

Any Questions about Tuesday's Learning Objectives

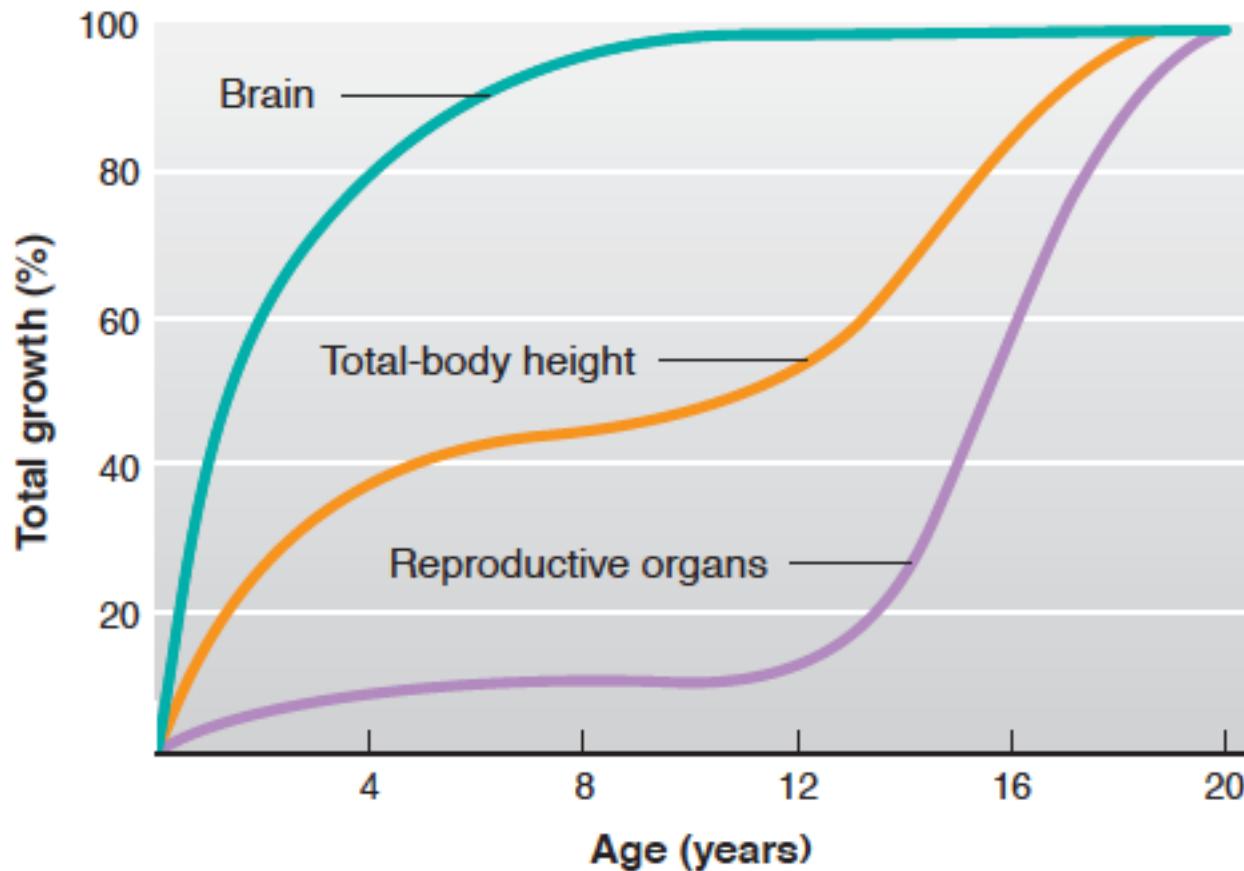
- Recall anatomical, biochemical, and functional evidence showing intimate relationships between hypothalamus and pituitary.
- Describe how hormones are sensed by the neurons of the hypothalamus, and the role that the blood brain barrier and transport mechanisms play.
- Recall how the central nervous system can integrate with the hypothalamus and modify both hormonal secretions and executive function.
- Describe the differences in how hypothalamic signals are passed to the posterior and anterior pituitary glands.
- List the known hypothalamic hormones which cause release (and release-inhibition) of anterior pituitary hormones, including their acronyms.
- Name two major posterior pituitary hormones, their chemical category, and succinctly describe their secretory mechanism.
- Describe cellular actions of vasopressin in terms of site of actions, receptors, and cellular signals.
- Discuss briefly aquaporin water channels and relation to vasopressin.
- Predict what the changes are expected in urine volume and osmolality and in ECF volume when vasopressin synthesis or secretion is severely impaired. Predict what will happen to water intake. Explain why there can be transient diabetes insipidus following a whiplash injury, and the rationale for therapy during this time.
- Describe the control of vasopressin release.
- Describe the function of oxytocin with respect to delivery and lactation.

Endocrine Control of Growth

Learning Objectives

- List the hormones important for growth at key times in a person's life.
- Describe the functions of human growth hormone on growth (bones and soft tissues), and on metabolism, and the regulation of its secretion. Explain what 'rhGH' means.
- State the "dual effector hypothesis" for GH actions, and the relative roles of GH and IGF-1 in growth control.
- Describe the interactions among all the key growth-regulating hormones at key times of a person's life: in utero, neonatally, childhood, puberty, adulthood, and senescence.
- Describe the daily regulation of GH levels and the physiological relevance of these cycles.

Human Organ Growth



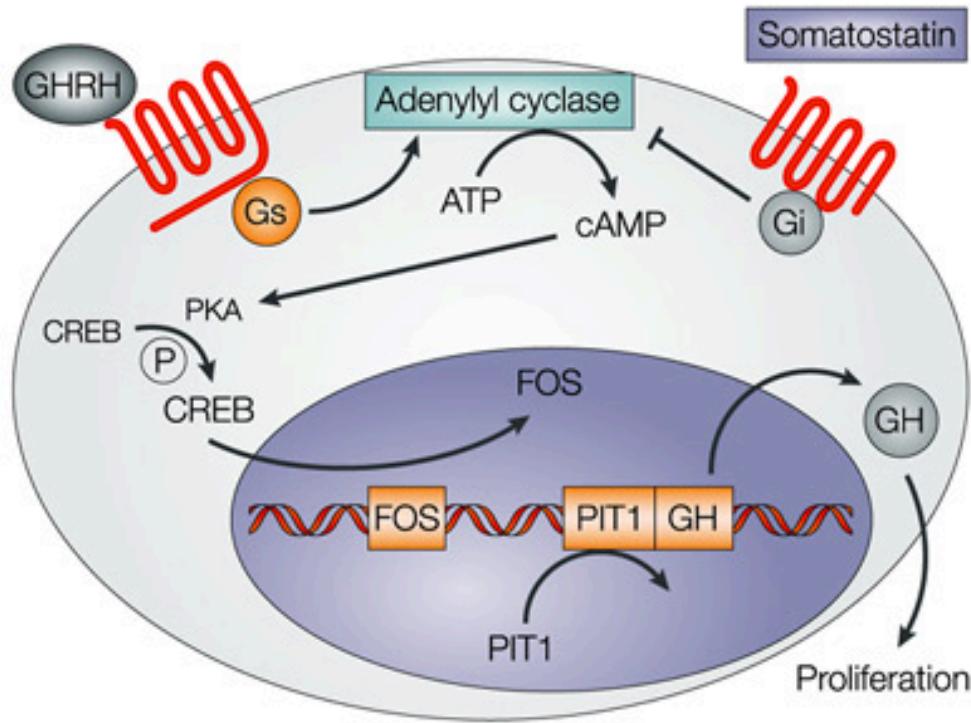
Hormones During Growth

Stage	Age	Hormonal Requirements
Prenatal	(9 months)	Insulin
Infantile	0-1	Insulin
Juvenile	1-12 years	GH, Insulin, T3, Vitamin D
Adolescent (Pubertal)	10-14 (F) 12-16 (M)	GH, insulin, T3, Vitamin D and Sex Steroids
Adult	Puberty – 100	Normally limited growth

Growth Hormone Summary

What chemical type is it?	Protein	
Where is it made?	Somatotropes of Anterior Pituitary	
What causes its release?	GHRH release (also regulated by somatostatin)	
What is its receptor?	Growth Hormone Receptor	JAK/STAT
What tissues does it affect?	Liver	IGF-1 Release
	Bones	Growth
	Muscle	Protein Synthesis
	Adipose Tissue	Lipolysis
How does it get turned off?	IGF Negative Feedback to Pituitary and Hypothalamus. GH/IGF1 Stimulation of somatostatin and receptor desensitization	

Regulation of GH Release

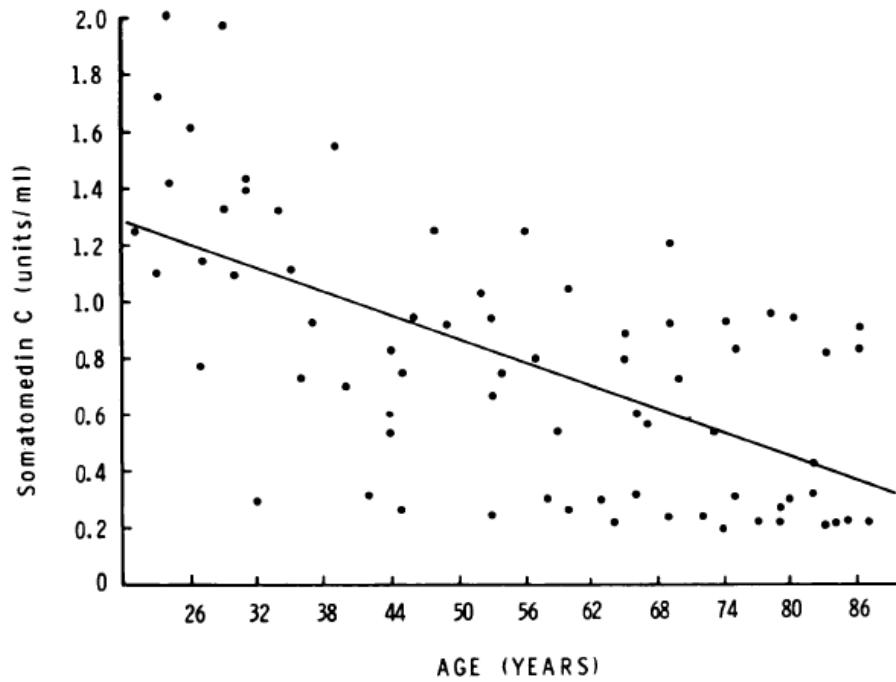
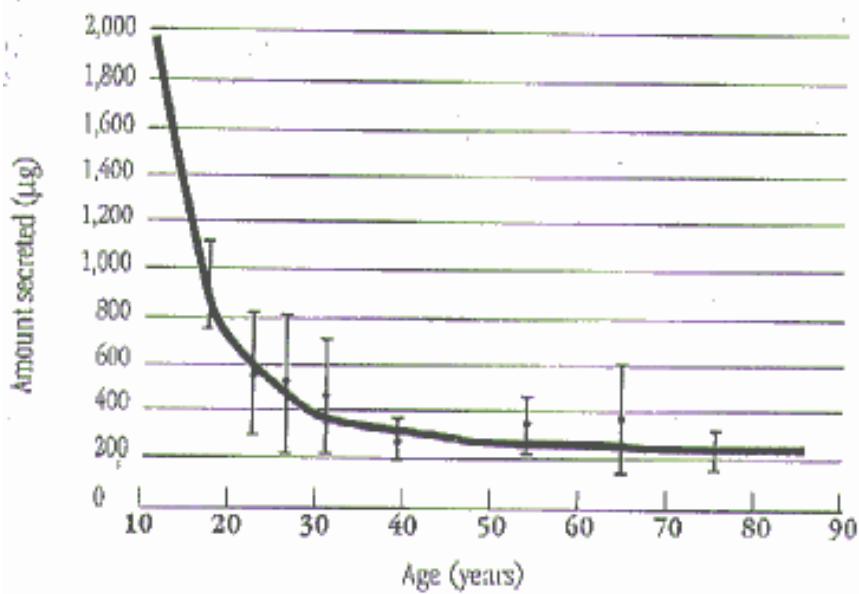


GH Decreases with Aging

- Think of some possible mechanisms by which this could happen?
- Less GH synthesis
- Less GHRH responsiveness
- Less GHRH synthesis
- More SST synthesis
- More SST responsiveness

GH and Aging

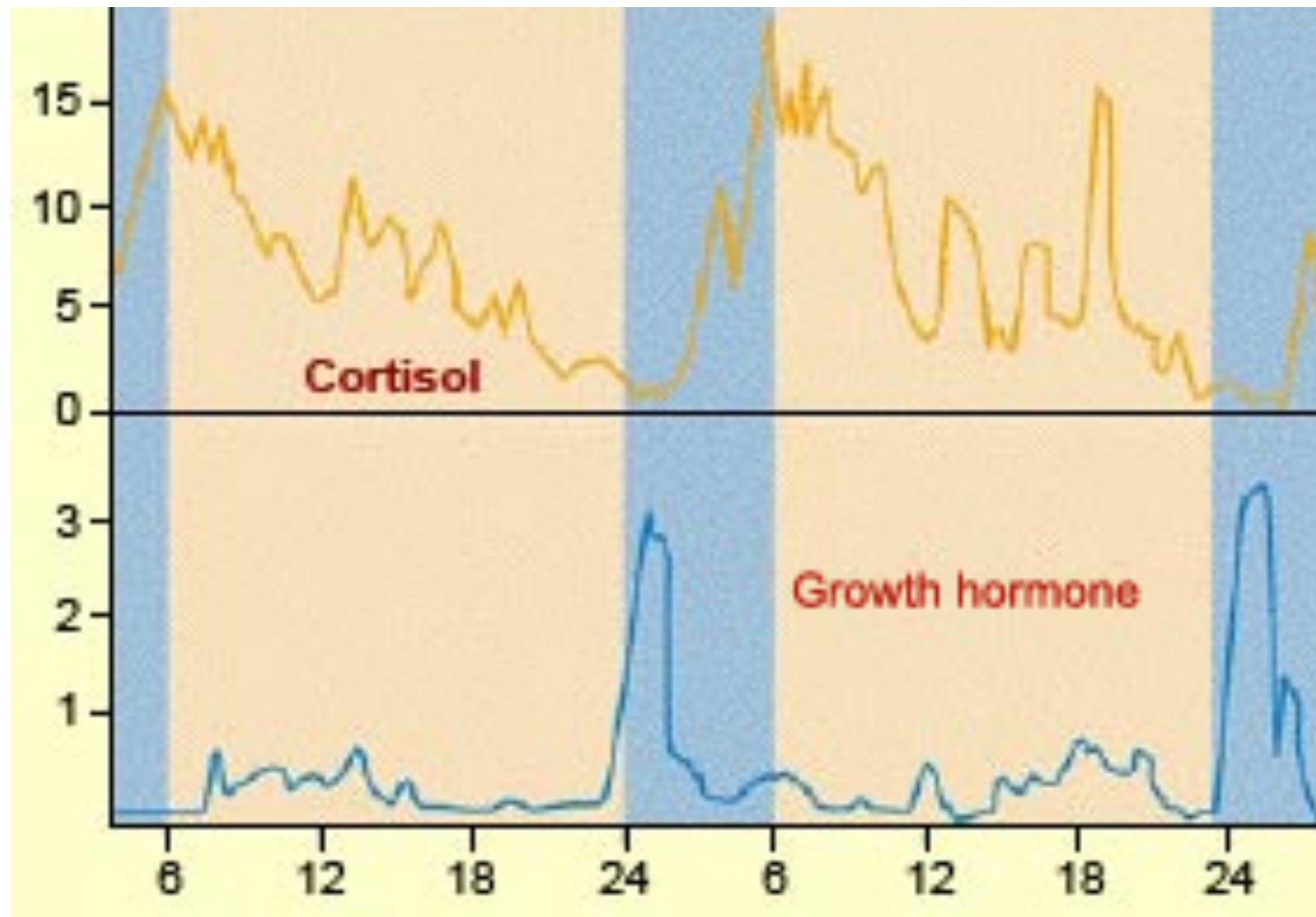
Growth Hormone Decline



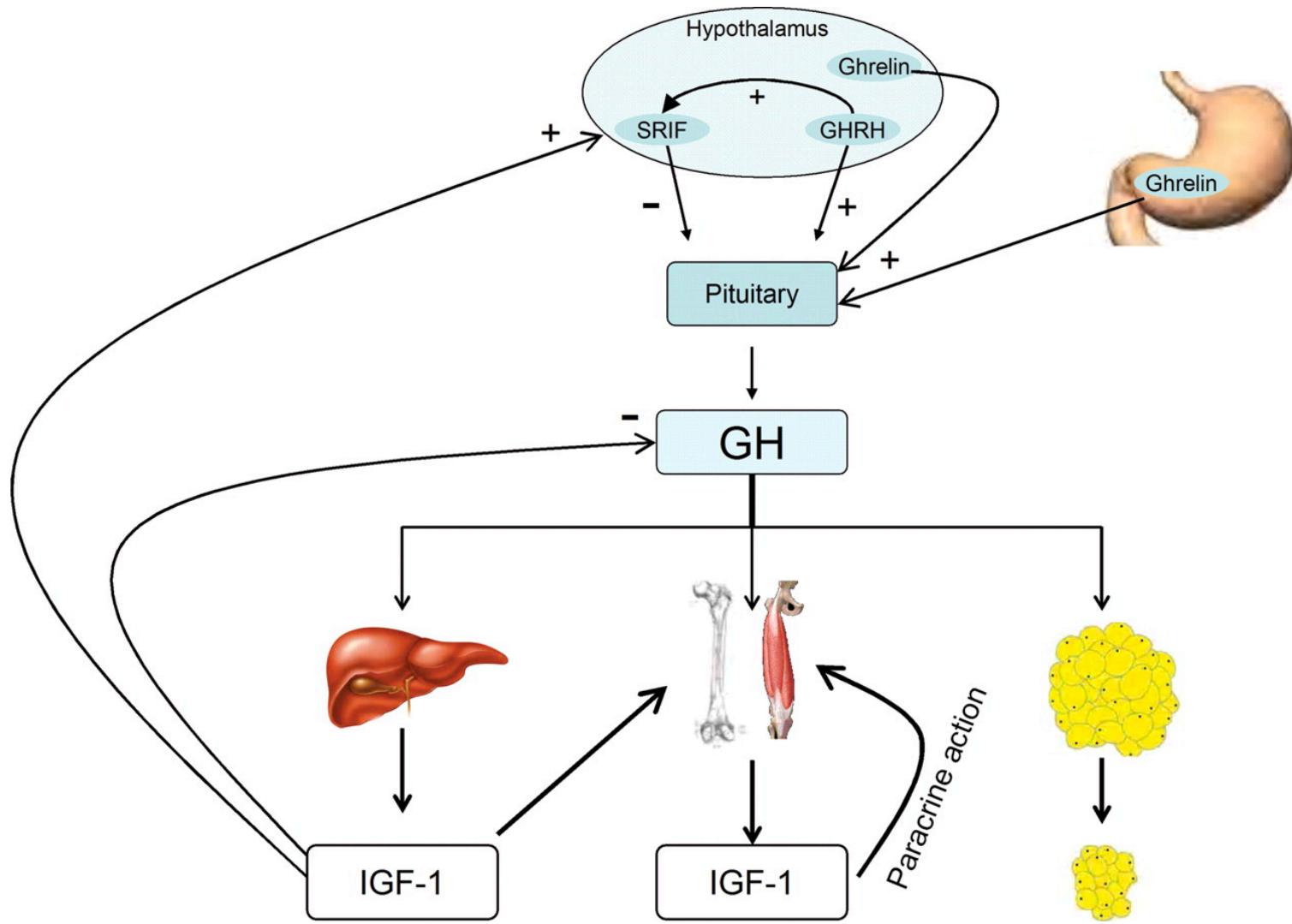
GHRH Levels

Rudman D, Kutner MH, Rogers CM, Lubin MF, Fleming G a., et al. (1981) Impaired growth hormone secretion in the adult population. Relation to age and adiposity. J Clin Invest 67: 1361–1369. doi:10.1172/JCI110164.

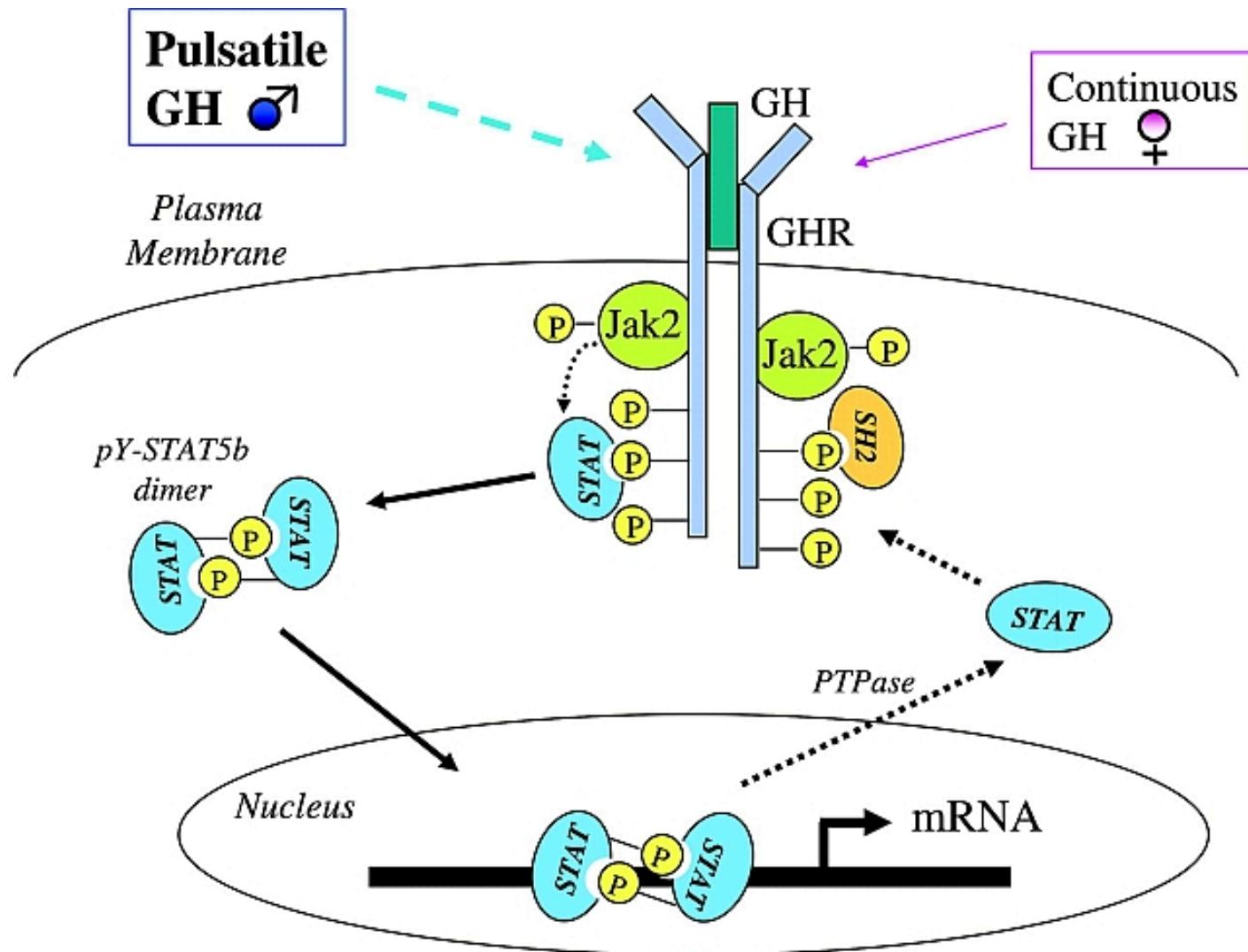
Diurnal Rhythms of GH Release



Growth Hormone Causes IGF-1 Release



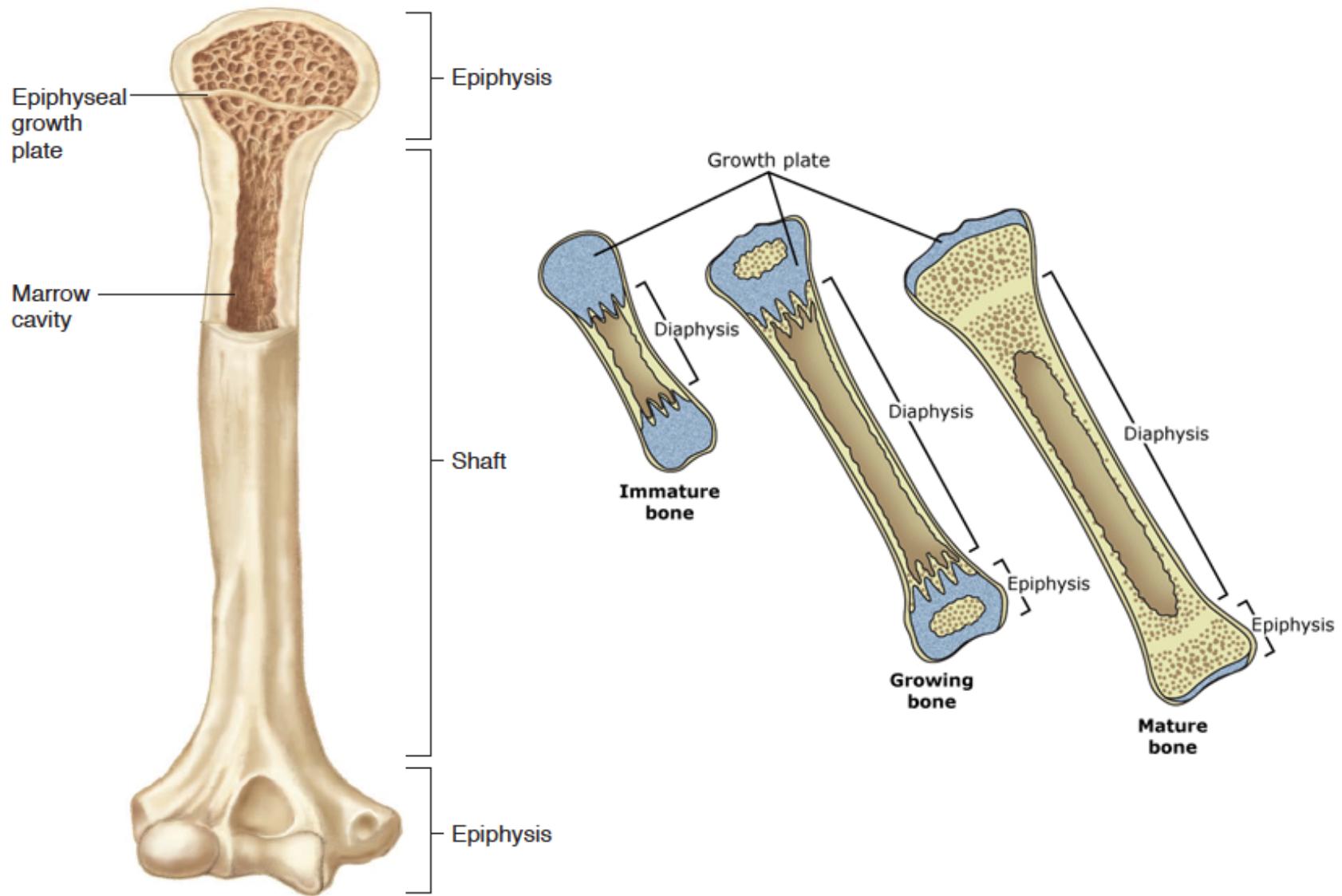
Growth Hormone Receptor



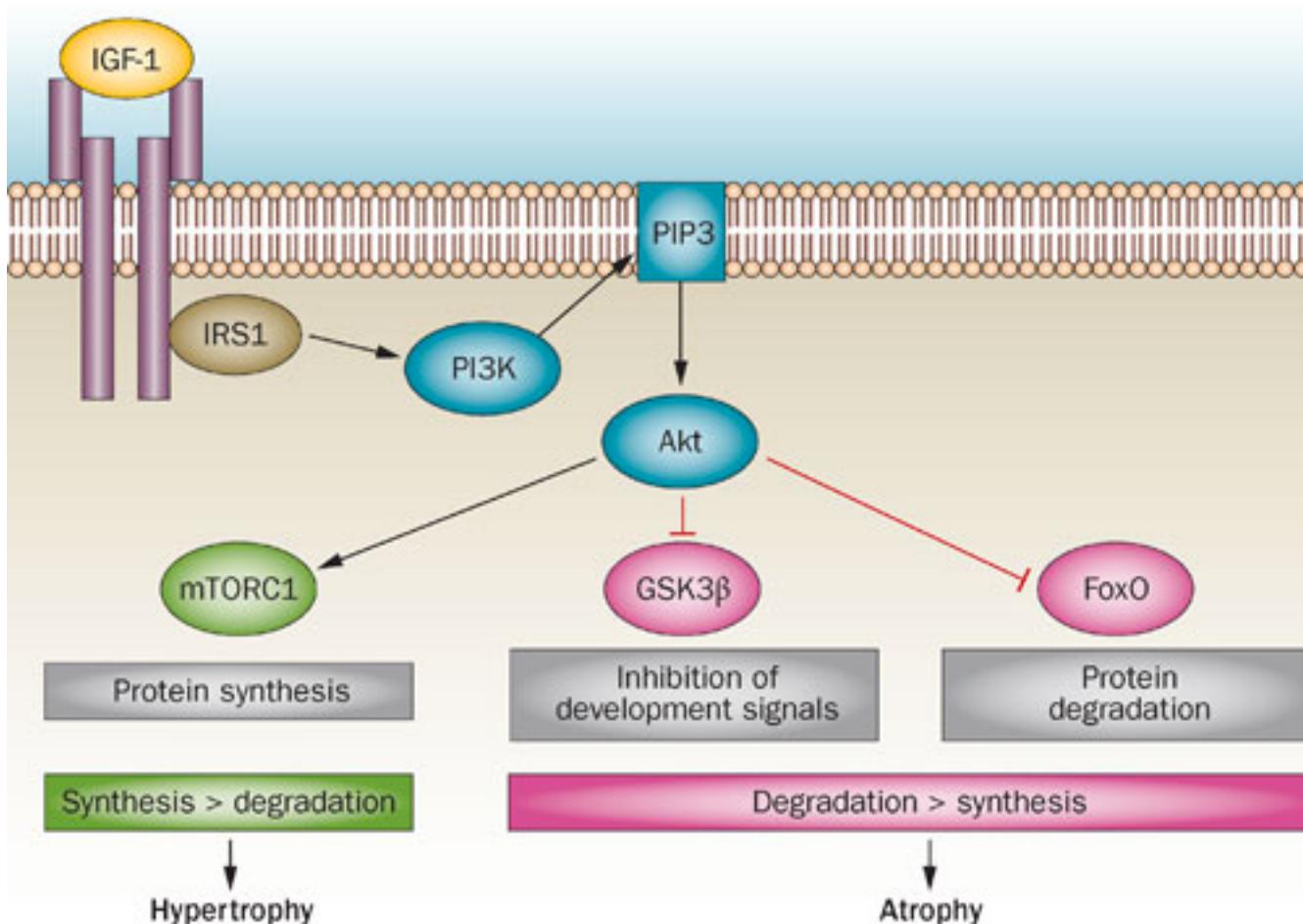
IGF-1 Summary

What chemical type is it?	Protein	
Where is it made?	Liver	
What causes its release?	GH Signaling	
What is its receptor?	IGF1R	Receptor Tyrosine Kinase
What tissues does it affect?	Liver	IGF-1 Release
	Bones	Chondrocyte replication
	Muscle	Protein Synthesis
How does it get turned off?	Receptor desensitization, Less GH production, IGF-1 degradation	

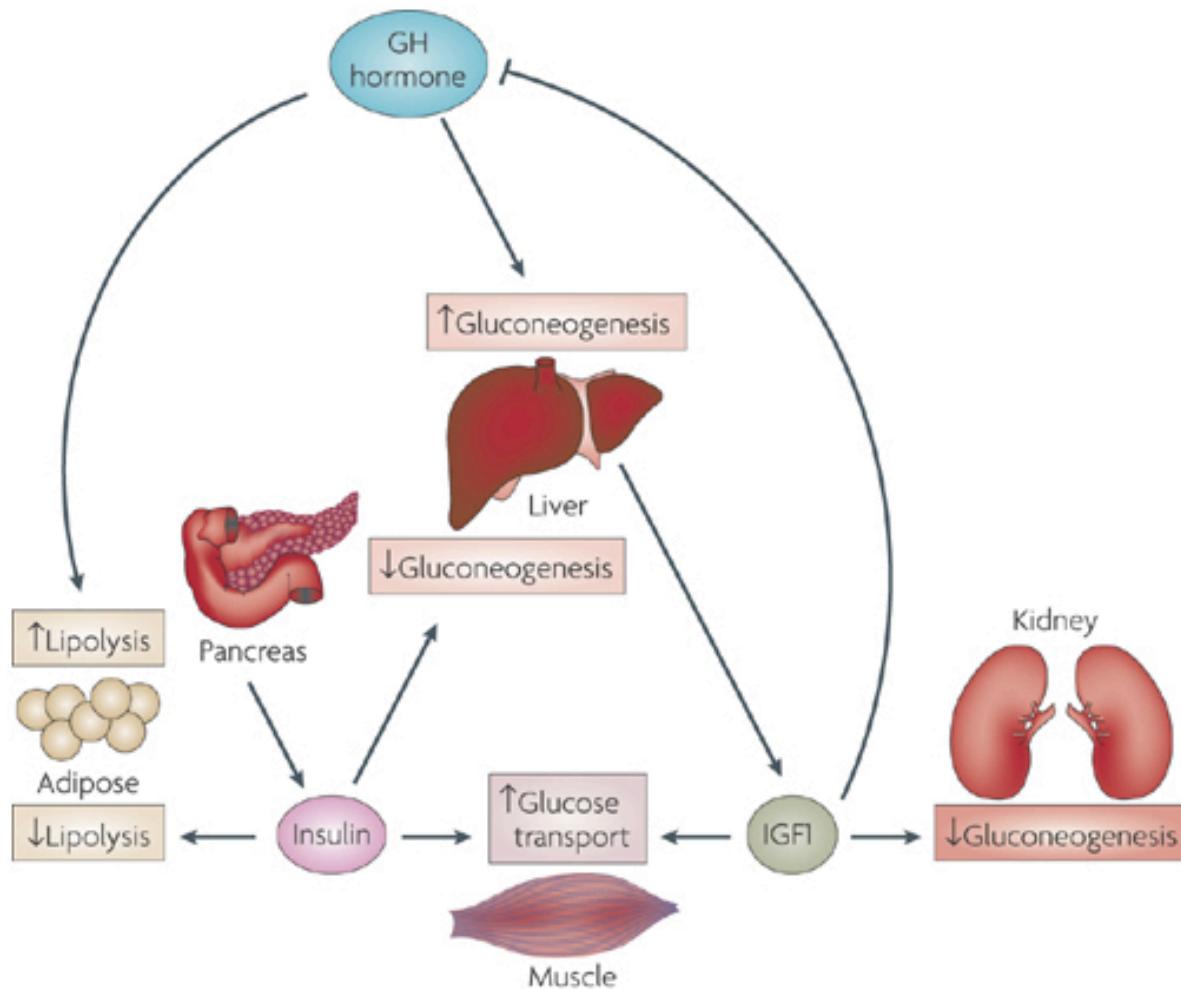
Regulation of Bone Growth



Regulation of Muscle Growth

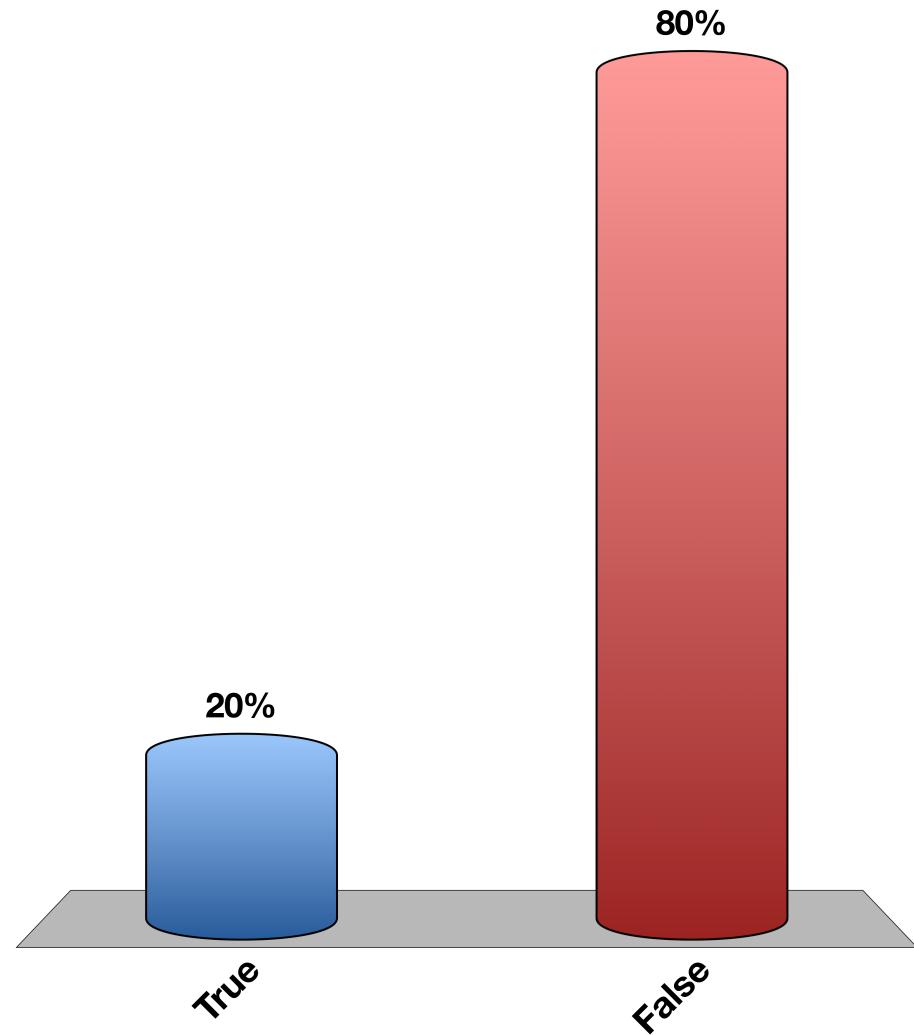


Effects of GH/IGF1 on Metabolism

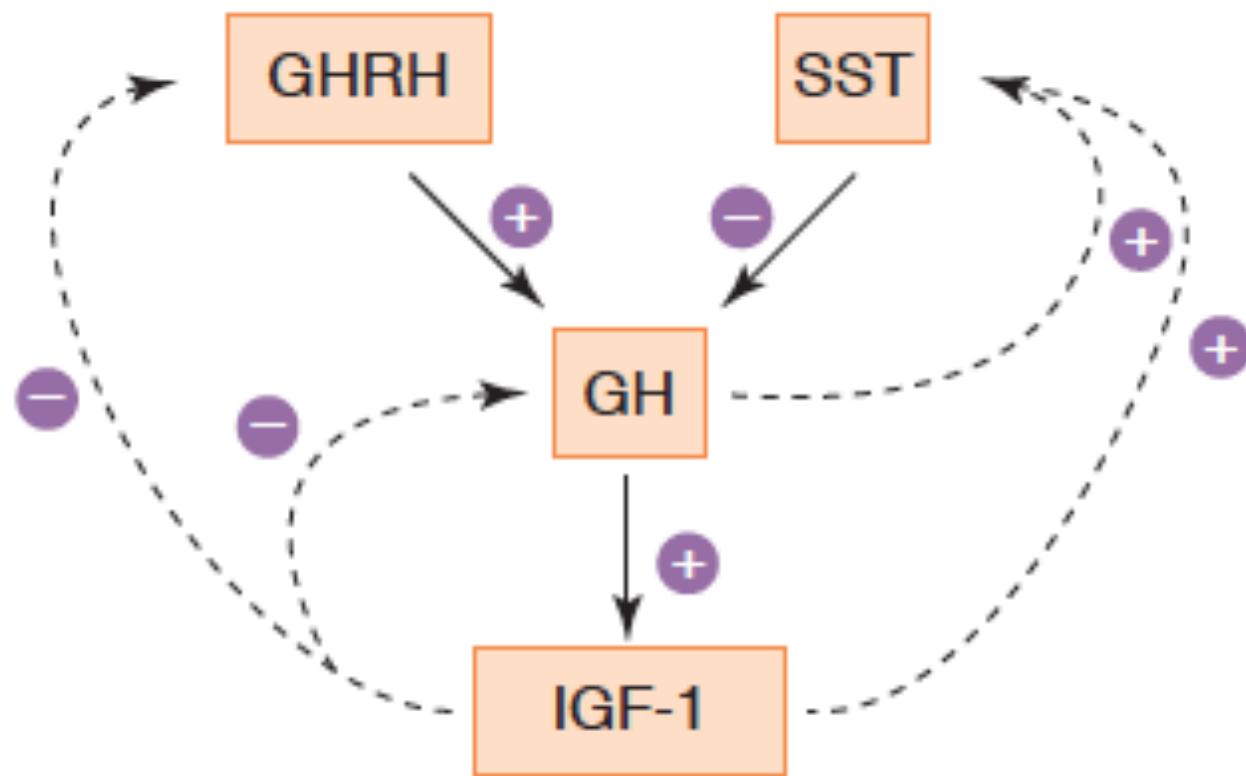


Can you recapitulate all the effects of GH by Providing IGF-1?

- A. True
- B. False



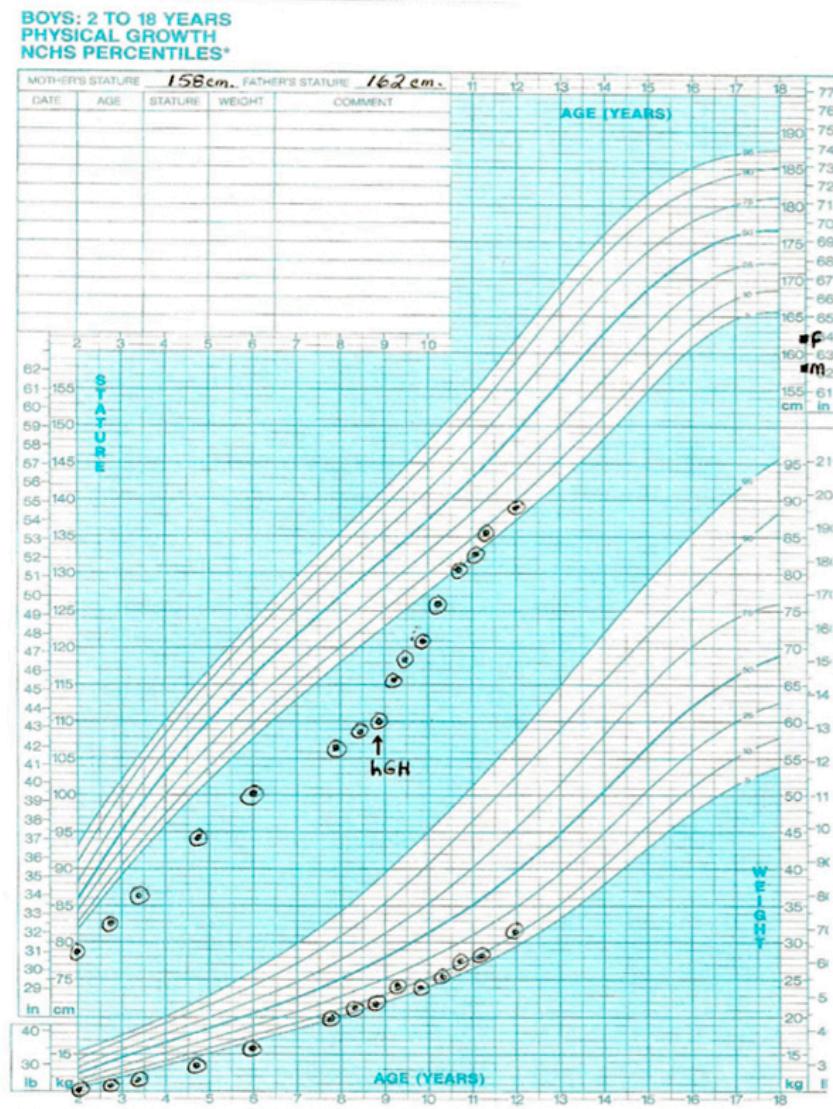
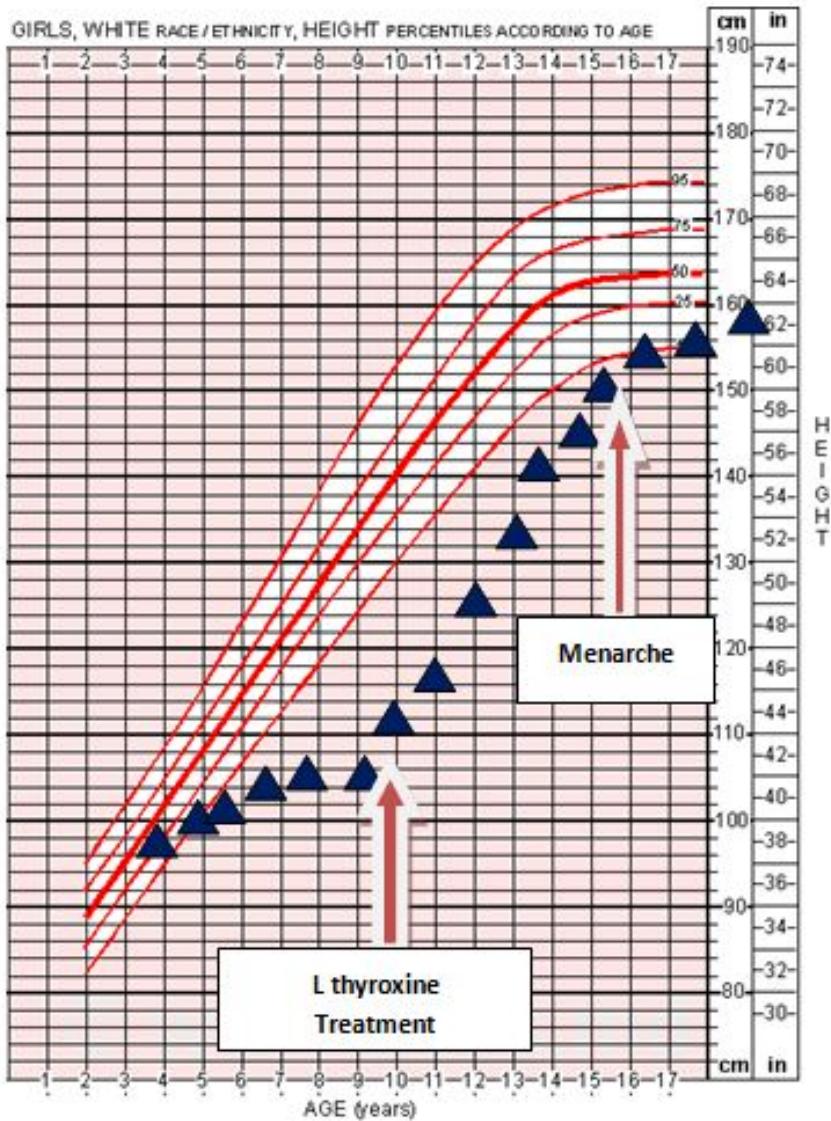
Negative Feedback of GH



Other Hormones Influencing Growth

Insulin	Stimulates fetal growth Stimulates postnatal growth by stimulating secretion of IGF-1 Stimulates protein synthesis
Thyroid hormone	Permissive for growth hormone's secretion and actions Permissive for development of the central nervous system
Testosterone	Stimulates growth at puberty, in large part by stimulating the secretion of growth hormone Causes eventual epiphyseal closure Stimulates protein synthesis in male
Estrogen	Stimulates the secretion of growth hormone at puberty Causes eventual epiphyseal closure
Cortisol	Inhibits growth Stimulates protein catabolism

Treatment of Hypothyroidism



Acromegaly

- Pituitary tumor of the somatotropes
- Overproduction of GH
- Clinical presentation
 - Bone growth
 - Protruding brow and jaw, spacing of teeth
 - Low body fat increased muscle
 - Insulin resistant/diabetic



Dwarfism/Growth Hormone Deficiency

- Congenital or immune destruction of somatotropes
- Can be GH deficiency or GH resistance
- Can be secondary to hypothyroidism
- Clinical features
 - Reduced height
 - Reduced muscle mass
 - Elevations in fat mass
 - Resistance to diabetes

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