Temperature and radiant heat

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Thermoregulation is the ability of an organism to keep its body temperature within certain boundaries, even when the surrounding temperature is very different. This process is one aspect of homeostasis. Homeostasis is a state of stability between an animal's internal environment and its external environment. When external temperatures are cold, the body uses certain techniques to warm itself up. Likewise, as heat levels rise during physical activity, heat must be dissipated. Endothermic and exothermic animals cope with temperature changes in different manners. Behavior is the most active form of thermoregulation. Most animals are mobile, sensitive to their environment, and capable of complex behaviors.

The simplest thermoregulatory behavior consists of moving to a favorable location. For example, when a human’s temperature gets to cold, placing themselves next to a fire can help the body thermo regulate. Operational temperature may also be altered by changing posture in a certain direction. For example, lizards face the sun to minimize the area exposed to solar heating, or turn broadside to maximize it, and some ground squirrels use their tail as a sunshade. Some reptiles and amphibians also expand or contract pigmented cells in their skin to increase or decrease solar heating.

Endothermic vs. Ectothermic

Thermoregulation in organisms ranges from endothermic to ectothermic. Endotherms create most of their heat from metabolic processes, and are also referred to as warm-blooded. Ectotherms use external sources of temperature to regulate their body temperatures. They are also referred to as cold-blooded despite the fact that body temperatures often stay within the same temperature ranges as warm-blooded animals. Endothermic

oranisms regulate their own body temperature. An endothermic reaction is any chemical reaction that absorbs heat from its environment. To regulate body temperature, an organism may need to prevent heat gain in dry environments. Evaporation of water, either across respiratory surfaces or across the skin in those animals having sweat glands, helps in cooling body temperature to within the organism's tolerance range. Animals with a body covered by fur have limited ability to sweat, relying mostly on panting to increase evaporation of water across the moist surfaces of the lungs, the tongue, and mouth.

Endothermic organisms also have to warm their own body temperatures. Many different techniques can be used such as shivering. Also, the body is able to convert fat into heat to help warm the body. Ectothermic organisms regulate their body temperature by the use of external sources. These organisms minimize heat lose by the use of convection. These organisms accomplish this by entering a warm pool of water, or warm air current. Also, they can build an insulated nest or burrow. To cope with low temperatures, ectothermic organisms use radiant heat. An example of radiant heat is an organism laying on a hot rock that is exposed to the sun, absorbing the heat from the rock.

Thermoregulation in Different Environments (Humans)

Human thermoregulation is an important part of human homeostasis. Humans have been able to adapt to a great diversity of climates, including hot arid, hot humid, and cold. High temperatures and also low temperatures can cause serious stresses for the human body, placing it in great danger of

injury or even death. In order to deal with these climatic conditions, humans have developed physiologic and cultural means of adaptation.

In hot arid conditions, the body uses 3 main techniques to thermo regulate. These techniques include sweating, hairs lying flat, and smooth muscle walls relaxing. When the body sweats, it releases a liquid of mostly water to the surface of the skin. This causes heat loss by evaporating liquid off the skin, but also causes loss of water which can lead to dehydration. When the hairs lie flat on the skin, it prevents heat from being trapped. Finally, when the smooth muscle walls relax, it increases the blood flow through the artery; this redirects blood increasing heat loss by convection.

In hot-humid conditions, clothing can block evaporation. In these environments, it helps to wear light clothing such as cotton that is absorbent to sweat but resistant to radiant heat from the sun. This minimizes the gaining of radiant heat, while allowing as much evaporation to occur as the environment will allow. Clothing such as plastic fabrics that are resistant to sweat and do not help heat loss through evaporation, can actually contribute to heat stress.

In cold conditions, the body will not produce sweat which would cool the skin. The body will get “ goose bumps”. By doing so, this makes the hair stand up, causing an insulating layer. Shivering is also an option. By shivering, the muscles in the body work, producing heat. Blood will also be routed away from the skin layer. By doing so, the blood stays closer towards the inner body where the core temperature is warmer.

Diseases and Syndromes Relating to Thermoregulation

Hypothermia is a medical emergency that occurs when your body loses heat faster than it can produce heat, causing a dangerously low body temperature. Normal body temperature is around 98. 6 F. Hypothermia occurs as your body temperature passes below 95 F. (Boomer’s Health, 2011) Hypothermia usually occurs from exposure to low temperatures, and is frequently complicated by alcohol. Any condition that decreases heat production, increases heat loss, or impairs thermoregulation can contribute to hypothermia. Hypothermia risk factors include any condition that affects judgment, the extremes of age, poor clothing, chronic medical conditions, substance abuse, homelessness, and living in a cold environment. Hypothermia also occurs frequently in major trauma. Hypothermia is also observed in severe cases of anorexia.

Hyperthermia (heat stroke) is a serious medical condition in which the body's temperature reaches higher than normal levels, often due to prolonged exposure to heat or excessive physical activity. When body temperatures are above 104 degrees Fahrenheit or 40 degrees Celsius it is considered life-threatening. Heat stroke occurs when thermoregulation is overwhelmed by a combination of excessive metabolic production of heat, excessive environmental heat, and insufficient or impaired heat loss, resulting in an abnormally high body temperature. Significant physical exertion in hot conditions can generate heat beyond the ability to cool, because, in addition to the heat, humidity of the environment may reduce the efficiency of the body's normal cooling mechanisms. Raynaud’s phenomenon is named for the French physician Maurice Raynaud, who first recognized the condition in 1862. The disease causes an interruption of blood flow to the fingers, toes,

nose, and/or ears when a spasm occurs in the blood vessels of these areas. Spasms are caused by exposure to cold or emotional stress.

During an attack of Raynaud's, the body limits blood flow to the hands and feet. This makes the fingers or toes feel cold and numb and then turn white or blue. As blood flow returns and the fingers or toes warm, they may turn red and begin to throb and feel painful. In rare cases, Raynaud's affects the nose or ears. An attack most often lasts only a few minutes. But in some cases it may last more than an hour.

Erythromelalgia, also known as Mitchell’s Disease, is a condition characterized by episodes of pain, redness, and swelling in various parts of the body, particularly the hands and feet. These episodes are usually triggered by increased body temperature, which may be caused by exercise or entering a warm room. The associated pain and burning sensations can be extremely severe. People with Mitchell’s Disease often make major adjustments to their lifestyles to avoid flare-ups. Even in mild-to-moderate cases, normal functioning such as walking, standing, working, socializing, exercising, and sleeping may be impaired.

The figure 1. 1 shows the severity of Mitchell’s Disease. FIGURE 1. 1 Thermoregulation, In Closing... Without thermoregulation an organism cannot maintain a steady body temperature. If organisms didn't regulate their temperature, then their bodies would be at the mercy of their environment. The human body is full of self-regulating processes, but thermoregulation is one of the most important due to that fact that it is used at all times. When external conditions threaten the stability of the body it reacts, sometimes immediately. These reactions are necessary for organisms

to survive in the many environments they inhabit. From the cold mountains of the Rockies to the humid rain forests of South America, organisms are able to survive because of their ability to thermo regulate their internal temperature.