ENDOCRINOLOGY

Posterior pituitary

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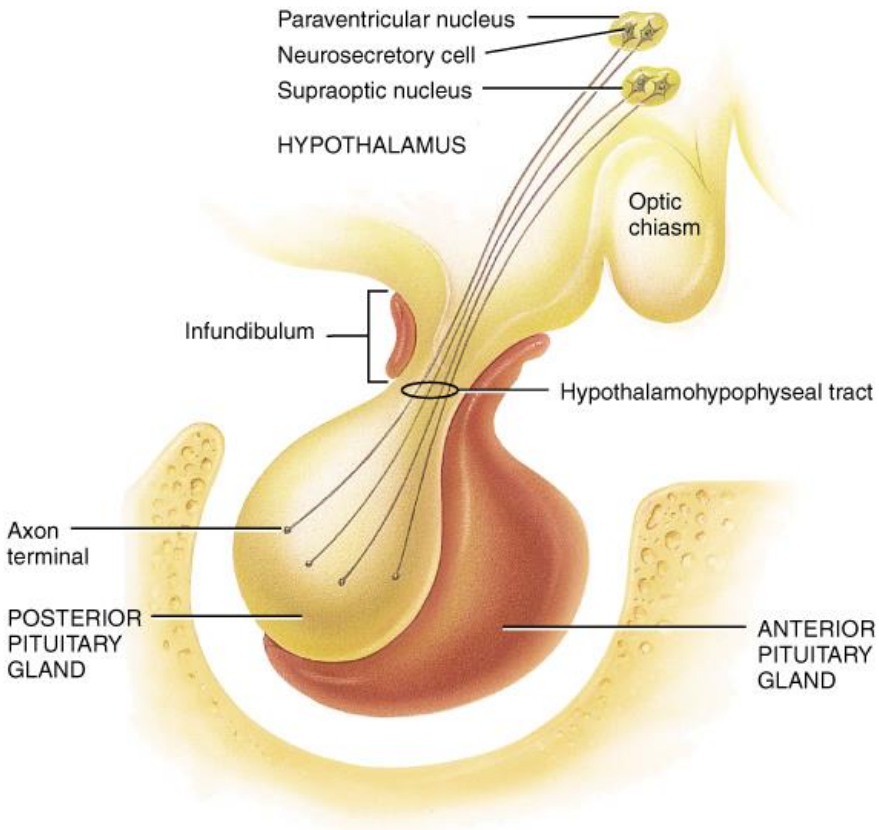
PHYSIOLOGY OF POSTERIOR PITUITARY GLAND

- Hypothalamic control
- Posterior pituitary hormones
  - ADH
    - Physiological functions
    - Control of secretion
      - Osmotic stimuli
      - Non-osmotic stimuli
  - Oxytocin
    - Physiological functions
    - Control of secretion

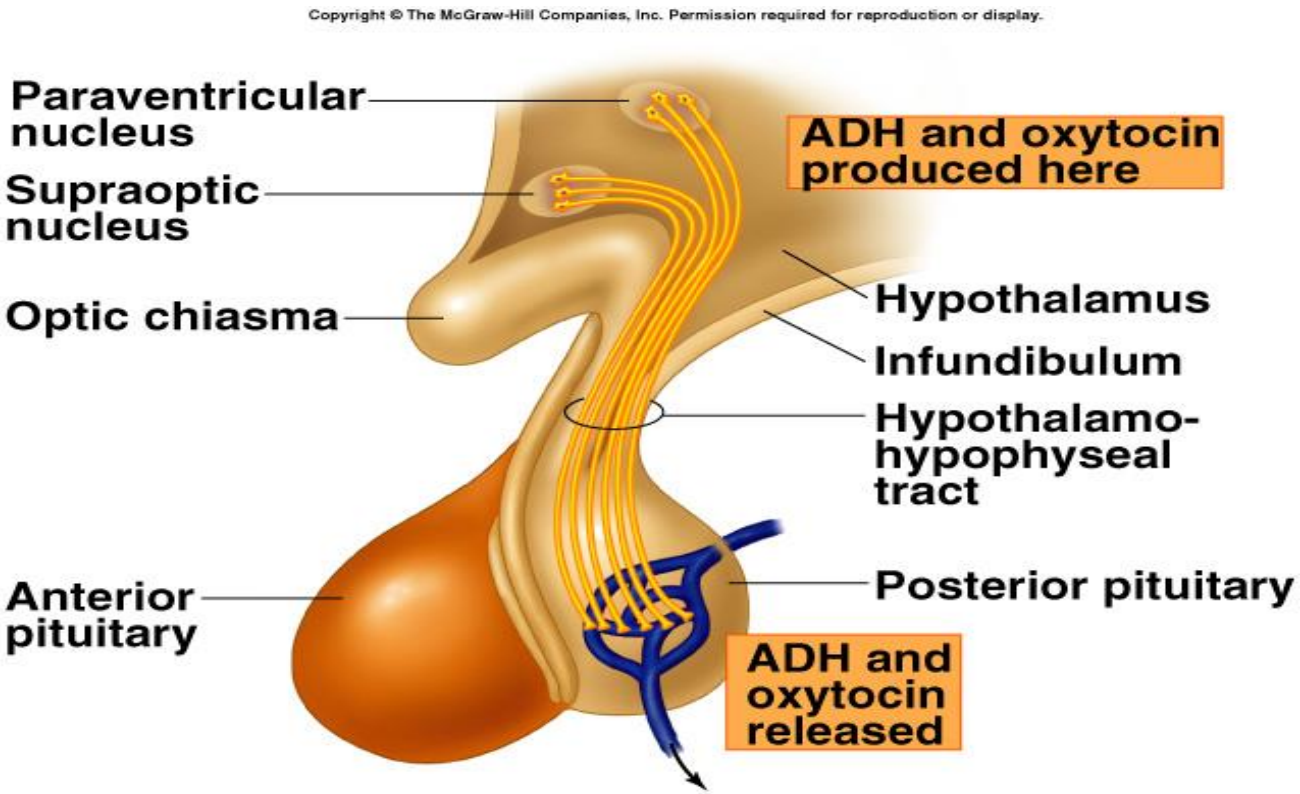
POSTERIOR PITUITARY GLAND



- Does not synthesize hormones
- Consists of axon terminals of hypothalamic neurons

HYPOTHALAMIC CONTROL OF PITUITARY SECRETIONS

- Secretions of the posterior pituitary are controlled by
  - Nervous signals from hypothalamus

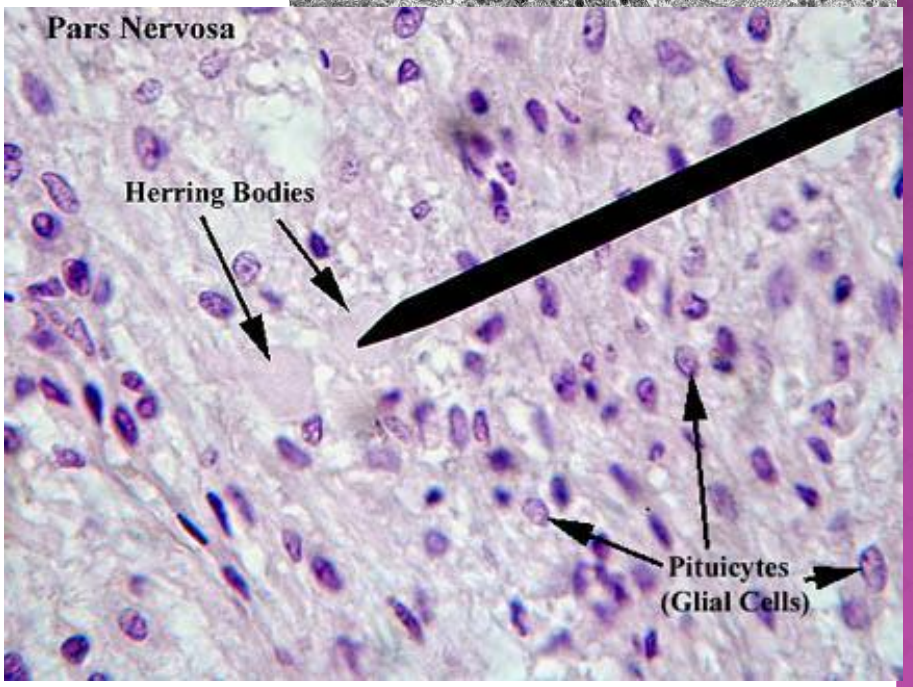


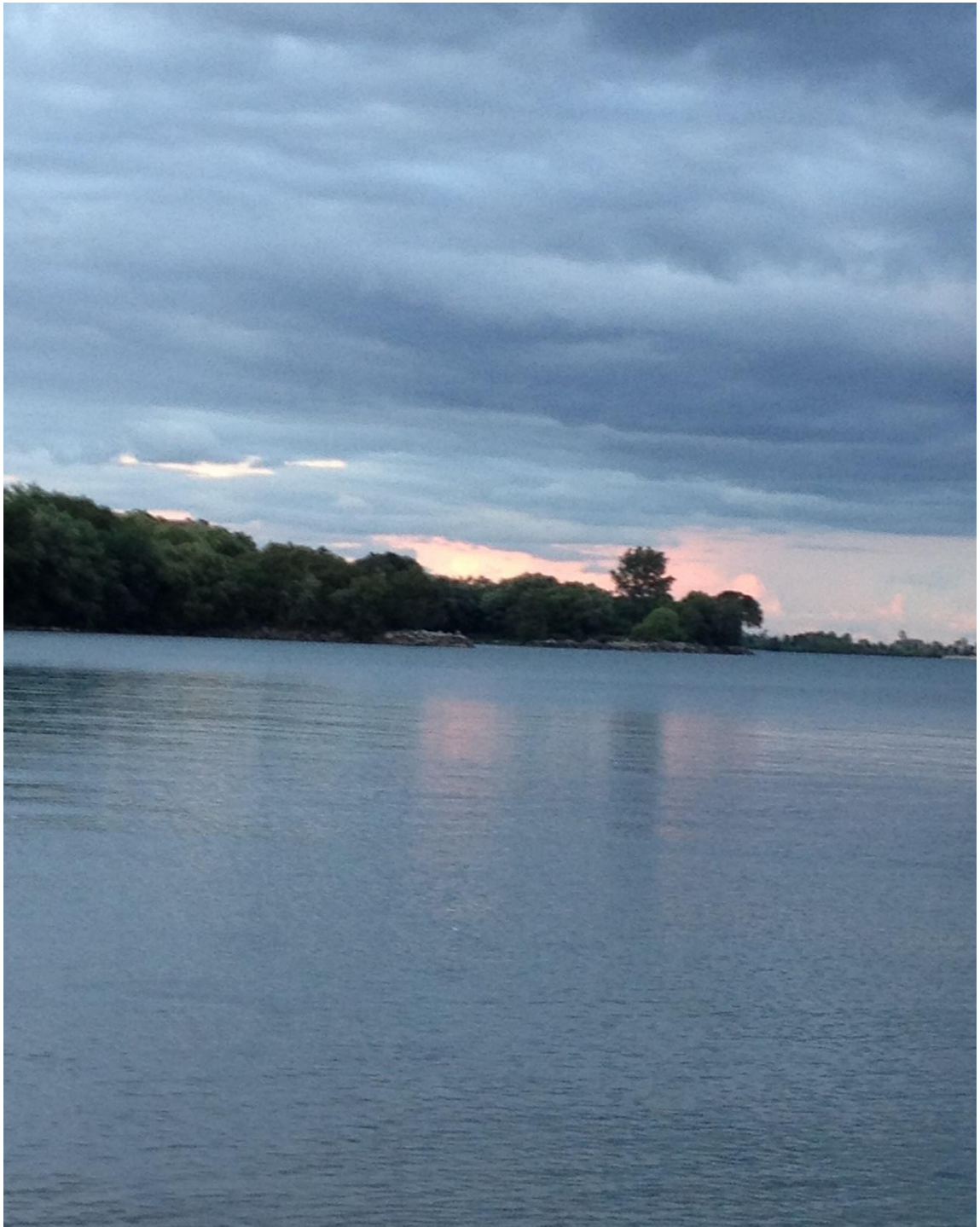
Herring Body

Pituicytes function

It forms physical and chemical barrier between nerve terminal and blood vessels

Amplify auto receptor negative feedback





ANTIDIURETIC HORMONE

(vasopressin)

SYNTHESIS OF ADH

- It is synthesized as pre-prohormone and processed into a nonapeptide (nine amino acids).
- ADH synthesized in the cell bodies of hypothalamic neurons(supraoptic nucleus)
- ADH is stored in the neurohypophysis (posterior pituitary)

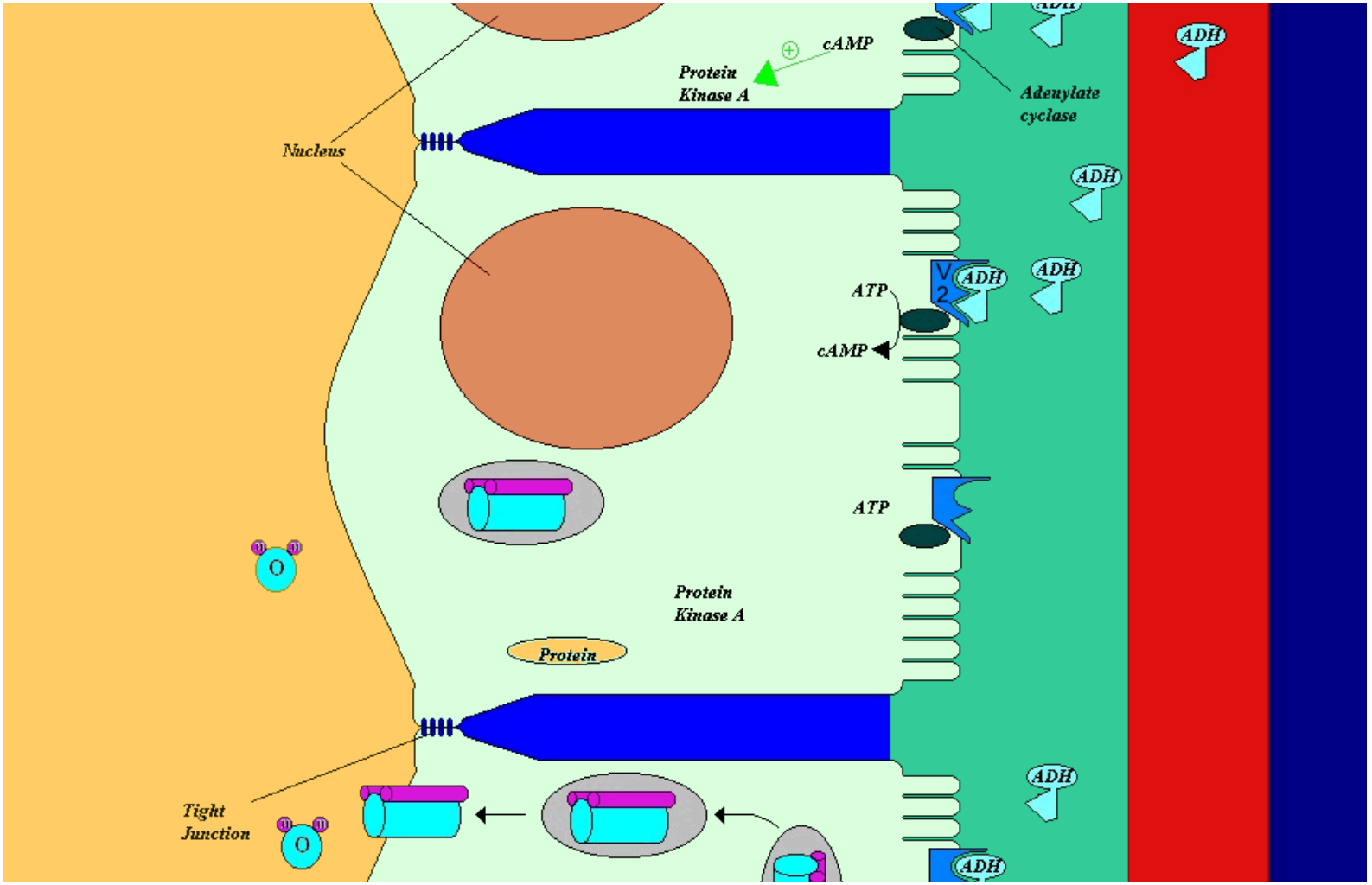
RECEPTORS OF ADH (VASOPRESSIN)

- There are 3 types of receptors for ADH:
  - V_{1A}
  - V_{1B}
  - V_2
- V_{1A} receptors mediate vasoconstriction
- V_{1A} receptors also found in the liver glycogenolysis
- V_{1B} receptors are unique to anterior pituitary and mediate increased ACTH secretion
- V_2 receptors are located in the principle cells in distal convoluted tubule and collecting ducts in the kidneys

MECHANISM OF ACTION OF ADH: ANTIDIURESIS

- ADH binds to V_2 receptors on the peritubular(serosal) surface of cells (principle cells) of the distal convoluted tubules and medullary collecting ducts.
- Via adenylate cyclase/cAMP induces production and insertion of **aquaporin2** into the luminal membrane and enhances permeability of cell to water.
- Increased membrane permeability to water permits back diffusion of solute-free water, resulting in increased urine osmolality (concentrates urine).

MECHANISM OF ACTION OF ADH



THE SINGLE MOST IMPORTANT FUNCTION OF ADH IS TO CONSERVE BODY WATER BY REDUCING URINE OUTPUT

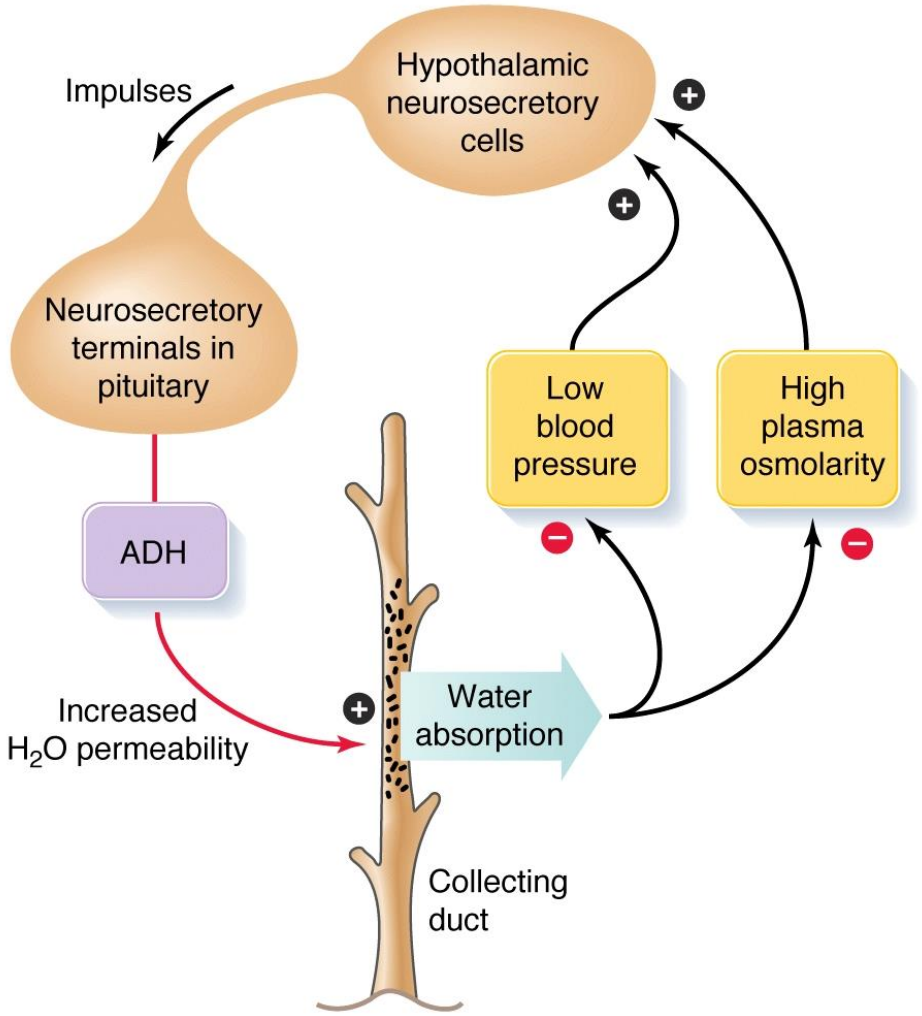
SECRETION OF ADH
OSMOTIC STIMULI

- If plasma osmolality is directly increased by administration of solutes, only those solutes that do not freely or rapidly penetrate cell membranes, such as sodium, cause ADH release.
- Conversely, substances that enter cells rapidly, such as urea, do not change osmotic equilibrium and thus do not stimulate ADH release.
- ADH secretion is very sensitive to changes in osmolality.
- Changes of 1-2% result in increased ADH secretion.

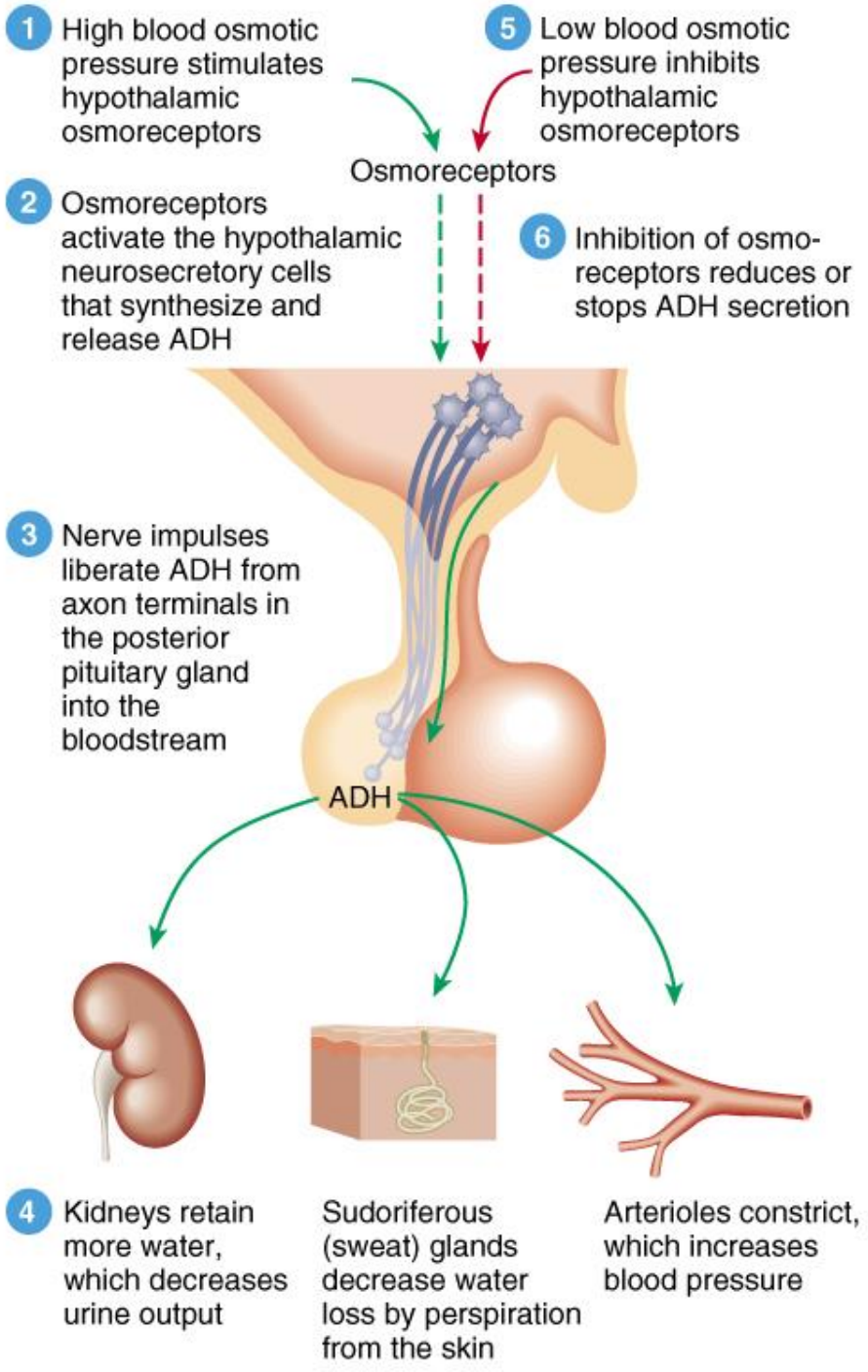
SECRETION OF ADH
NON-OSMOTIC STIMULI

- Hypovolemia is perceived by “pressure receptors” -- carotid and aortic baroreceptors, and stretch receptors in left atrium and pulmonary veins.
- Normally, pressure receptors tonically inhibit ADH release.
- Decrease in blood pressure induces ADH secretion by reducing input from pressure receptors.
- The reduced neural input to baroreceptors relieves the source of tonic inhibition on hypothalamic cells that secrete ADH.
- Sensitivity to baroreceptors is less than osmoreceptors- senses 5 to 10% change in volume

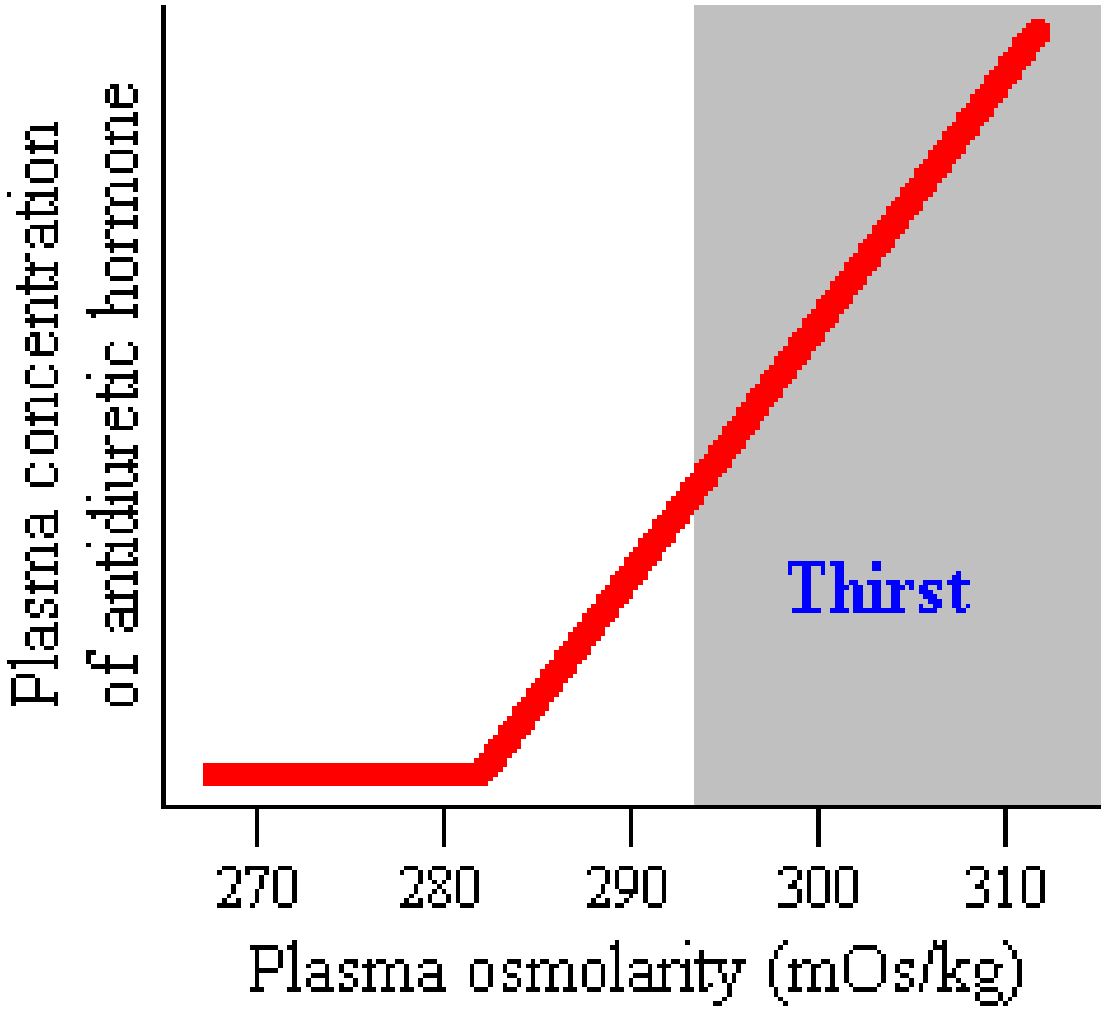
FUNCTION OF ADH (VASOPRESSIN)



REGULATION OF ADH



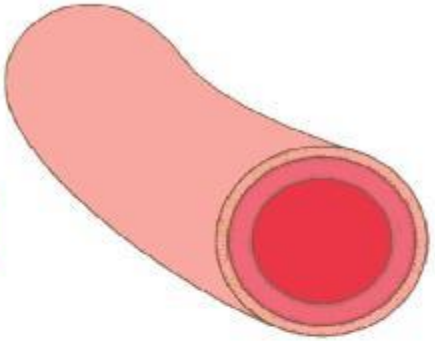
- Dehydration
  - ADH released
- Overhydration
  - ADH inhibited



Plasma Osmolarity stimulates both ADH release and thirst via OSMORECEOPTORS

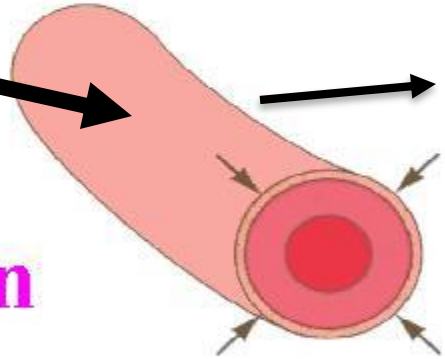
Effects on Blood Vessels

Normal



Angiotensin II

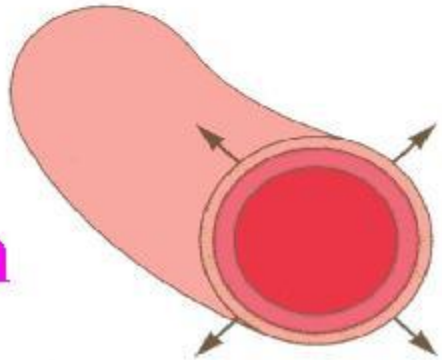
ADH



Increased Blood Pressure

Vasoconstriction

Vasodilitation



OTHER STIMULI THAT AFFECT ADH SECRETION

- Stimuli that increase ADH secretion:
  - Pain
  - Nausea
  - Surgical stress
  - Emotional stress
- Stimuli that decrease ADH secretion:
  - Alcohol intake

TABLE SUMMARIZES THE MAJOR CHARACTERISTICS OF OSMORECEPTORS AND BARORECEPTORS

Receptors	Osmoreceptors	Baroreceptors
Location	Anterolateral hypothalamus	Carotid sinus & aortic arch
Value Measured	Plasma osmolality	Circulating volume
ADH Release Stimulated By	Activation of receptor	Suppression of receptor
Change Required for Action	1% above 280 mosm/kg	10-15% decrease
Resulting Amount of ADH	Small	Large (vasoconstriction)
Override Other?	no	yes

CONTROL OF ADH RELEASE

- **Osmotic pressure**:
  - Osmoreceptor mediated
  - ↑osmolality → ↑ADH secretion
  - ↓osmolality → ↓ ADH secretion
- **Volume effects**
  - Baroreceptor mediated (vagus nerve)
  - ↑blood pressure → ↓ ADH secretion
  - ↓blood pressure → ↑ ADH secretion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OXYTOCIN

FUNCTION OF OXYTOCIN

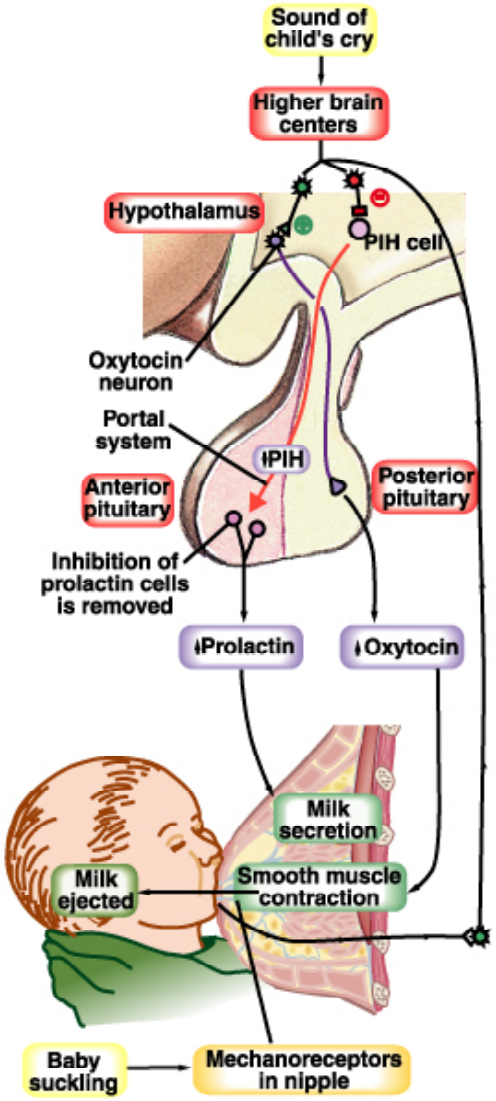
- **Breast-feeding**
  - contracts the myoepithelial cells of the alveoli

  (classic neuroendocrine reflex)

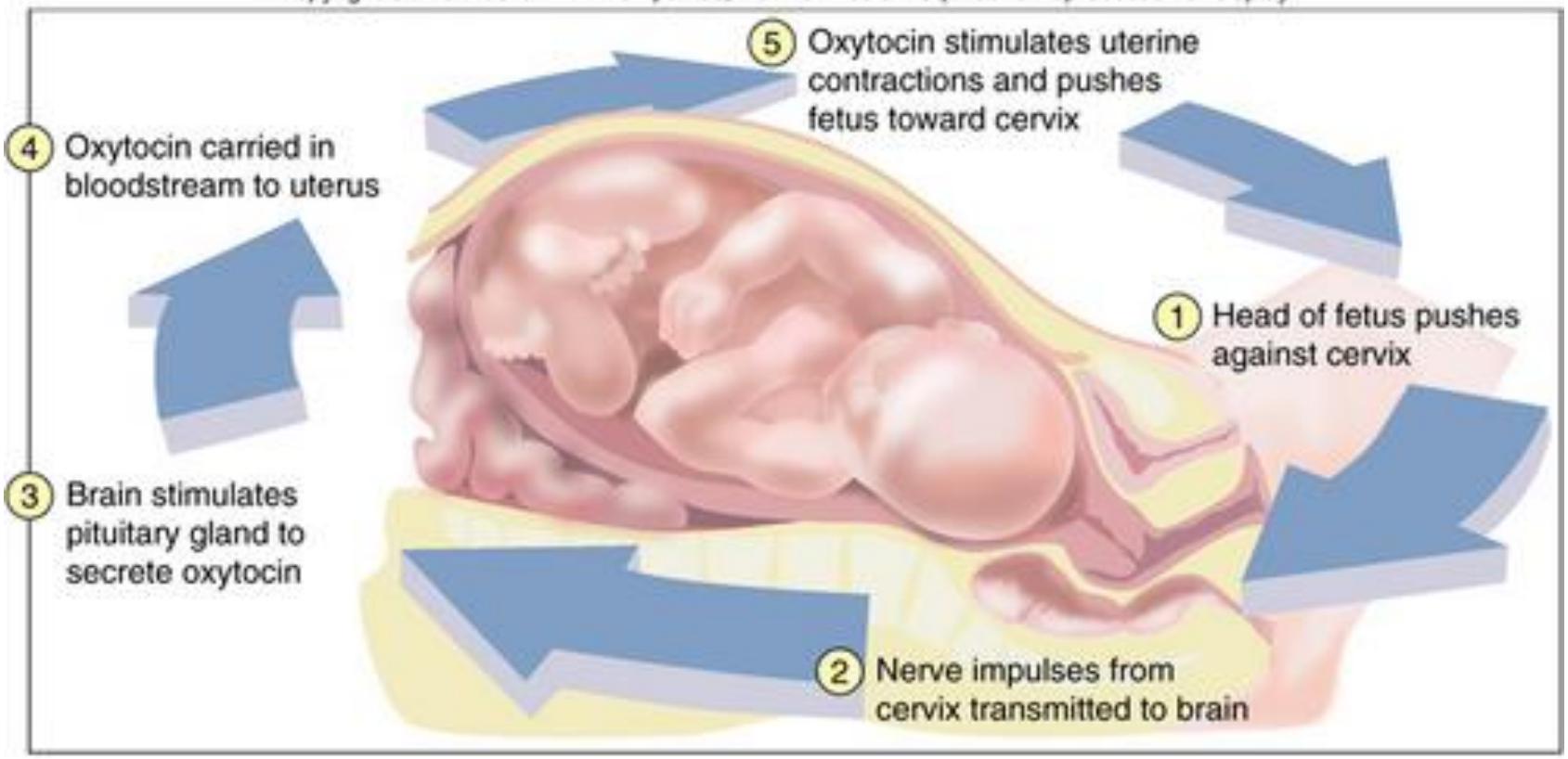
- **Childbirth** (parturition)
  - in late pregnancy, uterine smooth muscle (myometrium) becomes sensitive to oxytocin

    (positive feedback)

BREAST FEEDING



CHILDBIRTH




50 ml
Oxytocin
FERRING - LÉČIVA
Oxytocin

OTHER STIMULI THAT CONTROL RELEASE OF OXYTOCIN

- In humans, oxytocin is thought to be released during hugging, touching, and orgasm in both sexes.
- Release increased during stress
- Release inhibited by alcohol
- In males secretion increases at time of ejaculation (contraction of smooth muscle of vas deferens)

OXYTOCIN AND AUTISM

- Autistic group had significantly lower plasma oxytocin levels than in the non-autism group
- Elevated oxytocin was associated with higher scores on social and developmental measures for the non-autistic children
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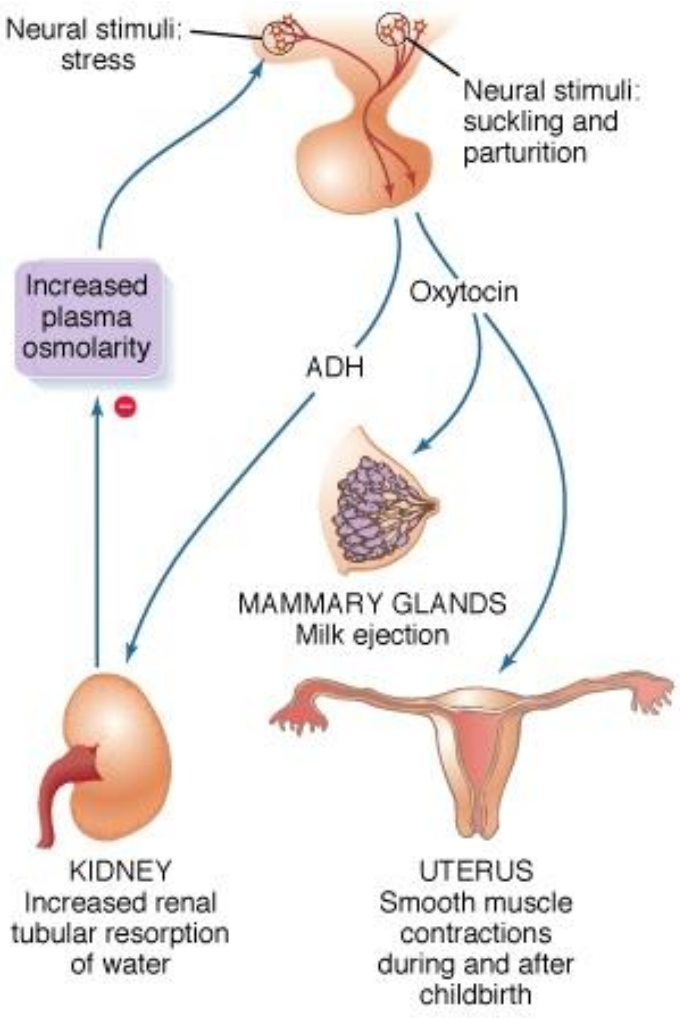
SUMMARY OF POSTERIOR PITUITARY HORMONES ACTIONS



CLINICAL APPLICATION

- What will happen if the pituitary stalk cut above the pituitary gland ?
  - Secretion of hormones stop totally.
  - Secretion of hormones will not be affected.
  - Secretion of hormones decreases then returne to normal level after few days.


الله أكبر