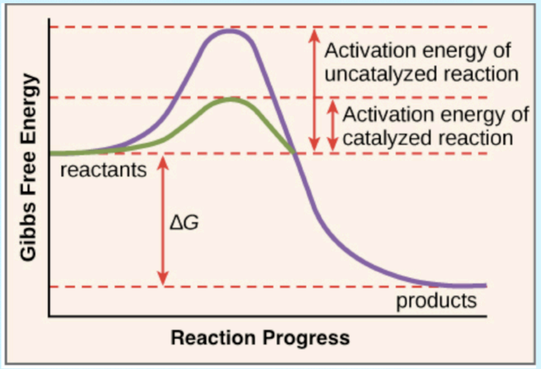
Enzymes and Metabolism

What we are covering today

- Enzymes
- Energy Generation and Metabolism
- Integrating Metabolism (putting it all together and all that)

Enzymes



What are enzymes?

Enzymes are proteins which acts as catalysts to bring about a specific chemical reaction
I.e. They help speed up metabolism and 'lower activation energy'

Why do we need enzymes?

They help your body with digestion of food particles, building muscle, destroying toxins etc...

Why is it important enzymes are regulated?

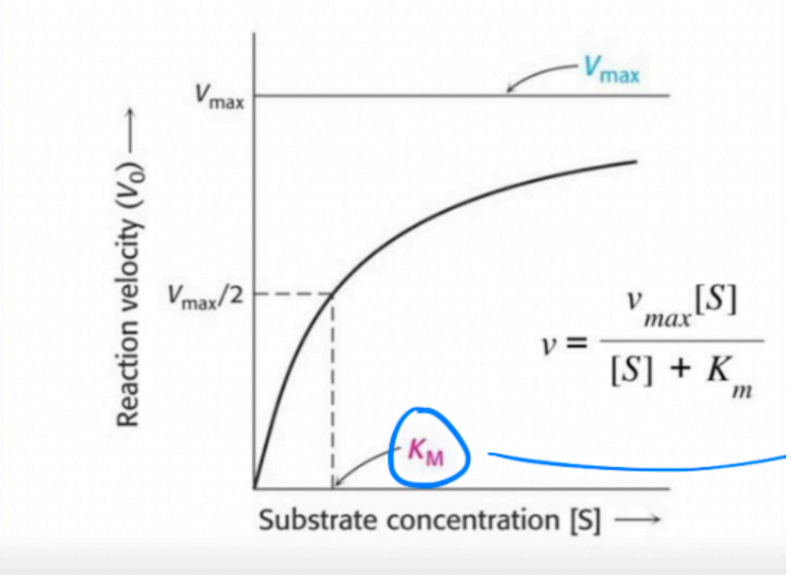
They regulate entire reaction speeds, so that it is possible to obtain the amount of product required at any time. With the incorrect conditions, enzyme product output would not be sufficient and can lead to major health defects

The 3 factors

pH : Varied depending on where in the body -> Pepsin can firm low pH but amylase can't. The changes are due to the different amino acids, their interactions and how they fold.

Temp : Increasing this can increase rate due to more collisions but optimum is 37C

Concentration : More concentrated = more collisions and faster rate. This is true up to a certain point where all active sites of enzymes are full. This is called VMax.



Km is just the Substrate concentration needed for half-maximal rate to be reached.

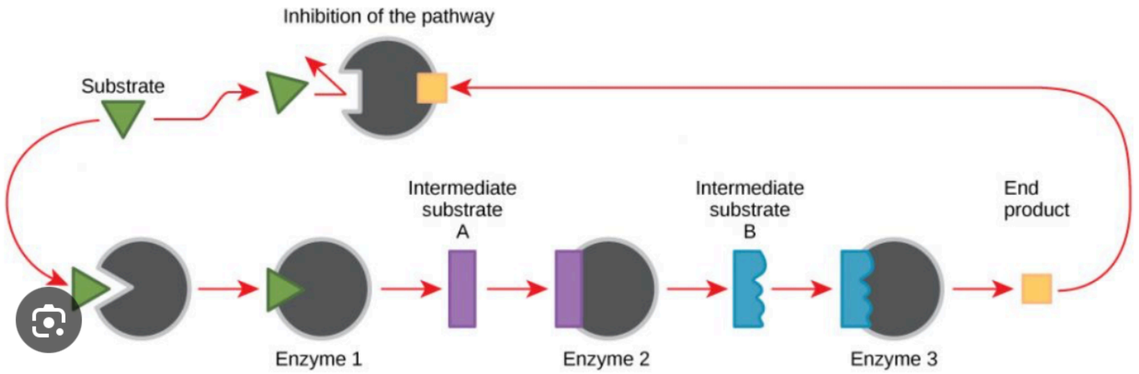
Inhibition of enzymes

Competitive inhibition: the inhibitor competes with the substrate, it binds to the enzyme active site --> stops the substrate from binding. It's almost like they're fighting for who gets the last seat at the Harold Cohen during exam season

Non-Competitive inhibition: the inhibitor does NOT compete, binds to somewhere else on the enzyme (allosteric site) --> changes the shape of binding site so

substrate can no longer bind

Negative feedback inhibition: the end product binds to the enzyme at the start of the pathway --> stops the metabolic pathway so products stop being produced.



Examples you need to know

Hexokinase:

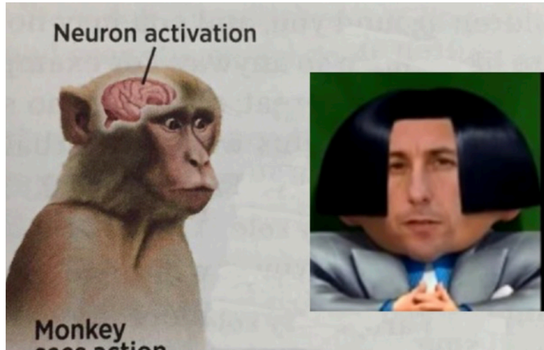
- Hexokinase is an enzyme that catalyses the ATP-dependent conversion of hexoses to hexose-6-phosphate (H6P) by phosphorylation
- It is used in glycolysis
- It is apart of glucose metabolism

Glucose-6-phosphate:

- It is the first intermediate of glucose metabolism and plays a central role in the energy metabolism of the liver
- It is apart of negative feedback inhibition
- It inhibits hexokinase to decrease the rate of glycolysis

Acetylcholinesterase (AChE)

- An enzyme that catalyses the breakdown of acetylcholine
- It is found at mainly neuromuscular junctions
- Acetylcholine (AchE) inhibitors inhibit the cholinesterase enzyme from breaking down ACh
- It is competitive inhibition



Exam style questions

l. How does an enzyme catalyse a reaction?

a. Enzyme provide activation energy for reaction
b. Enzyme activity can be regulated
c. It reduces the energy required for the reactants to form a transient state
d. Enzymes may be used many times for a specific reaction.

2. The active site of an enzyme differs from an antibody-antigen binding site in that the enzyme active site

a. Contains modified amino acids
b. Catalyses a chemical reaction
c. Is complementary to specific ligand
d. Contains amino acids without side chains

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Metabolism

Metabolism: the chemical reactions in the body's cells that change food into energy

Essential metabolic resources:

- Proteins
- Lipids
- Polysaccharides
- Oxygen
- Water
- Inorganic Ions
- Essential co-factors

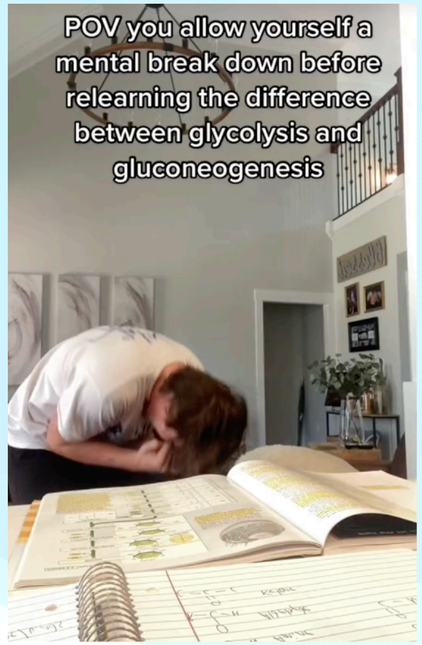
Waste metabolic products:

- CO_2
- Urea
- Ions

Understanding that life requires energy. Everything that happens in your body needs energy e.g. thinking, growing, digesting

Energy generation and Metabolism

- Glucose --> Glycogen = Glycogenesis
- Glycogen --> Glucose = Glycogenolysis
- Glucose --> Pyruvate = Glycolysis
- Amino acids & Fatty acids --> Glucose = Gluconeogensis



There is also a couple more you need to firm and learn:

- Beta oxidation = fatty acids --> acetyl co-A -- > enters the Krebs cycle

- Pentose phosphate pathway comes off from Glucose-6-phosphate, it converts NADP+ into NADPH

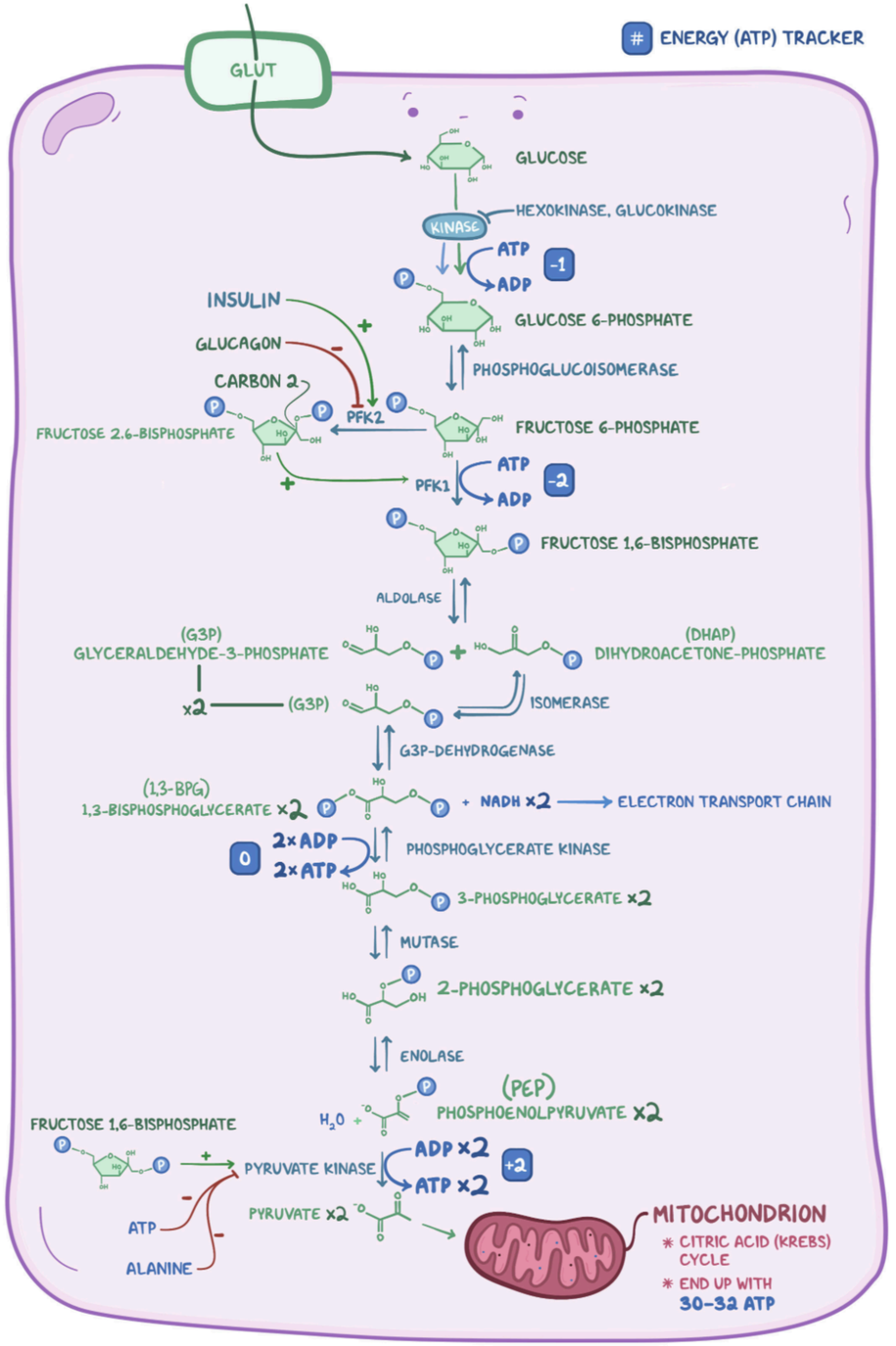


Figure 1.10 Glycolysis.

You do NOT need to learn beta-oxidation in detail but if ur interested (or just a nerd) here u go

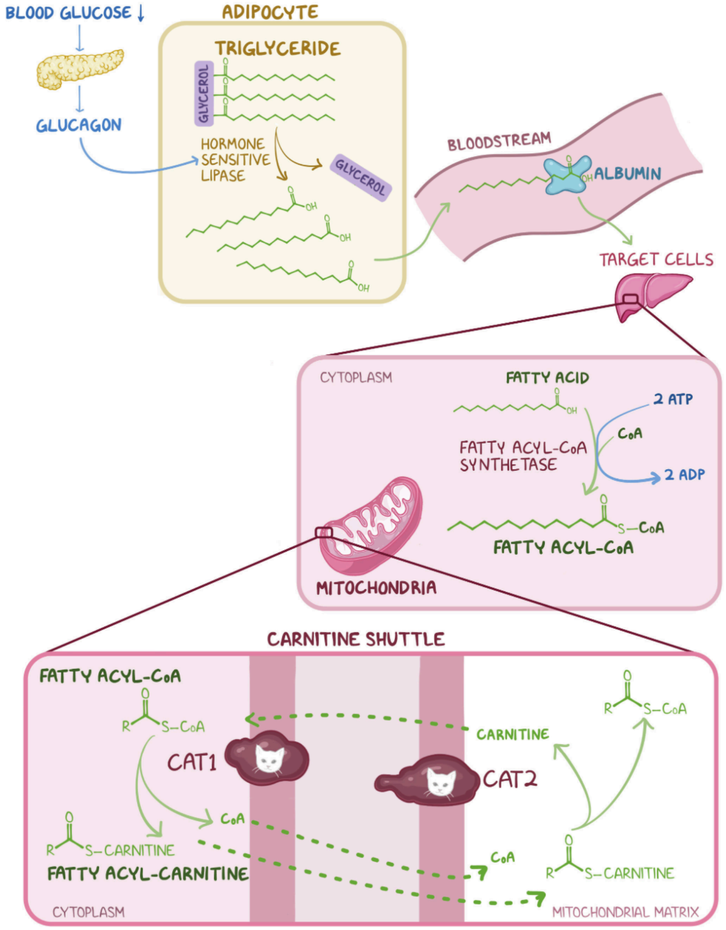


Figure 2.6 Oxidation preparation requires the use of two ATP molecules and results in fatty acyl-CoA being present in the mitochondrial matrix.

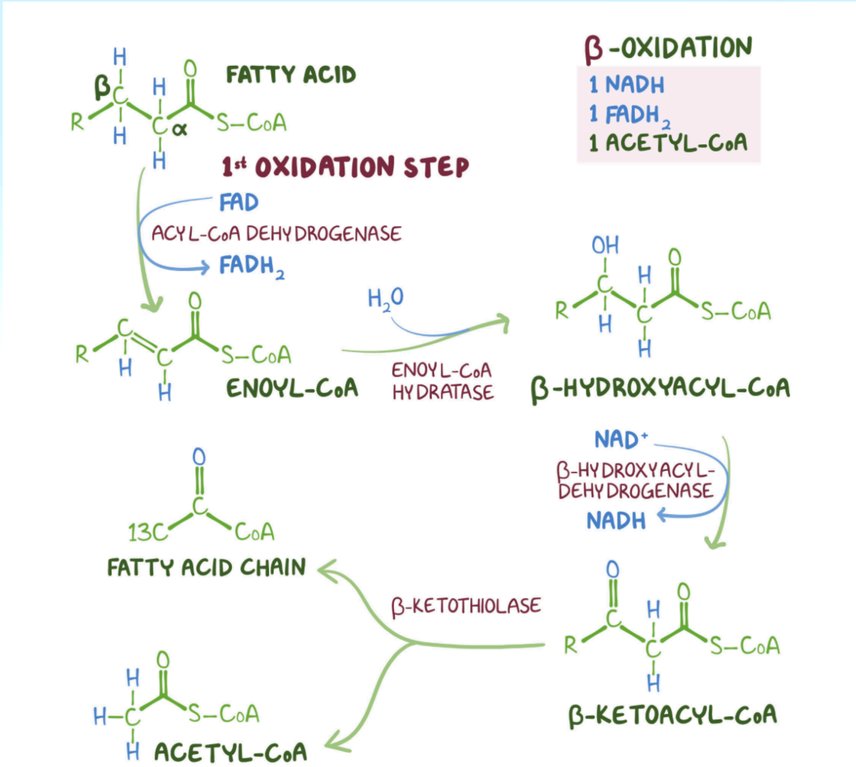
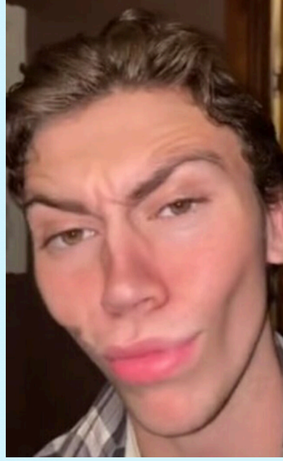


Figure 2.7 Oxidation preparation requires the use of two ATP molecules and results in fatty acyl-CoA being present in the mitochondrial matrix.

Integrating Metabolism Pathways



Definitions to learn

Catabolism: the breakdown of molecules (mostly oxidative = release energy)

Anabolism: requires energy to reduce substances and build them into larger molecules

Energy coupling: one system provides energy to power another system
Exergonic reactions: releases energy into the surrounding environment
Endogonic reactions: takes energy from the surrounding environment

ARCO - Anabolism Reduce,

Catabolism Oxidate

Examples of metabolic pathways:

Carbohydrate:

Glycolysis

Gluconeogenesis

Glycogen synthesis

Glycogenolysis

Fatty Acid:

Fatty acid oxidation

Lipogenesis

Protein:

Amino acid catabolism

Lipid:

Lipid synthesis

After digestion:

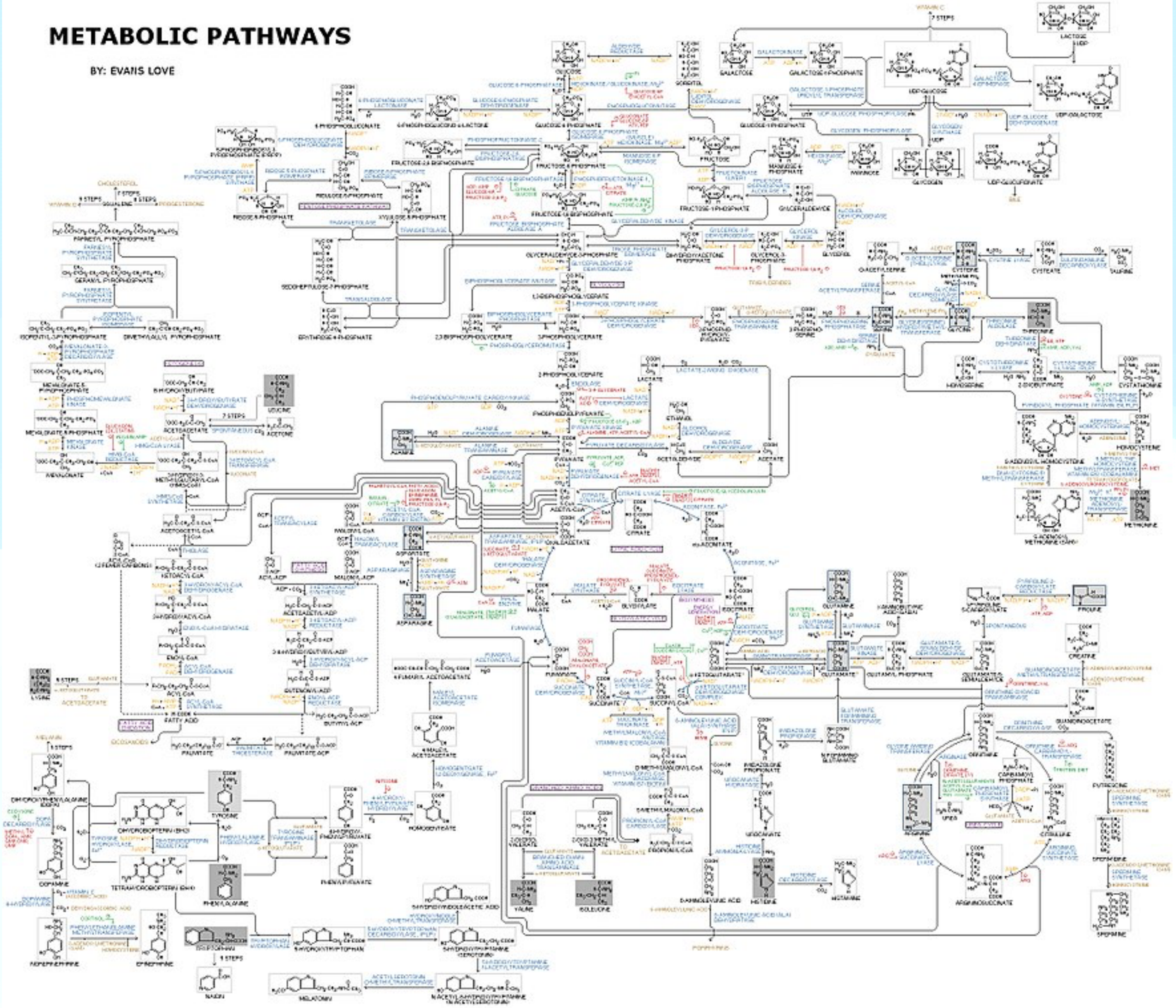
Amino acids, fatty acids, glucose and glycerol which get metabolise are turned into ACETYL COA

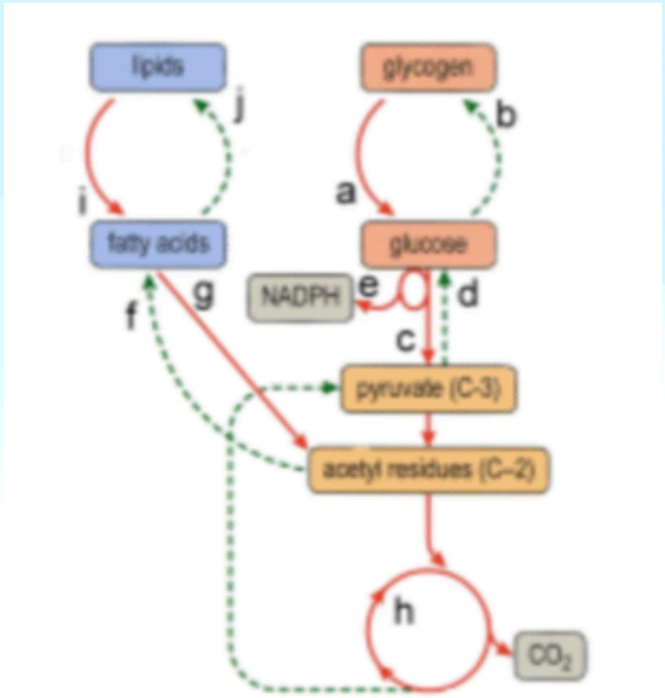
Lipolysis:

short and medium chains can enter mitochondria directly but longer chains are shuttled into the mitochondria using carrier proteins

METABOLIC PATHWAYS

BY: EVANS LOVE

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glycogen
j
b
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a
fatty acids
glucose
NADPH
e
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pyruvate (C-3)
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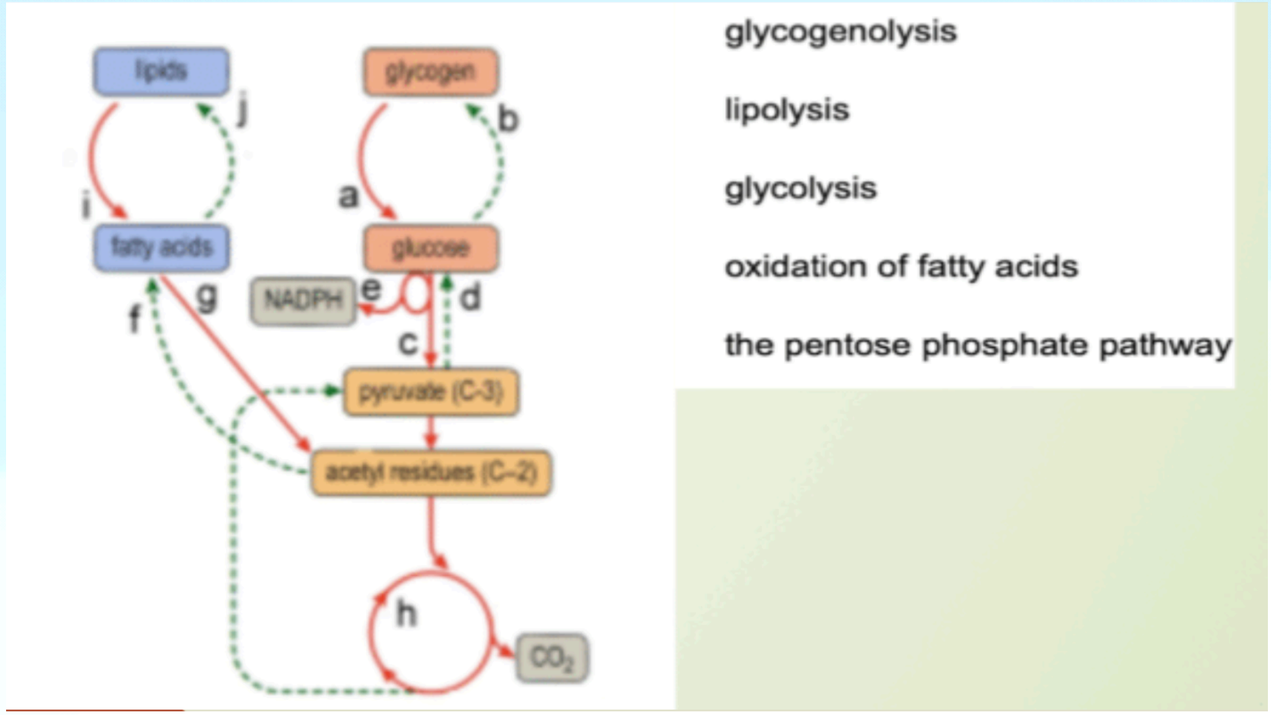
h
CO_2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oxidation of fatty acids
the pentose phosphate pathway

Find:

A -

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G -

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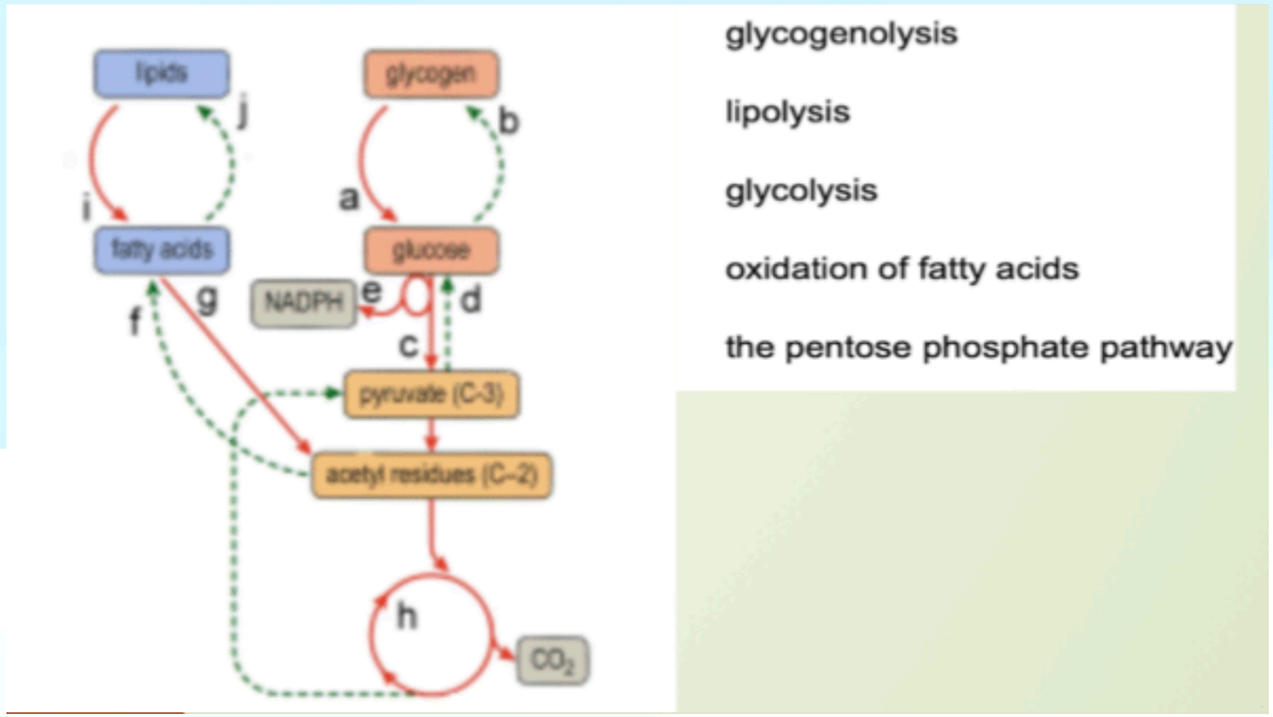

glycogenolysis

lipolysis

glycolysis

oxidation of fatty acids

the pentose phosphate pathway

Find:

A - Glycogenolysis

C - Glycolysis

E - Pentose Phosphate Pathway

G - Oxidation of Fatty Acids

I - Lipolysis

Random slide but I got a funny feeling about this so learn it just in case

What is entropy?

- It is a measure of quality of energy
- is a measure of randomness or disorder in a system

How do systems increase entropy?

- Entropy increases when a substance is broken up into multiple parts.
- Entropy increases with increasing temperature

What is Newton's 2nd law of thermodynamics?

The second law states that the acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object

More Questions

What is an Amphibolic reaction? Can you give an example?

Which of the following are TRUE for anabolic pathways?

I. They do not depend on enzymes.
2. They are usually highly spontaneous chemical reactions.
3. They consume energy to build up polymers from monomers.
4. They release energy as they degrade polymers to monomers.

Which metabolite is the end-product of carbohydrate , lipid and protein metabolism?

I. Glutamate
2. Pyruvate
3. Acetyl Co-A
4. Glutamate

What is an Amphibolic reaction? Can you give an example?

Amphibolic means Catabolic AND Anabolic. Krebs cycle is an example.

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@liverpoolcharityweek on insta

"Those who spend their wealth in Allah's cause are like grains of corn which produce seven ears, each bearing a hundred grains. And Allah multiplies the reward even more to whoever He wills. For Allah is All-Bountiful, All Knowing." - Quran [2:216]

https://www.islamic-relief.org.uk/giving/appeals/palestine/

Thank you for watching