Photosynthesis

Name: _____ Per: _____

Answer the questions below as we go through the activity together.

Glucose

Water

Carbon Dioxide

1. Glucose is a type of sugar. It is broken down by cells in a process called cellular respiration in order to release energy to power the cell. Glucose has a ring of carbons at its center. Find the glucose molecule and draw it in the box to the right.
2. Glucose is made out of three types of atoms. Complete the molecular formula for glucose below by filling in how many carbons, hydrogens, and oxygens make up a molecule of glucose:

   (Ex: H_2O has two hydrogen atoms and one oxygen) **C** ___ **H** ___ **O** ___
3. Plants build sugars like glucose from molecules of water and carbon dioxide. Find a molecule of water and draw it in the box at right.
4. What is the molecular formula for water? _____
5. Find a molecule of carbon dioxide and draw it in the box at right.
6. What is the molecular formula for carbon dioxide? _____
7. Describe two reasons plants build sugars like glucose from molecules of water and carbon dioxide (refer to section 8.1 in textbook for help).

   (1) _____

   (2) _____
8. How many molecules of carbon dioxide are needed to build one molecule of glucose? _____
9. What is your evidence? (How can you tell?) _____
10. How many molecules of water are needed to provide the rest of the atoms for one molecule of glucose? _____
11. What is your evidence? (How can you tell?) _____
12. Once a molecule of glucose is built out of the number of water molecules and carbon dioxide molecules you listed above, there are some atoms left over that are not used. What are they and how many are there?

    _____
13. These leftover atoms form a gas. Find this molecule. What is its molecular formula? _____
14. Where does this waste product end up going? _____
15. Where do plants get the water they need in order to build sugars via photosynthesis? _____
16. Where do plants get the carbon they need in order to build sugars via photosynthesis? _____
17. Photosynthesis is an exergonic reaction. This means the reactants (carbon dioxide and water) require less energy than the products (glucose and oxygen gas). Where does the energy come from to break apart carbon dioxide and water and reorganize their atoms into sugars? _____
18. Use the molecule cards to lay out the formula for photosynthesis by placing the number of carbon dioxide and water molecules needed on the left, an arrow in the middle, and the amount of glucose and oxygen gas produced on the right. Then add the energy source that powers the reaction. **Ask your teacher to check it before you go to the next step.**
19. Now 1) write out the final equation below using the molecular formula for each molecule and numbers in front to tell how many of each molecule is needed or produced, 2) write the chemical name of each molecule under it, 3) Underline and label the "ingredients to build sugar", 4) underline and label the molecule used to "store energy", 5) underline and label the "waste product", 6) write above each ingredient where it came from, and 7) write above each product where it ends up going.

20. Where does photosynthesis occur inside of plant cells? _____

21. Draw a chloroplast in the box at right and label the following parts: membrane, grana, thylakoid, stroma. (see figure 8-3 in the textbook)

Chloroplast

22. Photosynthesis actually occurs in two steps. The first step is the light-dependent reactions. Where do these reactions occur in a chloroplast?

_____

23. During the light dependent reactions, energy from light is converted into chemical energy stored briefly in ATP and NADPH, which are "energy carrier molecules". These energy stored briefly in these molecules is then used to build glucose in the second step of photosynthesis, called the Calvin cycle. Where in the chloroplasts does the Calvin cycle occur?

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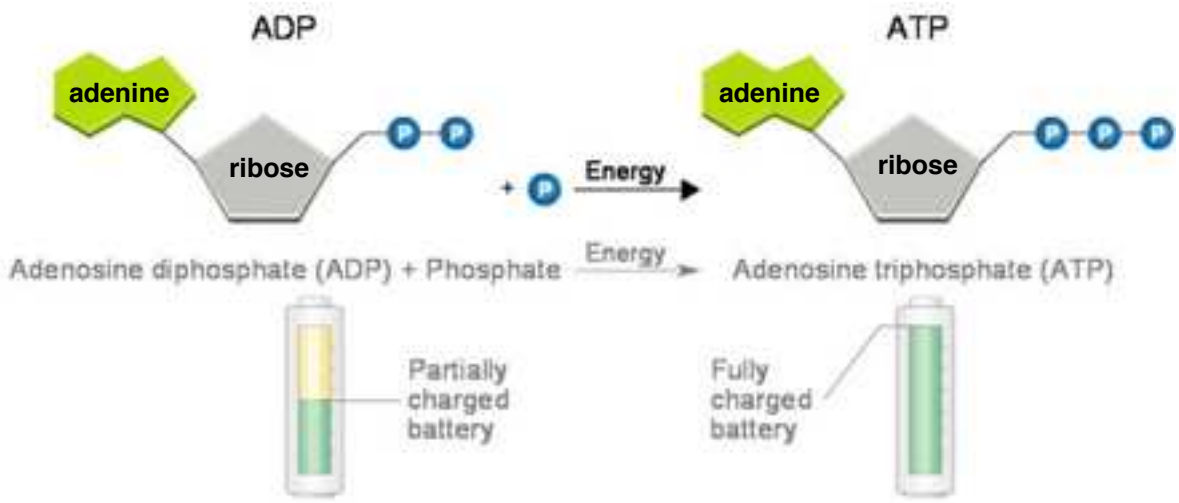
The most important energy carrier molecule for you to be aware of is ATP (adenosine triphosphate). Look at the chemical reaction below. It shows how energy is stored in a molecule of ATP.

24. How many phosphate groups does the starting molecule ADP (adenosine diphosphate) have? _____

25. How many phosphate groups does ATP have? _____



26. Adding phosphate groups to ADP is like charging a battery. You have to add energy to do it. The energy is stored chemically inside of the molecule just like energy is stored chemically inside of batteries. Since energy is needed to add phosphate groups, is the formation of ATP from ADP an endergonic reaction or an exergonic reaction?

_____

27. ATP can only store energy for a short period of time. The last phosphate comes off easily, transferring the stored energy to another chemical reaction, thereby enabling it to occur. When this happens, the ATP is converted back into ADP. Is the formation of ADP from ATP an endergonic reaction or an exergonic reaction?

_____

28. In the second step of photosynthesis, the energy transferred from carrier molecules like ATP is used to build sugar molecules like glucose. Then later, when the plant needs energy to power all of the chemical reactions inside of the cell and sunlight is not available, the plant breaks down the glucose and releases the energy back out. This process is called **cellular respiration**. Although animal cells cannot do photosynthesis, they can do cellular respiration. This is how animal cells get all of their energy. But instead of making their own sugars, where do animal cells get them from?

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