

Thermoregulation

- Different species of animals are adapted to different temperature ranges, and each animal has an optimal temperature range
- Thermoregulation is the maintenance of body temperatures within a range that enables cells to function efficiently
- Invertebrates (and most fish, amphibians and reptiles) are referred to as ectotherms because they depend on air (or water) temperature to regulate metabolic rates
- To overcome this limitation, some reptiles have developed behavioural adaptations (like sunning themselves or retreating to the shade) to regulate body temperature
- Mammals and birds are referred to as endotherms; they are able to maintain a constant body temperature
- Endotherms adjust to decreases in environmental temperatures by increasing the rate of cellular respiration to generate heat
- In humans, normal body temperature is usually stated as 37°C, however there is variation within any population
- Some humans have their thermostat (hypothalamus) set a few degrees lower, while others operate at higher temperatures
- Temperatures vary throughout the day and core temperatures are more stable than peripheral temperatures

Responses to Heat Stress

- When sensors in the brain detect a rise in body temperature, a nerve message is coordinated within the hypothalamus and a signal is sent to the sweat glands to initiate sweating (see Fig. 2, p. 339)
- The evaporation of sweat causes cooling
- At the same time, a nerve message is sent to the blood vessels in the skin causing them to dilate, allowing more blood flow to the skin
- Along with water, valuable salts are also carried to the skin's surface and lost with perspiration
- The kidneys regulate the loss of electrolytes

Response to Cold Stress

- When external temperatures drop, thermoreceptors in the skin send a message to the hypothalamus (see Fig. 2, p. 339)
- The hypothalamus sends messages to the organs and tissues to increase body temperature
- Nerves going to the arterioles of the skin cause smooth muscles to contract and the arterioles constrict, limiting blood flow
- This reduces heat loss from the skin and retains heat in the core
- Nerve messages are also carried to the smooth muscle that surrounds the hair follicles in your skin, causing goosebumps
- This is a vestigial feature, left from when our ancestors had a thick coat of body hair and could trap air close to the skin for insulation

- The hypothalamus also sends nerve messages to initiate shivering, generating heat production by increasing metabolism
- Prolonged exposure (like in cultures that live in the arctic) to cold can create a hormonal response that also elevates metabolism
- This type of heat production is most often associated with a special adipose tissue called brown fat (esp. important in newborns who lack the ability to shiver)

- Hypothermia is a condition in which the body core temperature falls below the normal range
- A drop in temperature of only a few degrees can lead to a coma and possibly death
- Some people, mainly small children, have survived sustained exposure to cold temperatures, explained by the mammalian diving reflex
- When a mammal is submerged in cold water, the heart rate slows and blood is diverted to the brain and other vital organs to conserve heat

Homework

Make notes on "Research in Canada: Freezing cells" p. 340

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