General Biology 1
BIO1101
Syllabus & Textbook: http://goo.gl/rvgdrH

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Email: mgotesman@citytech.cuny.edu

Letter Grade	Numerical Ranges
A	93-100
A-	90-92.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	70-76.9
D	60-69.9
F	59.9 and below

OER

Lecture:https://openlab.citytech.cuny.edu/bio-oer/page/2/
Lab: https://openlab.citytech.cuny.edu/bio-oer/

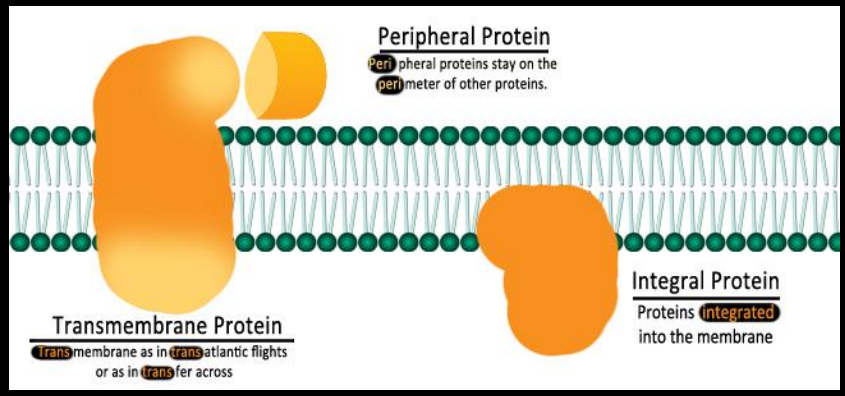
Grade Breakdown:

Exams (4): 20% Each
Quizzes: 20% Average

Recap: Meeting 13

A. Plasma Membrane

1) Common to all cells
2) Made of phospholipid bilayer
   1)– hydrophobic/hydrophilic -- amphipathic
3) Also has cholesterol/lipids and protein
4) Fluid Mosaic model

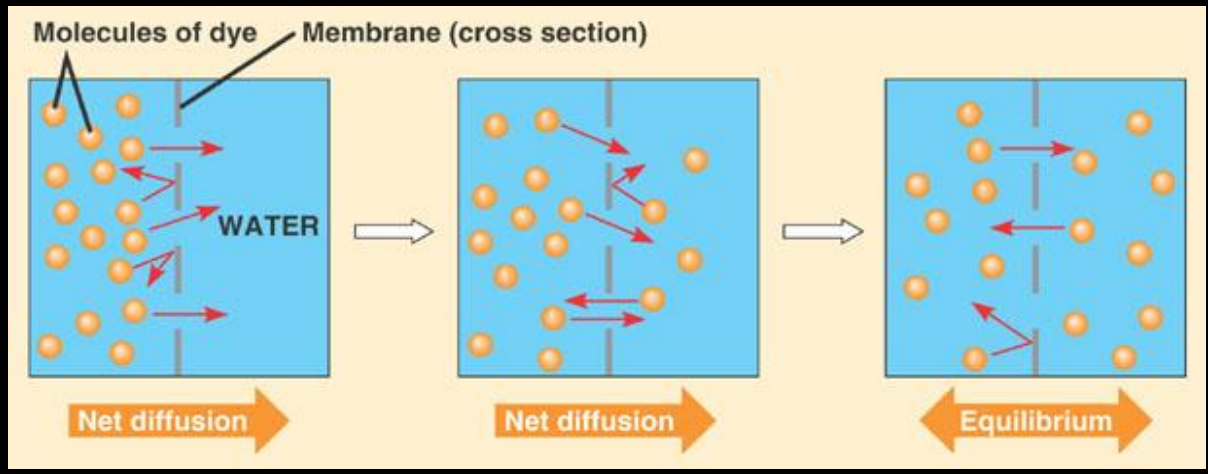


B. Proteins around cell membrane

Integral sometimes transmembrane
Peripheral
function of proteins in membrane?

C. Movement:

Diffusion
Osmosis
Passive Transport
Active Transport
Concentration Gradient



Study Strategies

Name: _____ Date: _____

KWL Chart

Select a topic you want to research. In the first column, write what you already know about the topic. In the second column, write what you want to know about the topic. After you have completed your research, write what you learned in the third column.

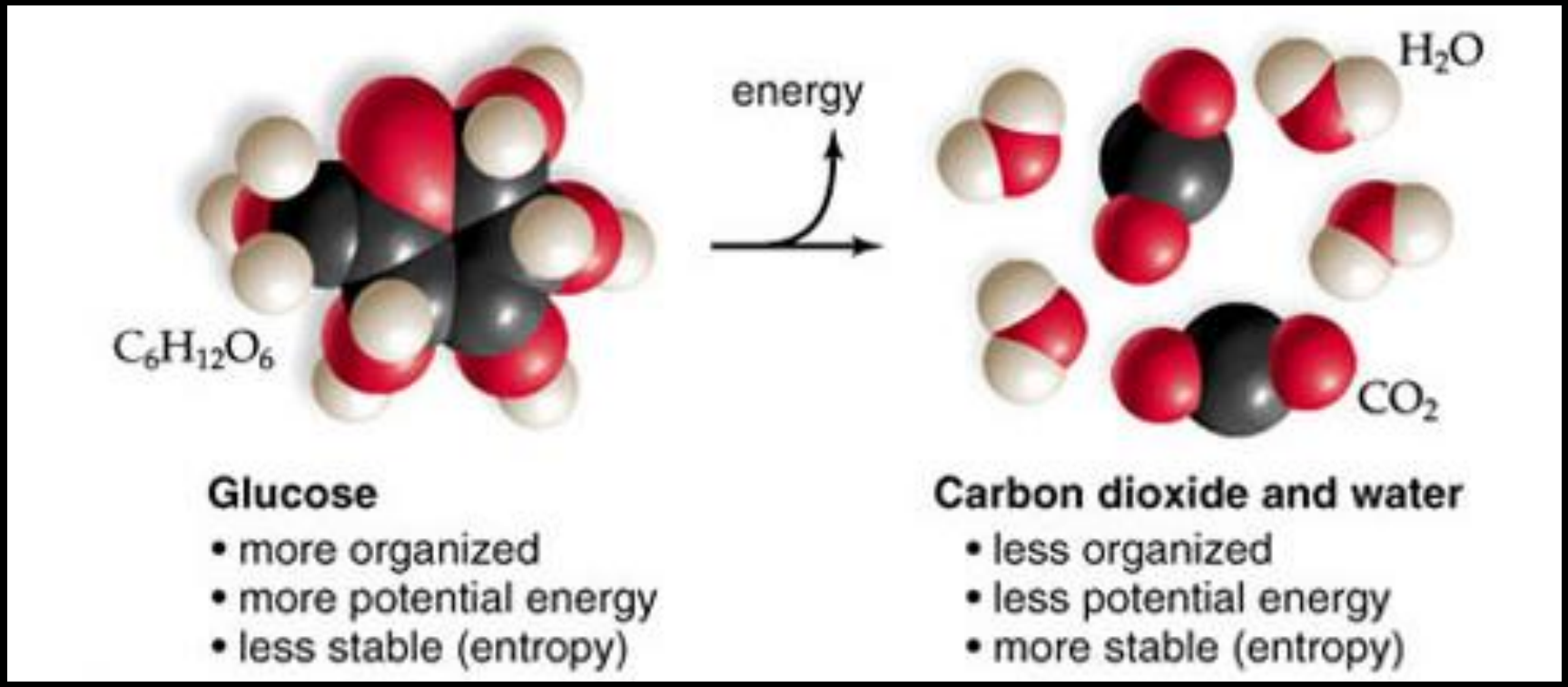
What I **K**now What I **W**ant to Know What I **L**earned

What I **K**now	What I **W**ant to Know	What I **L**earned

Introduction to Metabolism

Energy = Capacity to do work

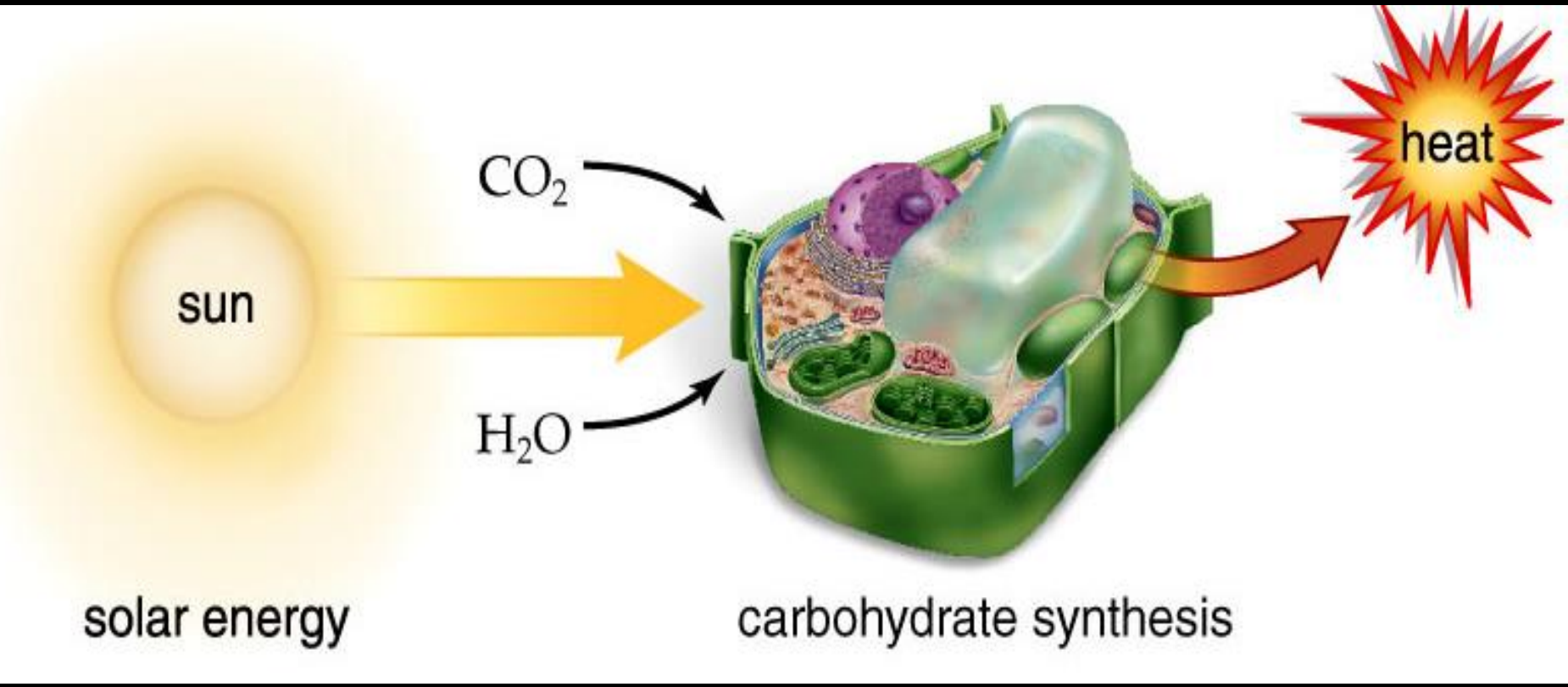
- **Kinetic Energy** – The Energy of MOTION
- **Potential Energy** – Energy that is STORED (in position or structure)
  - **Chemical energy** – Energy stored in chemical bonds



Metabolism…

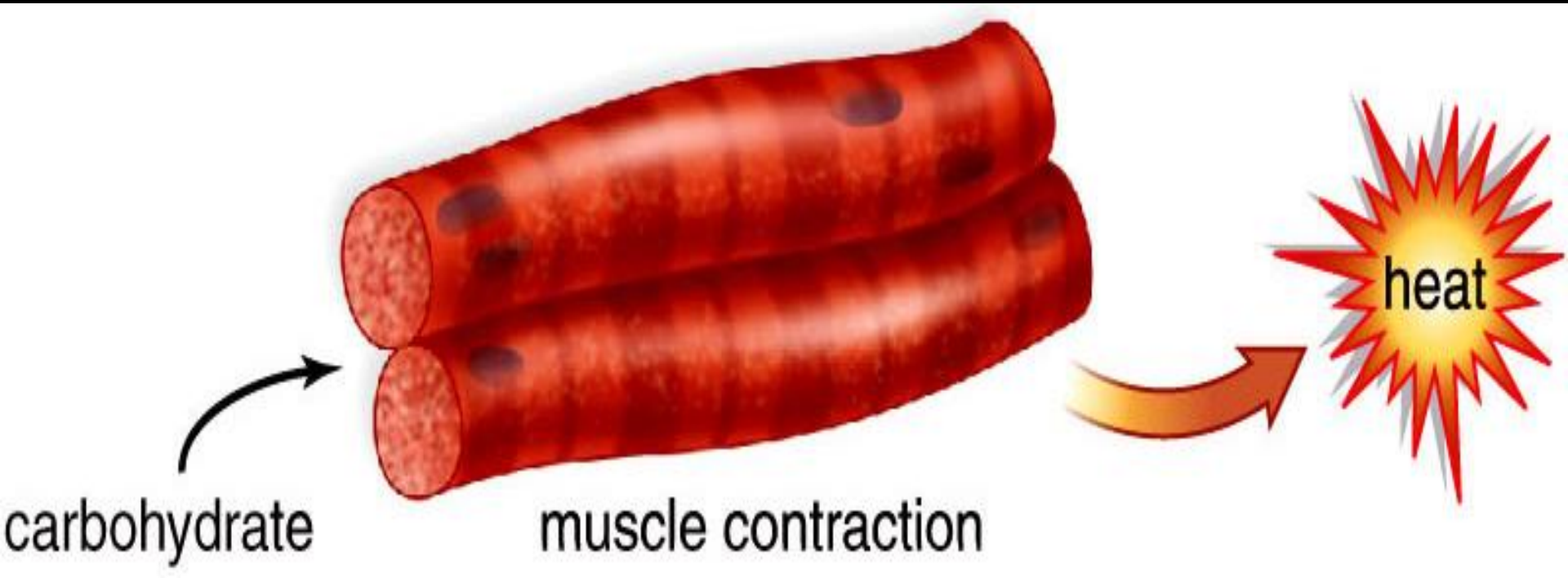
- …The sum of all an organism's chemical reactions
- …The management of a cell's material and Energy resources
- **Anabolic Pathways** – *consume* Energy by building large molecules out of smaller ones.
- **Catabolic Pathways** – *release* Energy by breaking down large molecules into smaller ones
  - e.g., glucose broken down to CO_2 and H_2O.
  - The released Energy powers the cells (ATP)
- **Energy Coupling** – Energy released from Catabolic pathways is used to drive Anabolic pathways

Carbohydrate Synthesis



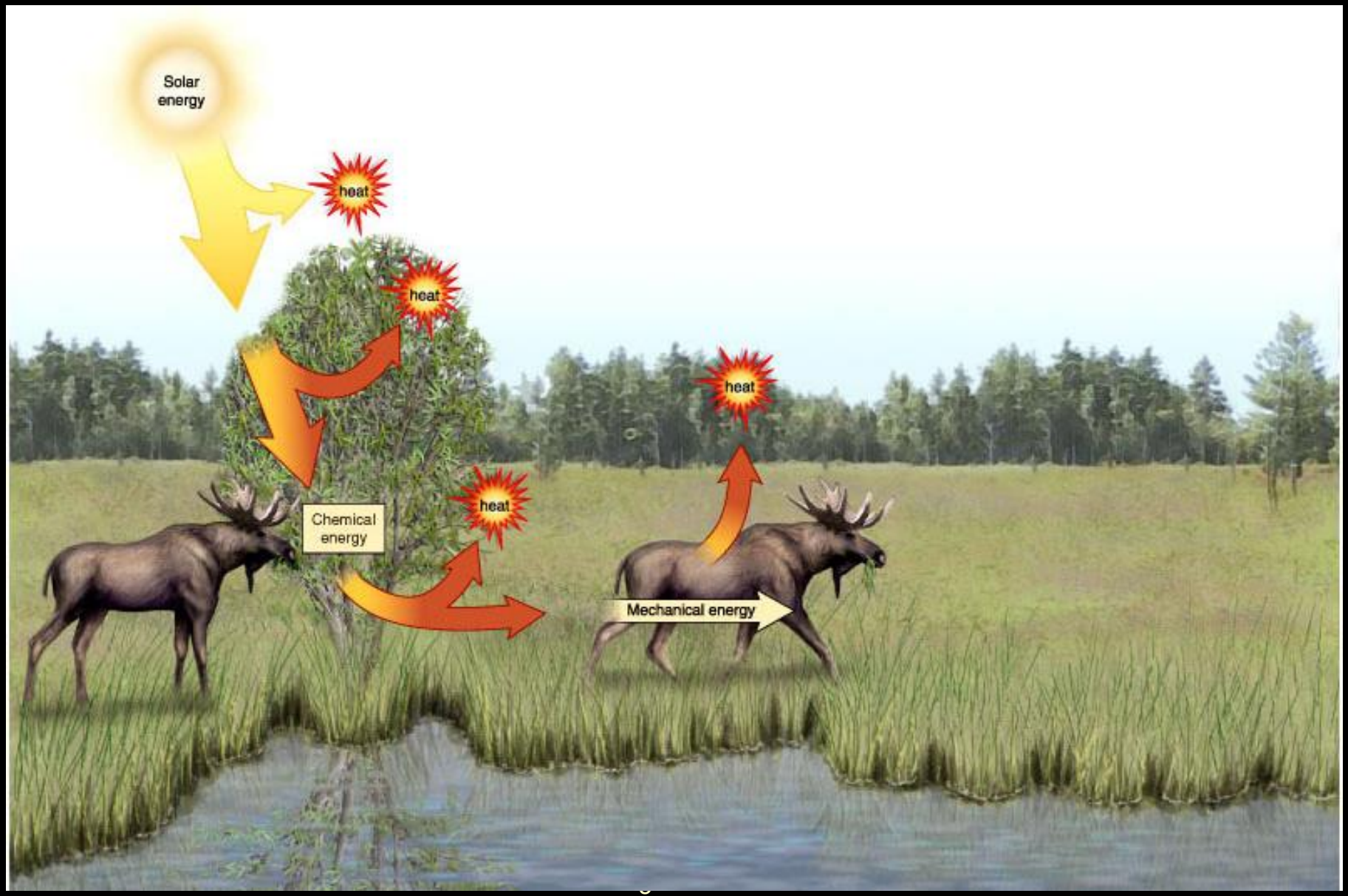
Anabolic or Catabolic?

Carbohydrate Metabolism



Anabolic or Catabolic?

Flow of Energy



Energy = Capacity to do work

- **Thermodynamics** – the study of energy transformations (transfer) in a "system"
  - System vs. surroundings
- **Entropy** – disorder (randomness)
  - Entropy is the measurement of disorder
- **Bioenergetics** – study of how an organism manages energy resources

The Laws of Thermodynamics

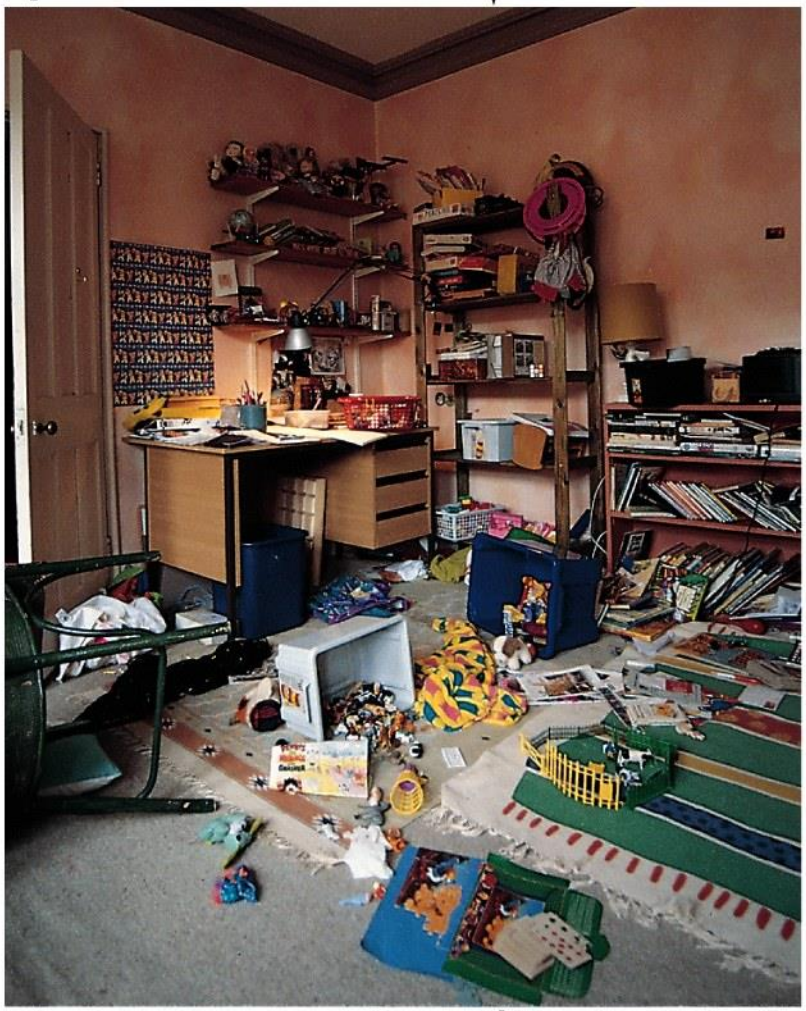
- **First Law – The E in the universe is constant**
  - Law of **conservation of energy**
  - Energy cannot be created or destroyed, but
  - Energy CAN be changed from one form to another

The Laws of Thermodynamics

- **First Law** – The E in the universe is constant
- **Second Law** – the Entropy of the universe is INCREASING
  - Law of **entropy**
  - When energy is changed from one form to another, there is a loss of usable energy
  - Waste energy goes to increase disorder

“SPONTANEOUS“ REACTION

as time elapses

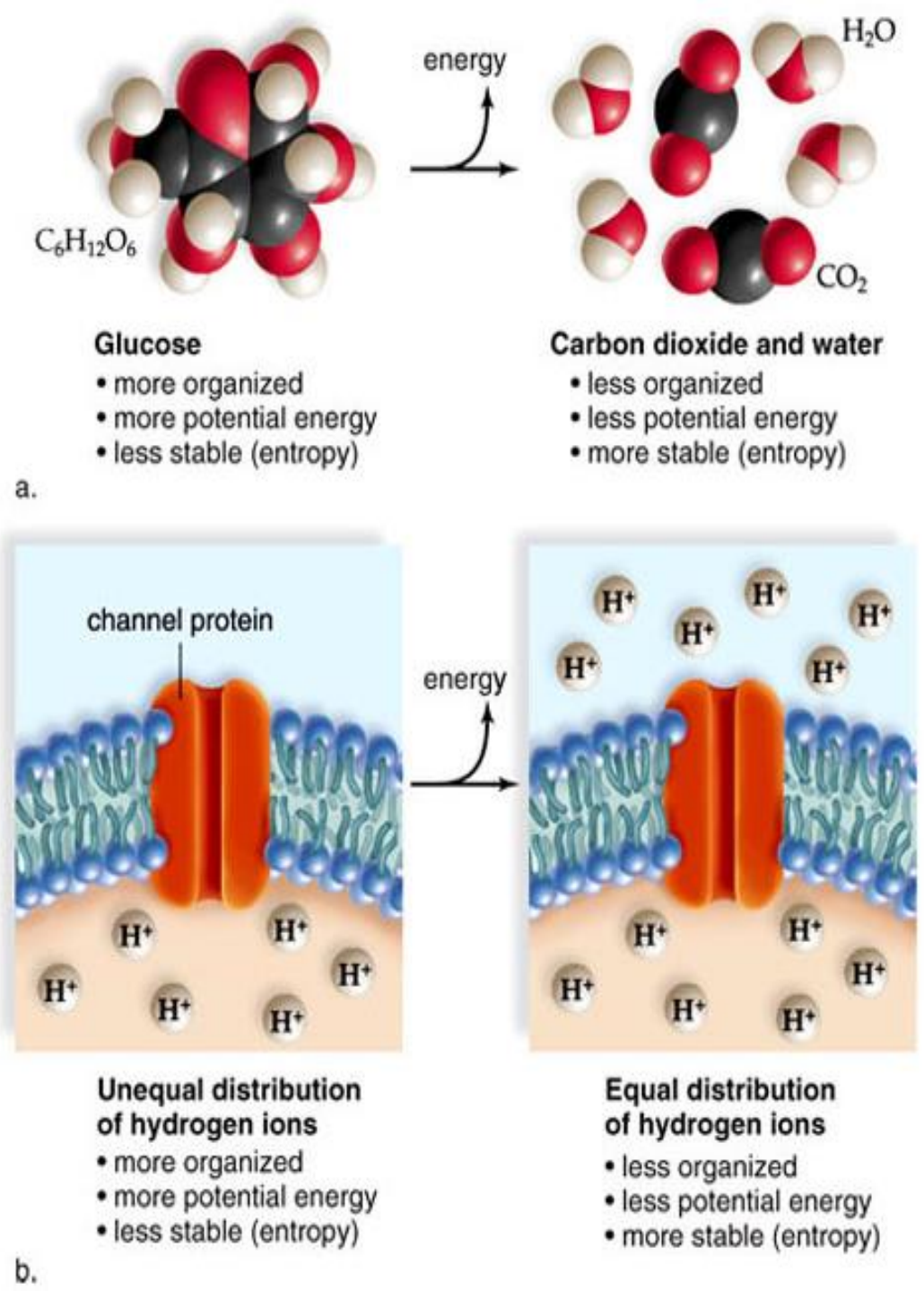


ORGANIZED EFFORT REQUIRING ENERGY INPUT

Cells and Energy

Things, reactions tend to go to a state of higher entropy:
-less organized
-lower energy but
- more stable

In order to keep it's high level of **organization**, a cell or a living organism needs a constant input of **energy**



Gibbs Free-energy (G)

- Combines potential E, kinetic E, and entropy
- G is most useful when looking at CHANGE (ΔG)

- $\Delta G = G(final) - G(initial)$

- Negative value in ΔG means free energy is RELEASED
  - SPONTANEOUS, FAVORABLE, no E required
- Positive value in ΔG means free energy is ABSORBED
  - Non-spontaneous, unfavorable, E is required

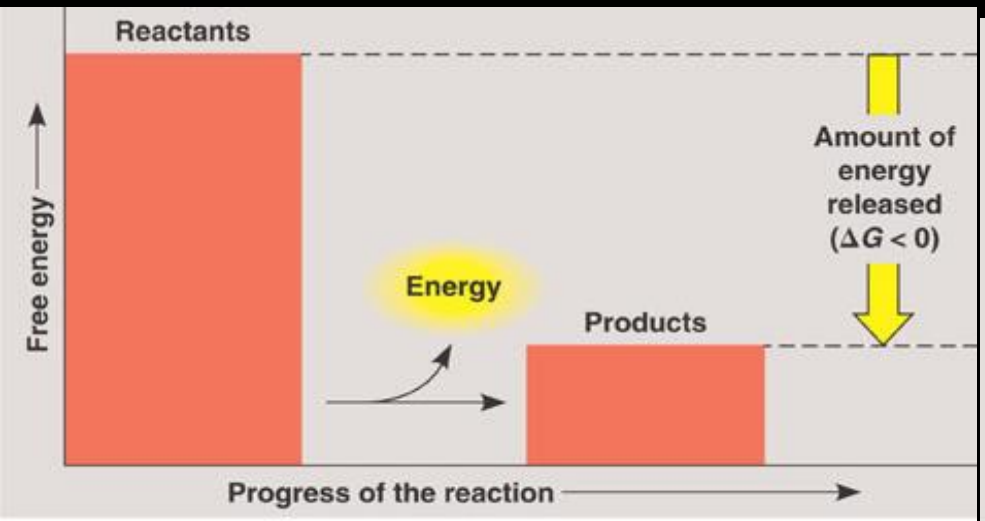
Exergonic *vs* Endergonic

Exergonic – A negative ΔG (spontaneous)

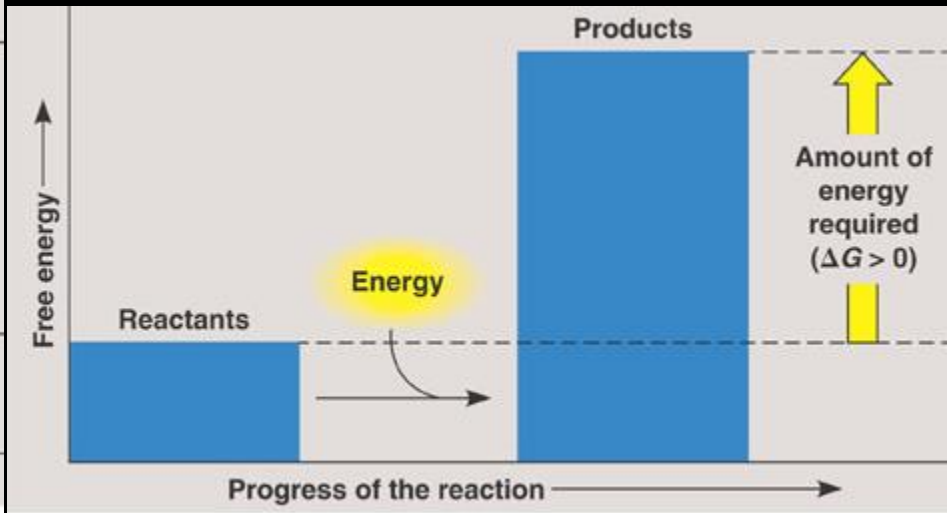
- Exergonic reactions "just happen" and gradually move toward equilibrium.

Endergonic – a positive ΔG (non-spontaneous)

- These reactions require E input from outside source



(a) Exergonic reaction: energy released



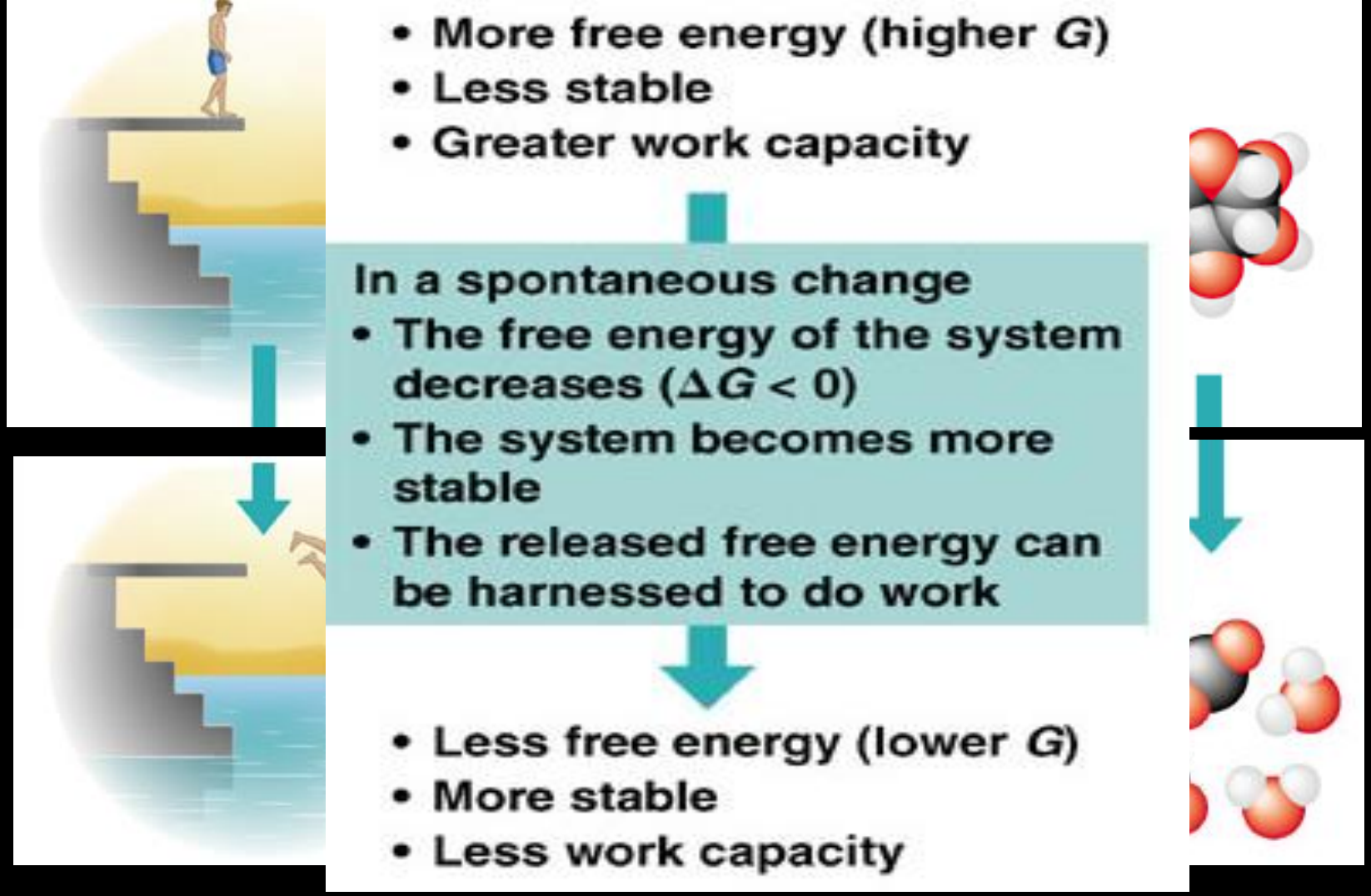
(b) Endergonic reaction: energy required

Gibbs and Metabolism

- In a chemical rxn, Equilibrium is achieved when FORWARD rxn proceeds at same rate as reverse rxn.
  - Thus… **at Equilibrium, $\Delta G = 0$** (performs no work)

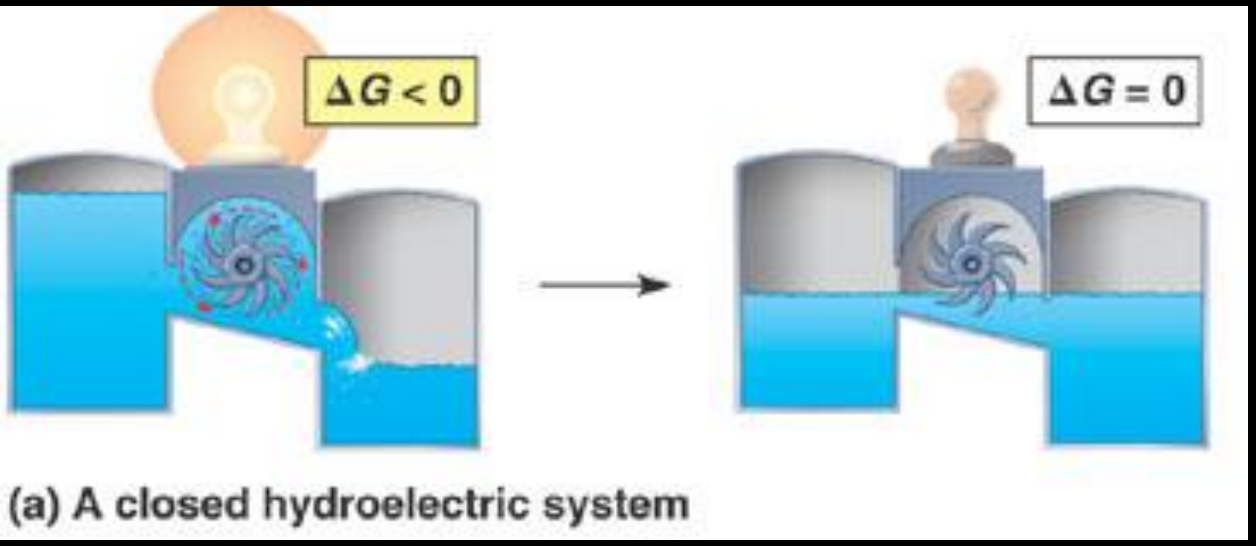
Endergonic – a positive ΔG (non-spontaneous)

- These reactions require E input from outside source
- Move the system AWAY from equilibrium
- Must **COUPLE** a $+\Delta G$ reaction to a $-\Delta G$ reaction!

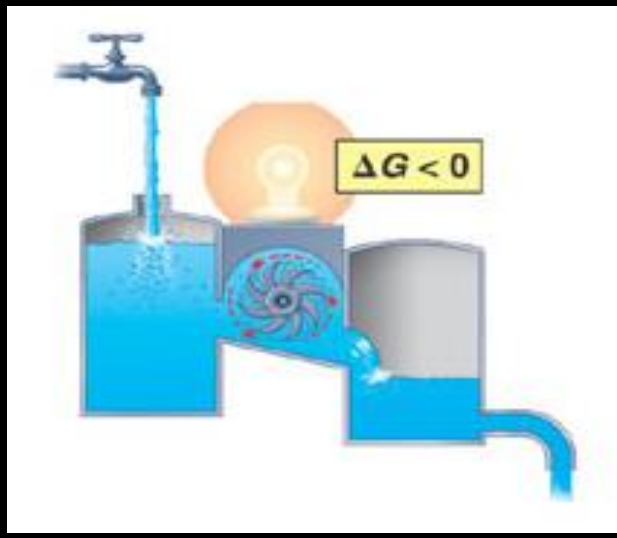

• More free energy (higher G)
• Less stable
• Greater work capacity
In a spontaneous change
• The free energy of the system decreases (ΔG < 0)
• The system becomes more stable
• The released free energy can be harnessed to do work
• Less free energy (lower G)
• More stable
• Less work capacity

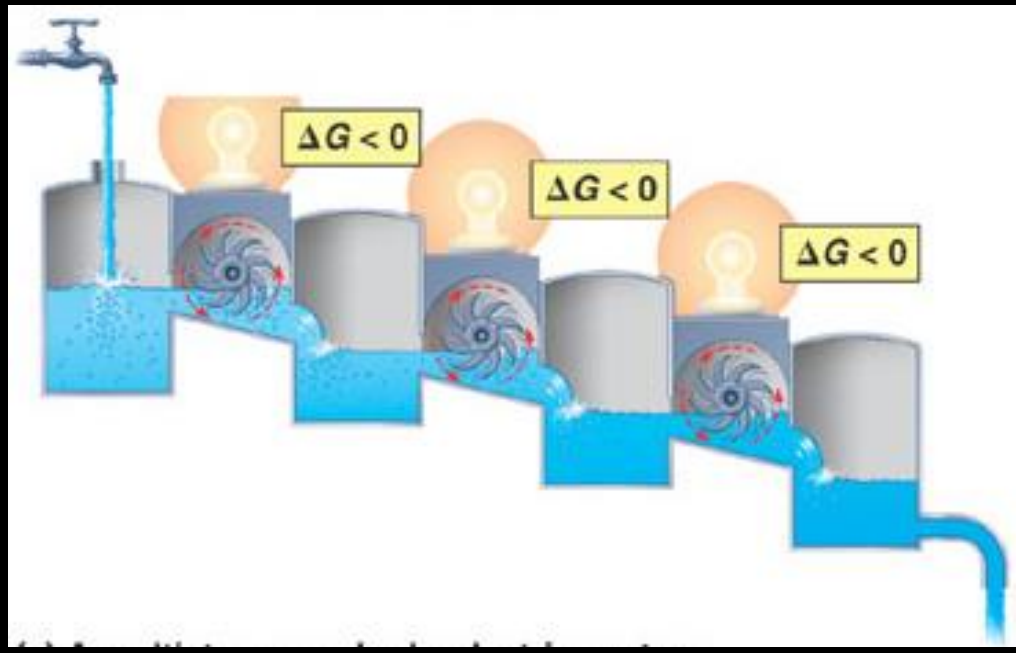
Examples

More Examples



(a) A closed hydroelectric system





ΔG and cellular metabolism

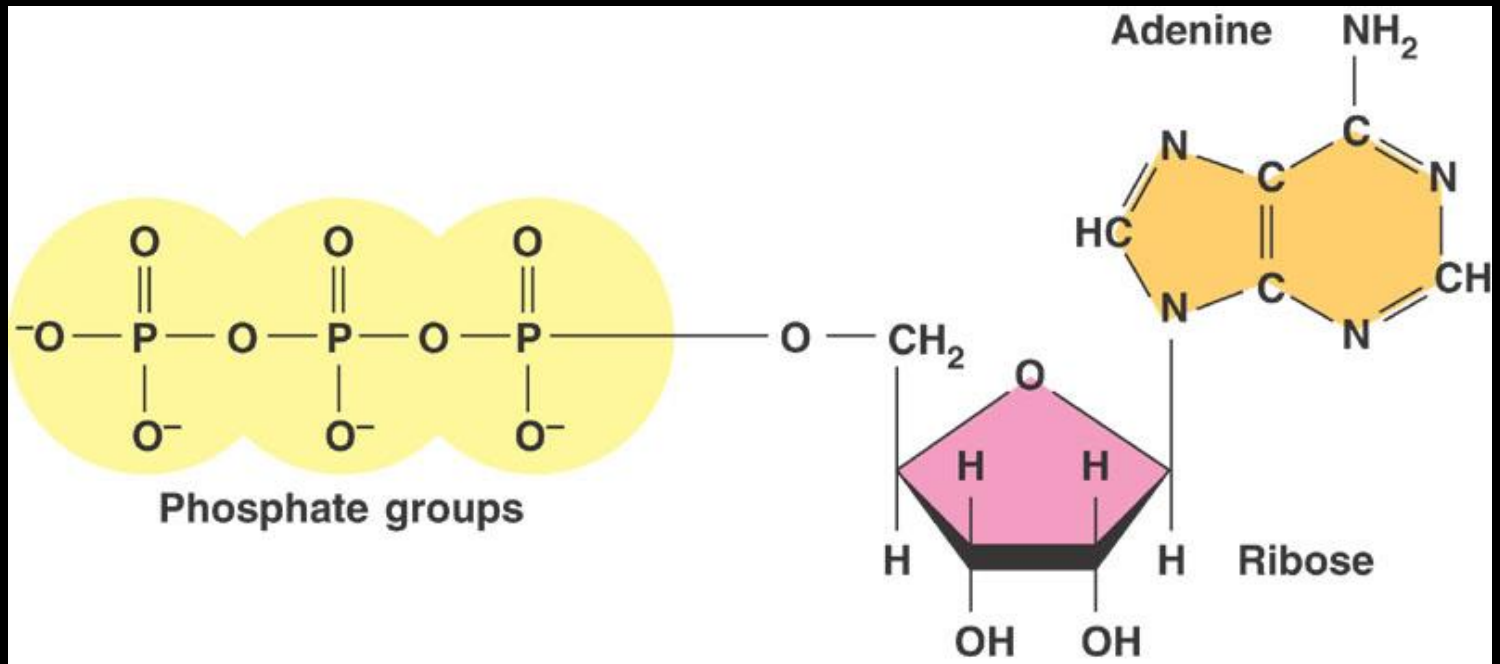
- Cellular Respiration:
  - $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$
  - ΔG = -686 kcal/mol ~ 180g **+ Chemical Energy!**
  - Spontaneous? **Yes!**
  - Exer- or Ender-gonic? **Exergonic**
- Photosynthesis:
  - $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$
  - ΔG = ? **+686 kcal/mol**
  - Spontaneous? **Nope!**
  - Exer- or Ender-gonic? **Endergonic**

Please Drink Responsibly

Solar Energy +

ATP: the "currency" of cellular E

- Three types of cellular work:
  - Mechanical work, Transport work, Chemical work
  - These are all endergonic things!
  - Must be coupled to exergonic things
- ATP mediates most energy coupling in cells
  - ATP is "unstable," meaning has high free-energy (G)
  - So, hydrolysis of ATP releases energy!



ATP

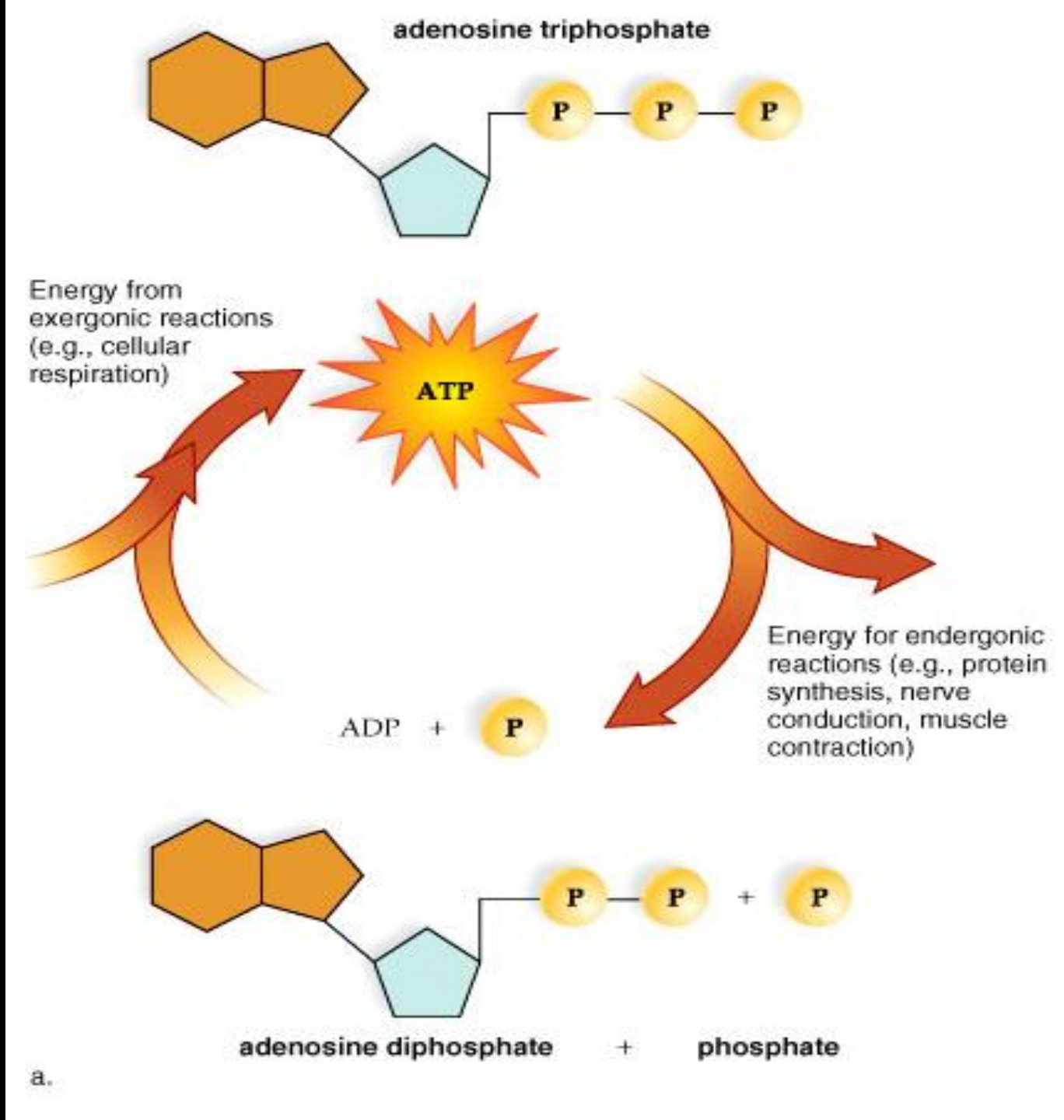
The Hydrolysis of ATP…

- …is very EXERGONIC (ΔG = -7.3 kcal/mol)
- …is easy to couple to other things!
- …involves water!
- The crowding of negative charges is like a "loaded spring"
- Cellular respiration has overall VERY negative ΔG
  - Makes LOTS of ATP, drives all cellular work!

ΔG = -7.3 kcal/mol ~ 507 g (ATP)
ΔG = -686 kcal/mol ~ 180g ($C_6H_{12}O_6$)

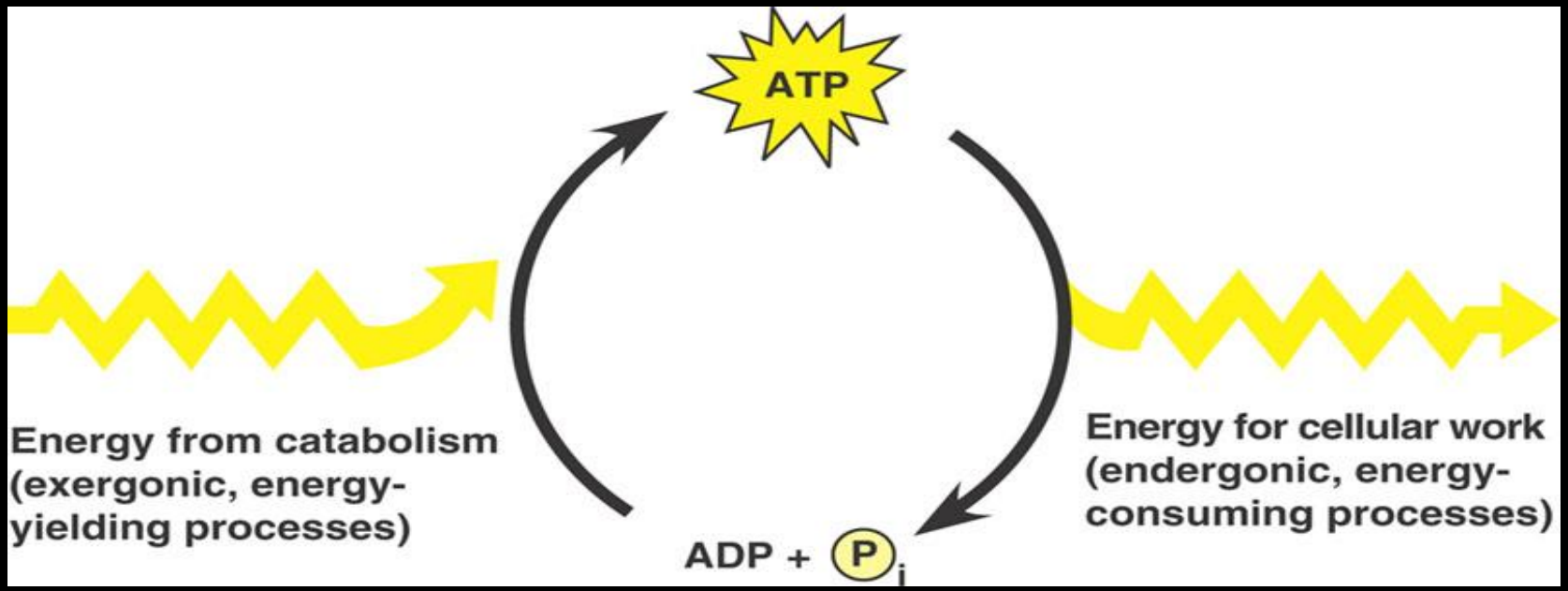
Which is more Exergonic?

The ATP Cycle



ATP cycle

- The E from catabolism (exergonic) generates ATP (from ADP and P_i)
- This drives anabolism (endergonic), which *consumes* ATP (back to ADP and P_i)

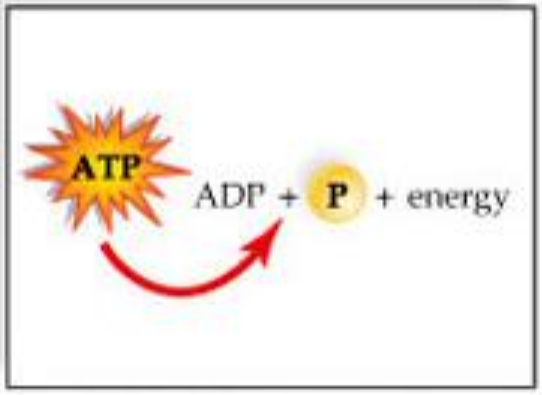


ATP and Coupled Reactions

- Adenosine triphosphate (ATP)
  - High energy compound used to drive metabolic reactions
  - Constantly being generated from adenosine diphosphate (ADP)
- Composed of:
  - Adenine and ribose (together = adenosine), and
  - Three phosphate groups

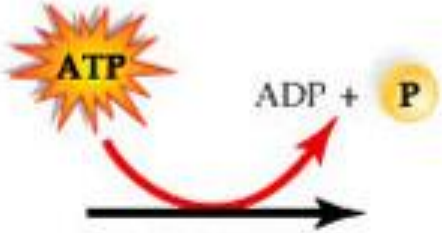
- **Coupled reactions**
  - Energy released by an exergonic reaction captured in ATP
  - That ATP used to drive an endergonic reaction

Coupled Reactions



a. ATP breakdown is exergonic.

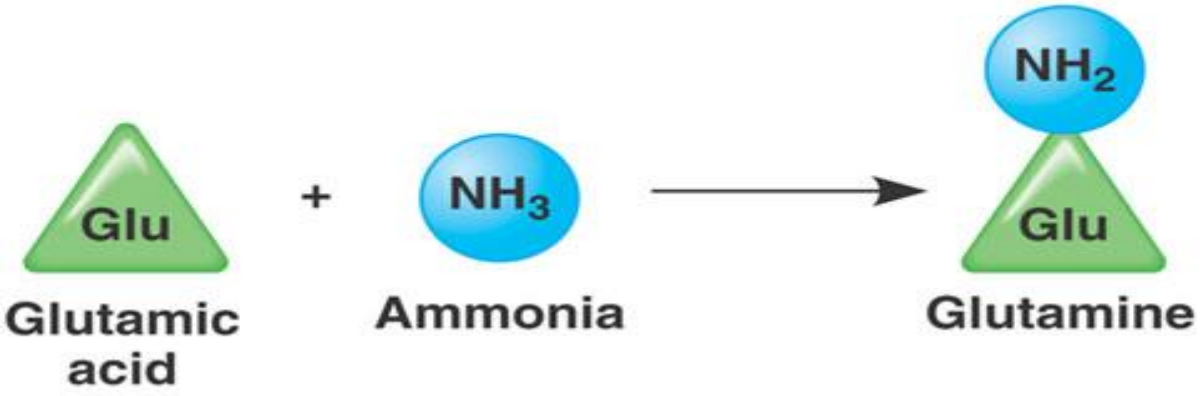
b. Muscle contraction is endergonic and cannot occur without an input of energy.



c. Muscle contraction becomes exergonic and can occur when it is coupled to ATP breakdown.

Coupling to ATP hydrolysis

Endergonic reaction: ΔG is positive, reaction is not spontaneous



ΔG = +3.4 kcal/mol

Exergonic reaction: ΔG is negative, reaction is spontaneous

ΔG = −7.3 kcal/mol

Coupled reactions: Overall ΔG is negative; together, reactions are spontaneous

ΔG = −3.9 kcal/mol

Quiz 6 – Not today

Study Strategies

Name: _____ Date: _____

KWL Chart

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What I **K**now	What I **W**ant to Know	What I **L**earned

Name: Quiz 6 03/22/16

Q1 (20 points): True or False, All Cells have a plasma membrane?

Q2 (10 points): Plasma membrane are mostly made of this special molecule. It can be abbreviated as PLB, what does PLB stand for?

Q3 (20 points): True or False, All Cells have a Cell Wall?

Q4 (10 points): What is the main component of Cell Walls (name of the compound?

Q5 (20 points): True or False, water would move into a cell from a very salty solution?

Q6 (20 points): True or False, Anabolic reactions breakdown larger molecules into smaller ones?

EC (5 points): How many States are there in the USA?