

ATP & HOMEOSTASIS IN THE CELL

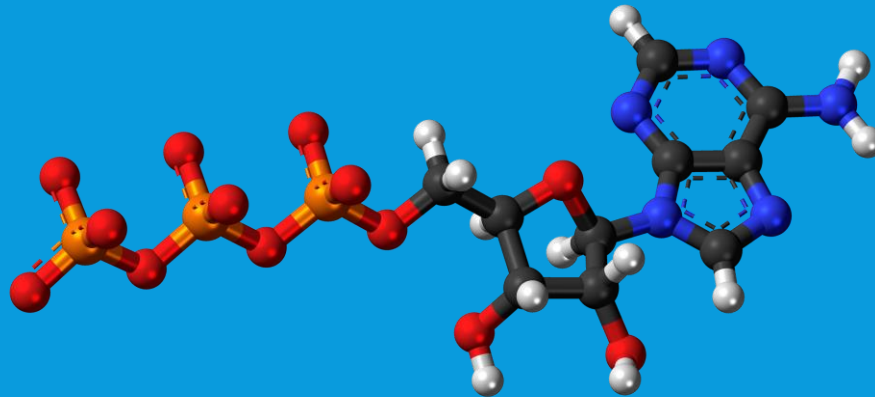
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ATP

- All fuel sources of Nature, all foodstuffs of living things, produce ATP, which in turn **powers virtually every activity of the cell** and organism.
- (ATP), energy-carrying molecule found in the cells of all living things.
- ATP captures chemical energy obtained from the breakdown of food molecules and releases it to fuel other cellular processes.

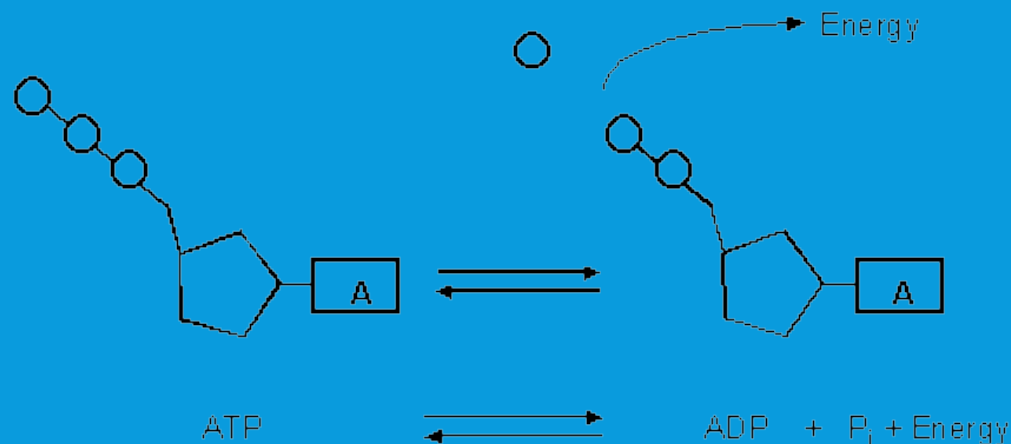
WHAT IS ATP?

- ATP is the abbreviation for **adenosine triphosphate**
- Adenosine triphosphate is the common **energy currency** in cells.
- All organisms from the simplest bacteria to us (complex humans) use ATP as their primary energy currency.
- The energy level it carries is just the right amount for most biological reactions.

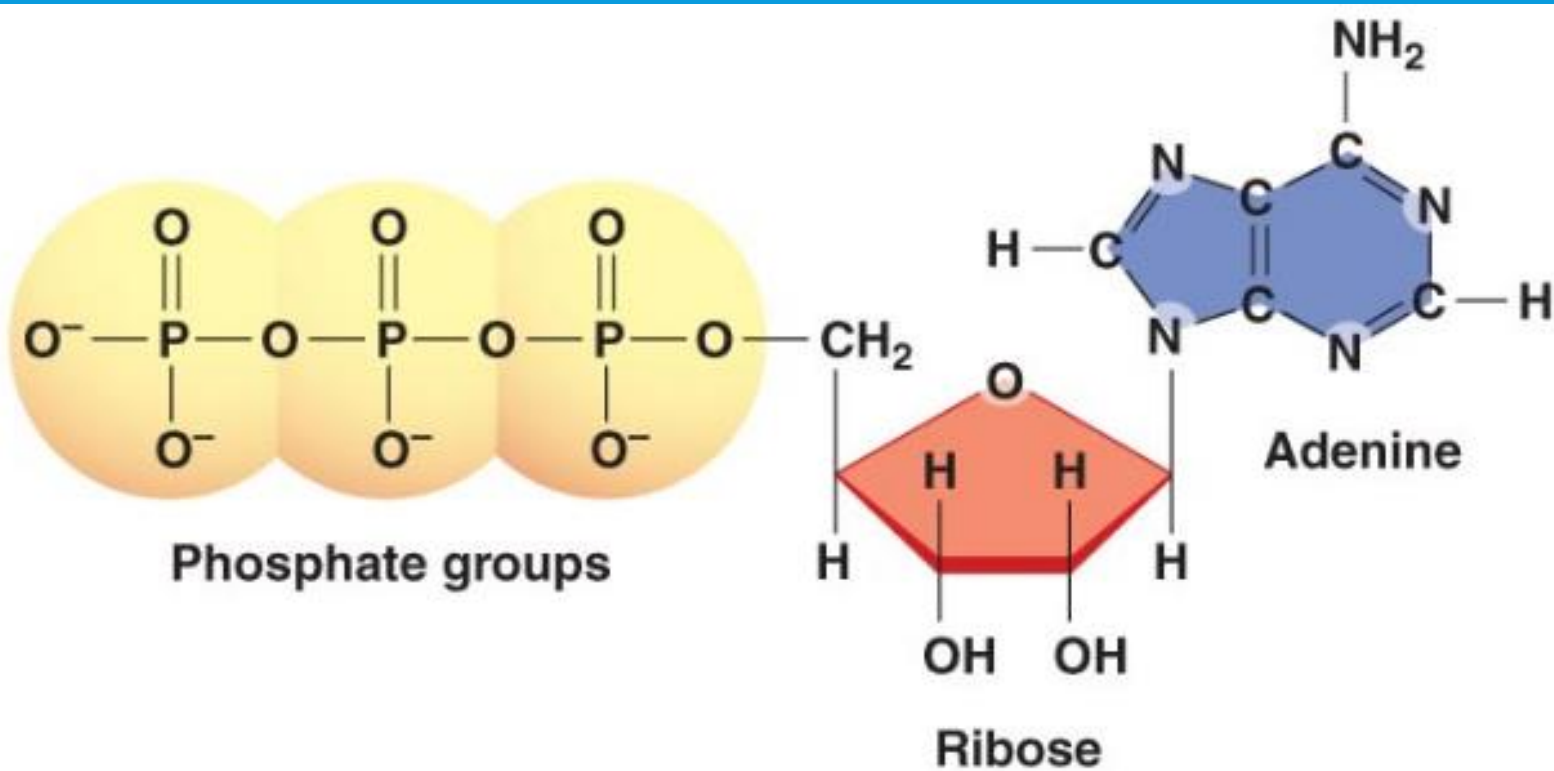


ATP GENERATION

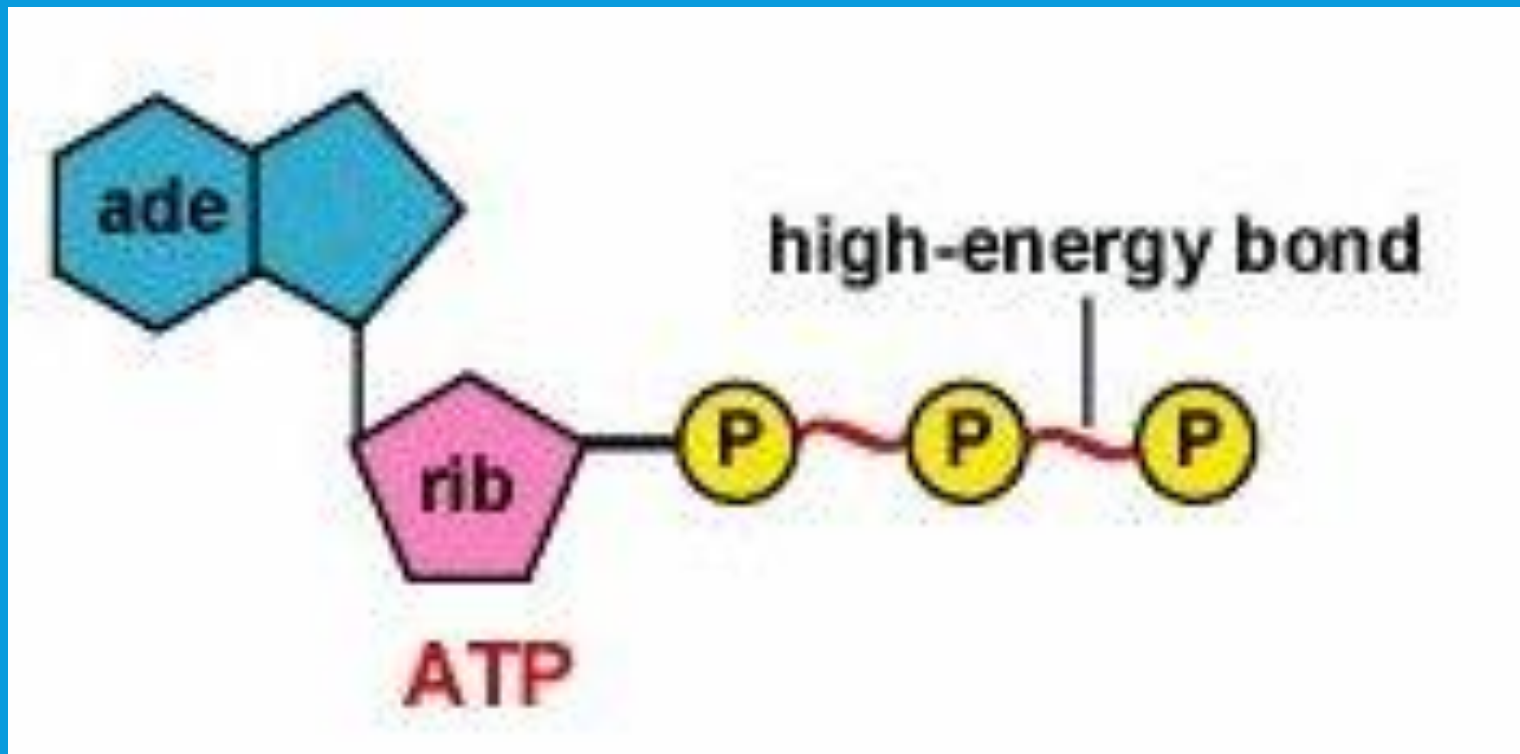
- Adenosine triphosphate is generated from 2 parts:
 - **ADP: adenosine diphosphate**
 - **Phosphate**



STRUCTURE OF ATP



STRUCTURE OF ATP



ADENOSINE DIPHOSPHATE

ADENOSINE

phosphate

phosphate

energy

phosphate

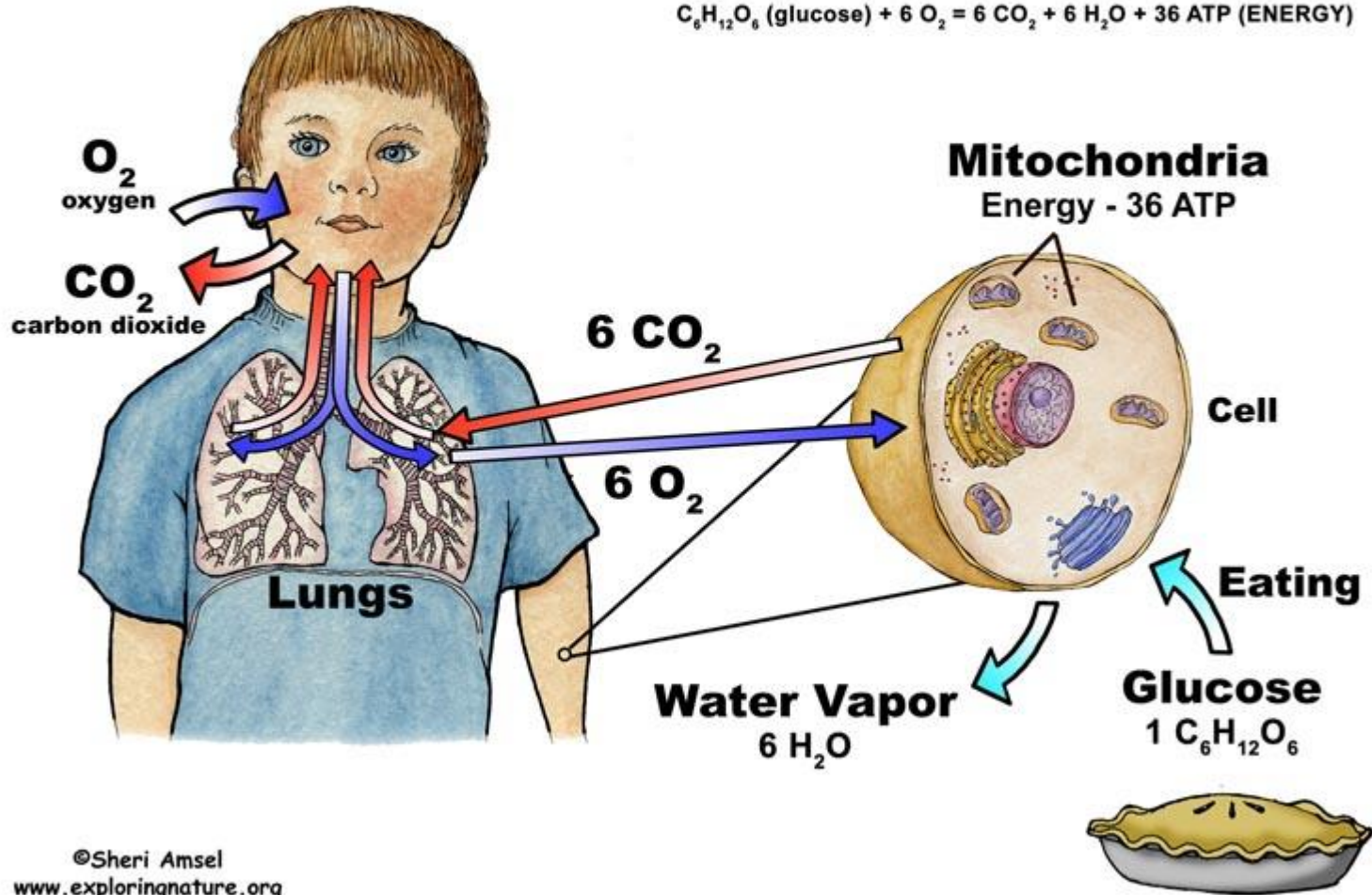
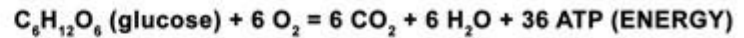


WHERE DOES ATP COME FROM?

- Adenosine triphosphate is the byproduct of **cellular respiration**, an essential reaction in the cell.
- **Cellular respiration** is a set of reactions that take place in the cells of organisms to convert biochemical energy from nutrients into adenosine triphosphate (ATP), and then release waste products.
- Sugar + oxygen = water + CO₂ + energy
- This occurs in the mitochondria of the cell.

Breathing

Cellular Respiration



Respiration is NOT breathing!

All organisms respire- it is the production of ATP from organic molecules.

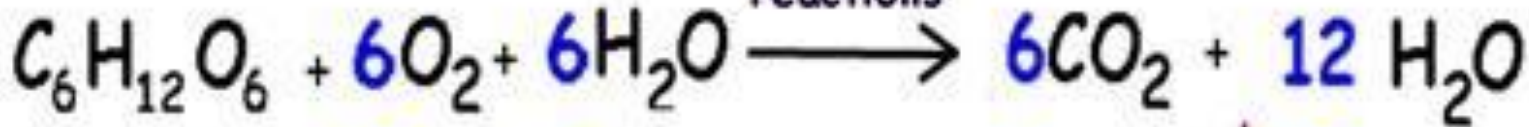
Aerobic respiration requires oxygen - this is where ventilation and gas exchange come in.



Reactants

Products

16 enzymatic
reactions



one molecule of glucose
six molecules of oxygen
six molecules of water






six molecules of carbon dioxide
twelve molecules of water



In the form of ATP

GLYCEMIC INDEX CHART

Low Glycemic (55 or Below) High Glycemic (70 or Higher)

SNACKS		STARCH		VEGETABLES		FRUITS		DAIRY	
G.I.		G.I.		G.I.		G.I.		G.I.	
									
	Pizza		Bagel, Plain		Broccoli		Cherries		Yogurt, Plain
	Chocolate Bar		White Rice		Pepper		Apple		Yogurt, Low Fat
	Pound Cake		White Spaghetti		Lettuce		Orange		Whole Milk
	Popcorn		Sweet Potato		Mushrooms		Grapes		Soy Milk
	Energy Bar		White Bread		Onions		Kiwi		Skim Milk
	Soda		Brown Rice		Green Peas		Banana		Chocolate Milk
	Doughnut		Pancakes		Carrots		Pineapple		Yogurt, Fruit
	Jelly Beans		Wheat Bread		Beets		Watermelon		Custard
	Pretzels		Baked Potato		Onions		Dates		Ice Cream

HOW DOES ATP WORK?

- 1) Energy is liberated from the ATP molecule to do work in the cell by a reaction.
- 2) This reaction removes one of the phosphate-oxygen groups, leaving adenosine *diphosphate* (ADP).
- 3) When the ATP converts to ADP, the ATP is said to be *spent*.
- 4) Then the ADP is usually immediately recycled in the mitochondria where it is recharged and comes out again as ATP.



Cells require chemical energy for three general types of tasks: to **drive metabolic reactions** that would not occur automatically; to **transport needed substances across membranes**; and to do **mechanical work**, such as moving muscles.

ATP is **not** a storage molecule for chemical energy; that is the job of carbohydrates, such as glycogen, and fats. When energy is needed by the cell, it is converted from storage molecules into ATP. ATP then serves as a **shuttle**, delivering energy to places within the cell where energy-consuming activities are taking place.

WHAT ARE THE FUNCTIONS OF ATP?

1) **Chemical Work:**

- ATP is used to synthesize macromolecules

Breaks down larger molecules into more manageable pieces for the cell to use.

2) **Transport Work:**

ATP is used to pump substances across the cell membrane in active transport.

3) **Mechanical Work:**

- Involved in muscle contraction, nerve impulses, movement of chromosomes, etc.

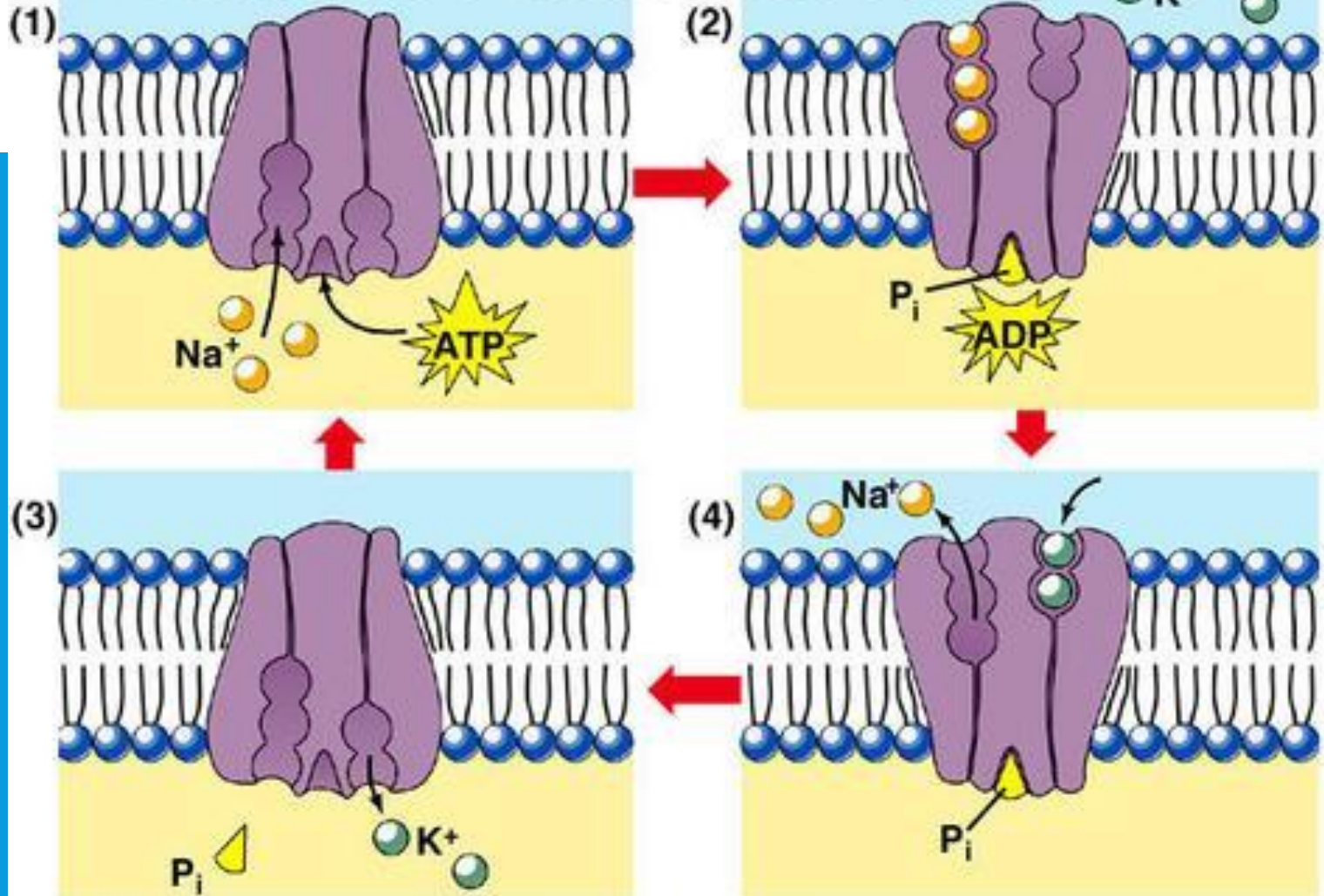
WHY IS ATP A GOOD ENERGY CARRIER?

- 1) ATP is a **common energy currency**. Therefore it can be used in different types of reactions without change.
- 2) ATP releases a sufficient and effective **amount of energy** needed by the cell.
- 3) The formation of ATP requires **minimal energy loss**.

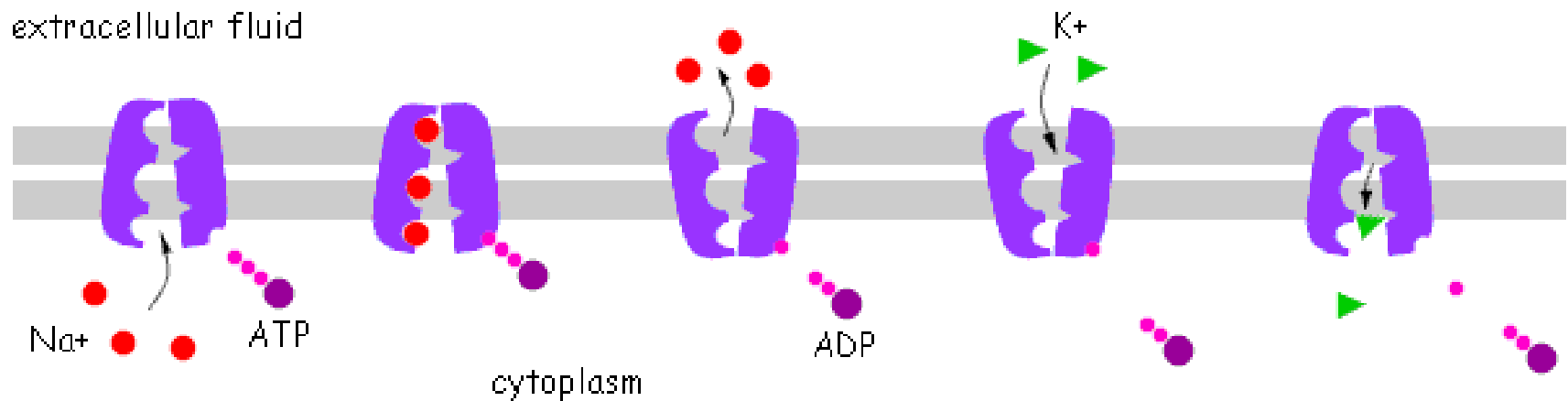
SODIUM-POTASSIUM PUMP:

- Active in all animal cells, especially nerve and muscle cells
- Moves sodium ions to the outside of the cell and potassium ions to the inside.
- The carrier protein involved is called a sodium-potassium pump

Sodium-Potassium Pump



extracellular fluid



- For every 3 ions of sodium taken out of the cell, 2 ions of potassium are moved into the cell.