Ministry of National Education, Youth and Sports

National Center for Educational Research and Development

Evaluation Teacher's Guide

Chemistry

October 1999

Ministry of National Education,
Youth & Sports
National Center for Educational Research
and Development NCERD

EVALUATION: **TEACHER'S GUIDE**

MATERIAL: **CHEMISTRY**

October 1999

INTRODUCTION

A self-evident tenet of curricula design is that such projects must encompass all the essential curricula elements, that is, the objectives, the contents, and teaching strategies and evaluation. Since the new published curricula did not initially include any evaluation, an evaluation system based upon continuous testing had to be added later, starting at the Basic Education level (excluding the Secondary cycle). However, upon trying out that system, a diversity of problems arose which drove a large majority of teachers to give up on it.

This reality led the Center for Educational Research and Development to take up a new challenge at the beginning of Year Two of the three-year period allowed for introducing the new programs i.e. eight out of the twelve years structured within the new educative system. It seems illogical and unacceptable to proceed to the implementation of new curricula while holding on to a traditional evaluation system exclusively devoted to memorizing information, in total disregard of a considerable part of the objectives introduced by the new curricula. To bridge the gap, a new commission has been charged with the task of developing the relevant evaluation system, as well as designing evaluation sheets, based on ideas and recommendations obtained during the teachers training sessions of summer 1999. Moreover, it is proposed that the sheets in their final form be distributed to all the schools at the beginning of the school year.

At this stage, we should particularly draw the teachers' attention to the difference between grading assessment and evaluation. Assessment focuses on the grade itself, which represents in this case the only indicator to appraise the student's achievement. Evaluation, on the other hand, goes beyond the grade which becomes only one of many elements taken into account to gauge the acquisition of the skills aimed at in the lesson and the wider scope of the subject being handled. Additionally, evaluation even examines attitudes relevant to certain situations.

Therefore it is of utmost importance to consider teaching and evaluation as two inseparable complementary entities to the extent that evaluation becomes an essential aspect of the learning/teaching process. It is of course essential that the

teacher be fully aware of the required skills – and that he informs the student of them – in order to select relevant work techniques for us in the teaching plan.

The teacher may resort to a series of techniques in order to evaluate the learning of the student. For example: direct knowledge is often gauged through an Objective Test while progress in the acquisition of competencies is evaluated through application, analysis and matching. We can thus say that evaluation is a comprehensive operation, which requires the use of various types of precision and estimation procedures. Furthermore, this operation is not limited to the grade, but involves numerous activities, which help the teacher appraise the student's work. Nevertheless, evaluation does not necessarily depend on pen-and-paper tests, but rather on the execution of definite tasks and activities as well as the observation of conducts. After collecting information through the evaluation of the student's work, the teacher will make use of it to reach two goals: on the one hand, to reassess continuously the teaching operation in order to improve it; and on the other, to make the student aware of his strengths and of his weaknesses.
We can point out that the introduction of such an evaluation system is a significant step forward in the development of our new curricula. It does not merely assess information – despite the importance of such information – but goes beyond that to use information and invest it for further building knowledge and attaining the required competencies.

Finally let us bear in mind that we do not claim that our work is perfect, which is why we urge all institutions and teachers, after trying out this evaluation system, to provide us with their opinions and comments which will be used for further reexamination and evaluation of the system.

President, Center for Educational Research and Development
Nemer FRAYHA

Summary

Material : Chemistry

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Explanatory text for domains and competencies in chemistry

As mentioned previously in the evaluation document, what is meant by the common trunk for the same discipline is that the domains of competencies are almost the same in the different cycles.

In chemistry we have kept in the first and second years of the secondary level the same domains of competencies listed for the 7th and 8th grades of the basic education level.

In this document the teacher finds:

- The domains of competencies and the competencies to be evaluated in the 7th and 8th grades of the basic education level.
- The domains of competencies and the competencies to be evaluated in the 1st and 2nd years of the secondary level.
- Two examples of evaluation-situation of the same competency for each domain.
- An example of the same concept appearing - depending on the choice of the teacher- in all the domain.
- An explanatory text in which the teacher finds the explanation and the details concerning each domain, the essential points which it includes and the reason for grouping the competencies in these domains.

Explanations of domains:

This list of competencies and the domains of competencies is a work tool. Complementary explanations are needed to apply them.

In general, the explanations given for a domain are the same, transversally (for different disciplines) and longitudinally (for different cycles for the same discipline). They reveal how tightly each domain is tuned and the elements which are examined during the evaluation of a competency in each domain.

The students should be informed, of these explanations.

1- Applying knowledge

This domain does not imply direct application of knowledge. The competencies of this domain should be evaluated in new complex situations and /or similar situations to those that have been encountered in the class.

The application of a law or many laws in a situation should be clear.

The student thus should choose the proper law as the only way to find out the unknown.

The elements that make up the apparent in the competencies of this domain may be in the form of:

a- Drawing, from a scientific document, the pertinent information concerning physical quantities relevant to chemical reactions, solutions, electrochemistry, thermochemistry, etc...

b- Analyzing data: that is to draw the essential information and place them next to the less important data. It should be noted that, in the same situation, information which is considered indispensable to answer a question, may not be necessary to answer another question.

Is the student able to relate the data given for a problem, with the acquired knowledge and to the situation.

c- Engage and apply appropriate chemical knowledge. Once the preceding relation is achieved, is the student able to choose the convenient knowledge (law, formula, definition units ....)? If he makes the right good choices is he able to apply them?

d- Select and apply knowledge out-of chemistry (calculation, scale graph, vectors...)

e- Verify the validity of results: physical sciences describe situations which are very closely related to everyday life. The results obtained, are they very close? Are the answers logical? Are the dimension of units and physical quantities properly used?

2- Illustration of a diagram

In this domain, the competencies to be evaluated are related to the following objectives:

a- Draw a diagram.

b- Give the physical significance of abscissa and ordinate.

c- Choose the appropriate scale.

d- Determine graphically the operating point of a device.

e- Draw from a graph the characteristics of a device.

f- Measure the values of some physical quantities in order to calculate the values of other physical quantities.

3- Conducting experiment

In this domain, the student should be able to perform an experiment.

The aim is that when once the student leaves school, he should acquainted with the characteristics of an apparatus and able to use the technique sheet that describes how to operate it properly.

a- Read the procedure of the experiment.

b- Choose and use the materials needed.

c- Assemble apparatus according to schematic drawing.

d- Follow safety rules (for persons and installations).

e- Make measurements and verify the validity of results.

f- Answer the questions.

g- Draw conclusions from results, and make clear and labeled schematic drawings.

4- Explaining physical science phenomena encountered in everyday life:

To explain a scientific phenomenon, the student should necessarily follow, as in the domain "applying knowledge" the different steps of the scientific method.

a- Observation: The student examines the phenomenon, which could be man-made or natural, in order to collect information.

b- Analysis of information: The student should select the pertinent information from other information based on his prior knowledge.

c- Elaboration of a hypothesis or a model: This phase is relatively difficult to students. It is more practical and more simple to ask the students to choose a model from many others and to justify their choice.

d- Use of knowledge: This is appropriate to physical sciences and to other disciplines at he end of the solving of problem. This phase is related to the autonomy in taking decision. The student is to decide what knowledge he will use, and how to organize and employ it to answer the question.

5- Communicating

The concept of this domain does not figure in the domains of all other competencies. There are, schematic drawings, tables, oral or written expressions, symbols ...etc.

The teacher should decide in each case what competency is applicable. He should also make clear his evaluation of this competency by allotting it a certain percentage out of the total grade.

The same concept may apply to different domains. Consider the concept of electrolysis:

a- Applying knowledge of electrolysis could be illustrated in a classical problem.

b- In the domain of illustration and scientific representation, electrolysis may be illustrated in a graphical study of the form u= f (I)

c- In the domain of conducting experiment, the student may be asked to perform electrolysis of a solution.

1- In the domain of illustrating a phenomenon related to everyday life, it is possible to propose a problem to be solved using electrolysis.

EVALUATION: **TEACHER'S GUIDE**

MATERIAL: **CHEMISTRY**

Cycle 3 of basic Education and Secondaire Cycle

Material : Chemistry **Year: Grade Seven Basic Education**

Domain	Competencies
Applying Knowledge	- Apply knowledge relevant to matter (mixture, solution, suspension, colloid…), chemical reactions (reactant, product, conservation of mass, energy transfer, combustion…) - Classify materials on the basis of their properties (heterogeneous, mixture, solution, pure substance, combusting agent…) - Relate sources and implications of environmental issues (air pollution, water pollution…)
Reading and Illustrating Scientific Representation	- Read and interpret a tabulated data (percent composition by volume of dry clean air, threshold of pollutants in air and drinking water, variation of solubility with temperature…) - Read and illustrate pictorials (processes at a typical waterplant, operation of scrubbers, variation of solubility of different solutes at different temperatures…)
Conducting Experiment	- Separate the components of homogeneous and heterogeneaous mixtures (decantation, filtration, distillation, crystallization, centrifugation, chromatography…) - Prepare saturated, unsaturated and supersaturated solutions - Distinguish between true solution, suspension and colloid (Tyndall effect) - Know the evidences which indicate that a reaction has occurred - Verify that mass is conserved in chemical reactions - Conduct experiments to demonstrate the role of oxygen in combustion reactions
Explaining Physical Science Phenomena Encountered in Everyday Life	– Explain and relate physical science concepts to everyday life to environmental issues (effect of pollutants on health, means of reducing air pollution, safety and combustion reaction, separation of crude oil, desalination, I.V. solution, water sanitation, light and electricity from chemical reactions…) –
Communicating	- Use appropriate scientific vocabulary - Use various methods to represent information (spoken written graphs, drawings, diagrams, charts…) - Conduct research using sources of information (media…)

Sample Evaluation Sheet

Example 1:
Domain : Applying knowledge

Competency: Apply relevant knowledge to solutions

Exercises:
1- Two identical flasks, one filled with carbon dioxide and the other with air, are inverted in a trough containing water. Some hours later, water rises only in the first flask. What do you conclude?

Competency: Classify materials on the basis of their properties (solution and pure substance)

Exercises:
2- A 200 ml graduated cylinder is half-filled with liquid (L_1), and another graduated cylinder is half-filled with liquid (L_2).
- A hydrometer is dipped in liquid (L_1) and another hydrometer is dipped in liquid (L_2). The hydrometer reading for liquid (L_2) is higher than that for liquid (L_1)
- 50 ml of distilled water is poured into each graduated cylinder. The hydrometer reading for liquid (L_2) changes whereas that of liquid (L_1) remains the same.
  Classify liquids (L_1) and (L_2) into: pure substance or solution. Justify your answer.

Example 2:
Domain : Reading and illustrating scientific representation

Competency: Read and interpret a tabulated data (threshold of air pollutant)

Exercises:
1- Maximum tolerable threshold of some pollutants in community (A) and community (B) are given in the following table.

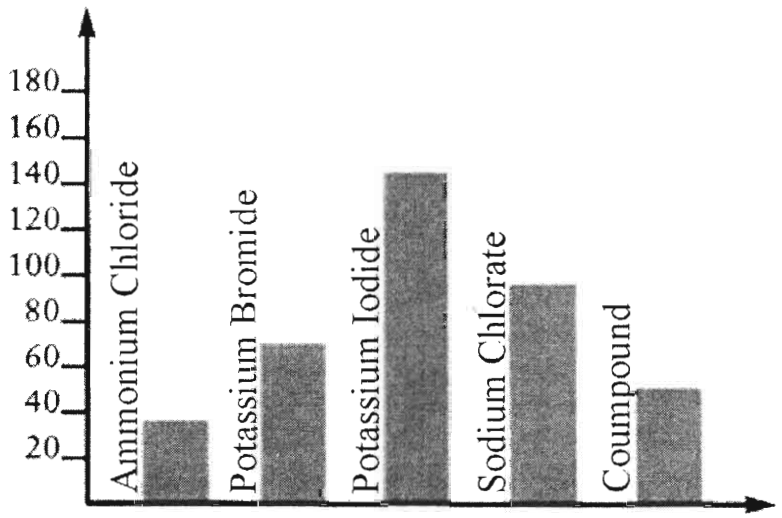
	Maximum tolerable level in $\mu g / m^3$	
Pollutants	**Community (A)**	**Community (B)**
Sulfur dioxide	75	115
Nitrogen oxides	120	130
Ozone	100	100
Carbon monoxide	10000	12000
Suspended particulates	150	120

Indicate which community allows the use of fuel having high sulfur content.

Competency: Read and illustrate pictorials (solubility of salts)

Exercises:

2- Use the histogram showing the solubility of various salts to answer the following questions:



a- Indicate which substance is the most soluble and which is the least soluble.

b- Determine the solubility of substance (X).

Example 3:

Domain : Conducting experiment

Competency: Separate a heterogeneous mixture (water + oil)

Exercises:

1- Describe an experiment to separate the components of a mixture of water + oil

Competency: Verify that mass is conserved in a chemical reaction (reaction with calcium chloride and sodium carbonate)

Exercises:

2- Using the substances calcium chloride and sodium carbonate describe an experiment to verify the law of conservation of mass during a chemical reaction.

Example 4:
Domain : Explain physical science phenomena encountered in everyday life

Competency: Explain and relate physical science concepts to everyday life (separation of crude oil)

Exercises:
1- Explain on what basis the different components of crude oil are separated.
2- Name the method of separation used.

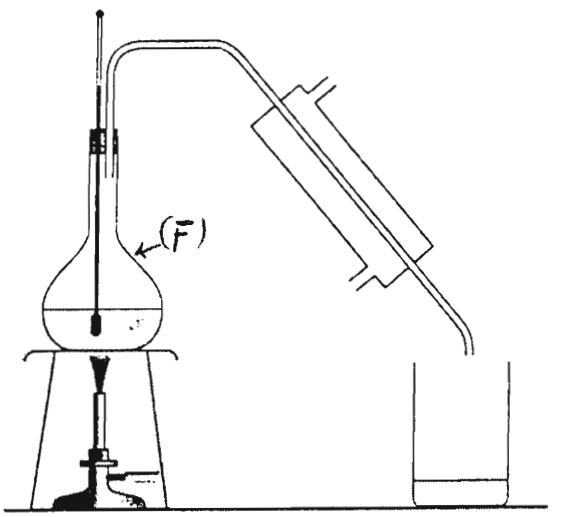
Competency: Explain phenomena related to environmental issues (air pollutants)

Exercises:
3- In community (B), maximum tolerable threshold for air pollutant CO(g) is 10000 mg/m^3 . It is reported that a great number of people in this community have felt dizziness.
- Do you expect the level CO(g) to be greater than the tolerable level in this community?
- Explain how carbon monoxide interferes with the body's ability to get oxygen.

Example 5:
Domain : Communicating

Competency: Use appropriate scientific vocabulary

Exercises:
1- A mixture contains water, alcohol (ethanol) and sugar. The mixture is poured into a flask (F). A thermometer indicates the temperature of the liquid in flask (F). We heat the mixture. The thermometer indicates a temperature of 90°C.
a- Label the diagram
b- Describe the process taking place.
c- Name the separation techniques used.



Competency: Use various methods to present information

Exercises:

2- During an experiment, solid (X) is dissolved in water at 25°C. The mass (m) of the solid and the volume (V) of water are measured respectively. The results obtained are given in the table below.

m(g)	1	2	3	4	5	6	7	8
M(mL)	20	40	60	80	100	120	140	160

-Plot the gragh, mass of solid (X) as a function volume of water.
What do you conclude?

Example 6:
Subject: Solution
Domain : Applying knowledge

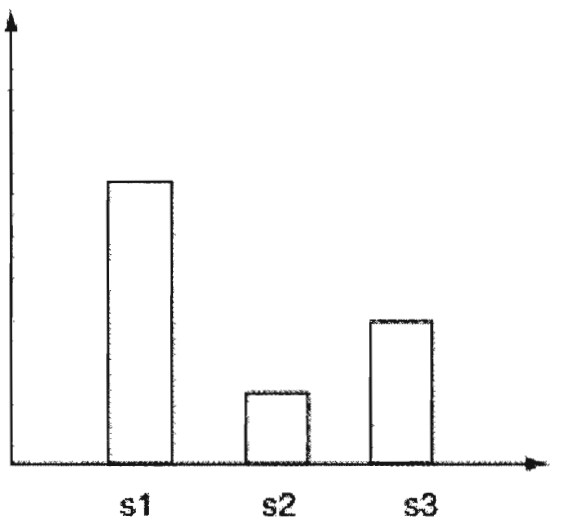
Competency: Classify materials on the basis of their properties (saturated solution)

Exercises:
The following sodium chloride solutions (S_1), (S_2) and (S_3) respectively contain 35.9g , 11g and 21g of sodium chloride per 100g of water at 20°C.
The solubility of sodium chloride at 20°C is 35.9g / 100g of water
Identify which solution is saturated.

Domain : Reading and illustrating scientific representation

Competency: Read and illustrate pictorials (variation of solubility of sodium chloride)

Exercises:
Use the bar-gragh given below: to classify solutions (S_1), (S_2) and (S_3) in order of increasing concentration



Domain : Conducting experiment

Competency: Explain and relate physical science concepts to everyday life

Exercises

Describe an experiment to show that solution (S_1) is a saturated solution.

Domain : Explaining physical-science phenomena encountered in everyday life

Competency: Use various methods to represent information (graphs)

Exercises

Blood plasma is a solution made mostly of water and dissolved salts like sodium chloride and other food substances including proteins...

When a sick person cannot take anything by month, intravenous solutions are prescribed. One type of intravenous solution is 0.9% sodium chloride solution, used to balance the concentration of salts in blood plasma.

Identify the role of a 0.9% sodium chloride solution which is given to a sick person.

Domain : Communicating

Competency:

Exercises

The solubility of sodium chloride at different temperatures is given in the table below.

Solubility of sodium chloride

$M_{(g)}$	35.4	35.9	37.1	39.2
$T_{(°c)}$	0°C	20°	60°	100°

- Plot the graph, variation of solubility at different temperatures.
- Find the mass (in grams) of sodium chloride that can be dissolved in 50g of water at 60°C.

Material : Chemistry **Year: Grade Eight Basic Education**

Domain	Competencies
Applying Knowledge	- Apply knowledge relevant to electrical nature of matter (electrification and electric discharge..), pure substances (elements, compounds, atoms, molecules, ions…), chemical reactions and solutions (types and rates of reactions, acid, base, salt, pH of solutions…) - Classify materials on the basis of their properties (conductor, insulator, metal, non-metal, element, compound, acidic, basic solutions…) - Relate sources and implications of environmental issues (acid rain, eutrofication…)
Reading and Illustrating Scientific Representation	- Read and interpret tabulated data (percentage, by mass, of the elements composing the earth's atmosphere; relative percentage, by mass, of elements in the earth's crust; distribution of biologically important elements in the human body…) - Read and illustrate pictorials (identify type of reaction depicted by diagram, read pH value on a label, translate information from a diagram, behavior of charges, concept mapping - pure substances, structure of matter…)
Conducting Experiment	- Show electrification (rubbing, contact, induction…) - Verify the purity of a substance (criteria of purity…) - Distinguish between elements and compounds, conductor and non conductor. - Construct models of molecules (H_2,Cl_2, HCl, NH_3, CH_4, H_2O, C_2H_4, CO_2, H_2O_2,…) - Identify type of chemical reactions (synthesis, decomposition, single and double displacement reactions…) and study rates of reactions - Determine the properties of acidic and basic solutions (reactions and pH…) - Identify some cations and anions present in solution
Explaining Physical Science Phenomena Encountered in Everyday Life	– Explain and relate physical science concepts to everyday life, to environmental issues (lightning , fabric softener, hair conditioner, fire extinguisher, matches, natural salts, hot and cold packs, role of catalyst in industry, static electric precipitator, air pollution, recycling of aluminum, water softening, ozone hole, effect of acid rain, effect of fertilizers on environment – eutrophication…)
Communicating	- Use appropriate scientific vocabulary - Use various methods to represent information (spoken and written, graphs, drawings, diagrams, charts…) - Conduct research using sources of information (media…)

Year: Grade Eight Basic Education

Sample Evaluation Sheet

Example 1:
Domain : Applying knowledge

Competency: Apply knowledge relevant to electrical nature of matter (electroscope)

Exercises:
1- State what happens when the knob of the neutral electroscope is brought near a rubbed ebonite.

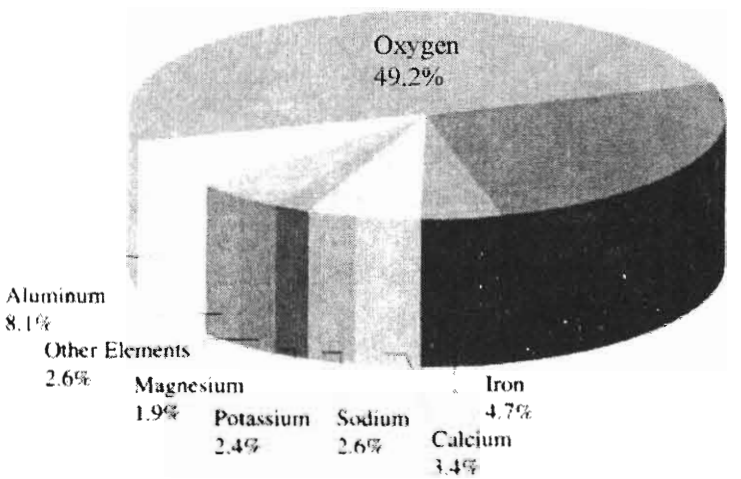
Competency: Classify materials on the basis of their properties (pH)

Exercises:
2- Using pH paper, mention the steps you have to follow in order to classify common substances such as orange juice, cleaning solutions, tap water and rain water into acids and bases.

Example 2:
Domain : Reading and illustrating scientific representation

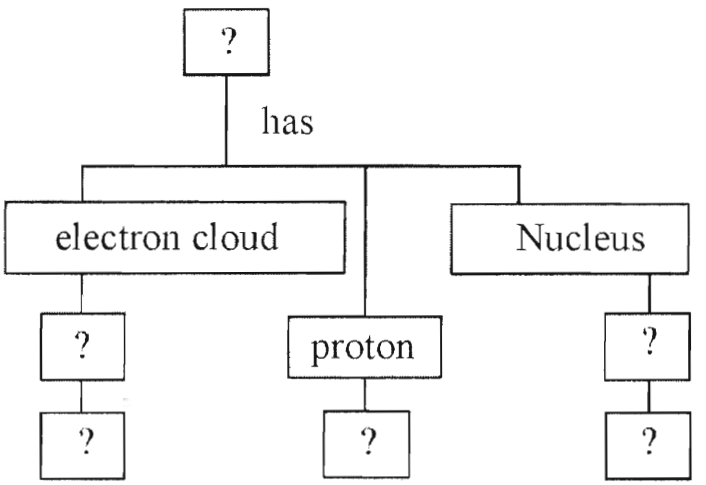
Competency: Read and interpret a tabulated data (element in the earth's crust)

Exercises:
1- The relative percentages by mass of elements in the earth's crust is represented by the following circle graph
The blue sector stands for the relative percentage of the element silicon.
a- Calculate the relative percentage by mass of the element silicon.
b- Give an explanation why oxygen has the largest relative % contribution to the earth's crust.



Competency: Read and illustrate pictorials (atom)

Exercises:
2- Below is a concept map. Copy the map and complete it with the proper words.



Example 3:
Domain : Conducting experiment

Competency: Conduct experiment to verify that some materials are good conductors (copper)

Exercises:
1- Describe an experiment to show that a copper wire is a good conductor.

Competency: Conduct experiment to show electrification

Exercises:
2- Describe an experiment to show how an electroscope can be charged positively.

Example 4:
Domain : Explain physical science phenomena encountered in everyday life

Competency: Explain and relate physical science concepts (antacids)

Exercises:
1- Explain the following observations
Antacids such as milk of magnesia are used to reduce excess stomach acid.

Competency: Explain phenomena related to environmental issues (air pollution)

Exercises:

2- Fuels having high-sulfur content contributes to air pollution. Explain.

Example 5:

Domain : Communicating

Competency: Use various methods to present information (bar graph of pH)

Exercises:

1- Create a bar graph that shows solutions with the following pHs in order from the most acidic to most basic: 7.6, 9.8, 4.5, 2.3, 4.0, 11.6

Competency: Conduct research using sources of information

Exercises:

2- Conduct a library research about the advantage of the fluoride ion in the toothpaste you use.

Example 6:

Subject: Aluminum

Domain: Applying knowledge

Competency: Apply knowledge to classify materials (conductors and non- conductors)

Exercises:

To complete the electrical circuit a small piece of aluminum wire is used and the bulb lights. Is aluminum a conductor or non-conductor? Why?

Domain: Reading and illustrating scientific representations

Competency: Read and interpret a tabulated data (alloy)

Exercises :

The following table describes some commercially important alloys of aluminum:

Common name of the alloy	**Element % mass composition**					**Uses**
	Iron	Nickel	Cobalt	Aluminum	Copper	
Alnico	50%	20%	10%	?	-	Magnets
Aluminum bronze	-	-	-	10%	?	Hinges

a- What is the % mass composition of aluminum in alnico? In aluminum bronze?

b- How many metals does the alloy alnico contain?

c-Is the alloy, aluminum bronze, a material with metallic properties or non-metallic properties? Why?

Domain: Conducting Experiment

Competency: Identify the types of chemical reactions (synthesis and simple displacement)

Exercises:

Using the following equipment and reagents, describe two simple experiments to identify a synthesis reaction and a single displacement reaction.

Equipment and reagents:

- Metallic tongs
- Bunsen burner
- Test tube holder
- Match
- Test tube
- Porcelain dish
- Aluminum wire
- Hydrochloric acid solution ($1 mol.L^{-1}$)

Domain: Explaining physical science phenomena encountered in everyday life.

Competency: Explain phenomena related to environmental issues (recycling of aluminium antacids)

Exercises:

1- Recycling has become an important environmental issue. The principal materials being recycled at present time are paper, glass and aluminum.
Aluminum cans are used in the beverage industry. Aluminum is non-toxic, odorless, tasteless, light in mass and the liquid inside the container can be cooled quickly.

a- Give two reasons for recycling aluminum.
b- Why is aluminum an ideal metal for making beverage cans?

Exercises:

2- Overuse of antacids might upset the acid base balance in the blood and may lead to a condition called alkalosis. Some antacids containing aluminum ions may deplete the body's essential phosphate ions through the formation of insoluble aluminum phosphate.
a- Write the symbol of aluminum atom and aluminum ion knowing that it has 3+ charges.
b- Write the formula of aluminum phosphate.
c- The antacid Rolaids contains aluminum ions. Describe a test to identify the presence of aluminum ions. When does the antacid Rolaid cause alkalosis?

Domain: Communicating

Competency: Use various methods to represent information.

Exercises:

1- Aluminum is the most abundant metal and the third most abundant element in the Earth's crust. The following relative abundance (% by mass) is given:
Oxygen (O) 49.4%; Silicon (Si) 25.7%; Aluminum (Al) 7.5%;
Iron (Fe) 4.7%; Calcium (Ca) 3.4% and other elements 9.3%
Write the above given information in a table form.
Draw the histogram of the relative abundance (% by mass) of the given elements.

Subject: Chemistry **Level: First Year Secondary**

Domain	Competencies
Applying Knowledge	- Apply knowledge relative to structure of matter, to reactions and solutions, to environmental issues. - Classify materials and chemical reactions on the basis of their properties (acid, base, cation, anion, synthese reaction, decomposition...) - Relate sources and implications of environmental issues (fertilizer), atmospheric pollution...
Reading and Interpreting Scientific Diagrams	- Read and interpret a tabulated data (atomic percentage of isotopes, distribution of water on the earth's surface, variation of solubility as a function of temperature, composition of dry and unpolluted air, periodic table, pollution of water…) - Read and draw conclusion from a photograph, a drawing, concept map, a graph, and a diagram (energy diagram of the atom, isotopic diagram, distribution of water on earth's surface, variation of solubility as a function of temperature, pH scale, composition of dry and unpolluted air, pollution of water…)
Conducting Experiment	- Construct models of some substances (H_2, Cl_2, N_2, HCl, H_2O, NH_3, and CH_4) - Carry out some experiments illustrating evidences for a chemical reaction (production or absorption of heat, release of gas, appearance or change of color, formation of precipitate…) - Perform experiment to prove the conservation of mass during a chemical reaction - Prepare a solution by dissolving a solid compound or by diluting - Master the technique of volumetric analysis, titration of acid-base. - Determine experimentally the pH of a solution. - Identify experimentally the cations and anions present in solution
Explaining Physical Science Phenomena Encountered in Everyday Life	- Explain phenomena and relate to chemical reactions, to fertilizer and pollution (Nitrogen cycle, greenhouse effect, ozone layer, pollution of water, eutrophisation, stalactites, and stalagmites, corrosion of iron, chemical leavening …)
Communicating	- Use accurate scientific vocabulary. - Use various methods to present information (spoken, written, drawings, charts, tables, diagrams, graphs…) - Conduct research using sources of information (audiovisual, media…)

Evaluation Sample Exercises

Example 1 :

Domain: Conducting Experiment
Competency: Prepare hydrochloric acid solution by dilution.

Exercises:

1- Prepare 50 mL of hydrochloric acid solution of concentration 0.02 mol.L-1 from HCl solution 0.1 mol.L-1. Describe the steps followed for this preparation.

Competency: Identify experimentally the gas carbon dioxide.

Exercises:

2- When an effervescent tablet of vitamin c is placed in water, carbon dioxide gas is released. Suggest a simple experiment that allows verifying this fact. Sketch a labeled schematic diagram for this experiment.

Competency: Master, experimentally, the technique of volumetric analysis through titration of hydrochloric acid solution and sodium hydroxide solution.

Exercises :

3- A volume of sodium hydroxide solution is titrated against hydrochloric acid solution. How is the titration practically carried out?

Example 2 :

Domain: Applying knowledge
Competency: Apply knowledge relevant to stoichiometry of a reaction.

Exercises:

1- Consider the reaction given by the balanced equation:

$4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$

A mixture containing 10 mol of oxygen gas and 20 mol of hydrogen chloride is made to react. What is the composition of the mixture obtained when the reaction is over?

Competency: Apply knowledge relevant to the structure of a molecule.

Exercises:

2- The formula of methanoic acid is $CH2O_2$. Applying the VSEPR method, give the geometric form of this molecule

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Example 3 :

Domain: Reading and illustrating scientific representation.
Competency: Read and illustrate isotopic diagram.

Exercises:

1- Compare, using histogram, the relative abundance of the isotopes of zinc.

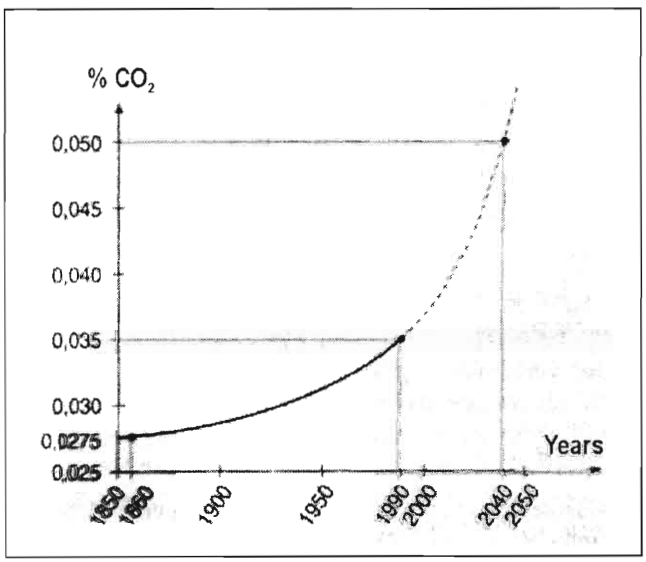
Isotope	Zn	Zn	Zn	Zn	Zn
% by atoms	48,89	27,81	4,11	18,57	0,62

Competency: Read and illustrate a graph related to atmospheric pollution

Exercises:

2- The following curve gives an idea about the increase of the threshold of carbon dioxide in the atmosphere.

- Interpret this graph
- Determine % CO_2 in the year 2400



Example 4 :

Domain: Explaining physical science phenomena encountered in everyday life.
Competency: Explain phenomena related to chemical reactions.

Exercise

1- The stalactites are icicles of calcium carbonate suspended from the ceiling in certain caverns, whereas the stalagmites are evolved from the ground just below the stalactites. Explain the formation of stalactites and stalagmites.

Exercise

2- The eutrophication of certain lakes results in the disappearance of its fauna. Explain the eutrophication phenomenon.

Example 5 :

Domain: Communication

Competency: Use appropriate scientific vocabulary.

Exercise:

1- The pH of a soil depends on its composition, it varies between 3.5-4 in marshy grounds, and it is about 9 in very calcareous grounds. The pH value has a very important consequence on vegetation.

The heath (moor), rhododendron, develop in acid soils (pH = 4-5). On the other hand, the clematis (vine-like plants that flower) develops in basic soil (pH =7.5-8). The maximum yield of a plant is not obtained if the pH of the soil does not fall between the two ranges given above. Practically, it is possible to modify the acidic-basic nature of the soil by adding moderate amounts of lime, marl, or peat. A lime solution makes phenolphthalein pink in color, whereas a solution of peat makes bromothymol blue - yellow.

Questions:

We have a soil of pH = 7.2, what should be added to see whether the following plants can grow in this soil:

a) clematis
b) heath

Competency: Conduct research using sources of information.

Exercise:

2- Conduct research about fullerenes.

Example 6 :

Domain: Applying knowledge

Competency: Applying knowledge relevant to reactions and solutions.

1- A solution (S) is obtained by mixing hydrochloric acid and sulfuric acid solutions. 10 mL of (S) is titrated with 40 mL of 0.1 mol.L-1 NaOH solution. An excess of $BaCl_2$ is added to 20 mL of solution (S). A white precipitate is obtained. The obtained precipitate when washed and dried weighs 0.233g.

a- Write the net ionic equation of the neutralization reaction.

b- Calculate the concentartion of H+ present in solution (S).

c- Tell what are the compatible and incompatible ions in the reaction system after adding barium chloride.

d- Write the net ionic equation of the precipitation reaction.

e- Calculate the molar concentration of each acid used to prepare solution (S).

Example 7 :

Domain: Conducting experiment
Applying knowledge
Communicating

Competency: Apply knowledge relevant to ions.
Apply knowledge relevant to reactions and solutions.
Identify cations and anions in solution.
Prepare a solution by dilution.
Master the technique of volumetric analysis, applied to acid-base titration.

Study of mineral water

The labels of bottled mineral water indicate the nature of the ions present and the mass concentration and the pH of water.

The label of a studied mineral water gives the following data:

Cations	Composition by mass ($mg.L^{-1}$)	Anions	Mass concentration ($mg.L^{-1}$)
Ca^{2+}	467	HCO_3^-	377
Mg^{2+}	84	SO_4^{2-}	1192
Na^+	7	Cl^-	7
K^+	3		

Dry residue at 180 0C: 2032 mg.L-1

pH = 7.9

We can verify experimentally:

- The presence of Calcium ions and Sulfate ions.
- The reading of the label concerning the concentration by mass of HCO3- ion.

To verify the above, we can carry out a titration of mineral water with hydrochloric acid solution (S) of concentration 0.1 mol.L-1.

Material available:

- Graduated pipettes: 10, 20, and 50 mL.
- Pipette filler or pipette bulb.
- Graduated buret, 25 mL.
- Volumetric flasks: 50, 100, and 250 mL.
- Beakers: 50, 100, and 250 mL.
- Graduated cylinders: 100, and 250 mL.
- Test tubes and test tube rack.
- Magnetic stirrer and magnetic bar.
- Stoppers.

Solutions available:

- Mineral water to be analyzed
- Hydrochloric acid solution (0.5 mol.L-1)
- Silver nitrate solution (0.1 mol.L-1)
- Barium chloride solution (0.1 mol.L-1)
- Ammonium oxalate solution (0.1 mol.L-1)
- Copper(II) sulfate solution (0.1 mol.L-1)
- The following colored indicators:
-

Indicator	Color in acid medium	PH range	Color in basic medium
Methyl orange	Red	3,1 – 4,4	Yellow
Bromothymol blue	Yellow	6 – 7,6	Blue
Phenophtaline	Colorless	8,2 - 10	Pink

Molar Mass (g.mol-1): H = 1 C = 12 O = 16

Questions:

I - Identification of ions:

1. Write a test to identify the presence of: Calcium ions and Sulfate ions in solution.
2. Write the net ionic equation of each of these tests.

II- Preparation of HCl solution (S)

Write the preparation of 100 mL of solution (S) precisely and indicate the nature of the glassware used.

III- Determination of the HCO_3- ion in the mineral water.

Put a volume v = 100 mL of mineral water in an Erlenmeyer flask. Add a few drops of colored indicator, and by means of a graduated buret, add slowly the HCl solution (S). The indicator changes color when the volume added is

Veq. = 6.1 mL of the solution (S) used. At this instant the pH = 4.

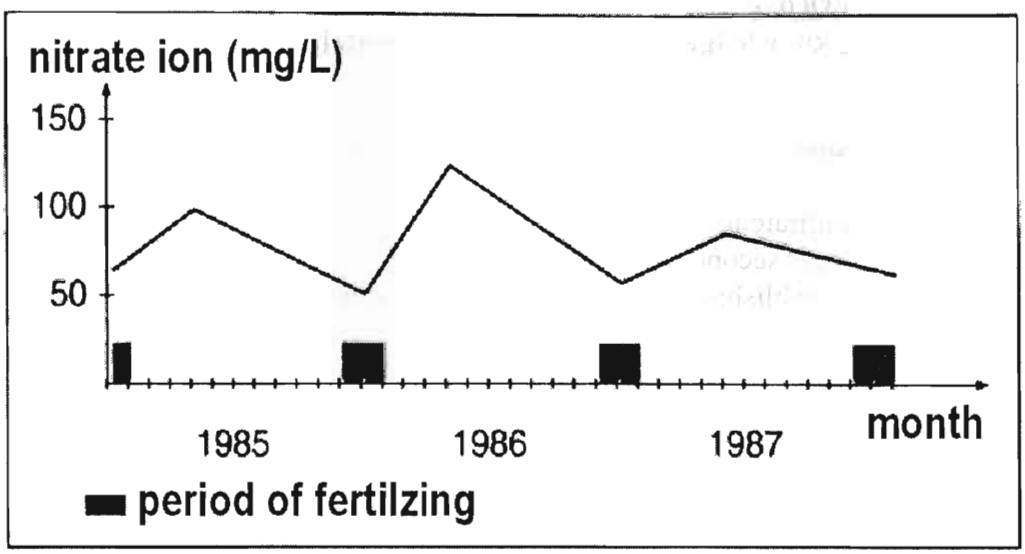
1- Draw a labeled schematic diagram of the titration.
2- Write the net ionic equation of the titration reaction.
3- Determine the concentration of the HCO_3- ion in the mineral water.
4- Compare the value obtained with value given on the label.
5- Which indicator is the most indicative for this titration. Justify.

Exercise 8 :

Subject : Water Pollution due to Nitrate Ions

Domain: Reading and illustrating graphical representation.
Competency: Read and illustrate a graph (water pollution)

Exercise:
The graph given below shows the variation of the nitrate ion level in an underground water located in an agricultural region where cereals are grown during the year.
Nitrogeneous fertilizers are used in general during the period which extends between the months March to May.
What does this graph bring to your attention?



Domain: Communication
Competency: Conduct research using resources of information: media

Exercise:
Conduct a research about expressions using the word water.
Give examples of liquid products involving the word water.

Domain: Explaining physical science phenomena encountered in everyday life.
Competency: Explain the phenomenon related to water pollution.

Exercise:
Eutrophication of some lakes results in the disappearance of their fauna. Explain this phenomena.

Domain: Conducting experiment
Competency: Identify experimentally the presence of cations and anions in solution (nitrate ion)

Exercise:
Describe an experiment to identify the presence of nitrate ion in solution.

Domain: Applying knowledge
Competency: Applying knowledge relevant to environmental issues (polluting water)

Exercise:
During a laboratory session, a group of two students used 1g of sodium nitrate containing 0.73 g of nitrate ions.
Estimate the quantity of nitrate ions drained through the sink due to washing by the students of a school having ten first year secondary classes; where each class consists of 35 students.
Give other examples of establishments that participate in polluting water.

Subject: Chemistry **Level: Second Year Secondary Sciences Section**

Domain of Competencies	Competencies
Applying Knowledge	- Apply knowledge relative to thermochemistry, to electrochemistry, to industrial chemistry, to metallurgy, to atomic orbitals, to organic chemistry, to petroleum and natural gas, to pollution due to solid wastes. - Classify materials and cells on the basis of their properties (oxydant, reductor, cells, accumulators, alkane, alkene...) - Relate sources and implications of environmental issues (solid wastes)
Reading and Interpreting Scientific Diagrams	- Read and interpret tabulated data (food tags, table of thermochemical classification…) - Read and draw conclusions from a photograph, a drawing, concept map, a graph, and a diagram (thermochemical diagram, Daniel cell, electrolyte, lead battery, V.S.E.P.R., distillation simple and fractional.
Conducting Experiment	- Perform calorimetric measurements - Carry out experiments to classify qualitatively redox couples - Carry out experiments to classify quantitatively redox couples - Construct electrochemical cell - Carry out electrolysis - Master the technique of volumetric analysis, using redox titration - Construct molecular models of some organic compounds - Identify an alkene by the decolorization of bromine solution - Perform simple distillation and fractional distillation
Explaining Physical Science Phenomena Encountered in Everyday Life	- Explain phenomena and relate to thermochemistry (spacecraft), electrochemistry (firework, purification, deposition of metals…), industrial chemistry (properties of soaps…), metallurgy (corrosion of metals…) to organic chemistry (ozone layer…) to pollution (pollution of solid wastes…)
Communicating	- Use accurate scientific vocabulary. - Use various methods to present information (spoken and written including graphs, drawings, chart …) - Conduct research using sources of information (audio-visual, media…)

Evaluation – Sample Exercises

Example 1 :

Domain: Conducting Experiment

Competency: Carry out experiments to classify qualitatively redox couples (couple Pb^{2+}/Pb)

Exercise:

1- Describe carefully an experiment to verify the placement of the redox $Pb^{2}+/Pb$ couple in the electrochemical qualitative classification.

Competency: Identify an alkene by the decolorization of bromine solution.

Exercise:

2- Two unlabeled flasks: one contains a liquid alkane and the other a liquid alkene. Describe a simple experiment to identify the content of each flask.

Example 2 :

Domain: Applying Knowledge

Competency: Apply knowledge relevant to thermochemistry (Hess low)

Exercise:

1- The heat of formation of liquid methanol is the heat of synthesis of one mole of the compound starting from its elements at standard conditions. This is the heat, (1) given by the equation:

$C(s) + 2H_2(g) + ½\ O_2(g) \rightarrow CH_3OH(l)$ (1)

Calculate H1 knowing that: H sub(C) = 717 KJ.mol-1

H vap (CH_3OH) = 37.4 KJ.mol-1 and the heat , H2, of the reaction given by the equation:

$C(s) + 2H_2(g) + ½\ O_2(g) \rightarrow CH_3OH(g)$ is equal to -218 $Kj.mol^{-1}$

Competency: Apply knowledge relevant to electrochemistry (cell)

Exercise:

2- A dry cell is made at standard conditions by connecting the redox couples Ag+/Ag and Ni^{2+}/Ni.

- Identify the anode, cathode, emf and the overall cell reaction.
- What change in mass is produced at the negative terminal of the dry cell, when a current I = 10 mA is passed for 3 hours?

Example 3 :

Domain: Explaining physical science phenomena encountered in everyday life.
Competency: explain phenomena relevant to electrochemistry (electrolysis)

Exercise:

1- The metallic parts of an abandoned ship wreck are often covered by protecting materials. When these metallic parts are raised to the surface, it can be seen whether they are damaged or not. How can the degradation of these parts be prevented?

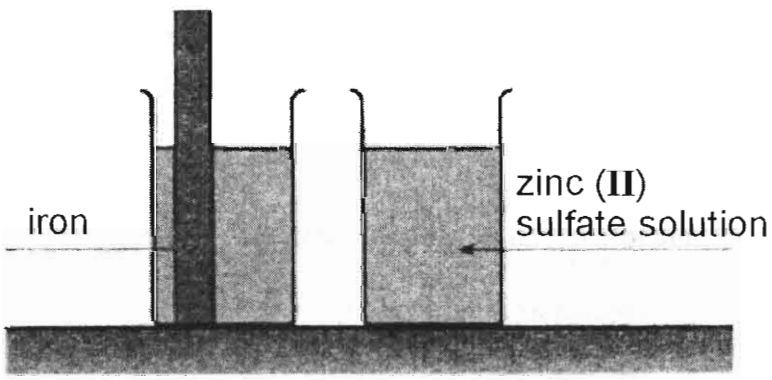
Example 4 :

Domain: Reading and illustrating scientific representation.
Competency: Read and illustrate schematic drawing of an electrochemical cell.

Exercise:

1- Complete the schematic drawing given below to obtain a standard dry cell ?

Iron strip Zinc(II) sulfate solution



Given: $Eo(Fe^{2+}/Fe) = 0.44V$ $Eo(Zn^{2+}/Zn) = -0.76V$

How does the concentration of Zn^{2+} ions change in the zinc half-cell.

Competency: Read and illustrate the table of electrochemical classification.

Exercise:

2- Using the electrochemical classification table of redox couples tell what gamma rules may happen when:

- Lead(II) nitrate solution is mixed with copper(II) nitrate solution.
- A strip of lead is dipped in copper(II) nitrate solution.

Competency: Read and interpret a table of data that gives the variation of molar volume, in terms of the temperature and the pressure.

Exercise:

3- The following table gives the molar volume at certain temperature and pressure values:

T (°C)	P (bar)	V_m (L.mol^{-1})
-56	0,1	180
0	1	22,7
0	1,013	22,4
21	1,013	24,1
100	1	31
800	2	44,6

Interpret this table

Example 5 :

Domain: Communicating

Competency: Use accurate scientific vocabulary

Exercise:

1- Application of explosives

Explosives have been employed extensive in the military domain, in the form of bombs, missiles, depth charges and the like. On the other hand, the application of explosives for peaceful purposes are numerous and important.

Explosives are used in excavation and in mining.

They have a recognizable role in realizing big construction projects: dams and tunnels.

a- Cite some important applications in metallurgy.

b- Are explosives used for the service of humankind?

Example 6:

Subject : For the purpose of protecting the two surfaces of a thin iron flat sheet of size (20cm x 10cm) and negligible thickness, we carry out electrolytic nickel plating.

Domain: Conducting experiment
Competency: Carry out electrolysis

Exercise:

1- Describe an experiment that can be used for protecting iron. Justify this experiment.

Domain: Applying knowledge
Competency: Apply knowledge relevant to electrochemistry (electrolysis).

Exercise:

- What electrochemical reactions occur at the electrodes?
- Explain why nickel plating protects iron from corrosion.
- A constant electric current of intensity 0.5A is passed for one hour. Calculate the mass of nickel deposited and the thickness of the deposited layer knowing that the density of nickel is $8.925 \times 10\text{-}3\ kg.m^{-3}$.

Domain: Communicating
Competency: Use various methods to present information.

Exercise:

1- Sketch the diagram for nickel plating. Indicate the direction of current flow and the movement of the charge carriers.

Domain: Reading and illustrating scientific representation.
Competency: Read and illustrate a graph (U = f(I))

Exercise:

2- During electrolysis, the values of the voltage U and the intensity I measured are presented in the following table.

U(V)	0	1	1,5	2	2,2	2,4	2,5	2,6	2,7	2,8
I (mA)	0	0	0	2	5	12	20	30	39	48

Plot the graph of the curve U=f(I).
Interpret the graph obtained.

Domain: Explaining physical science phenomena encountered in everyday life.
Competency: Explain the phenomena related to electrochemistry (electrolysis).

Exercise:

1- Certain statues are made by electrolytic process. Dscribe this process. Explain how electrolysis may help to manufacturing an object?

Subject: Chemistry **Level: Second Year Secondary Humanities Section**

Domain of Competencies	Competencies
Applying Knowledge	- Apply knowledge relevant to soaps and detergents, to synthetic polymers, to pesticides. - Classify materials on the basis of their properties (soaps, detergents, polymers, pesticides). - Relate sources and implications of environmental issues (detergents, polymers, pesticides).
Reading and Illustrating Scientific Representation	- Read and interpret a table of data (mass of fatty acid in 100mg of oil, toxicity of insecticides and herbicides, limit of quality of potable water. - Read and illustrate a diagram (field of application of synthetic polymers, population of insects after different treatment).
Conducting Experiment	- Conduct a reaction of saponification (preparation of soap). - Experimental study about the effect of the nature of water on the solubility of soap. - Measure the pH of some soaps. - Experimental study about the effect of the nature of water on the solubility of detergent. - Experimental study about the effect of additives on a soapy solution. - Construct a polymer. - Identify experimentally some synthetic polymers. - Experimental study about the effect of insecticide on aquatic animals.
Read a Documentary Activity	- Read and analyze a document related to soaps and detergents (biodegradable detergents, eutrophication…) to synthetic polymer (pollution problems, incineration, recycling…) to pesticides (labels on tags, knowing the resistance of insecticides, D.D.T., water pollution, communication of bees)
Communicating	- Use accurate scientific vocabulary. - Use various methods to present information – spoken, wrtitten – graphs, schematic drawings, charts, tables, diagrams, and text materials. - Conduct research, using sources of information (audio-visual, media)

Evaluation – Sample Exercises

Example 1 :

Domain: Applying knowledge

Competency: Apply knowledge relevant to polymers

Exercise:

1- On a plastic bag, the following recommendations are written:
This bag is made of P.E. recyclable material. Its destruction by incineration does not release harmful gas or corrosive substances. Protect our environment. Thank you. Do not throw the bag in public places, or in nature.

a- To what category of materials does this plastic bag P.E. belong?
b- What does the term plastic material mean?
c- What does incineration signify?
d- Indicate the products formed during the combustion of this material.
e- Why should not this bag be thrown away in public places or nature?

Exercise:

2- a) Research different types of beverage-making.
b) Compare their advantage and the inconveniences concerning their consumption and the environment.

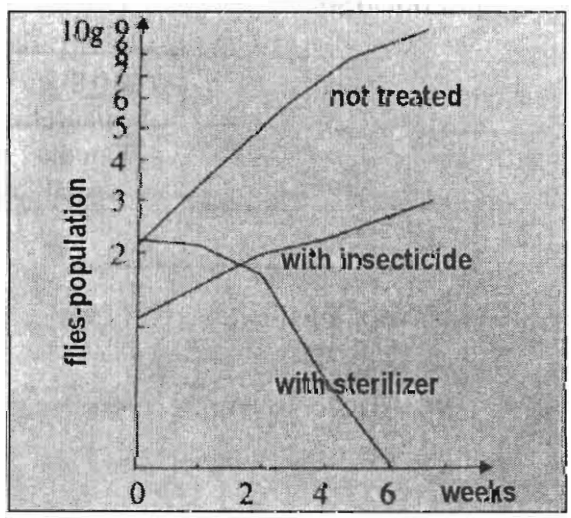
Example 2:

Domain: Reading and Illustrating scientific Representation

Competency : Read and interpret a graph (population of domestic flies after different treatments).

Exercise:

1- Read and interpret the following graph.



Exercise:
Read and interpret the following table (limit of quality of potable water).

Parameters	Limit of quality of potable water
Nitrate	50 $mg.L^{-1}$
Nitrite	0,1 $mg.L^{-1}$
Ammonium	0,5 $mg.L^{-1}$
Total pesticides	0,5 $\mu g\ L^{-1}$
Per pesticide*	0,1$\mu g\ L^{-1}$
* lindane only	0,01$\mu g\ L^{-1}$
Aldrin and dialdrin	0,03 $\mu g\ L^{-1}$

Example 3:
Domain: Conducting an experiment
Competency: Identify experimentally some synthetic polymers.

Exercise:
Rules concerning plastics are not all applicable to the same plastic. Some are made up of P.V.C. others are made up of plexiglass. What chemical test do you perform to distinguish one from another?

Example 4:
Domain: Read a documentary activity

Competency : Read and analyze a document (Eutrophication)

Exercise:
Lakes and rivers are biologically balanced environments for living things. The injection of nutrients into the water (mostly phosphorus and nitrogen), causes a change in the aquatic composition of the lake or river, from oligotrophy (poor in nutrients) into eutrophy (rich in nutrients). Excessive nutrients lead to proliferation of algae. Decomposition needs a large consumption of oxygen. This process leads to an anaerobic situation, where hydrogen sulfide is formed, releasing a putrid odor and forming methane, which prevents normal life. A kilogram of phosphorus allows 114kg of algae to grow. The decomposition of this amount which consumes the oxygen dissolved in 14 million liters of water. It is estimated that in European countries 20 to 33% of phosphorus comes from washing powders, in which polyphosphates are added to counteract the effects of calcareous water during washing processes. Moreover, the excessive nutritive mineral wastes (mainly nitrates and phosphates) favoris the excessive growth of algae that will blow cover the surface of the water. Eutrophication provokes asphyxia and the gradual disappearance of the fauna and flora.

a- What does the following terms mean: eutrophication and proliferation?
b- What is the effect of eutrophication on the fauna and flora?