Water and Electrolyte Balance in Animals
Diffusion

Solute

Solute transport is from the left to the right; movement of the solutes is due to the concentration gradient (dC/dx).
Osmosis

- Concentrated sugar solution
- Dilute sugar solution
- Partially permeable membrane
- Water molecules pass through not sugar
**Hypotonic solution**
- Animal cell: Lysed
- Plant cell: Turgid (normal)

**Isotonic solution**
- Animal cell: Normal
- Plant cell: Flaccid

**Hypertonic solution**
- Animal cell: Shriveled
- Plant cell: Plasmolyzed

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Diffusion

Solvent and solute particles move to equalize concentrations. No semipermeable membrane involved.

Osmosis

Equalizes the concentration of two solutions in

Only solvent particles move. Solute particles do not move. The movement is through a semipermeable membrane.
Water balance in a kangaroo rat (2 mL/day = 100%)

Water balance in a human (2,500 mL/day = 100%)

Water gain

Ingested in food (0.2)

Derived from metabolism (1.8)

Ingested in food (750)

Derived from metabolism (250)

Water loss

Feces (0.9)

Urine (0.45)

Evaporation (1.46)

Feces (100)

Urine (1,500)

Evaporation (900)
Glucose + Oxygen $\rightarrow$ Carbon Dioxide + Water + Energy

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + $Energy

Aerobic respiration

Metabolic water
hydrolysis
Proteins $\rightarrow$ Amino acids $\rightarrow$ Amino groups $\rightarrow$ NH$_2$

Nucleic acids $\rightarrow$ Nitrogenous bases $\rightarrow$ Amino groups

- **a.** Most aquatic animals, including most bony fishes
- **b.** Mammals, most amphibians, sharks, some bony fishes
- **c.** Many reptiles (including birds), insects, land snails

- NH$_3$ (Ammonia)
- O=C-NH$_2$ (Urea)
- Uric acid
Amino Acid Structure

Hydrogen

Amino

Carboxyl

R-group
(variant)
**Video of contractile vacuole**
Video of flame cell

1. Beating of cilia cause interstitial fluid to be filtered through slitlike openings in flame cell.

2. As fluid travels through tubule, most solutes are reabsorbed.

3. Excess water and wastes exit the body through nephriopiopores.
nephridia
Green gland
Osmotic stress in sea water
Osmotic stress in sea water

TMAO = trimethylamine
Osmotic stress in fresh water

Diagram showing the processes of active ion uptake through gills, water absorption through skin, direction of ion movement (Na⁺, K⁺, Cl⁻), and direction of water movement, as well as the dilution of urine.