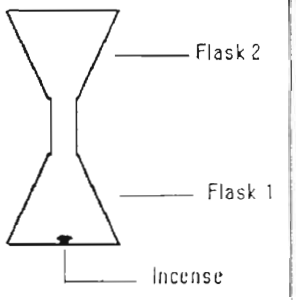
Chemistry

Contents	Learning Objectives (competencies...)	Activities	Remarks
I- Matter: classification and separation techniques **1. Classification of matter:** • Solids, liquids, gases	- Classify matter as solid, liquid, or gas - List the properties of solids, liquids, and gases - Compare and contrast the properties of solids, liquids, and gases.	**Student activities or demonstrations** - Construct a table containing 4 solids, 4 liquids, and 4 gases. In what ways are the substances different from each other? In what ways are they similar to each other? - Put several pieces of chalk in a beaker or glass jar and then in a flask or in a glass jar of a different shape . Conclude that solids retain their shape irrespective of the container in which they are put. - Repeat the procedure above using water instead of chalk. - Measure the volume of a piece of calcium carbonate (or any solid insoluble in water) using two graduated cylinders of different sizes containing water. Compare the two measures and conclude that the volume of the piece of calcium carbonate is constant. - Pour the same volume of water in two graduated containers of different shapes. Conclude that the volume of a liquid is constant and that liquids take the shape of the container in which they are put. **Demonstration:** - Burn a small amount of incense and drop it in a flask or glass jar. Close the flask tightly using a rubber stopper. When the gas from the incense fills the flask, turn a second identical flask or glass jar up-side-down, open the flask, and place the mouths of the two flasks exactly on top of each other (see picture in the Remarks column). Leave the two flasks for a few minutes. Conclude that gases take the shape and occupy the volume of the container in which they are put.	- The purpose of the activities is to demonstrate to students or help them conclude that solids have a constant shape and volume, liquids have a constant volume but take the shape of the container in which they are put, and that gases occupy the volume and take the shape of the container in which they are put. - You can use water or vaseline to seal the area of contact between the two flasks. 

Contents	Learning Objectives (competencies...)	Activities	Remarks
II- Solutions, Suspensions, colloids 2. **Suspensions and colloids**	— - Describe and distinguish among colloids, suspensions and solutions - Identify solutions, suspensions, and colloids by using light	- Bring to class different types of materials to prepare solutions, colloids, and suspensions (water, soil, egg white, salt ...). Mix water and albumin (egg white) to prepare a colloid, mix water and soil to prepare a suspension, and salt with water to prepare a solution. Use the mixtures prepared above to identify suspensions, colloids, and solutions using light (Tyndall effect). - Identify different types of colloids and suspensions and present them in table form.	

Contents	Learning Objectives (competencies)	Activities	Remarks
1. **Electrical nature of matter** 1 1 Electrification	• Describe three ways by which substances are charged. • Recognize the existence of two types of electric charge. • Conclude that matter is made of particles called atoms which contain sub-atomic particles, some of which are positively charged while others are negatively charged. • Describe mutual forces between charged particles. • Define the term electrostatic.	• Students activities or demonstrations. • Rub a plastic ruler with a piece of wool or rub a glass rod with a piece of wool. Approach the rubbed (charged) part to a piece of paper. Record your observations. • Approach a charged glass rod to a suspended ball of aluminum foil. Record your observations. • Approach a charged rod of ebonite to a charged ball of aluminum foil. Record your observations. • Approach a charged plastic ruler to another charged ruler suspended from a holder. Record your observations. • Approach a charged glass rod to a charged ruler suspended from a holder. Record your observations. • Put a metal rod supported by a glass support in contact with a charged ball of aluminum foil suspended from a holder. Touch the other end of the metal rod with a charged plastic ruler. Record your observations. Repeat the same activity by replacing the metal rod with a plastic ruler. Record your observations .	• Students should conclude that charging can be achieved by friction, conduction, and induction • Students should be led to conclude that there are two types of charges. • Students should conclude that metals are conductors and plastic is an insulator.

Contents	Learning Objectives (competencies)	Activities	Remarks
1 2 Electric discharge	• Describe an electroscope and explain how it works. • Explain the phenomenon of electric discharge	• Construct an electroscope. • Use the electroscope to demonstrate the phenomenon of electric discharge. Use everyday examples to explain this phenomenon in detail (lightening, chains suspended from trucks, ...).	
1 3 Conductors and insulators	• Define conductors and insulators • Classify familiar objects into conductors and insulators • Recognize that an electric current is a flow of charge.	• Tabulate the names of insulators and conductors from everyday life.	
1 4 Electricity and safety	• Describe safety measures to be taken when using electricity .	• Explain the precautions to be taken when using electrical appliances and electricity in general.	

Contents	Learning Objectives (Competencies)	Activities	Remarks
1. The Atom - Structure of the Atom • Periodic Table		• Bury different pieces of hardware in a modeling clay and form it into a ball. Ask students to use toothpicks to find out how many pieces of each kind of hardware are in the ball. Relate this to collecting evidence to come up with a model. • Bring to class a model of the atom with all the fundamental particles. Show students how particles are arranged emphasizing the fact that this arrangement is based on evidence collected from experiments. • Ask students to write a report on the different forms of the periodic table.	
2. Chemical Bonding • Ionic bond	• Describe the result of ionic bonding between elements as a regular pattern of ions in a crystal lattice.	• Use models to construct crystal lattices of ionic substances (simple cubic, body-centered cubic, face-centered cubic). • Conduct research on the properties of ionic and covalent substances and relate properties to uses.	
3.Electrochemistry • applications: electrochemical cells • applications: electrolysis of water, electroplating, cathodic protection.	• Describe the structure of the common dry cell. • Distinguish between cells and batteries. • Identify the everyday uses of cells and batteries. • Explain, with equations, the electrolysis (using inert electrodes) of: - concentrated sodium chloride solution (Brine).	• Show students the structures of cells and batteries. • Conduct electrolysis of: - concentrated sodium chloride solution.	

Contents	Learning Objectives (Competencies)	Activities	Remarks
4 Organic Chemistry • Hydrocarbons - Aliphatic hydrocarbons - Aromatic hydrocarbons	• Distinguish between aliphatic and aromatic hydrocarbons. • Name and draw the condensed-structural formulas and straight-chain structural formulas for : .- The alkyl groups of the third and the fourth alkanes • Name the normal alkenes and alkynes from n = 4 to n = 5. • Explain and write, using condensed-structural formula – addition reactions of ethyne (acetylene) with H_2, Cl_2, HCl and H_2O. • Write the structural formula of benzene. • List a number of physical properties of benzene. • Explain and write the equations of the following reactions, with benzene : – Complete combustion. – Addition of H_2. – Mono-substitution reaction with Cl_2 and nitric acid. • Name and draw the structure of the products obtained from addition and substitution reactions of benzene.	• Conduct an experiment to compare the different amounts of unsaturation in fats. • Conduct a complete combustion reaction of a hydrocarbon (e.g. burning butane in the Bunsen burner) in the laboratory and help students identify the products. • Conduct research on commercial products made from benzene.	• Mention to students the story of discovery of the structure of benzene by Kekule. • Inform students of the differences between benzene and gasoline. • Benzene and some of its derivatives are carcinogens. They are not recommended for use in schools.

Contents	Learning Objectives (Competencies)	Activities	Remarks
5. Chemistry and the environment: - Effects of pollution	• Recognize the effects of pollution on heavy metals. • Describe the carbon and nitrogen cycles.	• Draw charts/diagrams to explain the effects of pollutants on the environment (e.g. pollutants and the water cycle) • Prepare large charts of the carbon and nitrogen cycles and explain where in the cycle pollution has an effect. • Conduct a lab activity to identify heavy metal ions in water, propose ways to reduce amounts of these metals to acceptable levels. Focus on the need of chemistry and other subject areas (economics) in addressing chemical pollution problems.	
• Addressing pollution problems:	• Participate in activities to reduce environmental problems.	• Write a report on Lebanese laws to control pollution. • Organize a clean-up activity of a stream or part of a river, lake or beach area. • Organize separation and recycling activities in your school, start an environment club, invite speakers to awareness campaigns, join non-governmental organization with environmental agendas.	

Suspended Parts of the Chemistry Curriculum — First Year Secondary Level

Contents	Learning objectives (Competencies)	Activities	Remarks
1- Atoms 1 1- Structure 1 1.1- The nucleus • Protons and Neutrons • Charge and mass		• Construction of the following lattices using molecular models. ◊ The simple cubic lattice of zinc attained at T> 150°C. ◊ The body centered cubic lattice of iron. The face centered cubic lattice for each of copper and aluminum. • Documents on: 1. The historical development of atomic structure. 2 The discovery of the three subatomic fundamental particles. • Demonstration of the action of a magnetic field on a beam of electrons (deflectron) . • Calculation of the densities of some nuclei by assuming that nuclei are spherical • Documents on: ◊ The transformation of a neutron to proton and that of proton to neutron. ◊ Particle accelerators .	- Divide the class into 4 groups, and ask each group to construct a lattice. - Each of the preceding groups may work on a different activity

Contents	Learning objectives (Competencies)	Activities	Remarks
1.2- Electron configuration 1.2.1- The one-electron atom: energy levels.	• Interpret the atomic spectrum of the one-electron atom.	• An essay on mass spectroscopy • Demonstration of the emission atomic spectrum of hydrogen.	
1.2.2- Atoms containing more than one electron : energy sublevels.	• Relate the atomic spectrum to the transition of the electron from one energy level to another.	• Demonstration of the emission spectra of helium, mercury and nitrogen .	- Take into consideration the contribution of the interaction of electrons to the energy of an electron.
1.3.2- Description	• Comprehend that it is possible to encounter other forms of periodic tables.	• Preparation of different forms of periodic tables by groups of students. • Demonstration of the similar properties of alkali metals (action of oxygen and water).	
1.3.3-Periodicity	• Define the ionization energy and the electron affinity of an element. • Know that electron affinity of an atom is the energy needed to remove an electron from the negative ion of the atom. • Infer the periodicity in the variation of ionization energy and electron affinity of elements in the periodic table .	• A document on the determination of the ionization energy and electron affinity .	- Draw the students attention to the fact that the second ionization is higher than the first
1.4-Mole of atoms 1.4.2- Avogadro's number	• Know that there are many methods for determining Avogadro's number or Avogadro's constant, N_A.	• An essay for describing different method for the determination of Avogadro's constant.	

Contents	Learning objectives (Competencies)	Activities	Remarks
2- **Molecules** 2.2.4- Polarity of bonds and molecules	– Recognize whether the shared pair of electrons are arranged symmetrically or dissymmetrically between the bonding atoms. – Infer the polarity of a bond and the polarity of a molecule.	• Demonstration: Polarity of the water molecule.	- To ensure the success of this demonstration water should flow smoothly
2.3 1- Principle 2.4-Electronegetivity Pauling's scale		• An essay on the effect of electronegativity and multiple bonding on bond angles.	
2.4.2- Pauling's electronegativity scale	– Compare some bond energies. – Deduce the supplementary bond energy . – Relate the difference in electronegativity to the supplementary bond energy.	• An essay covering the calculation of electronegativities according to Pauling's method.	
2.4.3- Mulliken's electronegativity scale	– Know that there are scales of electronegativity other than that of Pauling's. – Know that Mulliken's electronegativity scale is based on ionization energy and electron affinity.		

Contents	Learning objectives (Competencies)	Activities	Remarks
3- Ions 3.1- Existence of ions.	– Predict the effect of an electric current on ions in solution. – Identify the charge of plates toward which the cations and anions migrate.	• Experimental demonstration 2) Mobility of ions: (using colored ions).	
3.2- Monoatomic ions 3.2 1- Formation	– Relate the charge of an ion to electron affinity		
3.5- Ionic compounds 3.5.1- The crystal lattice	– Construct crystal lattices. – Distinguish between simple cubic, body centered cubic, and face centered cubic lattices. – Locate the Na^+ and Cl^- ions in a NaCl lattice. – Deduce that in a unit cell the number of Na^+ ions is equal to the number of Cl^- ions. – Comprehend that the ionic bond is due to the electro-static attraction between oppositely charged ions. – Deduce that unlike the covalent bond, the ionic bond is not a directional bond.	• Construction of crystal lattices for representing the packing of ions in NaCl and CsCl. • Reading an essay on the analysis of some crystals by x-ray crystallography.	
3.5.2- The ionic bond	– Know that the ionic bond is a strong bond. – Relate that the close packing of ions in a crystal is due to the electrostatic interaction that exists in all directions . – Know the contribution of each ion to a unit cell. – Deduce the formula unit of an ionic compound.		

Contents	Learning objectives (Competencies)	Activities	Remarks
5- Water 5 1- Natural and pure water 5 1 1- Natural water - Importance	– Know the importance of water for maintaining life. – Appreciate the biological and industrial importance of water. – Relate the presence of water to the existence of life in the universe.	• Documents on 1) The use of water in industrial processes 2) The water cycle in the nature 3) Writing essays on the abundance and distribution of natural waters.	
- Abundance	– Know the water cycle in nature . – Search for statistical data pertaining to the abundance of natural waters.		
- Natural water is a mixture	– Test for the presence of dissolved substances in a sample of natural water, and infer that natural water is a mixture.	• Demonstration:Test for the presence of calcium ions in a sample of natural water.	
5.1 2- Pure water - Criteria of purity	– Relate the composition of natural water to its source. – Account for the necessity to have criteria of purity. – Use some of the criteria for the purity of water – Identify pure water.	• Experimental work: Carrying out a simple distillation	- It is preferable to use colored solution.
- Obtaining pure water from natural water	– Distinguish between pure and natural waters. – Know the processes for converting a sample of natural water into pure water. – Perform a simple distillation		
5.2- Structure 5.2 1- Structure of the water molecule	– Write the structural formula of a water molecule. – Construct the structure of water molecule with the aid of molecular models.		
	– Characterize water molecule by its structural constants (bond angle and bond length). – Deduce the polarization of the O — H bond and the polarity of the water molecule.	• Construction of a water molecule with the aid of molecular models . • Observation of the H-O-H bond angle	
5.2.2- The structure of water in the three states	– Recognize hydrogen bonding in water.		

Contents	Learning objectives (Competencies)	Activities	Remarks
	– Represent the structure of water in the gas, liquid, and the solid states. – Identify the phenomena that are due to the polarity of water molecules.	• Overhead projection of transparency to show the structure of water in the liquid and solid states.	
5.3- Physical properties	– Relate the physical properties of water in the three states to hydrogen bonding and to the polarity of water molecules. - Know that the freezing and boiling points of water are arbitrary values that are taken as reference points for measuring temperature by the Celsius scale.	• Demonstration of the variation of the boiling point of water with pressure.	
5.6- The different kinds of water	– Classify water as chemically pure water, sea water, freshwater, and ground water. – Be aware of the water pollution problem. – Relate the properties of a certain type of water to its source. – Define potable water.	• Documents on: 1) Treatment of natural water to render it potable. 2) Demineralized water 3) Desallination of sea water. 4) Water filters.	
5.7- Obtaining potable water	– Know how to obtain potable water from natural water. – Raise the issue of potable water quality. – Relate the quality of potable water to health.		- Distribute the activities to groups of students

Contents	Learning objectives (Competencies)	Activities	Remarks
8-Fertilizers 8 1- The plant needs in nutrients 8 1 1- Nutrients needed by plants	– Know the elements that are necessary for the nutrition of plants. – Recognize the primary nutrients or macronutrients, the secondary nutrients, and micronutrients.	• Projection,using over heads projectors, on agriculture, plants, nutrient deficiencies in plants, the use of fertilizers, and harvest...	
8 1 2- Forms of main nutrients	– Know the sources of main nutrients. – Specify the role of nutrients. – Identify the form in which the main nutrients are used by plants. – Know that nutrients are absorbed by the leaves and the roots of plants. – Recognize the effect of deficiency in nutrients. – Distinguish in the nutritive medium, the solid, liquid, and gaseous fractions. – Know the chemical nature of the nutritive medium. – Identify the characteristics of the nutritive medium.	• A document on the suitability of the pH of soil to the nature of plants to be cultivated. • Demonstration: Observation of samples of organic fertilizers and inorganic fertilizers (simple and mixed).	
8 2- Characteristics of the nutritive medium	– Comprehend the problem of the impoverishment of a nutritive medium. – Infer the necessity for applying fertilizers. – Plan how to interfere in the process of supplying nutrients.		
8.3- Necessity for providing nutritive elements	– Know the nature and the quantity of the nutrients to be supplied. – Choose convenient fertilizers.	• Documents on: 1. Manufacture of fertilizers 2. Data relevant to the consumption of fertilizers	- The documentary work should be done by group of students.
8.4- Classification of fertilizers	– Classify fertilizers into inorganic, and organic fertilizers.		
8.4 1- Inorganic fertilizers	– Classify inorganic fertilizers into simple and mixed fertilizers. – Relate the inorganic and organic fertilizers to the nutritional needs of plants.		

	– Recognize the simple fertilizers containing: nitrogen, phosphorus, and potassium. – Know the compounds that an inorganic fertilizer consists of. – Recognize the ions that are contained in a fertilizer. – Identify experimentally the ions that are provided by a fertilizer in an aqueous solution. – Interpret the commercial specifications indicated on the label of a simple or a mixed fertilizer.	• Experimental work: Performing identification tests for the following ions: potassium, ammonium, nitrate, phosphate, sulfate, sodium, and chloride.	
8.4.2- Organic fertilizers	– Know that a variety of organic matter act as sources of nutrients for plants. – Recognize the nutrients present in organic fertilizers. – Know that organic fertilizers are mineralized so that they can be absorbed by plants. – Know that the mineralization of organic fertilizers is ensured by certain microorganisms. – Distinguish between organic fertilizers of plant origin and organic fertilizers of animal origin.	• An essay on the production of organic fertilizers by the method of composting.	
8.5 Pollution due to use of fertilizers	– Make an inventory of the polluting elements. – Comprehend the steps that lead to the pollution of underground waters. – Know how to control pollution caused by the use of fertilizers. – Know the effect of water polluted by fertilizers, on health, vegetation, and aquatic animals. – Adopt measures that render optimum fertilization and minimum pollution.	• Experimental work: Test for the presence of nitrate and phosphate ions in a sample of polluted water. • A document on fertilizers and the environment.	- The documentary work should be done by group of students

Contents	Learning objectives (Competencies)	Activities	Remarks
9- Atmospheric pollution 9.1- Composition of clean air	– Know the composition of air. – Express the abundance of each component as volume percentage and as ppm. – Define clean air.	• Overhead projection of documents that indicate the composition of clean air. • Calculate the abundance of each constituent of clean air using ppm.	• This chapter will be studied by classroom discussion based on the documents.
9.2- Polluted air: pollutants and their sources	– Know that air can be polluted either by gases or a variety of particulates. – Relate air pollution to the following gases: carbon monoxide, carbon dioxide, oxides of nitrogen, oxides of sulfur, hydrogen sulfide, methane, ammonia, and ozone. – Identify the sources of the pollutant gases – Know that the amount of pollutants should not exceed a certain threshold value. – Know the effect of each pollutant on health and the environment. – Know the importance of mitigating air pollution. – Distinguish between permanent and accidental air pollution.	• Projection of documents that show tall and short smoke stacks, chimneys, and exhaust pipes of automobiles that cause air pollution by the emission of gases and particulates • A document that shows the effect of particulate pollution on health. • A document that shows the effect of gas pollution on health. • A document that shows an accidental air pollution. • A document showing the threshold values that should not be exceeded.	
9.3- Acid rain	– Know that acid rain is a consequence of the pollution of air by oxides of sulfur, hydrogen sulfide, and oxides of nitrogen. – Describe the impact of acid rain on vegetation, and aquatic life, as well as statues, buildings, and health.	• Documents that show the effect of acid rain on vegetation, marble statues, and metallic constructions	
9.4- Greenhouse effect	– Know the principle of the greenhouse effect. – Know that the greenhouse effect leads to global warming. – Relate the greenhouse effect to a certain number of gases, and understand that when the amount of these gases increase in the air the greenhouse effect intensifies. – Know that the greenhouse effect is beneficial in that	• Experimental work showing the action of nitric and sulfuric acids on a piece of marble, or on a metal. • Experimental work: Titration of sulfur dioxide and nitrate ions. • Projection of a diagram that shows the principle of the greenhouse effect.	

	it has provided us with moderate climate, but it becomes damaging if it intensifies due to atmospheric pollution. – Know the consequences of greenhouse effect on the climate, vegetation, and the melting of polar ice.		
9.5- The hole in the ozone layer	– Know the role of ozone in the stratosphere as a filter for UV rays. – Know that ground-level ozone is a toxic gas and acts as an indicator of air pollution. – Know that the amount of ozone in the upper atmosphere is decreasing, while it is increasing in the lower atmosphere due to pollution. – Comprehend the role of chlorofluorocarbons, CFCs in the destruction of the ozone layer. - Comprehend the mechanism for the destruction of ozone in the upper atmosphere and the mechanism for its formation in the lower atmosphere.	• A document that shows the upper atmosphere (stratosphere) and the lower atmosphere (troposphere). • A document that shows the use of ozone as a disinfectant. • A document showing how we can monitor the depletion of ozone layer in the stratosphere. • A document that shows the production of ozone.	
9.6- Smog	– Describe the formation of photochemical smog . – Know the sources of substances that form smog. – Know that smog is a type of pollution that forms in large cities due to the huge amount of automobile exhaust gases. – Know that the photochemical effect on NO_2 leads to the formation of ozone. – Know that smog is a complex form of air pollution. – Relate the formation of smog to sunlight, and its variation during the day.	• Documents that show the smog over some large cities. • Distribution of an essay on atmospheric pollution to be debated and criticized by the students. • An essay on catalytic converters of cars.	
9 7- Fight against pollution	– Be aware of the risks caused by pollution on health and the environment. – Discuss the advocated solutions for controlling pollution. – Develop an attitude of respect for the environment.	• Classroom debates on the advocated solutions for fighting air pollution. • Distribution of a questionnaire to assess the attitude of the students towards the environment.	

Suspended Parts of the Chemistry Curriculum — Second Year Secondary Level - Scientific section

Contents	Learning Objectives (competencies)	Activities	Remarks
1. Thermochemistry 1.1. Heat of Reaction at Constant Pressure ΔH			
1.1.4. Determination of the Heat of Reaction by Calorimetry	- Use a calorimeter - Calculate experimentally the heat capacity of a calorimeter – Characterize a calorimeter by: • the heat capacity of a calorimeter and its accessories • the heat capacity of water – Apply the rules of calorimetric measurement	Demonstrations: • Determination of the heat capacity of a calorimeter • Determination of the heat of neutralization of a strong acid by a strong base • Determination of the latent heat of fusion of ice – Documentation: Reading the commercial food tags (the calorie and the food diet)	- Calibrate the calorimeter and its accessories in a preliminary experiment. - Only use complete and rapid reactions.
1.2. Heat of Reaction at Constant Volume ΔU	– Define the heat of a chemical reaction at constant volume as the thermal effect of this reaction – Represent the heat of reaction at constant volume by ΔU – Relate ΔU to the quantity of matter transformed		

Contents	Learning Objectives (competencies...)	Activities	Remarks
3. Industrial Inorganic Chemistry 3.1-Study the principles for manufacturing of ammonia, nitric acid, sulfuric acid, hydrochloric acid, phosphoric acid and sodium hydroxide. 3.1.3 The Manufacture of Synthetic raw Materials			
- Nitric Acid	– Know that nitric acid is made in two steps from ammonia via the Ostwald process. – Write the equations for the reactions involved in the synthesis of nitric acid	– Documentation: Draw a flowchart for the industrial synthesis of nitric acid – Application: Calculate the overall ΔH for the transformation, using the individual ΔH's and Hess's Law	- It is suggested that to provide the example $C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl$
- Hydrochloric acid	– Know that hydrochloric acid is generated as a by-product of other industrial processes (90%) – Give an example of a direct process to manufacture HCl (from hydrogen and chlorine) – Appreciate the need for special apparatus to accomodate the corrosive properties of HCl and the heat of reaction	– Application: • Calculate the overall ΔH for this conversion Draw a flowchart diagram of an H_2SO_4 plant	
- Phosphoric Acid	– Describe the manufacture of phosphoric acid from phosphate rock and sulfuric acid – Specify that this process also produces gypsum		

Contents	Learning Objectives (competencies...)	Activities	Remarks
- Sodium Hydroxide and Chlorine	– Describe the preparation of sodium hydroxide and chlorine by the electrolysis of concentrated NaCl – Write the equation for the half-reactions and the overall reaction involved – Draw a diagram of the diaphragm cell used in the chlor-alkali process – Know that the cells must be designed to separate Cl_2 from H_2 and NaOH.		
3.2. Utilization of the Preceding Products as Raw Materials in the Chemical Industry			
3.2.1. Agricultural Industry - Nitrogen Fertilizers	– Understand that plant soils require the addition of nutrients that the plant cannot store or make – Recognize that nitrogen is the most important plant nutrient since it is used in protein synthesis – Know that ammonia and ammonium salts are used as nitrogen fertilizers – Describe the conversion of ammonia to ammonium sulfate	- Activity: Know the soil fertilization periods and types of fertilizers used	
- Phosphorus Fertilizers.	– Identify phosphorus as essential element for plant growth. – Realize that the natural form of phosphorus.		

Contents	Learning Objectives (competencies...)	Activities	Remarks
	apatite, is insoluble in water – Deduce the need for conversion of apatite into normal superphosphate or triple superphosphate for use as fertilizers – Write the over all equation for the conversion of apatite into normal superphosphate and triple superphosphate. – Describe the conversion of apatite ad sulfuric acid into superphosphate – Describe the conversion of apatite and phosphoric acid into triple superphosphate		
3.2.2. The Explosives Industry	– Define an explosive – Know that the world's most used explosive is ammonium nitrate – Write the equation for the synthesis of ammonium nitrate from ammonia and nitric acid (acid-base reaction) – Know that the major explosive component of dynamite is nitroglycerin and that it is associated with wood flour and ammonium nitrate – Write the equation for the synthesis of nitroglycerin from glycerin and a mixture of nitric and sulfuric acid – Know that modern guns use smokeless powder, a containing nitrocellulose and an oily material – Know that nitrocellulose is manufactured by the reaction of cellulose with nitric and sulfuric acid – Understand that major applications of explosive are peaceful	Documentation: the first explosives (gun powder) Documentation: the history of the Nobel Prize Documentation: uses of explosives	- List the 2 types of explosives primary or initiating explosives. (detonators) and secondary or high explosives (boosters)

Contents	Learning Objectives (competencies...)	Activities	Remarks
3.2.3. Soaps	– Define a soap – Write the chemical formula of a soap molecule – Define hydrophilic and hydrophobic groups – Identify the hydrophilic and hydrophobic groups in a soap molecule – Deduce the structure of a soap micelle in water – Deduce the mechanism of action of a soap molecule – Know that a soap molecule is manufactured by the reaction of a fat or oil with sodium hydroxide – Write the equation for the conversion of a fat into a soap – Specify that the quality of a soap is determined by the fat/oil precursor .	Documentation: historical-discovery of soap Activity: the synthesis of a soap from different kinds of fats and oils	
3.3. Cement and Glass			Consider the following abbreviations:
3.3.1. The Manufacture of Cement	– Know that the most common type of cement is a complex mixture of calcium and aluminum silicates called Portland cement. – List the abbreviations of the cement industry for the constituents of cement – List the two types of materials involved in the manufacture of cement: one rich in calcium (limestone) and one rich in silica (clay) – Know that in the manufacture of cement, the ingredients must be intimately mixed and finely ground before being introduced into a long heating tube (the kiln) – List the reactions that occur in the various regions	– Documentation: Types of cement – Activity: Visit of a cement factory	CaO=**C**, SiO_2=**S**, Al_2O_3=**A**, Fe_2O_3=**F** – θ >500°C: H_2O removed from clay – θ >900°C: CO_2 removed from limestone to produce lime CaO – θ >1000°C: lime and clay combine to produce cement – θ >1280°C: completion of cement formation List the constituents of Portland cement: C_3S, C_3A, C_2S, C_4AF

Contents	Learning Objectives (competencies...)	Activities	Remarks
	of the kiln – Write the equations for the conversion of limestone ($CaCO_3$) and clay ($Al_2O_3.SiO_2.2H_2O$) into the components of cement. – Describe the setting, or hardening of cement as hydration and hydrolysis processes that take place when cement is mixed with water – Specify that cement itself is not strong enough and that mixtures of cement, sand and gravel called concrete are used instead	– Documentation: factors that determine the setting of cement	
3.3.2. The Manufacture of Glass	– List the constituents of glass: lime (CaO), silica (SiO_2) and soda (Na_2O) – Describe the manufacture of glass by the fusion of limestone ($CaCO_3$), soda ash (Na_2CO_3) and sand (SiO_2) in a furnace at 1500°C – Identify glass as a liquid, which upon cooling, is so viscous that it stops flowing – Write the equations involved in the manufacture of glass – List the three most important types of glass: soda-lime glass (SiO_2,CaO,Na_2O), borosilicate or Pyrex (SiO_2, B_2O_3, Na_2O) and lead glass (SiO_2, PbO, Na_2O) – Specify that the color of glass is due to the presence of metals or metal ions in trace quantities	– Documentation: the discovery of glass and early uses – Activity: Draw a diagram for the manufacture of window glass – Documentation: • types of glass and uses • colored glass	– Note: the cool liquid glass does not crystallize

Contents	Learning Objectives (competencies...)	Activities	Remarks
4. Metallurgy. Metals and Alloys 4.1. Extraction of iron, copper, aluminum and gold			
- The metallurgy of copper	– Know that copper exists in nature mostly as copper sulfide or carbonate – Specify that copper sulfide ores contain both copper sulfide and iron sulfide – Deduce the need for a more complex recovery procedure of copper from its ore than the process used for iron – Know that after concentrating the ore, roasting below 800° C converts the iron sulfide to its oxide, with the copper remaining as the sulfide – Know that the separation of iron and copper compounds occurs at higher temperatures – Specify that in the final step air is blown through the molten mass and copper oxide is converted to copper – Write the equations for the chemical reactions involved in the extraction of copper – Know that the final purification of copper is accomplished by electrolysis	– Documentation: abundance of copper in the region and the world – Activity: Draw a schematic representation of a blast furnace	- Copper did exist in nature in its elemental state but the copper reserves have been consumed
- Aluminum	– Define the composition of the principal ore of aluminum (bauxite) – Use the acidity of Al_2O_3 and $Al(OH)_3$ to separate these components from the impurities. – Describe the electrolysis process to convert these substances to aluminum – Write the equations for the half-reactions involved at each electrode	– Documentation: uses of aluminum	– Note the need of a special solvent to dissolve Al_2O_3 for electrolysis (cryolite, Na_3AlF_6)
Contents	Learning Objectives (competencies...)	Activities	Remarks

- Gold	- Know that gold exists in nature in elemental form because it is difficult to oxidize - Describe the mechanical separation of gold from sand - Describe the recovery of gold by treatment of an NaCN solution in the presence of air followed by precipitation with zinc - Specify that it is difficult to separate gold from silver and platinum impurities		
- Alloys	- Define an alloy - Define substitutional alloy - Give examples of substitutional alloys - Define interstitial alloy - Know that steel is an interstitial alloy that contains carbon in an iron crystal - Specify that the presence of carbon and iron in steel results in a very hard material - Specify that other metals are added in the steel-making process to form alloy steels		Examples of substitutional alloys: Bronze: Cu + Sn Solder: Pb + Sn Brass: Cu + Zn Gold, less than 24 carat Au + Ag

Contents	Learning Objectives (competencies...)	Activities	Remarks
4.2 Utilisation, Protection and Recycling			
4.2 1. Uses	– Know the importance of metals in everyday life	Documentation: the uses of metals in everyday life	
4.2.2. Metal Corrosion	– Define corrosion – Recognize the economic impact of corrosion – Know that most metals corrode because their redox potentials are less positive than that of oxygen – Know that the formation of a thin oxide layer on the metal surface slows down its corrosion – Deduce that metal coating is employed to protect it from corrosion – Specify that chromium and tin are used to cast steel because their oxides are durable – Specify that zinc is used to coat steel (galvanizing) because zinc is oxidized faster than iron (sacrificial coating) – Know that used metals can be recycled	Documentation: the corrosion products of Al, Fe, Cu and Ag	Note that a fifth of iron/steel is produced to replace rusted materials.

Contents	Learning Objectives (competencies...)	Activities	Remarks
5. Atomic Orbitals 5.1 Probabilistic Approach that leads to the Notion of Atomic Orbitals	– Distinguish between an orbit and a disordered trajectory for the electron		
5.1.1The Probability of Presence	– Know that classical mechanics is not capable of defining the motion of the electron around the nucleus – Know the wave-particle duality – Understand the Heisenberg uncertainty principle – Replace the concept of the electron position by the probability of finding the electron at a certain position from the nucleus	– Documentation: Classical mechanics and wave mechanics	– The probability of presence may be represented by electron density
5.1.2. The Wave function	– Understand the existence of the wavefunction – Know that the wavefunction allows the study of the dependence of probability of finding the electron on direction	– Documentation: Schroedinger's equation	– The atomic orbitals are the possible values that the wavefunction can take
5.1.3. Quantum Numbers	– Define atomic orbital – Represent the atomic orbital by a quantum box – Define the quantum numbers – Know the significance of the quantum numbers – Use the quantum number n to determine the number of subshells in an energy level (shell) – Use the quantum number l to determine the number of orbitals in a subshell		– Specify the significance of each quantum number n: defines orbital energy l : defines orbital shape m_l:defines orbital orientation – For the quantum number m_s, limit the discussion to the direction of spin of the electron

Contents	Learning Objectives (competencies...)	Activities	Remarks
5.1.4. The Electronic Configuration of the Atom	– Understand the Pauli exclusion principle – Define the single (lone) electron and the electron pair – Represent the single electron by ↑ and the doublet by ↑↓ – Know the stability principle – Understand the orbital ordering rule (Klechkowski rule) – Understand Hund's rule – Apply the Aufbau principle (orbital filling principle) – Write the electronic configuration of the elements		
5.2. Representation of the *s* and *p* atomic orbitals	– Know that the probability of finding the electron in an *s* orbital is independent of direction – Deduce the symmetry of the probability of an *s* orbital – Represent the *s* orbital by a sphere centered on the nucleus – Know that the probability of a *p* orbital does depend on direction – Know that a *p* orbital is cylindrically symmetrical around a defined direction – Represent the *p* orbital by two spheres tangent to the nucleus		- Know that the probability decreases as the distance between the electron and the nucleus increases

Contents	Learning Objectives (competencies...)	Activities	Remarks
5.3. Hybridization of atomic orbitals			– Limit the discussion to the diatomic molecules studies in first secondary.
5.3.1. Bonding Orbital: Molecular Orbital	– Relate the orbital concept to the covalent bond – Define molecular orbital – Explain the formation of a molecular orbital – Explain the axial overlap of two orbitals s-s, p-p or s-p – Define the σ bond – Explain the parallel overlap of two p orbitals – Define the π bond		– Avoid the use of the oxygen molecule as an example
5.3.2. Principles of Hybridization	– Distinguish between the experimental angle of two molecular orbitals and the predicted angle using *s* and *p* orbitals – Deduce the need for a new orbital type – Define hybrid orbital – Explain the different hybrid orbitals of *s* and *p* orbitals: sp^3 , sp^2 , sp		– Use the H_2O molecule as an example Note that the electronegativity of carbon increase when its hybridation change from sp^3 to sp^2 to sp
5.4. Molecular Shapes of Some Molecules	– Apply the hybridization principle to the carbon atom – Explain the shape of the following organic molecules: H_2O, NH_3, CH_4 , C_2H_4 , C_2H_2 . – Deduce the complementarity between the VSEPR and the hybridization methods	– Construction of some organic molecules using molecular models	

Contents	Learning Objectives (competencies	Activities	Remarks
6. Organic Chemistry I 6.3. Hydrocarbons: Alkanes, Alkenes, Alkynes and Benzene (Nomenclature, structure, isomerism, physical properties, reactions, applications)	– Classify the hydrocarbons as saturated and unsaturated through the carbon atom hybridization – Know that this classification helps in the study of hydrocarbon properties		
6.3.2 The Alkenes - Reactions	– Specify that the reactivity of alkenes is due to the presence of a π bond in the alkene molecule		
6.3.3. The Alkynes	– Define an alkyne – Write the general formula of an alkyne – Know that alkynes do not exist in natural form		
- Nomenclature	– Name alkynes using IUPAC rules		
- Structure and Isomerism	– Build molecular models for acetylene and propyne – Deduce the linearity of the acetylene atoms – Define structural and positional isomers in alkynes	– Experimental Activity: Use a molecular model set	
- Physical Properties	– List some physical properties of alkynes – Consult the tables of physical properties of alkynes		
- Reactions	– Deduce that the existence of π bonds in alkynes imparts chemical properties comparable to alkene properties		
- Addition Reactions	– Define the addition reactions to alkynes – Know that alkyne addition occurs in two steps, the first giving an alkene compound and the second a saturated compound		

Contents	Learning Objectives (competencies)	Activities	Remarks
• Hydrogenation	– Define the hydrogenation of an alkyne – Write the equations for the hydrogenation of some alkynes		
• Halogenation	– Define the halogenation of an alkyne – Write equations for the halogenation of some alkynes		– The addition may be limited to a monoaddition by using a large excess of alkyne
• Addition of HX	– Define the addition of HX to alkynes – Define a monosubstituted alkyne – Write the equation for the addition of HX to an alkyne – Apply Markovnikov's rule in the case of a monosubstituted alkyne	– Documentation: Preparation of PVC	– Note that alkyne hydrogenation, in the presence of deactivated palladium, gives an alkene
• Hydration	– Define an alkyne hydration reaction – Write the equation for an alkyne hydration reaction	– Documentation: Preparation of acetone	
6.3.4. Benzene - Structure	– Know the hybridization of the carbon atoms in the molecule		

Suspended Parts of the Chemistry Curriculum Second Year Secondary Level- Humanities section

Contents	Learning Objectives (Competencies)	Activities	Remarks
Soaps and detergents 1 2 Detergents – Preparation and characteristics of principle types of detergents	• Recognize that anionic and cationic detergents are incompatible when mixed	Mix a cationic detergent (hair conditioner for example) and an anionic detergent (laundry detergent for example) in water and observe the results	• Include laundry detergents, dishwashing liquids, shampoos and conditioners.
2. Synthetic polymers Synthesis of polymers		• Prepare Nylon 6,6. Use a glass rod or tweezers to demonstrate the formation of the Nylon 6,6 filaments. • Perform de-polymerization of Plexiglas by the action of heat. Collect the condensed monomer. Carry out a similar experiment with polystyrene. Compare and contrast the results of the two experiments	• Fomulas and equations should not be the focus in the preparation of nylon 6,6. This activity is meant to demonstrate the synthesis of polymer.

Contents	Learning Objectives (Competencies)	Activities	Remarks
3. Pesticides 3.1 Pesticides: - Study of the active materials of some pesticides - Resistance of insects	• Name three main types of insecticides (organochlorines, organophosphates, and carbamates), and one type of each of fungicides, herbicides and rodenticides. • State the generic names of some common organochlorines, organophosphates & carbamates • State the generic names of some common herbicides, fungicides, & rodenticides • Describe the development of resistance to insecticides • Describe the phenomena of resurgence and secondary pest outbreaks	• Make a list of different brands of pesticides and find the generic names of the pesticide they contain • Conduct research on resistance to insecticides and its impact on the economy and the environment.	- DDT, benzene hexachloride (BHC), parathion, malathion and carbamyl should be included in the list. - Introduce students to the hazards of handling and using of pesticides.
3.2 Chemical Communication among insects – Pheromones – Allelochemicals	• Define pheromones and allelochemicals	• Write a research report on the use of pheromones in honey-bee cultures	

Contents	Learning objectives (Competencies)	Activities	Remarks
2 Chemical Kinetics 2 4 Order of reaction: first order, second order and zero order.	-Express a reaction rate as follows: V=f (concentration). -Deduce the reaction order. -Acquire the significance of zero order, first order, and second order. -Distinguish between order and stœchiometric coefficient. -Define an elementary reaction. -Identify the rate-determining step of a reaction. -Use experimental results to determine the order and the rate constant of a reaction. -Identify the unit of the rate constant. -Relate the unit of the rate constant to the reaction order.		Partial orders are limited to zero, one and two
2 5 Half-life of a reaction.	-Deduce a characteristic of the half-life of a reaction that is related to order of the reaction. -Deduce that the half-life of a reaction decreases when temperature increases.		
2.6 Catalysis		-Experimental activities: *Synthesis of water using platinum.	

Contents	Learning objectives (Competencies)	Activities	Remarks
3. **Chemical Equilibrium** 3.5. Solubility equilibria and the solubility product.	-Distinguish between saturated and unsaturated solution. -Deduce the solubility of a compound. -Apply the equilibrium law to the dissolution of an ionic solid which is slightly soluble. -Define solubility product constant K_{sp} . -Recognize the change in the solubility product with temperature. -Identify a saturated solution. -Predict the formation of a precipitate. -Apply Le Chatelier's Principle to dissolution-precipitation equilibrium. -Relate the solubility of some substances to the pH of their solutions.		- The study of the equilibrium of dissolution-precipitation is limited to aqueous-solutions

Contents	Learning objectives (competencies)	Activities	Remarks
6.Polymers 6 1 Natural polymers and synthetic polymers.	-Define a polymer. -Distinguish between natural and synthetic polymers. -Recognize the evolution of the industry of synthetic polymers. -Identify synthetic organic polymers. -Recognize that petroleum is the major source of synthetic organic polymers.	-Construct the molecular model of a synthetic polymer. -Experimental activities: *Test the chemical resistance of a number of synthetic polymers to acetone, ethanol, acids, and bases.	-Examples of natural polymers include rubber, cellulose, and protein. -This study is limited to organic synthetic polymers.
6 2 Characteristics and uses	-Classify synthetic polymers into linear, branched, and cross-linked carbon chain polymers. -Distinghish between thermoplastics and thermosets. -Identify an elastomer. -Define addition and condensation polymerization. -Define monomer, homopolymer, copolymer, and degree of polymerization. -Recognize the characteristics of synthetic polymers. -Recognize the applications of synthetic polymers. -Relate the properties of synthetic polymers to their uses. -Deduce the importance of synthetic polymers in every day life.	*Perform flame test to detect chlorine in synthetic polymers. *Preparation of Nylon6-6, and depolymerisation of plexiglas.	-PE, PS, PP, and PVC are the polymers prepared by addition polymerization. -PA, and polyesters are the polymers prepared by condensation polymerization. -Synthetic polymers are characterized by their hardness, density, tensile strength, chemical resistance, and thermal resistance.
6 3 Economic aspect.	-Recognize the importance of the polymer industry on the national and international economy. -Recognize that the production of plastics contributes in saving natural products.	Documentation: The importance of the industry of polymers in economy.	
6 4 Impact on the environment	-Identify the pollution caused by synthetic polymers. -Recognize the importance of the production of biodegradable polymers. -Recognize the importance of recycling synthetic polymers.	-Documentation: Biodegradable polymers.	

Contents	Learning objectives (Competencies)	Activities	Remarks
2. **Chemical Kinetics** 2.4. Order of reaction: first order, second order and zero order.	-Express a reaction rate as follows: V=f (concentration). -Deduce the reaction order. -Acquire the significance of zero order, first order, and second order. -Distinguish between order and stœchiometric coefficient. -Define an elementary reaction. -Identify the rate-determining step of a reaction. -Use experimental results to determine the order and the rate constant of a reaction. -Identify the unit of the rate constant. -Relate the unit of the rate constant to the reaction order.		Partial orders are limited to zero, one and two.
2.5. Half-life of a reaction.	-Deduce a characteristic of the half-life of a reaction that is related to order of the reaction. -Deduce that the half-life of a reaction decreases when temperature increases.		
2.6. Catalysis.		-Experimental activities: *Synthesis of water using platinum.	

Contents	Learning objectives (Competencies)	Activities	Remarks
3 Chemical Equilibrium 3 5. Solubility equilibria and the solubility product.	-Distinguish between saturated and unsaturated solution. -Deduce the solubility of a compound. -Apply the equilibrium law to the dissolution of an ionic solid which is slightly soluble. -Define solubility product constant K_{sp} . -Recognize the change in the solubility product with temperature. -Identify a saturated solution. -Predict the formation of a precipitate. -Apply Le Chatelier's Principle to dissolution-precipitation equilibrium. -Relate the solubility of some substances to the pH of their solutions.		- The study of the equilibrium of dissolution-precipitation is limited to aqueous-solutions

Contents	Learning objectives (competencies...)	Activities	Remarks
5.**Organic chemistry II** Organic compounds containing oxygen or nitrogen, and isomerism 5.5. α-amino acids. -Enantiomerism.	-Recognize the effect of a chiral molecule on polarized light. -Acquire the terms dextrorotatory and levorotatory. -Write the Fischer representation of two enantiomers. -Perform the transformation of Fischer representation to three-dimensional representation. -Represent using Fischer the Cα of an α-amino acid. -Recognize the D and L convention. -Recognize that the amino acids that play an important role in the biological process have the L configuration.		

Contents	Learning objectives (competencies)	Activities	Remarks
6.Polymers 6 1 Natural polymers and synthetic polymers.	-Define a polymer. -Distinguish between natural and synthetic polymers. -Recognize the evolution of the industry of synthetic polymers. -Identify synthetic organic polymers. -Recognize that petroleum is the major source of synthetic organic polymers.	-Construct the molecular model of a synthetic polymer. -Experimental activities: *Test the chemical resistance of a number of synthetic polymers to acetone, ethanol, acids, and bases.	-Examples of natural polymers include rubber, cellulose, and protein. -This study is limited to organic synthetic polymers.
6 2. Characteristics and uses.	-Classify synthetic polymers into linear, branched, and cross-linked carbon chain polymers. -Distinghish between thermoplastics and thermosets. -Identify an elastomer. -Define addition and condensation polymerization. -Define monomer, homopolymer, copolymer, and degree of polymerization. -Recognize the characteristics of synthetic polymers. -Recognize the applications of synthetic polymers. -Relate the properties of synthetic polymers to their uses. -Deduce the importance of synthetic polymers in every day life.	*Perform flame test to detect chlorine in synthetic polymers. *Preparation of Nylon6-6, and depolymerisation of plexiglas.	-PE, PS, PP, and PVC are the polymers prepared by addition polymerization. -PA, and polyesters are the polymers prepared by condensation polymerization. -Synthetic polymers are characterized by their hardness, density, tensile strength, chemical resistance, and thermal resistance.
6 3 Economic aspect	-Recognize the importance of the polymer industry on the national and international economy. -Recognize that the production of plastics contributes in saving natural products.	Documentation: The importance of the industry of polymers in economy.	
6 4 Impact on the environment	-Identify the pollution caused by synthetic polymers. -Recognize the importance of the production of biodegradable polymers. -Recognize the importance of recycling synthetic polymers.	-Documentation: Biodegradable polymers.	

Contents	Learning objectives (competencies)	Activities	Remarks
7.Soaps and detergents 7.3. Synthetic detergents.	-Identify the surfactants, the builders, and the additives in a detergent. -Identify the raw materials used in the preparation of the surfactants. -Classify the surfactants into anionic, cationic, and non ionic. -Recognize the general formula of each type of surfactant. -Recognize the properties of each type of surfactant. -Identify the role of the builders in detergents. -Identify the role of the additives in detergents. -Recognize the pollutants in detergents. -Recognize the importance of the usage of biodegradable substances in soaps and detergents. -Relate the eutrophication of water to the presence of phosphates in detergents. -Recognize the economical importance of the industry of soaps and detergents.	-Documentation: Production of soaps and detergents in Lebanon.	-In general, detergents are made of a mixture of surfactants

Contents	Learning objectives (competencies)	Activities	Remarks
8. Current Medicinal Drugs.			
8.2 Anesthetics	-Define anesthetics. -Classify anesthetics into local and general. -Distinguish between the effect of local and general anesthetics.		-The formula of local anesthetic contains: *an aromatic nucleus *particular intermediate chain. *an amine function.
8.2 1 Local anesthetics.	-Recognize the chemical structure of local anesthetic. -Identify the organic functions in the formula of a local anesthetic. -Recognize the effect of overdose.	-Documentation: Side effects of local anesthetics.	-The intermediate chain may contain an ester, an amide, and an ether functions. Give an example of each. -The student should not memorize these formulas.
8.2.2 General anesthetics.	-Classify general anesthetics into intravenous and inhaled. -Recognize the formulas of inhaled anesthetics. -Classify intravenous anesthetics into barbiturates, morphines, and others. -Recognize the main effects of general anesthetics.	-Documentation: Side effects of general anesthetics.	-The inhaled anesthetics are limited to nitrogen dioxide, cyclopropane, and diethylether. -Give the formulas of thiopental, fentanyl, and propofol. The student should not memorize these formulas.
8.3 Antacids.	-Define antacids. -Classify antacids into cationic and anionic.	-Documentation: Side effects of antacids.	-The cationic antacids are aluminium and magnesium derivatives. -The anionic antacids are sodium bicarbonate and calcium carbonate.
			-The classification of the anti-inflammatory drugs is limited to salicylates, pyrazolates, and

8.4.Anti-inflammatory.	-Define anti-inflammatory drugs. -Recognize that anti-inflammatory drugs are classified into families. -Define the anti-inflammatory drug family. -Differentiate the anti-inflammatory drugs that belong to the same family by a radical.	-Documentation: Side effects of anti-inflammatory drugs.	propionates derivatives. -Give the basic formula for each of the three families. -Give the formulas of aspirin, tanderil, and brufen. The student should not memorize these formulas.
8 5 Antibiotics.	-Define antibiotics. -Classify antibiotics into sulfonamides, penicillins, and others antibiotics (tetracyclines). -Define an antibiotic family. -Differentiate the antibiotics that belong to the same family by a radical, a nucleus, or different carbon chains.	-Documentation: Side effects of antibiotics.	-Give the basic formula for each of the three families. -Give the formulas of monosubstituted and disubstituted sulfamide. -Give the formulas of ampicillin, amoxycillin and penicillin G. -Give the formulas of chlorotetracycline and tetracycline. -The student should not memorize these formulas. -Give the formulas of valium and librium. The student should not memorize these fromulas.
8.6. Tranquilizers.	-Define tranquilizers. -Recognize the effects of tranquilizer. -Recognize the effects of overdose.	-Documentation: Side effects of tranquilizers.	
8 7 Antidepressants.	-Define antidepressants. -Recognize the effects of antidepressant. -Recognize that antidepressants are classified according to their chemical structure. -Recognize the effect of overdose.	-Documentation: Side effects of antidepressants.	-The classification of antidepressants is limited to tricyclic and bicyclic structures -Give the formulas of tofranil (imipramine)and prozac (fluoxetine). -The student should not memorize these formulas.

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Contents	Learning Objectives (Competencies...)	Activities	Remarks
. Perfumes and Cosmetics Definition	• Define Cosmetics. • Recognize that the distinction between drugs and cosmetics is sometimes not clear (antiperspirants, for example, stop the secretion of sweat glands).		
The principal formulations Hygiene products Care products Well-being products	• Define Perfumes. • Classify cosmetics into hygiene products, care products, and well-being products. • Give examples of hygiene products (Soap, other bathing products such as bath salts, bath cubes, showering products, antiperspirants, deodorants, oral rinses) • Give examples of hair and skin care products. (Moisturizers, anti-aging products, sunscreen products, baby care products, dental care products . . .). • Give examples of well-being products (hair dyes, slimming products, coloring cosmetics, perfumes, hair gels, . . .).		
Composition Vehicle or excipient	• Define a Vehicle or an excipient. • Define emulsion. • Name a number of substances that can be used as vehicles in a variety of cosmetics (mineral oils, natural oils, synthetic oils, creams, oil-in-water (O/W) emulsifiers, Water-in-oil (W/O) emulsifiers, talc in face powder). • Name a number of substances that can be used as excipients in a variety of cosmetics (waxes, gum, thickeners added to shampoos).		

Contents	Learning Objectives (Competencies...)	Activities	Remarks
– Preservatives	• Recognize the need for the addition of a preservative. • Name some preservatives that are added to shampoos. • Define humectant. • Describe the role of humectants in protecting emulsions.		• Discuss the therapeutic properties of some essential oils.
– Colorings	• Recognize that coloring substances can be of organic or inorganic origin.		
– Perfumes	• Describe the different roles of perfumes in cosmetic products (masking a smell, antimicrobial activity, ...). • Recognize the percentages of essence, alcohol and fixative in a perfume. • Define colognes. • Give examples of key raw materials used in the manufacture of perfumes. • Classify perfumery raw materials into natural and synthetic. • Recognize that natural perfumery materials can be of animal or plant origin. • Describe the extraction of an essential oil by steam distillation. • Describe the solvent extraction of an essential oil • Name the functional group that is associated with an aroma (simple ester, aldehyde, or alcohol). • Give the composition of a modern toothpaste and list the different active ingredients (fluoride, anti-plaque, anti-calcareous agents).	• Prepare an ester used in perfumes. • Write a report on the extraction of rose water, bitter orange water, and an essential oil.	
– Active elements	• Give the composition of an oral rinse and list the active ingredients. • Name some active ingredients that are used as tooth whiteners. • Give the composition of an antiperspirant product and name some active ingredients that act as antiperspirant.	• Read the labels of different tooth pastes and try to find a relationship between price and the ingredients used. • Write an essay on the controversy regarding the use of deodorants versus antiperspirants	

Contents	Learning Objectives (Competencies...)	Activities	Remarks
	• Name some active ingredients that are used in sunscreens. • Explain how a sunscreen blocks some of the harmful UV rays.		• Discuss the possible toxic effect of p-aminobenzoic acid (PABAA) in sunscreens.
Properties - Hydrating substance	• Recognize that moisturizers (hydrating substances) are usually emulsions, either O/W or W/O. • Justify the need for using a moisturizer.		
- Softening substances	• Give an example of a good skin softener (lanolin).		
- Anti-age products - Biological products stimulating cellular activity	• Give the names of some substances that are effective in reducing face wrinkles.		• Explain that some of the anti-age products can be classified as drugs.
- Astringent substances	• Define the role of an astringent substance and give some examples.	• Write an essay of the risks of using cosmetics (for example, hair dyes).	
- Slimming products	• Define the role of a slimming product and give some examples.		
Risks of uses	• Recognize that drugs require elaborate safety testing prior to receiving approval from the concerned authorities, but cosmetics do not. • Recognize the risks associated with some cosmetic products.		
Economical aspects	• Recognize that global spending on cosmetic products is tremendous. • Appreciate the positive contribution of cosmetics industry to the economy of a country.	• Estimate the money your family or a Lebanese family spends on cosmetics and then calculate the money that is spent on cosmetics in Lebanon. • Find the brand names of cosmetics made in Lebanon.	

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• The principal formulations – Hygiene products – Care products – Well-being products	• Define Perfumes. • Classify cosmetics into hygiene products, care products, and well-being products. • Give examples of hygiene products (Soap, other bathing products such as bath salts, bath cubes, showering products, antiperspirants, deodorants, oral rinses) • Give examples of hair and skin care products. (Moisturizers, anti-aging products, sunscreen products, baby care products, dental care products . . .). • Give examples of well-being products (hair dyes, slimming products, coloring cosmetics, perfumes,		
• Composition	hair gels, . . .).		
– Vehicle or excipient	• Define a Vehicle or an excipient. • Define emulsion. • Name a number of substances that can be used as vehicles in a variety of cosmetics (mineral oils, natural oils, synthetic oils, creams, oil-in-water (O/W) emulsifiers, Water-in-oil (W/O) emulsifiers, talc in face powder). • Name a number of substances that can be used as excipients in a variety of cosmetics (waxes, gum, thickeners added to shampoos).		

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Colorings	• Recognize that coloring substances can be of organic or inorganic origin.		
Perfumes	• Describe the different roles of perfumes in cosmetic products (masking a smell, antimicrobial activity, ...). • Recognize the percentages of essence, alcohol and fixative in a perfume. • Define colognes. • Give examples of key raw materials used in the manufacture of perfumes. • Classify perfumery raw materials into natural and synthetic. • Recognize that natural perfumery materials can be of animal or plant origin. • Describe the extraction of an essential oil by steam distillation. • Describe the solvent extraction of an essential oil • Name the functional group that is associated with an aroma (simple ester, aldehyde, or alcohol). • Give the composition of a modern toothpaste and list the different active ingredients (fluoride, anti-plaque, anti-calcareous agents).	• Prepare an ester used in perfumes. • Write a report on the extraction of rose water, bitter orange water, and an essential oil.	
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– Astringent substances	• Define the role of an astringent substance and give some examples.	• Write an essay of the risks of using cosmetics (for example, hair dyes).	
– Slimming products	• Define the role of a slimming product and give some examples.		
• Risks of uses	• Recognize that drugs require elaborate safety testing prior to receiving approval from the concerned authorities, but cosmetics do not. • Recognize the risks associated with some cosmetic products.		
• Economical aspects	• Recognize that global spending on cosmetic products is tremendous. • Appreciate the positive contribution of cosmetics industry to the economy of a country.	• Estimate the money your family or a Lebanese family spends on cosmetics and then calculate the money that is spent on cosmetics in Lebanon. • Find the brand names of cosmetics made in Lebanon.	

Contents	Learning Objectives (competencies)	Activities	Remarks
Treatment of astes ture of waste atments	• List pollutants of water (Trace elements such as heavy metals, inorganic pollutants such as acids, bases, and salts, organic pollutants such as pesticides and petroleum wastes, sewage, human and animal wastes. • Identify sources of water pollution (industry, acid rain, agriculture, sewage systems, ...) • Describe methods for water treatment (sewage treatment, removal of calcium, removal of dissolved organic substances, removal of inorganic substances, water disinfecting....). • Describe the health effects of water pollutants (carcinogens, heavy metals, pathogens, ...)	• Conduct a field trip to a water treatment plant. • Test the acidity of the drinking water and rain water. • Conduct research on different types of water filters. • Describe methods of treating and re-using sewage water.	Air pollution was discussed in grade 11. Students can work on the activities in groups. Each group may select one or more topics on which to work.
	• List pollutants of soil (pesticides...) • Identify sources of soil pollution (agriculture, acid rain, organic compounds,...) • Describe methods of treatment of polluted soil (separation of soil pollutants, destruction of soil pollutants) • Describe the economic effects of soil pollution (effect on agriculture, drinking water, medical expenses, ...)	• Write a research report on separation techniques or destruction of soil pollutants as methods of soil treatment.	
	• List examples of solid waste (garbage, scrap metal, plastics,..). • Identify major sources of solid waste (e.g. agricultural, commercial, industrial, and residential activities). • Identify and describe methods of solid waste disposal (landfills, incineration...). Describe the advantages and disadvantages of the methods of solid waste disposal (landfills, incineration...).	• Write a report on solutions to the residential and municipal waste problem . • Write a report on types of landfills and problems associated with each of them. • Write a report on using energy from incineration plants.	Encourage students to participate in cleaning campaigns.

Contents	Learning Objectives (competencies)	Activities	Remarks
	• Identify and describe solutions to the solid waste problem (waste reduction, recycling, re-use...). • Describe the role of chemistry in creating and reducing the problems resulting from solid waste. • Define hazardous waste. • List types of hazardous waste and give examples of each (Asbestos, flammable liquids (gasoline), explosives (dynamite and ammunition), compressed gases (sulfur dioxide), corrosive materials (caustic soda, sulfuric acid, poisonous materials (cyanides,...), and radioactive materials (platinum, Co-60). • Identify origins of hazardous wastes (leaching from waste dumps, leakage from underground storage tanks, accidents). • Describe methods of treatment and disposal of hazardous waste. (Waste reduction such as source reduction, separation and recycling, physical methods, such as filtration, distillation, chemical treatment such as acid base neutralization, ion exchange, thermal treatment methods such as incineration hazardous waste fuels, aerobic and anaerobic treatment of biodegradable wastes, sanitary landfills, deep well disposal). • Describe the health problems arising from hazardous waste.	• Write a case study on accidents involving hazardous waste (Chernobyl, petroleum spills, chemical spills).	