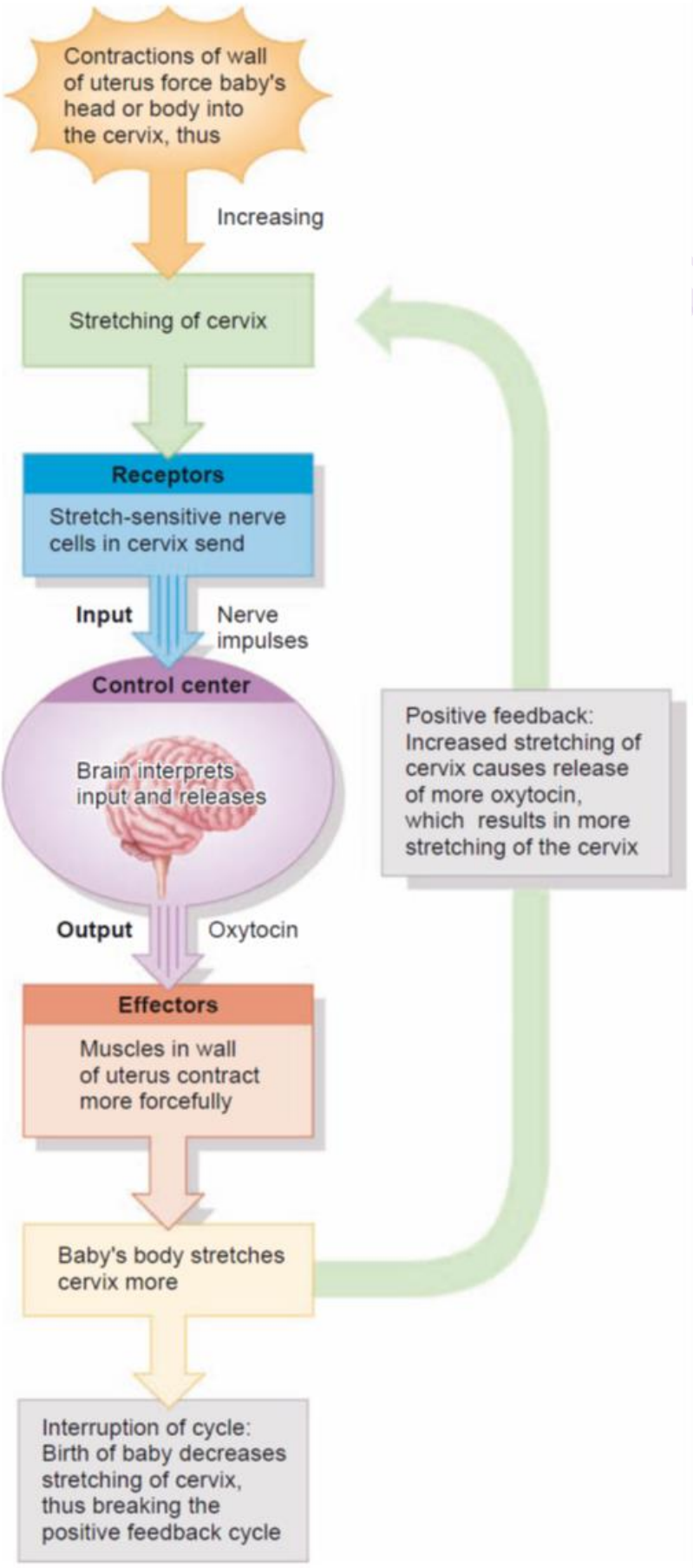
Medical Endocrinology / Introduction 4

Medical Endocrinology

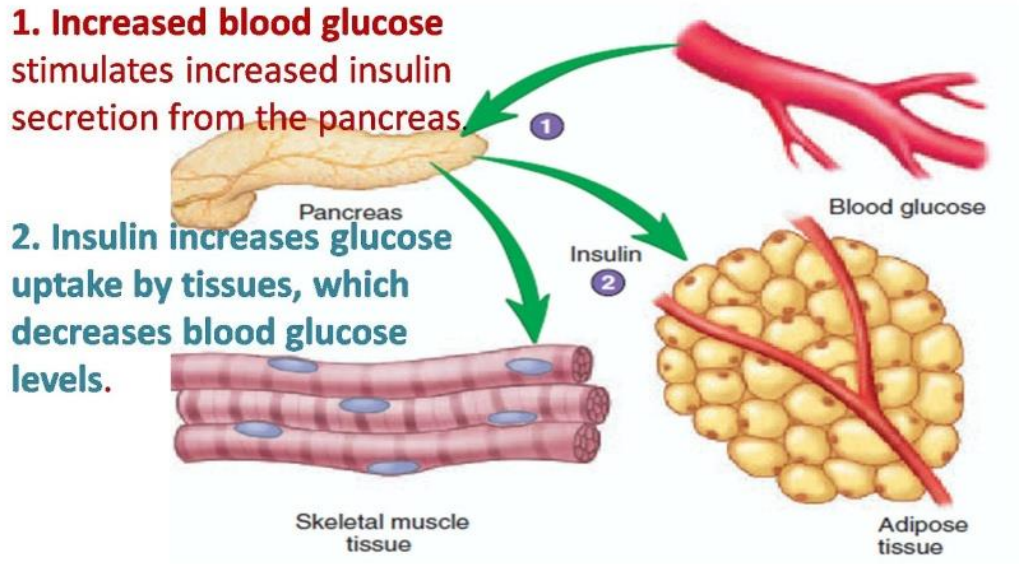

Contractions of wall of uterus force baby's head or body into the cervix, thus
Increasing
Stretching of cervix
Receptors
Stretch-sensitive nerve cells in cervix send
Input
Nerve impulses
Control center
Brain interprets input and releases
Output
Oxytocin
Effectors
Muscles in wall of uterus contract more forcefully
Baby's body stretches cervix more
Interruption of cycle: Birth of baby decreases stretching of cervix, thus breaking the positive feedback cycle
Positive feedback: Increased stretching of cervix causes release of more oxytocin, which results in more stretching of the cervix

: **Positive feedback control of labor contractions during birth of a baby.** The solid return arrow symbolizes positive feedback.

If the response enhances or intensifies the stimulus, a system is operating by positive feedback.

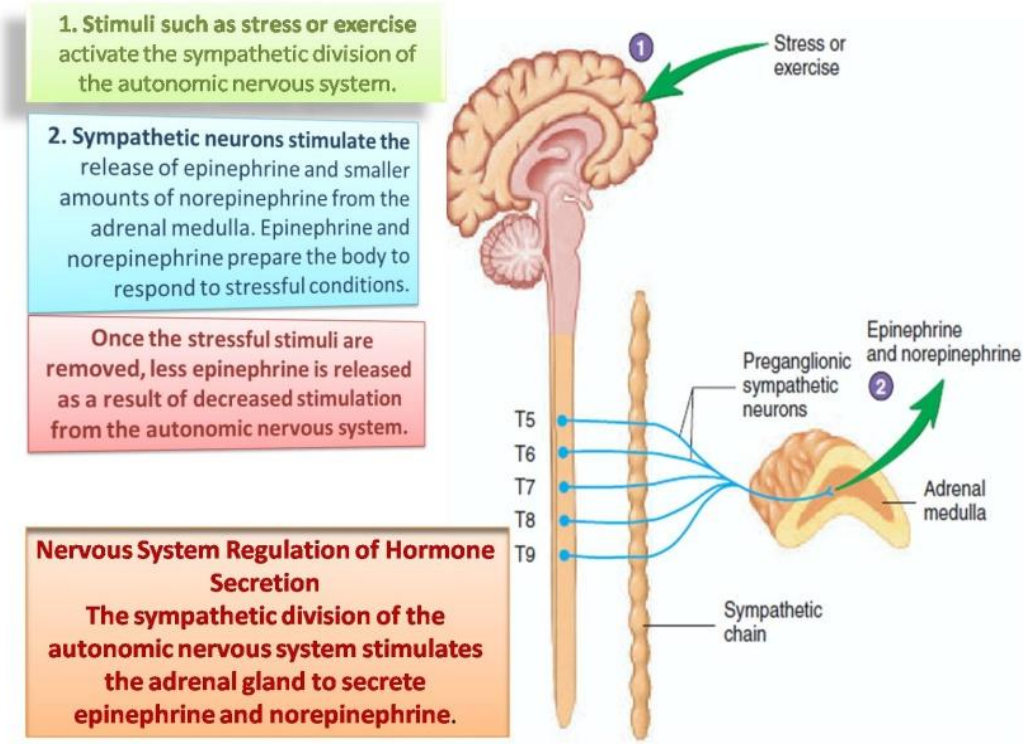
Hormones have three major patterns of regulation

1. **One pattern involves the action of a substance other than a hormone** on the endocrine gland. Figure describes the influence of blood glucose on insulin secretion from the pancreas. An increasing blood glucose level causes an increase in insulin secretion from the pancreas. Insulin increases glucose movement into cells, resulting in a decrease in blood glucose levels, which in turn causes a decrease in insulin secretion. Thus insulin levels increase and decrease in response to changes in blood glucose levels.



Nonhormonal Regulation of Hormone Secretion
Glucose, which is not a hormone, regulates the secretion of insulin from the pancreas.

2. **A second pattern of hormone regulation involves neural control of the endocrine gland**. Neurons synapse with the cells that produce the hormone, and, when action potentials result, the neurons release a neurotransmitter. In some cases, the neurotransmitter is stimulatory and causes the cells to increase hormone secretion. In other cases the neurotransmitter is inhibitory and decreases hormone secretion. Thus sensory input and emotions acting through the nervous system can influence hormone secretion. Figure illustrates the neural control of epinephrine and norepinephrine secretion from the adrenal gland. In response to stimuli such as stress or exercise, the nervous system stimulates the adrenal gland to secrete epinephrine and norepinephrine, which help the body respond to the stimuli .When the stimuli are no longer present, secretion of epinephrine and norepinephrine decreases.



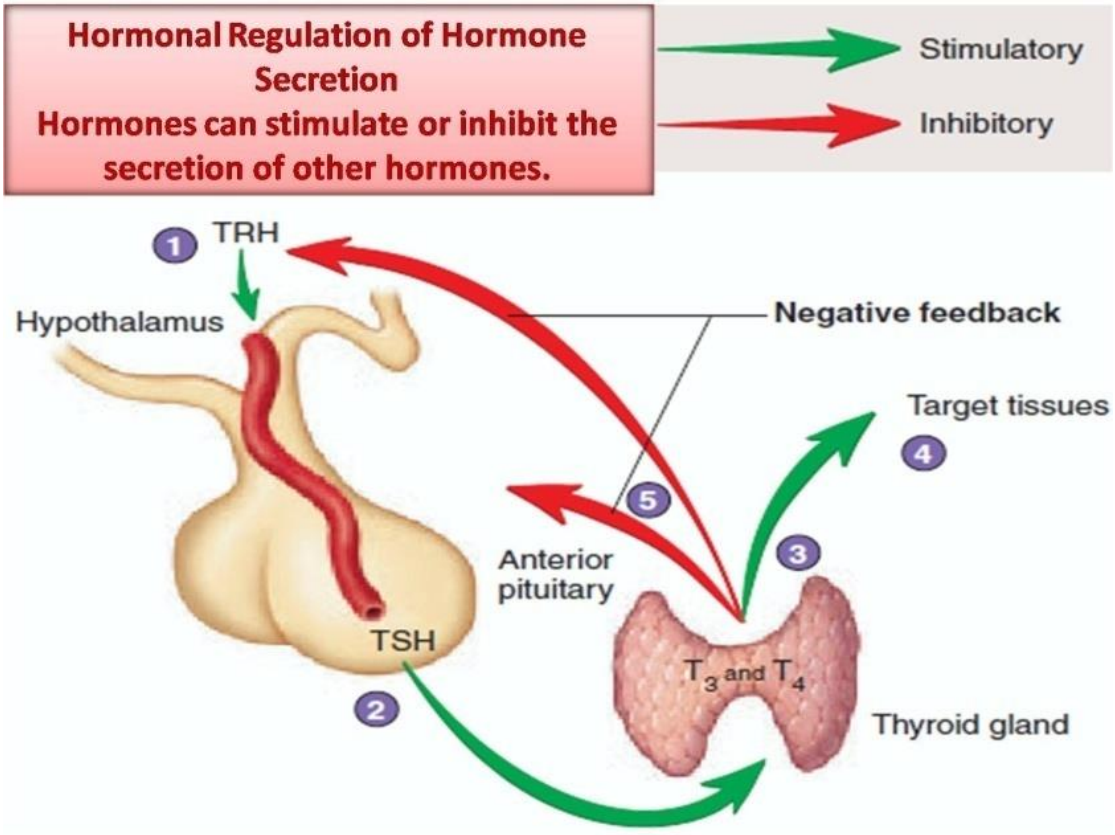
Nervous System Regulation of Hormone Secretion

The sympathetic division of the autonomic nervous system stimulates the adrenal gland to secrete epinephrine and norepinephrine.

Neural Control of Insulin Secretion:

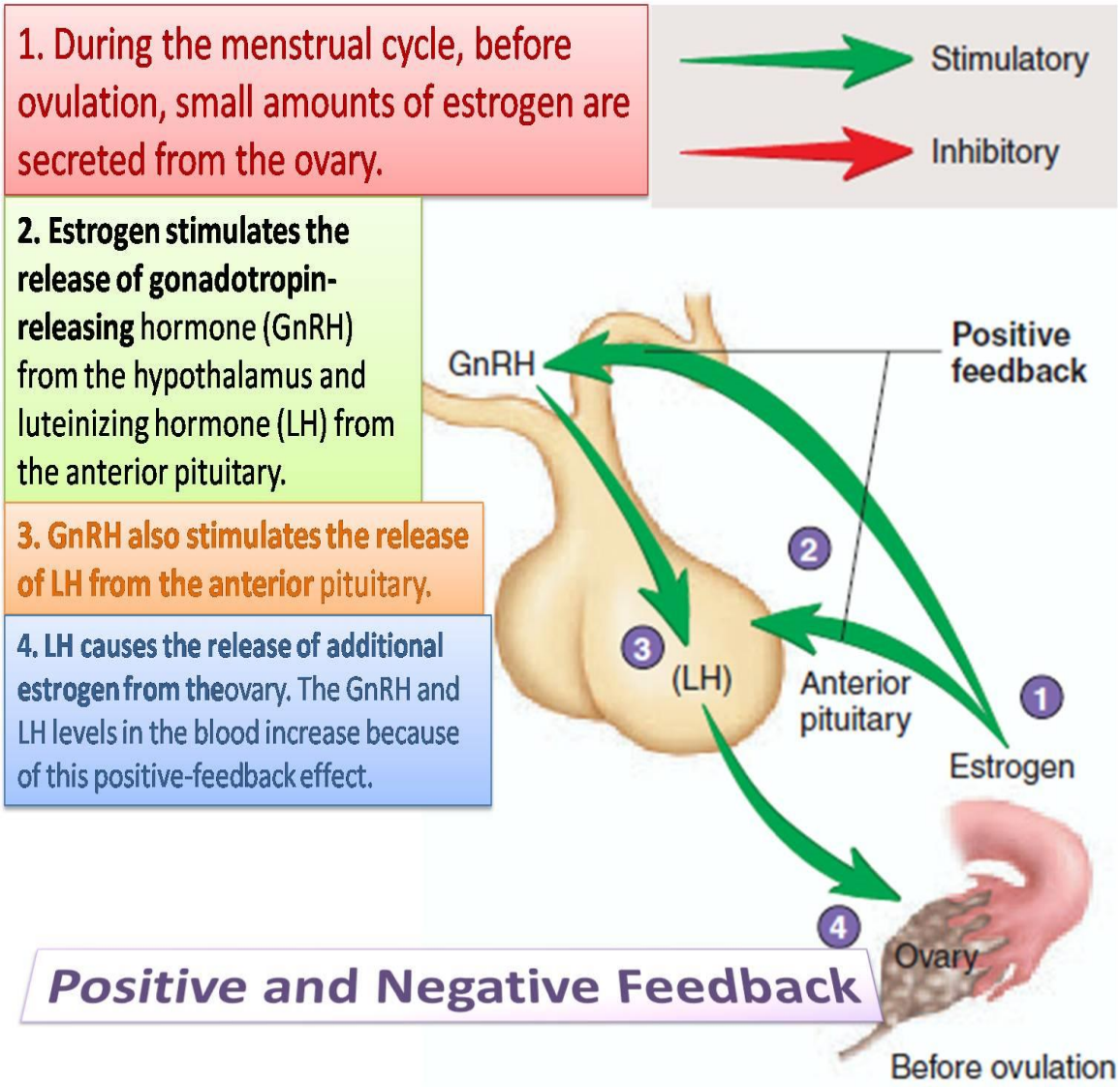
Blood glucose levels regulate insulin secretion, but insulin secretion is also regulated by the nervous system. When action potentials in parasympathetic neurons that innervate the pancreas increase, the neurotransmitter acetylcholine is released. Acetylcholine causes depolarization of pancreatic cells, and insulin is secreted. When action potentials in sympathetic neurons that innervate the pancreas increase, the neurotransmitter norepinephrine is released. Norepinephrine causes hyperpolarization of pancreatic cells, and insulin secretion decreases. Thus, nervous stimulation of the pancreas can either increase or decrease insulin secretion.

3. **A third pattern of hormone regulation involves the control of the secretory activity of one endocrine gland by a hormone or a neurohormone secreted by another endocrine gland**. Figure illustrates how thyroid-releasing hormone (TRH) from the hypothalamus the brain stimulates the secretion of thyroid-stimulating hormone (TSH) from the anterior pituitary gland, which, in turn, stimulates the secretion of thyroid hormones from the thyroid gland. A negative-feedback mechanism for regulating thyroid hormone secretion exists because thyroid hormones can inhibit the secretion of TRH and TSH. Thus, the concentrations of TRH, TSH, and thyroid hormone increase and decrease within a normal range.

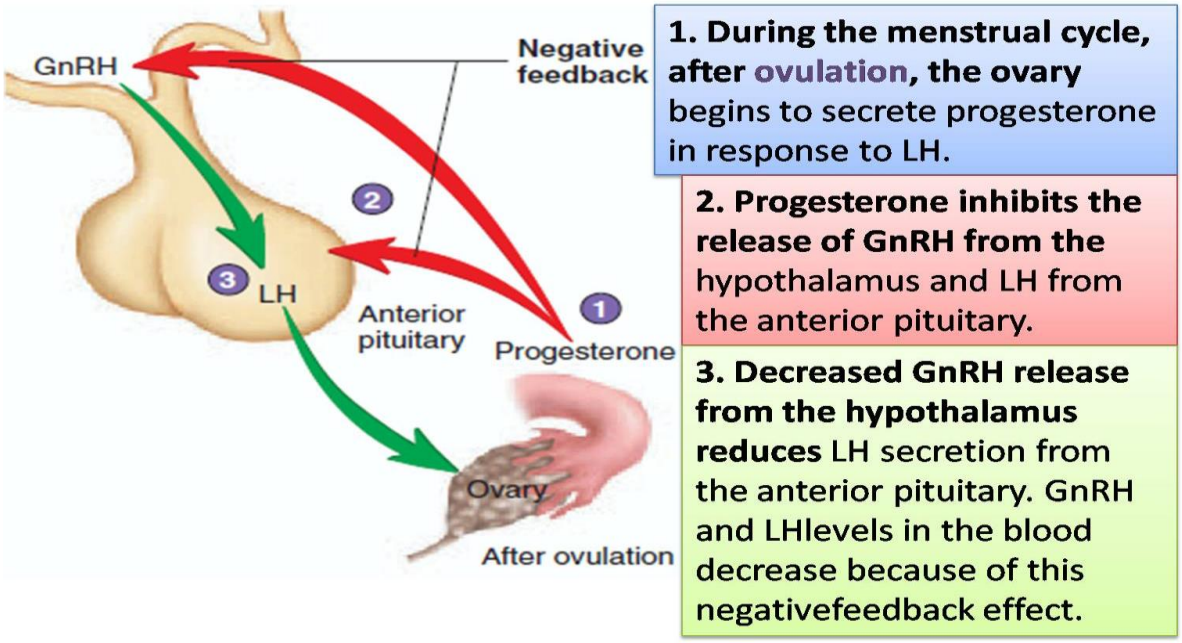


One of these three major patterns by which hormone secretion is regulated applies to each hormone, but the complete picture isn't quite so simple. The regulation of hormone secretion often involves more than one mechanism. For example, both the concentration of blood glucose and the autonomic nervous system influence insulin secretion from the pancreas.

A few examples of positive-feedback regulation in the endocrine system exist. Prior to ovulation, estrogen from the ovary stimulates luteinizing hormone (LH) secretion from the anterior pituitary gland. LH, in turn, stimulates estrogen secretion from the ovary. Consequently, blood levels of estrogen and LH increase prior to ovulation . The release of oxytocin during delivery of an infant is another example .

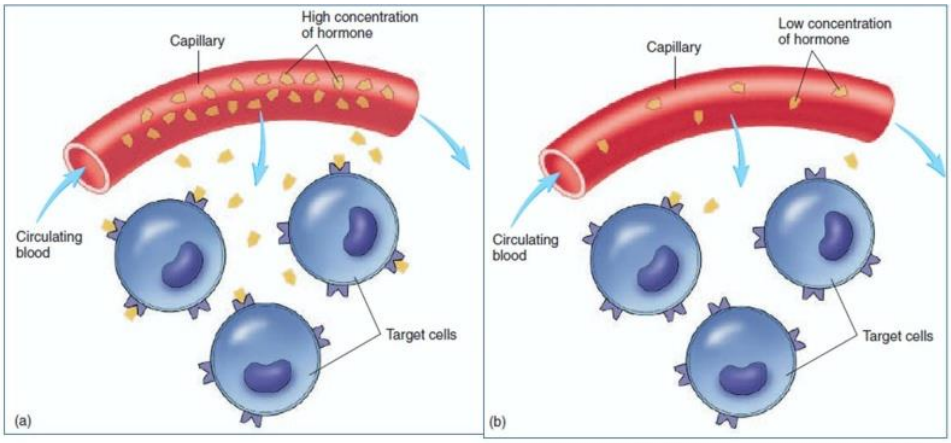


In cases of positive feedback, negative feedback limits the degree to which positive feedback proceeds . For example, after ovulation the ovary secretes progesterone, which inhibits LH secretion.



Positive and Negative Feedback

Some hormones are in the circulatory system at relatively constant levels, some change suddenly in response to certain stimuli, and others change in relatively constant cycles . For example, thyroid hormones in the blood vary within a small range of concentrations that remain relatively constant. Epinephrine is released in large amounts in response to stress or physical exercise; thus its concentration can change suddenly .Reproductive hormones increase and decrease in a cyclic fashion in women during their reproductive years.

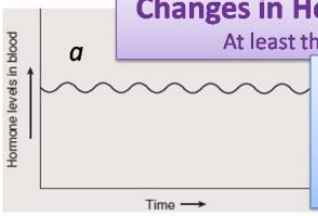


Hormone Concentrations at the Target Cell

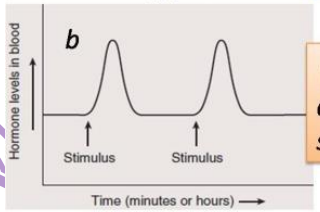
Hormone molecules diffuse from the blood through the walls of the capillaries into the interstitial spaces. Once within the interstitial spaces, they diffuse to the target cells. *(a) As the concentration of free hormone molecules increases* in the blood, more molecules diffuse from the capillary to the target cells.
(b) As the concentration of free hormone molecules decreases in the blood, fewer diffuse from the capillary to the target cells.

Changes in Hormone Secretion Through Time

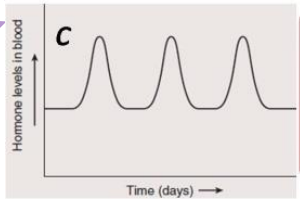
At least three basic patterns of hormone secretion exist



(a) Chronic hormone regulation: *the maintenance of a relatively constant concentration of* hormone in the circulating blood over a relatively long period.



(b) Acute hormone regulation: *a hormone rapidly increases in the blood for a short* time in response to a stimulus.



(c) Cyclic hormone regulation: *a hormone is* regulated so that it increases and decreases in the blood at a relatively constant time and to roughly the same amount

THANK YOU

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