

Section 9.3: Thermoregulation

Research This: Professor Popsicle, page 440

A. Hypothermia can be classified as mild, moderate or severe based on the core body temperature. Mild hypothermia occurs when the core body temperature drops to 35 to 32 °C. The person remains conscious, experiences vigorous shivering, thermoregulatory mechanisms are functioning, and the person is able to move. Moderate hypothermia occurs when the core body temperature drops to 32 to 28 °C. At these core temperatures, shivering slows as thermoregulatory mechanisms become ineffective, consciousness can be lost, and the heart starts to beat irregularly. Severe hypothermia occurs when the core body temperature drops to less than 28 °C. At this point, shivering stops completely, cardiac arrest occurs, and ultimately death.

B. For all levels of hypothermia, the person should be removed from the cold and all wet clothing removed. It is recommended that the person be insulated in as much warm dry clothing as reasonably possible. For mild hypothermia, the person should be wrapped in dry blankets and allowed to shiver to allow re-warming to occur. Give the person a warm sugary drink (but not alcohol), if they can swallow without assistance. If an external heat source is available (i.e., hot water bottle or another person), it can be applied to assist in re-warming. For moderate and severe hypothermia, re-warming treatment involves using warmed intravenous fluids, using warm fluids to irrigate and warm the body cavity, using warmed humidified air or in severe cases, re-warming using a heart and lung machine.

C. Hypothermia from water exposure is more dangerous than hypothermia from air exposure. This is because heat is lost much more rapidly in water than in air. For example, water at 10 °C can lead to death in one hour, where 10 °C in air is a nice spring day!

D. Frostbite is localized damage to the skin as a result of prolonged exposure to extreme cold. This is very different than hypothermia, which is a drop in a person's core body temperature.

E. Answers will vary. Summaries should clearly identify the levels of hypothermia, the treatments for each level, the sources consulted, and the results found.

Section 9.3 Questions, page 441

1. Thermoregulation is used by humans to control body temperature. When the body temperature is too low, the arteries in the skin constrict, shivering occurs, and behavioural patterns such as curling into a ball or putting on warm clothing occur. These help increase core body temperature. When the body temperature rises, the arteries dilate, the skin sweats, and one seeks out cooler areas or removes clothing to decrease core body temperature.

2. Answers may vary. Sample answer: Ectotherms would absorb thermal energy from the sun or a hot surface. Endotherms would engage in physical activity, put on warm clothing, and shiver.

3. Answers may vary. Sample answer: The last time I experienced a change in body temperature was when I had a fever. I began to sweat and took a cool bath to bring my body temperature back down to normal.

4. Summaries may vary. Findings should include reference to reducing injury to tissue by lowering body temperature, the effect of hypothermia on cell membranes and cell metabolic rate, risk involved with therapeutic hypothermia, and procedures for rewarming.

5. For both the Tundra and Sahara runs, dehydration would have been an issue. For the Tundra run, Ray would also have had to worry about hypothermia and frostbite, especially if he began to sweat as he ran. Wet clothing as a result of sweating could increase the risk of hypothermia and also result in frostbite.

- 6.** Allowing the extremities to be cooler than the core body temperature saves thermal energy. It is important for the core temperature to be higher because the vital organs, liver, heart, lungs, etc. are constantly at work and must maintain the homeostatic range to function properly.
- 7.** The species of ectotherms that live in tropical areas need less energy to thermoregulate and therefore can spend more energy growing.
- 8.** Answers may vary. Sample answer: Endothermy has several advantages, which include the ability of organisms to live in colder habitats, and the fact that increased temperature allows muscles to provide sustained power and increase performance. One disadvantage to endothermy is that it requires a lot of energy, and one needs to eat more to obtain that energy.
- 9.** Ontario is home to the four species of frogs that freeze during winter months: the wood frog, the spring peeper, the chorus frog, and the grey tree frog. All of these frogs live in forested areas with ponds in cold northern climates.
- 10.** Answers may vary. Sample answer: Animals survive seasons with cold weather by adding fat, seeking shelter, growing winter coats, and migrating south.
- 11.** The body sweats as you work; however, when it is cold outside, instead of evaporating like it does in the heat, the sweat can freeze and cause frostbite. Additionally, wet clothing can increase heat loss and lead to hypothermia.
- 12.** Both estivation and torpor are forms of dormancy or sleep. Estivation occurs in hot desert climates while torpor occurs in cold climates or winter.
- 13.** Diurnal torpor is being inactive or sleeping during part of the day and being active and awake the other part of the day. In the case of bats, they sleep during the day and are active at night. Hummingbirds and frogs also exhibit diurnal torpor, but they are awake and active during the day and sleep at night.