1. What do our cells need to extract from the foods we eat in order to create ATP (energy)? glucose

2. What is the chemical formula for cellular respiration? \[ \text{C}_6\text{H}_12\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} \]

3. Write the chemical formula for cellular respiration in words: One oxygen plus six

   glucose = six carbon dioxide and six water

4. In what organelle does cellular respiration take place? mitochondria

5. What does it mean to be aerobic? Oxygen is present. Anaerobic? no oxygen

6. If oxygen is present (aerobic), there are three main parts to cellular respiration. They are:
   a. glycolysis
   b. Krebs Cycle
   c. ETC

7. If oxygen is not present (anaerobic), there are two main parts to fermentation. They are:
   a. glycolysis
   b. fermentation

   Anaerobic:

   GLYCOLYSIS:

8. What are the three main products of glycolysis?
   a. 2 Pyruvic Acid
   b. 2 NADH
   c. 4 ATP (takes 2, but produces 4, so net total of 2 ATP)

FERMENTATION:

9. If oxygen is not available, the pyruvic acid from glycolysis will either enter the alcoholic fermentation pathway or the lactic acid fermentation pathway.

10. Does fermentation provide enough energy for a cell for long term energy? NO

11. Why do your muscles hurt after you have a hard work out? Why does lactic acid build up in your muscles?
    Answer in terms of oxygen/lack of oxygen.
    Muscles do not get enough \( \text{O}_2 \). They use lactic acid fermentation (anaerobic) instead of Krebs/ETC (aerobic) pathway. Lactic Acid buildup.

Aerobic:

GLYCOLYSIS:

12. Glucose is broken down into 2 molecules of pyruvic acid in Glycolysis.

13. During Glycolysis, 2 molecules of ATP are used to break apart a molecule of glucose into 2 pyruvic acid. However, 4 ATP molecules are made. Thus, the cell gains 2 ATP in glycolysis.

14. Another product of glycolysis is NADH, the electron carrier. Glycolysis makes 2 NADH. Where do these go after they are created? ETC
15. What are the three main products of glycolysis?
   a. 2 Pyruvic Acid
   b. 1 NADH
   c. 2 ATP

16. 

17. At the end of glycolysis, 90% of the chemical energy from one glucose molecule is still unused.

18. To extract the remaining energy from glucose, oxygen is needed.

KREBS CYCLE:

19. During the Krebs Cycle, in the presence of oxygen, pyruvic acid is broken down into CO2 in a series of energy extracting reactions.

20. On Your Own: Where does the oxygen in the Krebs Cycle come from? Breathing
    What part of this process, specifically? Inhaling

21. The carbon dioxide produced in the Krebs Cycle is used in photosynthesis.

22. What are the products of the Krebs Cycle?
   a. 4 NADH (these go to the ETC)
   b. 1 FADH2 (these go to the ETC)
   c. 1 ATP (used for cellular activities)
   d. Carbon Dioxide (goes to atmosphere for photosynthesis)

CALVIN CYCLE

23. The ETC uses high energy electrons from the Krebs cycle and glycolysis to convert ADP into ATP.

24. How are these high energy electrons carried? NADH & FADH2

25. These high energy electrons move through the electron transport chain. At the end of the chain, there are enzymes that combine these electrons with hydrogen ions and oxygen to form water. This water is released from the mitochondria.

26. The hydrogen ions move across the inner membrane of the mitochondria through protein channels.

27. When the hydrogen ions move through these channels, the enzyme ATP synthase at the end of the protein channel spins, allowing ADP molecules to pick up another phosphate, thus creating ATP.

28. For each glucose molecule that enters glycolysis, 36 ATP molecules are formed from glycolysis, the Krebs cycle, and the ETC.

29. ETC: Make a drawing of hydrogen ions moving through a protein channel in the mitochondrial membrane. Show how ADP turns into ATP.
1. What is the reactant of Glycolysis?
   - Glucose

2. What are the products of Glycolysis?
   - ATP + Pyruvic Acid + NADH

3. What is the reactant of Krebs Cycle?
   - Pyruvic Acid

4. What are the products of the Krebs Cycle?
   - ATP + NADH + FADH₂

5. What are the reactants of the Electron Transport Chain(ETC)?
   - NADH + FADH₂

6. What is the product of the Electron Transport Chain(ETC)?
   - ATP

7. During Cellular respiration where is ATP produced?
   - Glycolysis, ETC, Krebs Cycle

8. What process occurs in the cytoplasm?
   - Glycolysis

9. What processes occur in the mitochondrion?
   - Krebs Cycle, ETC

10. What is the order of cellular respiration?
    - Glycolysis, Krebs Cycle, ETC

11. What is the equation in words for cellular respiration? Label products and reactants.
    - Oxygen + Glucose → Carbon dioxide + Water + Energy

12. Describe the relationship between photosynthesis and cellular respiration.
    - Products of photosynthesis are the reactants of cellular respiration.
13. In what type of cells does cellular respiration occur? **Eukaryotic Cells (plants/Animals)**

14. What is the net gain of ATP for Glycolysis? 2

15. How many ATP are created during cellular respiration? 36

16. What are the electron carriers of cellular respiration? NADH, FADH₂

17. How do high energy electrons help make ATP in cellular respiration?
   Give energy to H⁺ so it can go through ATP Synthase

18. What are the two types of fermentation? Give an example of where each occur.
   **Alcoholic - Bread**
   **Lactic Acid - Muscles**

19. What decides if a cell will get its energy from cellular respiration or fermentation?
   **if oxygen is present**

20. What molecule goes through ATP Synthase?
   H⁺

Fill out the table.

<table>
<thead>
<tr>
<th>Pathway/Event</th>
<th>Location</th>
<th>Reactants</th>
<th>Products</th>
<th>Big event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycolysis</td>
<td>Cytoplasm</td>
<td>Glucose</td>
<td>ATP, Pyruvic Acid</td>
<td>Glucose is broken in half</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NADH</td>
<td>Pyruvic Acid made</td>
</tr>
<tr>
<td>Krebs Cycle</td>
<td>Mitochondria</td>
<td>Pyruvic Acid</td>
<td>ATP, NADH, FADH₂</td>
<td>Pyruvic Acid breaks into CO₂</td>
</tr>
<tr>
<td>ETC</td>
<td></td>
<td>NADH, FADH₂</td>
<td>ATP</td>
<td>H⁺ bonds with O₂ to make water, H⁺ goes through ATP Synthase to make ATP</td>
</tr>
</tbody>
</table>