Atoms and Molecules: Photosynthesis
Plants make their own food

Name _____
Class/date_____

Part 1: Introduction to soil and plants

A) How much soil is absorbed by plants? Vote your opinion. Afterwards we will record the results from the whole class.

What % of a plant's weight comes from the soil?

A. 60% _____
B. 40% _____
C. 20% _____
D. 10 % _____
E. 0.1% _____

} Our class's voting results

The answer:

_____%

of a plant's weight comes from the soil.

B) To answer this question about soil and plants, Van Helmont did this experiment in Holland back in the 1600s:

Van Helmont's set up:

plant weight _____

dry soil weight _____

5 years later...

Van Helmont's results:

plant weight _____

dry soil weight _____

Plant gained_____

The soil lost _____

C) Discussion: Why do you think people have difficulty believing that most of the mass of a tree comes from the air?

1. _____

2. _____

3. _____

Part 2: LEGO® Lab:
A) Model molecules in LEGO and review chemistry vocabulary

Matter is anything that has mass and takes up space.
There are 3 major types of matter: elements, compounds, and mixtures.
Examples of matter are: <u>a hat</u>, ______________, ________________, _______________. *Is air matter? Y / N*

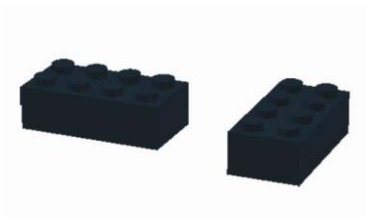
1) Element - a pure substance that has only one kind of **atom** in it.

Examples of elements:

____

____

____



These bricks are black. What element do they represent?

Atom - the smallest unit of an element. Atoms can exist either alone or in combination with other atoms.

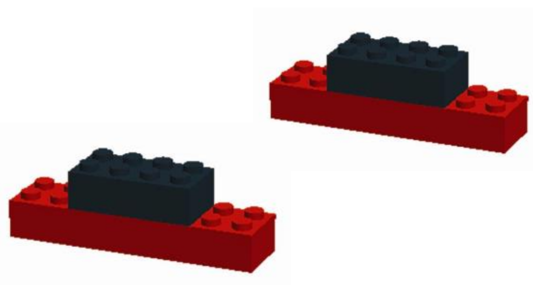
2) Compound - a pure substance made up of 2 or more different kinds of atoms bonded together. New properties appear.

Examples of compounds:

____

____

____



Make the compound carbon dioxide. The chemical formula is CO_2

Now make a water molecule. What might it look like?

Molecule – a combination of atoms bonded together. It comes from a Latin word meaning "little lump."

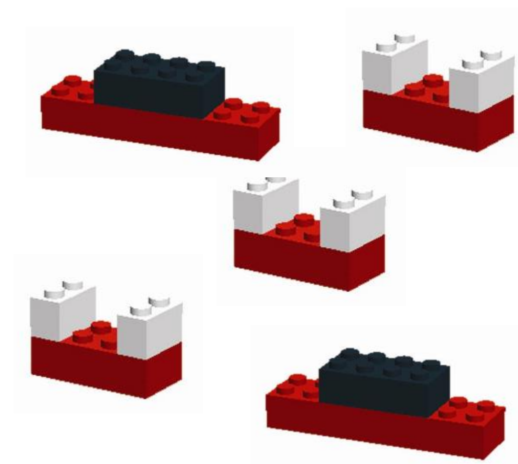
3) Mixture - a combination of two or more pure substances (elements or compounds) that can be separated by physical methods. The substances keep their original properties.

Examples of mixtures:

____

____

____



Make some carbonated water (soda). It is a mixture of CO_2 and H_2O. Could you still separate the molecules? How?

Review of chemistry vocabulary (continued)

Matter can change in appearance.

Is it a physical change or a chemical change?
Here's how to decide:

4) Physical change - *molecules are the same before and after the change, although the matter may look different.*

Examples:

_____

_____

Hints:
1) Physical changes include making mixtures, dissolving one thing in another, and cutting or breaking something.
2) All **changes of state** are physical changes. A water molecule is the same water molecule when it is ice, when it is liquid water, and when it is water vapor in the air.

5) Chemical change - *new and different molecules are formed.*

Examples:

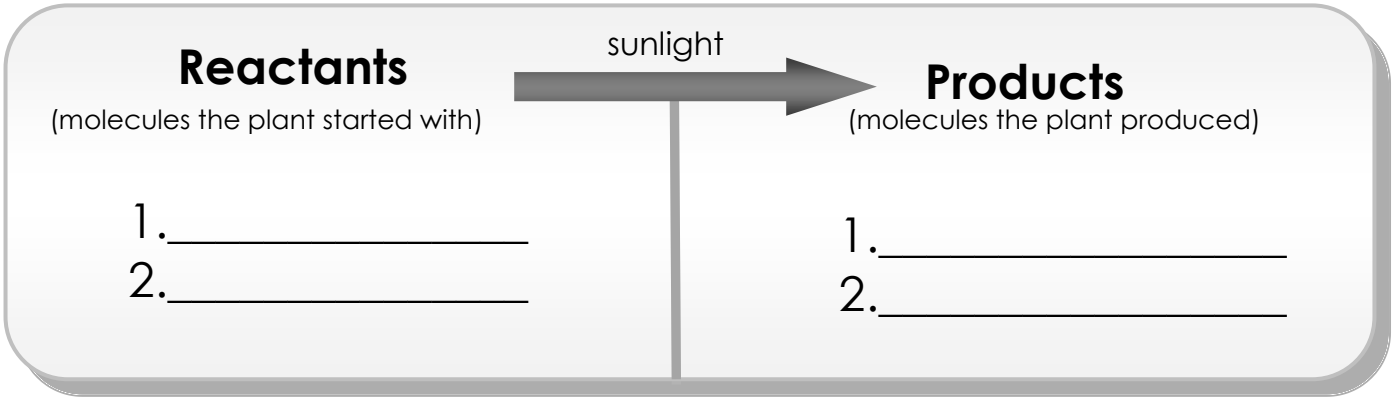
_____

_____

Hints:
1) The bonds between the atoms are broken and the atoms recombine in new ways.
2) New properties appear.
3) All **chemical reactions** are chemical changes.

B) Overview of photosynthesis, a chemical reaction occurring inside plant cells

What did the plant cell start with, and what are the new substances?



C) Write the chemical equations for 2 important chemical reactions in plant cells: Photosynthesis and Cellular Respiration

_____+ _____ _____+ _____

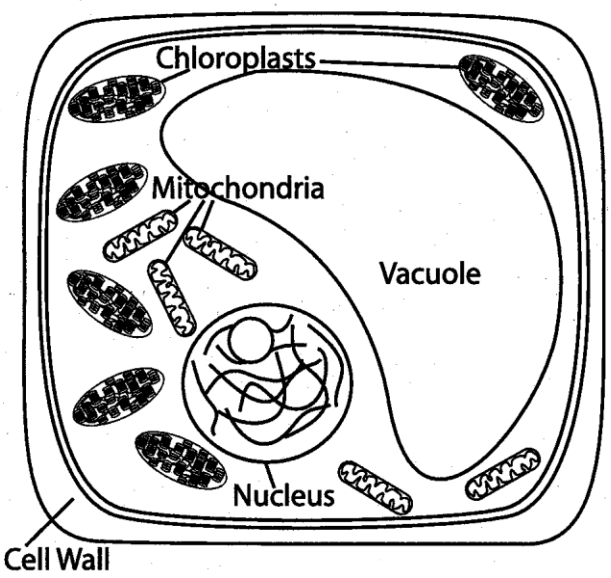
D) Model chemical reactions occurring inside plant cells:

Photosynthesis occurs inside of chloroplasts, and cellular respiration occurs inside of mitochondria.

1. First illustrate the photosynthesis equation with LEGO molecules on the large paper.
   - Build all 19 molecules.
   - Place each LEGO molecule near its chemical formula. Check all the models for correctness (the numbers of atoms and the number of molecules)

2. Now perform photosynthesis like a plant. Before starting, remove the products on the right side of the equation (the 6 O_2 + C_6 $H_{12}O_6$) and place them back in the kit.
   - Only use the 6 H_2O and 6 CO_2 to build a glucose molecule.
   - What is left over this time when you build glucose? _____

3. After plants have made their own food (glucose) they need to get the energy out of this sugar. (Plants and animals must "burn" sugar to get the energy out of it.)
   - This reaction with oxygen is called _____.
   - This reaction occurs in the power houses of the cell, called _____.



Photosynthesis light energy

$6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$

Cellular Respiration

$6H_2O + 6CO_2 \leftarrow C_6H_{12}O_6 + 6O_2$

energy for the cell

E) Plant cells build structures from glucose molecules. Plants build larger molecules by linking glucose molecules end-to-end. These processes in the cell are also chemical reactions! Write the formulas for the reactants and products in this equation:

_____ + _____ → _____ + _____

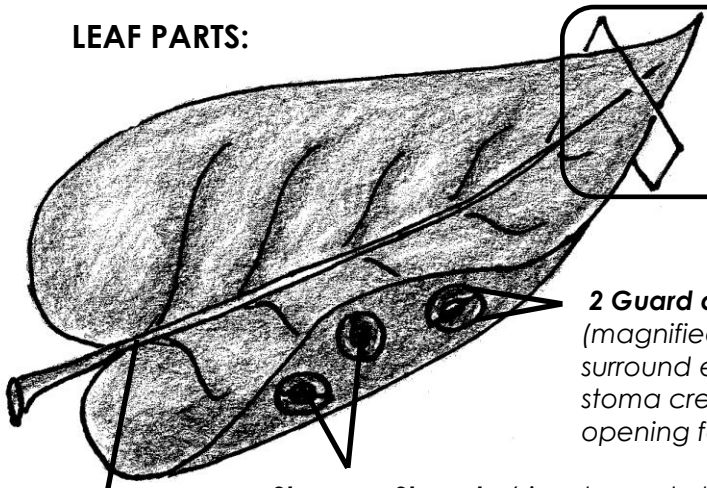
Glucose Glucose Disaccharide Water

F) Build starch and cellulose molecules with the LEGO atoms.

G) Examine a plant leaf. Plants perform an amazing chemical reaction (photosynthesis) that produces NEW substances in their leaves. This is how they <u>make</u> their own food: glucose.

With the addition of tiny amounts of dissolved minerals and water obtained by the roots, plants can make their own structures from glucose.

LEAF PARTS:



2 Guard cells *(magnified) surround each stoma creating an opening for air.*

Stoma or Stomata *(singular and plural) are the openings in the leaf. "Stomata" means "mouths."*

Veins *distribute water and dissolved minerals brought up from the roots.*

Cut leaf tip…. Look inside.

PHOTOSYNTHESIS IN A CUT LEAF TIP:

Fill in the blanks with the following phrases:

- *cell containing glucos*
- *vein bringing water*
- *O_2 exiting leaf*
- *stoma (or pore)*
- *CO_2 entering leaf*