

Topic 1: Introduction to Metabolism

What's the point of Metabolisms:

Cells have to carry out thousands of chemical reactions to maintain their proper function. All of these reactions need energy. Since the beginning of evolution, cells have developed highly efficient metabolic systems. The specific methods differ from species to species, for example, plant cells derive their energy from photosynthesis and animal cells rely on aerobic respiration. Although the mechanisms differ, the end goal of all metabolic systems is the same, **to produce ATP molecules**.

METABOLISM:

The processes involved in extracting energy from our environment and using it to generate new products.

****Reaction in metabolic pathways do NOT act in isolation****

- The products of one reaction are usually the reactants of the next reactions and the pathways are not usually linear.

Over the next few videos we will attempt to understand the following key elements of metabolic pathways:

1. Function of the pathway
2. Where does it take place?
3. What are the sequence of events?
4. What are the key reactions?
5. What happens when the steps are inhibited?
6. What are the mechanisms of regulation?

Metabolism can be broken down into two parts:

1. Catabolism
2. Anabolism

Catabolism

This is the **BREAKDOWN** of molecules into smaller molecules. Examples of this are Glycolysis and Glycogenolysis (breakdown of glycogen).

CATABOLISM = RELEASE ENERGY

Catabolic pathways produce ATP / NADH and require complex energy containing molecules usually sourced from our food, such as, Carbohydrates, Fats and Proteins. These reactions then break down the complex molecules into smaller simpler molecules and release ATP / NADH in the process, thus feeding anabolic reactions in a cycle.

Anabolism

This is the **SYNTHESIS** of molecules from smaller molecules. Examples include, Protein synthesis and Gluconeogenesis.

ANABOLISM = REQUIRES ENERGY

Anabolic pathways require ATP / NADH in order to provide the energy necessary for the pathways to work. They also need precursor molecules that can come in the form of; amino acids, sugars, fatty acids or nitrogenous bases all found within the cell. These precursors will then undergo anabolic reactions catalyzed by ATP and NADH to produce cell macromolecules such as proteins, polysaccharides, lipids and nucleic acids.

****The interplay of the above-mentioned process is called HOMEOSTASIS which allows the cells to survive in changing environments****

The complete glucose oxidation

In the body the energy released from the oxidation of glucose is captured in high energy molecules such as **ATP** and **NADH**.

For a simple 6 carbon molecule of glucose the **standard free energy change is -2,840 kJ / mol**

SUMMARY

1. Metabolism requires a balance of catabolism and anabolism OR the energy production and energy usage.
2. Metabolic pathways are intertwined.
3. Reactions with a large negative delta G will essentially be irreversible in a acellular environment due to the large amount of energy needed.
4. Delta G values are additive, so reactions can be coupled to enable otherwise unfavorable reactions to proceed.
5. We will identify key elements of metabolic pathways that are the most important.