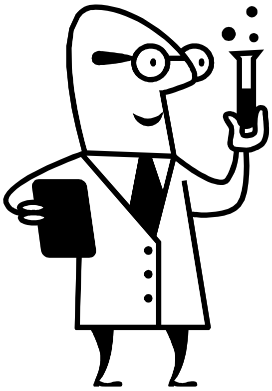


Chemical Change

Name:_____________

About acids
Acids react chemically with metals. They can also burn your skin. Because of this they are said to be **corrosive.** Other chemicals are also corrosive. For example, caustic soda (an alkali) is used to clear blocked drains by reacting with the grease that builds up in them.

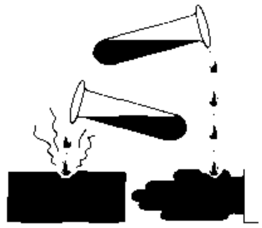
Concentrated and dilute
If they are spilt, acids and alkalis will attack your clothing, your skin or the bench. **Concentrated** solutions of acids have a lot of acid in them, and not much water. They are very dangerous, and you will not use them. **Dilute** solutions have more water in them. They are less dangerous than concentrated acids, but should also be handled with care.

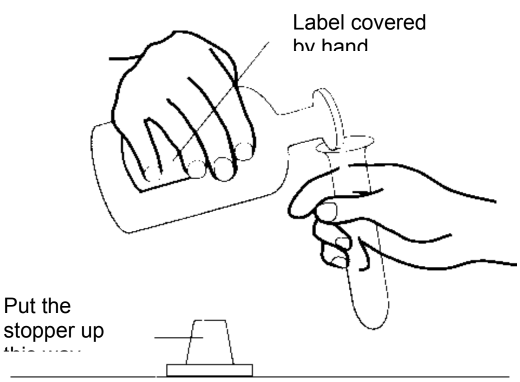
Whenever you are working in the laboratory, you should *wear protective clothing;* for example, a laboratory coat, apron, or old shirt with the sleeves buttoned up. *Wear shoes,* not sandals or thongs, in case corrosive liquids spill onto the floor.

It is also a good idea to *wear safety goggles* when handling corrosive liquids.

Handling acids
Always check the label on a bottle before using it. Bottles containing acids and alkalis often have a corrosive liquid symbol on them.

For laboratory use, acids are often kept in dropper bottles. This way you can measure how much acid you are using. Also, there is less chance of spilling the acid. When using a bottle with a stopper, don't lift the bottle by the stopper. When pouring, put the t bottle on the mouth of the test tube, and pour the liquid in slowly, as shown in the figure.





When acids are spilt
If you spill any acid or alkali on your clothes, your skin or the bench, do not panic. *Wash the area immediately with lots of water, and send someone near by to tell your teacher.*

Acids in your eye
If you spill any acid or alkali in your eye, wash it ***immediately*** with lots of water, and keep doing this for up to 20 minutes. Blink your eyelid under water. Your laboratory may have a special eyewash fountain or bottle. *Ask someone to tell your teacher straight away.*

Make sure you can answer these questions:

1 What does *corrosive* mean?

____

2 What should you do if you spill an acid or alkali on yourself or your clothes?

____

____

____

3 What should you do if you spill an acid on the bench?

____

____

____

4 What should you do if you splash a corrosive liquid into your eye?

____

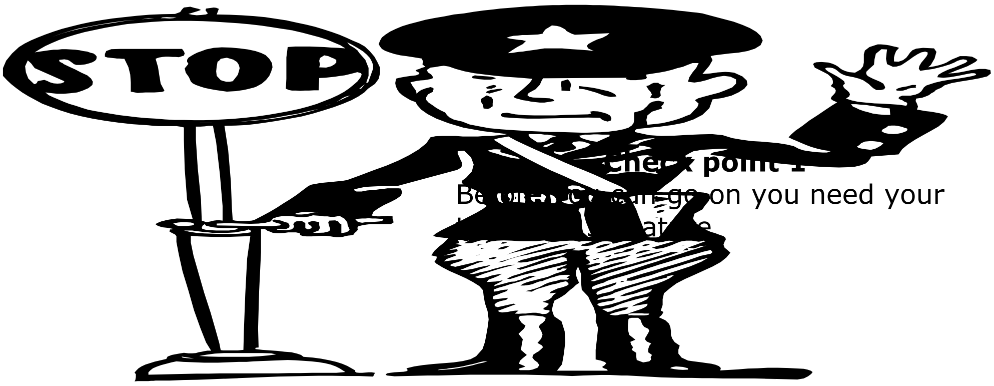
____

____

5 A bricklayer pours some water into a jar. She then adds an equal volume of hydrochloric acid from a bottle. Which is more concentrated — the acid in the bottle or the acid she has made in the jar? Which is more corrosive?

____

____



Before we can start to understand the world of chemical reaction we must accustom ourselves with the scientific art of observing reactions.

Observing Reactions Experiment

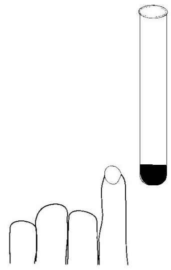
> **Stop**
>
> Before you can start an experiment you need to get your teacher's signature, Beware you may be asked some questions so you will have to read it before starting

Aim
To observe a variety of reactions.

Materials
- baking soda (sodium hydrogen carbonate)
- copper nitrate crystals
- a small piece of copper
- 2 small pieces of magnesium ribbon
- vinegar (dilute acetic acid)
- dilute nitric acid (6M)
- dilute hydrochloric acid (2M)
- copper sulphate solution
- lead nitrate solution
- iodine
- potassium iodide solution
- 6 test tubes
- a test tube rack
- a test tube holder
- a Bunsen burner
- methylated spirits
- limewater
- starch suspension
- straw

in dropper

Note: Use only small quantities of chemicals. Whenever you read *add a small amount of liquid,* you should add liquid to the test tube to a depth of about one centimetre (about the length of your little fingernail).

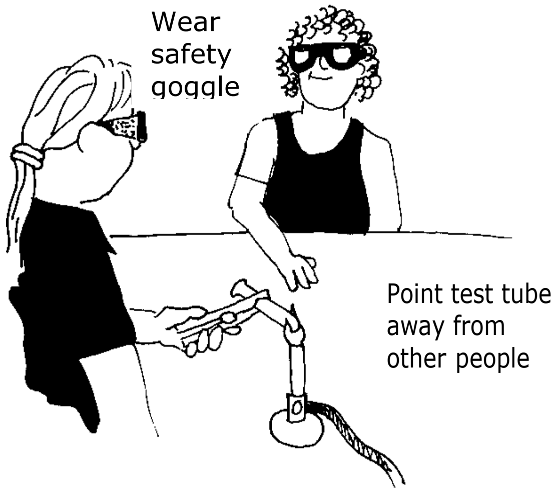


Method
1 Set up six test tubes, and number them 1 to 6.
2 Carry out the six reactions that follow. For each reaction:
  a. Describe the changes you see.
  b. Describe the new substance(s) formed.
  c. Feel the test tube to see if any heat has been produced. (Do *not do this for Reaction 6.)*

Reaction 1: Add a small amount of vinegar to some baking soda (about enough to cover the bottom of the test tube).

Reaction 2: Add a small amount of dilute nitric acid to a small piece of copper. ***(Warning:** If possible, do this near an open window.)*
Reaction 3: Add a small amount of dilute hydrochloric acid to a small piece of magnesium ribbon.
Reaction 4: Add a small piece of magnesium ribbon to a test tube half full of copper sulphate solution.

Reaction 5: Add a small amount of potassium iodide solution to a small amount of lead nitrate solution. Let the test tube stand for a few minutes.

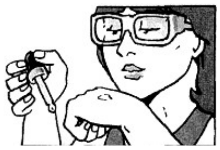


Reaction 6: Heat some copper nitrate crystals (about enough to cover the bottom of the test tube). *Be sure to point the test tube away from other people.* Also, in case any spitting occurs during heating, *wear safety goggles.*

Reaction 7: Place a few drops of starch suspension in a clean test tube. Add a drop of iodine solution.

Reaction 8: Quarter fill a very small beaker with limewater. Gently blow out through a drinking straw into the limewater.

Reaction 8: Use an eyedropper to place one drop of methylated spirits onto the back of your hand. Blow air gently across the back of your hand.



Results

Substances mixed (reactants)	Changes noticed	Is heat produced? (yes/no)	New substances formed (yes/no)

Questions and conclusions

1 In which of the reactions was there a colour change?

2 In which of the reactions was a gas produced?

3 Which was the fastest reaction? Which was the slowest?

4 Which of the reactions (if any) produced heat?

Physical and Chemical Change

The changes to materials that we see around us can be classified as either **physical changes or chemical changes.**

During a physical change no new substances are formed. Some of the properties (characteristics) of the substances change, but the substance are still the same. A change in the size, shape or state (solid, liquid or gas) of a substance is a physical change.

Examples of physical changes include chocolate melting, glass bottles breaking and the filament in a light globe glowing white-hot. One feature of physical changes is that they can usually be easily reversed. Melted chocolate can be changed back into solid chocolate. Broken glass can be recycled into a new bottle and when the electricity is turned off the filament in the light globe returns to its usual appearance.

In a chemical change, one or more new substances are formed. For example, when wood burns, smoke and colourless gases form, leaving behind ash (carbon). These are new substances different from those originally present in the wood. When iron tools are left outside, a crumbly brown layer forms over them. The iron combines with oxygen in the air to form a completely new substance, iron oxide (rust). Cooking food is an example of a chemical change. When you boil an egg, bake a cake or barbecue sausages, the carbohydrates, fats and proteins in the foods are changed into new substances.

The following can be used as evidence of a chemical change.

- The production of a gas, when a cake is cooked, the presence of bicarbonate of soda allows carbon dioxide gas to be released, which causes the cake to rise. The gas that is produced tells us that a reaction has taken place.
- A permanent change in colour, the colours displayed when fireworks explode are due to chemical reactions.
- The formation of a precipitate, a precipitate is a solid that forms when two solutions are mixed.
- Energy is either taken in or given off (i.e. heat and light).

Chemical changes are also called **chemical reactions.** In a chemical reaction the substances you begin with are called the **reactants.** The atoms that make up the reactants become rearranged in the reaction to form new substances called the **products.** It is important to understand that no atoms are created or destroyed in a chemical reaction. What do change are the bonds that hold the atoms together. The bonds inside the reactants are broken then new bonds form to hold the atoms together in the products. This breaking of bonds and rearranging of atoms means it is often much harder to reverse chemical changes. Sometimes it is impossible. When a stick of dynamite explodes, releasing heat energy and gases in all directions, it is impossible to reverse the reaction.

Physical Change	**Chemical Change**
A physical change does not change the way the atoms are linked up. The substance may look different. But no new substance has been formed. The chemical properties are not changed. In a physical change, no energy is taken in or given off unless there is a change of state.	In a chemical change, the atoms change the way they link up. New substances are formed. The new substances have different chemical properties from the old substance. When atoms change the way they link up, we say a chemical reaction has taken place. Energy is always part of a chemical reaction. In a chemical reaction, energy is either taken in or given off.

Word and Symbol equations

A chemical equation shows the reactants and products in a chemical reaction, and the proportions in which they react. The names of the reactants and products can be written in a word equation. The formulae for the reactants and products can also be written in a symbol equation. Numbers may also appear in front of the formulae in symbol equations. These show the proportions in which the reactants combine to form the products. For example, consider the following word and symbol equations for a neutralisation reaction

zinc oxide + hydrochloric acid -> zinc chloride + water

$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

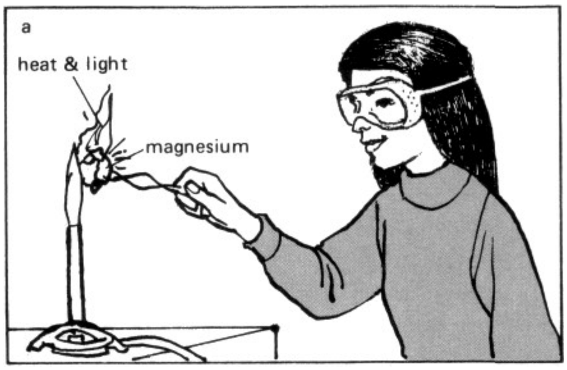
EXAMPLES OF PHYSICAL & CHEMICAL CHANGE

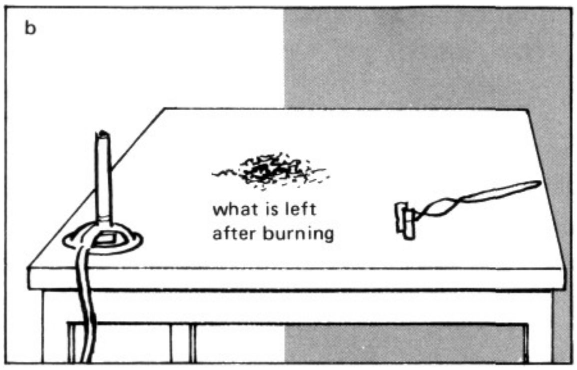
Look closely at each of the following examples of change. Then answer the questions about each change.

I. THE BURNING OF MAGNESIUM

This equation tells how magnesium joins with oxygen. Study it and then answer the questions below.

Element		Element		Compound
Magnesium $2Mg$ Solid	+	Oxygen O_2 Gas	$\rightarrow$	Magnesium oxide $2MgO$ Solid in powder form





1. Name the elements we started with. ________________________________.
2. Name the elements we ended with. ________________________________.
3. Did the elements stay separate? ___________________.
4. Was a new product formed? _______________________.

5. Were any new elements added? ____________________.

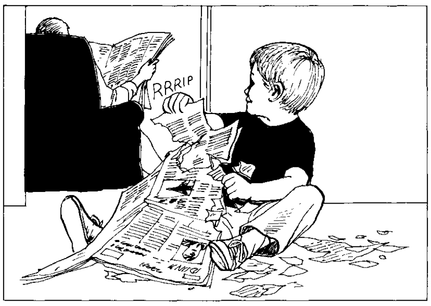
6. Were any elements lost? ___________________.

7. In this reaction, energy was ____________________.
taken in, given off

8. Name the kinds of energy ________________ & _________________.

9. The burning of magnesium causes a ___________________________.
physical change, chemical change

II. **TEARING PAPER**



1. The tearing of paper is an example of a physical change. Does the paper look different after being torn? ____.
2. Is the paper still paper? ___________.
3. Are the atoms taking in energy? _________.
4. The chemical properties of the paper_____________ changed.
are, are not

5. A chemical equation ____________________ be written to show a physical change.
can, cannot

Burning Magnesium Experiment

Aim: To Investigate what happens when a substance such as magnesium burns.

Write down your hypothesis about what you think will happen in this experiment

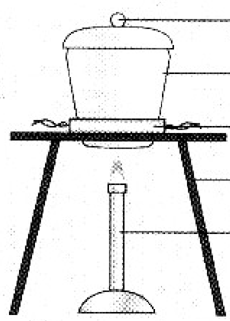
____

____

____

Materials:
Crucible with a lid, pipe clay triangle, tripod stand, Bunsen burner, electronic balance, 5 cm strip of magnesium, steel wool, paper towel, wire loop, matches.

Method:



Stop

Before you can start an experiment you need to get your teacher's signature, Beware you may be asked some questions so you will have to read it before starting

1 Weigh an empty crucible with Its lid and record Its mass,
2 Shine a 5 cm strip of magnesium with steel wool. Hold the magnesium with a paper towel so the grease from your fingers will not get onto It. (Finger grease will stop It from burning quickly.)
3 Fold the magnesium strip so it sits neatly on the bottom of the crucible. Weigh the crucible, lid and magnesium and record this mass.
4 Heat the crucible so that the magnesium burns. Do not let any white smoke escape. The white ash formed is magnesium oxide.
5 If the magnesium is not burning, carefully lift the lid using a wire loop. The magnesium will burst into flames as air reaches It. Replace the lid.
6 Heat for one minute. Lift the lid again carefully, let some air in and replace it again. Repeat until there is no more flaring up.

7 Let the crucible cool. When It Is cool, weigh It. Record the mass of the crucible, lid and magnesium oxide.

Results

In the following space draw a scientific draw of the experimental equipment.

Results:

Materials to be weighed	Mass in grams
Mass of empty crucible and lid	
Mass of crucible, lid and Magnesium metal strip	
Mass of magnesium metal strip (unburnt)	
Mass of magnesium oxide, crucible and lid	
Mass of magnesium oxide	

Discussion:

1 What is the colour of the clean surface of the magnesium? Is it flexible or brittle?

2 What colour is the flame of burning magnesium?

3 What is the colour and nature of the product formed by burning magnesium?

____

____

4 Is the product soft or hard, metallic or metallic?

____

____

5 What evidence chemical change has occurred?

____

____

6 Was there any change in the mass of burn magnesium (magnesium oxide) compared with the unburnt magnesium? Explain.

____

____

7 Write a chemical equation for this reaction.

____

____

8 Would it be easy to convert the product back to magnesium?

____

____

TRUE OR FALSE

Write T on the line next to the number if the sentence is true. Write F if the sentence is false.

1. ______ A chemical reaction causes a chemical change.
2. ______ A chemical change makes new products.
3. ______ Elements can be lost or gained in a chemical reaction.
4. ______ Energy can only be taken in during a chemical reaction.
5. ______ The substances that take part in a chemical reaction keep their properties.
6. ______ The new substances made in a chemical reaction have new properties.
7. ______ A physical change makes new products.
8. ______ The boiling of water is an example of a chemical change.
9. ______ An equation tells the story of a physical change.

PHYSICAL CHANGE OR CHEMICAL CHANGE?

Tell whether each of the following is a chemical change or a physical change.

1. mixing salt and pepper ____________

2. evaporation of water ____________
3. decomposed of water _________________
4. cutting a rnarshmallow _________________
5. toasting a marshmallow _________________
6. burning magnesium _________________
7. adding chocolate syrup to milk
8. the rusting of iron ________
9. melting of sugar _________

Discoveries in Chemistry

What do rubber, safety glass and Teflon have in common? They are materials that were developed by chance, accidental discoveries that have made improvements to everyday living. In each case, the person making the accidental discovery was not just lucky, they were observant. They also realised that what they had observed was new and important.

> Have you ever made a chance discovery by being observant? Have you ever found an unusual rock, fossil or shell? Louis Pasteur was a famous scientist who made many important discoveries. He said 'In the fields of observation chance favours only the prepared mind'. What do you think he meant by this? How can you 'prepare your mind'?

Rubber

Natural rubber (latex) comes from certain trees found in tropical regions. It is elastic and can be used to waterproof materials. However, it has the tendency to become soft and sticky on hot days and hard and stiff on cold days. An American inventor, Charles Goodyear, became interested in rubber. He wanted to discover a way of improving the properties of rubber. He wasn't a trained chemist and so he worked by trial and error, mixing many substances with the rubber without success. Goodyear heard that other people had been mixing sulfur with rubber, so he tried it too. In 1839, by chance, some of the rubber-sulfur mixture came in contact with a hot stove. To Goodyear's astonishment the rubber had become dry and flexible. He immediately tested this new form of rubber and found that it stayed dry and flexible when heated and cooled. Goodyear then set about experimenting to find the best way of making this new rubber. He called his process **vulcanisation.**

Vulcanised rubber has many uses such as in shoe soles and hoses. It was used to make car tyres but so much is needed that a synthetic form of rubber had to be developed.

Safety glass

Natural glass forms from the intense heat of volcanic activity on sand (silica). How people discovered a method of making glass is not known. Perhaps this was an accidental discovery by ancient people who built fires on sandy beaches. However, we do know that the Egyptians were moulding glass as early as 1400 BC.

Glass is a strong material but very brittle. It shatters into sharp fragments. This property led to an important discovery by a French chemist named Edouard Benedictus in 1903. Benedictus had been investigating a plastic called cellulose nitrate. He accidentally dropped a flask on a hard floor. He observed that the flask shattered but did not fall apart. When Benedictus examined the flask he found a thin film of the plastic inside it which had held the broken pieces together. He kept the flask but thought no more about it until he read about several automobile accidents where the passengers were badly cut by the shattered glass. Benedictus realised his earlier discovery could be put to good use and he immediately set to work to make the first safety glass. He did this by using the cellulose nitrate as a glue to hold two sheets of glass together. Today safety glass has many uses in buildings and vehicles.

Teflon

A young chemist named Roy Plunkett in 1938 discovered this amazing material. Plunkett worked in a research laboratory in New Jersey, USA. One morning he opened a new cylinder of the gas tetrafluoroethylene. He was puzzled about why the cylinder that should have contained 1000 g of gas only contained 990 g. After opening up the tank he found a curious white powder that he realised must have formed from the gas. He investigated the white waxy powder and found that it had some remarkable properties.

Plunkett's discovery was named poly-tetrafluoroethylene. It later became known as Teflon. This new plastic was not affected by hot corrosive acids, did not dissolve in solvents and could be heated to 500°C without burning. These properties made it suitable for use as a protective covering on the first atomic bomb, space vehicles and on the moon suits worn by the Apollo astronauts. It is so unreactive that it is used to coat pacemakers and other artificial parts because the body doesn't reject it.

It is also used as a coating on cookware, dental floss and as a stain repellent for clothing and furnishings.

1 Describe three properties of natural rubber.

---

2 What happens to natural rubber when it is vulcanised?

---

3 How did Edouard Benedictus's discovery benefit people?

---

4 Which property of Teflon makes it suitable for use:

a on dental floss?

---

b as a coating on glass eyes?

---

c as a lining for chemical containers?

---

d as a stain-repellent?

---

5 What personality traits did Charles Goodyear, Edouard Benedictus and Roy Plunkett have in common?

Summary

Physical change

A physical change is a change in the appearance of a substance. It is still the same chemical substance, it just looks different.

Example:	Melting wax
	Gushing salt
	Dissolving copper sulfate

Physical changes are often reversible. This means that they can be undone. Wax melts easily. Molten wax can be cooled and turned back into a solid. The wax may have a different shape, but it is still wax. Crystals of copper sulfate can be dissolved to make a solution. When the water evaporates, crystals form. The crystals may be a different size but they are still crystals of copper sulfate.

Chemical change

A chemical change is a change that makes a new substance. The new substance looks different, smells different and has different properties—because it *is* different.

Example:	Putting magnesium into acid
	Burning paper
	Making sedimentary rocks

Chemical changes are usually one-way changes. They cannot go backwards. You cannot unburn paper, or get the magnesium back after it has reacted with the acid.
How do you know when a chemical change has happened? Some clues to look for are:

- a change in colour
- bubbles or fizzing (which means a gas is being made)
- a change in temperature (the reaction becomes hotter or colder)
- change in solubility (substances can dissolve or crystallise)
- light, sound or heat energy released (such as in a wood fire)

When *a* chemical change has occurred we say a chemical reaction has taken place. A chemical reaction produces new chemicals. Some reactions, like rusting, are slow. Some reactions are explosively fast. Some reactions need to be started with heat energy, and some reactions start by themselves.
Find each of the following words.

PRODUCTS	PHYSICAL CHANGE	CONDENSATION	COLOUR
MAGNESIUM	PRECIPITATE	GAS	CRUCIBLE
REACTANTS	EQUATIONS	MELTING	BOND
FREEZING	CHEMICAL CHANGE	ENERGY	
ELEMENTS	ATOMS	EVAPORATION	

E	B	O	I	S	P	E	C	A	O	R	M	B	M	F	E	R	T	M	A	C	G	D
N	S	Y	A	P	A	U	O	Q	E	G	M	A	G	N	E	S	I	U	M	R	E	G
N	T	T	R	S	U	C	K	A	M	R	L	A	E	C	Y	T	G	E	E	U	R	O
G	E	S	C	C	R	P	U	U	G	C	O	L	O	U	R	R	L	A	L	T	C	U
T	O	V	M	U	L	N	E	Q	U	A	T	I	O	N	S	T	C	Y	B	P	O	O
A	M	E	A	O	D	E	L	E	M	E	N	T	S	O	I	T	G	T	I	R	N	M
N	S		H	P	T	O	T	C	B	O	N	D	E	N	A	R	U	S	C	E	D	C
C	E	N	D	S	O	A	R	T	Z	O	A	H	G	N	E	T	N	I	U	C	E	N
C	E	M	E	E	E	R	C	P	S	E	E	D	T	N	O	H	E	O	R	I	N	E
E	D	C	S	O	A	Y	A	O	G	A	N	S	E	O	S	O	U	O	C	P	S	N
F	R	E	E	Z	I	N	G	T	A	I	I	O	D	P	T	T	O	I	N	I	A	T
E	G	A	S	O	P	H	Y	S	I	C	A	L	-	C	H	A	N	G	E	T	T	R
N	L	N	L	U	N	B	N	M	M	O	U	N	C	P	E	R	C	C	C	A	I	A
G	N	S	V	T	O	D	I	N	N	A	N	H	M	C	R	H	I	T	L	T	O	N
C	H	E	M	I	C	A	L	-	C	H	A	N	G	E	E	I	T	M	U	E	N	E
H	D	N	M	T	A	G	Y	U	R	N	H	T	T	R	P	Z	I	I	D	R	C	E