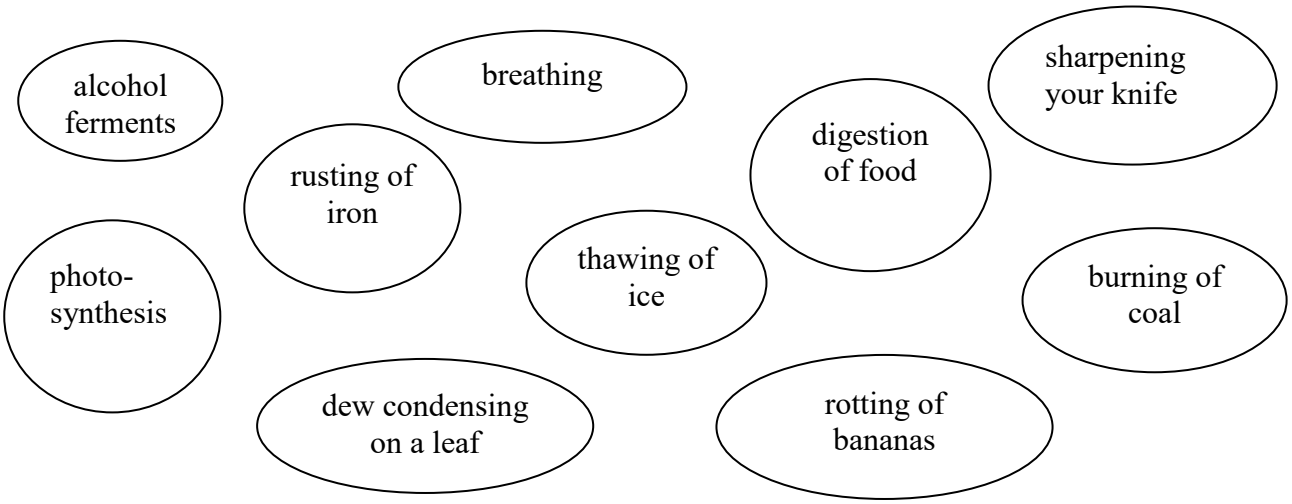
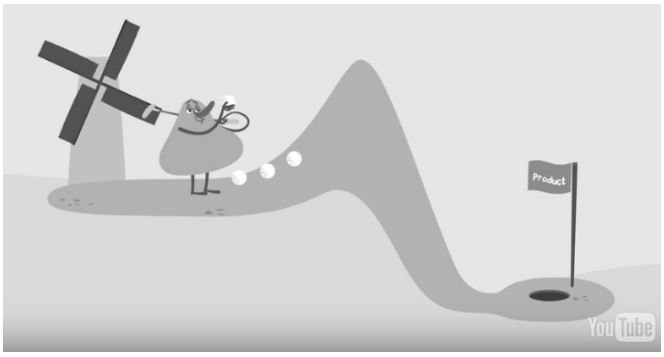
11 CHEMICAL REACTIONS

1. Warm-up: Which of these processes are chemical reactions and which are not? Why?



2. What triggers a chemical reaction http://ed.ted.com/lessons/what-triggers-a-chemical-reaction-kareem-jarrah

Describe what this picture means from a chemical point of view



Make sure you understand the phrases below:

increase or decrease of energy
potential energy
be likely to react
combustion of hydrogen and oxygen
release energy
activate a reaction
structure of proteins
randomness, chaos
shift to instability
transition from structure to disorder

How does the video explain what is:

Enthalpy

Entropy

Exothermic reaction

Endothermic reaction

3. Grammar: Verb Patterns https://advice.writing.utoronto.ca/english-language/gerunds/

A. Some verbs have the structure verb + object + to…

tell, ask, want, would like, remind, invite, warn, advise, expect, encourage, enable, allow, cause …etc.

*The professor **encouraged me to** do the experiment.*
*Intensive heating **causes water to** evaporate.*
*Our competitors did not **expect us to** win the match.*
*We **invite you to** attend the ceremony.*
*We could **ask her to** demonstrate the process.*
*They will **require us to** submit a summary.*

B. Complete the sentences with suitable verb form with 'to ' or without 'to'. Check: 2.00 – 2.50

1. Exothermic reactions are more likely to happen than endothermic ones because they **require** less energy …….. (occur) .
2. There's another independent factor that can **make** reactions …….. (happen) – entropy.
3. Shift to higher entropy can **allow** reactions …… (happen) .
4. Transition from structure to disorder gets some reactants past the hump and **lets** them …… (start) a reaction.

C. Practice:

Discuss several things that can ***cause/ let/ make/ allow*** some chemical reactions ***(to) proceed/ run*** faster.
Write several ideas in sentences with the infinitive structure (*with/ without 'to'*).

4. Complete the gaps and practise reading the equations.

decomposes into *combine to produce* *to react with* *yield*

$2H_2O_2 \longrightarrow O_2 + 2H_2O$
Two molecules of hydrogen peroxide go to form one molecule of oxygen gas plus two molecules of water.

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
Methane and oxygen …… carbon dioxide and water.

$2C + O_2 \longrightarrow 2CO$
Two atoms of carbon plus one molecule of oxygen …… two molecules of carbon monoxide.

$C + O_2 \longrightarrow CO_2$
Carbon reacts with oxygen to form carbon dioxide.

$2\ NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O$
It takes 2 molecules of sodium hydroxide …… 1 molecule of sulphuric acid to produce 1 molecule of sodium sulphate and 2 molecules of water.

$H_2O \longleftrightarrow H^+ + OH^-$
Water can break down into hydrogen and hydroxide ions, but hydrogen and hydroxide ions can also combine back together to form water.

$2H_2O_2 \longrightarrow 2H_2O + O_2(g)$
2 molecules of H_2O_2 decompose to form 2 molecules of H_2O plus one molecule of oxygen gas
OR: Hydrogen peroxide …… water and oxygen gas.

5. Types of reactions – suggest the words.

1. A complex molecule breaks down to form simpler ones.

   D _ _ _ _ _ _ _ _ _ _ _ _

2. Reaction between an acid and base which yields a salt and water.

   N _ _ _ _ _ _ _ _ _ _ _ _

3. One reactive element is replaced by another element in a compound formula.

   D I S _ _ _ _ _ _ _ _ _

4. Molecules of two reactants exchange some atoms or groups of atoms and give two new compounds; rearrangement takes place.

   C O N _ _ _ _ _ _ _

5. Two or more reactants combine to form one product.

   S _ _ _ _ _ _ _ _

6. Reaction of a compound or element with oxygen to form an oxide and produce heat.

   C O M _ _ _ _ _ _ _

6. Read these equations and identify the type of reaction according to ex.5.

A. The burning of naphthalene	$C_{10}H_8 + 12\ O_2$ ---> $10\ CO_2 + 4\ H_2O$
B. The combination of iron and sulphur	$8\ Fe + S_8$ ---> $8\ FeS$
C. The electrolysis of water	$2\ H_2O$ ---> $2\ H_2 + O_2$
D. Magnesium in water	$Mg + 2\ H_2O$ ---> $Mg(OH)_2 + H_2$
E. The formation of an insoluble salt	$BaCl_2 + H_2SO_4$ ---> $2\ HCl + BaSO_4$
F. The reaction of hydrobromic acid with sodium hydroxide	$HBr + NaOH$ ---> $NaBr + H_2O$

7. Forming questions

Look at the information from the textbook summary and write questions asking about the underlined parts.

Example

Chemical equations are used <u>to describe reactions.</u> Why are chemical equations used?

<u>Reactants</u> yield products. What yields products?

1. Equations must be balanced <u>to be consistent with the law of conservation of matter.</u>

2. Formula weights are determined <u>by adding together the atomic weights of the atoms in the formula unit.</u>

3. One mole of a substance contains <u>6.02×10^{23}</u> units of a substance.

4. <u>The coefficients in an equation</u> give the combining ratio of moles.

5. The coefficients in an equation give <u>the combining ratio of moles.</u>

CHAPTER SUMMARY

Chemical reactions are changes involving the outermost electrons of elements and compounds. A chemical equation is used to describe reactions in the following manner.

$$\text{Reactants (starting materials)} \xrightarrow{\text{yield}} \text{products}$$

Such equations must be balanced to be consistent with the law of conservation of matter, which states that matter is neither created nor destroyed in chemical reactions. In a balanced equation the number of atoms of a particular element distributed among the reactants equals the number among the products.

The coefficients in a balanced equation give directly the correct ratio of reacting units (compounds or elements). If the formula weights of the reacting units are known, the equation can also be used to calculate the combining weight ratios. Formula weights are determined by adding together the atomic weights of the atoms in the formula unit. A mole is a gram formula weight, that is, the formula weight expressed in grams. One mole of a substance contains Avogadro's number, 6.02×10^{23} units, of the substance. The coefficients in an equation also give directly the combining ratio of moles.

Chemical reactions may be exothermic (involving a net release of heat) or endothermic (involving a net absorption of heat). Exothermic reactions are generally favored in nature. Both exothermic and endothermic reactions require an initial input of energy (the activation energy) to initiate bond breaking. Energy diagrams are used to illustrate the changes in potential energy that occur during a reaction.

Temperature, concentration of reactants, and catalysts influence the rates of chemical reactions. Reaction rates increase with increases in temperature and concentration because both these changes increase the number of effective reaction collisions. Catalysts also increase the number of effective reaction collisions, but they do so by changing the mechanism of the reaction and lowering the activation energy. Although a catalyst is involved in a reaction, it undergoes no permanent change in the reaction. Enzymes are biological catalysts that mediate reactions in living systems.

A reversible reaction is one that can proceed in both a forward and a reverse direction. Reversible reactions may reach equilibrium, a condition in which the rates of the forward and reverse reactions are equal. Le Chatelier's principle states that if an equilibrium system is disturbed (by changes in concentration, temperature, and so on), the system will react in a way that will relieve the stress.

Oxidation-reduction (redox) reactions are a major class of reactions of great importance in living systems. Photosynthesis is a redox reaction, and the metabolic conversion of carbohydrates to carbon dioxide is the reverse redox reaction. Oxidation is defined as the addition of oxygen, the removal of hydrogen, the removal of electrons, or an increase in oxidation number. Reduction is defined as the reverse of these processes. Oxidation numbers are calculated according to the rules given in Table 6.1. Oxidation and reduction are always coupled. A substance that is oxidized in a reaction is called a reducing agent, and a substance that is reduced is referred to as an oxidizing agent. A number of oxidizing agents are used as antiseptics and disinfectants.