

LEGO® Atoms and Molecules: Chemical Reactions

What defines a chemical reaction?



Part 1: Wet Lab.

A) Safety. Listen to the safety rules for today's experiment. Write one of them down here:

B) Observations. Write down your observations of the three substances:

Baking soda –

Calcium chloride –

Phenol red solution –

C) Procedure.

Step 1. Put 1 teaspoon of baking soda into a sealable bag.

Step 2. Put 2 teaspoons of calcium chloride into the same bag.

Step 3. Place a test tube with 10 mL of phenol red solution into the bag and hold it upright.

Step 4. Remove the top of the tube. While holding the tube upright, squeeze all the air out of the bag and seal the bag. (The test tube will stay in the bag.) Have your partner make sure the bag is well sealed.

Step 5. Tip the tube of phenol red solution onto the solids. Mix gently from the outside of the bag with your fingertips. (You can let the test tube fall to the bottom.)

D) Results. Write down your observations of the reaction:



E) **Flame test.** Placing a flame into different gasses can help to identify the gasses.

Hydrogen gas = makes a popping sound

Oxygen gas = _____

Carbon dioxide gas = _____

Watch the flame test. What new gas was formed? _____

F) **The BIG Idea:** Not all chemical reactions produce heat, a color change, or a gas.
All chemical reactions will produce NEW substances (new molecules)!

Write the definition for yourself here:

G) **Reactants and Products.** What did we start with, and what are the new substances made in today's chemical reaction?

Reactants	H_2O	Products
1. _____	→	1. _____
2. _____		2. _____
		3. _____
		4. _____

H) **Frequently asked questions:**

Why isn't phenol red listed as a reactant?

It is an "indicator" and it changed color, showing that other new substances were present.

Why is water listed above the arrow?

The phenol red was a powder mixed with water. So water was present in the reaction. It allowed the baking soda and calcium chloride molecules to come close enough together to trade some of their atoms, and therefore form new molecules. Without the water the reaction wouldn't occur. We write it above the arrow to show that the reaction happened in the presence of water.

A) Chemical 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: a hat, _____, _____, _____, _____.

Is air matter? Y / N


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

Examples of elements:



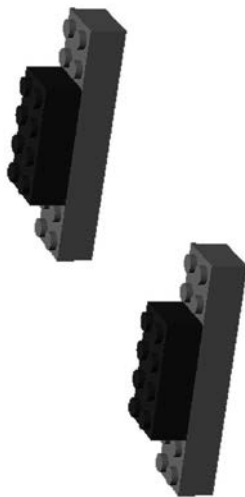
These bricks are black. What element do they represent?

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 CO₂

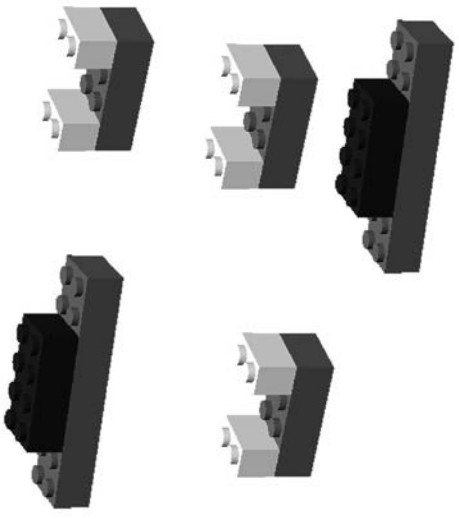
Now make a water molecule. What might it look like?

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 CO₂ and H₂O. Could you still separate the molecules? How?

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

B) Modeling a chemical reaction.

Directions:

- 1) Write the formulas for the molecules on the lines below.
- 2) Build and place each LEGO molecule on its formula using the "Chemical Reactants" and "Chemical Products" cards.

H_2O
CHEMICAL REACTION!


Reactants

(What we put in the bag)

baking soda molecule

baking soda molecule

calcium chloride molecule



Products

(What ended up in the bag)


salt molecule

salt molecule

chalk molecule

carbon dioxide molecule

water molecule



Look!
Different molecules have appeared in the bag!

C) Practice Writing Chemical Formulas.

A chemical formula is an easy way to tell what atoms are present in a compound.

Use the "LEGO® Atom Key" to find the **chemical symbol** for each element.

It is important to write your formula using the correct uppercase or lowercase letters. The subscript number refers to the atom before it. Remember that "H₂O" means there are 2 hydrogen atoms and 1 oxygen atom. We write the subscript 2 for the hydrogen but it is unnecessary to write the 1 after the oxygen.

Chemists have a complicated set of rules about the order of atoms in their formulas. For this activity, we'll keep it simple, and list the atoms in order starting from the top of the LEGO Atom Key.

Directions.

- 1) Watch your teacher demonstrate how to write a formula.
- 2) Build a compound with less than 10 LEGO bricks. (Don't worry about whether it would be a real compound. Build any shape/color you like!)
- 3) Write out the formula for YOUR compound here (write the symbols in the order of the Atom Key, from top to bottom):

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- 4) Trade your compound with your teammate and write out the formula for your TEAMMATE's compound here:

Compare answers with your teammate. Do you agree? Y/N

- 5) Build a second molecule and name it.

My formula

My Teammate's formula

Look! These formulas follow more complicated rules but are still neat to see!

CH₃COOH is the formula for vinegar!	C₁₉H₁₄O₅S is the formula for phenolsulfonphthalein or phenol red!	CH₄ is the formula for methane gas!	C₆H₁₂O₆ is the formula for glucose!	NaOCl is the formula for bleach!
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