Chapter Ten: Cellular Respiration
Lesson 10.3: Fermentation

Remember the 3 stages of cellular respiration.

1. Glycolysis – doesn't require oxygen, produces 4 ATP (uses 2 ATP in the beginning), and occurs in the cytoplasm
    a. Removes electrons and passes it to the electron carrier **NAD+** to be used in the Electron Transport chain
2. The Krebs cycle – requires oxygen, produces 2 ATPs, and occurs in the mitochondria
3. Electron Transport chain – requires oxygen, produces 30-36 ATPs, and occurs in the mitochondria
    a. Uses NADH to push H+ ions to help make ATP

What happens when your body doesn't have oxygen?

- **Fermentation:** in the absence of oxygen, it releases energy from food molecules by producing ATP
    - This occurs during glycolysis
    - Cells convert NADH to NAD+ by passing electrons back to pyruvic acid allowing glycolysis to keep going
    - Alcoholic fermentation: carried out by yeast producing ethyl alcohol and carbon dioxide
        - Pyruvic acid + NADH → Alcohol + CO_2 + NAD+
        - Used to make beer, wine, and other alcoholic beverages
        - Causes bread dough to rise (air spaces in bread)
            - The alcohol produced evaporates in baking
    - Lactic acid fermentation: carried out in our muscles and in making certain foods

        - Pyruvic acid + NADH → Lactic acid + NAD+
        - There is no carbon dioxide produced
        - Certain bacteria produce lactic acid as a waste product. This waste product is used to produce cheese, yogurt, buttermilk, and sour cream. Pickles and sauerkraut are also produced using lactic acid fermentation.

Your muscles do something called quick energy.

- If you were going for a leisurely swim, your body would produce enough ATP to keep you going.
- If you were doing a 50-meter race in the water (or running a race), you need all the ATP you can get NOW!
    - This is where lactic acid fermentation occurs.
    - Provides all the ATP you need for 30-45 seconds in glycolysis.
    - It usually takes a minute or two for your body to respond back to normal. This is why you are breathing so hard. You used up all your oxygen supply and you need to replenish it.
- For exercises longer then 90 seconds (about), your body relies on cellular respiration to make all your ATP.
    - You must pace yourself in order not to get tired out.
    - Your body stores the carbohydrate glycogen that can last for 20 minutes of activity.
        - After that, your body will use up fat to convert into energy
        - Running, dancing, and swimming are good for weight control