

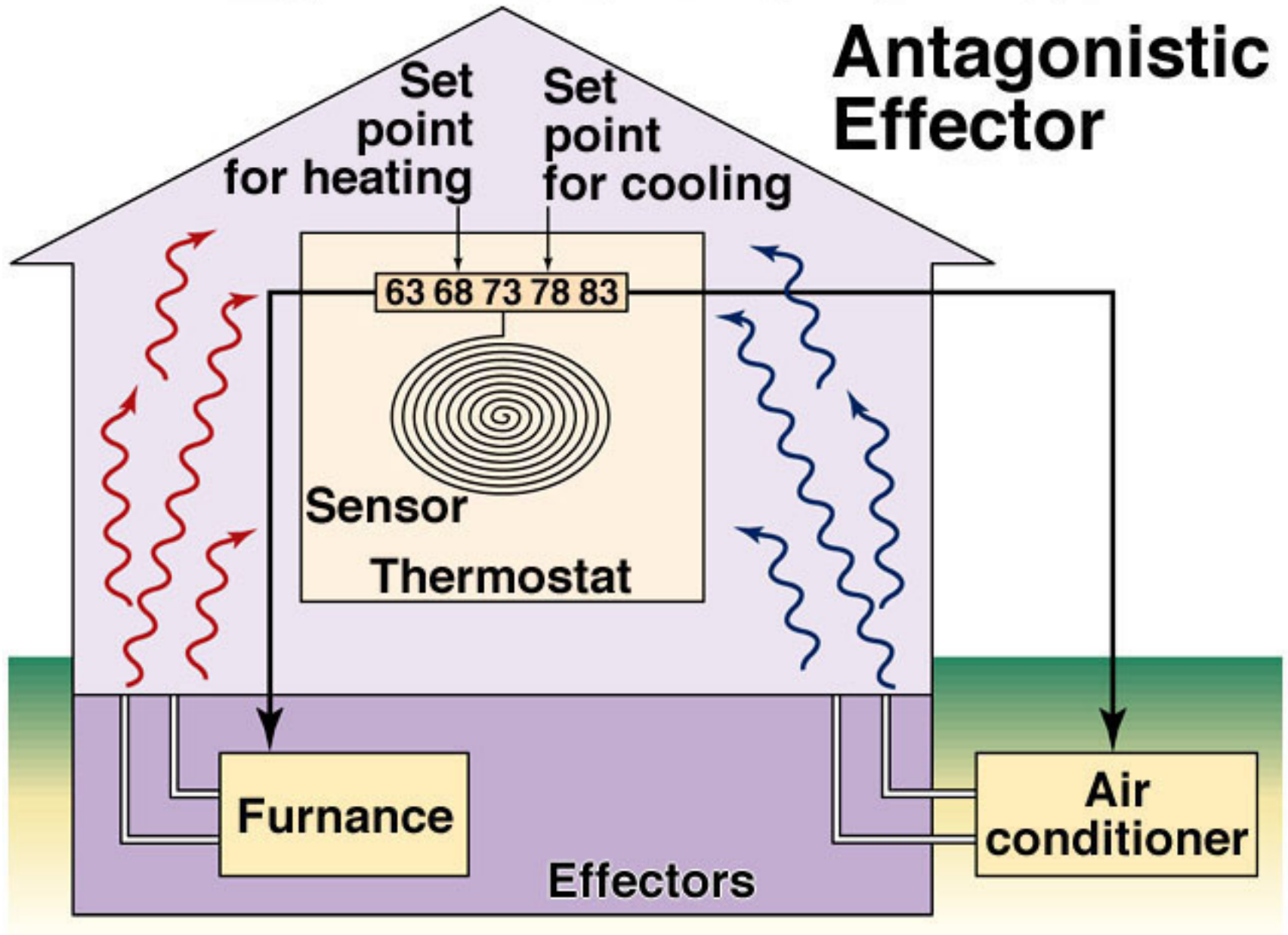
# Hormones

# Homeostasis

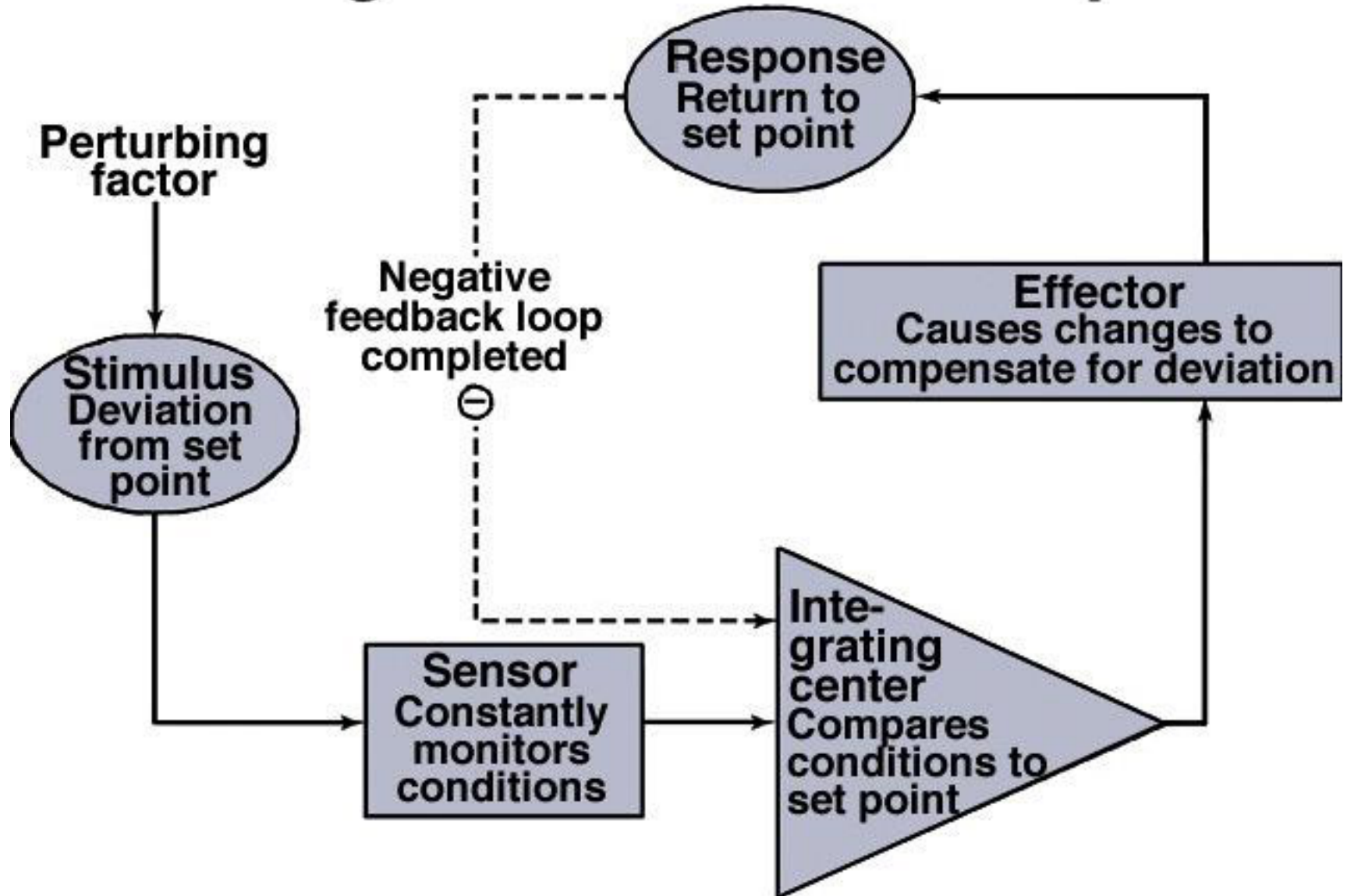
Dynamic Equilibrium

Negative Feedback

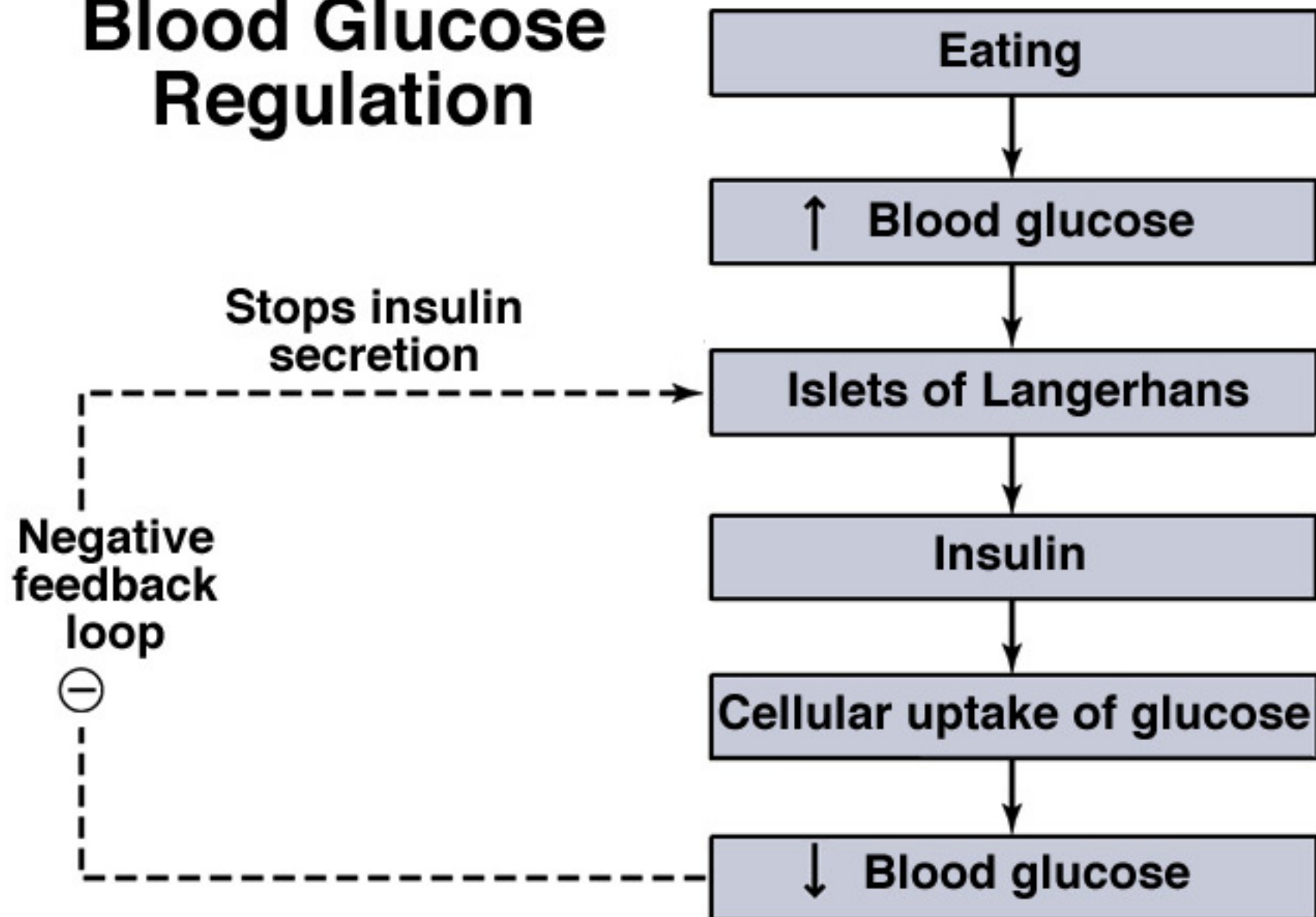
Antagonistic Hormones



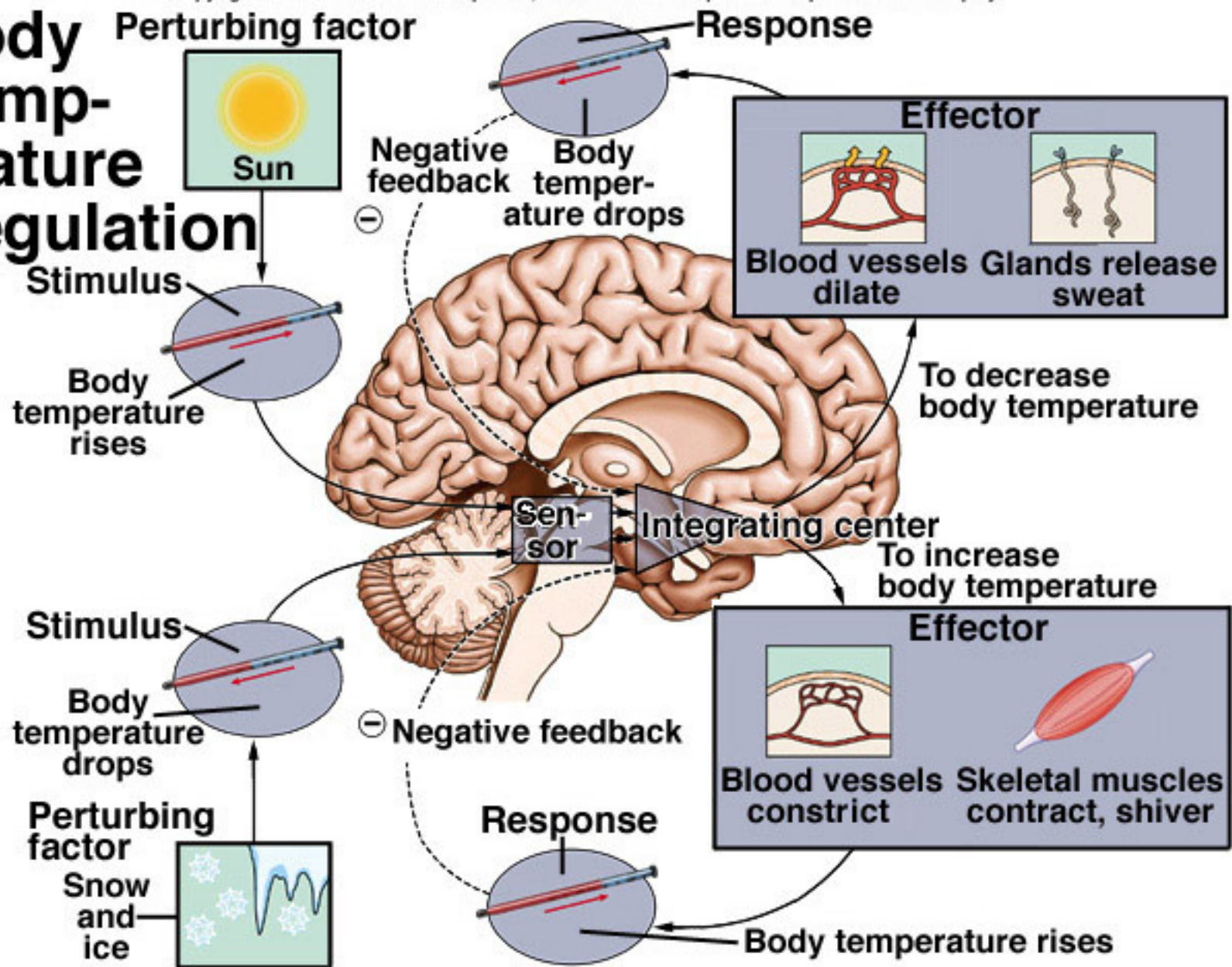
# Negative Feedback Loop



# Blood Glucose Regulation



# Body Temperature Regulation





# Chemical Signals in Animals

- Endocrine system
  - Composed of hormone secreting cells and/or glands
- Related to and interconnected to the nervous system
  - Nervous system – high speed short lived effects
  - Endocrine system – slow longer lasting effects

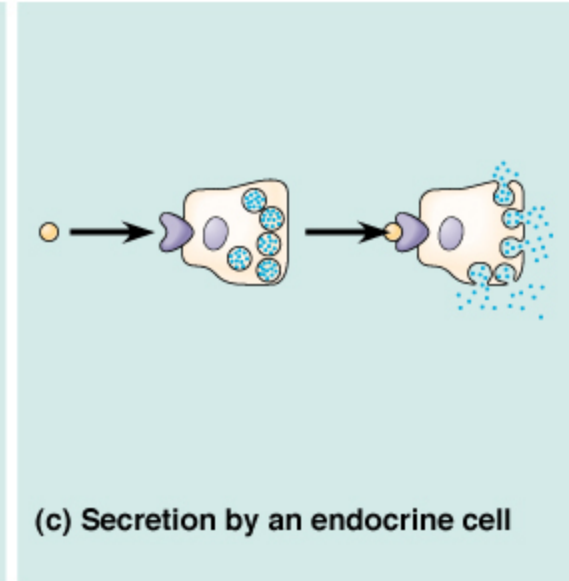
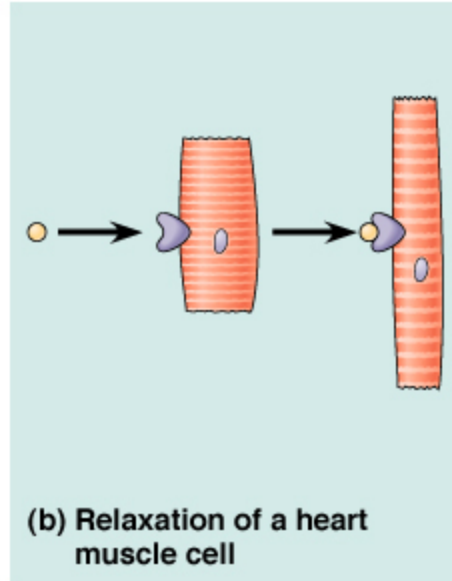
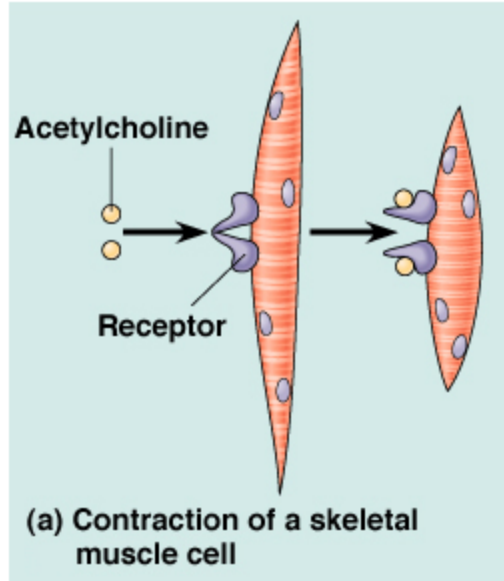
# Protein Activation and Inhibition

- Direct protein modification
  - Example – peptide hormones
  - Hormone binds to receptor protein on cell surface
  - Activates signal transduction cascade
- Transcriptional control
  - Example – steroid hormones
  - Hormone enters the cell and binds to transcription factor
  - Transcription factor/hormone combination binds to DNA affecting transcription of specific genes.



# Same Signal – Different Effect

- Signals used in different context have different effects on target cells
- Effect depends on proteins receiving the signal



# Hormones

- Four main types
  - Peptide hormones
  - Steroid hormones
  - Thyroid hormones
  - Catecholamine hormones

# Peptide Hormones

- Example – insulin and glucagon
  - Produced by Langerhans cells in pancreas
  - Small protein
- Antagonistic pair
  - Insulin (beta cells) – lowers glucose level
  - Glucagon (alpha cells) – raises glucose level

# Glucose Homeostasis

## ↑ Glucose – insulin released

– Most cells have insulin receptors

- Cells take up glucose from blood
- Slows glycogen breakdown in liver
- Stops sugar production from amino acids and fatty acids

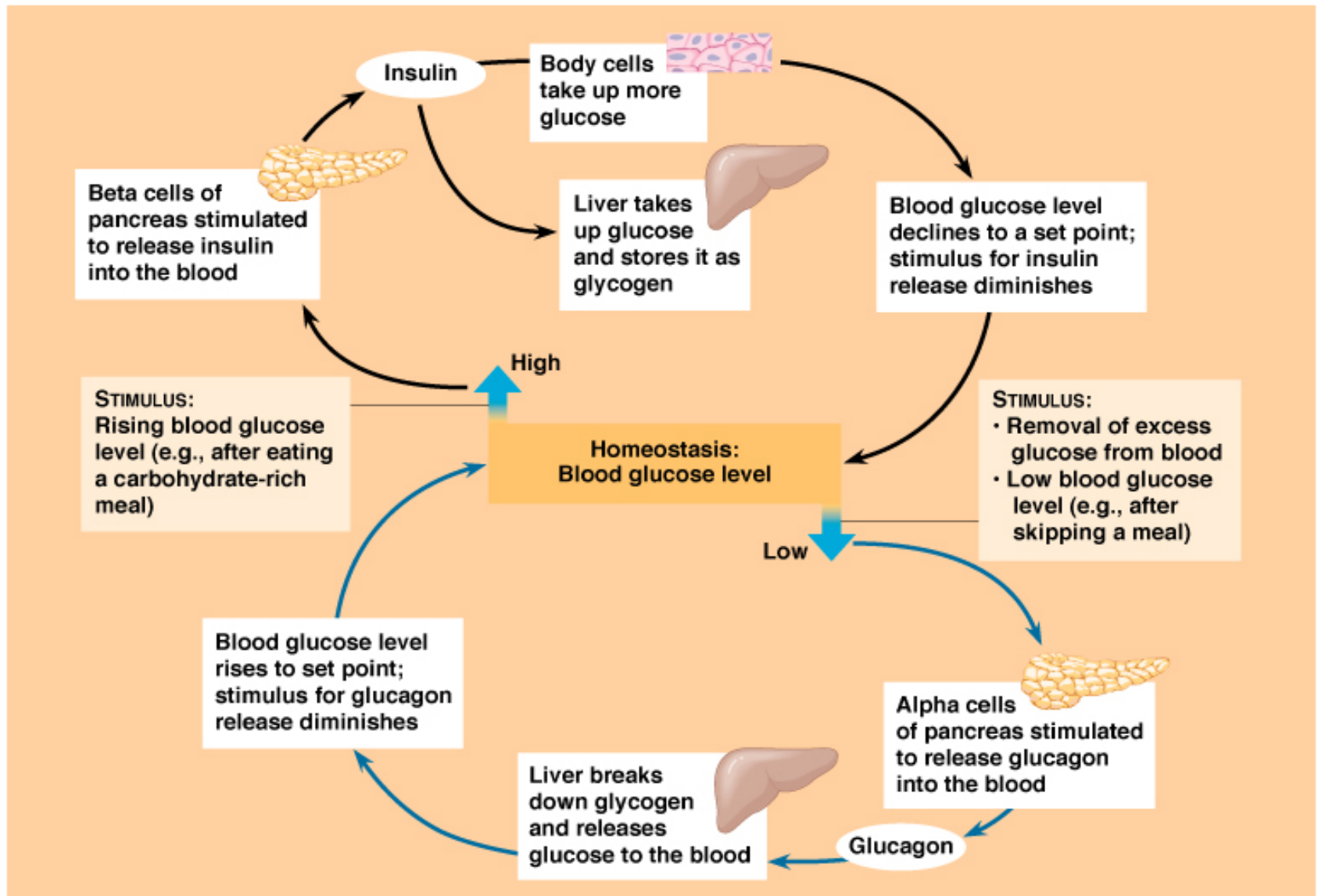
• 90mg/100ml

## ↓ Glucose – glucagon releases

– Liver cells have glucagon receptors

- Glycogen converted to glucose
- Fats and amino acids converted to sugar

# Glucose Homeostasis



# Steroid Hormones

- Example – corticosteroids
  - Produced by the adrenal cortex
  - Small lipophilic molecule
  - Can pass through the plasma membrane
  - Control at the transcriptional level

# Catecholamine Hormones

- Example – epinephrine and norepinephrine
  - Synthesized in the adrenal medulla
  - Derived from the amino acid tyrosine

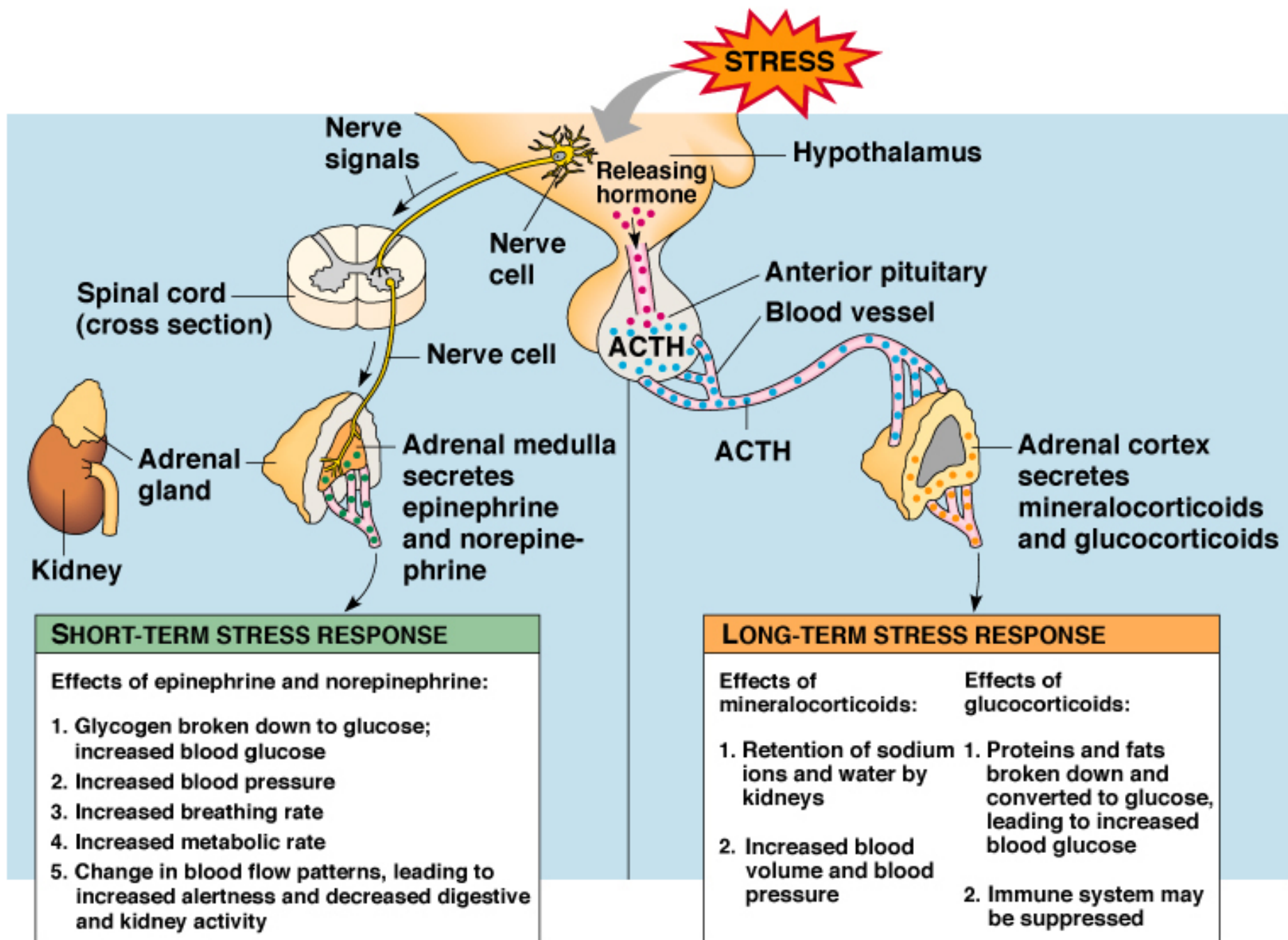


# Stress Response

- Short term response
  - Increase glucose (break down glycogen)
  - Increase heart and breathing rate
  - Increase blood pressure
  - Increase metabolic rate
  - Divert blood flow to brain and skeletal muscles
- Long term response
  - Increase blood volume and pressure
  - Breakdown of protein and fat into sugar

# Stress Response Hormones

- Adrenal medulla (short terms stress response)
  - Directly stimulated by nerve cells from hypothalamus
  - Produces epinephrine and norepinephrine
    - Catecholamine hormones
- Adrenal cortex (long term stress response)
  - Hypothalamus → releasing factor → pituitary
  - Pituitary → ACTH → adrenal cortex
  - Produces corticosteroids



# Thyroid Hormones

- Control metabolism and development
- Two hormones derived from tyrosine
  - Triiodothyronine (T3)
  - Thyroxine (T4)
- Controlled by negative feedback loops
  - Hypothalamus
    - TRH (TSH-releasing hormone)
  - Anterior pituitary
    - TSH (thyroid stimulating hormone)

# Thyroid Negative Feedback

