

# TOPIC 6.6: HORMONES & HOMEOSTASIS

## Homeostasis

Homeostasis is the maintenance of a constant internal environment within physiological tolerance limits

- A disease ensues if a factor deviates from its normal range

Physiological processes are regulated by **negative feedback**

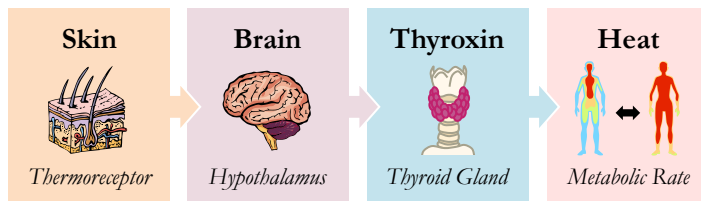
- An effect is antagonistic (opposite) to the stimulus
- This means the detected change is reversed

## Thermoregulation

Body temperature is regulated by the hormone **thyroxin**

- Thermoreceptors (skin) send signals to the hypothalamus
- Thyroxin is released from the thyroid gland when body temperature is low and increases metabolism (*generates heat*)

Thyroxin production requires iodine and a deficiency will result in **goitre** (enlargement of the thyroid gland)



## Circadian Rhythms

Circadian rhythms are regulated by the hormone **melatonin**

- Photoreceptors (eyes) send signals to the hypothalamus
- Melatonin is secreted by the pineal gland (in the brain)
- Melatonin release is inhibited by light (levels high at night)
- High levels of melatonin promote sleep in diurnal animals

Changing time zones can disrupt melatonin release (**jet lag**)

- Melatonin supplements can recalibrate sleep patterns

## Appetite Control

Appetite suppression is regulated by the hormone **leptin**

- Adipose cells secrete leptin to suppress appetite ( $\downarrow$  *hunger*)
- Leptin binds to receptors located in the hypothalamus

Over-eating causes more fat cells to be produced (**obesity**)

- Over time, obese people become desensitized to leptin and therefore are more likely to continue to over-eat
- Hence, leptin treatments for obese people are ineffective (obesity linked to leptin *unresponsiveness* – not a deficiency)

## Endocrine System

The endocrine system releases chemical messengers called hormones into the blood to act on distant target cells

- Hormones only act on the cells with a *specific* receptor

The endocrine system works in tandem with the nervous system to maintain physiological balance (homeostasis)

- Hormones initiate slower responses (longer durations)

## Blood Glucose Regulation

Blood sugar levels are regulated by **insulin** and **glucagon**

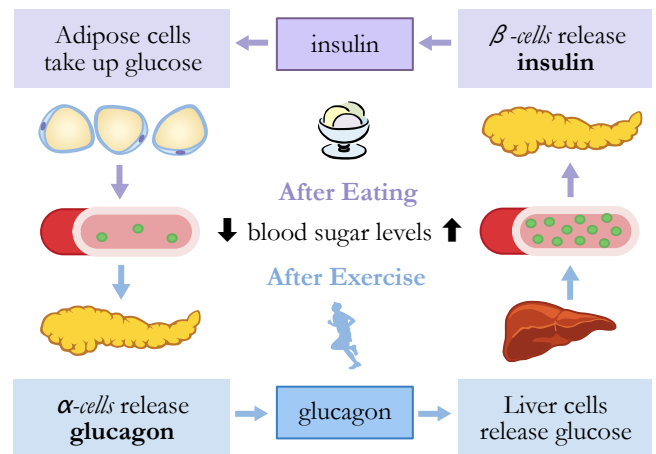
- These hormones are secreted by cells in the pancreas

Insulin is secreted by  $\beta$ -cells to lower blood sugar levels

- Stimulates glucose uptake by the liver and adipose cells
- Increases the rate of glucose metabolism ( $\uparrow$  *respiration*)

Glucagon is secreted by  $\alpha$ -cells to raise blood sugar levels

- Stimulates glycogen breakdown within the liver
- Decreases the rate of glucose metabolism ( $\downarrow$  *respiration*)



## Diabetes

**Diabetes** is a disorder that prevents blood sugar regulation

- It can be either type I (IDDM) or type II (NIDDM)

	Type I	Type II
Onset	Early (childhood)	Late (adulthood)
Effect	Body does not <i>produce</i> insulin	Body does not <i>respond</i> to insulin
Cause	$\beta$ -cells destroyed (autoimmune?)	Insulin receptors down-regulated
Treatment	Insulin injections	Diet management