Forest Ecology Project
Buds, Leaves, and Global Warming

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16. Recognize that producers (plants that contain chlorophyll) use the energy from sunlight to make sugars from carbon dioxide and water through a process called photosynthesis. This food can be used immediately, stored for later use, or used by other organisms.
5. Recognize that there are more than 100 elements that combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter.

7. Give basic examples of elements and compounds.

8. Differentiate between compounds and mixtures.

10. Differentiate between physical changes and chemical changes.
Physical & Chemical Properties

Outline of Activities

- Physical Properties of Leaves Activity
- Lab on Leaf Chromatography
- ComicLife Cartoon on Photosynthesis and Respiration
Physical Properties of Leaves

Info Sheet - WHAT TREE IS THAT?

Information sheet to help identify tree
Tree identification can be accomplished by looking at the shape and pattern of the leaves on the trees.

**CLUE 1: TWIGS AND BUDS**

Trees have either alternate or opposite buds.

Alternate buds: oaks, alder, birch, beech

Opposite: maple, ash, dogwood

**CLUE 2: SIMPLE VERSUS COMPOUND LEAF**

Simple: the leaf blade is NOT divided into leaflets

Compound: the leaf blade is divided into leaflets

**CLUE 3: VEINS, SHAPES, AND MARGINS**
Pinnate: Central mid vein with side veins arising from it
Palmate: Several main veins

CLUE 4: DICHOTOMOUS TREE KEY

Use the books in class or the following websites to identify your tree.

Arbor Day Foundation Animation on how to identify trees:
http://www.arborday.org/trees/wt11/
Arbor Day Foundation Guide to identify your tree:
http://www.arborday.org/trees/whatTree/WhatTree.cfm?ItemID=E6A
Environmental Education for Kids – Tree Key:
http://dnr.wi.gov/org/caer/ce-cek/yeg/treekey/index.htm
Physical Properties of Leaves

Activity - TREE ID

Leaf Observation Activity to identify physical properties of leaves
Draw the shape of the leaf and show its vein pattern in this box.

Alternates or opposite

Simple or compound

Length of leaf: [ ] cm

Width of leaf: [ ] cm

Physical properties:
color, veins, shape, smell, etc
**TREE ID**

Draw the shape of the leaf and show its vein pattern in this box.

**Type of tree:** Silver Maple

<table>
<thead>
<tr>
<th>ALTERNATE or</th>
<th>OPPOSITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMPL</td>
<td>COMPOUND</td>
</tr>
</tbody>
</table>

| LENGTH OF LEAF: | 20 cm |
| WIDTH OF LEAF:  | 12 cm |

**PHYSICAL PROPERTIES:**
- Color, veins, shape, smell, etc.
- Red stem
- Dark green leaf
- Veins are light green
- Brown stick
- Pointy, deciduous
- Smells like the wood and outdoor
- Paris are triangle
- Smells fresh
**Type of tree:** White Oak

**Draw the shape of the leaf and show its vein pattern in this box.**

- **Length of leaf:** 17.5 cm
- **Width of leaf:** 11.3 cm

**Physical properties:**
- Color, veins, shape, smell, etc.
- Green with brown spots, light green veins, smells like wood with lobed margins, pinnately lobed, palmate veins.
Physical Properties of Leaves

Worksheet

BRANCH SCETCH

Worksheet for sketching branch
Draw your branch and label the six leaves you will be studying.
Leaf Chromatography
Step 1: Collect leaf from tree!
Step 2: Deposit pigment on filter paper!

Deposit the pigment by rolling a quarter over a spinach leaf about 15 times to make a heavy green line here.
Step 3: Place filter paper in alcohol.
Step 4: Remove filter paper and let it dry.
Step 5: Label and measure each pigment!
Teacher Tips

- Must transfer LOTS of pigment to filter paper
- Alcohol level should not go above pigment line
- Chromatography can take 30-45 minutes
- Pigment front – measure distance pigment moved from starting line (NOT bottom of the filter paper)
- Filter paper or white construction paper works best
Alternative Method
Leaf Chromatography Assessment

Draw and label pictures of their chromatography strip.

Measure the pigment fronts and calculated the \( R_f \) (retardation factor) value for each pigment.

Answer conclusion questions about the process of chromatography, the data collected in the lab, and supported/rejected their claim based on their evidence.

Measure and calculate the \( R_f \) value for a chromatography sample.
Leaf Chromatography Lab

Problem: Do green leaves contain other pigments?

Claim: 

Background Information:

Several substances mixed together but not chemically combined is called a mixture. Mixtures can be separated by different physical techniques. For example, salad is a mixture that can be separated by picking out the different pieces with your hands. Salt water is a mixture that can be separated by evaporating off the water and leaving the salt behind. Chromatography is another way to separate a mixture and one of the most useful techniques chemists have to analyze everything from biological materials to finding clues at a crime scene.

Paper chromatography is a technique that uses filter paper to separate and identify the different substances in a mixture. It works on the idea that different pigments will travel through a piece of filter paper at different speeds. A sample mixture is placed on the filter paper. The paper is then placed in a solvent, usually water or alcohol. We will use alcohol in our lab. The substances in the mixture dissolve in the alcohol and move up the paper. The heavier substances move up the paper more slowly. The lighter substances move up the paper more quickly.

Think of chromatography as a race and you'll find it's much simpler than it sounds. Waiting on the starting line, you've got a mixture of chemicals in some unidentified substance, just like a group of runners at the starting line. When a race starts, runners soon spread out because they have different abilities. In exactly the same way, substances in a mixture spread out over the filter paper because they travel at different speeds.

We will use paper chromatography to identify the pigments in a leaf. The key to identifying the different pigments in the leaf is measuring how far the pigment has traveled from its starting point. Be very precise in your measurements. You will calculate the Rf (retardation factor) value for each pigment. This factor is calculated by comparing the distance the alcohol has moved with the distance the pigment has moved.

Materials: Coffee filter, ruler, pencil, leaf, coin, isopropyl alcohol, beaker, tape, colored pencils
**Procedures:**

1. Get a piece of coffee filter paper that is 3 cm wide.

2. Make a pencil mark *(do not use a pen!)* on the coffee filter 2 cm from the bottom.

3. Using a coin, rub a leaf onto the line that you just drew at the bottom of the filter paper. Keep rubbing until a lot of pigment has been transferred.

4. Pour alcohol into the beaker until it is about 1 cm high.

5. Carefully place the bottom portion of the filter paper (closest to the line you drew) into the jar. The bottom of the paper should come into contact with the alcohol but the alcohol should not touch the pigment line.

6. Use a piece of tape to secure the filter paper to the rim of the jar.

7. **Wait 15 to 20 minutes for the chromatograms to develop.**

8. Remove your filter paper from the jar and place it onto the table.

9. Use a pencil *(do NOT use a pen!)* to mark where the alcohol stopped as it moved up the filter paper. It should still be wet! This is called the alcohol or solvent front.

10. Let the filter paper dry for about a minute.

11. Use a pencil to mark the highest point of each pigment (color).

12. Draw your results below using colored pencils and label the pigments.

13. Using a ruler, measure the distance (in cm) between the pigment origin (the line you drew on the bottom of the filter paper) and the highest point of each pigment. Record your data in the chart provided. *Note: depending on the type of leaf that you use, you may not see all of the pigments listed on the data table.*

14. Measure the distance between the pigment origin and the solvent front (the highest point the alcohol traveled). This number should be the same for each pigment. Record data in the chart.

15. Using the formula provided, calculate the $R_f$ value for each pigment and record on the data chart.
Observations & Data:

Pigment Identification:

Chlorophyll a – blue/green
Chlorophyll b - yellow green
Xanthophyll - yellow
Carotene – orange
Anthocyanin - red

Data Table 1: Pigments in Leaf

<table>
<thead>
<tr>
<th>Pigment Origin</th>
<th>Chlorophyll a</th>
<th>Chlorophyll b</th>
<th>Xanthophyll</th>
<th>Carotene</th>
<th>Anthocyanin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment Front</td>
<td>2 cm</td>
<td>2 cm</td>
<td>2 cm</td>
<td>2 cm</td>
<td>2 cm</td>
</tr>
<tr>
<td>Alcohol Front</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rf Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pigment Front: distance moved by pigment from original spot
Alcohol Front: distance moved by alcohol from original spot

Rf Value = Pigment Front
          Alcohol Front
Conclusion Questions: Please answer in complete sentences!

1. Why is paper chromatography an appropriate technique to use to determine if different pigments are present in a leaf?

2. How does paper chromatography work?

3. Was your ‘claim’ correct? Use your results to support your answer.

4. Based on what you have learned, explain why leaves tend to change color in the fall.
5. Use the chromatography below to complete the data chart.

<table>
<thead>
<tr>
<th>Pigment/ Solvent Origin (1cm)</th>
<th>Chlorophyll a</th>
<th>Chlorophyll b</th>
<th>Xanthophyll</th>
<th>Carotene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigment Origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigment Front</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvent Front</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rf Value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chemical Reactions in Leaves

Carbon Dioxide + Water → Light → Carbohydrates → Oxygen
Photosynthesis & Respiration

- Poem, video, and Brainpop clip introducing Photosynthesis and Respiration
- PowerPoint and background readings on the topic
- Kinesthetic activity modeling the compounds
- Chart on similarities and differences between the two processes
- Differentiated fact sheet showing chemical equation, reactants, products, and location of each process
### Cell Processes Fact Sheet

**Directions:** Fill in the information needed to complete this fact sheet on photosynthesis and respiration, and fermentation.

<table>
<thead>
<tr>
<th>Process</th>
<th>Goal</th>
<th>Chemical Equation</th>
<th>Reactants - Substances Needed (including quantity)</th>
<th>Products - Substances Produced (including quantity)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photosynthesis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only occurs in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiration</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Occurs in:</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
# Cell Processes Fact Sheet

**Directions:** Fill in the information needed to complete this fact sheet on photosynthesis and respiration.

<table>
<thead>
<tr>
<th>Process</th>
<th>Purpose</th>
<th>Chemical Equation</th>
<th>Reactants: Substances Needed (including quantity)</th>
<th>Products: Substances Produced (including quantity)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photosynthesis</td>
<td>Produce</td>
<td>(6 \text{ CO}_2 + 6 \text{ H}_2\text{O})</td>
<td>Sunlight, 6 molecules of (\text{H}_2\text{O}) and 6 molecules of (\text{H}_2\text{O})</td>
<td>1 molecule of (\text{C}_6\text{H}_12\text{O}_6) (or (\text{H}_2\text{O})) and 6 molecules of (\text{O}_2)</td>
<td>_________</td>
</tr>
<tr>
<td></td>
<td>Only occurs in</td>
<td>(\text{C}_6\text{H}_12\text{O}_6 + 6 \text{ O}_2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Respiration | Produce | \(\text{C}_6\text{H}_12\text{O}_6 + 6 \text{ O}_2\) | 1 molecule of \(\text{H}_2\text{O}\) (or \(\text{H}_2\text{O}\)) and 6 molecules of \(\text{O}_2\) | 6 molecules of \(\text{H}_2\text{O}\), 6 molecules of \(\text{H}_2\text{O}\) and a large amount of \(\text{O}_2\) | First stage-
<p>| Occurs in   | using     | (6 \text{ CO}_2 + 6 \text{ H}_2\text{O} + \text{ energy}) | | | Second Stage-|
|             | things    | | | | |</p>
<table>
<thead>
<tr>
<th>Process</th>
<th>Purpose</th>
<th>Chemical Equation</th>
<th>Reactants (including quantity)</th>
<th>Products (including quantity)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photosynthesis</td>
<td>Produce food</td>
<td>$6 \text{ CO}_2 + 6 \text{ H}_2\text{O}$</td>
<td>Sunlight, 6 molecules of water and 6 molecules of carbon dioxide</td>
<td>1 molecule of sugar (or glucose) and 6 molecules of oxygen</td>
<td>Chloroplasts</td>
</tr>
<tr>
<td></td>
<td>Only occurs in</td>
<td>$C_6\text{H}_12\text{O}_6 + 6 \text{ O}_2$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>plants (autotrophs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellular Respiration</td>
<td>Produce energy</td>
<td>$C_6\text{H}_12\text{O}_6 + 6 \text{ O}_2$</td>
<td>1 molecule of sugar (or glucose) and 6 molecules of oxygen</td>
<td>6 molecules of water, 6 molecules of carbon dioxide and a large amount of energy</td>
<td>First Stage-Cytoplasm, Second Stage-Mitochondria</td>
</tr>
<tr>
<td></td>
<td>using oxygen</td>
<td>$6 \text{ CO}_2 + 6 \text{ H}_2\text{O} + \text{ energy}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Photosynthesis & Respiration Cartoon

I am in desperate need of energy! Money is tight, so I am only looking to purchase one glucose molecule. Using the software ComicLife, your task is to make a cartoon explaining how organisms obtain energy. Be as creative as you want!
Photosynthesis & Respiration Cartoon

Task:

I am in desperate need of energy! Money is tight, so I am only looking to purchase one glucose molecule. Using the software Comic Life, your task is to make a cartoon explaining how organisms obtain energy. Be as creative as you want!

Requirements:

1) Photosynthesis AND respiration are explained in detail
2) Names, chemical formulas, and quantities of the substances involved in each reaction are included
3) Shows how the molecules combine for EACH reaction
4) Any environmental factors needed for the reaction to happen are stated and depicted with a picture/graphic
5) Pictures/graphics are included for EACH substance and for EACH process
6) Correct spelling/grammar
7) Use vocabulary from class – photosynthesis, respiration, molecule, reactants, products, chloroplasts, chlorophyll, mitochondria, stomata, phloem, xylem
8) BE CREATIVE!!!!!!

Grading: See rubric

Timeline: 3 days in the computer room

Alternative Assignment: Please see me for approval if you want to work on a different project that demonstrates your understanding of photosynthesis and respiration.
Template to Make Cartoon

List the process taking place, include which organisms use this process and a picture of the organism.

Describe any specific environment needed for the process to occur and include a picture.

How organisms obtain energy:

Describe any specific environment needed for the process to occur and include a picture.

List the name of the compound, the molecular formula, the correct number of molecules, where the compound comes from or is going to, and a picture that represents the molecule.

List the name of the compound, the molecular formula, the correct number of molecules, where the compound comes from or is going to, and a picture that represents the molecule.
<table>
<thead>
<tr>
<th>Cartoon Requirements</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Processes</strong></td>
<td>Covers processes in depth with details and examples. Subject knowledge is excellent.</td>
<td>Explains the processes. Subject knowledge is good.</td>
<td>Includes essential information about the processes but there are one or two factual errors.</td>
<td>Both processes lack detail. Content knowledge is questionable. More than two factual errors.</td>
</tr>
<tr>
<td><strong>Substances</strong></td>
<td>All of the substances are correctly spelled and identified.</td>
<td>One of the substances is not identified or spelled correctly.</td>
<td>Two of the substances are not identified or spelled correctly.</td>
<td>Three or more of the substances are not identified or spelled correctly.</td>
</tr>
<tr>
<td><strong>Chemical Formulas</strong></td>
<td>All four chemical formulas are written correctly.</td>
<td>Only three of the chemical formulas are written correctly.</td>
<td>Only two of the chemical formulas are written correctly.</td>
<td>Only one of the chemical formulas is written correctly.</td>
</tr>
<tr>
<td><strong>Proportions</strong></td>
<td>All four of the molecular formulas are in the correct proportion.</td>
<td>Only three of the molecular formulas are in the correct proportion.</td>
<td>Only two of the molecular formulas are in the correct proportion.</td>
<td>Only one of the formulas is in the correct proportion.</td>
</tr>
<tr>
<td><strong>Environmental Conditions</strong></td>
<td>Appropriate environmental conditions are clearly stated and represented with an image.</td>
<td>Missing image(s) for environmental factors.</td>
<td>Missing the environmental condition(s).</td>
<td>Missing both the environmental condition and the image.</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>The order in which the molecules combine is correct and easily followed. Content is well organized and follows a logical order.</td>
<td>One of the molecules is not represented and/or the order is unclear. Content is logically organized.</td>
<td>Two or more of the molecules are not represented and/or the order is unclear.</td>
<td>Three or more of the molecules are not represented and/or the order is unclear. Content shows little organization.</td>
</tr>
<tr>
<td><strong>Picture Choice and Graphics</strong></td>
<td>The pictures are attractive (size and color) and clearly and cleverly support the content.</td>
<td>The pictures clearly support the content.</td>
<td>All graphics are attractive but a few do not support the content.</td>
<td>Several pictures do not represent the content with which they are associated.</td>
</tr>
<tr>
<td><strong>Formatting</strong></td>
<td>Can move text/objects to create an attractive, complex document. Choice of fonts and formats enhances readability and content.</td>
<td>Is able to perform most functions independently. Choice of fonts and formats enhances readability.</td>
<td>Requires assistance to complete more basis skills. Choice of fonts and formats complement the content but may be too hard to read.</td>
<td>Has little concept of editing or laying out the comic. Font and formatting makes it difficult to read the material.</td>
</tr>
<tr>
<td><strong>Creativity</strong></td>
<td>Exceptional degree of student creativity in their creation.</td>
<td>Comic reflects creativity in its creation.</td>
<td>Comic design elements are based on template given in class.</td>
<td>Comic design used the template given in class.</td>
</tr>
<tr>
<td><strong>Grammar and Spelling</strong></td>
<td>No grammar or spelling mistakes.</td>
<td>One grammar or spelling mistake.</td>
<td>Two grammar or spelling mistakes.</td>
<td>More than two grammar or spelling mistakes.</td>
</tr>
</tbody>
</table>
Photosynthesis is the process in which green plants (autotrophs) capture energy from the sunlight and use it to make food.

Energy from sunlight—used to make carbon dioxide and water into oxygen and sugar.

Photosynthesis—two stages.

In the second stage of photosynthesis, the plant uses the stored energy to make food.

- Two reactants needed for this stage: carbon dioxide and water.
- Carbon dioxide—through the stomata under the leaf and water moves through the xylem.
- Chloroplasts, water and carbon dioxide go through chemical reactions powered by the energy from the first stage.
- Sugar and oxygen—products of the chemical reactions.
- Food—goes through the phloem.

The left side of the equation represents the reactants for photosynthesis. The right side of the equation the products of photosynthesis. Oxygen gas is released into the air. Most of the oxygen from the air is in the atmosphere. The sugar molecules are used for food, made into different materials such as glucose. They are stored for later use.
Cellular Respiration

1. **Molecular Construction of Glucose**
   - **Glucose**: C₆H₁₂O₆
   - **Carbon**: Black
   - **Hydrogen**: Blue
   - **Oxygen**: Orange

2. **First Stage of Cellular Respiration**
   - **In the cytoplasm**
   - **Glucose** is broken down into smaller molecules, releasing a small amount of energy.

3. **Two Stages of Respiration**
   - First stage: Oxidation of glucose in the cytoplasm.
   - Second stage: Oxidation of organic compounds in the mitochondria.

4. **Environment for Cellular Respiration**
   - **Energy**, **Oxygen**, and **Plants**

5. **Second Stage of Cellular Respiration**
   - **In the mitochondria**
   - **Molecules** from the first stage are broken down into smaller molecules.
   - **Release a lot of energy**
   - **Requires oxygen**
   - **Carbon dioxide and water are produced**

6. **Photosynthesis** and **Respiration**
   - **Photosynthesis** creates **energy and oxygen**.
   - **Respiration** uses **energy and oxygen**.
   - **Photosynthesis** is **opposite** process of **respiration**.

**Julia Tseng Class 3**
HOW DO ORGANISMS MAKE ENERGY?

I ALWAYS FEEL LIKE I NEED MORE ENERGY!

I ALWAYS HAVE THAT THREE O’CLOCK FEELING... ZZZZZZ

IF ONLY THERE WAS A WAY TO GET MORE SUGAR AND ENERGY!

I NEVER KNEW THAT WHEN I ATE FOOD, I WOULD BE GAINING ENERGY!

PHOTOSYNTHESIS

DO YOU LOVE GLUCOSE? DO YOU FEEL YOU NEED MORE, BUT DON’T KNOW HOW TO GET IT AND/OR STORE IT? WELL, PHOTOSYNTHESIS CAN HELP YOU! THIS BREAKTHROUGH FORMULA PROVIDES A SAFE AND EASY WAY TO OBTAIN AND STORE YOUR NEEDED GLUCOSE! ALL YOU NEED IS SUNLIGHT, WATER, AND CARBON DIOXIDE.

FIRST, ABSORB SUNLIGHT WITH CHLOROPLASTS, A GREEN ORGANELLE THAT CONTAINS A SUBSTANCE CALLED CHLOROPHYLL, WHICH CAPTURES SUNLIGHT. THEN, ROOTS ABSORB WATER AND MINERALS AS THE STOMATA IN THE LEAVES TAKES IN CARBON DIOXIDE. INSIDE THE CHLOROPLASTS, THESE COMPOUNDS ARE CONVERTED USING A SIMPLE EQUATION: \( 6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2 \).

THE PRODUCTS OF THIS REACTION IS OXYGEN AND GLUCOSE. FINALLY, THE EXTRA GLUCOSE IS STORED INSIDE THE VEINS. WARNING! DO NOT USE THIS FORMULA IF YOU ARE A HETEROTROPH. ONLY USE IF YOU ARE AN AUTOTROPH. ALSO, THIS FORMULA ONLY WORKS WHEN IT IS DAYTIME! SIDE EFFECTS ARE LARGE AMOUNTS OF GLUCOSE, LOTS OF ENERGY, AND OBESITY. CONSULT YOUR DOCTOR BEFORE USE.

RESPIRATION

DO YOU ALWAYS HAVE THAT THREE O’CLOCK FEELING? DO YOU FIND IT HARD TO STAY ACTIVE THROUGHOUT THE DAY? WELL, RESPIRATION CAN HELP! RESPIRATION IS THE TRANSPORTATION OF SUGAR MOLECULES INTO ENERGY. WITH THE GLUCOSE MOLECULES AND OXYGEN MOLECULES, WE CAN CONVERT THAT INTO A HIGH SUPPLY OF ENERGY! IN THE CYTOPLASM, THESE MOLECULES ARE BROKEN DOWN INTO SMALLER PARTS. THEN, IN THE MITOCHONDRIA, THOSE MOLECULES ARE BROKEN DOWN EVEN MORE! THE FORMULA IS VERY SIMILAR TO PHOTOSYNTHESIS: \( C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{ENERGY} \). THE REACTANTS FOR THIS FORMULA ARE GLUCOSE AND OXYGEN, WHICH IS THEN FORMED INTO CARBON DIOXIDE, WATER, AND ENERGY. THE ENERGY IS THEN USED IN THE BODY AS FUEL. WARNING! DO NOT USE THIS FORMULA IF YOU HAVE AN EXCESS AMOUNT OF ENERGY. THIS COULD CAUSE HYPERACTIVITY IN SOME PATIENTS. THIS IS MEANT FOR HETEROTROPHS AS WELL AS AUTOTROPHS. CONSULT YOUR DOCTOR BEFORE USING.
Respiration helps me stay active and awake. All I need to do is use oxygen and glucose, to make carbon dioxide, water, and most importantly...energy!

Finally! Photosynthesis is a way for me to use carbon dioxide, water, and sunlight, to produce glucose and oxygen! My life is complete.

Look! I have leaves now! I can get all the glucose I want!

I feel so awake now.
How Organisms Obtain Energy
Cookbook Edition
**Photosynthesis in Plants**

**Working with Photosynthesis for Plants**

**Ingredients:**
- ~6 molecules of liquid water
- ~6 molecules of carbon dioxide
- sunlight

\[ 6 \text{CO}_2 + 6 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \]

**Steps:**

1. Mix the 6 molecules of water and 6 molecules of carbon dioxide together.
2. Let blended ingredients sit in the sun. When it's ready, you will have...

   1 molecule of sugar and 6 molecules of oxygen gas. Congratulations, you have completed photosynthesis!

**Respiration in Animals and Plants**

**Working with Respiration for Animals**

**Ingredients:**
- ~1 molecule of sugar
- ~6 molecules of oxygen

\[ \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6\text{H}_2\text{O} \]

**Steps:**

1. Blend the molecule of sugar and 6 molecules of oxygen together.
2. Let mixture sit in the rain or shine and when it's done, you are left with...

   6 molecules of carbon dioxide, 6 molecules of water and LOTS of energy. You have completed respiration! Enjoy!
**Photosynthesis**

Use energy from the sun to make food, happens in the chloroplasts which make chlorophyll.

- **Reactants**
  - Sunlight
  - Water (H₂O)
  - CO₂

- **Products**
  - Sugar/glucose
  - Oxygen (O₂)

**Respiration**

Use food to make energy, it happens in the mitochondria.

- **Reactants**
  - Sugar/glucose
  - Oxygen (O₂)

- **Products**
  - Water (H₂O)
  - Carbon dioxide (CO₂)
  - Energy


Picture Websites

- Slide 4 – Tree through the season http://www.rupert.id.au/examples/tree.gif
- Slide 5 – Fall color http://brucefong.files.wordpress.com/2010/10/autumn-trees.jpg
- Slide 6 - What Tree is That? http://wwwarborday.org/trees/graphics/wtit-logo.gif
- Slide 6 – Alternative or Opposite Buds http://www-saps.plantsci.cam.ac.uk/trees/images/altopp.gif
- Slide 6 – Veins, Shapes, & Margins http://www.enchantedlearning.com/subjects/plants/gifs/leafmargins.GIF
- Slide 6 – Leaf Identification Chart http://cdn-media.gardenguides.com
- Slide 8 – Leaf Changing Color http://www.charliechestnut.org/Phase1/TACFgifs/LeafAnim.gif