Chapter 8 Breakdown

1. Energy is the ability to do work and is governed by the laws of thermodynamics.
   1. Energy cannot be created or destroyed.
   2. Everything gets less organized over time.
2. Cells need energy to survive. This energy comes in the form of ATP
   1. ATP is the energy currency of cells.
      1. Made of an adenine, a ribose, and three phosphates
      2. The energy of ATP is stored in the third phosphate bond.
      3. Energy is released from ATP when the third bond is broken, and stored in ATP when a phosphate is added to ADP.
3. **Cells get energy by breaking down glucose to convert it into energy in one of three ways.**
   1. Glycolysis: The same for all steps
      1. All the ways to break down glucose using glycolysis.
      2. Glycolysis starts when **glucose** is *energized* by a molecule of **ATP** and rearranges.
      3. A **second ATP** is added and chops the glucose into **two 3 Carbon blocks**.
      4. These blocks gain **one phosphate each** and, at the same time **give 2 electrons** and one **hydrogen** to **NAD+** to make NADH.
         1. NADH gets used later to make ATP
      5. The second **phosphates** from step iv combine with **ADP** to make **2 ATP**.
      6. The final **phosphate** is then added to **ADP** to make ATP (happens twice).
      7. In total, **4 ATP are produced**, but two were needed at the start, so glycolysis makes ***2 net ATP***.
      8. The blocks from before are called **pyruvate**, there are two of them.
   2. **IF THERE IS OYGEN:** 
      1. **The Krebs cycle occurs**. The Krebs cycle produces **NADH** and **FADH2** which will be used later to make **ATP**.
      2. Electron Transport Chain/ Oxidative Phosphorylation
         1. **NADH** and **FADH2** made in the Kreb’s cycle **carry electrons** to the electron transport chain in the inner-mitochondrial membrane.
         2. Originally, these electrons came from glucose.
         3. These **electrons** move **from one electron carrier to another**, releasing energy as they move through each step. This energy is used to pump **protons (H+)** against their concentration gradient over the membrane of the mitochondria.
         4. The **protons (H+)** reenter the mitochondria through the **ATP Synthase** enzyme. ATP synthase is like a **tiny rotary motor**, like one on a river ferry. H+ protons flow across ATP Synthase, spinning a turbine and causing the motor to turn (mechanical energy). 3-4 protons moving through this motor is enough to **attach a phosphate to ADP, making ATP**.
         5. H+ protons are accepted by O2 to create H2O
   3. **IF THERE IS NOT OXYGEN:**
      1. In yeast and bacteria: alcoholic fermentation
         1. Pyruvate from glycolysis is decarboxyated (CO2 is taken out of it). NADH gives a hydrogen and the atoms rearrange into Ethanol.
      2. In animals: lactic acid fermentation
         1. NADH donates a H+ to pyruvate, creating lactic acid
4. The glucose has to come from somewhere. Autotrophs make it using photosynthesis
   1. Two steps
      1. Light Dependent
         1. Photosynthesis uses light energy from the Sun to produce glucose.
         2. Plants take in CO2 through their stomata, and H2O through their leaves. These are the basic components needed for photosynthesis.
         3. Plants also need sunlight for this process. Plants absorb mostly red and blue wavelengths of light, they reflect green light, which causes the green appearance of leaves.
         4. Chloroplasts are the site of photosynthesis, they have stroma, a gel-like matrix, thylakoid membranes, grana, and granum
         5. Photosynthesis begins in the chloroplasts when chlorophyll molecules in the thylakoid absorb light energy. This gets electrons in **H2O** excited and moving quickly, splitting it into H+, O2, and an electron.
         6. The electron goes through the electron transport chain. H+ protons are pumped against their concentration gradient out of the thylakoid. H+ protons move through the ATP Synthase molecule (just like the one from CR) to make ATP from ADP.
         7. The H+ molecules are picked up by NADPH
         8. The ATP is used in the Calvin Cycle (light independent reaction) to fix carbon into usable glucose.
      2. Light Independent Reactions
         1. Six RuBP molecules (5-Carbon compounds) bond with six CO2 molecules to make re arranged into 12 3-carbon sugars.
         2. 12 ATP and 12 NADPH from light dependent reactions are used to change the composition of the 3-carbon molecule.
            1. NADP+ and ADP can now be used in the light-dependent reactions
         3. 2 3-carbon molecules leave the cycle and are converted into glucose
         4. 10 3-carbon molecules are converted into 6 5-carbon compounds by rubisco and 6 ATP, then the cycle starts over.