

# Mechanisms of Thermoregulation

The process of controlling body temperature is called **thermoregulation**. For many years, animals were classified as either homeotherms (= constant body temperature) or poikilotherms (= variable body temperature). Unfortunately, these terms are not particularly accurate for many animals; for example, some mammals (typical homeotherms), may

have unstable body temperatures. A more recent, thermal classification of animals is based on the source of the body heat: whether it is largely from the environment (**ectothermic**) or from metabolic activity (**endothermic**). This classification can be more accurately applied to most animals but, in reality, many animals still fall somewhere between the two extremes.

## How Body Temperature Varies



Aquatic invertebrates like jellyfish are true poikilotherms: their temperature is the same as the environment.



Tuna and some of the larger sharks can maintain body temperatures up to 14°C above the water temperature.



Hibernating rodents and bats let their body temperature drop to well below what is typical for most mammals.



Most birds and mammals maintain a body temperature that varies less than 2°C: they are true homeotherms.

### Poikilothermic

*Increasingly homeothermic*

### Homeothermic

Body temperature varies with the environmental temperature. Traditionally includes all animals other than birds and mammals, but many reptiles, some large insects and some large fish are not true poikilotherms because they may maintain body temperatures that are different from the surrounding environment.

Body temperature remains almost constant despite environmental fluctuations. Traditionally includes birds and mammals, which typically maintain body temperatures close to 37-38°C. Many reptiles are partially homeothermic and achieve often quite constant body temperatures through behavioral mechanisms.

## Source of Body Heat



With a few exceptions, most fish are fully ectothermic. Unlike many reptiles they do not usually thermoregulate.



Snakes use heat energy from the environment to increase their body temperature for activity.



Some large insects like bumblebees may raise their temperature for short periods through muscular activity.



Mammals (and birds) achieve high body temperatures through metabolic activity and reduction of heat losses.

### Ectothermic

*Increasingly endothermic*

### Endothermic

Ectotherms depend on the environment for their heat energy. The term ectotherm is often equated with poikilotherm, although they are not the same. Poikilotherms are also ectotherms but many ectotherms may regulate body temperature (often within narrow limits) by changing their behavior (e.g. snakes and lizards).

Endotherms rely largely on metabolic activity for their heat energy. Since they usually maintain a constant body temperature, most endotherms are also homeotherms. As well as birds and mammals, some fast swimming fish, like tuna, and some large insects may also use muscular activity to maintain a high body temperature.

## Daily temperature variations in ectotherms and endotherms

**Ectotherm:** Diurnal lizard (top right)  
Body temperature is regulated by behavior so that it does not rise above 40°C. Basking increases heat uptake from the sun. Activity occurs when body temperature is high. Underground burrows are used for retreat.

**Endotherm:** Human (bottom right)  
Body temperature fluctuates within narrow limits over a 24 hour period. Exercise and eating increase body temperature for a short time. Body temperature falls during rest and is partly controlled by an internal rhythm.

