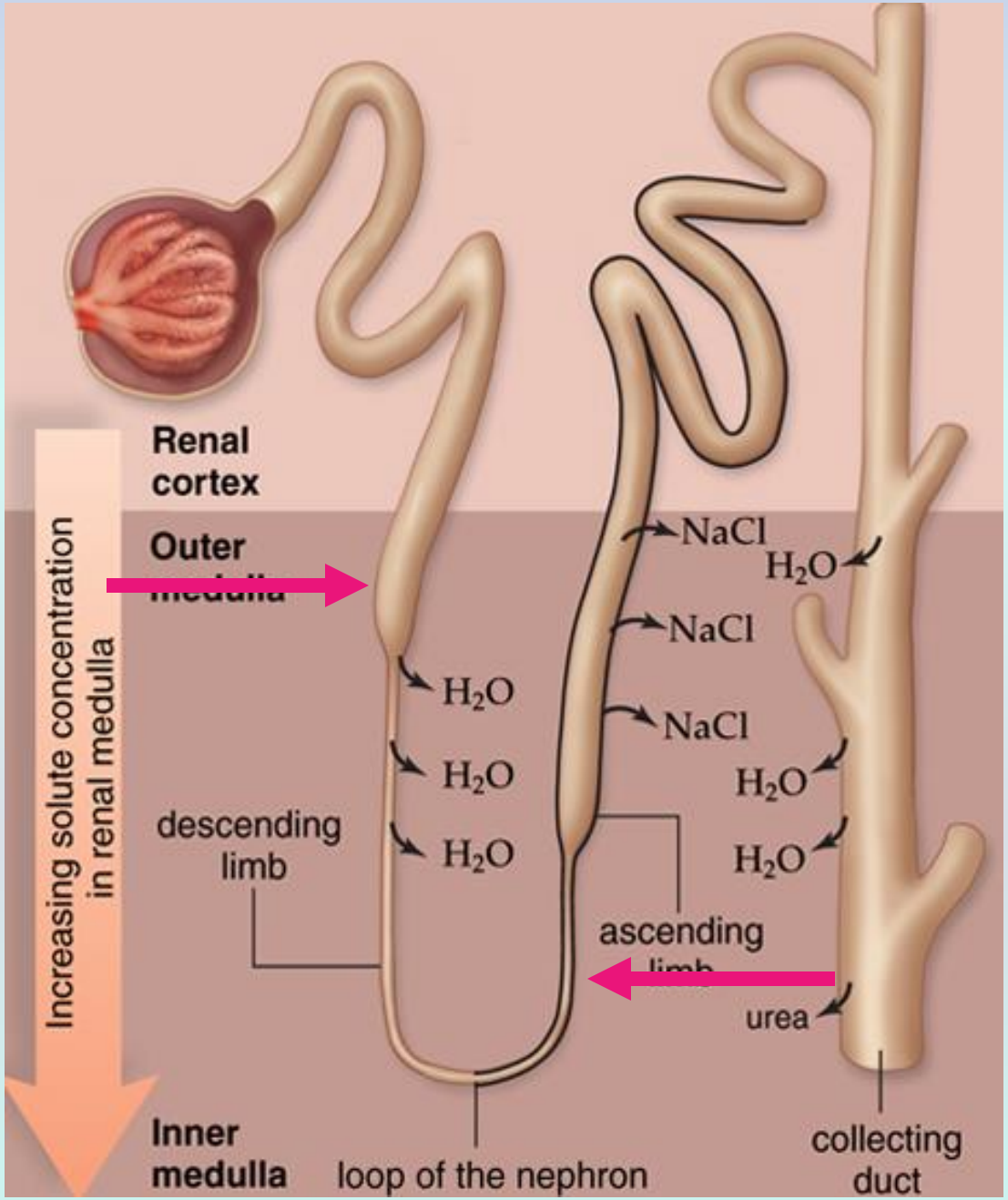
1. Afferent Arteriole = high BP to bring wastes to glomerulus
2. Pressure filtration at glomerulus to push small molecules out of blood (formed elements and proteins not filtered)
3. Filtrate enters glomerular capsule
4. Blood leaving the glomerulus enters the efferent arteriole
5. At the proximal convoluted tubule reabsorption of nutrients (glucose, amino acids), water, salt – both actively & passively; PCT has microvilli and mitochondria to help with maximal transport of molecules across nephron



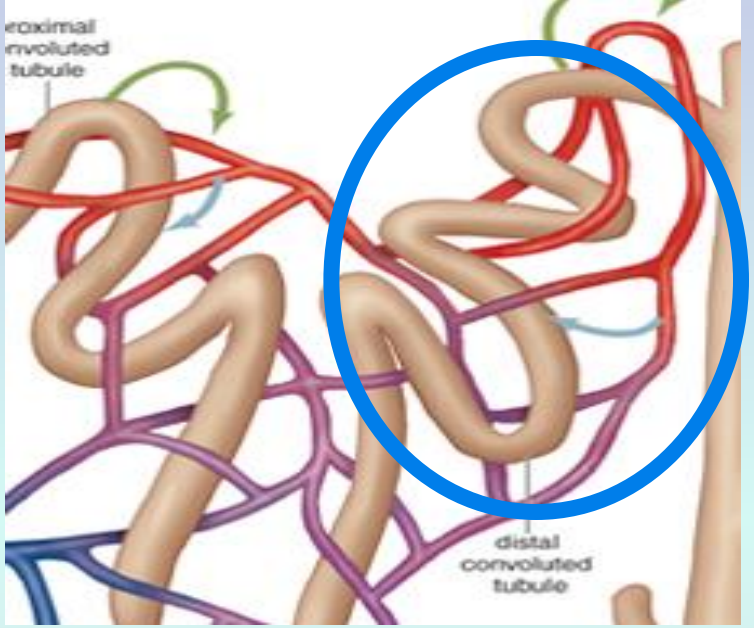


5. Filtrate goes down into the loop of the nephron where it is hypertonic outside the tubule. This causes water to be reabsorbed along the descending limb of the loop
6. Salt (NaCl or Na+) is reabsorbed along the ascending limb of the loop. This is what causes the medulla to become hypertonic drawing the water out of the tubule by osmosis at the descending limb.

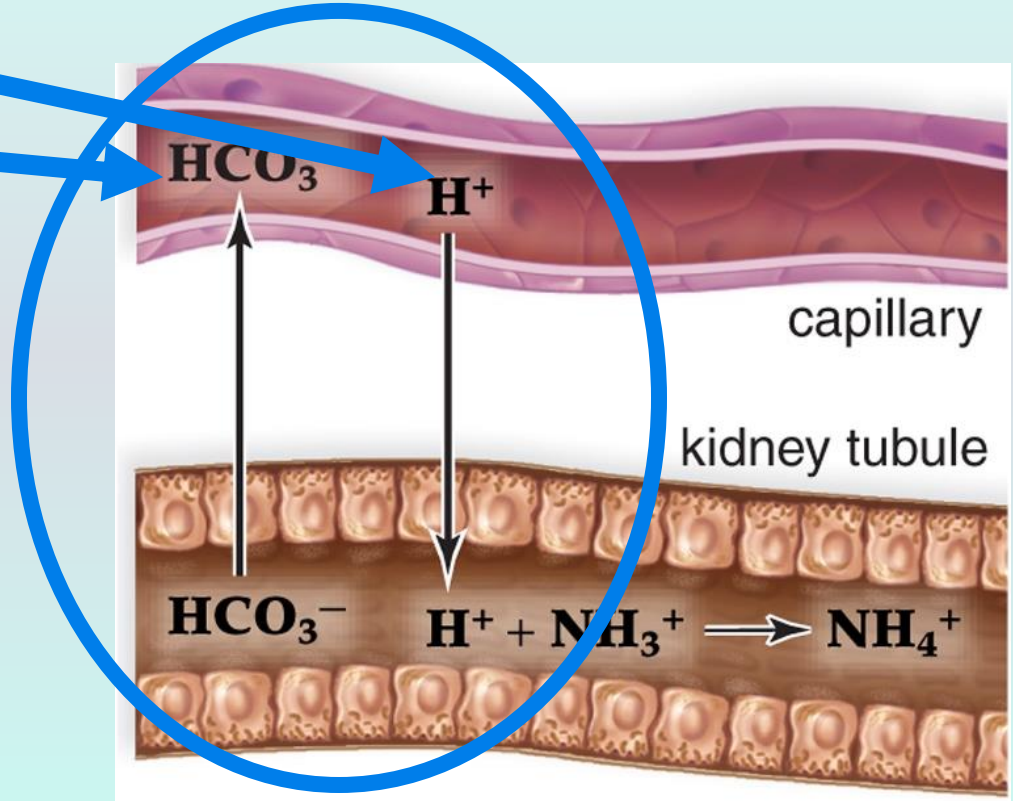
Note: water reabsorption also occurs at the collecting duct due to the hypertonic medulla



7. The filtrate travels up into the renal cortex again into the distal convoluted tubule where additional wastes like creatinine is excreted. Also drugs and Hydrogen ions.



To maintain pH balance, H+ is excreted and HCO3- is reabsorbed. The H+ is buffered by ammonia in the tubule and urine



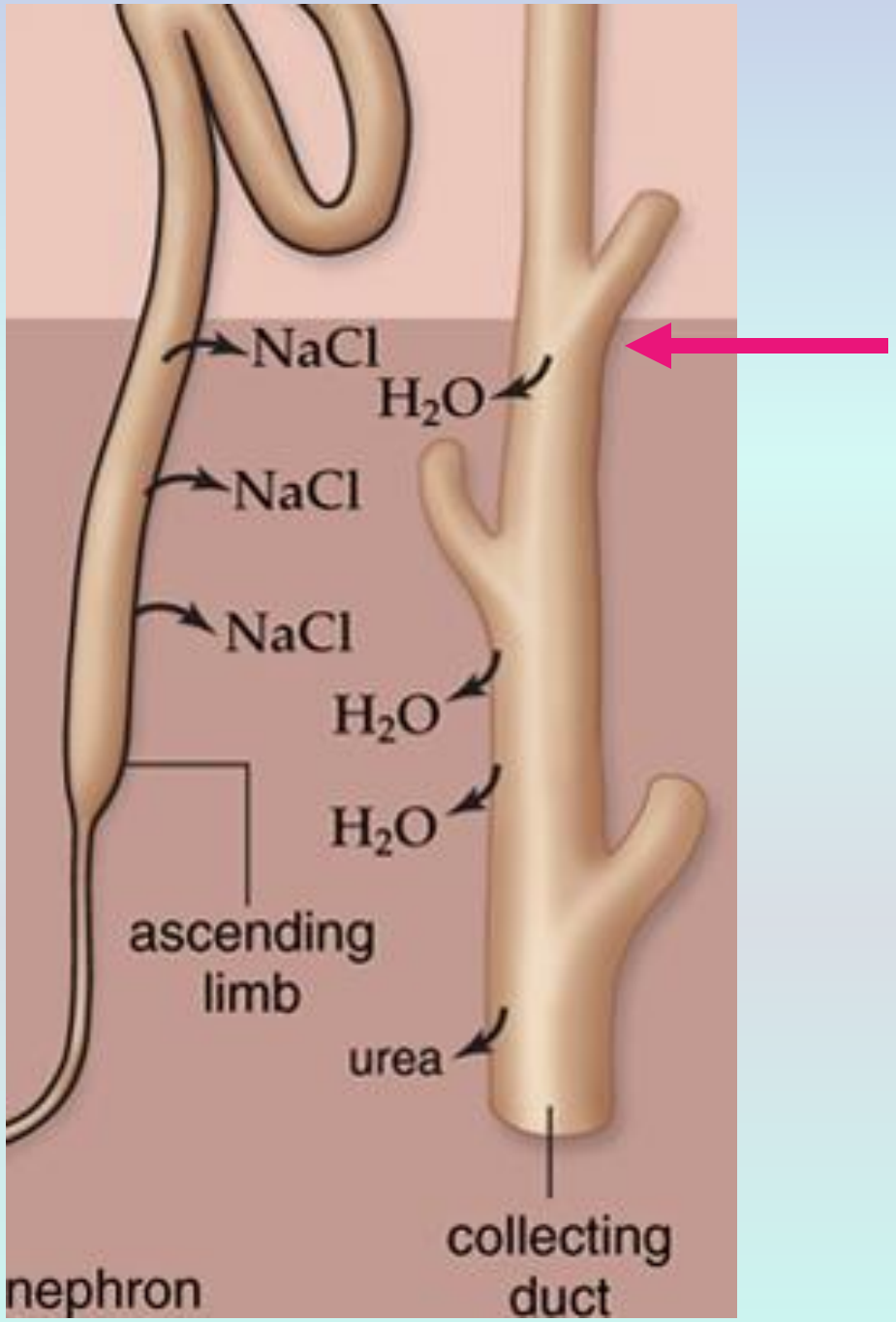
pH < 7.4 (acidic) = ↑ H^+ excreted and ↑ HCO_3^- reabsorbed

pH > 7.4 (basic) = ↓ H^+ excreted and ↓ HCO_3^- reabsorbed

H^+ is buffered in the urine by ammonium; however some H^+ is still found in the urine. pH of urine is acidic at around a pH of 6

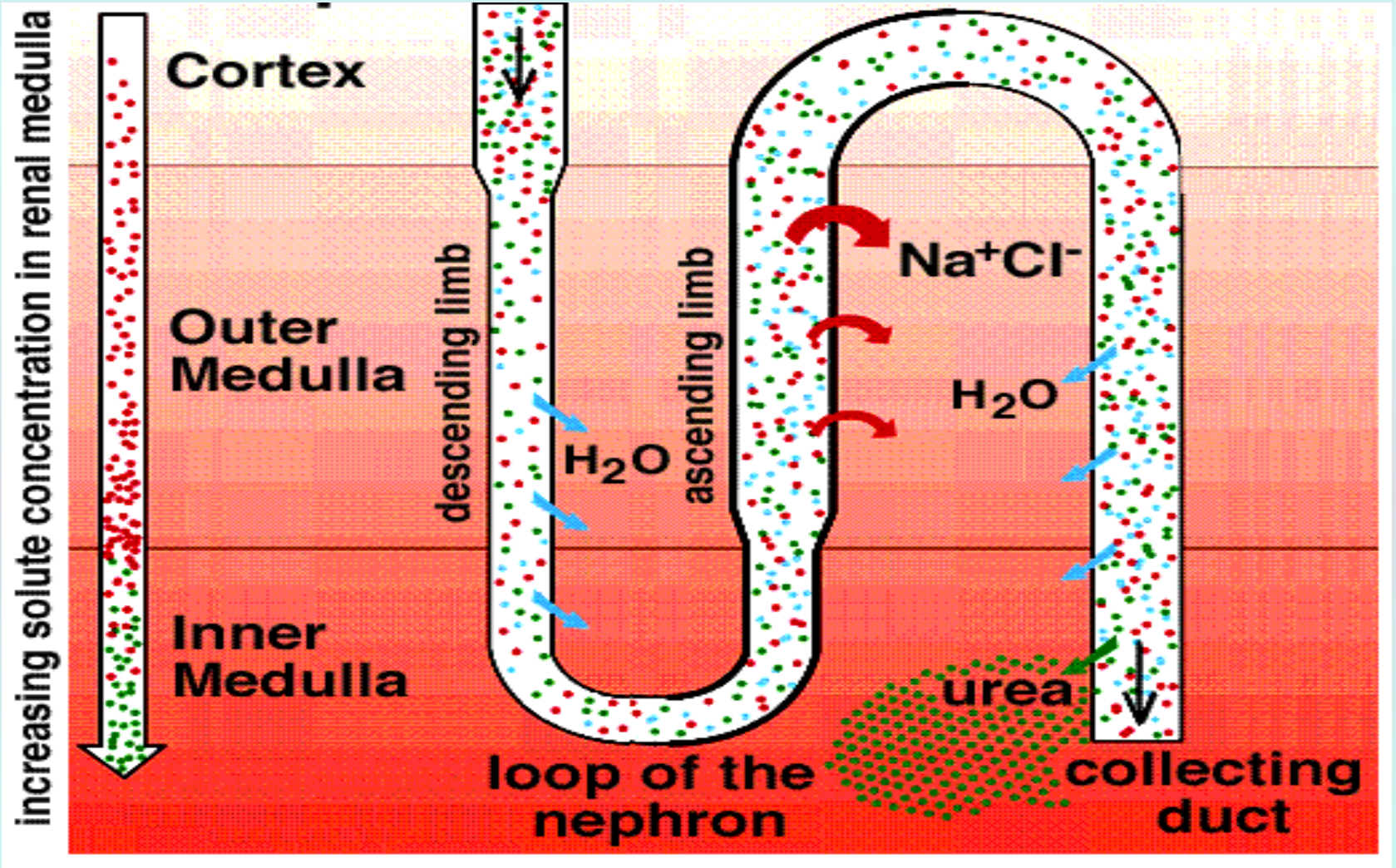
8. The filtrate from many nephrons is now collected by the collecting duct. Since is passes through the renal medulla again, additional water is reabsorbed as it passes through this hypertonic area. This concentrates the urine.

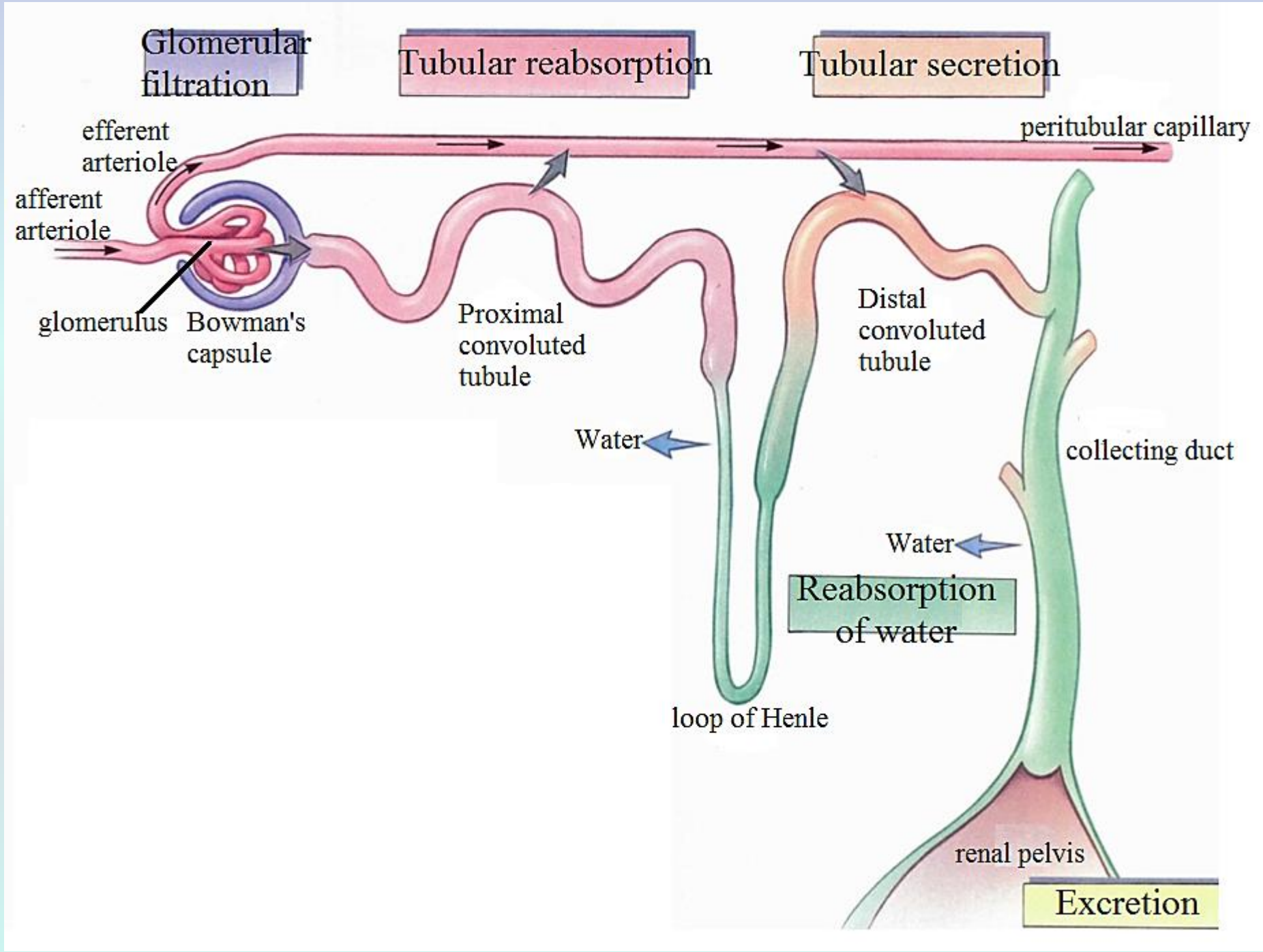
Note: some urea may be reabsorbed due to the concentration gradient.



Summary of Osmoregularity:

Increased salt reabsorption at the ascending limb causes an increasingly hypertonic renal medulla resulting in increased water reabsorption along the descending limb and the collecting ducts




Glomerular filtration
Tubular reabsorption
Tubular secretion
efferent arteriole
peritubular capillary
afferent arteriole
glomerulus
Bowman's capsule
Proximal convoluted tubule
Distal convoluted tubule
Water
collecting duct
Water
Reabsorption of water
loop of Henle
renal pelvis
Excretion

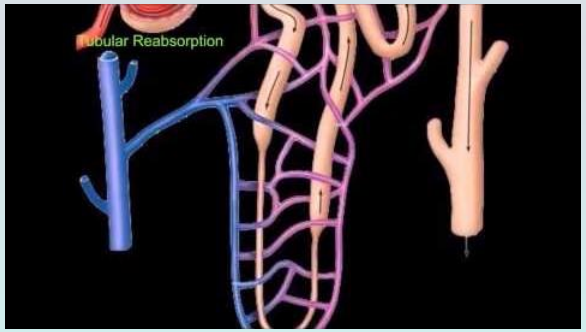
Summary

Nephron Function

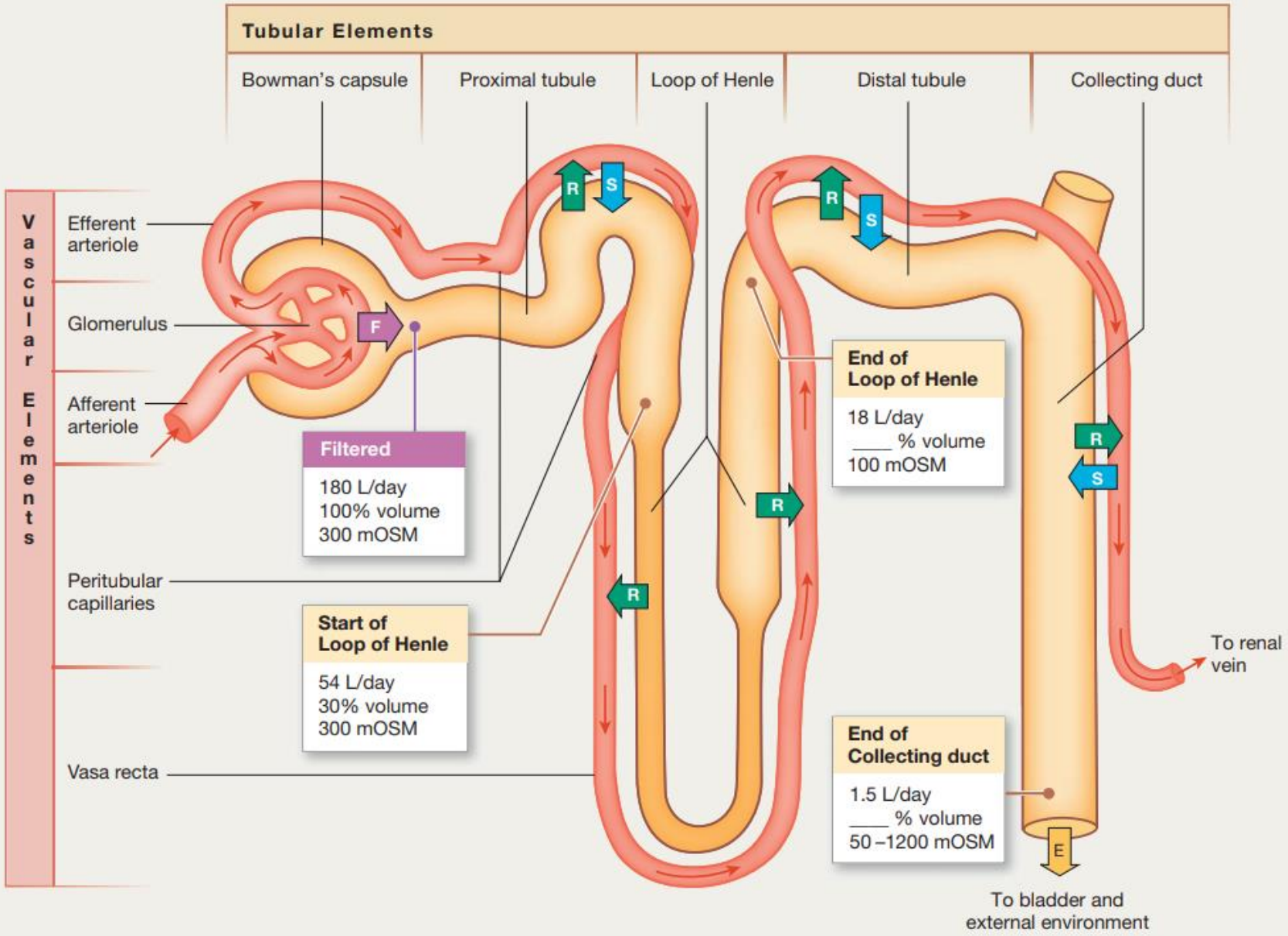
The four processes of the nephron are:

- F = **Filtration**: movement from blood to lumen
- R = **Reabsorption**: from lumen to blood
- S = **Secretion**: from blood to lumen
- E = **Excretion**: from lumen to outside the body

[Detailed Explanation of Urine Formation at Nephron]

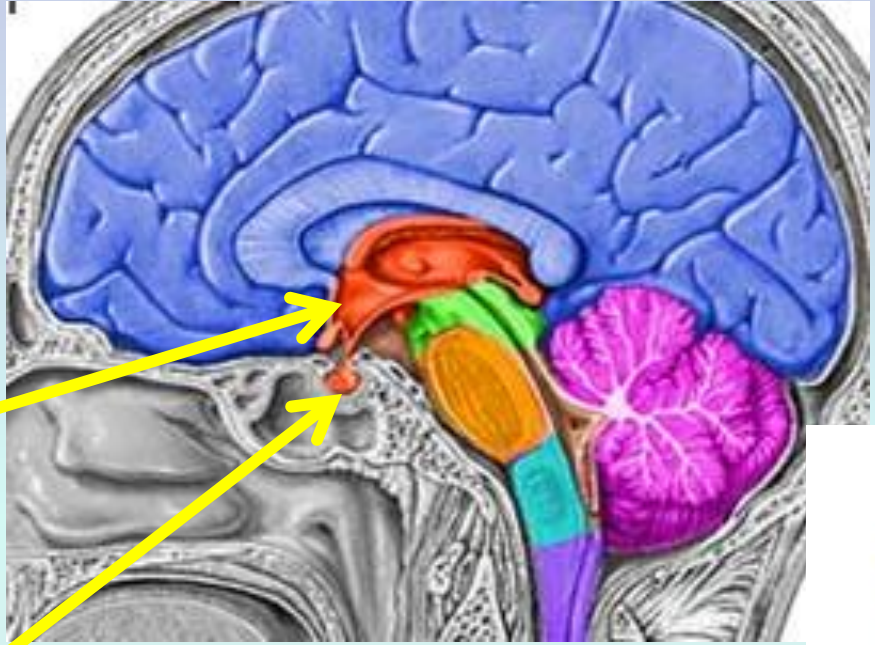


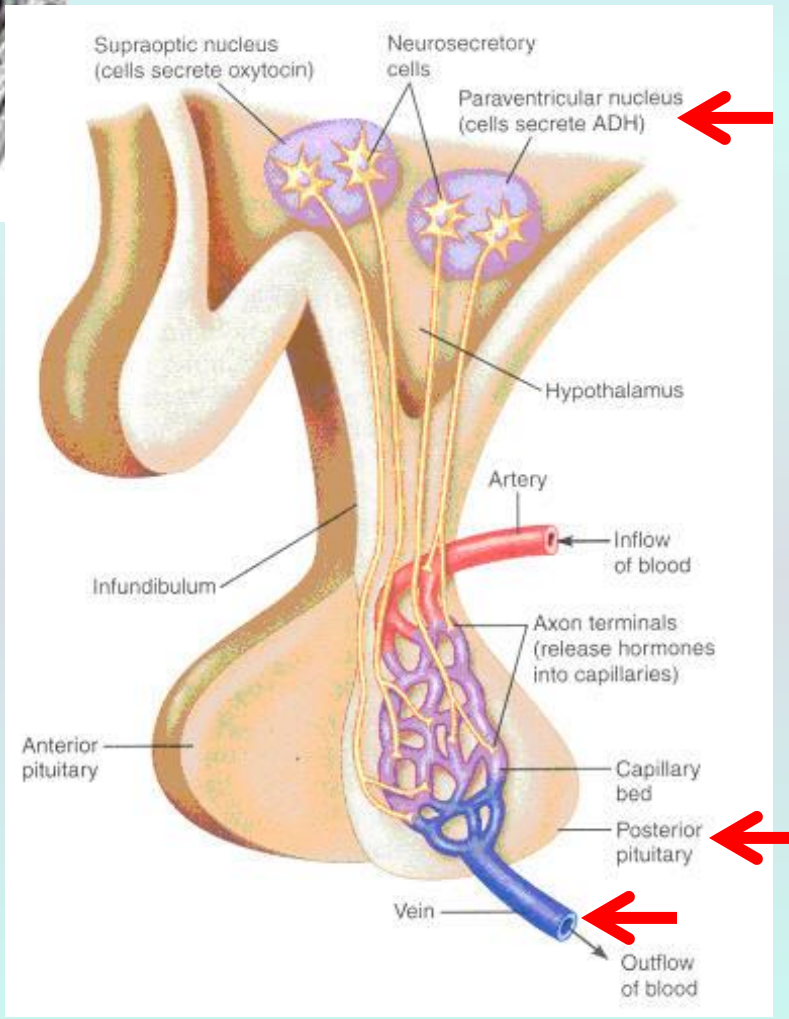
This model nephron has been untwisted so that fluid flows left to right.



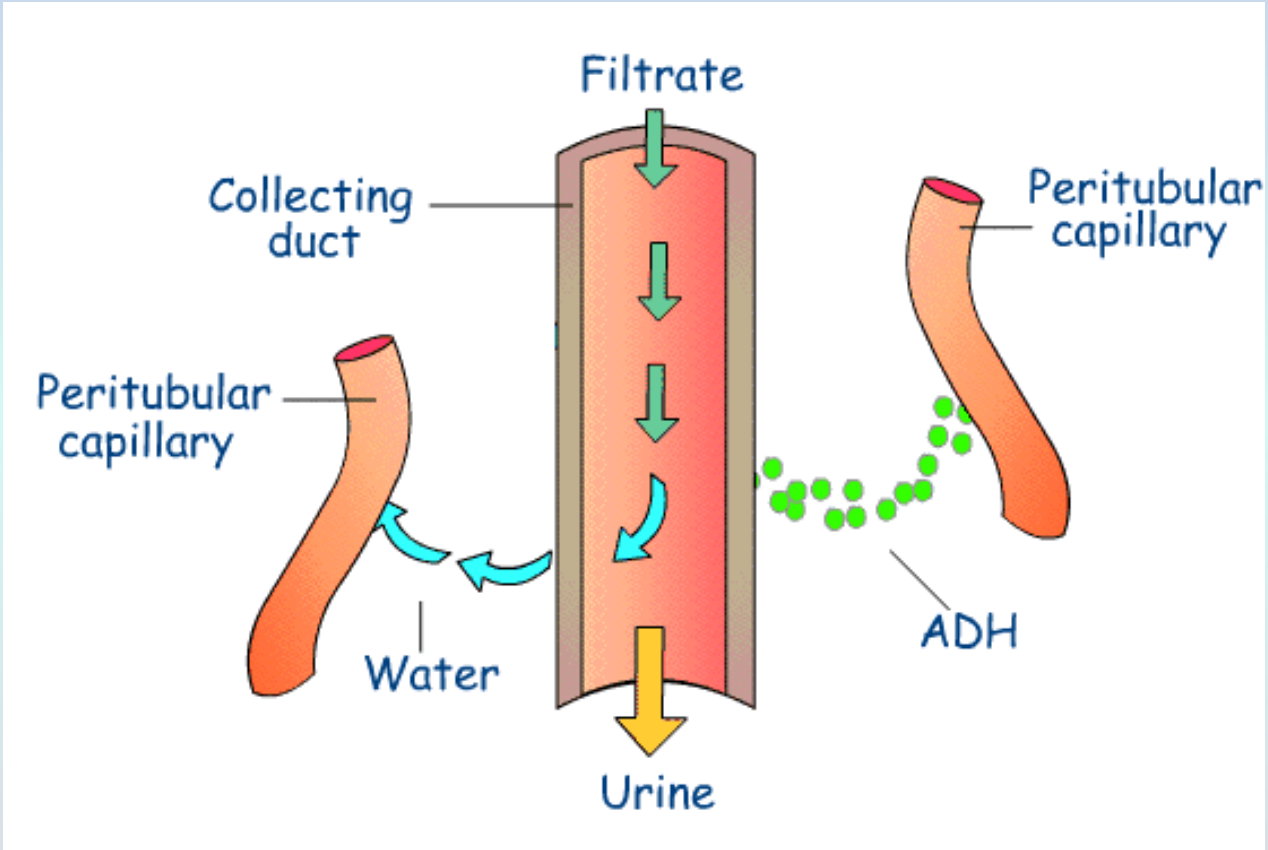
Hormones

- During dehydration or low water concentration in the blood, the hypothalamus produces Anti-Diuretic Hormone (ADH).
- ADH is secreted out the posterior pituitary gland into the blood to act on the kidney



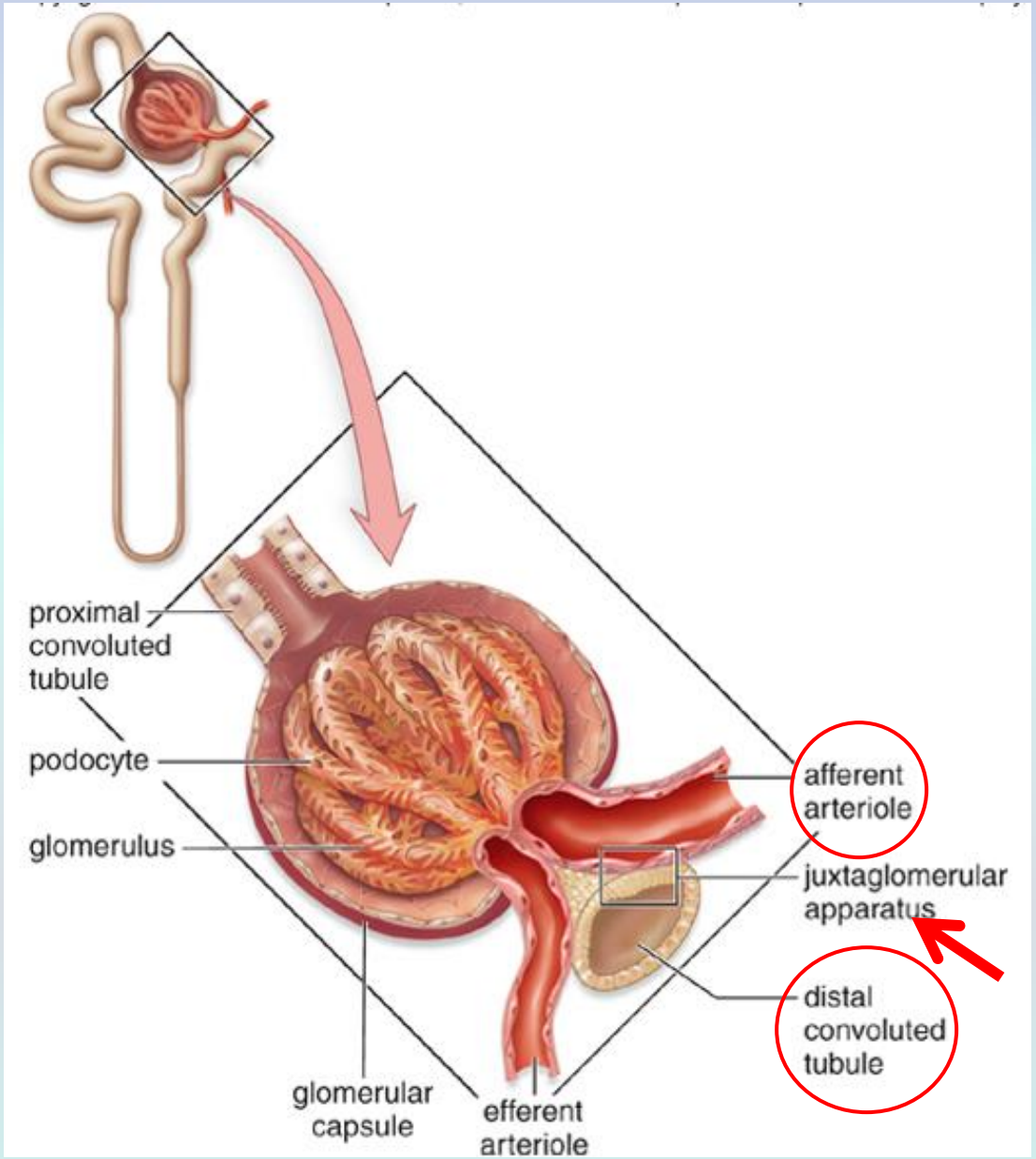


- ADH acts on the collecting ducts of the nephrons to increase water reabsorption
- This increases blood volume and water concentration which is detected by the hypothalamus
- Negative feedback results and the hypothalamus decreases ADH production
- Urine is also more concentrated due to less water content in urine

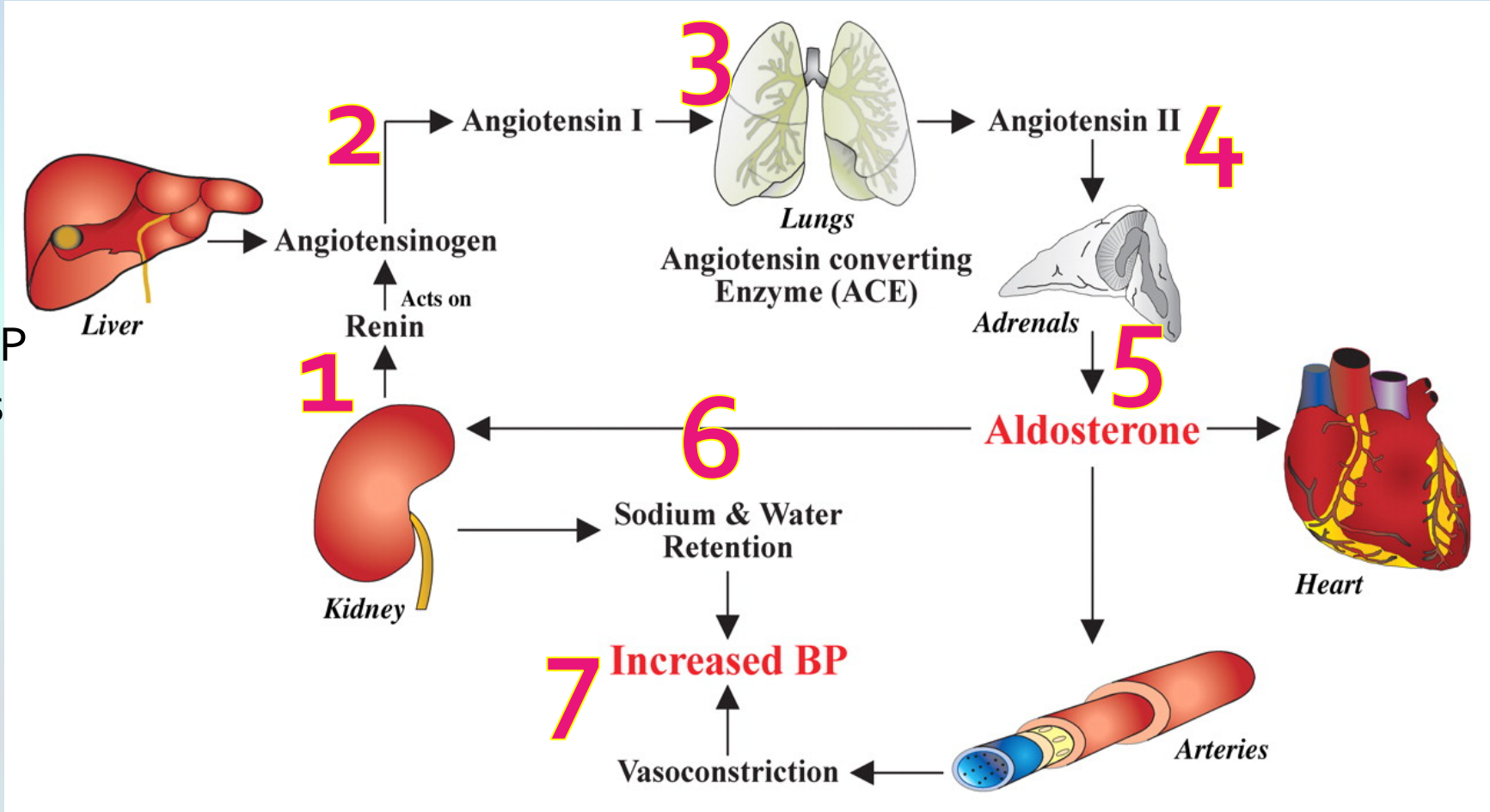


Aldosterone

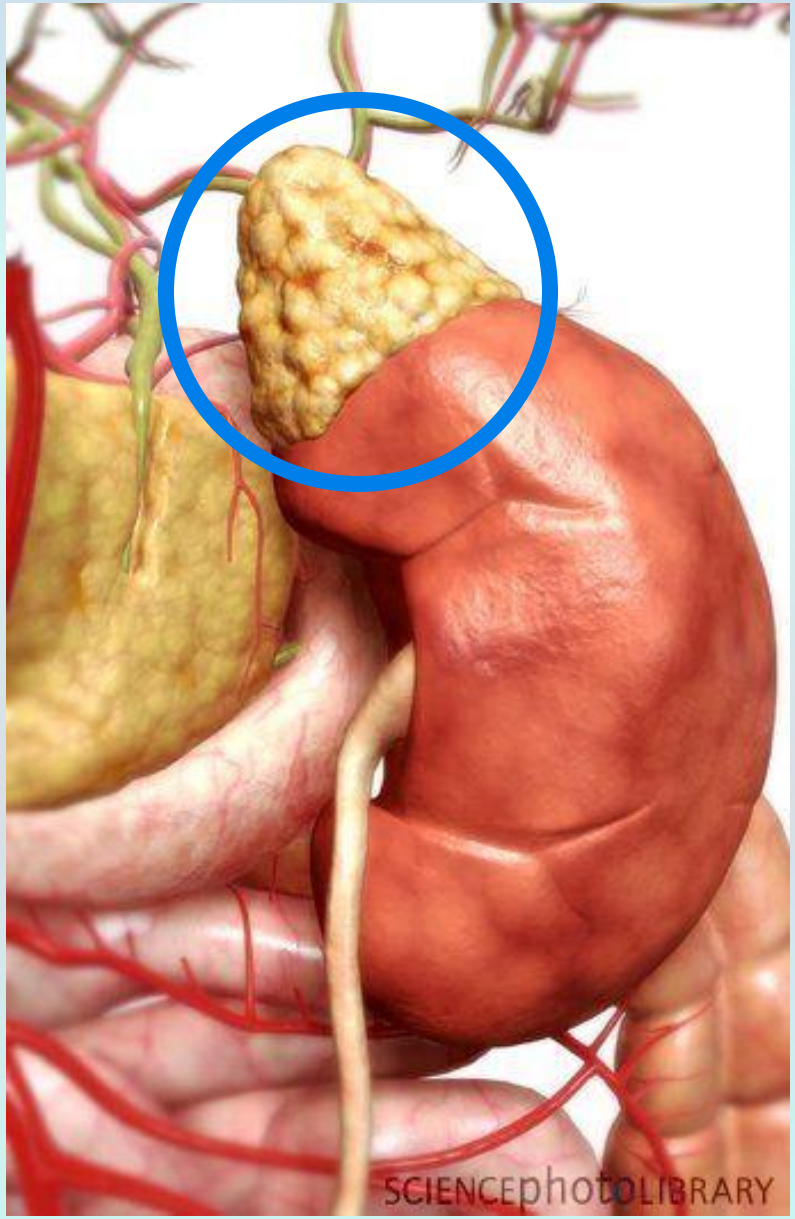
- When there is **low BP** due to low blood volume, a specialized group of cells in the kidney called the juxtaglomerular apparatus detects this low BP and secretes renin into the blood

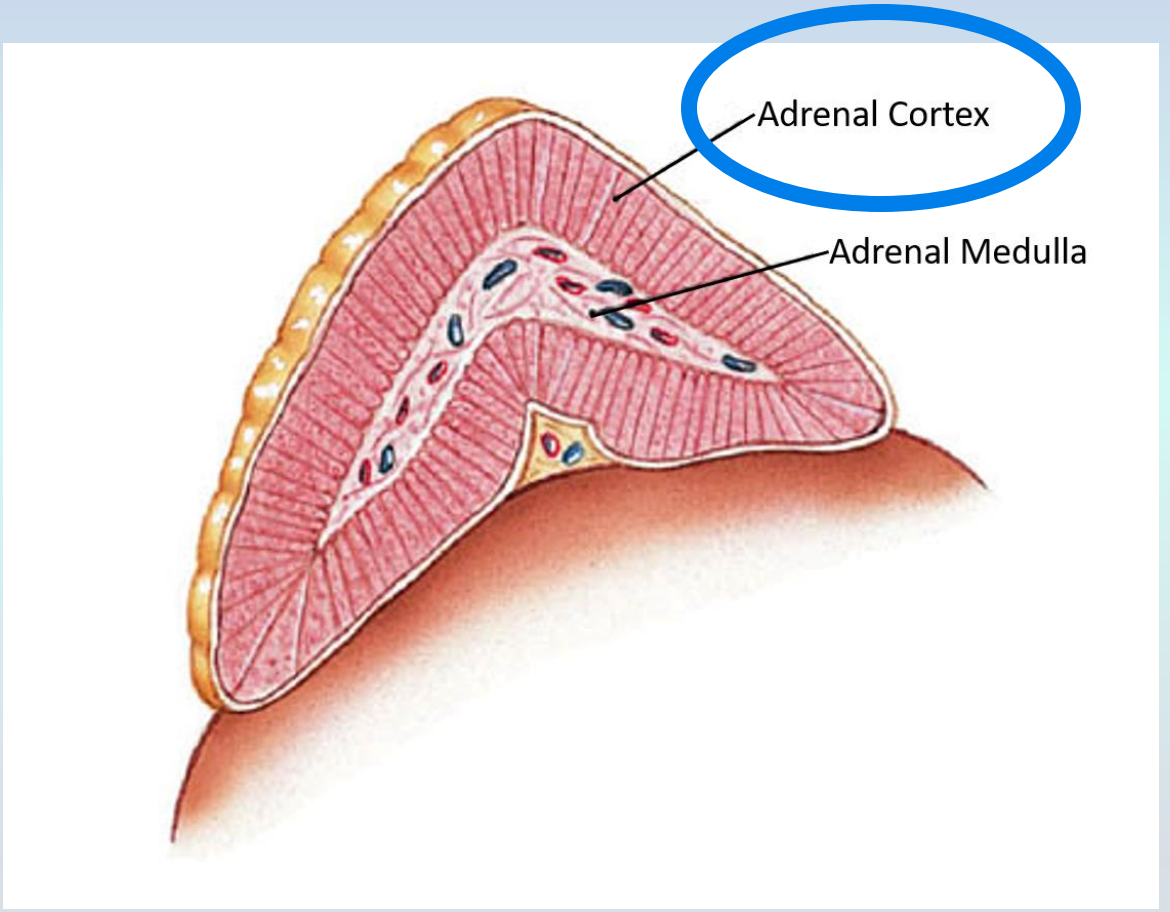


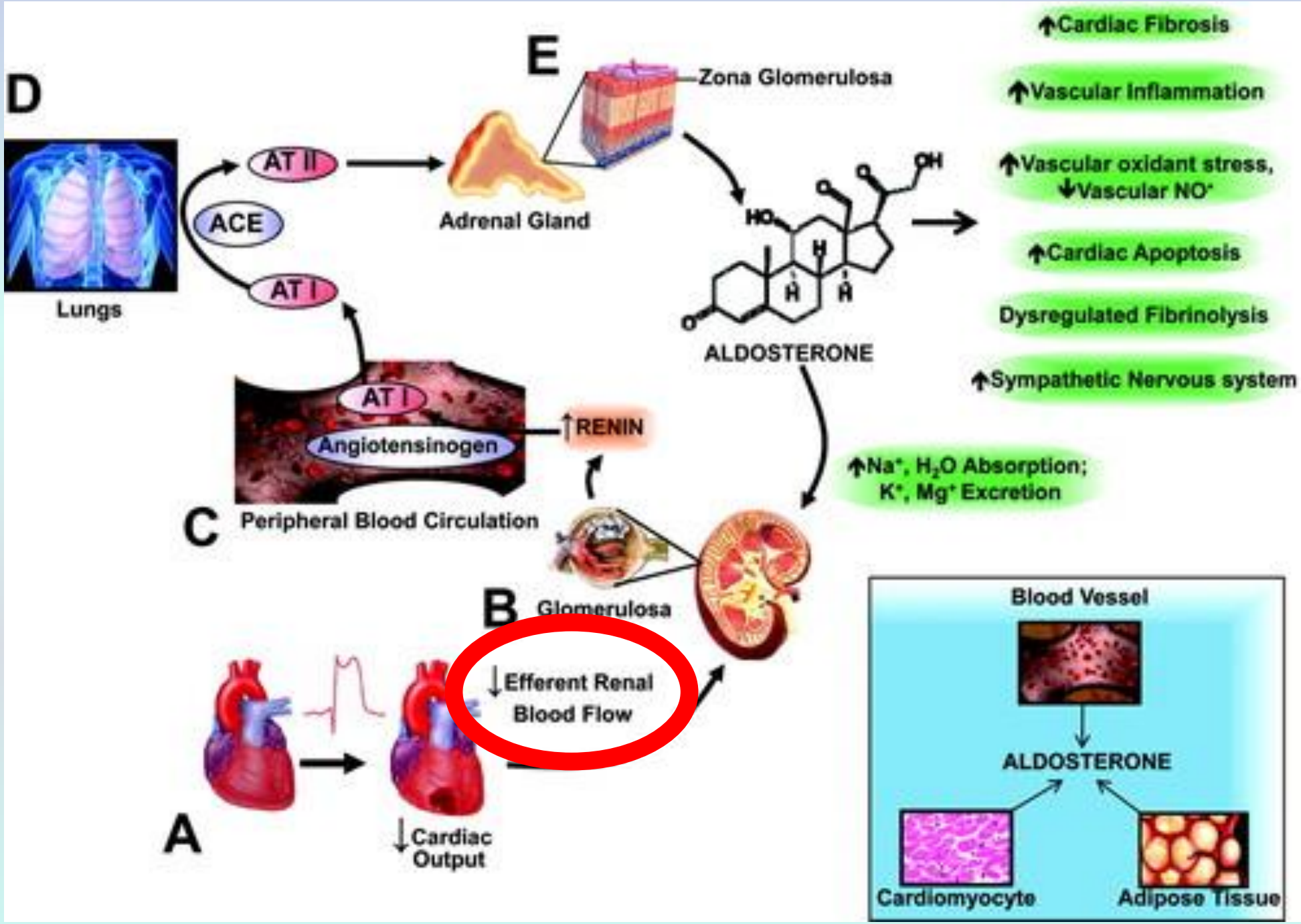
- Renin causes the conversion of Angiotensinogen (a plasma protein from the liver) to Angiotensin I
- Angiotensin I is converted to Angiotensin II in the lungs
- Angiotensin II causes vasoconstriction to increase BP & it acts on the adrenal glands to secrete aldosterone
- Aldosterone is secreted from the adrenal cortex
- It causes an increase in salt (NaCl or Na+) reabsorption at the nephron
- This results in an increase in water reabsorption resulting in an increase in blood volume and blood pressure



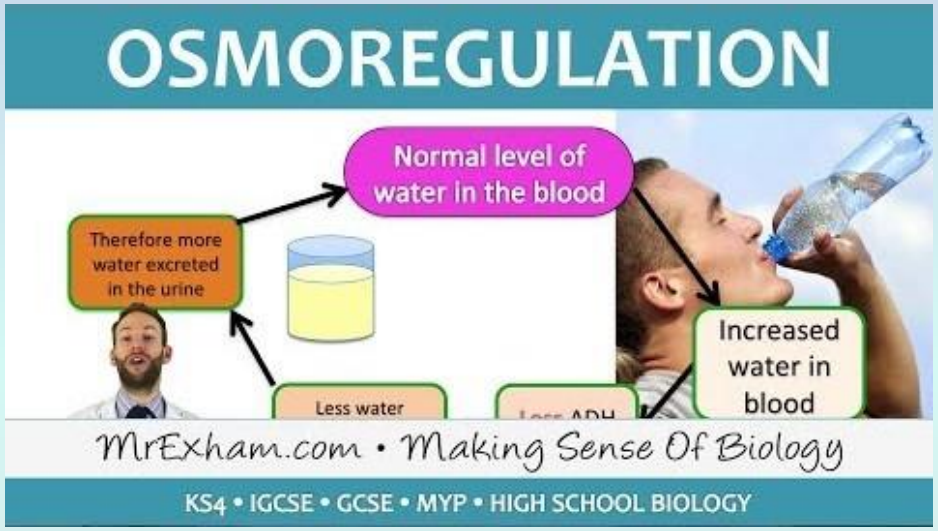
- Adrenal Gland





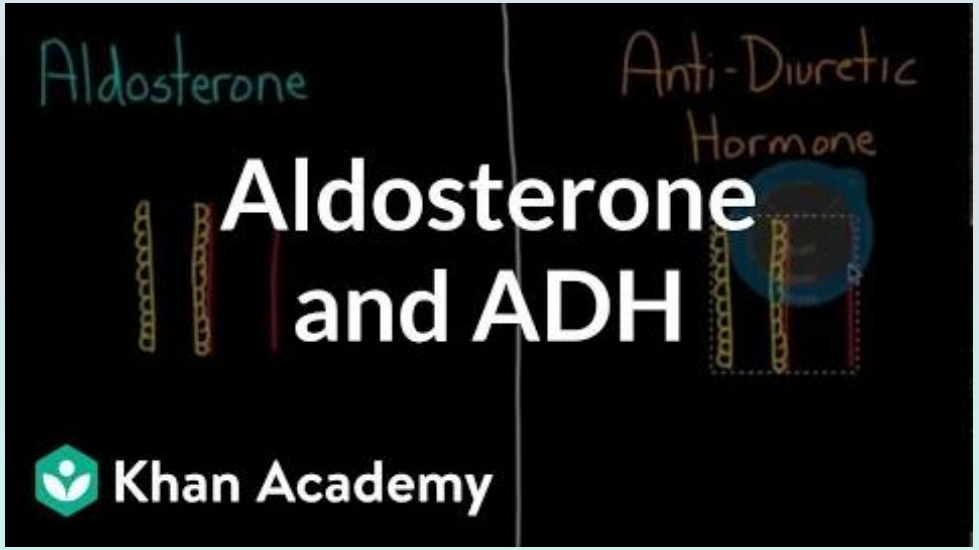

D
E
Zona Glomerulosa
Adrenal Gland
AT II
ACE
AT I
Lungs
↑Cardiac Fibrosis
↑Vascular Inflammation
↑Vascular oxidant stress,
↓Vascular NO•
↑Cardiac Apoptosis
Dysregulated Fibrinolysis
↑Sympathetic Nervous system
ALDOSTERONE
AT I
Angiotensinogen
↑RENIN
C
Peripheral Blood Circulation
↑Na+, H2O Absorption;
K+, Mg+ Excretion
B
Glomerulosa
↓Efferent Renal
Blood Flow
A
↓Cardiac
Output
Blood Vessel
ALDOSTERONE
Cardiomyocyte
Adipose Tissue

ADH and Homeostasis Video



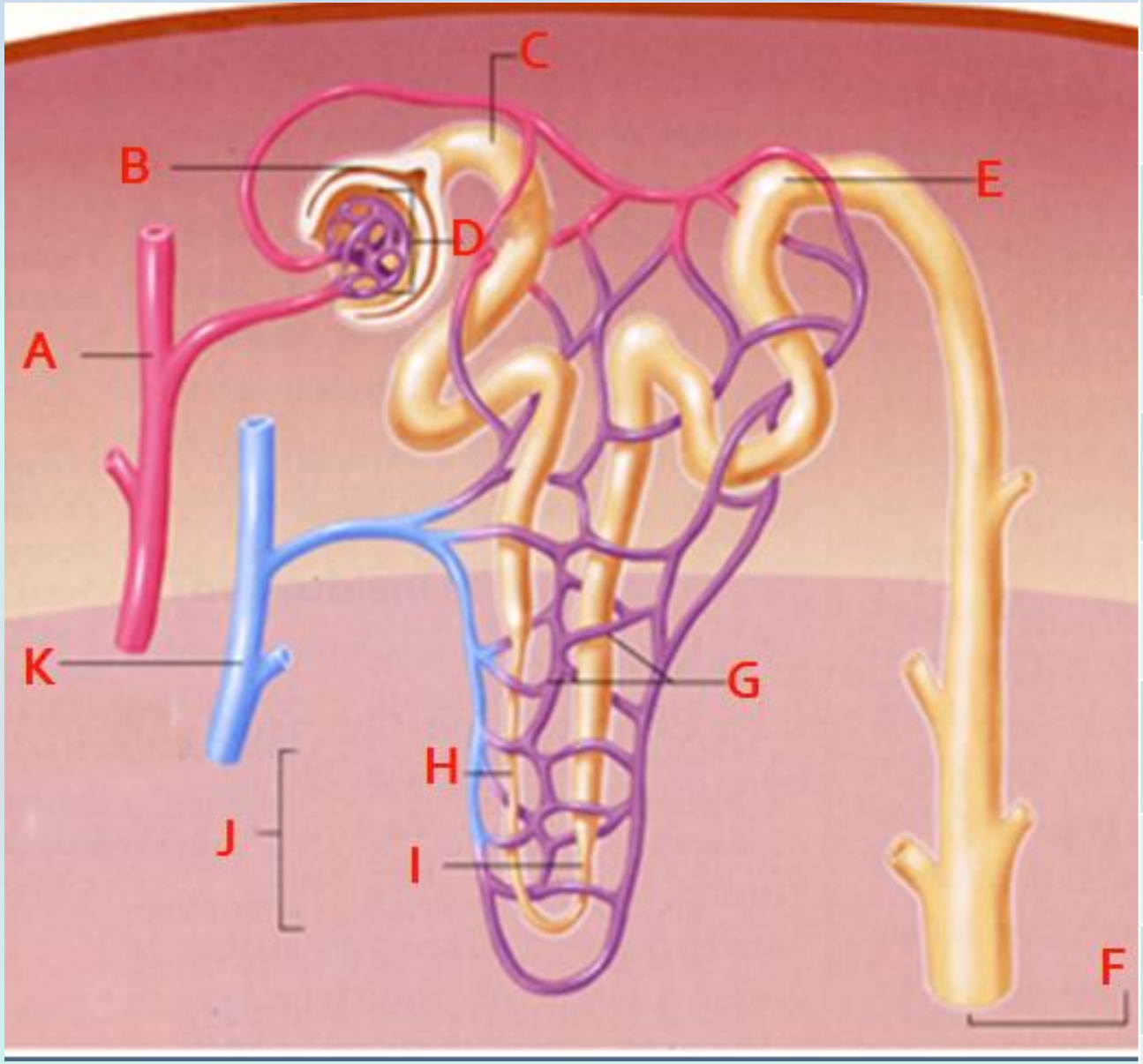
Renin-Angiotensin-Aldosterone System Video

Comparison of ADH to Aldosterone Video



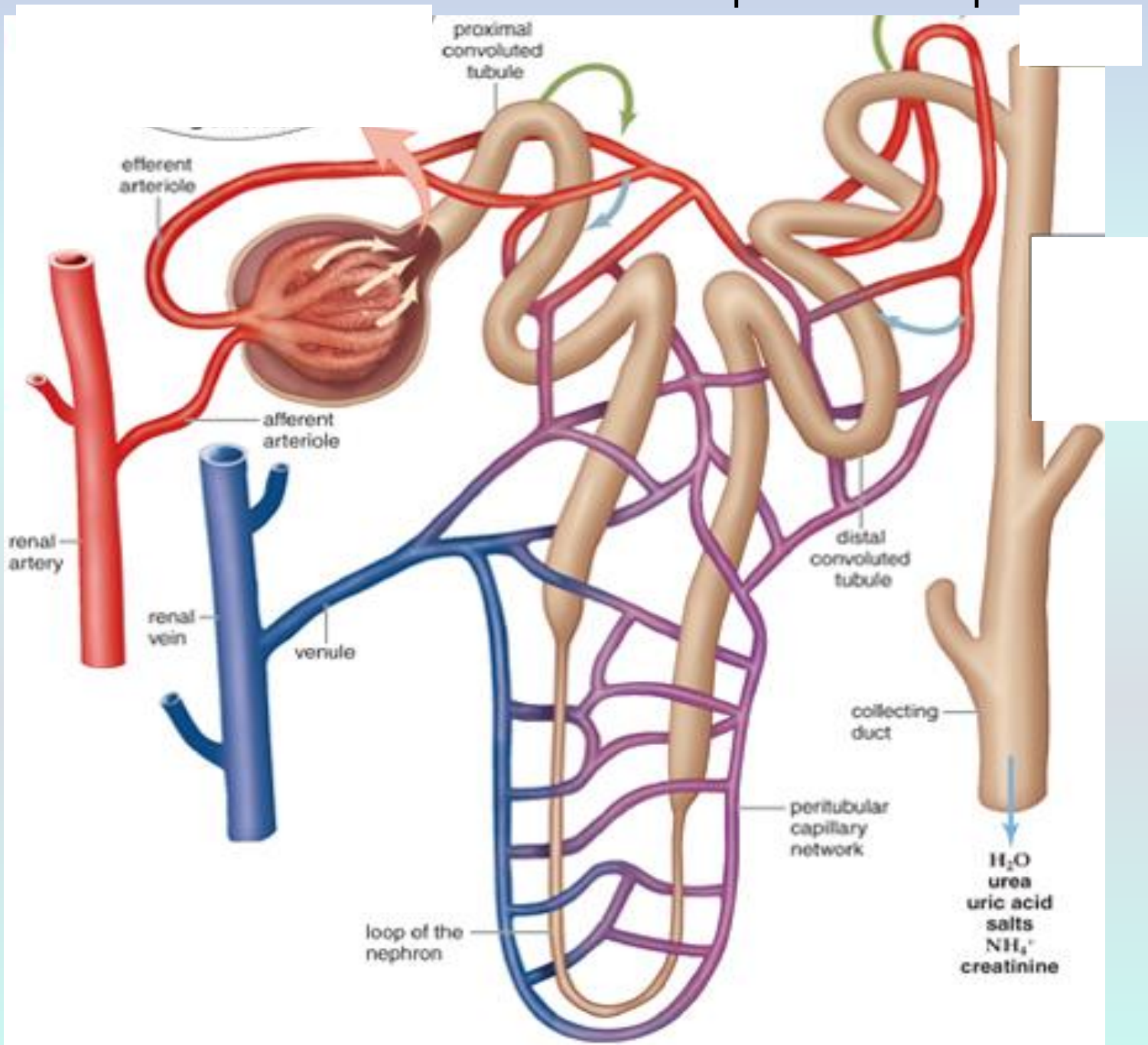
Structure/Molecule	Function
Glomerulus/Glomerular Capsule	Site of pressure filtration
Glucose & amino acids	These molecules are completely reabsorbed at the PCT
Collecting Duct (& DCT)	ADH acts here to increase water reabsorption
Descending limb of loop	The part is impermeable to salt reabsorption
Hydrogen ion / H+	When blood pH is low, there is an increase in excretion of this molecule
Salt/NaCl/Na+	Reabsorption of this molecule creates a hypertonic medulla
Collecting Duct	The is the last place in the nephron that water is reabsorbed
Adrenal Gland (adrenal cortex is more specific)	Aldosterone is secreted from this gland
Aldosterone	This hormone causes increased salt reabsorption

Structure/Molecule	Function
PCT	Site of glucose reabsorption
Microvilli	Increases surface area for transport of molecules through nephron
Urea & Uric Acid	This waste is filtered out of blood at the glomerulus
Renin	When BP drops, the nephron produces this hormone
DCT	Blood pH is regulated by transport of molecules at this part of the nephron
Water/H_2O	This molecule is reabsorbed at the PCT, loop, and collecting duct
Renal Pelvis	This part of the kidney collects all of the urine from the nephrons
Bladder	This structure help to store urine
Ureter(s)	Peristalsis along this tube transports urine to the bladder



	Function
	Contains lowest amount of wastes in blood
	Reabsorption of nutrients
	Pressure filtration is due to high BP
	Collects small molecules from blood
	Water reabsorption and transport of urine to renal pelvis
	Salt (Na+) reabsorption to make a hypertonic medulla
	Only permeable to water
	Acid base balance and drug excretion
	Delivers blood high in wastes towards kidney
	Reabsorbed molecules re-enter blood here

Label all molecules with direction of transport in the nephron



Chapter 14: Reproduction

MALES

SEMINAL VESICLE: Adds fructose secretions so mitochondria can produce ATP for flagellum to move sperm. Also provided prostaglandins to help uterus contract so sperm and travel up the female tract.

VAS DEFERENS: Sperm travel here from epididymis and during ejaculation

PROSTATE GLAND: Secreted an alkaline fluid to protect sperm from acidity in urethra and vagina

EJACULATORY DUCTS: During ejaculation, the ejaculatory duct contracts and propels sperm along with secretions from the 3 accessory organs into the Urethra. This is now called semen.

URETHRA: When penis is erect and during orgasm, the penis contracts to propel semen out of the penis and into the female . It is also a passage for urine during urination. The external sphincter under the bladder is contracted during ejaculation.

COWPER'S GLAND (Bubourethral Gland): Adds mucus for lubrication during intercourse

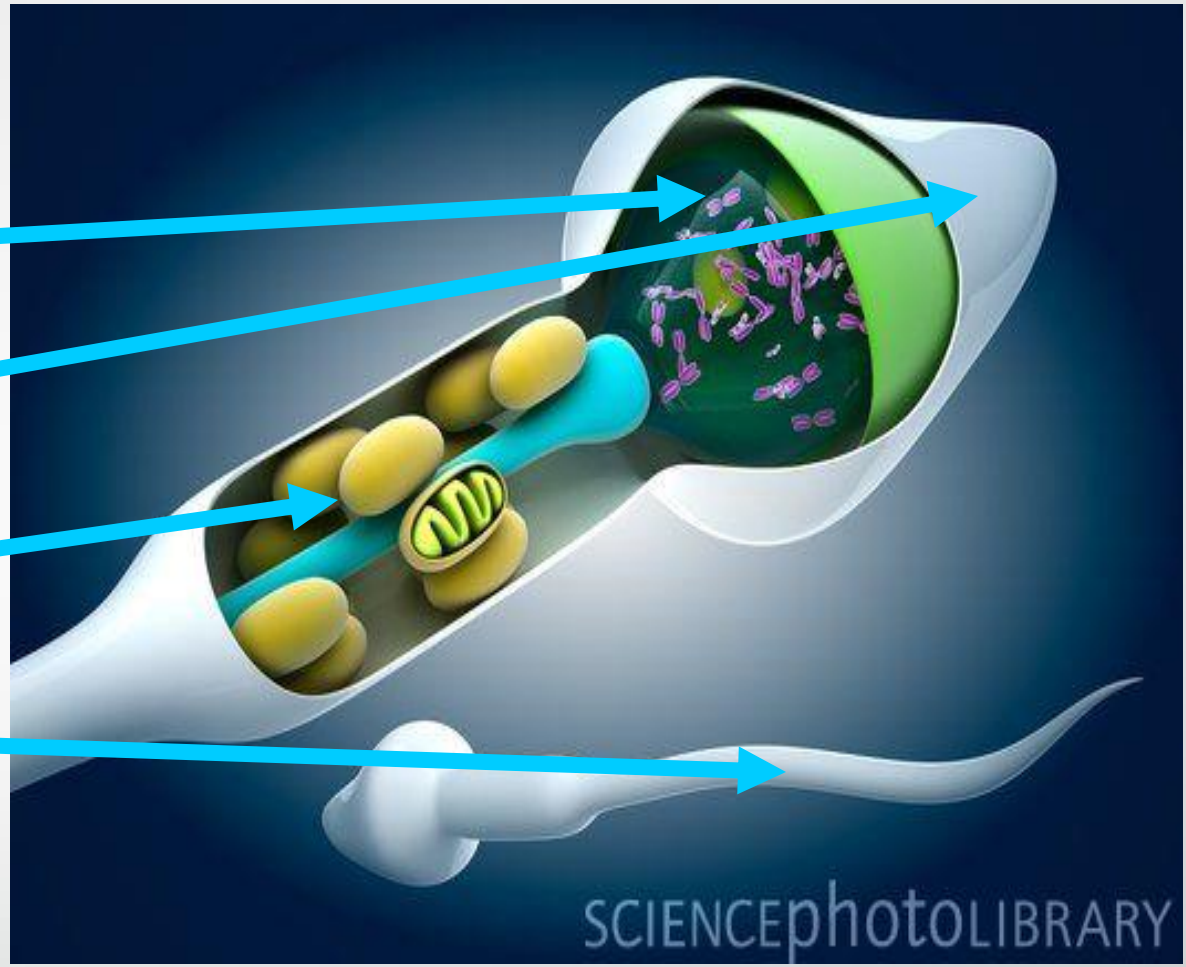
EPIDIDYMIS: Sperm finish maturing and become motile here.

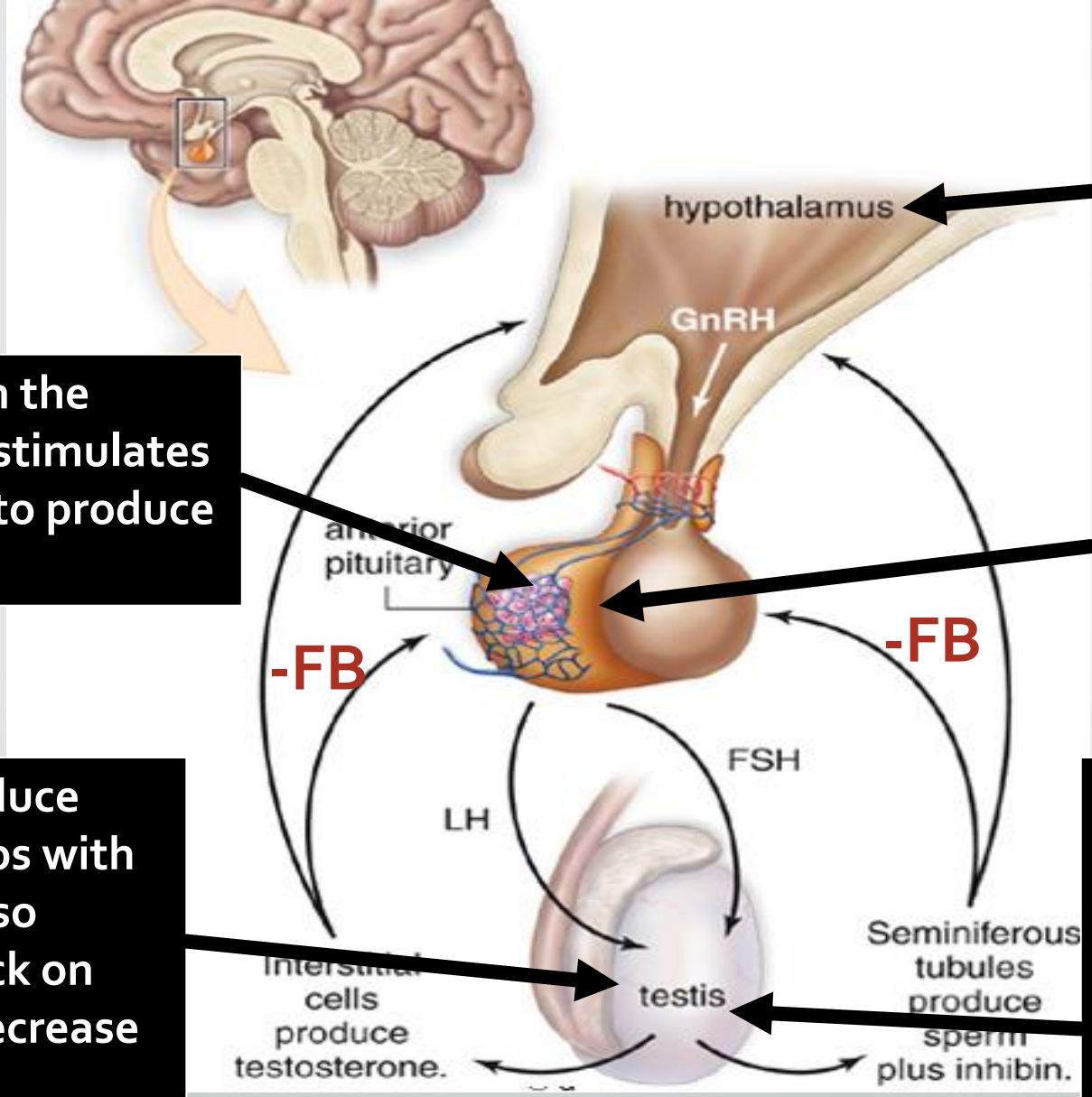
TESTES: Site of Spermatogenesis inside the seminiferous tubules & Testosterone production in the interstitial cells

Structure	Function
1. Testes •Seminiferous Tubules •Interstitial Cells	Site of Spermatogenesis inside the seminiferous tubules & Testosterone production in the interstitial cells
2. Epididymis	Sperm finish maturing and become motile here.
3. Vas Deferens	Sperm travel here from epididymis and during ejaculation
4. Ejaculatory Duct	During ejaculation, the ejaculatory duct contracts and propels sperm along with secretions from the 3 accessory organs into the Urethra. This is now called semen.
Seminal Vesicle	Adds fructose secretions so mitochondria can produce ATP for flagellum to move sperm. Also provided prostaglandins to help uterus contract so sperm and travel up the female tract
Prostate Gland	Secreted an alkaline fluid to protect sperm from acidity in urethra and vagina.
Bulborethral Gland	Adds mucus for lubrication during intercourse
5. Urethra	When penis is erect and during orgasm, the penis contracts to propel semen out of the penis and into the female . It is also a passage for urine during urination. The external sphincter under the bladder is contracted during ejaculation.

Sperm

- Head = contains the 23 chromosomes which will provide the genetic information to create a new human
- Acrosome = covers the head and contains powerful enzymes that can dissolve through the egg shell to penetrate
- Middle Piece = contains mitochondria that breaks down fructose in semen to produce ATP for flagellum movement
- Tail = a flagellum that helps the sperm to move towards the egg





1. Hypothalamus secretes GnRH which stimulates the anterior pituitary

2a. LH is secreted from the anterior pituitary and stimulates the interstitial glands to produce testosterone

2b. FSH is secreted from the anterior pituitary and stimulates the seminiferous tubules for spermatogenesis

3a. Interstitial cells produce testosterone which helps with sperm production. It also exerts negative feedback on the hypothalamus to decrease LH

3b. Sertolli cells in the tubules takes up testosterone which helps nourish the sperm during spermatogenesis. At the same time, inhibin is secreted which exerts negative feedback on the hypothalamus to decrease FSHa

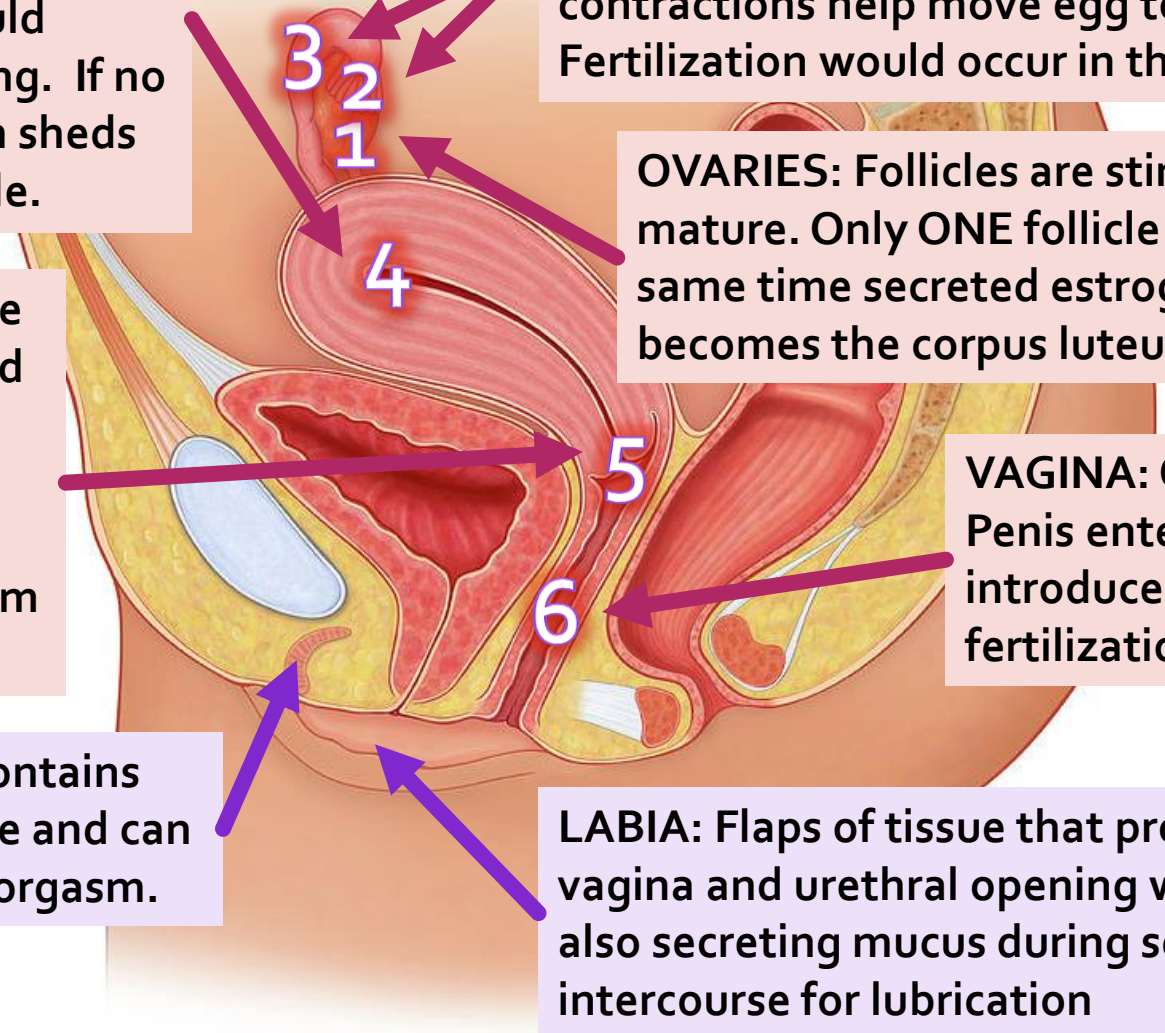
Effects of Testosterone During Puberty

- Causes initiation of sperm production = spermatogenesis
- Increased growth of the gonads (testes and penis)
- Increases hair grow (chest, axillary, pubic)
- Larger larynx for deeper voice
- Broader shoulders
- Greater muscle growth
- Lengthening of legs relative to torso
- Testosterone also contributes to aggressive behaviour

FEMALES

UTERUS: The lining of the uterus is called the endometrium ; which is made of vascular tissue. If egg is fertilized, then the embryo would attach to the endometrium lining. If no embryo, then the endometrium sheds at the end of the menstrual cycle.

FIMBRIAE: At ovulation when the egg is released, the Fimbriae sweep the egg into the oviducts. Cilia and smooth muscle contractions help move egg to the uterus. Fertilization would occur in the oviducts.



OVARIES: Follicles are stimulated by FSH to help the egg mature. Only ONE follicle and egg will mature; while at the same time secreted estrogen. After ovulation, the follicle becomes the corpus luteum which produces progesterone.

CERVIX: Opening to the uterus. Usually plugged with mucus to protect uterus from bacteria. Becomes watery at ovulation to allow sperm to enter.

VAGINA: Organ of sexual intercourse. Penis enters and ejaculate can introduce sperm into female tract so fertilization can occur.

CLITORIS: Contains erectile tissue and can facilitate an orgasm.

LABIA: Flaps of tissue that protect vagina and urethral opening while also secreting mucus during sexual intercourse for lubrication

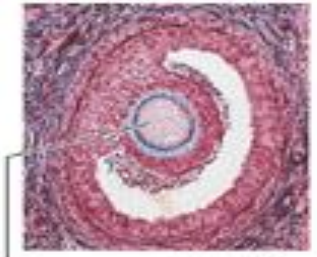
Structure	Function
1. Ovaries	Follicles are stimulated by FSH to help the egg mature. Only ONE follicle and egg will mature; while at the same time secreted estrogen. After ovulation, the follicle becomes the corpus luteum which produces progesterone.
2. Oviducts (Fallopian Tubes)	At ovulation when the egg is released, the Fimbriae sweep the egg into the oviducts. Cilia and smooth muscle contractions help move egg to the uterus. Fertilization would occur in the oviducts.
3. Uterus	The lining of the uterus is called the endometrium ; which is made of vascular tissue. If egg is fertilized, then the embryo would attach to the endometrium lining. If no embryo, then the endometrium sheds at the end of the menstrual cycle.
4. Cervix	Opening to the uterus. Usually plugged with mucus to protect uterus from bacteria. Becomes watery at ovulation to allow sperm to enter.
5. Vagina	Organ of sexual intercourse. Penis enters and ejaculate can introduce sperm into female tract so fertilization can occur.
Clitoris	Contains erectile tissue and can facilitate an orgasm.
Labia	Flaps of tissue that protect vagina and urethral opening while also secreting mucus during sexual intercourse for lubrication

Menstrual Cycle

- The 28 day menstrual cycle is divided into to parts:
  - The Ovarian Cycle – anterior pituitary hormones cause changes that occur in the ovary
  - The Uterine Cycle – ovarian hormones cause changes in the endometrium (uterine lining)

Ovarian Cycle

2. The secondary follicle contains a primary oocyte and produces the sex hormones estrogen and some progesterone.



3. Vesicular (Graafian) follicle develops.

secondary follicle

oocyte

vesicular (Graafian) follicle

primary follicles

1. A primary follicle contains an oocyte and begins producing the sex hormone estrogen.

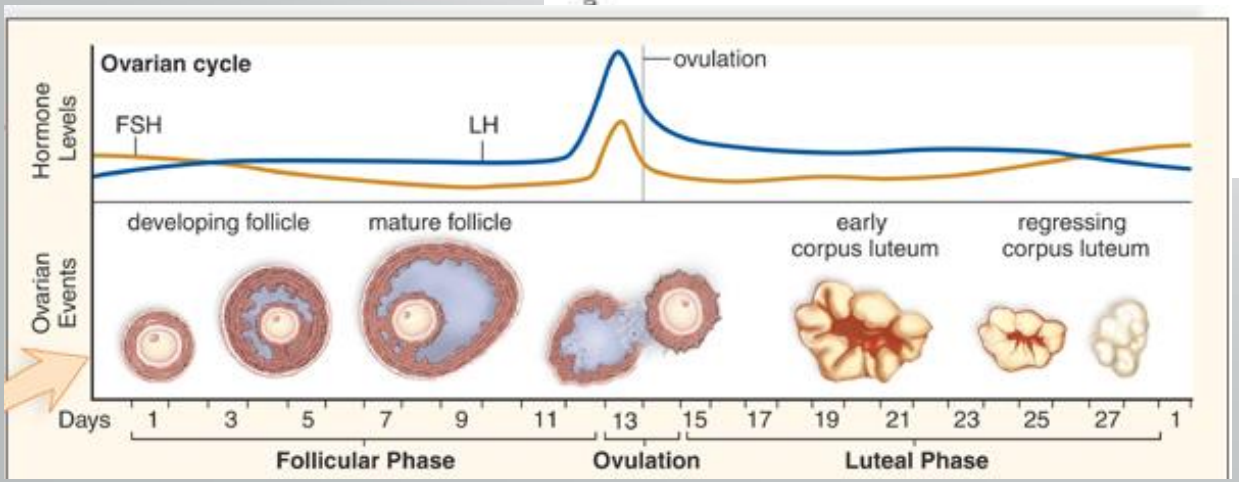
6. Corpus luteum degenerates.

corpus luteum

5. Corpus luteum produces the sex hormones progesterone and some estrogen.

secondary oocyte

4. Ovulation: The secondary oocyte is released.



Ovarian Cycle

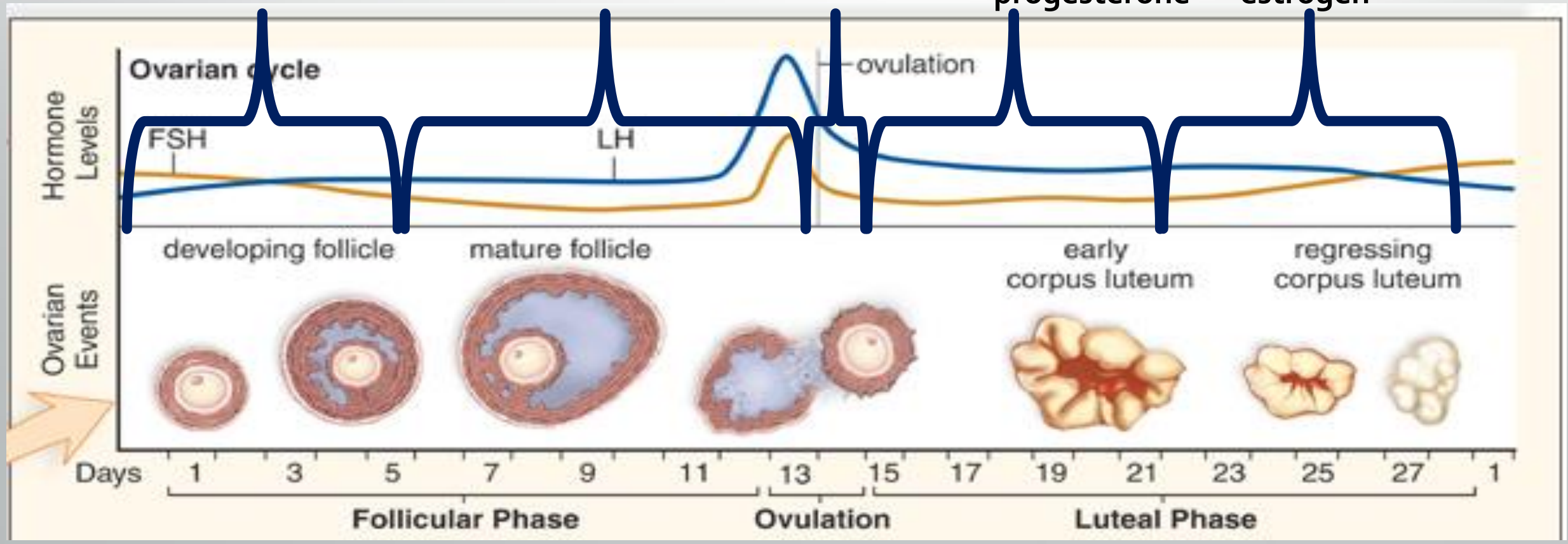
Day 1-5: FSH stimulates follicle development and oogenesis. Estrogen production increases

Day 6-13: FSH decreases due to negative feedback of estrogen

Day 14: estrogen exerts positive feedback causing the LH surge which triggers ovulation

Day 15-21: LH is higher and helps to maintain the corpus luteum in the ovary; this increases production of progesterone

Day 22-28: Due to negative feedback of progesterone, the LH levels decrease and the corpus luteum degenerates causing lower levels of progesterone and estrogen

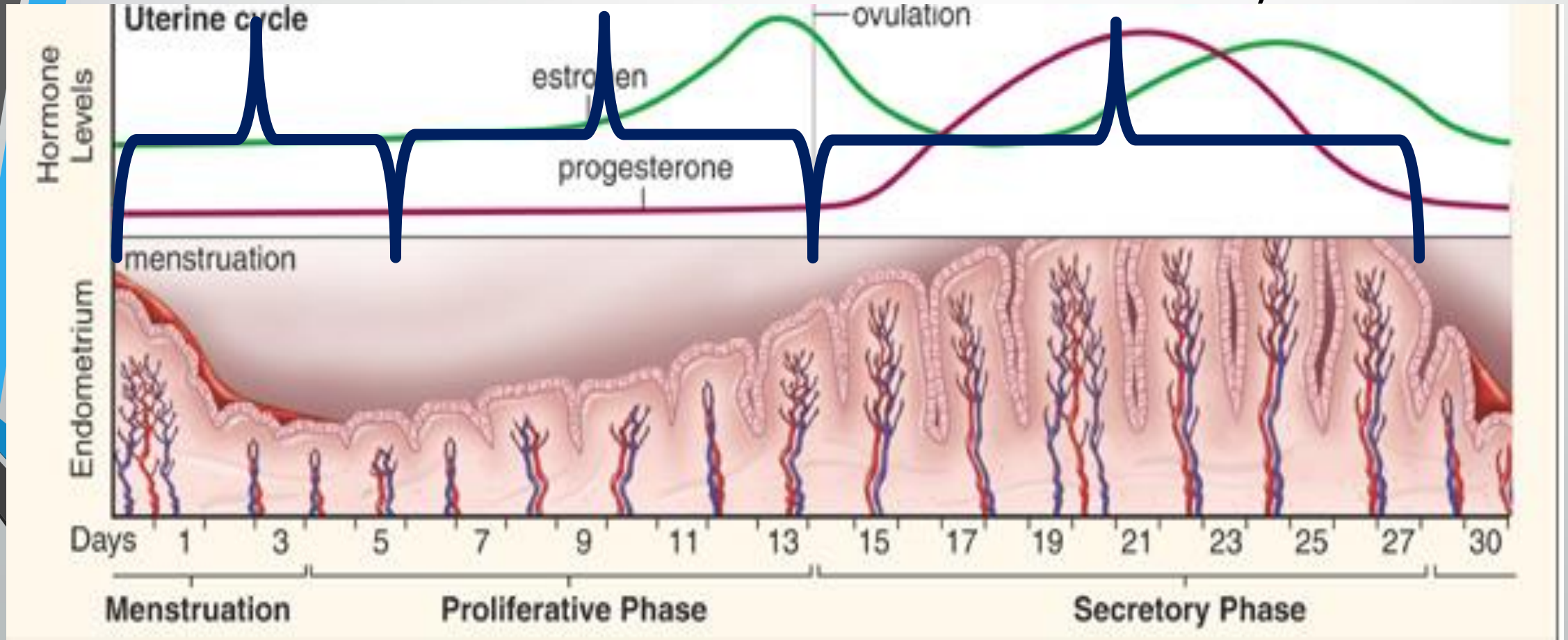


Uterine Cycle

Day 1-5: menstruation due to the low hormone levels from end of previous cycle

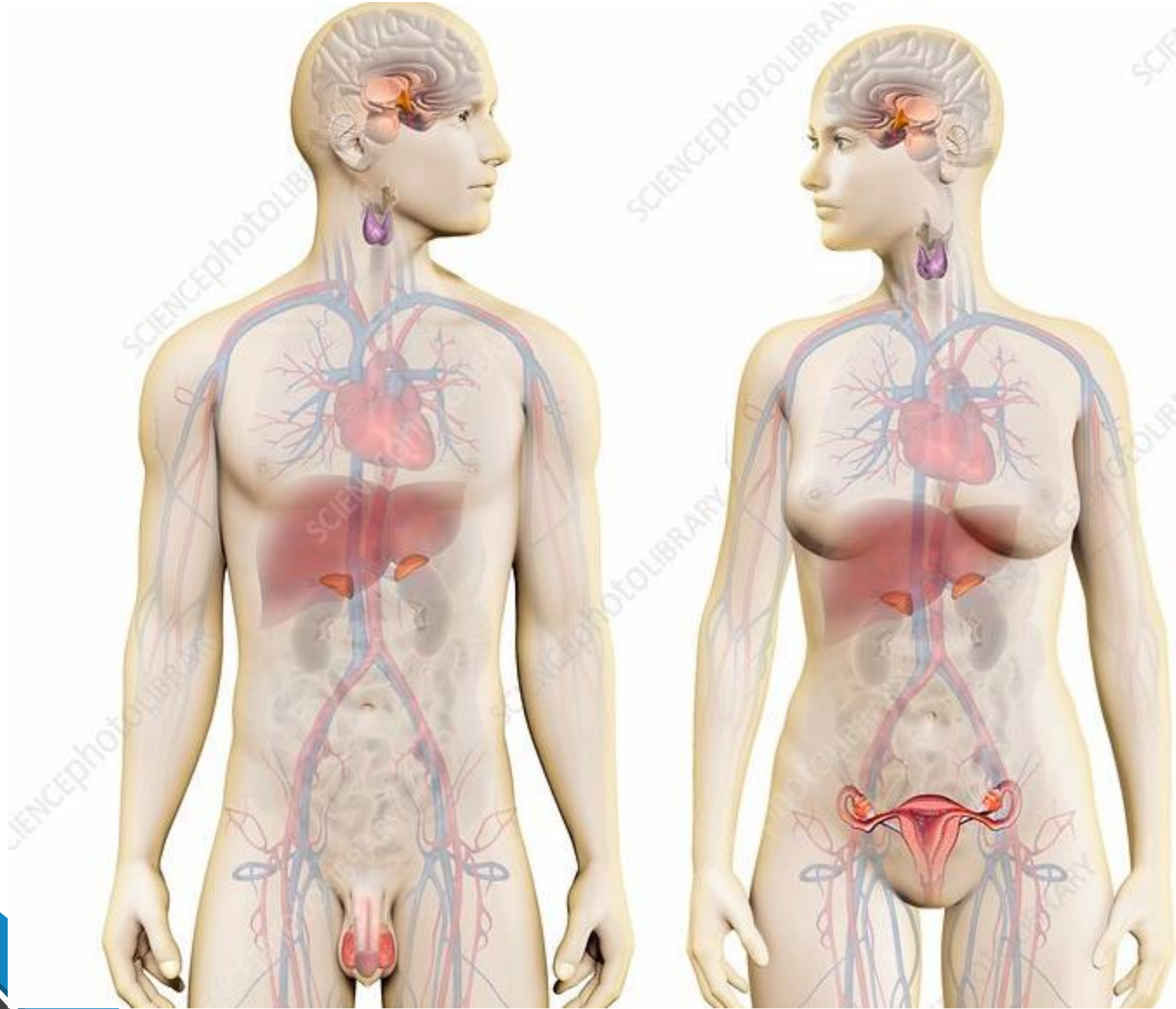
Day 6-14: as follicle grows there is an increase production of estrogen which causes the endometrium to become vascular and rebuild/grow

Day 14-28: the corpus luteum secretes progesterone causing the endometrium to double/triple in thickness and become secretory

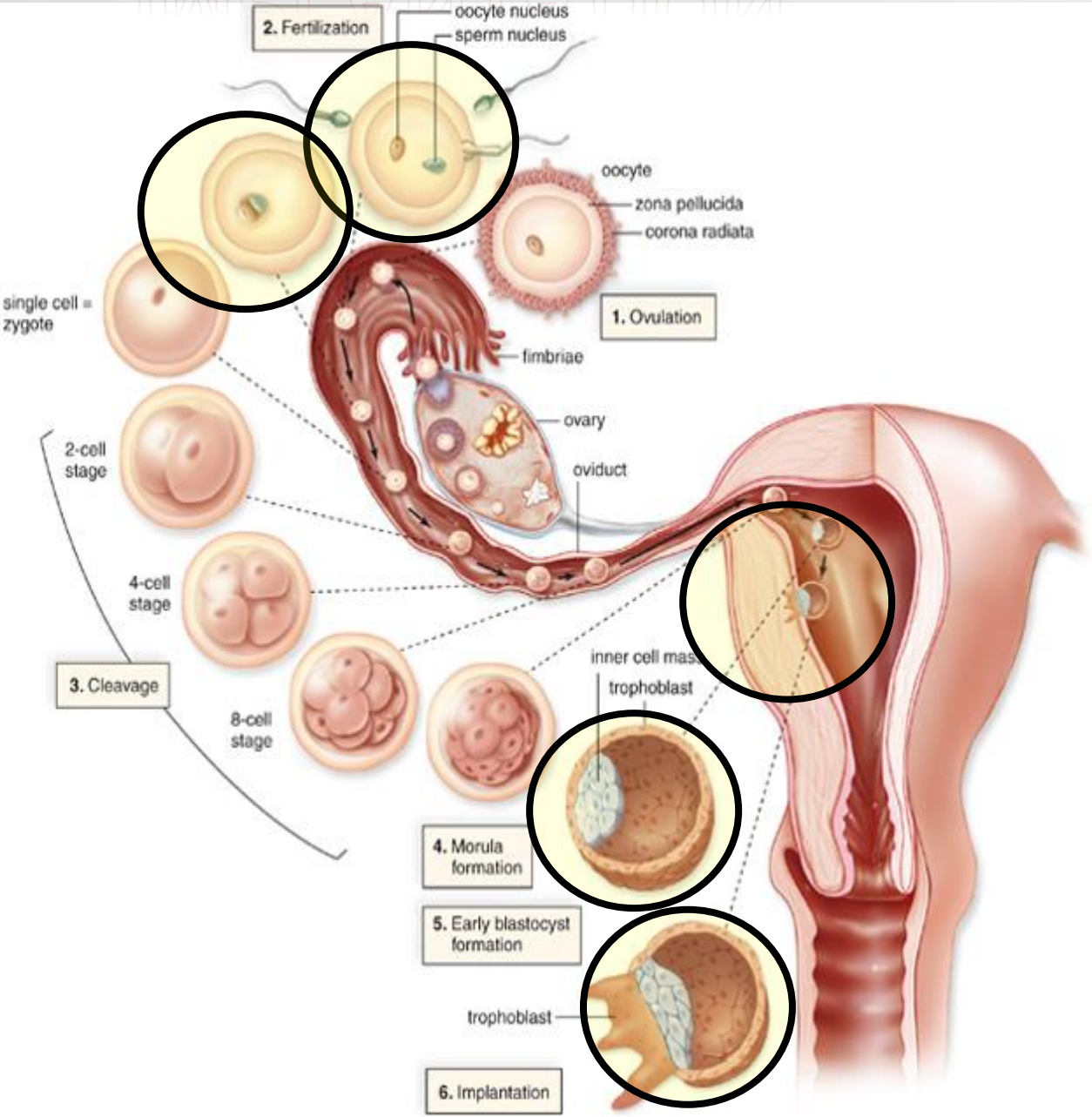


Effects of Estrogen During Puberty

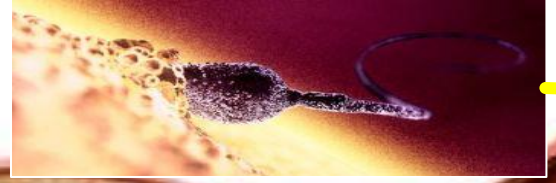
- Menstrual cycle beings promoting production of eggs (oocytes) = initiates oogenesis
- Promotes breast develop
- Increased hair axillary and pubic hair growth
- Promotes wider hips
- Increases fat deposition on body



IMPLANTATION



- After ovulation, the egg only survives for 12-24 hours or it will disintegrate and be removed along the endometrium during menstruation.
- If it is fertilized inside the oviduct, then cell divisions begin as it continues to travel towards the uterus.
- When the embryo reaches the uterus it can implant in the endometrium = this is called IMPLANTATION
- It releases the hormone HCG which signals to the ovary to maintain the corpus luteum
- The corpus luteum continues secreting progesterone and estrogen which helps to keep the endometrium intact and prevents menstruation along with exerting negative feedback on the hypothalamus and anterior pituitary to keep FSH low so no new follicles will develop.
- When the placenta develops, it produces enough estrogen and progesterone to maintain the endometrium for the entire term of the pregnancy.
- After birthing, the placenta is removed and the hormone levels in the blood drop triggering Day 1 when menstruation starts.



Cilia in oviduct helps conduct egg or embryo to uterus

Fertilization of the egg occurs here

Implantation of the embryo in the endometrium

Embryo

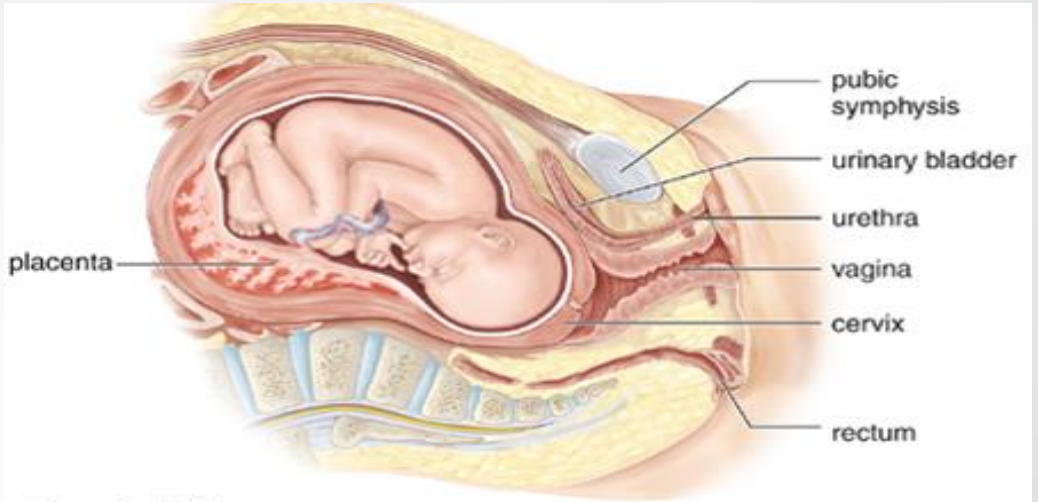
Birthing = positive feedback of oxytocin

- At the end of 9 months when the fetus has grown very large, it exerts a greater pressure on the cervix

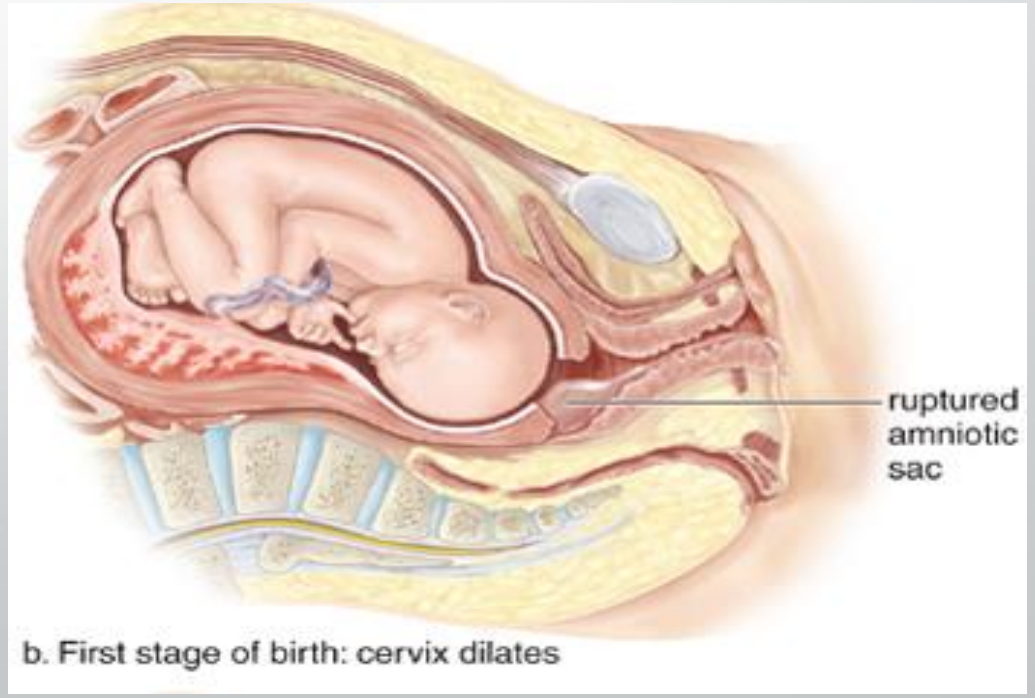
- This sends a signal in the form of action potentials to the hypothalamus

- The hypothalamus produces oxytocin which is secreted out of the posterior pituitary

- Oxytocin causes uterine contractions which squeeze the fetus and causes it to push more on the cervix as it dilates.



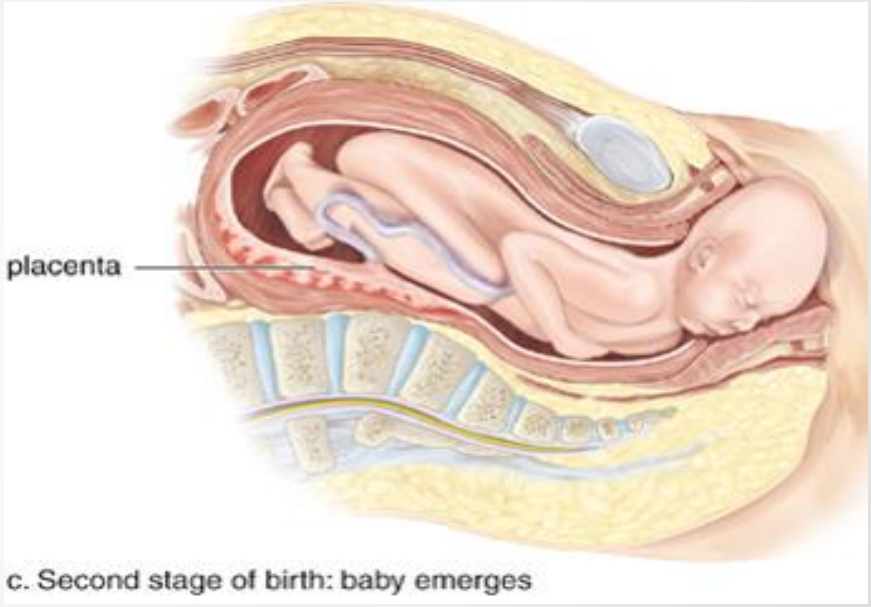
a. 9-month-old fetus



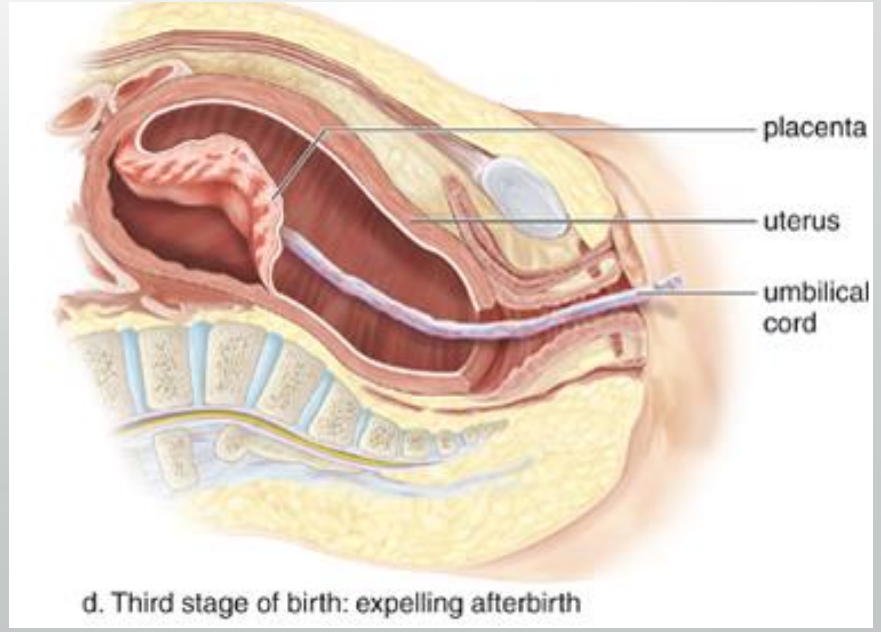
b. First stage of birth: cervix dilates

Birthing = positive feedback of oxytocin

- The increased pressure of the fetus' head on the cervix causes increased signals to the hypothalamus which increase the production and secretion of oxytocin.
- This is positive feedback
- The cycle continues until the baby and placenta is birthed removing the initial stimulus of pressure on the cervix.



c. Second stage of birth: baby emerges

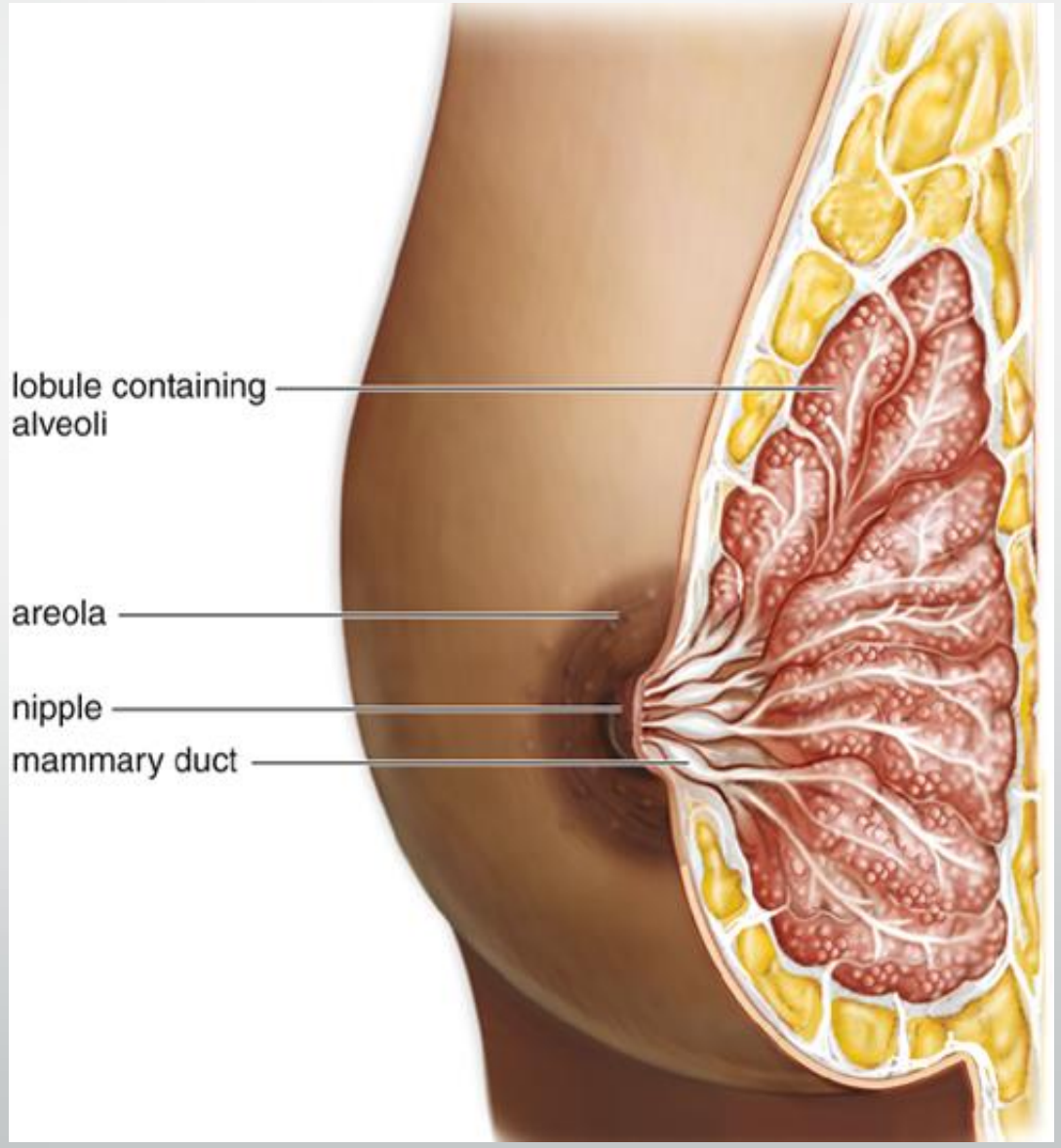


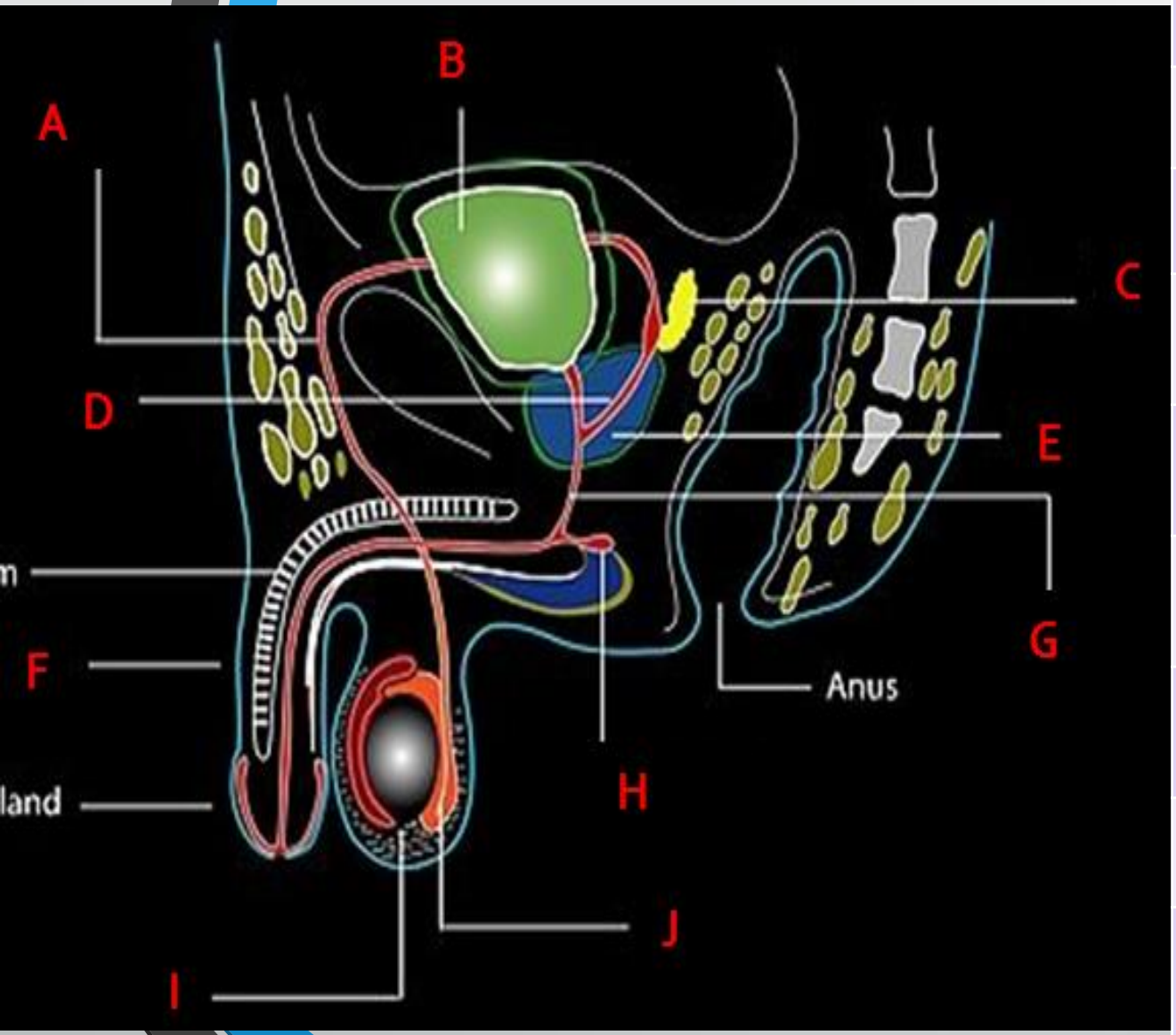
d. Third stage of birth: expelling afterbirth

Oxytocin and milk letdown

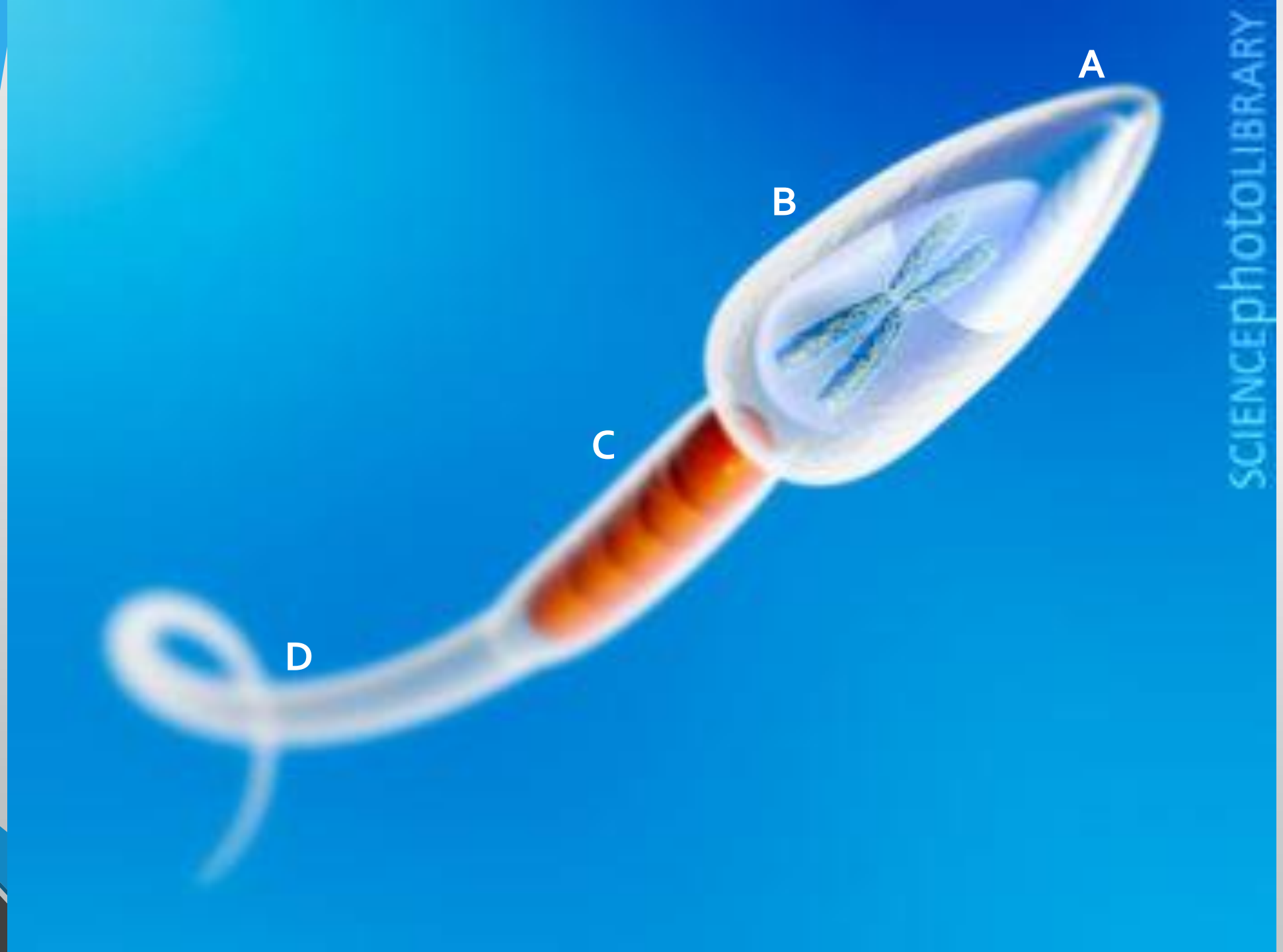
During breast feeding, the suckling of the nipple sends a signal to the hypothalamus to produce and secrete oxytocin which is secreted out of the posterior pituitary.

Oxytocin causes the milk to letdown from the mammary glands in the breast to feed the baby.





	Function
	Organ of sexual intercourse
	Stores urine
	Secretes Fructose into semen
	Provides and alkaline fluid and prostaglandins to semen
	Site of sperm maturation and gain ability to swim
	Site of spermatogenesis and testosterone production
	Secretes mucus for lubrication during intercourse and into semen
	Common passage for semen and urine
	Stores sperm and transports it during ejaculation
	Contractions help add secretions to make semen enter urethra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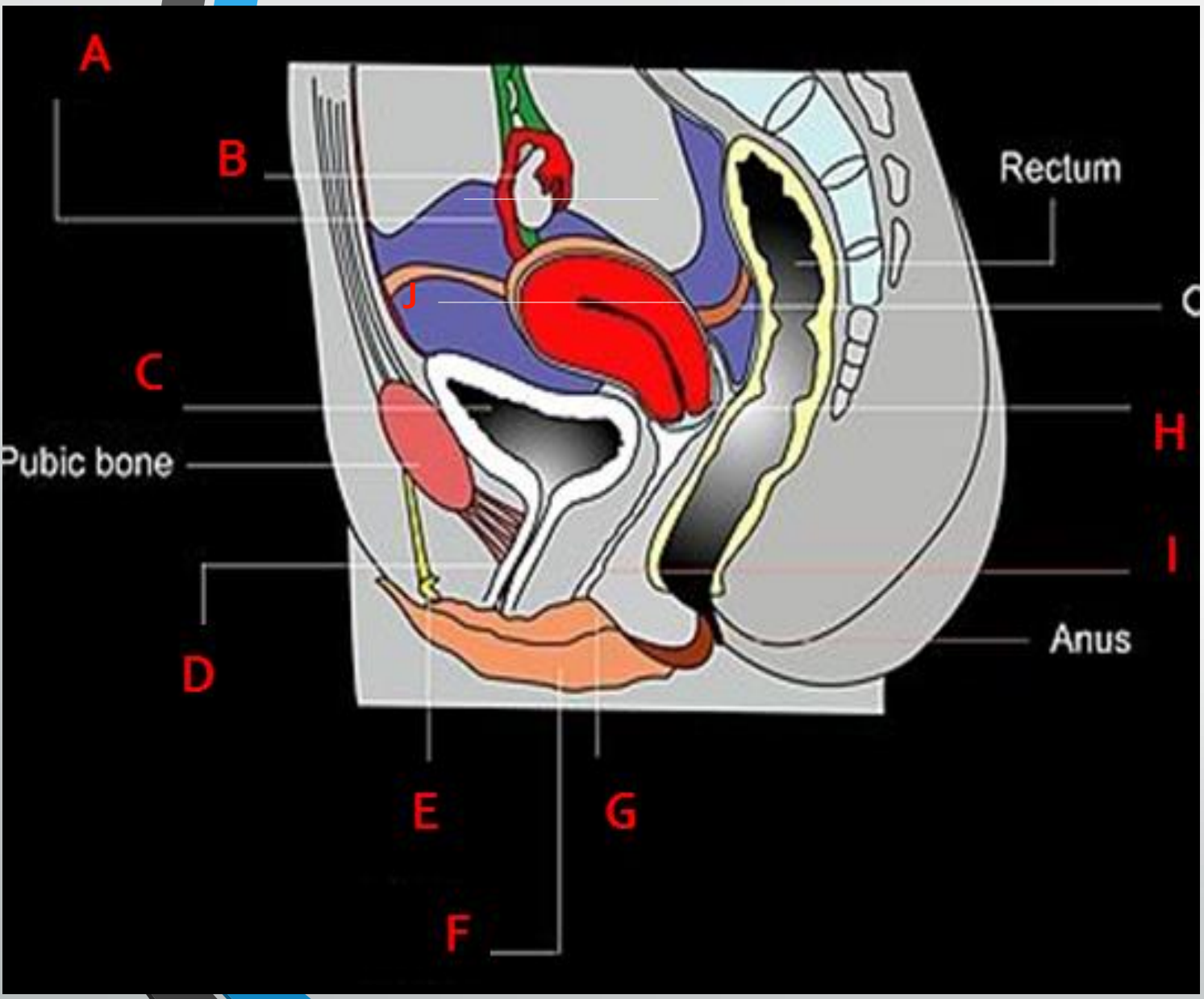
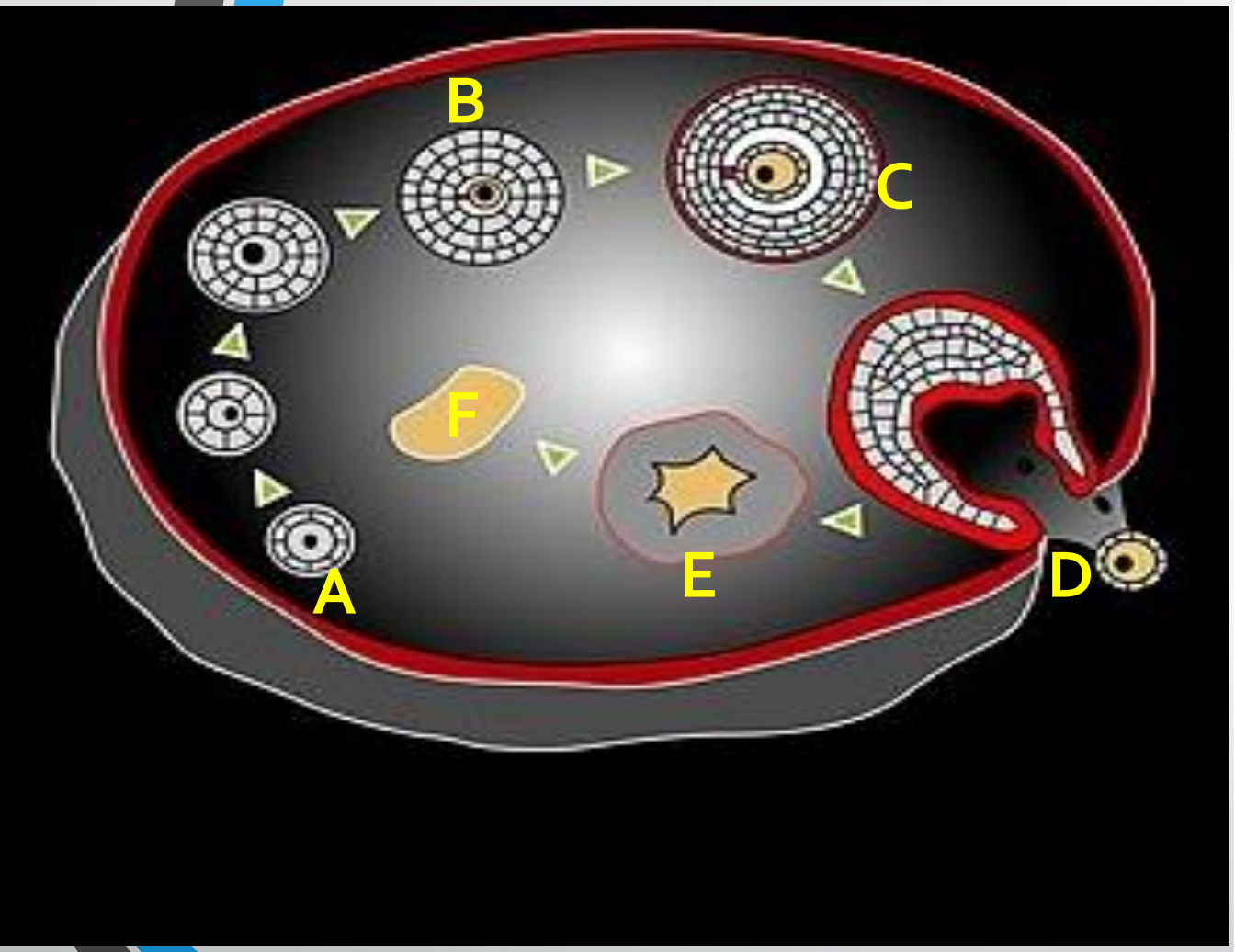
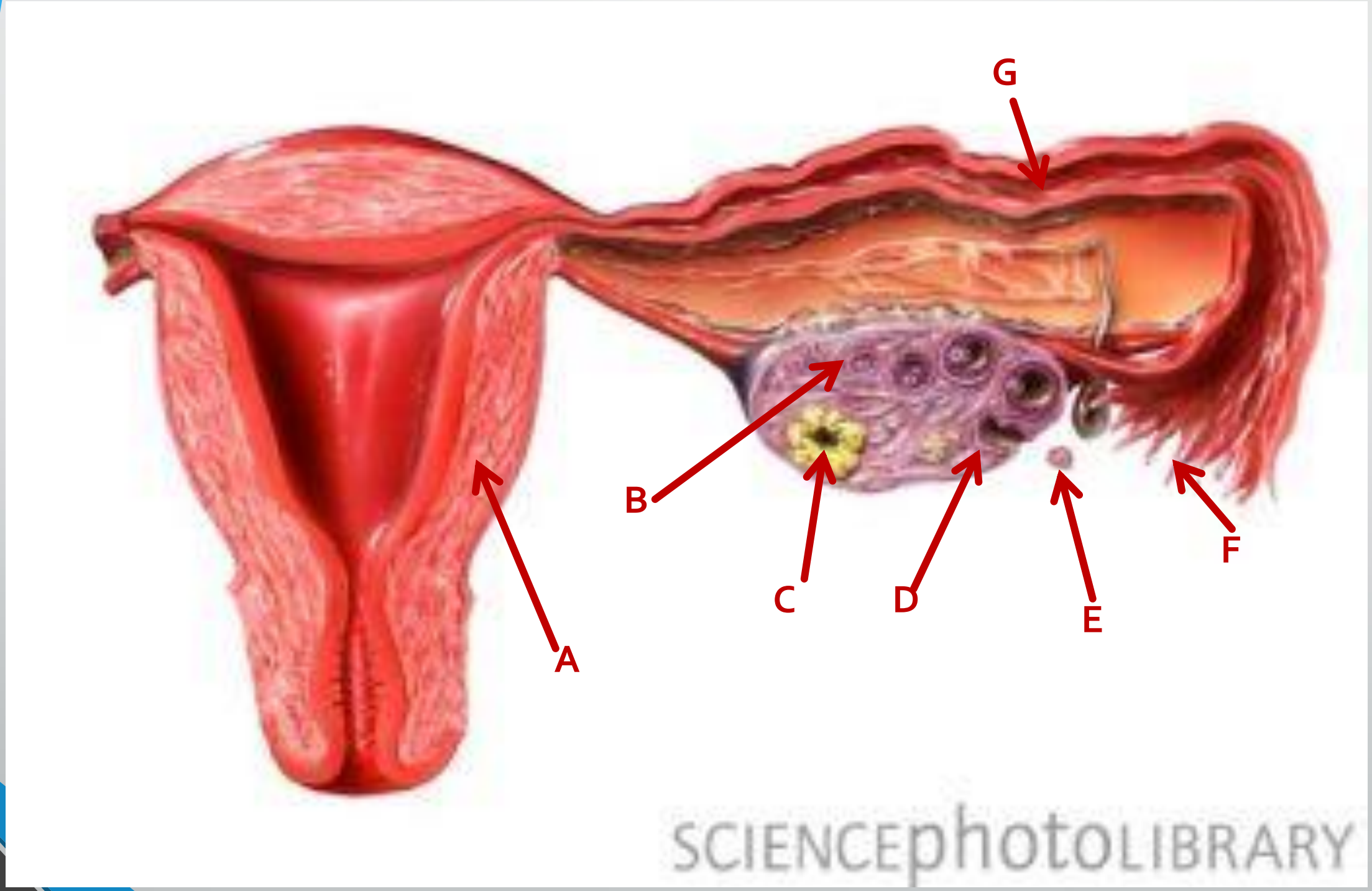


	Function
	Produces estrogen and progesterone along with oocyte
	Opening to uterus and normally plugged with mucus
	Stores urine
	Contains erectile tissue and plays and important role in female orgasm
	Organ of sexual intercourse
	Houses fetus
	Transports urine out of body



Function
Follicle
Oocyte
Estrogen
Ovulation
Corpus Luteum
Progesterone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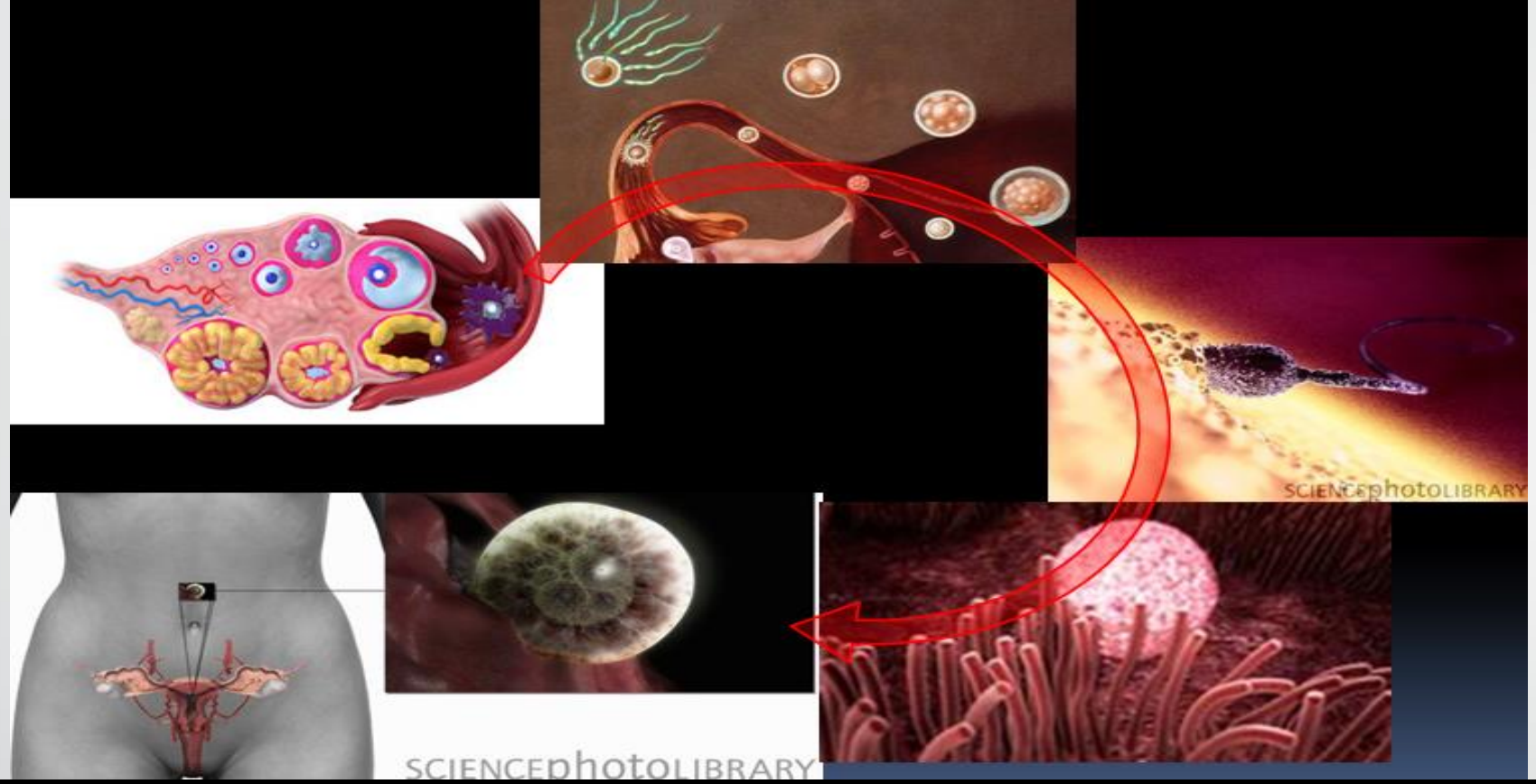
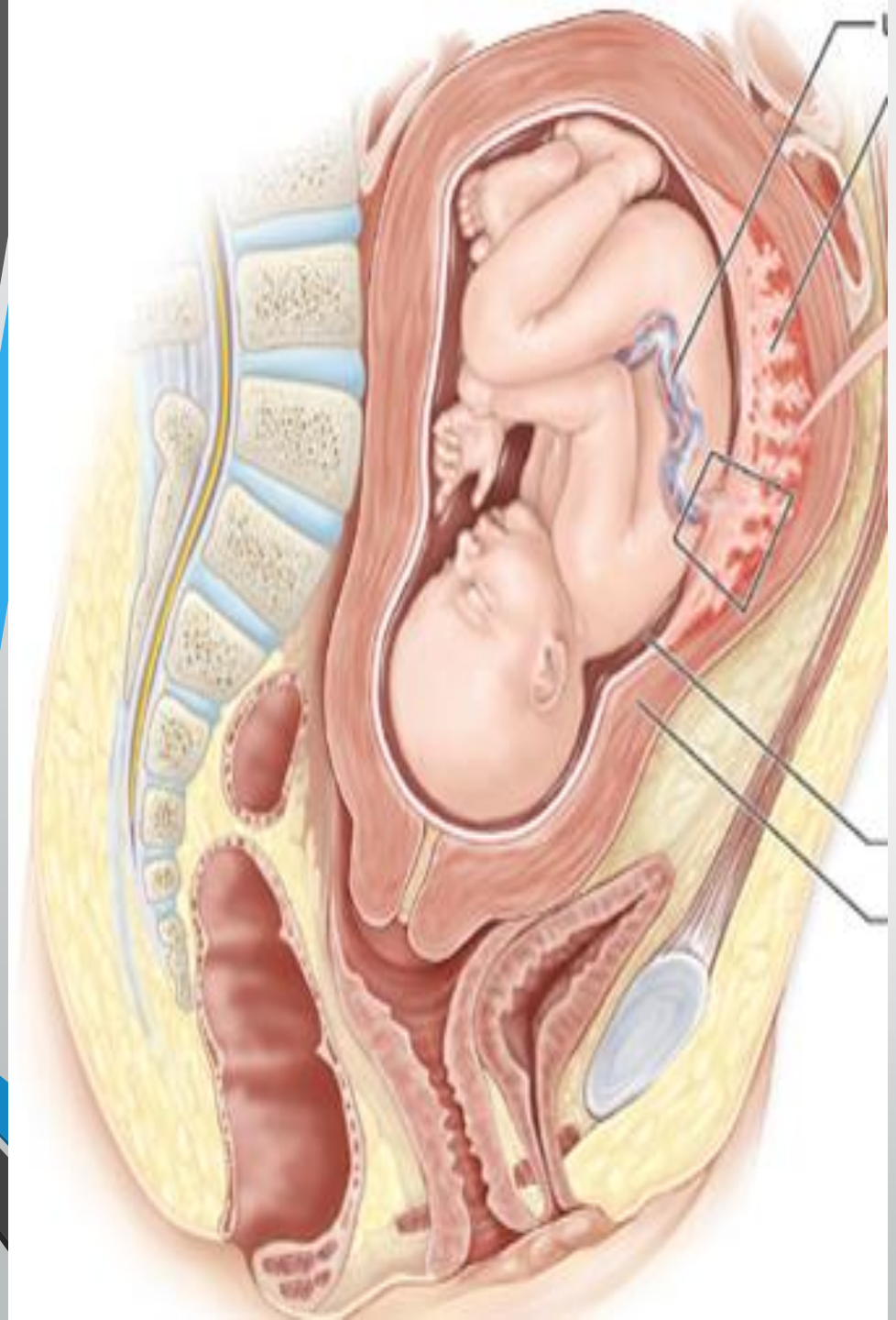


- Ovulation occurs at Day _____.
- _____ must occur within 12-24 hours after ovulation or the egg will disintegrate
- Fertilization occurs in the _____
- The embryo travel to the _____ by movement of _____ and muscle contractions
- The embryo implants in the _____ and secretes the hormone _____
- This hormone prevents the _____ _____ from degenerating so the hormone levels remain high.
- Levels of _____ and _____ remain high to keep endometrium intact and prevent _____



Process of Birthing

1	**Fetus' head exerts pressure on the _____**
2	**Impulse (_____) is sent to the _____**
3	**Oxytocin is produced and secreted out the _____ _____**
4	**_____ causes uterine contractions**
5	**Increases pressure of fetus on the _____**
6	**_____ produces increased _____ causing increased uterine contractions until fetus birthed**