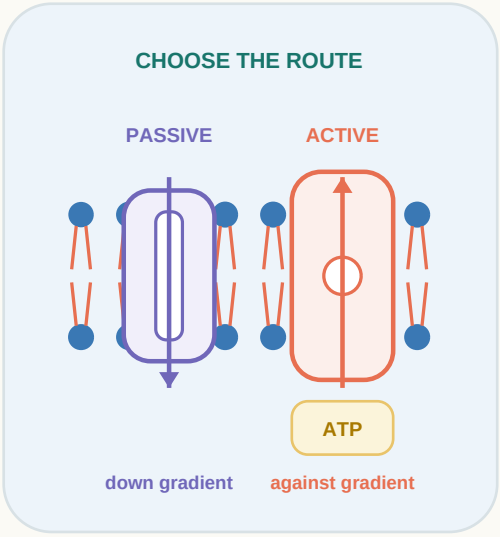
AP BIOLOGY | UNIT 2

TOPIC 2.5

Membrane Transport

Cells select a transport route based on the substance, its gradient, energy requirements, and cargo size.



THE CORE CAUSAL CHAIN

CARGO
size + properties

→

GRADIENT
direction of movement

→

ENERGY
ATP needed or not

→

ROUTE
bilayer, protein, vesicle

BY THE END, YOU SHOULD BE ABLE TO...

1. Compare passive and active transport.
2. Match substances to bilayer, protein, or vesicle routes.
3. Explain how transport helps cells maintain homeostasis.

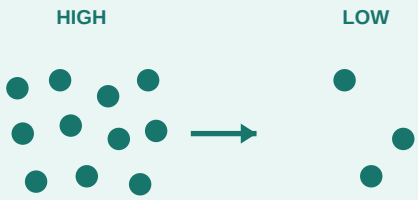
BIG IDEA

Membrane transport is controlled, not random. Gradient direction determines whether energy is required, while cargo properties determine the route.

1 Passive vs. active transport

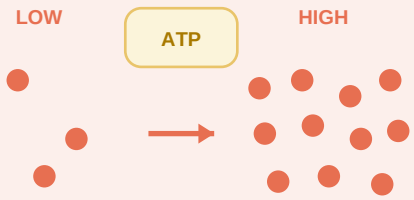
The key distinction is movement relative to a gradient and whether cellular energy is required.

PASSIVE TRANSPORT



Moves from high to low concentration, down the gradient. No direct ATP input is required.

ACTIVE TRANSPORT



Moves from low to high concentration, against the gradient. Requires energy and a transport protein.

SIDE-BY-SIDE

	PASSIVE	ACTIVE
GRADIENT	Down: high to low	Against: low to high
ENERGY	No direct ATP input	Energy required
PROTEIN?	Sometimes	Yes for membrane pumps
EXAMPLES	Diffusion; facilitated diffusion	Ion pumps; cotransport

ENERGY CHECK

A membrane protein does not automatically mean active transport. Facilitated diffusion uses proteins but remains passive because movement is down the gradient.

2 Choose the transport route

Cargo size, chemical properties, gradient direction, and energy needs determine how material crosses a membrane.

O2 SIMPLE DIFFUSION

Small nonpolar molecules: O2 and CO2

GRADIENT	**Down**
ENERGY	**No direct ATP**

P FACILITATED DIFFUSION

Ions or polar molecules through channels/carriers

GRADIENT	**Down**
ENERGY	**No direct ATP**

ATP ACTIVE TRANSPORT

Ions or molecules moved by pumps/cotransporters

GRADIENT	**Against**
ENERGY	**Required**

V VESICLE TRANSPORT

Large molecules, particles, or bulk fluid

GRADIENT	**Not a simple gradient route**
ENERGY	**Required**

QUICK DECISION PATH

1 LARGE OR BULK?
Use a vesicle.

2 CAN IT CROSS LIPIDS?
Use simple diffusion.

3 DOWN THE GRADIENT?
Use facilitated diffusion.

4 AGAINST THE GRADIENT?
Use active transport.

COMMON ERROR

All transport is selective, but not all transport uses ATP. Always state the gradient direction and energy requirement.