

INTRODUCTION TO HOMEOSTASIS

Important variables within the body:

- blood sugar
- fluid balance
- body temperature
- oxygen levels
- blood pressure
- pH

These variables must stay within certain ranges.

Changes in the external environment can cause these variables to change.

Homeostasis:

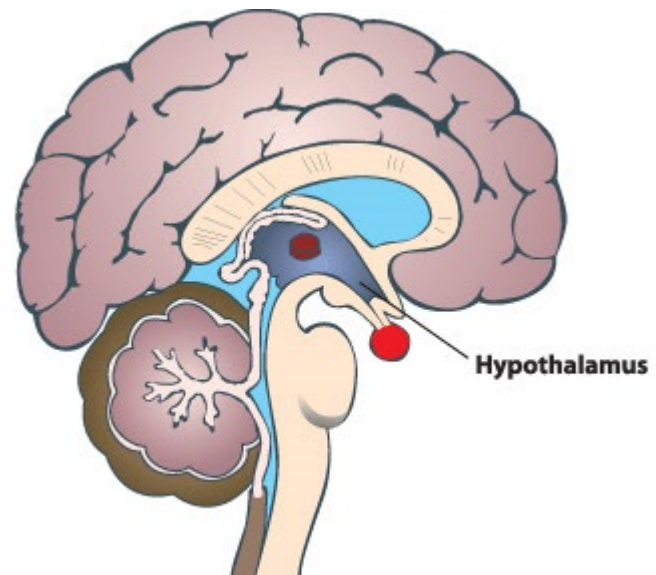
The process by which a stable internal environment is maintained despite changes in the external environment.

Components of a homeostatic control system:

Component	Function
Monitor	detects a change in variable
Co-ordinating centre	receives a message from the monitor. directs a response via a regulator.
Regulator	carries out the response initiated by the co-ordinating centre

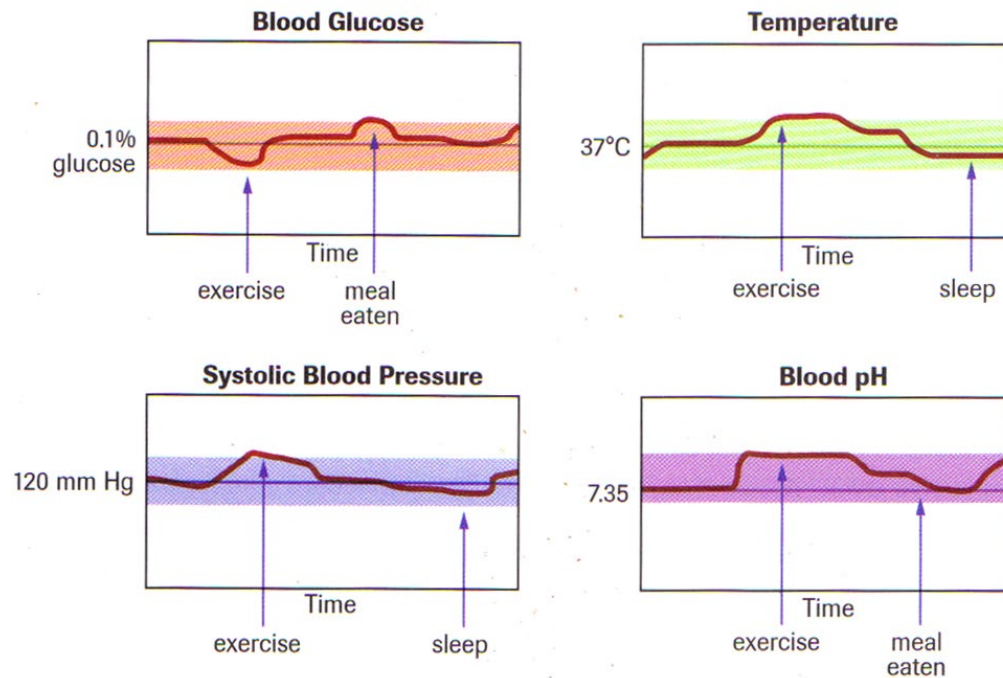
The hypothalamus

- Part of the brain
- Often serves as the co-ordinating centre:
 - Receives messages from monitors
- Initiates a hormonal/nervous response



Dynamic equilibrium

- Homeostasis is also called **dynamic equilibrium**:

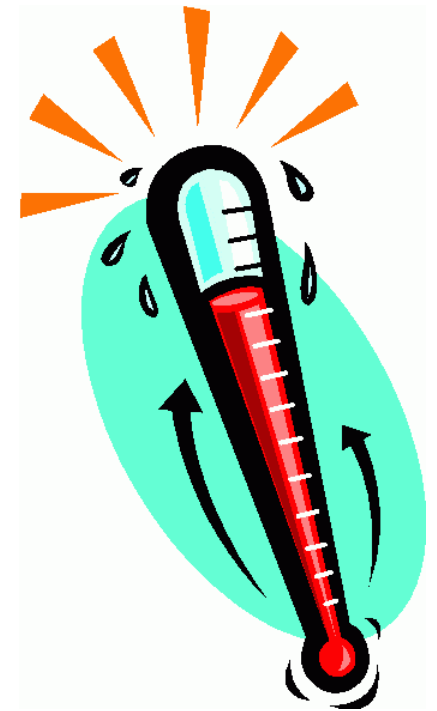


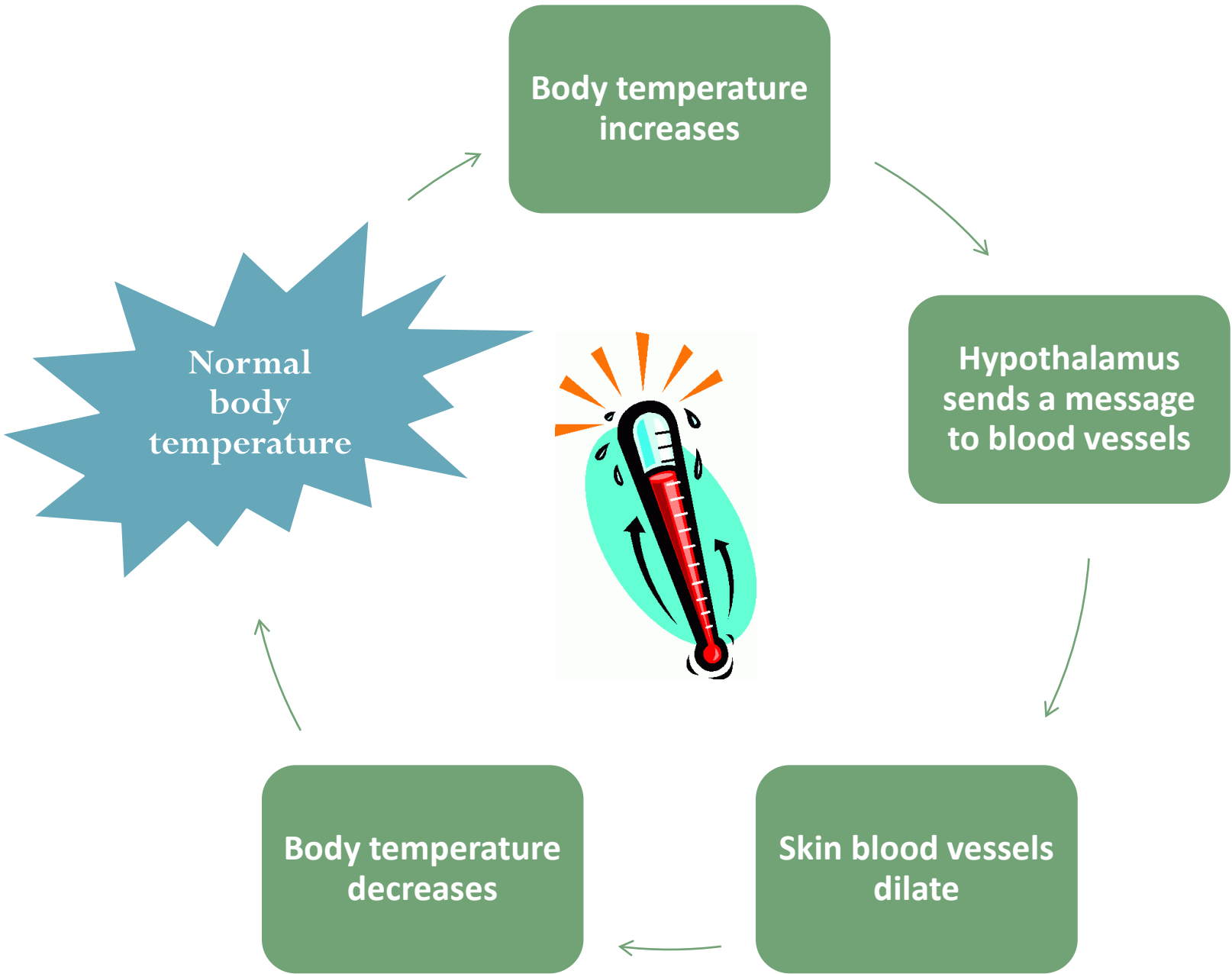
- Conditions *do* fluctuate, but within an acceptable range

- How is dynamic equilibrium maintained?
 - Feedback systems
 - Negative feedback
 - Positive feedback

Negative feedback

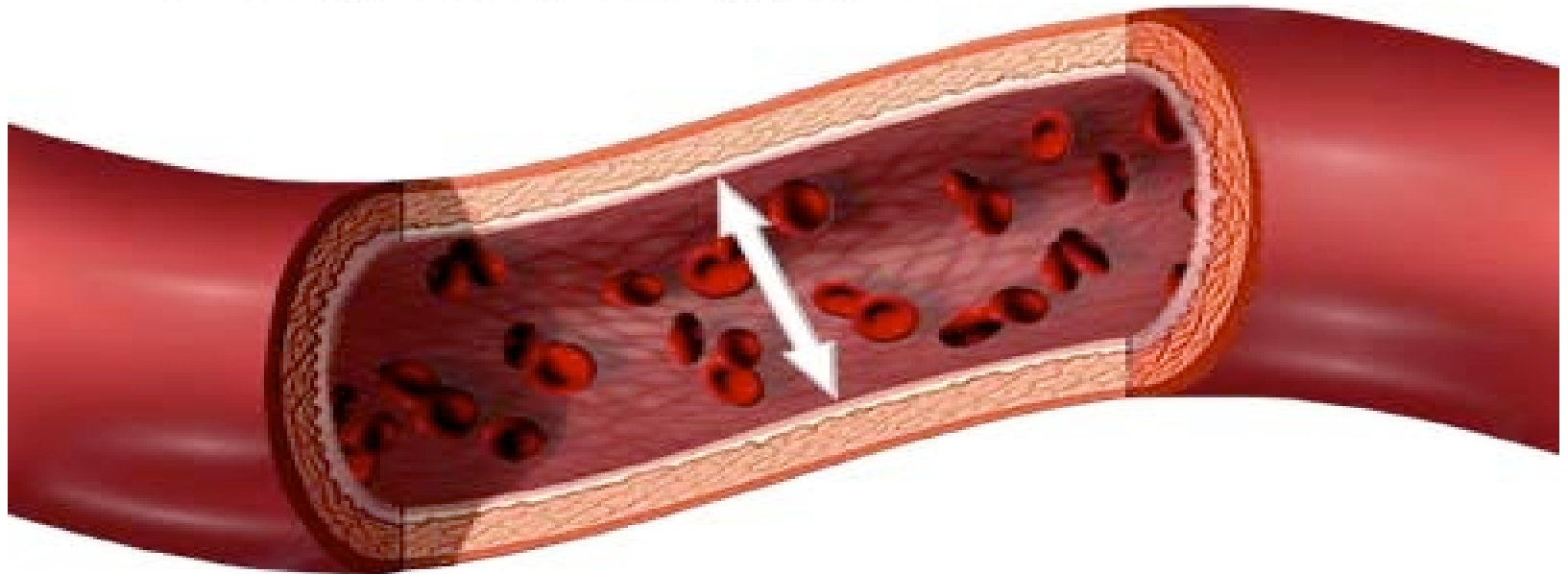
- **Negative feedback:** Response triggered by changed conditions serves to reverse the change
- E.g., Body temperature increases → Skin blood vessels dilate → Body temperature decreases





Example: Blood Pressure Regulation

Blood pressure is the measurement of force applied to artery walls

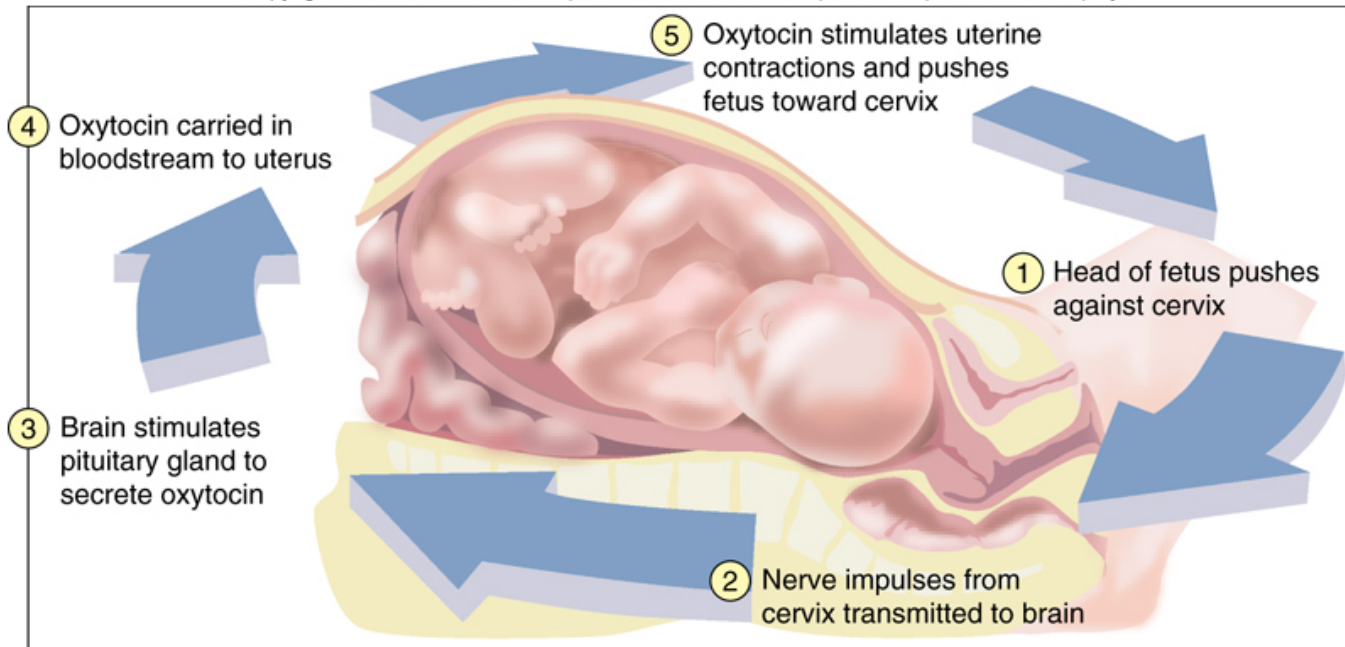


Positive feedback

- **Positive feedback:** The response triggered by changing conditions serves to move the variable even further away from its steady state
- E.g., uterine contractions are stimulated by oxytocin → baby moves towards cervix → more oxytocin is released

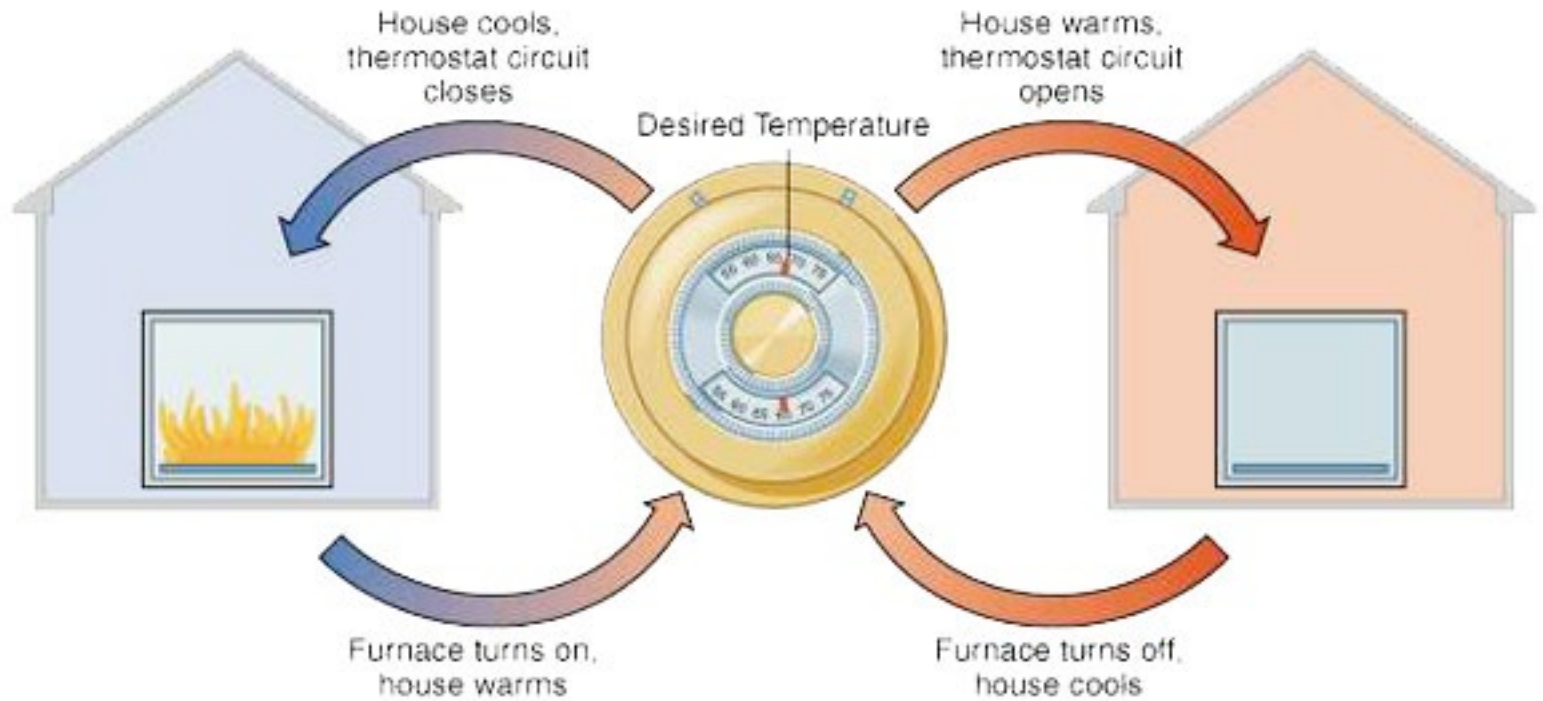


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Thermoregulation

Maintaining body temperature



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Body temperature

Average human body temperature: 37°C

- Core body temperature is slightly higher
- Interindividual variation



Thermoregulation

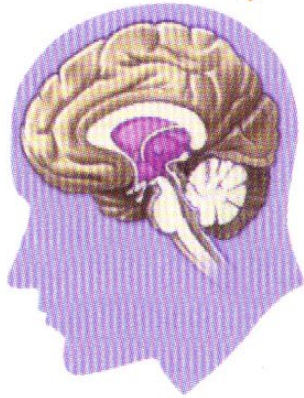
- **Thermoregulation:** The maintenance of body temperatures within a range that enables cells to function effectively
 - Recall: Enzymes have optimal temperatures
 - High temperatures can denature proteins

Types of temperature stress

- Heat stress
- Cold stress



coordinating centre:
hypothalamus turns
on cooling systems

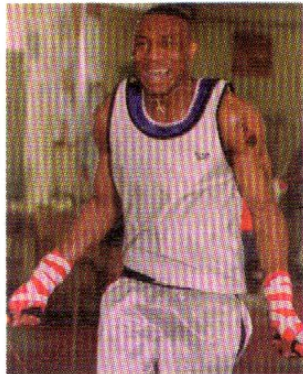


regulator: skin blood vessels
dilate; increased blood flow to
skin; heat exudes from skin



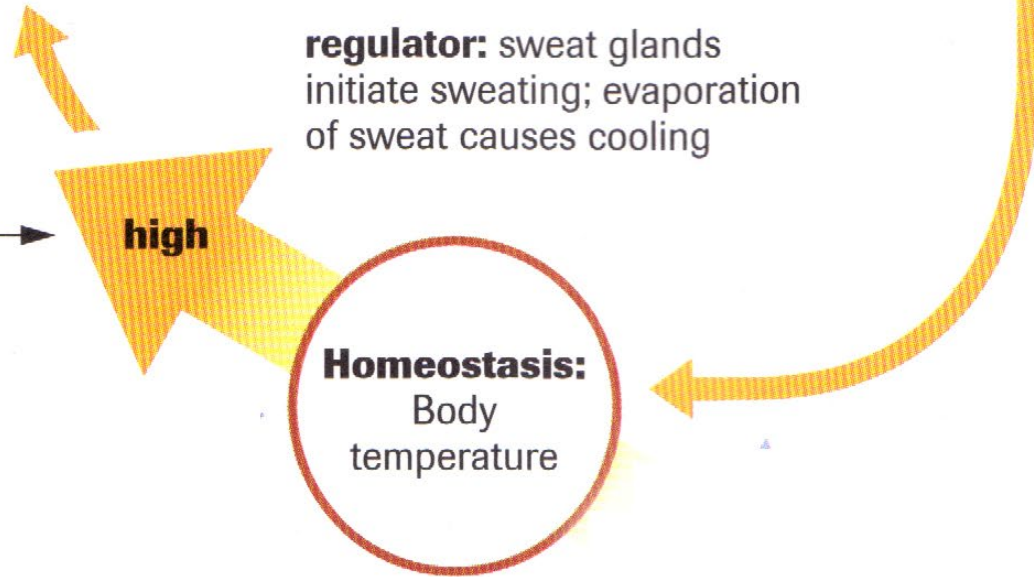
regulator: sweat glands
initiate sweating; evaporation
of sweat causes cooling

result: body
temperature
decreases;
hypothalamus
turns off
cooling
systems



high

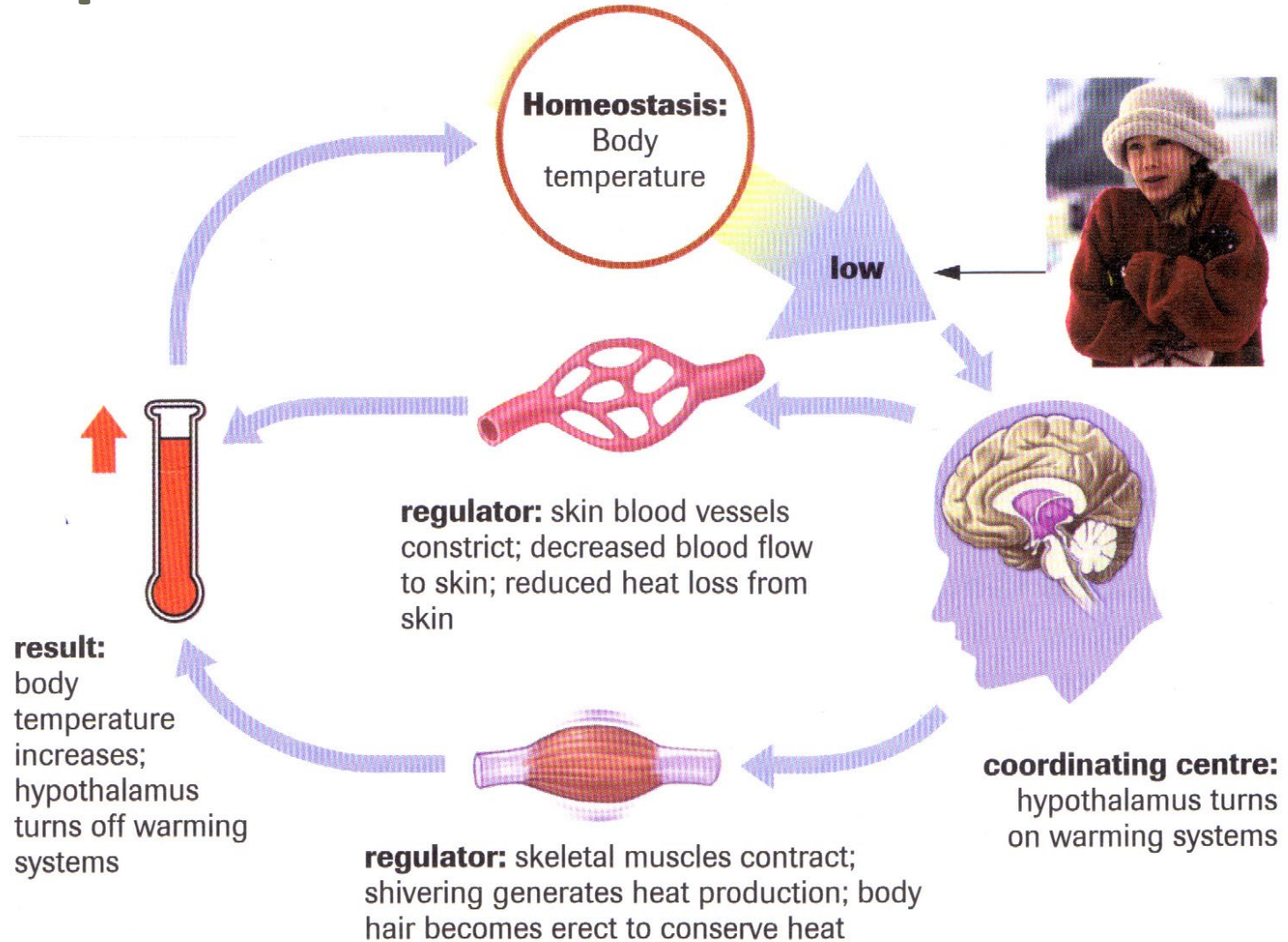
Homeostasis:
Body
temperature



Response to Heat Stress

- Co-ordinating centre is the *hypothalamus*
- Responses:
 - Skin blood vessels will dilate
 - Sweat glands will produce perspiration
- Both responses serve to *lower* body temperature
→ Return to normal range

Response to Cold Stress



Response to Cold Stress

- Co-ordinating centre is the *hypothalamus*
- Responses:
 - Skin blood vessels will constrict
 - Skeletal muscle will contract rapidly (shivering), increasing metabolism
 - Smooth muscle around hair follicles will contract, producing goosebumps
- Responses serve to raise body temperature →
Return to normal range

Prolonged exposure to cold stress

- May cause an increase in the rate of metabolism
- Special fat cells called “brown fat”
 - Particularly important for babies



Hypothermia: Occurs when core body temperature drops below normal range.

- Usually results in coma, then death

Summary of thermoregulation

Stimulus	Physiological response	Adjustment
Cold	<ul style="list-style-type: none">•constriction of blood vessels in skin•hairs on body erect•shivering	<ul style="list-style-type: none">•heat is conserved•heat is generated by increasing metabolism
Heat	<ul style="list-style-type: none">•dilation of blood vessels in skin•sweating	<ul style="list-style-type: none">•heat is released

Homework