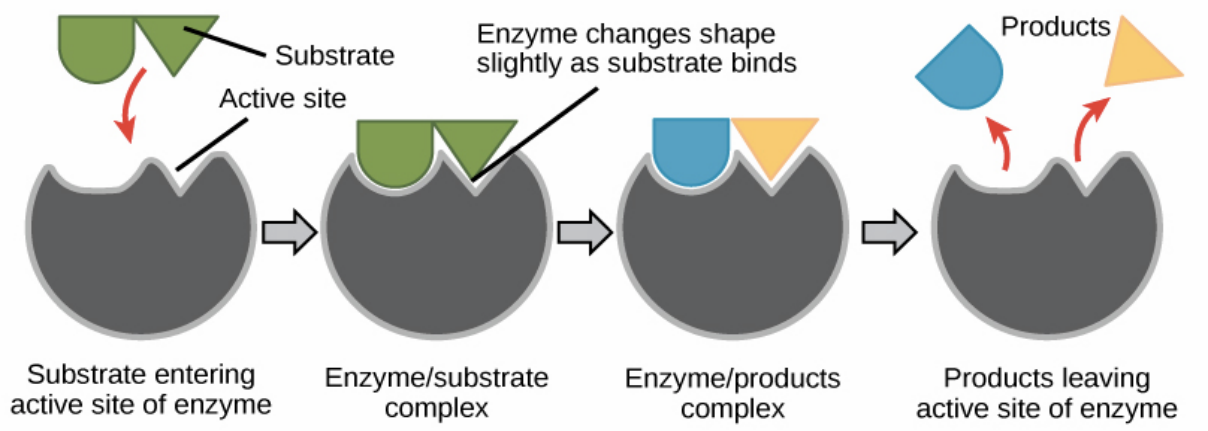
Enzyme Specificity

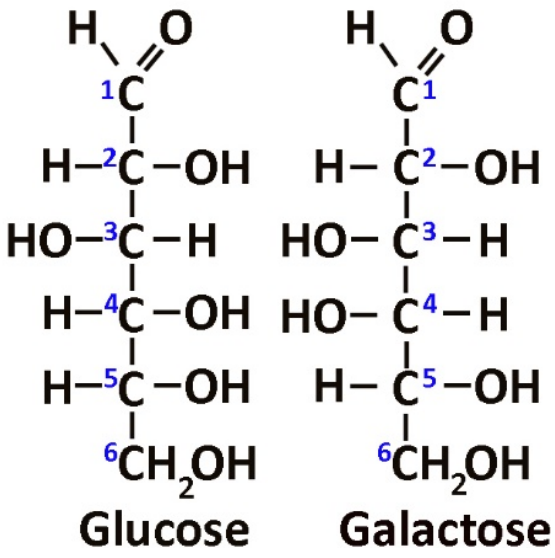
Enzymes typically on catalyze a single reaction or type of reaction. This characteristic is called specificity. Some enzymes exhibit absolute specificity meaning they bind one and only one substrate. Other enzymes may bind one substrate or related molecules or similar bonds, but generally enzymes are very specific binding and performing chemistry on one or a very limited number of molecules. The specificity is determined by the shape of the active site. The active site is the location on the enzyme where the substrate binds and where the chemistry happens.

Just as a reminder, enzymes bind their substrate at the active site. The substrate must 'fit' into the active site for the enzyme to act upon it. The enzyme then flexes, bends and facilitates the chemistry of synthesis or hydrolysis. The product of the enzyme is then released.



https://www.khanacademy.org/science/biology/energy-and-enzymes/introduction-to-enzymes/a/enzymes-and-the-active-site

In this activity two very similar sugars, glucose and galactose, with identical formulas will be 'fed' to yeast. The sugars glucose and galactose are shown below.

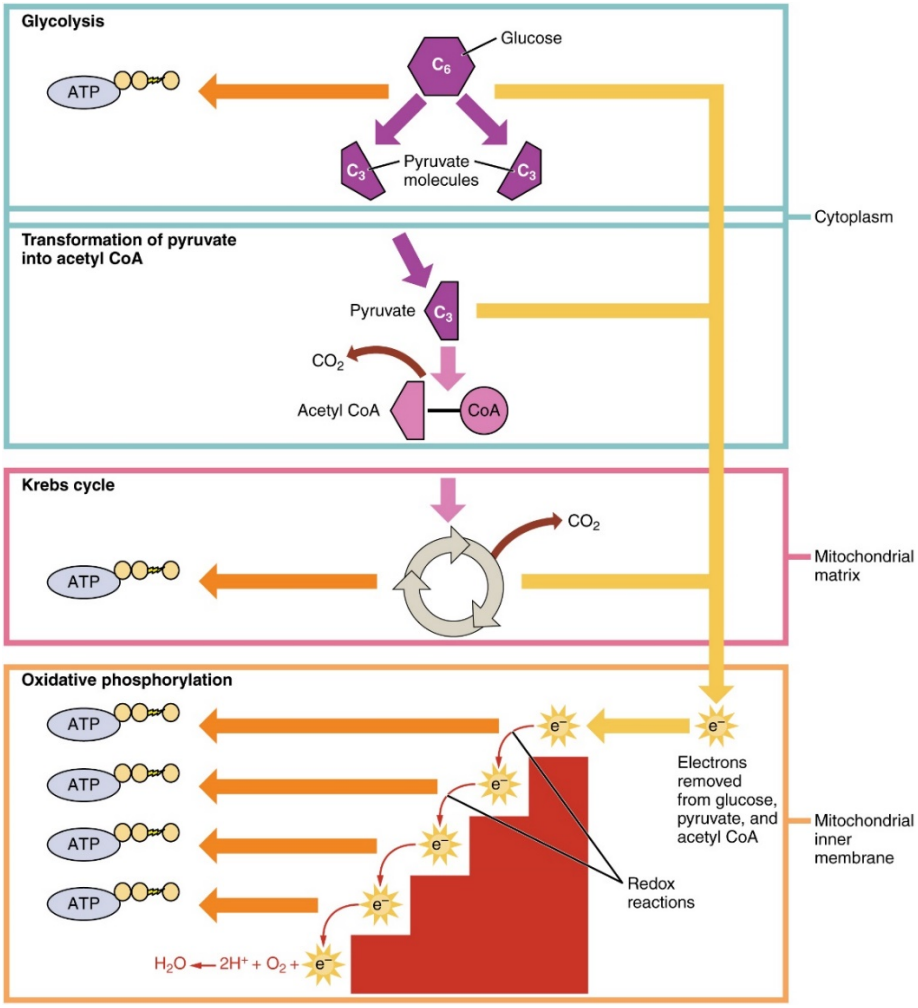


Look at the structures carefully. How are they different? _____

_____

While these differences do not seem striking to us, they are significant to the enzymes within yeast cells that are responsible for harvesting energy from sugars.

While organisms can utilize proteins, lipids and carbohydrates for energy generation, simple sugars provide the most direct entry into glycolysis. ATP generation involves several multi-step processes mediated by many enzymes and co-factors. There are generally four separate processes which occur in different locations within the eukaryotic cell. The first step, glycolysis occurs in the cytoplasm of cells and splits glucose into 2 molecules of pyruvate. The next stage, sometimes called the intermediary reactions, removes a carbon dioxide from each pyruvate and a co-enzyme then carries the remaining 2 carbons from pyruvate into the mitochondrion. In the mitochondrion, the final two processes the Kreb's cycle and oxidative phosphorylation occur. At the completion of these processes glucose has been completing broken down to carbon dioxide, water and ATP (cell energy) has been formed. A summary diagram is shown below with attribution to Anatomy & Physiology, Connexions Web site. http://cnx.org/content/col11496/1.6/.



Materials

Yeast
Galactose solution
Glucose solution
Graduated cylinder - 25 mL
Fermentation tubes
Distilled water

Procedure

1. Obtain 3 fermentation tubes.

2. Label one tube “water”, label the second tube “glucose” and label the third tube “galactose”.

3. Add 15 mL of yeast suspension to each tube.

4. Use the graduated cylinder to add 10 mL of distilled water to the tube labeled water.

5. Use the graduated cylinder to add 10 mL of galactose to the tube labeled galactose. Rinse the graduated cylinder.

6. Use the graduated cylinder to add 10 mL of glucose to the tube labeled glucose. Rinse the graduated cylinder and return it to the supply table.

7. Place your thumb over the opening of the fermentation tube labeled water and invert the tube to mix the contents and remove the air bubble from the top of the tube.

8. Use the thumb on your other hand and repeat this procedure with the fermentation tube labeled galactose. Wash your hands.

9. Place your thumb over the opening of the fermentation tube labeled glucose and invert the tube to mix the contents and remove the air bubble from the top of the tube.

10. Allow the tubes to sit on your lab bench for 30 minutes undisturbed. Observe the tubes after 30 minutes, what do you see? _____

Write your hypothesis for this activity here: _____

_____

What is the control? _____

What is/are the independent variable/s? _____

What is the dependent variable? _____

What is the substrate for the reaction? _____

What is the source of the enzymes? _____

What is the product? _____