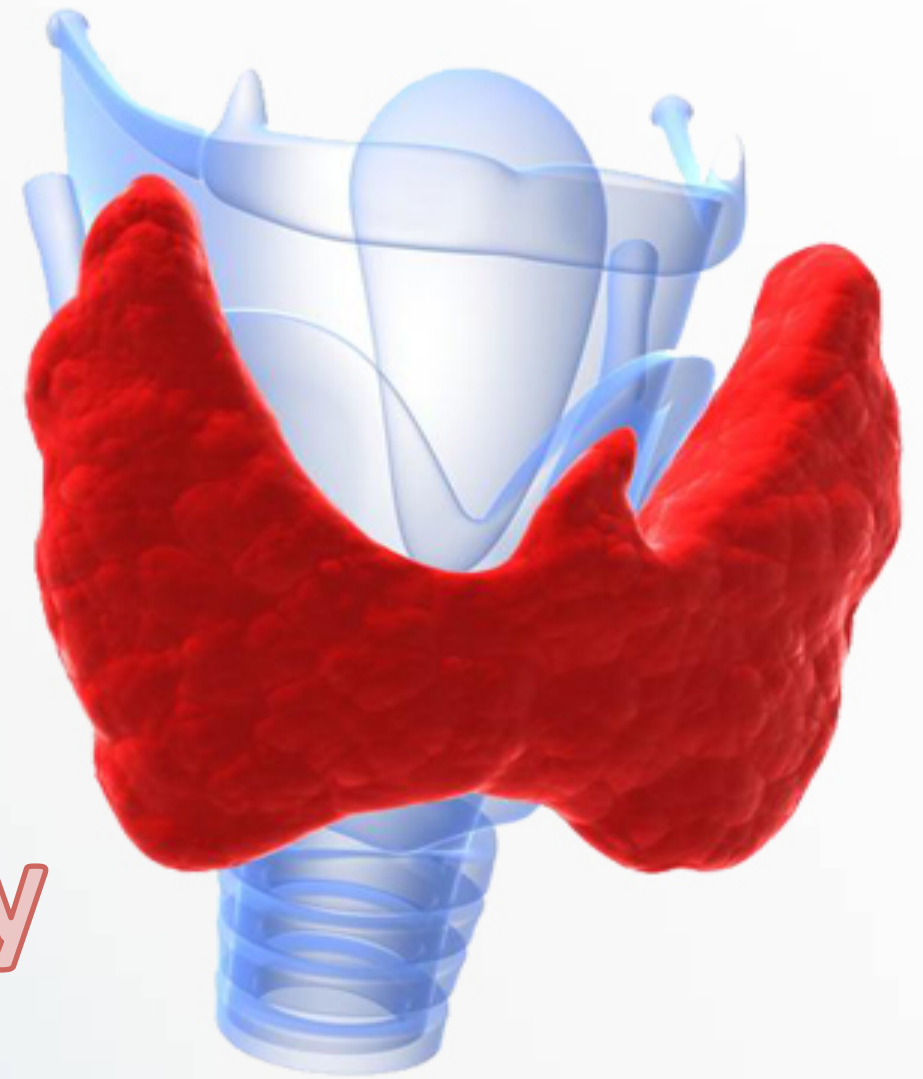




Physiology team

# 4 The posterior pituitary gland

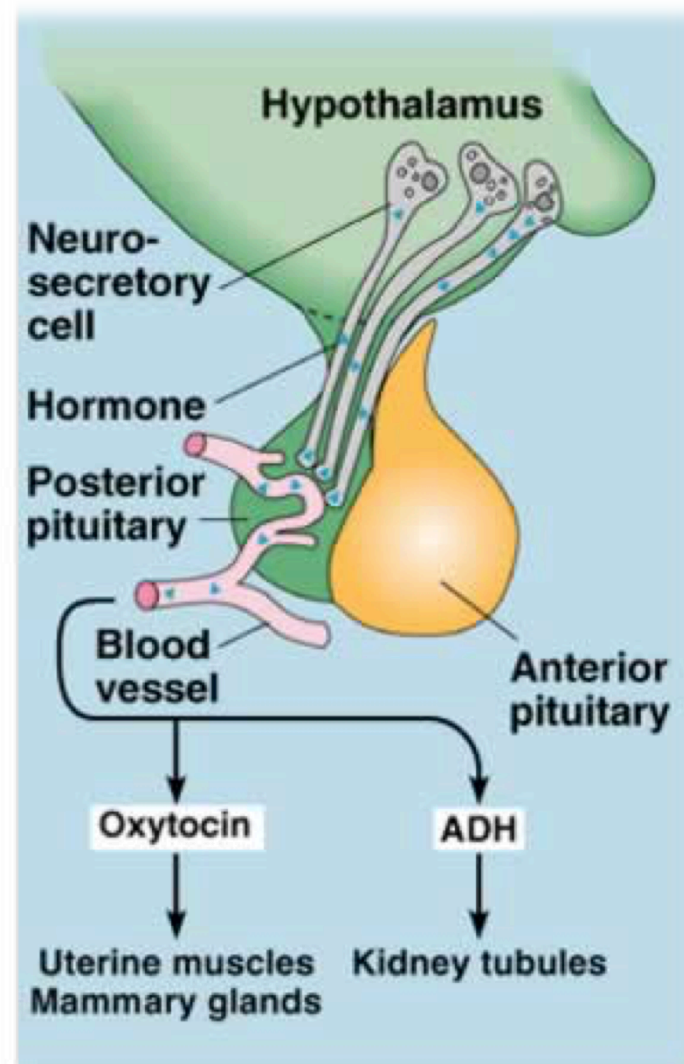


## Sources:

- ✓ Slides
- ✓ Guyton and hall
- ✓ Physiology Linda
- ✓ BRS physiology

# Mind Map

posterior  
pituitary gland



ADH

function

WATER  
retention

vasoconstriction

regulation

Releasing  
control

Oxytocin

function

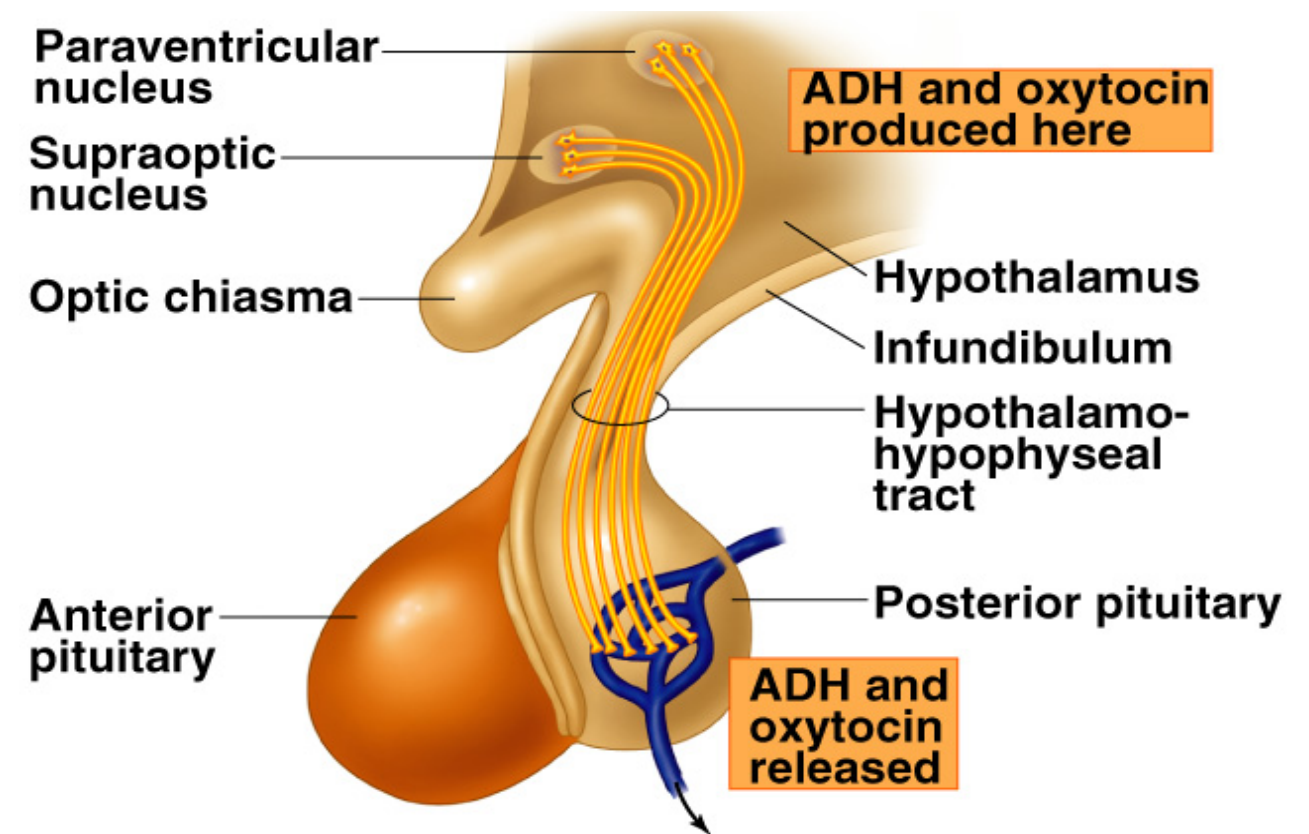
Breast-feeding

Childbirth

regulation

# posterior pituitary gland

- ✓ Composed mainly of cells called **Pituicytes**, which act as packing & supporting cells.
- ✓ Stores & releases hormones into the close capillaries. it is not synthesizing the hormones just storing it
- ✓ These hormones are **produced in hypothalamus**.
- ✓ Both hormones are polypeptides, each contains 9 amino acids.



## Secretion of Posterior Pituitary Hormones

⇐ Pituicytes act as a supporting structure for numbers of terminal nerve fibers and terminal nerve endings from **supraoptic** and **paraventricular** nuclei of the hypothalamus

↪ These nerve pass to the neurohypophysis through the pituitary stalk

↪ The synthesized hormones in the cell bodies are transported along the **hypothalamo-hypophyseal tract** in combination with "carrier" proteins called **neurophysins** down to the nerve endings in the posterior pituitary gland. (**stored**)

⇐ The nerve endings are bulbous knobs that contain many secretory granules where they secrete **Two posterior pituitary hormones (1)**:  
**A- Antidiuretic hormone (ADH), Or vasopressin**  
**B- Oxytocin**

↪ When nerve impulses are transmitted downward along the, the hormone is immediately released from the secretory granules in the nerve endings by exocytosis and is absorbed into adjacent capillaries.

(1)

- ✓ **Supraoptic nucleus** → **ADH** + 1/6 oxytocin
- ✓ **Paraventricular nucleus** → **Oxytocin** + 1/6 ADH



# A. Antidiuretic hormone (ADH)

## A) Main effect of ADH<sup>1.</sup>

1. In the kidneys<sup>2.</sup>

Increase **water reabsorption** (regulation of body fluid osmolarity) by acting on the principal cells of late distal tubule and collecting ducts → decrease osmotic pressure of the blood.

regulated by **V<sub>2</sub> receptors** through the action of cAMP (which via phosphorylation directs the bind of aquaporin 2 to the luminal membrane thus increase water reabsorption)

2. vascular smooth muscles

Contraction of vascular smooth muscles → **generalized vasoconstriction.**

This effect is regulated by **V<sub>1</sub> receptors**, through the action of IP<sub>3</sub>/Ca<sup>2+</sup>

## B) Control of ADH release

1.

Increase osmotic pressure of ECF (E.g. dehydration, Hypovolemia)



stimulate Osmoreceptors in the hypothalamus



1- Increase the secretion of ADH  
2- thirst



1- Acts on V<sub>2</sub> Receptors in the collecting ducts of the kidney  
2- ↑ Water intake



Dilution of ECF by Increase **water reabsorption**

1. [https://www.youtube.com/watch?v=Ot1We4\\_EfRE](https://www.youtube.com/watch?v=Ot1We4_EfRE)

2. Check slide 7 for further explanation

## B) Control of ADH release

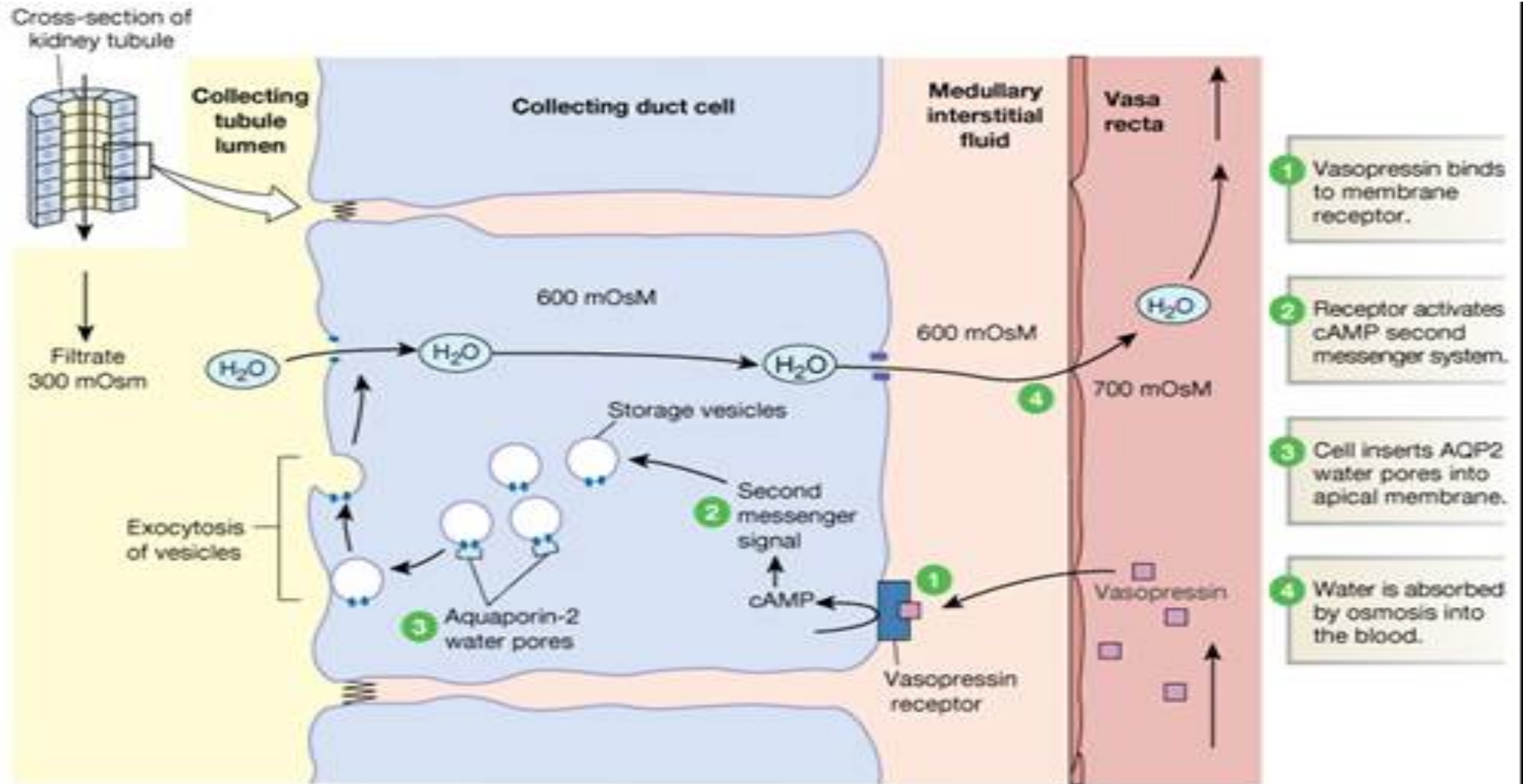
Increase ADH secretion	Decrease ADH secretion
2. Decrease arterial blood pressure, due to Decreased blood volume 3. Age water retention & hyponatremia. 4. Pain, emotional stress & physical trauma 5. Drugs e.g. morphine, barbiturates, & nicotine	1. Alcohol 2. Hypertension 3. Hypo-osmolality of ECF

stimuli	Receptor mediated	Decrease ADH secretion	Increase ADH secretion
a. Osmotic	Osmoreceptor	↓ osmolality	↑ osmolality
b. Non-osmotic (Volume effects)	Baroreceptor (vagus nerve)	↑ blood pressure	↓ blood pressure

Stimulatory factors *	Inhibitory factors *
Increased serum osmolarity	decreased serum osmolarity
Decreased ECF volume	ethanol
Angiotensin 2	Alpha adrenergic agonists
hypoglycemia	Atrial natriuretic peptide (ANP)

\* Extra Factors from Linda physiology (table 9-6 / page: 399)

# Actions of ADH



# B. Oxytocin Hormone

Hormone Action	Oxytocin Causes Contraction of the Pregnant Uterus.	Oxytocin Aids in Milk Ejection by the Breasts.
<b>Acts on</b>	uterine smooth muscle (myometrium)	Myoepithelial cells of the alveoli
<b>Action</b>	<p>partially responsible for causing birth of the baby.</p> <ol style="list-style-type: none"> <li>In a hypophysectomized animal, the duration of labor is prolonged, indicating a possible effect of oxytocin during delivery.</li> <li><b>Stimulation of the cervix</b> in a pregnant animal elicits nervous signals that pass to the hypothalamus and cause increased secretion of oxytocin. in a positive feedback manner. <small>Figure 2</small></li> <li>The amount of <b>oxytocin in the plasma increases during labor</b>, especially during the last stage.</li> </ol>	<p>causes milk to be expressed from the alveoli into the ducts of the breast so that the baby can obtain it by suckling.  <b>(classic neuroendocrine reflex)</b>  <b>milk let down reflex.</b> <small>Figure 1</small></p>
<b>Stimuli</b>	<ul style="list-style-type: none"> <li>✓ Estrogen during pregnancy</li> <li>✓ stretch of cervix</li> </ul>	<ul style="list-style-type: none"> <li>✓ Suckling by the baby</li> <li>✓ Conditioned response: sight, sound, or smell of the infant</li> </ul>

- Inhibitory factor that can affect Oxytocin secretion is Opioids (endorphins)



# B. Oxytocin Hormone

Figure 1; Milk Letdown reflex or milk ejection

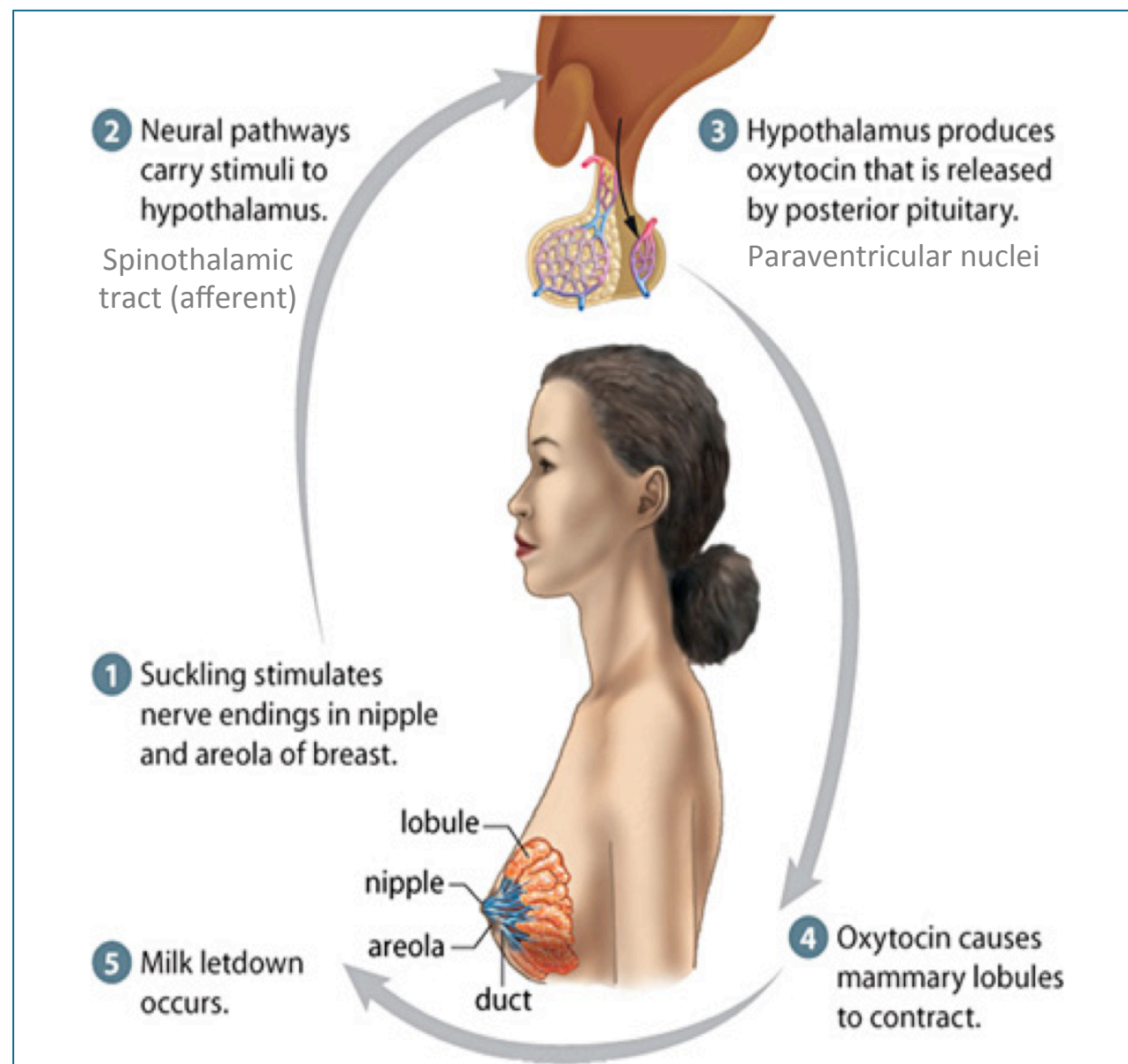
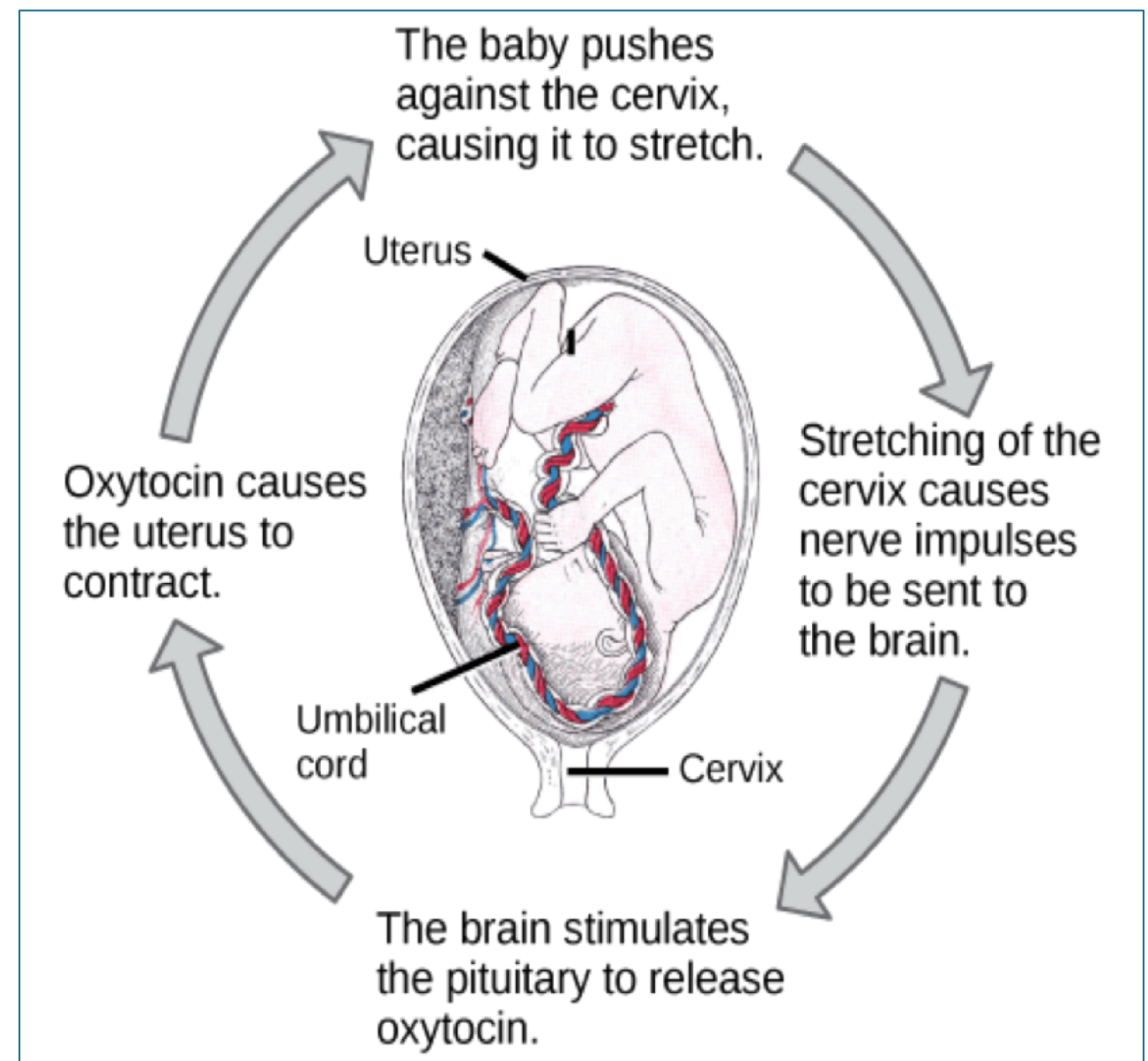


Figure 2; Example of positive feedback mechanism (by Stimulation of the cervix)





# Summary

**posterior pituitary gland** Composed mainly of Pituicytes, which act as packing & supporting cells.

posterior pituitary gland Stores & releases hormones do NOT synthesize  
hormones are produced in hypothalamus

A. Posterior pituitary hormones:

1. Antidiuretic hormone (ADH), Or vasopressin → from Supraoptic nuclei
2. Oxytocin → Paraventricular nuclei

**Nerves** from Supraoptic and Paraventricular nuclei pass to the neurohypophysis through the pituitary stalk

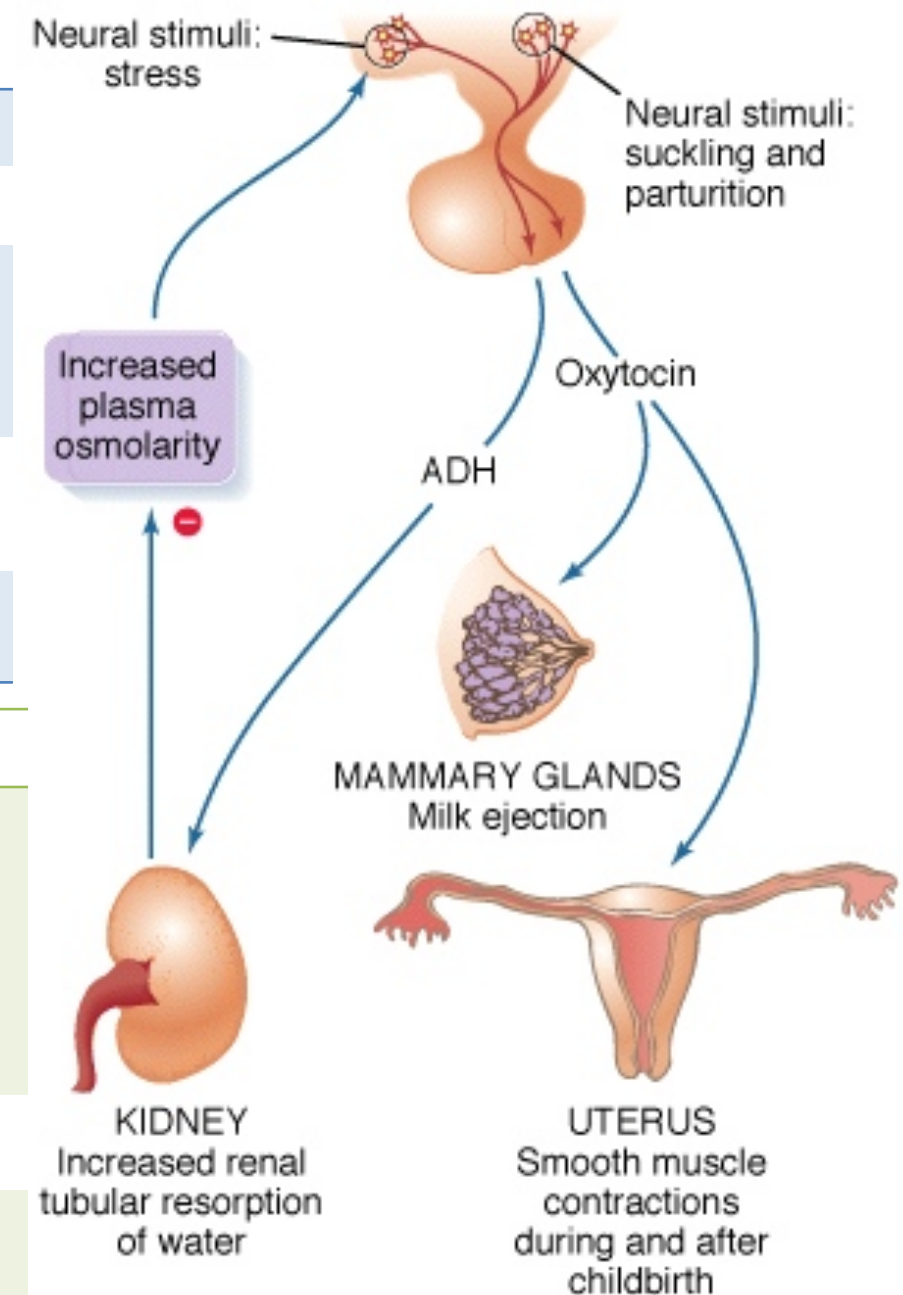
**The synthesized hormones** in the cell bodies are transported along the hypothalamo-hypophyseal tract in neurophysins (carrier protein)

## B. Antidiuretic hormone (ADH)

Action	regulation of body fluid osmolarity
	<ol style="list-style-type: none"> <li>1. In the kidneys → Increase water reabsorption &amp; regulated by V2 receptors through the action of cAMP</li> <li>2. Vascular smooth muscles → → generalized vasoconstriction &amp; regulated by V1 receptors, through the action of IP3/Ca<sup>2+</sup></li> </ol>
Control	↑ Increase osmotic pressure of ECF/Decrease arterial blood pressure/Age/ Drugs/ Pain
	↓ Decrease osmotic pressure of ECF/increase arterial blood pressure/Alcohol

## C. Oxytocin Hormone

- Action
1. **Breast-feeding** → contracts the myoepithelial cells of the alveoli → milk let down reflex.
  2. **Childbirth** (parturition) → uterine smooth muscle (myometrium) becomes sensitive to oxytocin due to the synergistic effect of estrogen. During labor stretch of cervix enhances oxytocin release in a positive feedback manner.



# Summary

## C. Hormones of the posterior lobe of the pituitary

- are antidiuretic hormone (ADH) and oxytocin.
- are homologous nonapeptides.
- are **synthesized in hypothalamic nuclei** and are packaged in secretory granules with their respective **neurophysins**.
- travel down the nerve axons for secretion by the posterior pituitary.

### 1. ADH (see Chapter 5 VII)

- originates primarily in the **supraoptic nuclei** of the hypothalamus.
- regulates serum osmolarity by increasing the H<sub>2</sub>O permeability of the late distal tubules and collecting ducts.

#### a. Regulation of ADH secretion (Table 7-4)

t a b l e 7-4 Regulation of ADH Secretion	
Factors that Increase ADH Secretion	Factors that Decrease ADH Secretion
Serum osmolarity	↓ Serum osmolarity
Volume contraction	Ethanol
Pain	α-Agonists
Nausea (powerful stimulant)	ANP
Hypoglycemia	
Nicotine, opiates, antineoplastic drugs	

ADH = antidiuretic hormone; ANP = atrial natriuretic peptide.

#### b. Actions of ADH

- (1) ↑ **H<sub>2</sub>O permeability (aquaporin 2, AQP2)** of the principal cells of the late distal tubule and collecting duct (via a **V<sub>2</sub> receptor** and an adenylate cyclase–cAMP mechanism)
- (2) **Constriction of vascular smooth muscle** (via a **V<sub>1</sub> receptor** and an IP<sub>3</sub>/Ca<sup>2+</sup> mechanism)

# Summery

## 2. Oxytocin

- originates primarily in the **paraventricular nuclei** of the hypothalamus.
- causes **ejection of milk from the breast** when stimulated by suckling.

### a. Regulation of oxytocin secretion

#### (1) *Suckling*

- is the major stimulus for oxytocin secretion.
- Afferent fibers carry impulses from the nipple to the spinal cord. Relays in the hypothalamus trigger the release of oxytocin from the posterior pituitary.
- The sight or sound of the infant may stimulate the hypothalamic neurons to secrete oxytocin, even in the absence of suckling.

#### (2) *Dilation of the cervix and orgasm*

- increases the secretion of oxytocin.

### b. Actions of oxytocin

#### (1) *Contraction of myoepithelial cells in the breast*

- Milk is forced from the mammary alveoli into the ducts and delivered to the infant.

#### (2) *Contraction of the uterus*

- During pregnancy, oxytocin receptors in the uterus are up-regulated as parturition approaches, although the role of oxytocin in normal labor is uncertain.
- Oxytocin can be used to induce labor and **reduce postpartum bleeding**.

# MCOQs

<b>Q1</b>	<b>Synthesized hormones in the hypothalamus are transported to the posterior pituitary glands in ?</b>	<b>Q2</b>	<b>Increase water reabsorption in the kidney by ADH through the action of?</b>
	<ul style="list-style-type: none"> <li>a. neurophysins</li> <li>b. Albumin</li> <li>c. Heptopglbin</li> </ul>		<ul style="list-style-type: none"> <li>a. <math>IP_3/Ca^{2+}</math></li> <li>b. Calcium-calmodulin system</li> <li>c. cAMP</li> </ul>
<b>Q3</b>	<b>When ADH acts on the vascular smooth muscles its effect is regulated by which of the following receptors</b>	<b>Q4</b>	<b>The stimulation of Oxytocin hormone initiated in which nucleus</b>
	<ul style="list-style-type: none"> <li>a. <math>V_1</math> receptors</li> <li>b. <math>V_2</math> receptors</li> <li>c. <math>V_3</math> receptors</li> </ul>		<ul style="list-style-type: none"> <li>a. Supraoptic nucleus</li> <li>b. Paraventricular nucleus</li> <li>c. Both</li> </ul>
<b>Q5</b>	<b>Which of the following hormones will be increased when estrogen level is high</b>	<b>Q6</b>	<b>Which of the non osmotic stimuli will increase ADH secretion</b>
	<ul style="list-style-type: none"> <li>a. FSH</li> <li>b. Oxytocin</li> <li>c. ADH</li> </ul>		<ul style="list-style-type: none"> <li>a. Increase blood pressure</li> <li>b. Dehydration</li> <li>c. Decrease blood pressure</li> </ul>
<b>Q7</b>	<b>The hormone responsible for milk let down reflex is ?</b>	<b>Q8</b>	<b>What's the most potent stimuli for Oxytocin secretion</b>
	<ul style="list-style-type: none"> <li>a. Prolactin</li> <li>b. Oxytocin</li> <li>c. ADH</li> </ul>		<ul style="list-style-type: none"> <li>a. Estrogen during pregnancy</li> <li>b. stretch of cervix</li> <li>c. Suckling</li> </ul>

<b>Answers</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
	a	c	a	b	b	c	b	c





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