9.2 Hormonal Regulation of Growth
Hormonal Regulation of Growth

- Pituitary gland regulates growth and development
- Thyroid gland regulates metabolic rate
  (exception: some hormones for growth and development)
The Pituitary Gland

- Located below the hypothalamus at the base of the brain
- About the size of a pea (1 cm)
- Has two lobes:
  1. posterior lobe
  2. anterior lobe
The Posterior Pituitary Gland

- Part of the nervous system
- Stores and secretes antidiuretic hormone (ADH) and oxytocin
- These hormones are produced in the hypothalamus
The Anterior Pituitary Gland

- Produces and secretes six major hormones
  - TSH
  - ACTH
  - PRL
  - hGH
  - FSH and LH
- Hypothalamus stimulates the release of these hormones
Human Growth Hormone

- Regulates growth, development, metabolism
- Produced and secreted by the anterior pituitary gland
- Sent to the liver
  - liver releases growth factors
  - Increases:
    - protein synthesis
    - cell division and growth
    - breakdown and release of fats in adipose tissue
Human Growth Hormone

During childhood:
- Excess → gigantism
- Insufficient → dwarfism
Human Growth Hormone

In adulthood

- Excess hGH $\rightarrow$ acromegaly
- Cannot increase in height
- Results in widening of bones and soft tissues

- Debilitating headache
- Enlarged heart, liver, and kidneys
- Coarse facial features: prominent forehead, enlarged nose, tongue, and lips, widely spaced teeth
- Other effects: fatigue, excessive perspiration, visual disturbances, breathing difficulties, missed menstrual periods, impotence

- Enlarged hands and feet
The Thyroid Gland

- Lies below the larynx
- Has 2 lobes
- Produces and secretes thyroxine ($T_4$):
  - Increases metabolic rate of fats, proteins, and carbohydrates for energy
  - Increases cellular respiration in heart, skeletal muscles, liver, and kidneys
High thyroid hormones: 
- Overproduction of thyroxine 
- Can result in Graves’ disease (immune system attacks the thyroid gland) 
- Treated with medication or removal of part of the thyroid gland 
- Symptoms: anxiety, insomnia, weight loss

Low thyroid hormones: 
- Low production of thyroxine 
- Can result in cretinism (stocky, shorter, delayed mental development) 
- Hormonal injections are required in childhood 
- Symptoms: fatigue and weight gain due to slow metabolism
(1) hypothalamus secretes a releasing hormone
(2) anterior pituitary releases TSH into the bloodstream
(3) TSH targets the thyroid gland
(4) Thyroid secretes thyroxine into the bloodstream → increase cellular respiration in target cells
(5) High levels of thyroxine cause negative feedback on the pituitary and hypothalamus, shutting down production of TSH.
T4 Regulation

(1) hypothalamus secretes a releasing hormone

(2) anterior pituitary releases TSH into the bloodstream

(3) TSH targets the thyroid gland

(4) Thyroid secretes thyroxine into the bloodstream → increase cellular respiration in target cells

(5) High levels of thyroxine cause negative feedback on the pituitary and hypothalamus, shutting down production of TSH
T4 Regulation

- The thyroid gland requires **iodine** to make thyroxine.
- Insufficient iodine in the diet:
  - Cannot make thyroxine.
  - No signal to stop TSH secretion.
  - Constant stimulation of the thyroid gland by TSH.
  - Causes a **goitre** (an enlargement of the thyroid gland).
- Dietary sources of iodine: seafood and dairy products.
- In Canada, iodine is added to table salt.
Calcium Homeostasis

- an essential mineral for nerve conduction, muscle contraction, skeletal development, and healthy teeth

- calcium levels in the blood are regulated in a negative feedback system by two hormones:

  - calcium levels **too high** → calcitonin is released
  - calcium levels **too low** → parathyroid hormone (PTH) is released
When blood calcium levels are too high, the **thyroid gland** secretes **calcitonin**:  
- promote uptake of calcium by the bones
When blood calcium levels are low, the parathyroid glands release parathyroid hormone (PTH):

- stimulates bones to break down bone material and secrete calcium into the blood
- stimulates kidneys to reabsorb calcium from the urine. This activates vitamin D, which stimulates the absorption of calcium from the digestive tract