Co-funded by the
Erasmus+ Programme
of the European Union

The ENVIRONMENTAL SCIENCE / THE CHEMISTRY lesson plan provides teachers and students with the opportunity to investigate the impact climate change is having on the environment through classroom activities.

SUBJECT MATTER (SCHOOL DISCIPLINE / LEARNING AREA)– THE ENVIRONMENTAL SCIENCE / THE CHEMISTRY

LESSON- Environmental Chemistry and chemical reactions – virtual laboratory

OBJECTIVE - Integrating environment and climate change subconsciously to the learning outcome *Environmental Chemistry* using digital games' web 2.0 tools. Thus, the students will be able to learn about *Environmental Chemistry* consciously while they are raising awareness on the environment and climate change subconsciously using digital games. These games can be applied to indoor and outdoor learning environments, distance and traditional (face-to-face) classrooms.

Learning Objectives of the lesson:

Upon completion of this lesson, students will be able to:

- **understand the meaning of environmental chemistry**
- **collect, analyze, and interpret reactions on environmental quality**
- **categorize chemical reactions;**
- **identify chemical compounds;**
- **understand strategies for reducing waste;**

Learning outcomes and environmental awareness and climate change implications - The environmental issues suggested by the game are represented by the identification of the chemical reactions that are important in the environment, and also their effect upon climate change and environment. The outcome is to assess the impact of chemical pollution on a local environment.

Description of the game and activities and technical specs: The digital game will allow to combine the substances correctly, label them correctly and add them to the correct column / bubble; this virtual laboratory is designed to challenge students to identify types of chemical reactions and distinguish between those that use safer, less hazardous chemicals and those that are more dangerous. Students will make a choice as to which reaction they will perform using the 12 Principles of Environmental Chemistry.

INSTRUCTIONS/ PROCEDURES

Teacher- Question 1 - What is Environmental Chemistry or Green Chemistry?

Teacher will introduce students to the term of environmental chemistry or green chemistry. Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment. Explain to the students that they will be exploring reactions through a series of virtual labs. Chemists developing products or procedures in the lab constantly have to evaluate reactions and decide which ones will meet a specific need.

Activity 1

In the digital game, the students will be combining and labeling chemical substances, will be evaluating reactions and looking at them through the perspective of green chemistry.

Web 2.0 tool digital game model: app matrix https://learningapps.org/13673184

Teacher – Question 2 – How can we use Green Chemistry to understand Types of Chemical Reactions ?

The principles of Environmental Chemistry can be used to diminish the amount of waste created and lower the environmental impact factor of a particular chemical process. It is the design of chemical products and processes that reduce or eliminate the use and formation of pollution at its source. Among the principles and guidelines of Environmental Chemistry intended to fulfill goals for any chemical process, whether industrial or laboratory scale, the teacher mentions:

Make better use of available resources for the development of a chemical process.

Reduce waste generated in any preparation or handling of chemicals.

Materials should be prepared by improved processes that reduce unwanted effects on the environment.

Replace toxic reagents and products with others that have the same properties and applications but have less impact on the environment.

Activity 2

This virtual lab digital game is designed to challenge students to identify types of chemical reactions and distinguish between those that use safer, less hazardous chemicals and those that are more dangerous. Students will make a choice as to which reaction they will perform using the 12 Principles of Green Chemistry.

Web 2.0 tool digital game model: group assignment https://learningapps.org/20728212

Teacher - Question 3 – What are the chemical reactions categorized?

There are five types of chemical reactions: composition (also called synthesis or combination), decomposition, single replacement, double replacement, and combustion.

Composition is the combining of two or more substances to make a single more complex compound. It can be depicted as:

$A + B \rightarrow AB$

Decomposition is the breaking down of a more complex compound into simpler substances. Decomposition and composition are opposites. Decomposition can be depicted as:

$AB \rightarrow A + B$

Single replacement is a reaction where an element replaces a similar element in a compound. It is also called single displacement. Single replacement can be depicted as:

$A + BC \rightarrow AC + B$

Double replacement is a reaction where the positive and negative ions in two ionic compounds switch places to form two new compounds. It is also called double displacement. Double replacement can be depicted as:

$AB+CD \rightarrow AD+CB$

In green chemistry a set of twelve principles guide chemists to choose reactants that result in the safest, most economical, and environmentally sound reactions to create a product with the desired properties.

Activity 3

The teacher will describe the following digital game -Green Chemistry Reaction Lab Game – it will allow students to choose of the two procedures listed under each reaction type. There will be three or four teams; the aim is to use the 12 Principles of Green Chemistry and the supplemental information given by the teacher to decide which one each team will conduct. Each team will analyze each reaction type, then they will fill out the table below with their criteria for choosing those procedures/ or they will record their answers.

	Procedure chosen (1 or 2)	Criteria for choosing the procedure used	Green Chemistry Principle that guided your choice
Reaction A			

Reaction B			
Reaction C			
Reaction D			

Web 2.0 tool digital game model: fill table https://learningapps.org/285514

Follow –up discussion

Consolidate key points with students and those game results that were not done correctly.

Assessment/ Evaluation

Upon completion of the three activities, ask students to write a project about waste reduction using Environmental Chemistry.