An animal’s regulation of body temperature helps maintain homeostasis

Thermoregulation: The process by which animals maintain and internal temperature within a tolerable range

Endotherms: Birds, mammals, reptiles, some fishes, and many insects

Ectotherms: Most amphibians, lizards, many fishes, and most invertebrates
Heat is gained or lost in four ways:

- **Radiation**
- **Convection**
- **Conduction**
- **Evaporation**
Thermoregulation involves adaptations that balance heat gain and loss

- Metabolic heat production
- Insulation
- Circulatory adaptations

Countercurrent heat exchange
Animals balance the gain and loss of water and solutes through osmoregulation

Perch, a freshwater fish

- Uptake of some ions in food
- Uptake of salt by gills
- Excretion of large amounts of water in dilute urine from kidneys
- Osmotic water gain through gills and other parts of body surface

Cod, a saltwater fish

- Gain of water and salt from food and by drinking seawater
- Osmotic water loss through gills and other parts of body surface
- Excretion of excess ions
- Excretion of salt from gills
- Excretion of small amounts of water in scanty urine from kidneys
A variety of ways to dispose of nitrogenous wastes have evolved in animals.

Proteins → Amino acids → Nitrogenous bases → Nucleic acids

- Amino groups
  - NH₂

Most aquatic animals, including most fishes
  - NH₃

Mammals, amphibians, sharks, some bony fishes
  - O=C\(\overset{\text{NH}_2}{\text{C}}\text{NH}_2\)

Birds and many other reptiles, insects, land snails
  - O=C\(\overset{\text{HN}}{\text{C}}\text{NH}_2\)

Ammonia

Urea

Uric acid
The urinary system plays several major roles in homeostasis.
Overview: The key processes of the urinary system are filtration, reabsorption, secretion, and excretion.
Blood filtrate is refined to urine through reabsorption and secretion.
Kidney dialysis can be a lifesaver