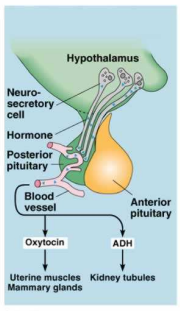
Hormones that Affect Growth, Development and Metabolism

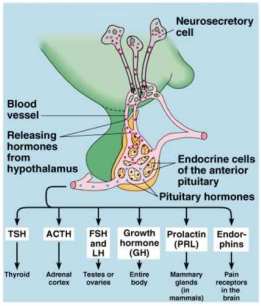
SBI 4UI

The Pituitary Gland

- about 1 cm in diameter (about the size of a pea), with two lobes:
  - **posterior pituitary**
    - part of nervous system
    - does not produce any hormones, but stores and releases ADH and oxytocin
  - **anterior pituitary**
    - true hormone-synthesizing gland
    - produces and stores six major hormones (TSH, ACTH, PRL, hGH, FSH, LH

The Pituitary Gland





Human Growth Hormone

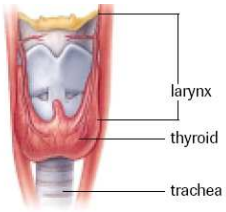
- produced and secreted from anterior pituitary
- ultimately affects almost every body tissue, for example:
  - protein synthesis
  - cell division and growth (especially of cartilage, bone and muscle)
  - metabolic breakdown and release of fats stored in fat tissue

GH over/underproduction

- In children:
  - Low secretion: **dwarfism**
  - High secretion: **gigantism**
- In adults (after growth plates fuse)
  - **acromegaly**

Thyroid Gland

- located directly below larynx
- has two lobes (one on each side of the trachea)
- releases **thyroxine (T_4)**



Thyroxine

- Regulate metabolic rate:
  - Higher secretion = higher metabolic rate
  - Lower secretion = lower metabolic rate
    - Can't break down sugars as quickly – excess glucose → glycogen → fat
    - Muscle weakness, cold intolerance, and dry skin and hair

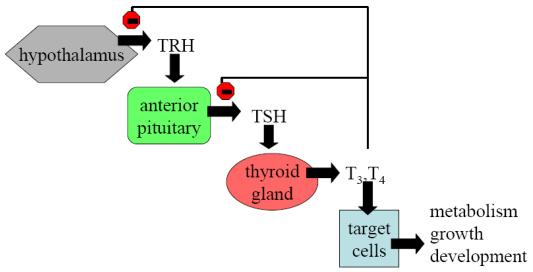
Thyroxine

- **hypothyroidism**
  - condition resulting when thyroid produces extremely low levels of thyroxine
- **hyperthyroidism**
  - condition resulting when thyroid produces extremely high levels of thyroxine

Thyroxine Regulation

- Negative feedback
- Increase in metabolic rate:
  - Hypothalamus secretes **thyroid-releasing hormone (TRH)**
  - TRH → pituitary to release **thyroid-stimulating hormone (TSH)**
  - TSH → thyroid gland to release thyroxine
  - thyroxine increases cells' sugar utilization
- Higher thyroxine levels inhibits TRH release from hypothalamus

Thyroxine Feedback Control



Thyroid Disorders

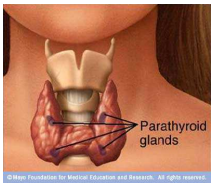
- Inadequate iodine:
  - Decrease in thyroxine secretion
  - → more TSH produced
  - → thyroid enlargement (goitre) (no negative feedback, so thyroid is stimulated more and more)

The Thyroid Gland and Calcitonin

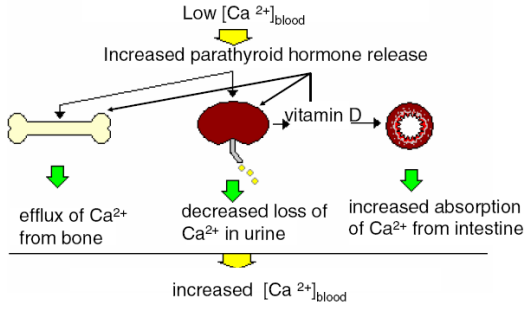
- calcium is essential for healthy teeth and skeletal development
- calcium also plays an important role in nerve conduction, blood clotting and muscle contraction
- when the concentration of calcium in the blood rises too high, **calcitonin** is released:
  - stimulates the uptake of calcium into bones

Parathyroid Glands

- Hidden within thyroid gland
- If removed: tetanus (muscle seizing caused by abnormal calcium levels)
- Not controlled by nerves – respond directly to local chemical changes
  - Ex. Low calcium in blood stimulate parathyroid hormone (PTH) release
  - Calcium levels increase in blood and phosphate levels decrease
  - Increase in calcium inhibits PTH release



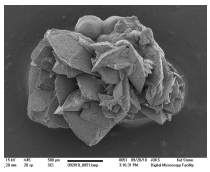
PTH regulation of calcium



http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/thyroid/pth_targets.gif

PTH regulation of calcium

- Increase in Ca^{2+} inhibits PTH release
- Too much PTH:
  - Bone breakdown
  - Calcification of blood vessels,
  - Formation of kidney stones
- Too little PTH:
  - Vit.D inactivation
  - Rickets



Try this:

- Learning Check Q. Pg. 399 #7-12
- Learning Check Q. Pg. 402 #13,14,16