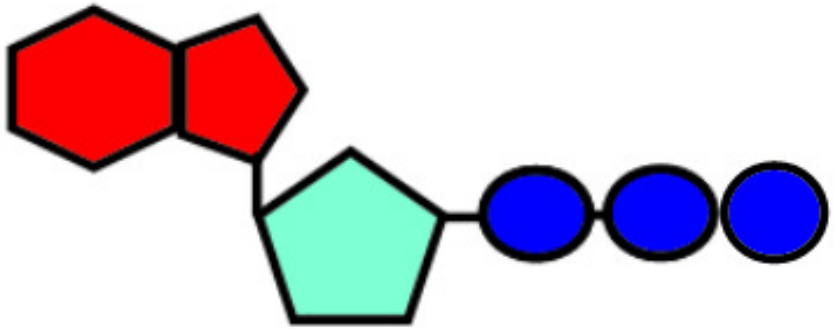
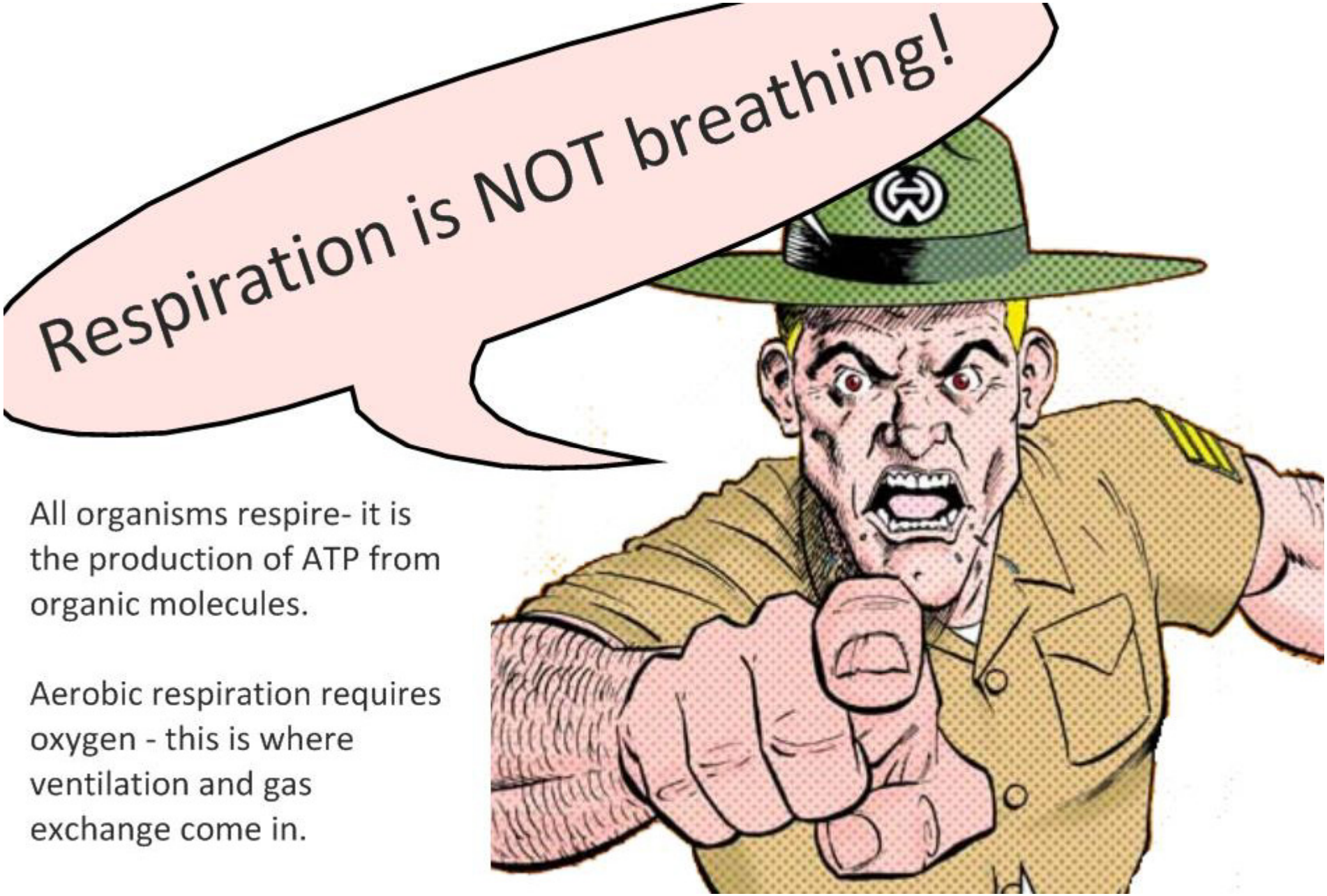


Cellular Respiration
Core & AHL (or SL Option C!)

http://www.youtube.com/watch?v=3aZrkdzrd04
http://www.youtube.com/watch?v=VCpNk92uswY

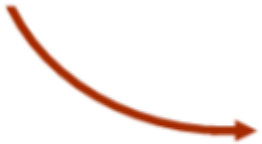


All organisms respire- it is the production of ATP from organic molecules.

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

Cell Respiration

"The controlled release of energy



by enzymes:
metabolic pathways and cycles!

Cell Respiration

"The controlled release of energy

by enzymes:

metabolic pathways and cycles!

How can cells control the rate of enzyme catalysed pathways and cycles?

Cell Respiration

"The controlled release of energy

by enzymes:

metabolic pathways and cycles!

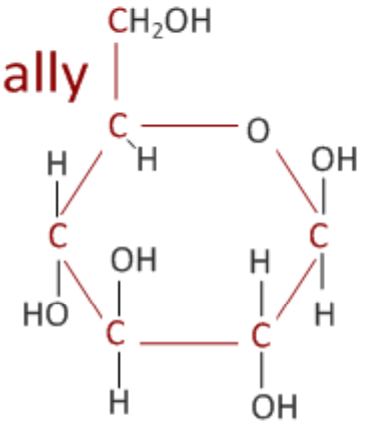
How can cells control the rate of enzyme catalysed pathways and cycles?

end product inhibition!

Cell Respiration

"The controlled release of energy from organic compounds in cells

usually

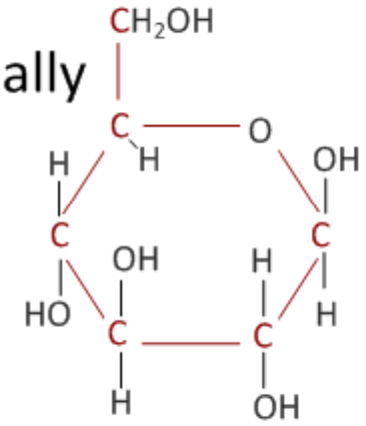


glucose/ carbohydrates

Cell Respiration

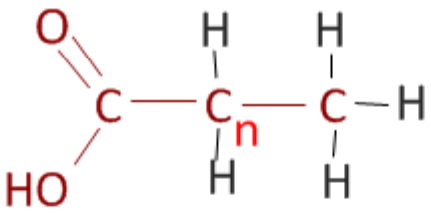
"The controlled release of energy from organic compounds in cells

usually

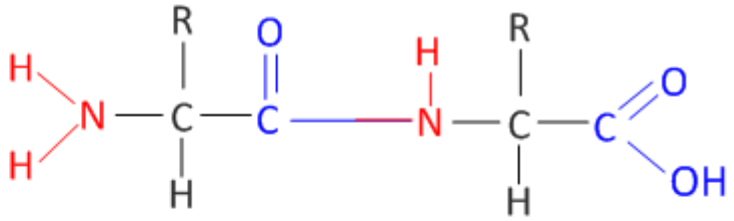


glucose/ carbohydrates

sometimes



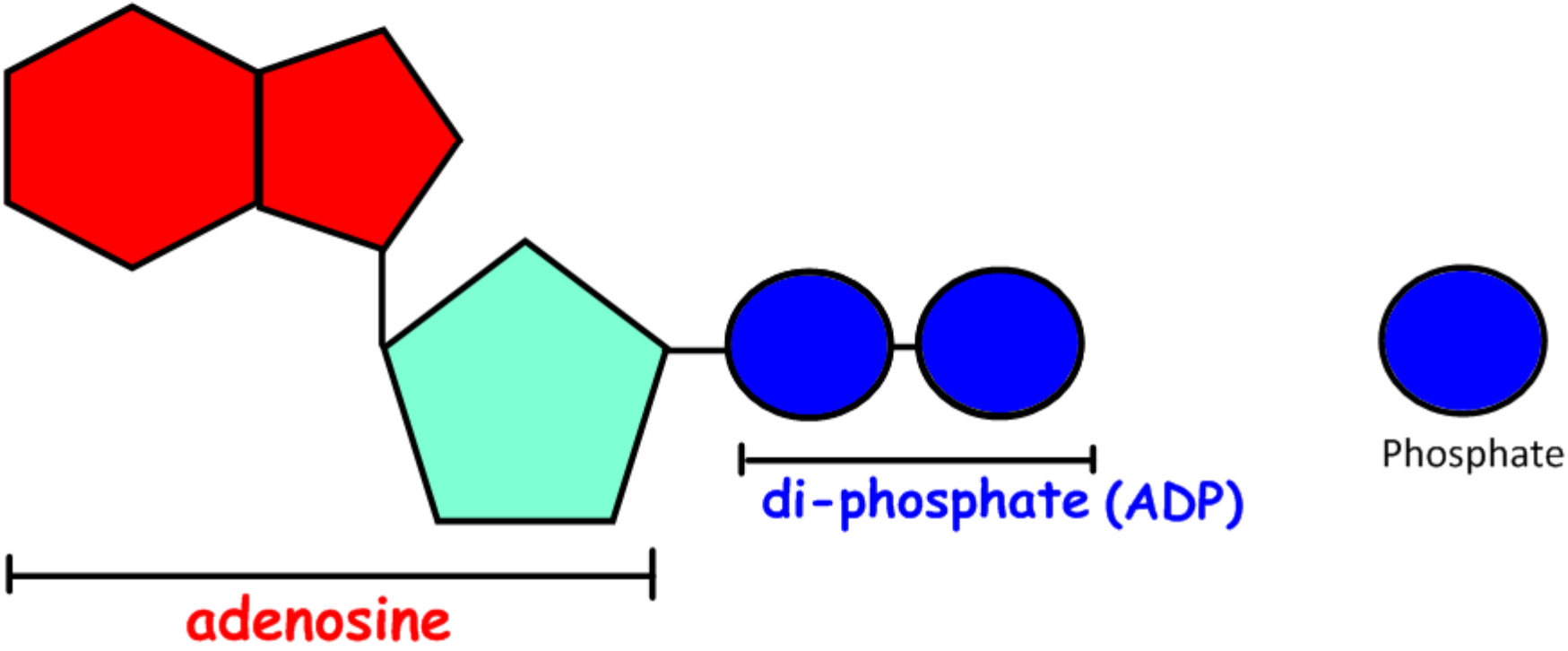
lipids/ fatty acids



proteins

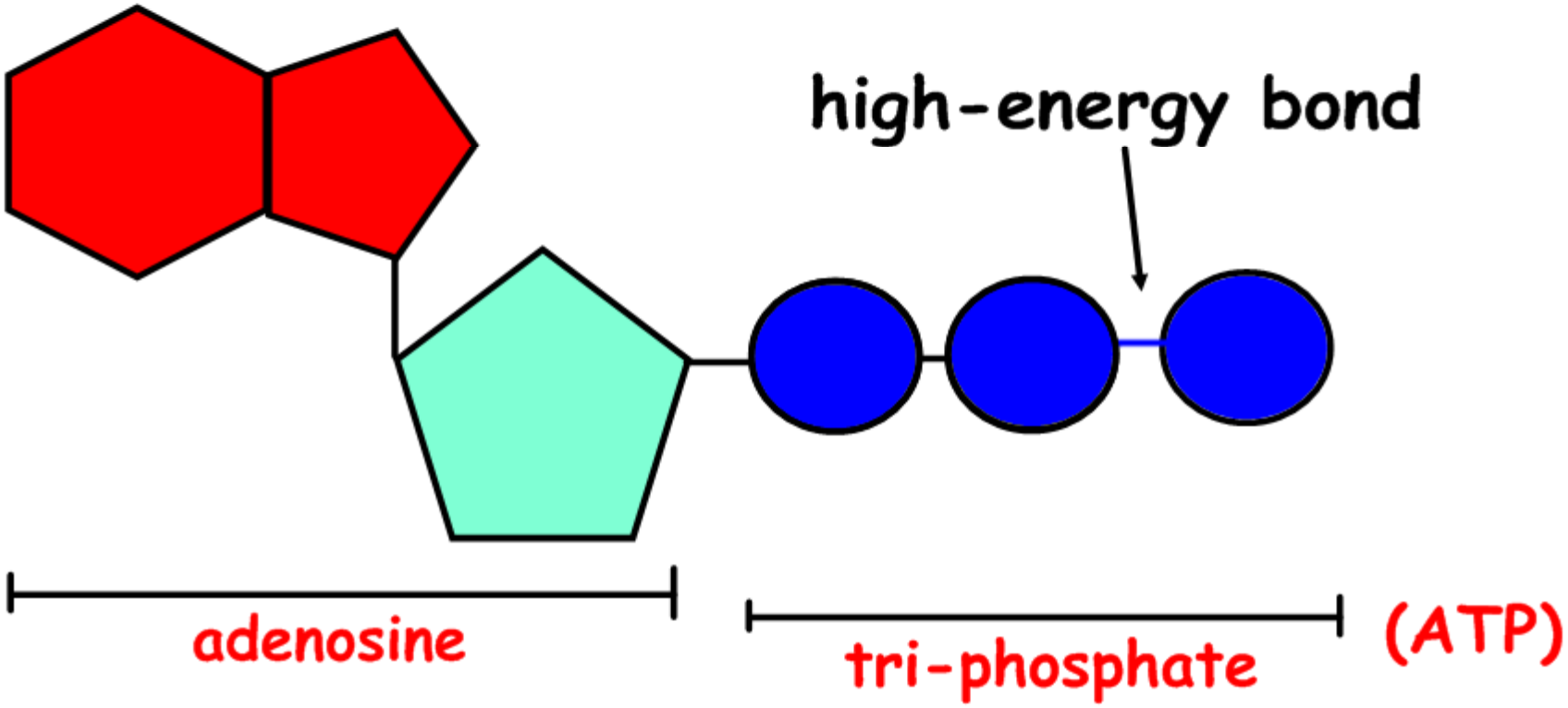
Cell Respiration

"The controlled release of energy from organic compounds in cells to form ATP"



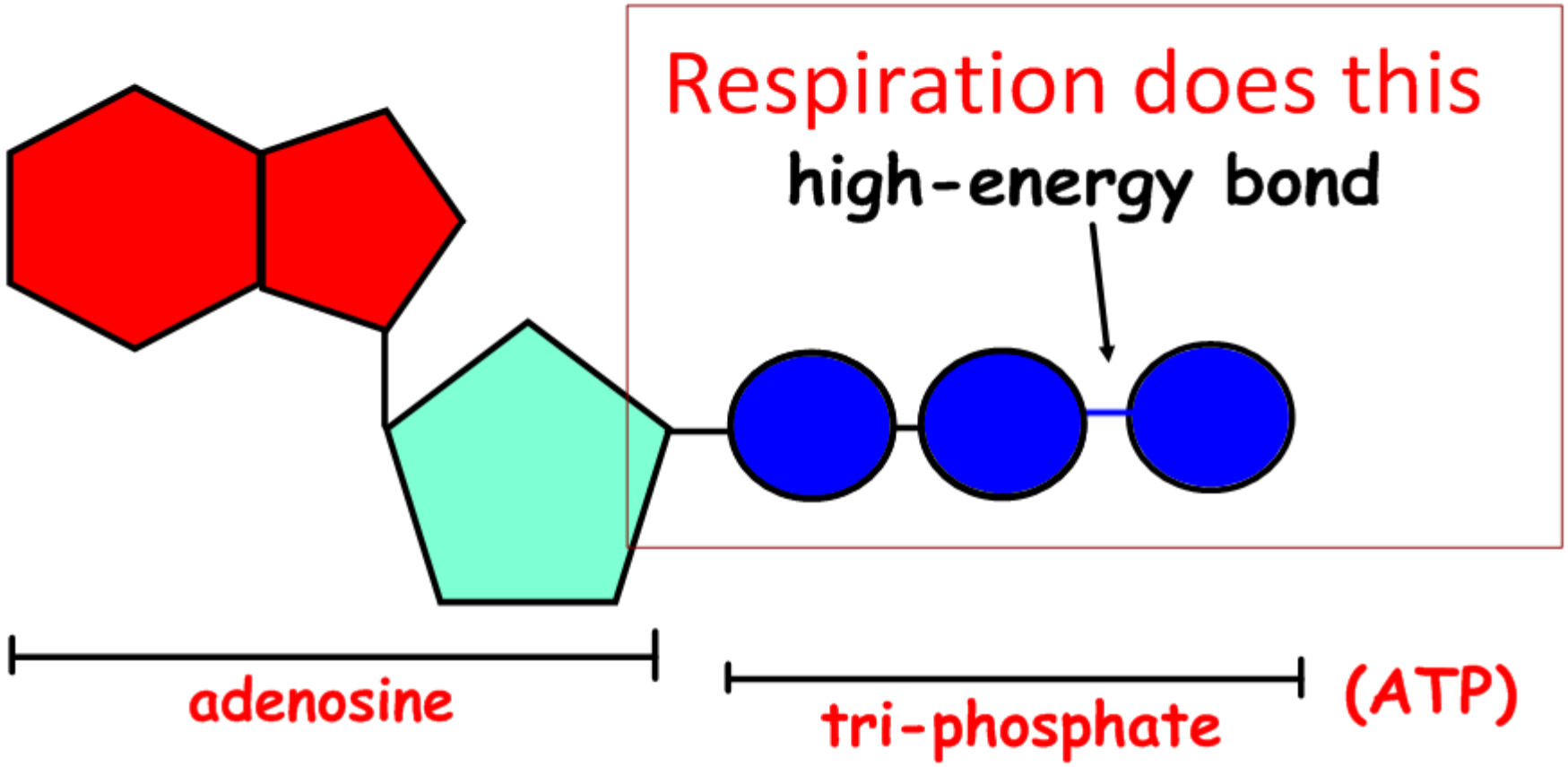
Cell Respiration

"The controlled release of energy from organic compounds in cells to form ATP"



Cell Respiration

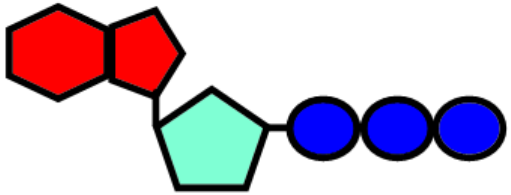
"The controlled release of energy from organic compounds in cells to form ATP"



Cell Respiration

Universality vs diversity!

"The controlled release of energy from organic compounds in cells to form ATP"



used for
energetic processes

muscle contraction

active transport

protein synthesis

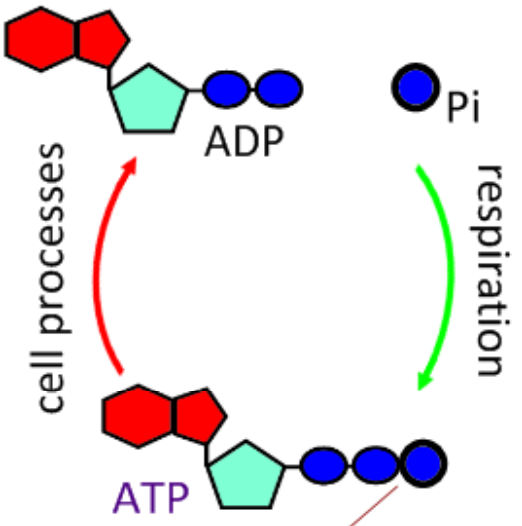
vesicle transport

DNA/ RNA replication

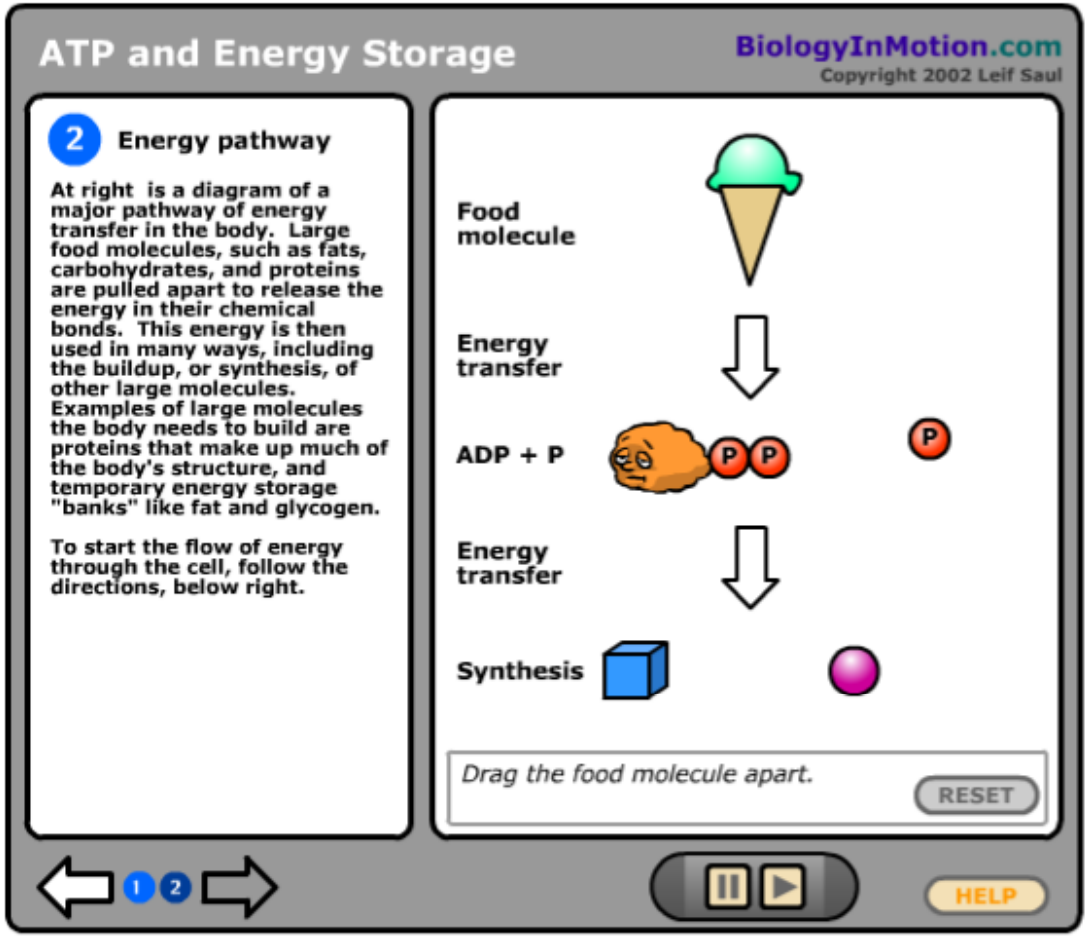
cell signalling

ATP adenosine tri-phosphate

Respiration generates ATP from ADP and phosphate ions in the cell.



This high energy bond is a temporary store of energy, which is broken to release energy in cell processes.

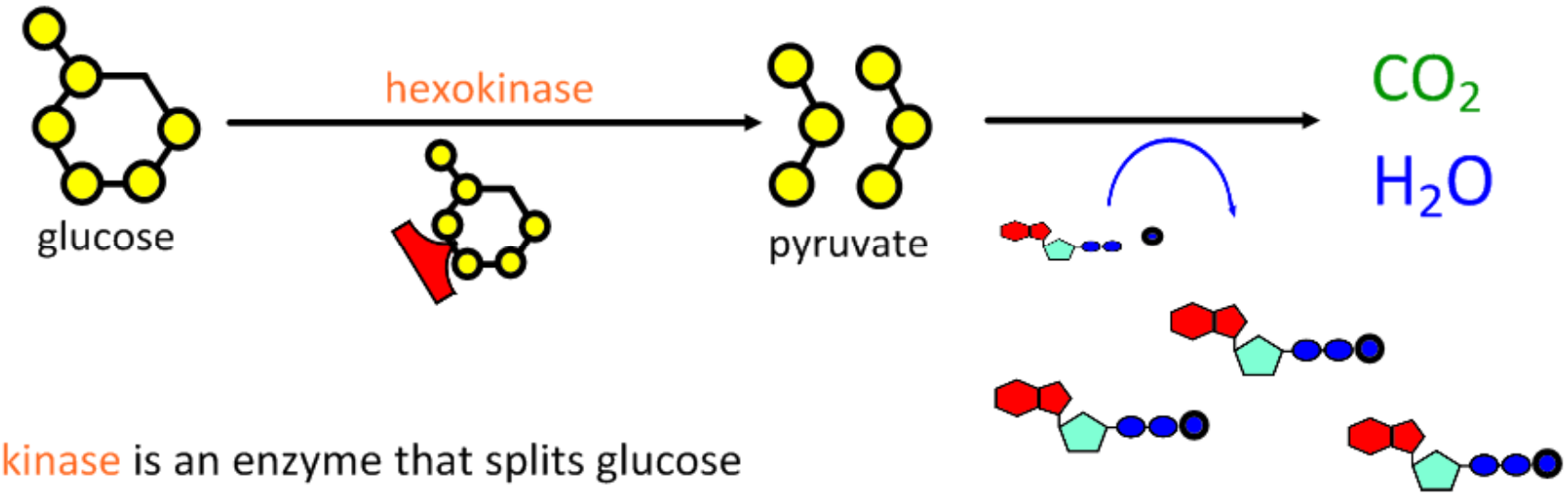


http://www.biologyinmotion.com/atp/index.html

ATP is not a stable long-term energy store. Cells in tissues which have a high energy demand are rich in mitochondria, in order to keep generating sufficient ATP. Long-term stores include lipids and glycogen, which can be metabolised through respiration as needed.

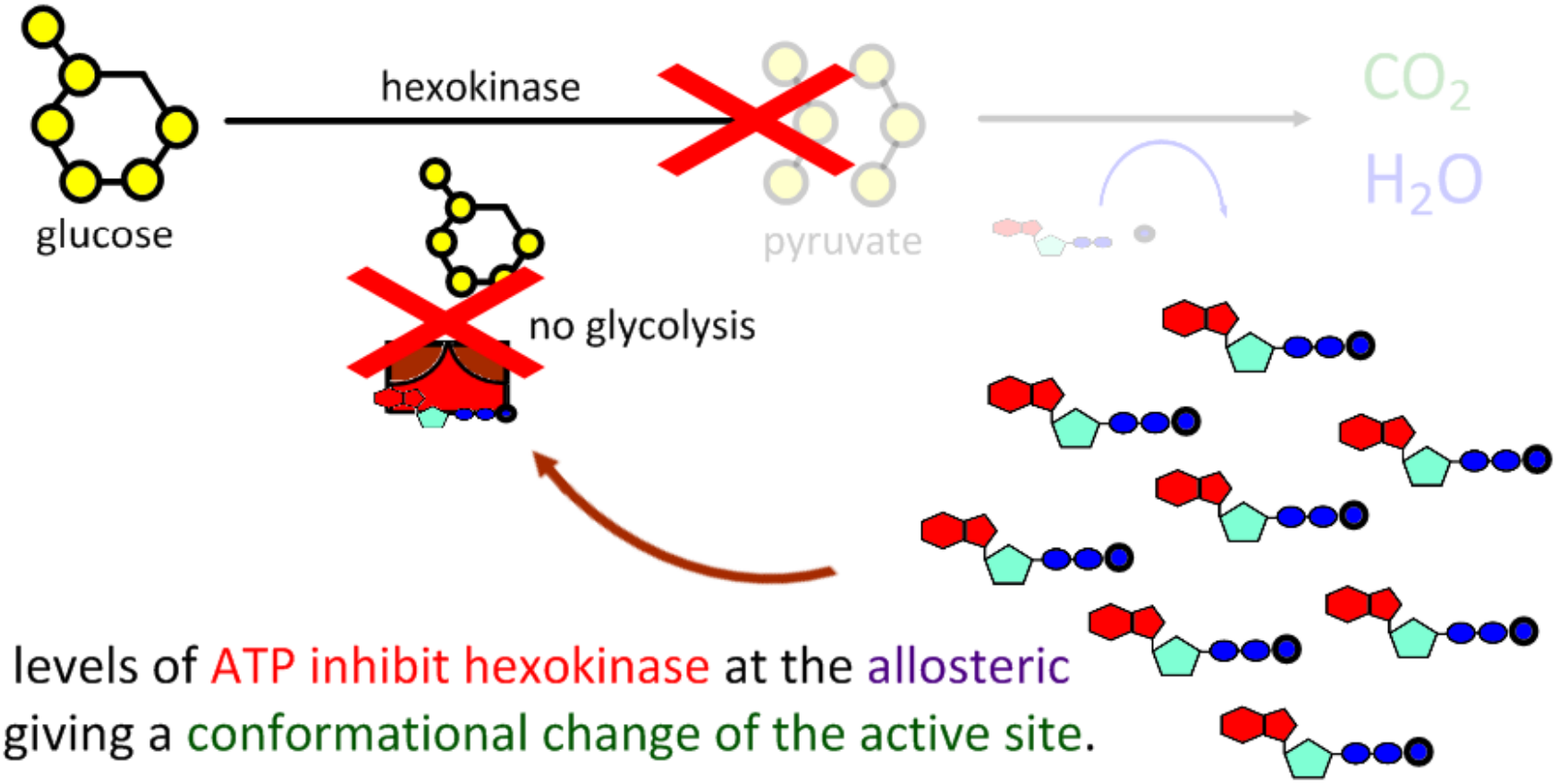
http://www.biologyinmotion.com/atp/

Cell Respiration is an enzyme-controlled metabolic pathway which can be controlled by end-product inhibition.



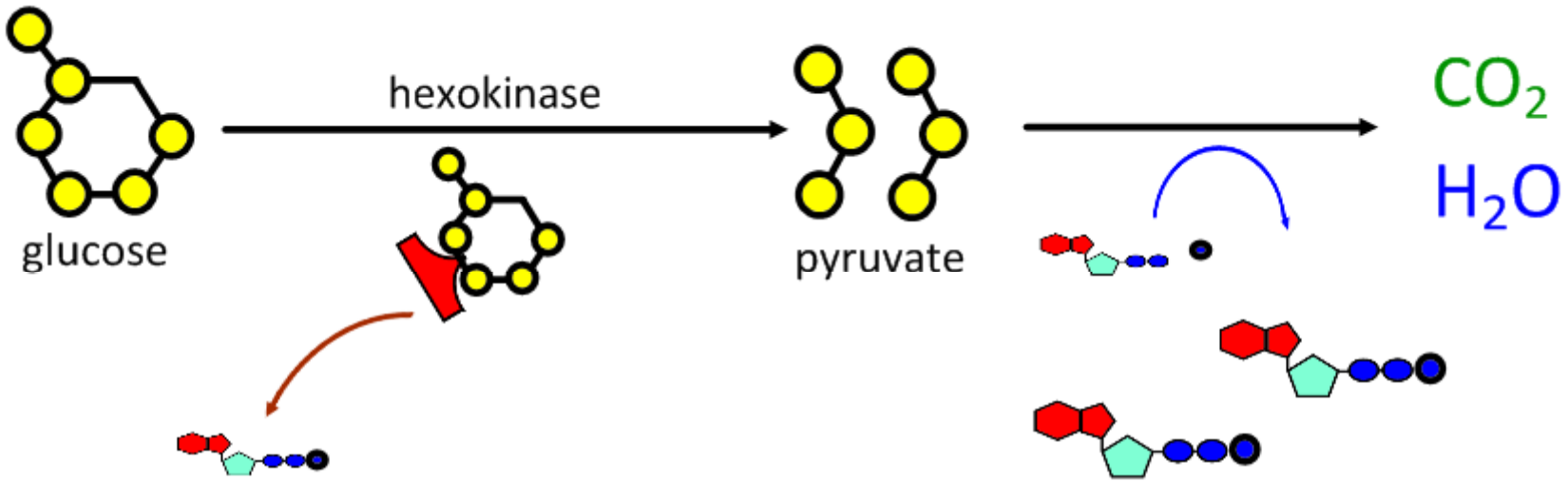
hexokinase is an enzyme that splits glucose into pyruvate molecules (glycolysis).

Cell Respiration is an enzyme-controlled metabolic pathway which can be controlled by end-product inhibition.



High levels of ATP inhibit hexokinase at the allosteric site, giving a conformational change of the active site.

Cell Respiration is an enzyme-controlled metabolic pathway which can be controlled by end-product inhibition.



High levels of ATP inhibit hexokinase at the allosteric site, giving a conformational change of the active site.
This is reversed when ATP levels return to normal.

"Respiration is the controlled release of energy from organic compounds in cells to form ATP"

$C_6H_{12}O_6$

glucose
(an organic molecule)

"Respiration is the controlled release of energy from organic compounds in cells to form ATP"

$C_6H_{12}O_6 + 6O_2$

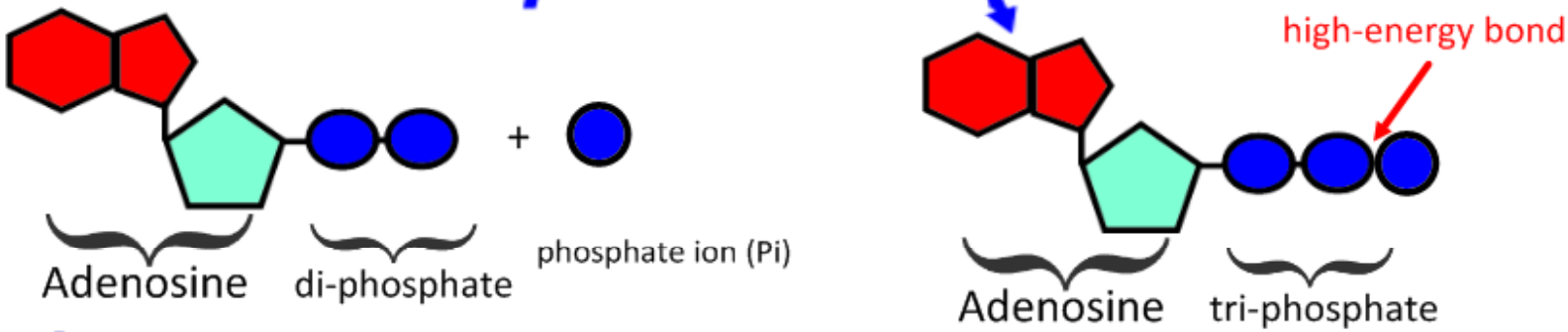
oxygen:
aerobic respiration gives a better yield of ATP

"Respiration is the controlled release of energy from organic compounds in cells to form ATP"

Cell Respiration

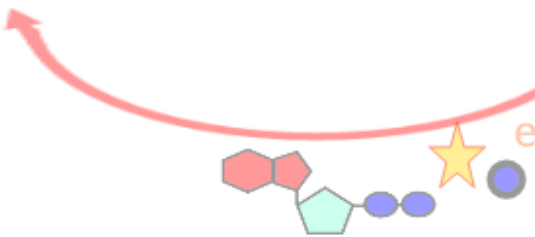
$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2$

(or other organic molecules)



ADP = low energy

ATP = high energy

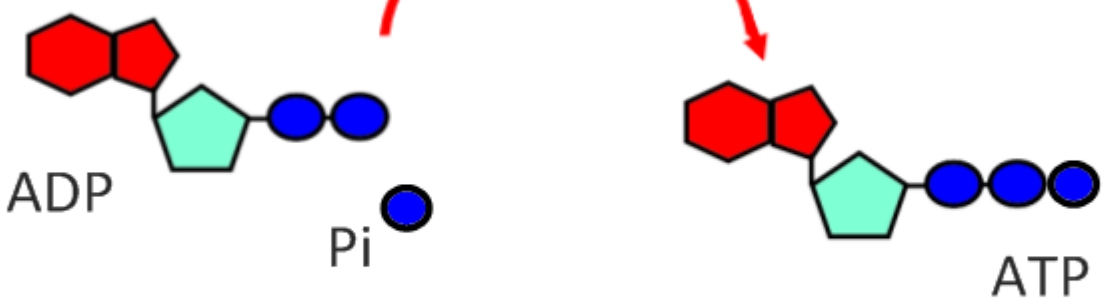


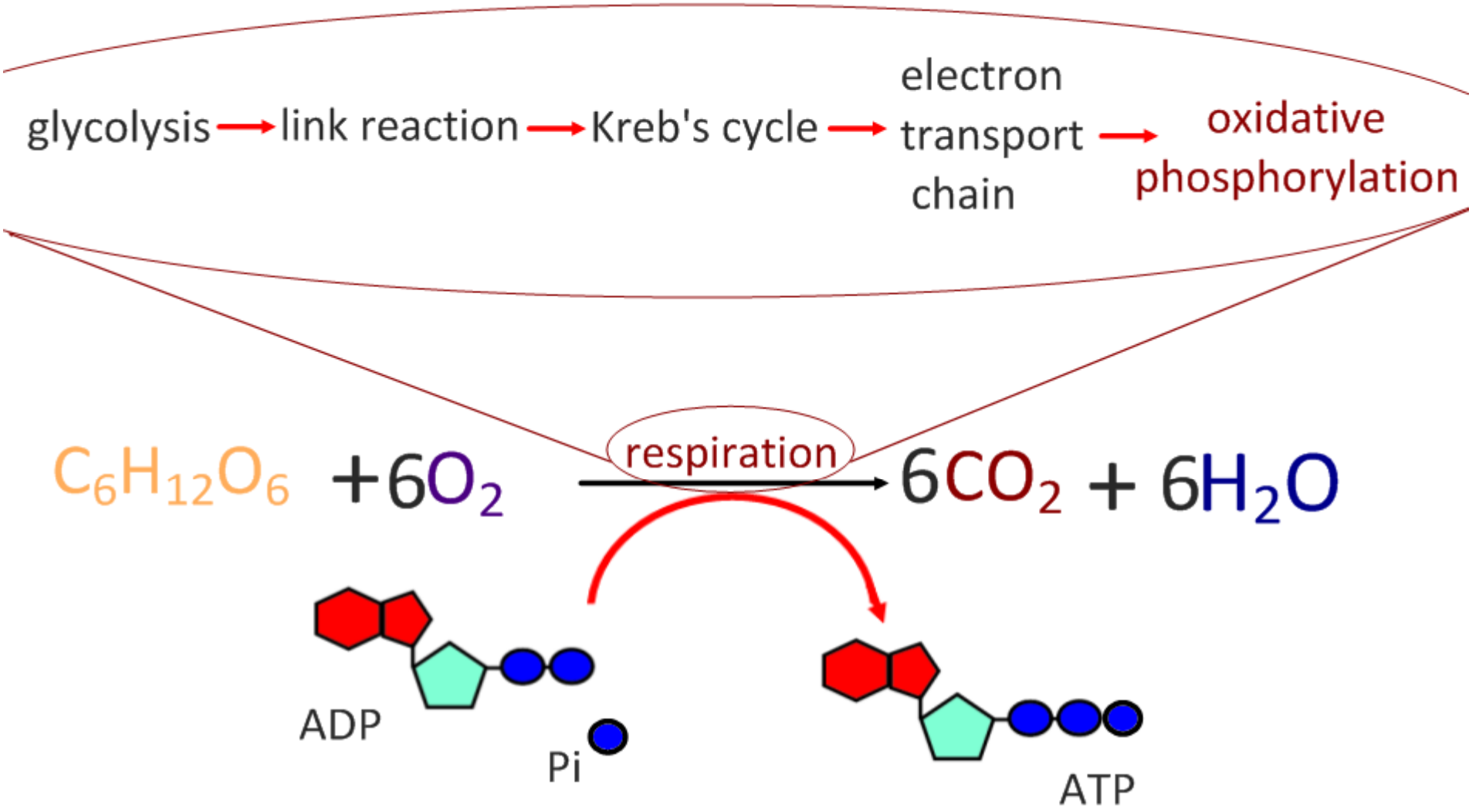
Cellular Processes

- active transport
- vesicle transport
- muscle contraction
- protein synthesis
- DNA/ RNA replication
- Cell signalling

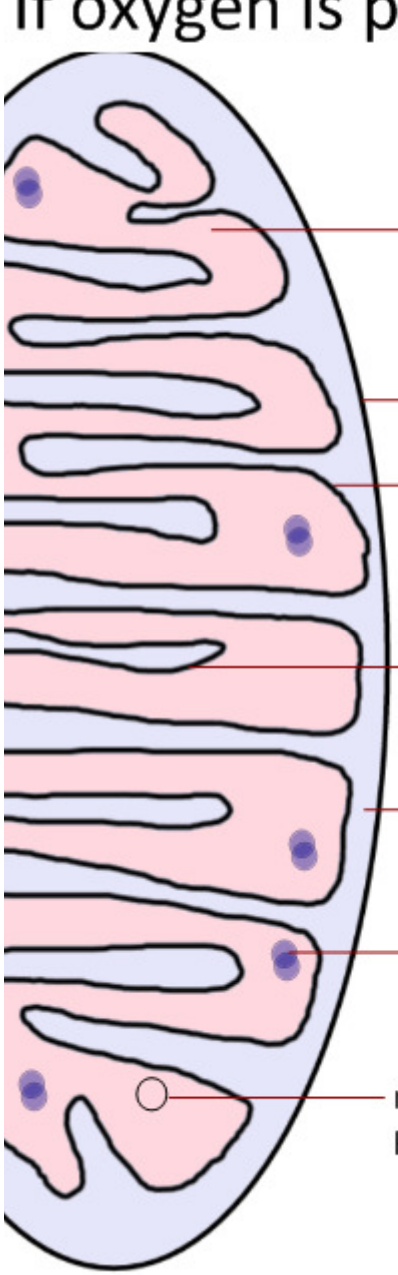
"Respiration is the controlled release of energy from organic compounds in cells to form ATP"

$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{respiration}} 6CO_2 + 6H_2O$




glycolysis
link reaction
Kreb's cycle
electron transport chain
oxidative phosphorylation
$C_6H_{12}O_6$ +6O_2
respiration
6CO_2 + 6H_2O
ADP
Pi
ATP

If oxygen is present, reactions move to the mitochondria:



Matrix
contains enzymes and solutes for
Link Reaction and Krebs Cycle

Outer Mitochondrial Membrane

Inner Mitochondrial Membrane
site for electron transport chain and oxidative phosporylation

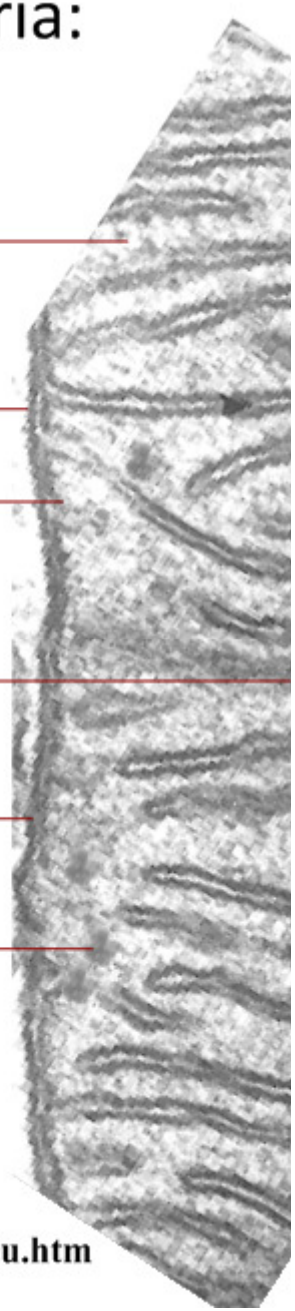
folded into

Cristae
to maximise surface area for reactions

Small Inter-membrane Space
more efficient generation of H^+ concentration gradient

70S Ribosomes
protein production

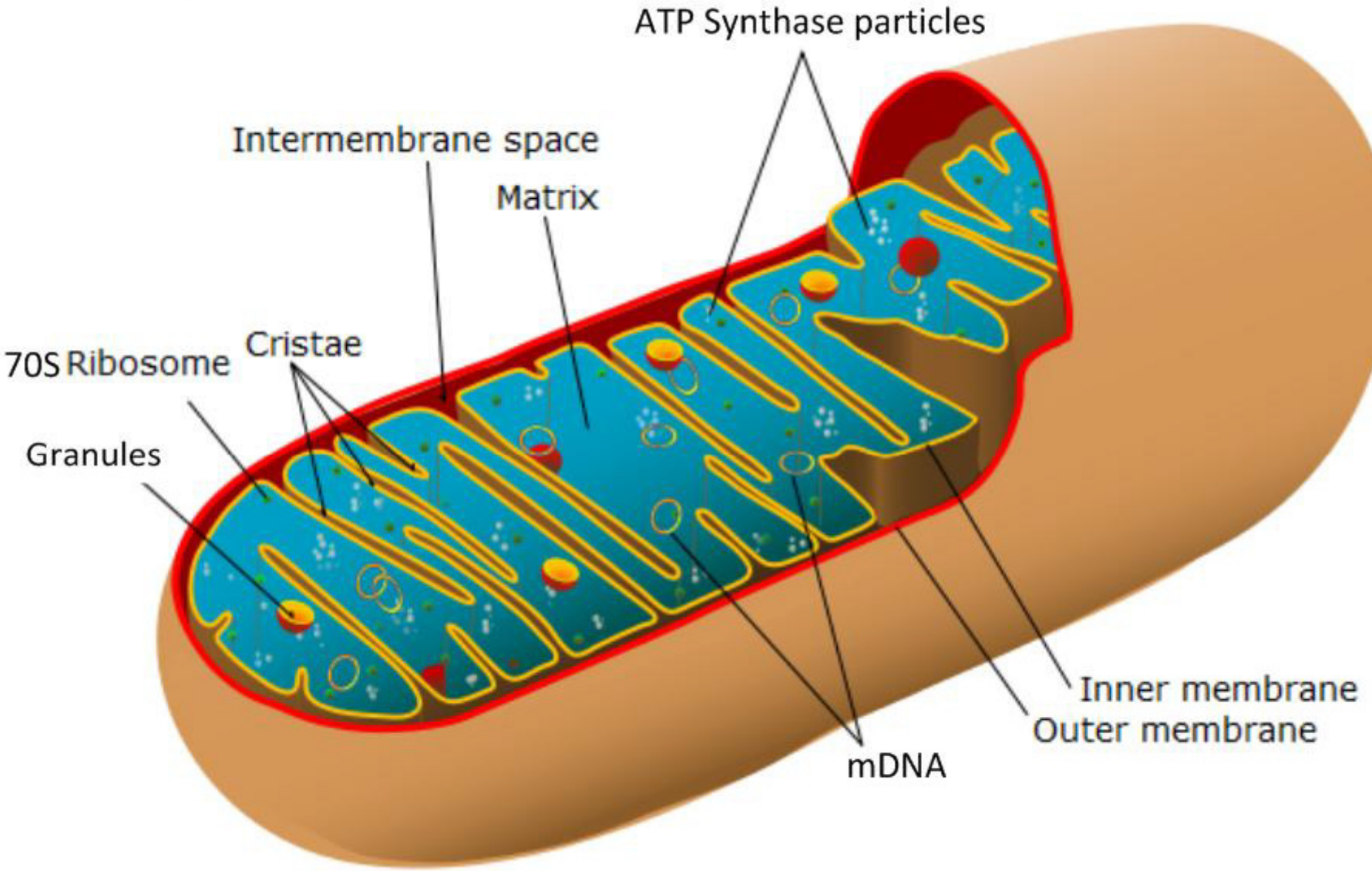
naked loops of DNA (mitochondrial DNA/ mDNA)
Passed unchanged from mother to child



1µm

http://www.udel.edu/biology/Wags/histopage/empage/ecu/ecu.htm

Label the parts:



http://en.wikipedia.org/wiki/Mitochondrion

Label the parts:

outer membrane

inner membrane

inter-membrane space

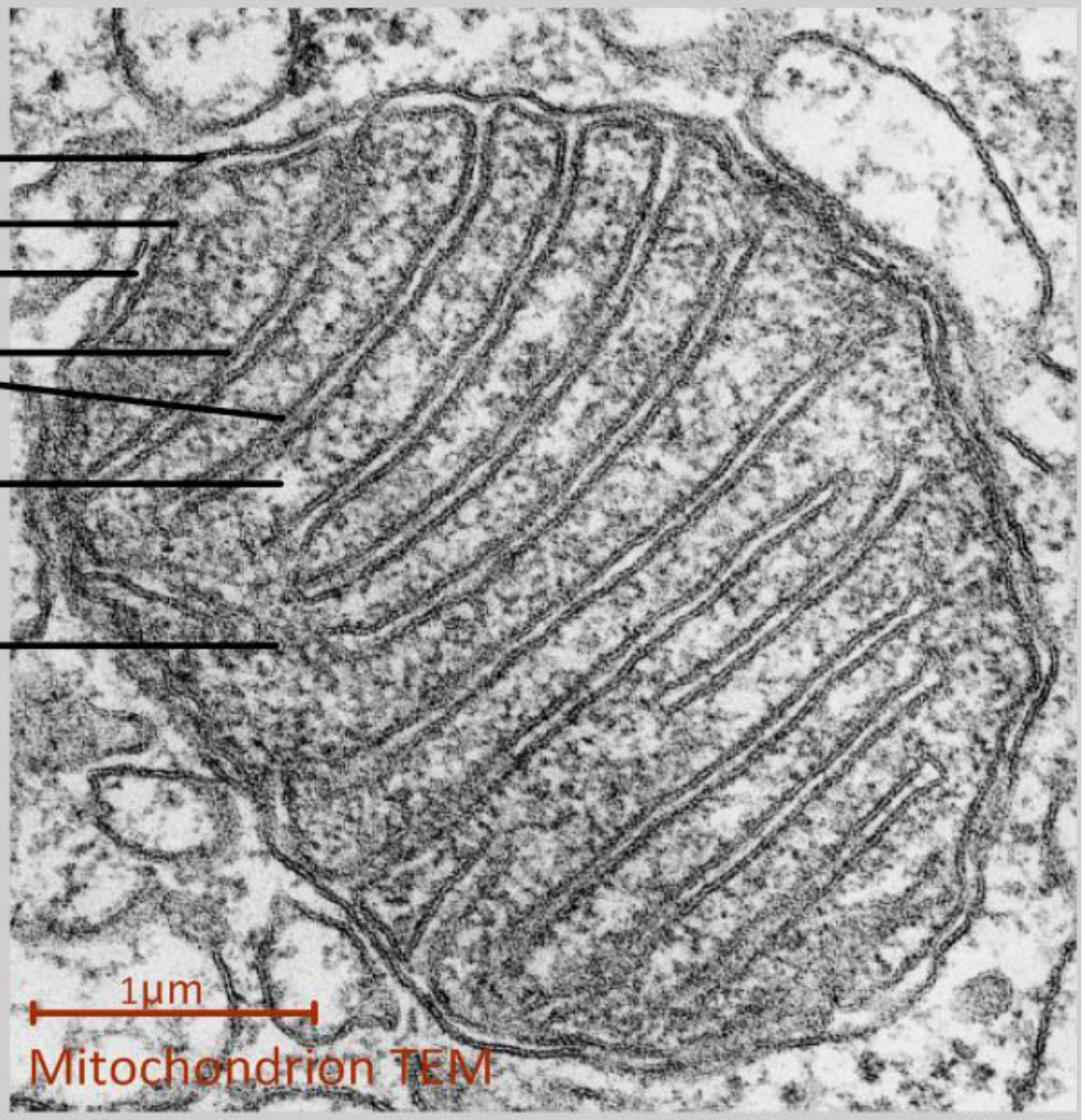
christae

matrix

70S Ribosomes

not easily visible:
- mDNA

Print this image and calculate:
- magnification
- maximum length
- width of one crista



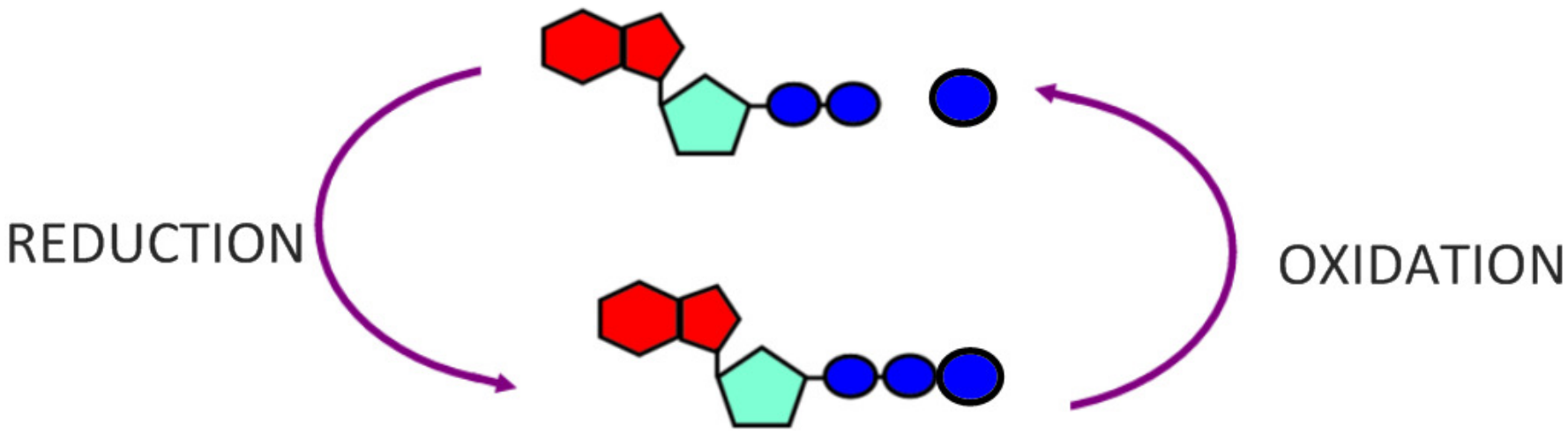
http://antiparos.zoo.ox.ac.uk/presentations/Talks/20060526-DataWeb-tech.html

Make your own Mitochondria ☺

First: Remember Oxidation and Reduction!?

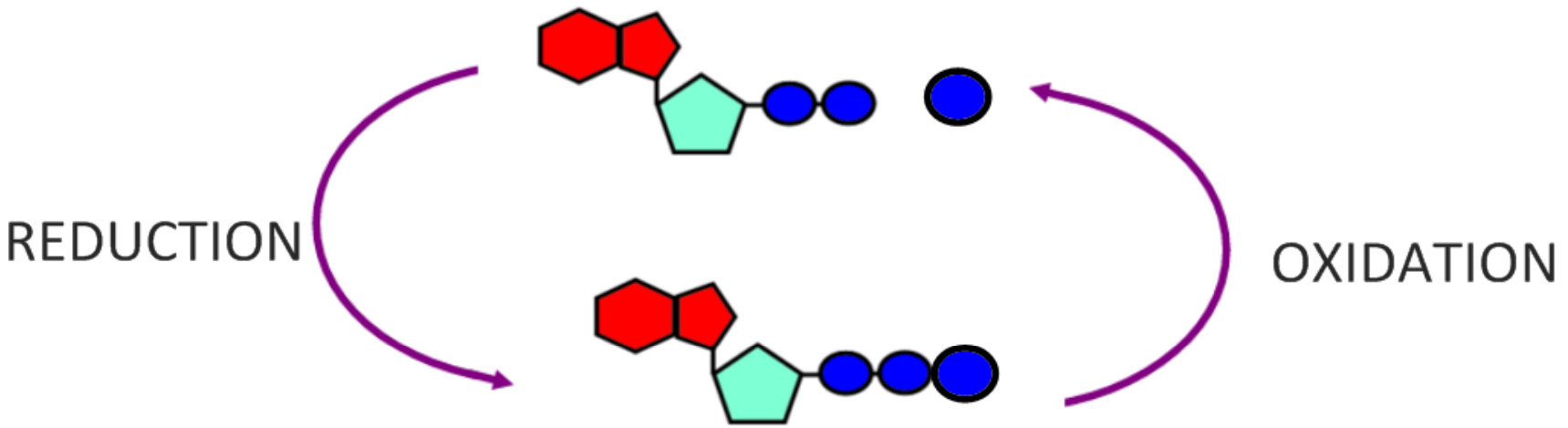
Many biochemical reactions are classed as either

REDUCTION or OXIDATION



Many biochemical reactions are classed as either

REDUCTION or OXIDATION



electrons are gained electrons are lost

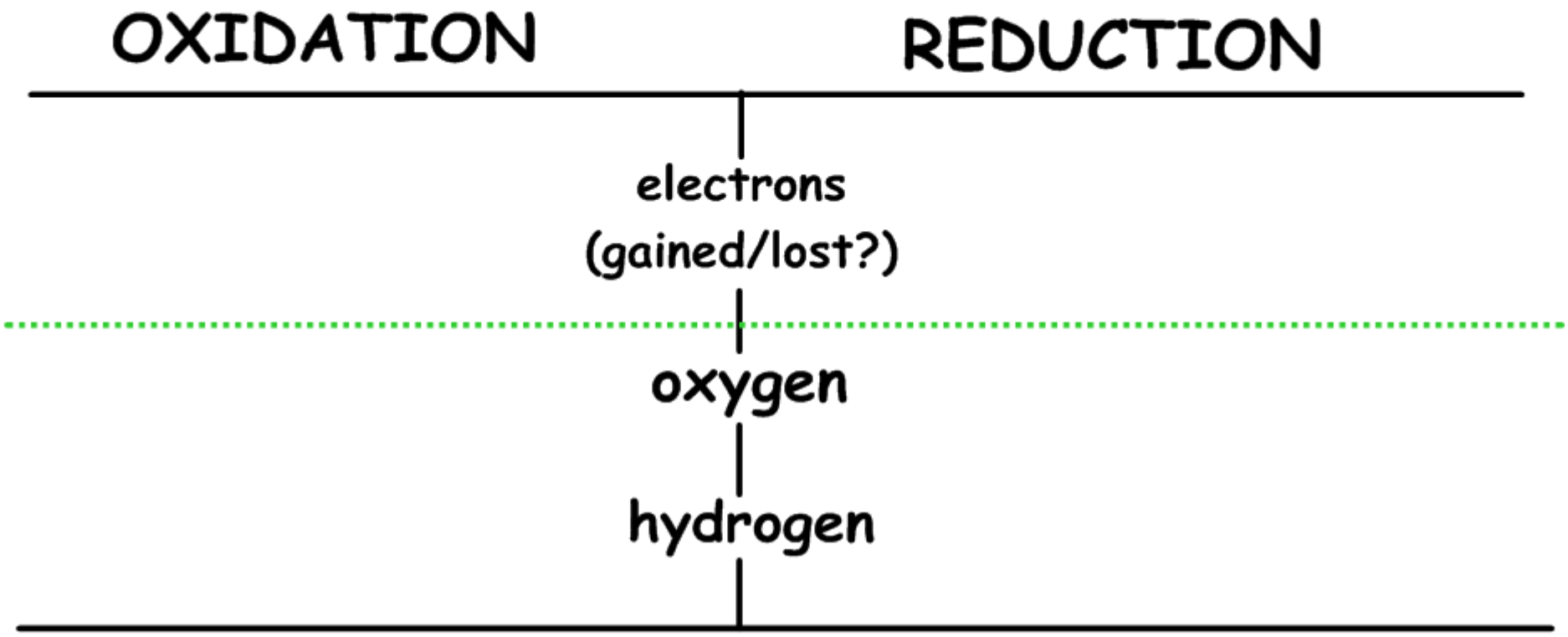
or

oxygen is removed oxygen is added

or

hydrogen is gained hydrogen is lost

COMPARE OXIDATION AND REDUCTION



COMPARE OXIDATION AND REDUCTION

OXIDATION		REDUCTION
lost	electrons (gained/lost?)	gained
gained	oxygen	lost
lost	hydrogen	gained

remember: OILRIG

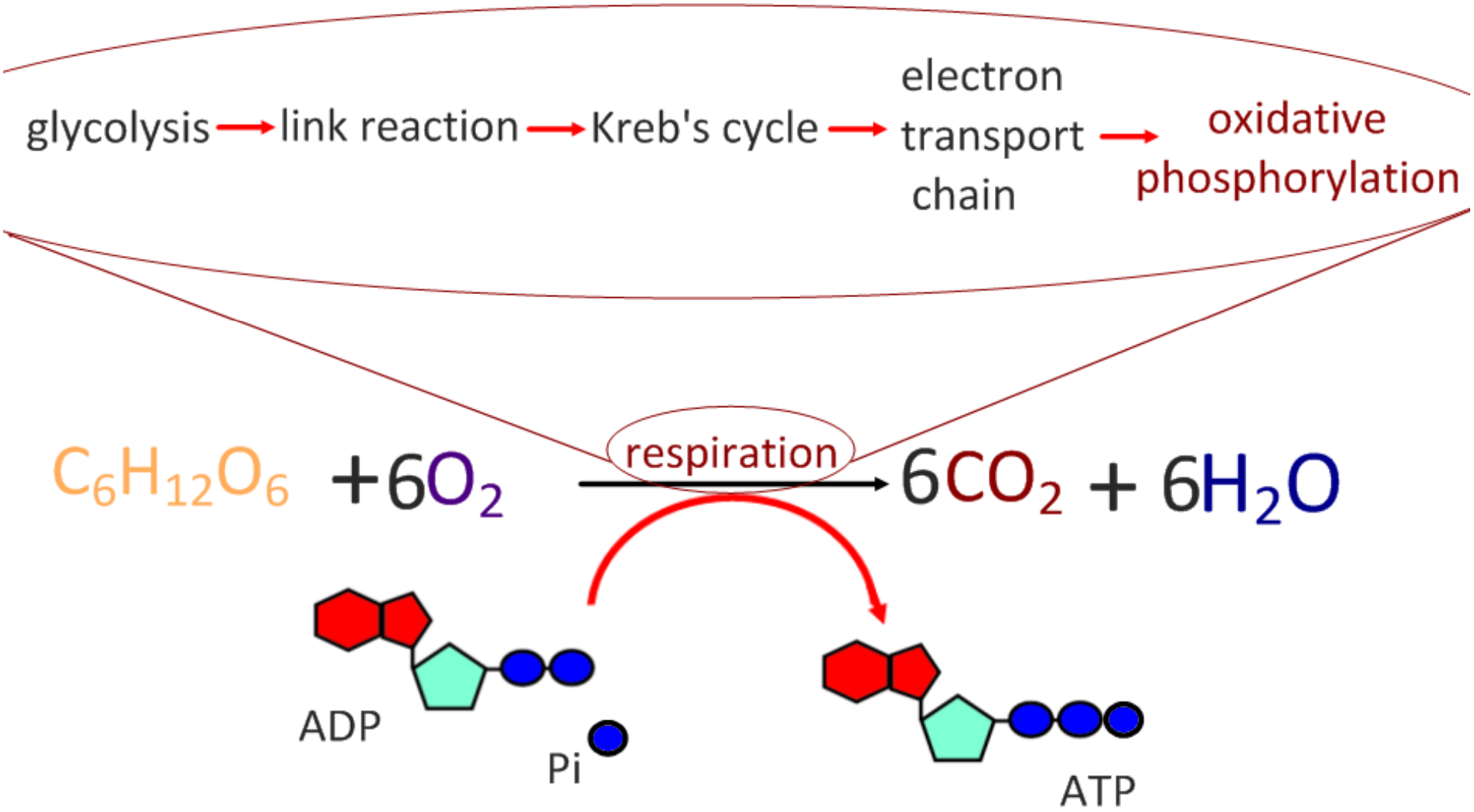
Oxidation / Reduction (Redox) Examples

Oxidized / reducing agent…

Nice Resource – good explanation!

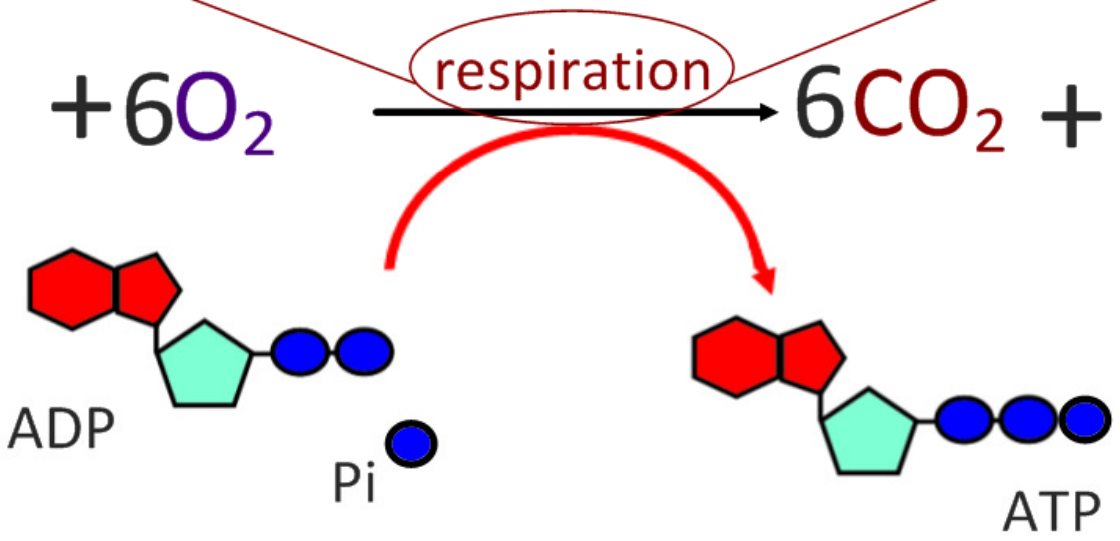
http://www.chemistry.co.nz/redox_new.htm

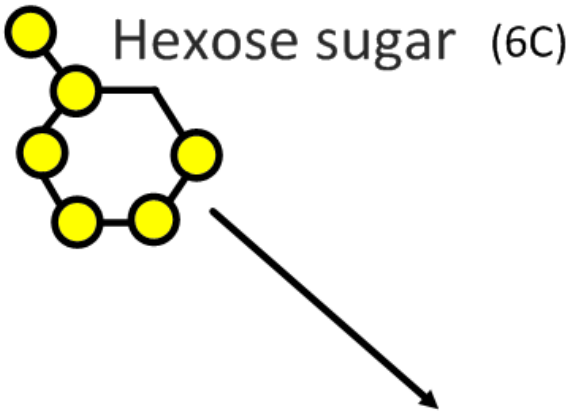
Back to work…


glycolysis
link reaction
Kreb's cycle
electron transport chain
oxidative phosphorylation
$C_6H_{12}O_6 + 6O_2$
respiration
$6CO_2 + 6H_2O$
ADP
Pi
ATP

glycolysis

$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{respiration}} 6CO_2 + 6H_2O$





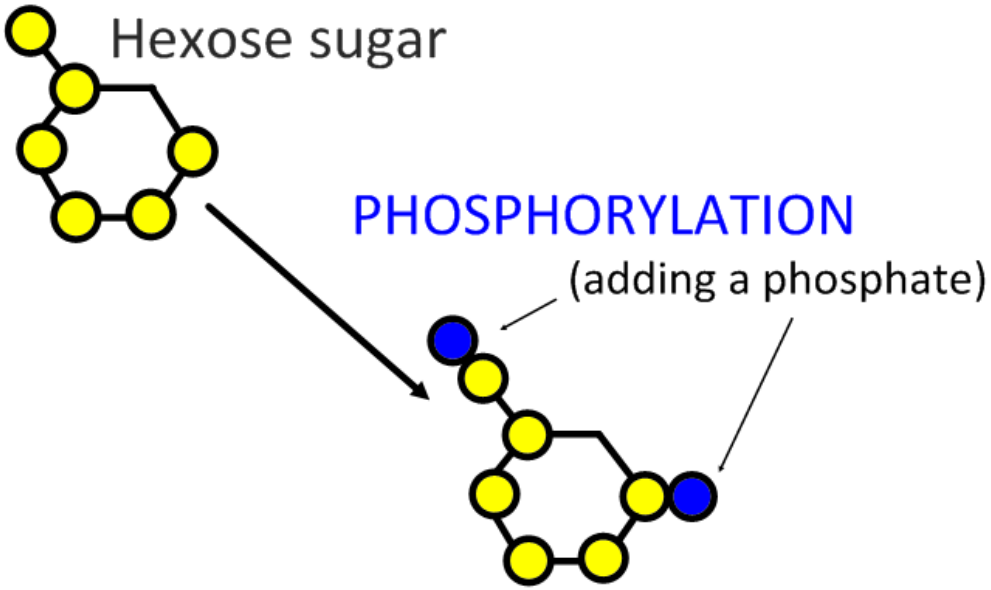
GLYCOLYSIS

sugar splitting

(cytoplasm)

GLYCOLYSIS

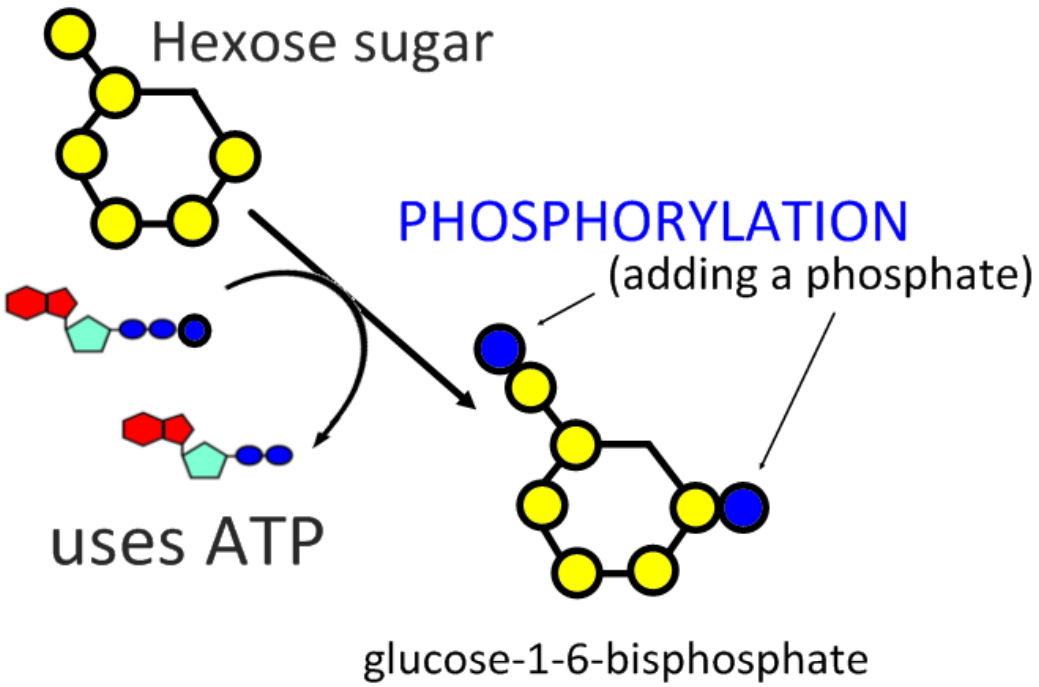
sugar splitting



(cytoplasm)

GLYCOLYSIS

sugar splitting

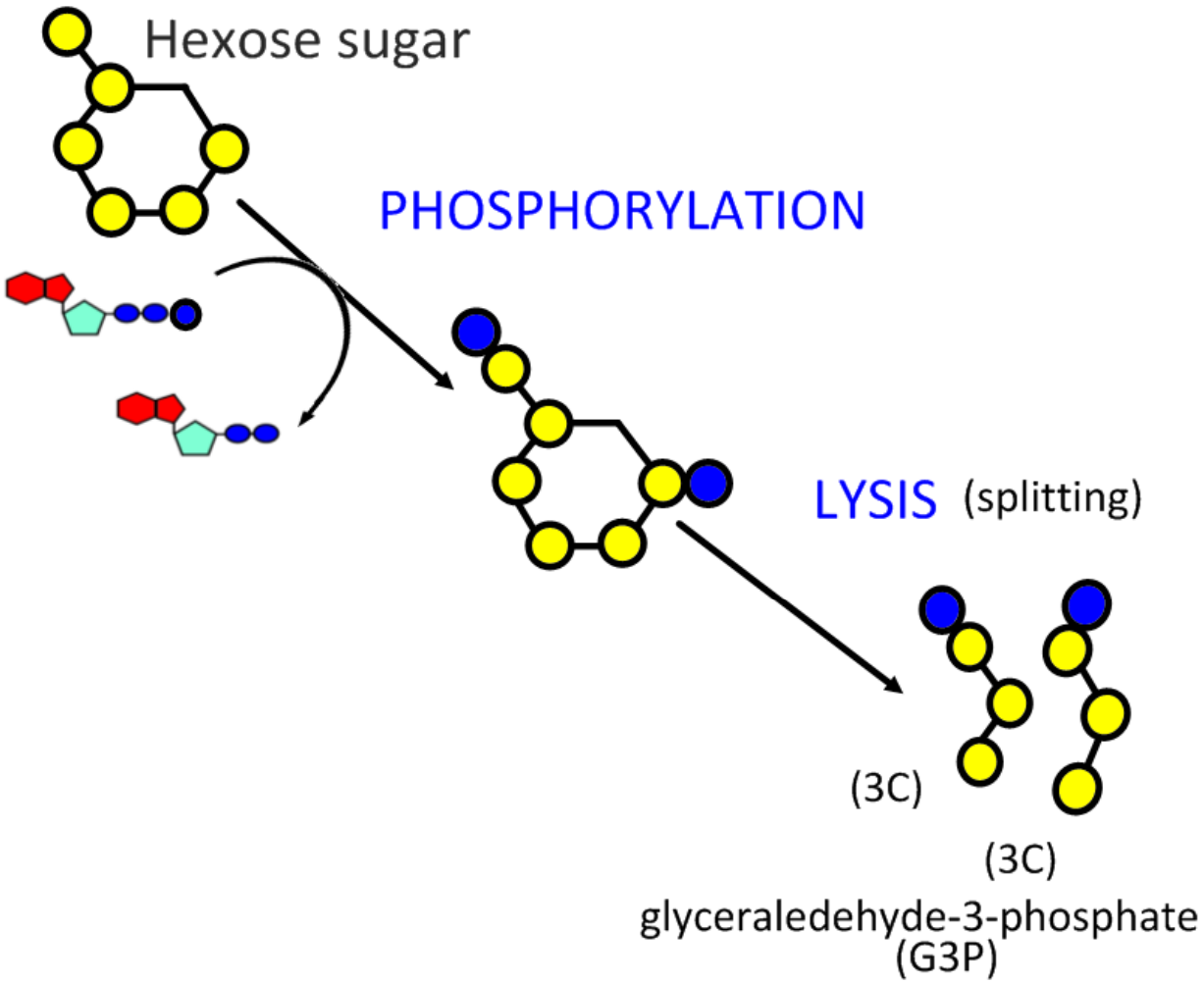


(cytoplasm)

GLYCOLYSIS

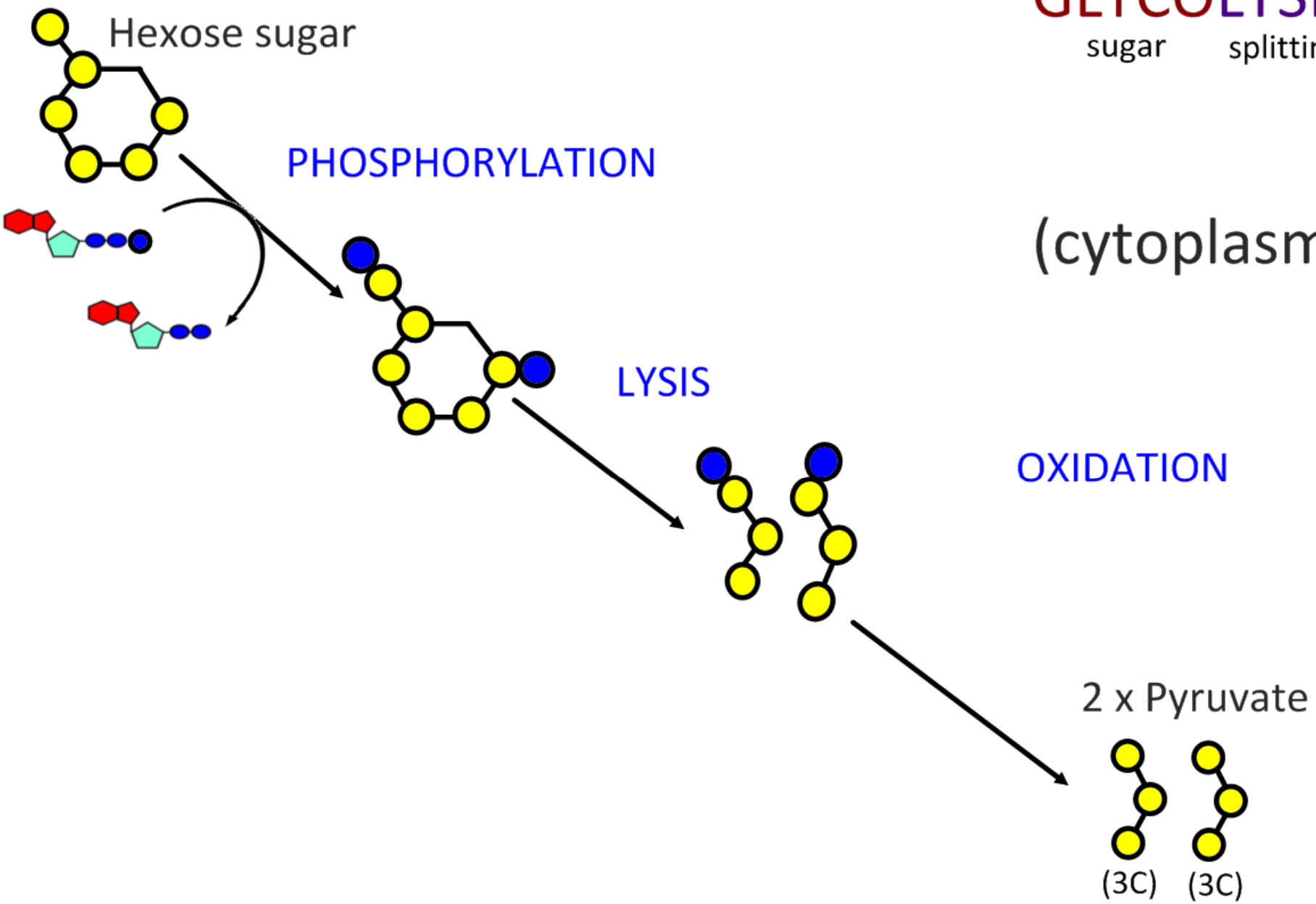
sugar splitting

(cytoplasm)



GLYCOLYSIS

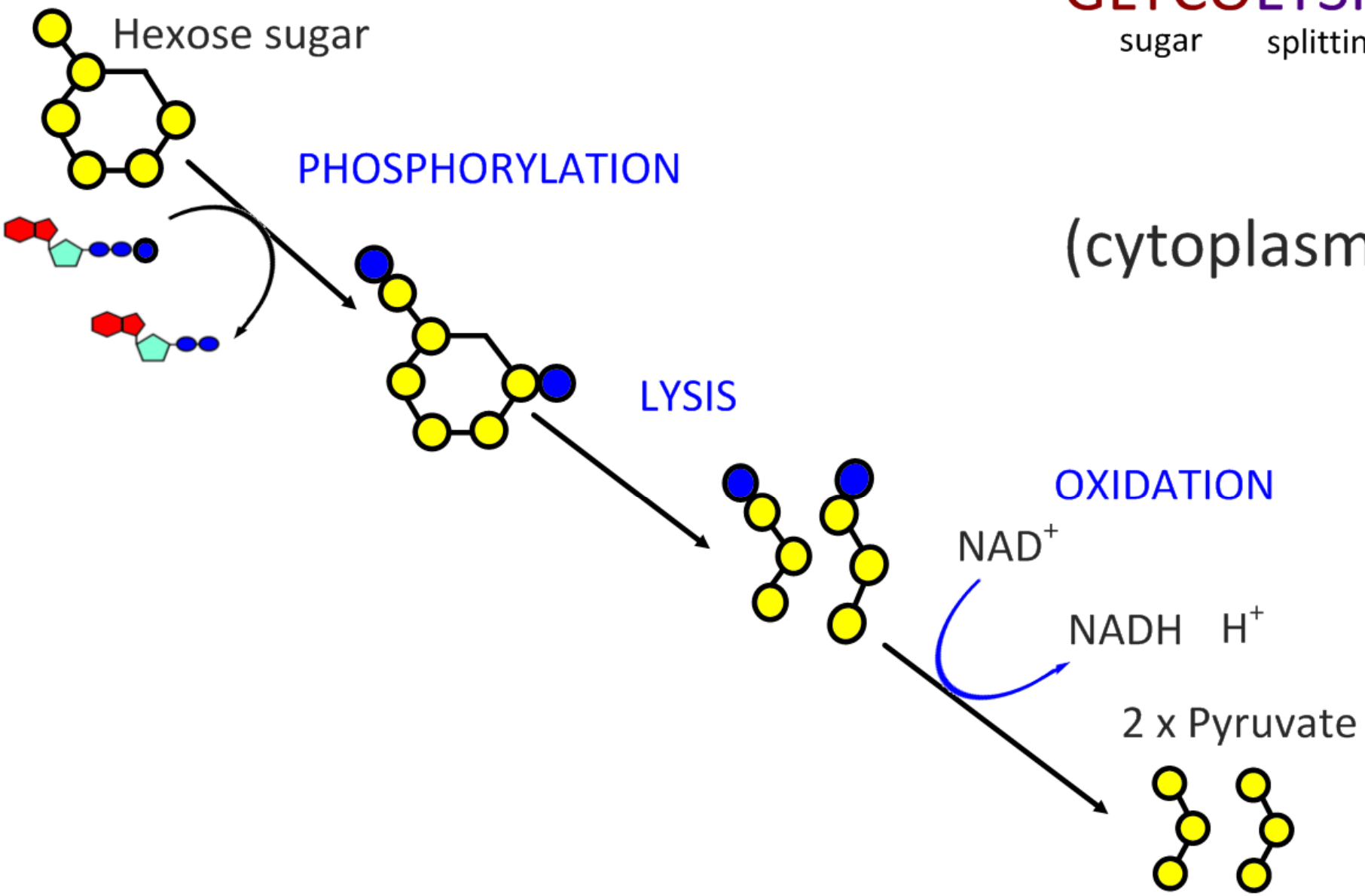
sugar splitting



(cytoplasm)

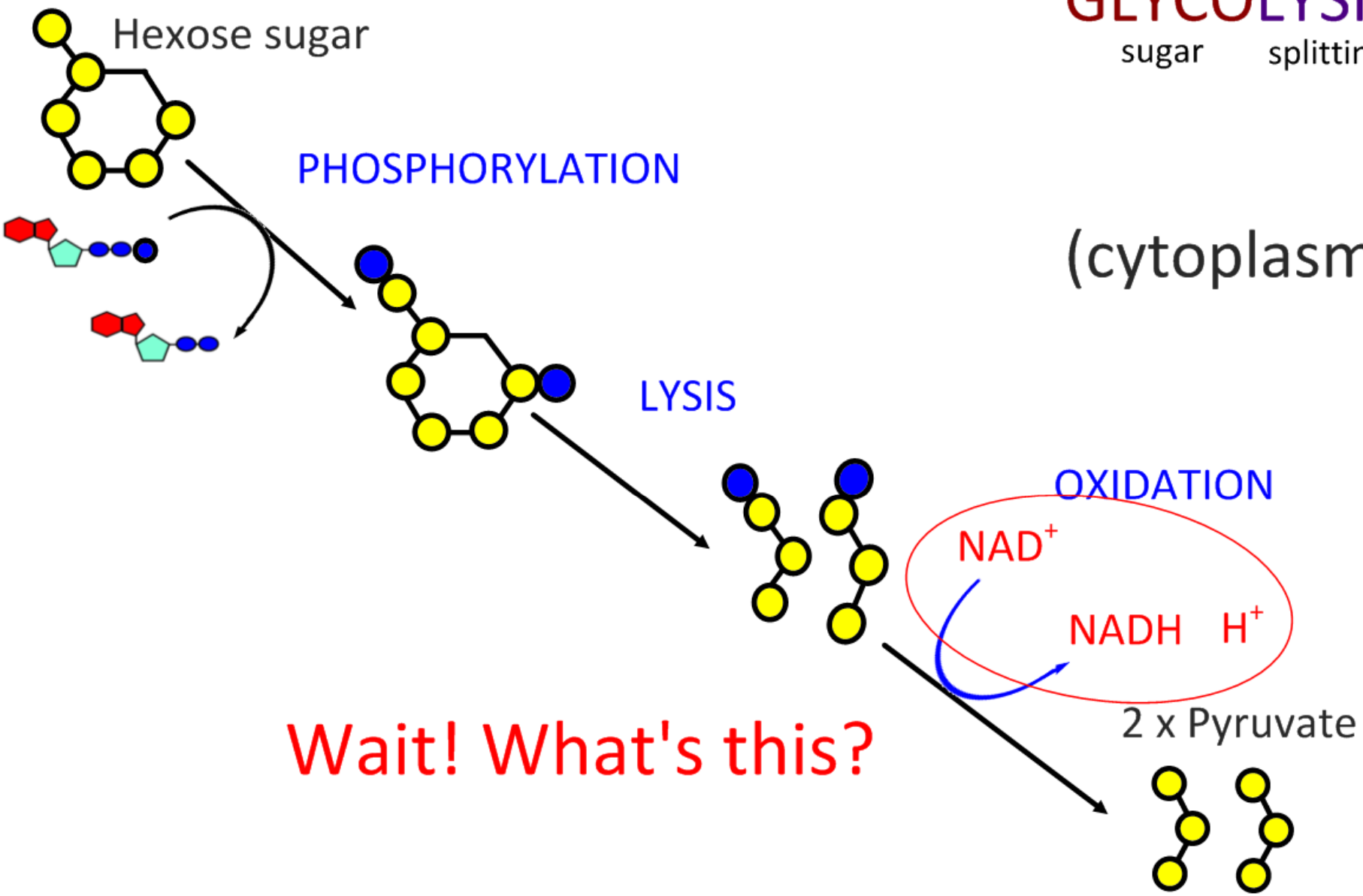
GLYCOLYSIS

sugar splitting



GLYCOLYSIS

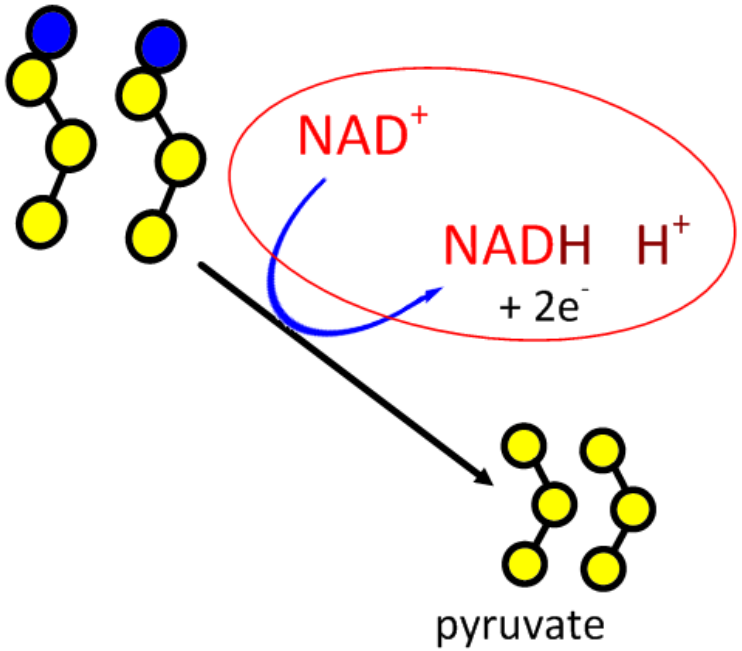
sugar splitting



(cytoplasm)

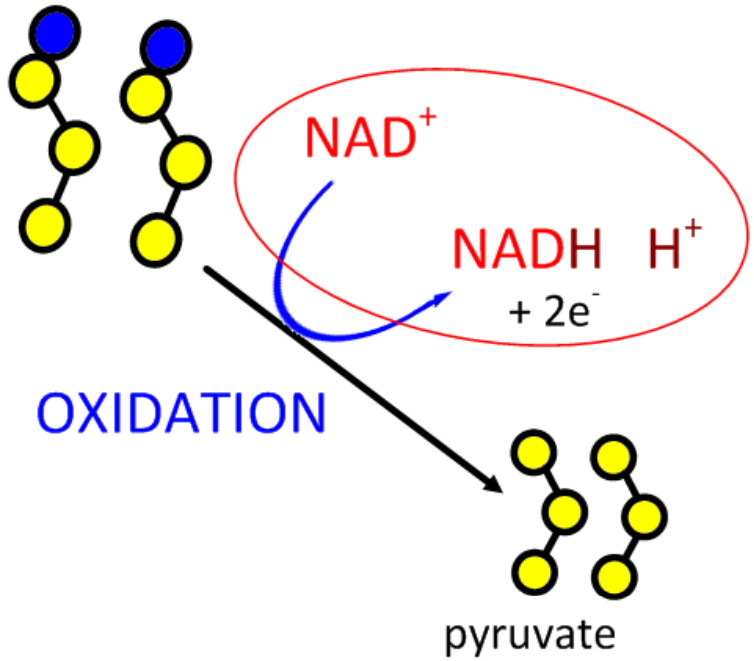
Wait! What's this?

Electron Carriers carry Hydrogen ions to the Electron Transport Chain



Electron Carriers carry Hydrogen ions to the Electron Transport Chain

G3P is oxidised
(lose electrons
and hydrogens)



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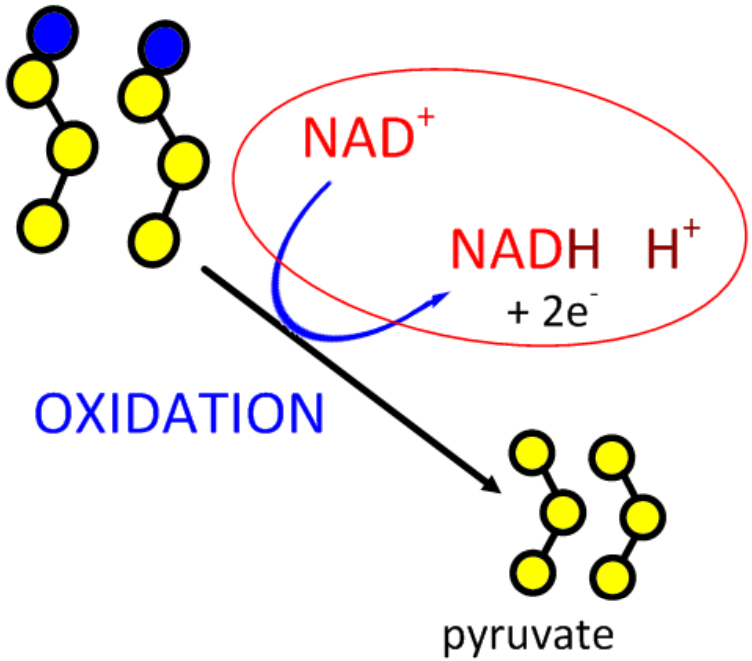
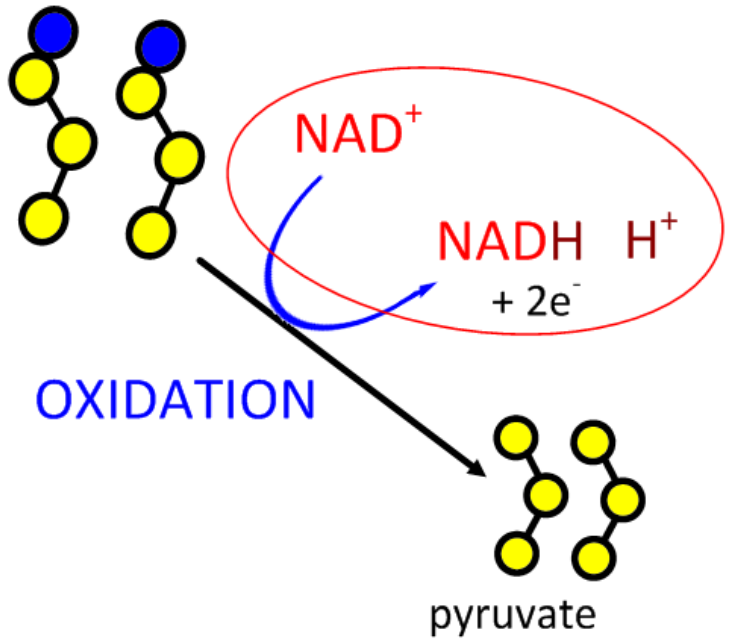


NAD^+ is reduced
(it gains 2 electrons and 2 hydrogens)

Electron Carriers carry Hydrogen ions to the Electron Transport Chain

G3P is oxidised
(lose electrons and hydrogens)

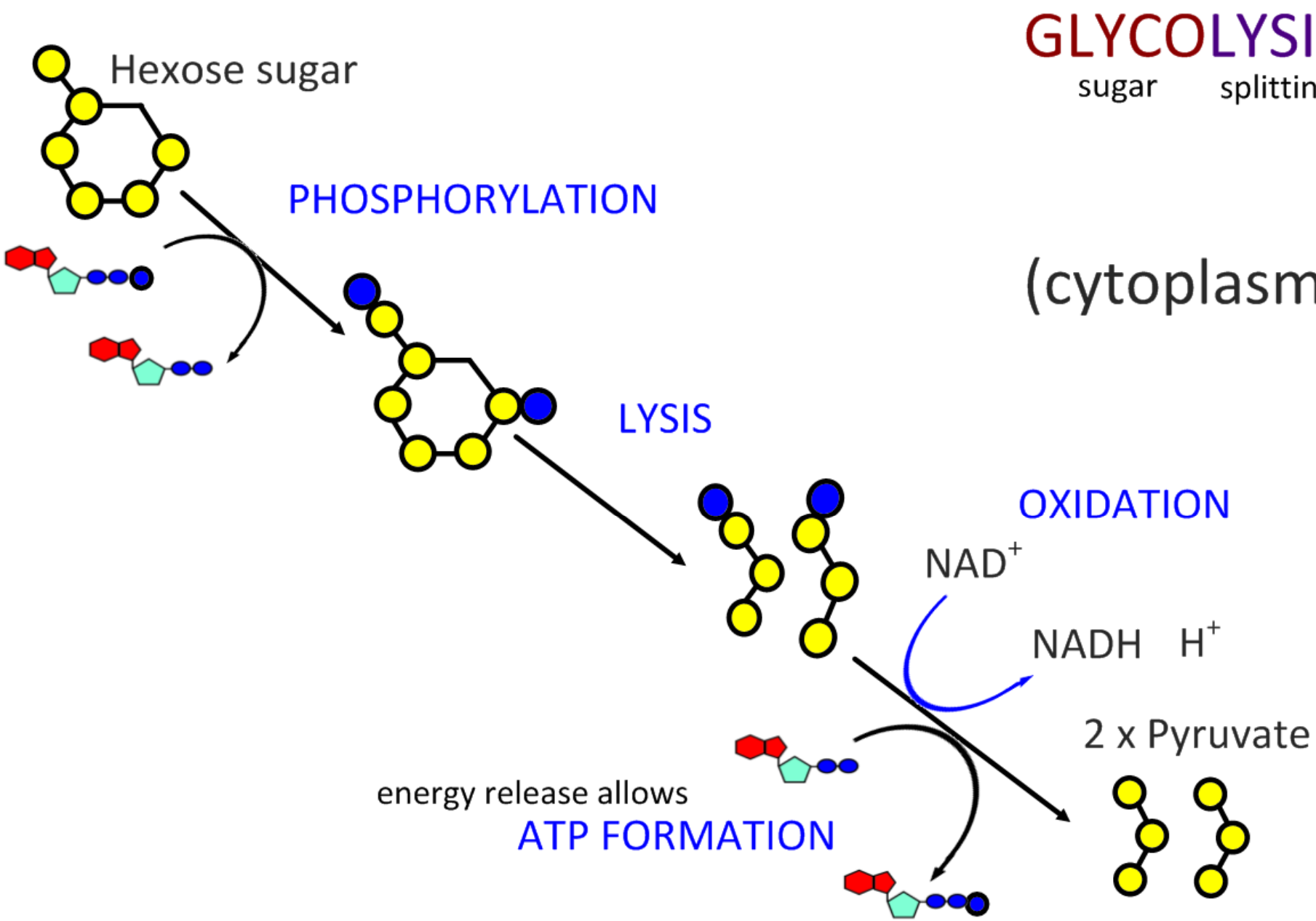


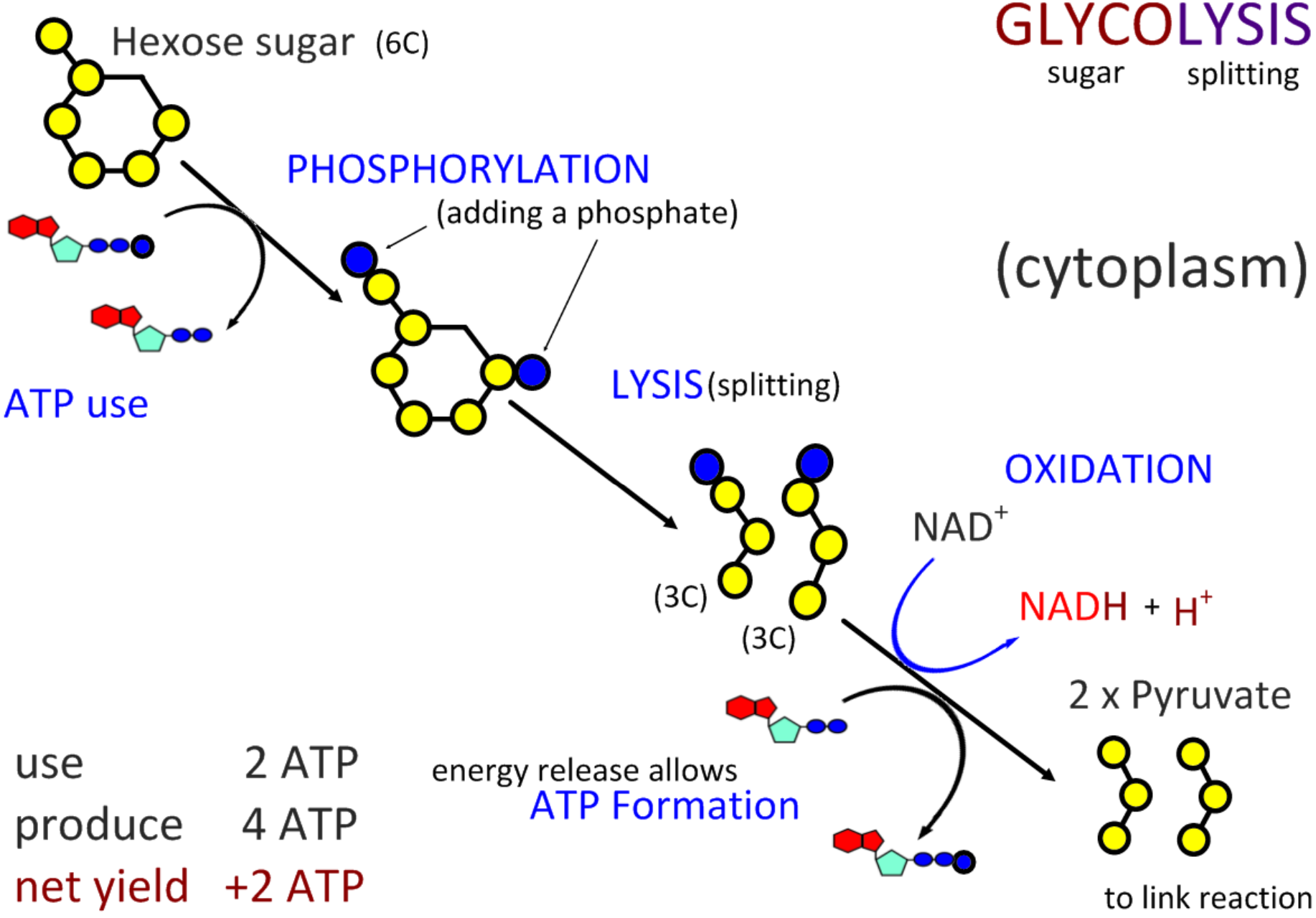
NAD^+ is reduced
(it gains 2 electrons and 2 hydrogens)

-Carried to electron transport chain
-Energy from electrons
-Pumps H^+ across inner mitochondrial membrane
-Generates H^+ concentration gradient
-Powers ATP synthase, making ATP

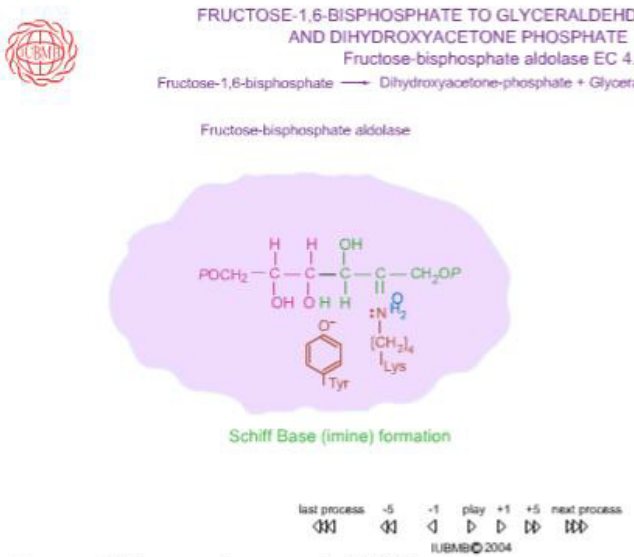
Another electron carrier we'll see later:

$$FADH \xrightarrow[\text{and two electrons}]{\text{add two hydrogens}} FADH_2$$


GLYCOLYSIS
sugar splitting
Hexose sugar
PHOSPHORYLATION
(cytoplasm)
LYSIS
OXIDATION
NAD+
NADH H+
2 x Pyruvate
energy release allows
ATP FORMATION

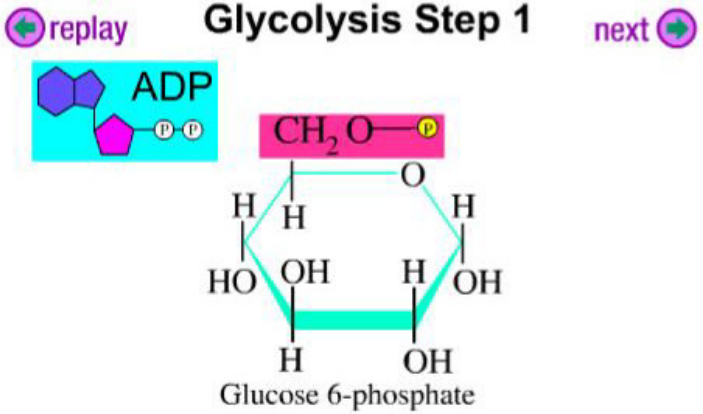

GLYCOLYSIS
sugar splitting
Hexose sugar (6C)
PHOSPHORYLATION
(adding a phosphate)
(cytoplasm)
ATP use
LYSIS (splitting)
OXIDATION
NAD+
(3C)
(3C)
NADH + H+
2 x Pyruvate
use 2 ATP
produce 4 ATP
net yield +2 ATP
energy release allows
ATP Formation
to link reaction

Glycolysis Animations



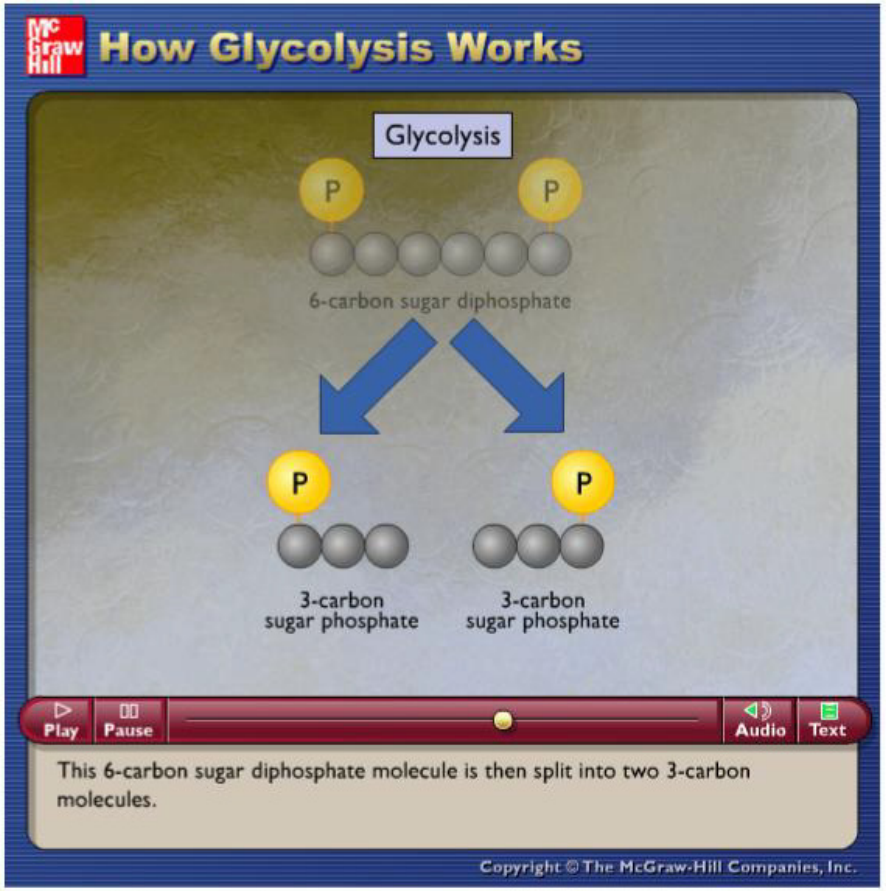
17.5

http://tinyurl.com/ydl5jkn



The enzyme hexokinase transfers a phosphate group from ATP to glucose.The suffix kinase means that a phosphate group will be transferred.

http://tinyurl.com/oc2v3



http://tinyurl.com/yayelo9