

Summary: Control of Body Temperature and Water Balance

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1 Mechanisms for maintaining homeostasis in climatically volatile conditions

There exist various permutations, or implementations, if you will, of the general principle of *thermoregulation*—the mechanism through which an internal temperature can be restricted to an acceptable range conducive to the survival of a host. Two of these “implementations” may be described as such¹:

- **Endothermic heat regulation:** Body heat is derived from the metabolic systems already possessed by a host.
- **Ectothermic heat regulation:** Body heat is derived from an external source.

1.1 Methods of heat exchange

As does thermoregulation, the act of *heat exchange* can occur in one of several ways:

- **Conduction:** the transfer of heat between objects that are in direct contact with each other.
- **Radiation:** the emission of electromagnetic waves, which can transfer heat between objects that are not in direct contact.
- **Convection:** the transfer of heat by the movement of air or liquid over a surface.
- **Evaporation:** the vaporization of molecules from the surface of a liquid.

1.2 A demonstration of heat exchange

Each of these disambiguations rely on the principle that heat flows from an object of higher temperature to one of lower temperature. Yet, they each serve unique purposes. For example, suppose an ectothermic lizard houses itself atop a warm rock. The aforementioned modes of heat exchange operate on the body temperature of the lizard in four ways:

1. *Conductively* — Heat is transferred between the surface of the rock and the scales of the lizard through the immediate contact established between the rock and the lizard.
2. *In a radiative manner* — Energy from the sun warms the lizard’s back. Furthermore, heat is released from the lizard itself, in much the same manner, into the environment.
3. *In a convective manner* — A breeze lifts heat from the lizard’s tail.
4. *In an evaporative manner* — Moisture evaporates from the nostrils of the lizard.

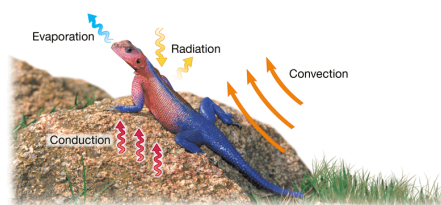


Figure 1: The lizard from our example

¹It is not uncommon for an animal to utilize both endothermic and ectothermic heat regulation mechanisms. Take, for example, the *Pygoscelis papua*—a member of the Penguin family—. While these birds do regulate body temperature in a largely endothermic manner, they do warm themselves in the sun. This is an example of both endothermic and ectothermic behavior. The same is true for the ectothermic lizard.

2 Classifications of thermoregulation adaptations

While the aforementioned principle of temperature regulation, or *thermoregulation* can be grouped into two disambiguations: endothermism and ectothermism, five common implementations of thermoregulation can be derived from these larger categorizations. More specifically, the aforementioned five distinct categorizations are as such:

1. **Metabolic heat production**
2. **Insulation**
3. **Circulatory adaptations**
4. **Evaporative cooling**
5. **Behavioral responses**