Homeostasis: *keeping the balance*

- temperature
- blood sugar levels
- energy production
- water balance
- nutrients
- ion balance
- cell growth
1. What is considered to be normal body temperature in a human?

2. Why is temperature homeostasis important for an organism?
The relationship between body temperature and environmental temperature in two organisms.

![Graph showing the relationship between body temperature and environmental temperature for two organisms.](image)
# Conformers vs. Regulators

<table>
<thead>
<tr>
<th>Regulate internal environment</th>
<th>Conform to external environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain relatively constant internal conditions</td>
<td>Allow internal conditions to fluctuate along with external changes</td>
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</tbody>
</table>
Energy budgets for four animals

**Regulator**
- Basal metabolic rate: 340,000 kcal/yr
- Temperature regulation costs
- Growth
- Activity costs

(a) Total annual energy expenditures
- 60-kg female human from temperate climate: 800,000 kcal/yr
- 4-kg male Adélie penguin from Antarctica (brooding): 340,000 kcal/yr
- 0.025-kg female deer mouse from temperate North America: 4,000 kcal/yr
- 4-kg female python from Australia: 8,000 kcal/yr

(b) Energy expenditures per unit mass (kcal/kg•day)
- Deer mouse: 233 kcal/kg•day
- Adélie penguin: 438 kcal/kg•day
- Human: 36.5 kcal/kg•day
- Python: 5.5 kcal/kg•day
Take your forehead temperature

- Anonymously report using Active Votes
- View results
Take your forehead temperature

- Anonymously report using Active Votes
- View results

Why do you think there is so little difference in normal human body temperature while humans vary so much in other traits?
Homeostasis:
Internal body temperature of approximately 36–38°C
Increased body temperature (such as when exercising or in hot surroundings)

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Internal body temperature of approximately 36–38°C
Thermostat in hypothalamus activates cooling mechanisms.

**Increased body temperature** (such as when exercising or in hot surroundings)

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- Internal body temperature of approximately 36–38°C
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis: Internal body temperature of approximately 36–38°C
Evaporative Cooling

Cooling of a liquid's surface when a liquid evaporates.

– From the surface, as select water molecules are untethered from all hydrogen bonds, they escape into the atmosphere.

– The surface molecules with the highest kinetic energy are most likely to escape into gaseous form; the average kinetic energy of the remaining surface molecules is thus lower.
A terrestrial mammal bathing, an adaptation that enhances evaporative cooling
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis:
Internal body temperature of approximately 36–38°C

Vasodilation
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Body temperature decreases; thermostat shuts off cooling mechanisms.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis:
Internal body temperature of approximately 36–38°C
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Body temperature decreases; thermostat shuts off cooling mechanisms.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis: Internal body temperature of approximately 36–38°C

Decreased body temperature (such as when in cold surroundings)
Thermostat in hypothalamus activates cooling mechanisms.

Increased body temperature (such as when exercising or in hot surroundings)

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Homeostasis: Internal body temperature of approximately 36–38°C

Decreased body temperature (such as when in cold surroundings)

Body temperature decreases; thermostat shuts off cooling mechanisms.

Thermostat in hypothalamus activates warming mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Thermostat in hypothalamus activates warming mechanisms.
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Body temperature decreases; thermostat shuts off cooling mechanisms.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis: Internal body temperature of approximately 36–38°C

Decreased body temperature (such as when in cold surroundings)

Blood vessels in skin constrict, diverting blood from skin to deeper tissues and reducing heat loss from skin surface.

Vasoconstriction

Thermostat in hypothalamus activates warming mechanisms.
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Body temperature decreases; thermostat shuts off cooling mechanisms.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis:
Internal body temperature of approximately 36–38°C

Decreased body temperature (such as when in cold surroundings)

Blood vessels in skin constrict, diverting blood from skin to deeper tissues and reducing heat loss from skin surface.

Thermostat in hypothalamus activates warming mechanisms.

Skeletal muscles rapidly contract, expending energy though cell respiration which generates heat as a by product.

Shivering
Thermostat in hypothalamus activates cooling mechanisms.

Sweat glands secrete sweat that evaporates, cooling the body.

Blood vessels in skin open: capillaries fill with warm blood; heat radiates from skin surface out of the body.

Body temperature decreases; thermostat shuts off cooling mechanisms.

Increased body temperature (such as when exercising or in hot surroundings)

Homeostasis:
Internal body temperature of approximately 36–38°C

Body temperature increases; thermostat shuts off warming mechanisms.

Decreased body temperature (such as when in cold surroundings)

Blood vessels in skin constrict, diverting blood from skin to deeper tissues and reducing heat loss from skin surface.

Skeletal muscles rapidly contract, expending energy though cell respiration which generates heat as a by product.

Thermostat in hypothalamus activates warming mechanisms.
Draw the negative feedback loop for temperature regulation without looking at your notes.
Statement 6.5.10

Explain the control of body temperature, including the transfer of heat in blood, and the roles of the hypothalamus, sweat glands, skin arterioles and shivering.