



Chemical elements, atoms and molecules – VEGA Teaching Scenario

Topic: The chemical elements of the periodic table. Atom and molecule as building blocks of matter.

Subject(s): Chemistry, Social anthropology

Age / Grade: 13-14 years old (2nd class of secondary school)

Short description of the interactive games in this scenario:

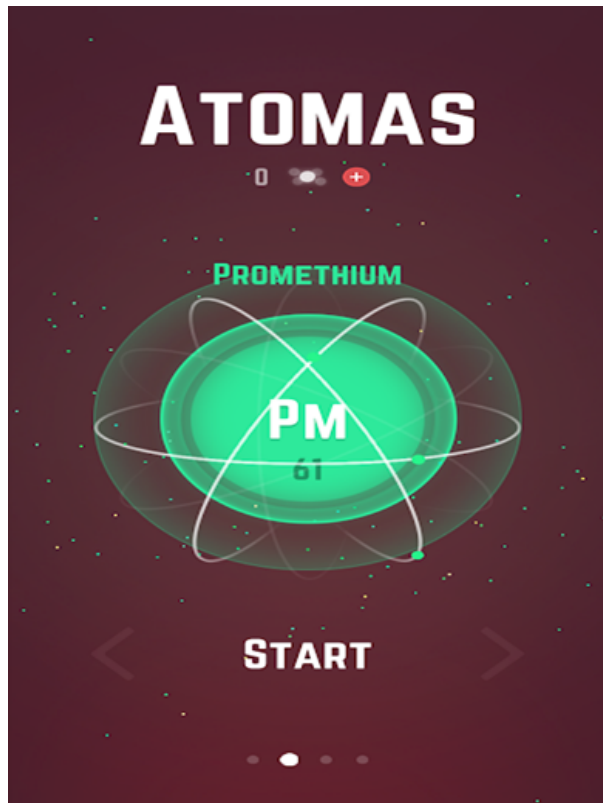
- [CHEMISTRY GAME](#) is a free educational game designed by the "LET'S PLAY" team for students or anyone who loves chemistry. This science game contains a number of tests that teach the basic elements that build the universe and its chemical properties in a fun and learning way.

Features:

- Cool animation and effects.
- Learning the basic elements.
- Learning the chemical properties of the elements.
- Understanding the periodic table and how to deal with it.

In this [video](#) the game's content is presented.

- [ATOMAS](#) is a puzzle game in which the player can create chemical elements by increasing or reducing atoms. The game universe starts with hydrogen atoms only but with the help of the energy rich plus atoms the player is able to fusion two hydrogen atoms into one helium atom, 2 helium atoms into one lithium atom and so on.



The primary goal is to create valuable elements like Gold, Platinum and Silver. The game offers 4 different modes and 124 different atoms to create. Last but not least, players can share their score on twitter and Facebook.

In the following [video](#) you can watch a teaser for the game.

Introduction to the scenario:

In this scenario students learn how to name chemical elements, their symbols and the difference between chemical compounds and formulas. Moreover, the students will learn to distinguish atoms and molecules. Electronic games about chemicals and atoms will be used to consolidate students' knowledge.

Learning outcomes:

The students are able to:

- Name chemical elements and write their chemical symbols.
- Distinguish chemical elements in metals and non-metals.
- Mention simple chemical compounds.
- Distinguish chemical elements from chemical compounds when given chemical formulas.
- To define atoms and molecules as building blocks of matter.
- Give examples of matter made up of atoms and molecules.
- Understand the infinitesimally small size of the particles that make up matter.
- To distinguish the atom from the molecule.
- Represent atoms and molecules using models.
- Distinguish the molecules of chemical elements from the molecules of chemical compounds.
- Classify substances into chemical elements, chemical compounds and mixtures.

A selection of learning outcomes from the Cypriot Curriculum:

- Recognize the contribution of Chemistry to humanity.
- Appreciate the role that chemistry plays in the evolution of civilization.
- Give examples of applications of Chemistry in everyday life.
- Understand the usefulness and applications of Chemistry in everyday life.
- To be aware of the chemical dimension of the great problems facing humanity (climate change, pollution, diseases, energy, nutrition) but also of the chemical dimension of possible solutions in order to be able to follow as an active citizen and participate in the relevant political decisions.
- To acquire critical thinking and reflective knowledge management.
- To form theoretical thinking and ability to turn theory into practice.
- To creatively direct their own thinking and learn how to learn.
- Learn to identify the important problems to which Chemistry can provide solutions and to acquire creativity and possibilities to offer creative solutions.

Formative assessment

Number of students: 20 students (4 students/group)

Duration: 4 lessons of 40-45 min each

Prerequisites:

- Computers with internet connection
- CHEMISTRY GAME and ATOMAS downloaded on laptops or other mobile devices
- Check that the internet is working
- Information about the topic to mediate to the students (videos, pictures, Educational tools etc.)

Before the program begins (preparatory work for teacher):

- Search and collect information and material about the topic
- Get properly acquainted with the games
- Prepare a glossary

https://docs.google.com/document/d/1PMM5gIIAwinT7h4v_N31_S5Aj7hAG0soxGU1FfZY894/edit?usp=sharing with important terms
as the games are only in English

- Learn how basic game functions work (make a manual for the students if necessary)
- Prepare and collect all things needed for the scenario
- Divide students into groups of maximum four per laptop or mobile device

The main part of the scenario (number of lessons):

Part One (2 lessons of 40-45 minutes)

Lessons 1 & 2

Preparations:

- Check that the internet is working
- Download the videos that will be used for the delivery of the lessons
- Ensure that the atom simulators are available in the lab

Learning sessions:

Lesson 1:

- The teacher starts the lesson by showing to the students from the following video <https://youtu.be/bFIArIW2iWA> (video in Greek language) the part from 4:38'' until 6:34''. This part of the video refers to the ancient Greek philosophers' theories about the elements that make up the universe and the earth.
- Next the teacher initiates a discussion with the students on how they view these theories. The teacher can also use as an example the alchemists' efforts to transform base metals to noble metals to introduce them to the concept of matter and the elements that make it up.
- The teacher explains to the students the atomic theory and that matter is composed of particles called atoms. This theory comes from the ancient Greek philosophers according to whom if one were to cut a piece of matter into smaller parts, s/he

would eventually reach a point where the pieces could not be further cut into anything smaller. Actually the word atoms in Greek means something that it's uncut - atomos. The following [video](#) summarises the history of atomic theory starting from Democritus up to contemporary scientists

- The next concept to explain will be that atoms can be combined and create molecules that are either chemical elements or chemical compounds. The teacher clarifies the difference between them.
- Then the structure of an atom is presented using atom simulators available in the lab.

Debriefing:

A person alone or a molecule alone has no color. In a set of atoms or molecules, however, relationships and interactions develop between them, from which the color of chemical elements or chemical compounds emerges. By analogy, when a person is part of various social groups (family, school, work, church, etc.), s/he shapes his behavior in relation to them, supports the goals of the whole by overcoming his individualism and generally acquires social consciousness.

Lesson 2:

- Some initial thoughts to share with the students before teaching the symbols for chemical elements and compounds are the following. In Great Britain it is called sulphur (in the USA sulfur) in France soufre, in Germany Schwefel, in Italy zolfo. In Greece it's called θειάφι (thiafi). Chemists around the world have agreed to symbolise it S. Think that today there are more than 20,000,000 known chemical compounds. Can you imagine what a huge problem scientists around the world would face if there was no common chemical language?
- The teacher introduces the students to the symbols of the main chemical elements and compounds.

Debriefing:

The teacher asks the students to select which chemical element they would wish to be and explain the reasons for their choice.

Part two (2 lessons x 45 minutes)

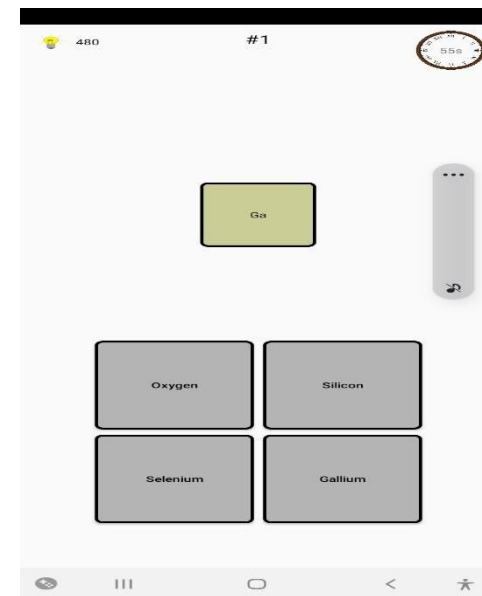
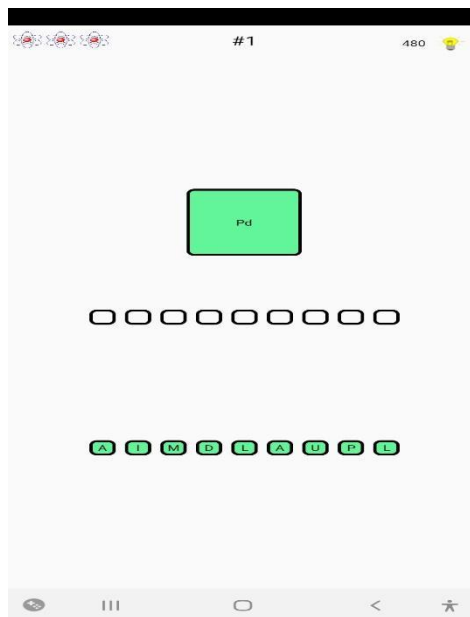
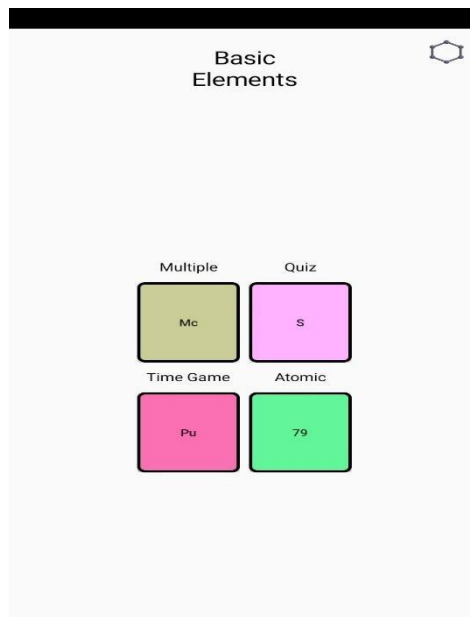
Lessons 3 & 4:

Preparations:

- Familiarise yourself with the games you are going to use
- Download the games on the mobile devices
- Check that the internet is working

Lesson 3:

- The teacher will present to the students the periodic table, how chemical elements are organised and what information it provides for each element.
- Then, the teacher divides students into groups according to the number of mobile devices available in the classroom. The maximum number of students per group should be four.
- The first game that students will use will be the Chemistry Game. The teacher will explain the game and how they should play. All teams will start with the Basic Elements part of the game. There will be four choices with subgames. All teams will start with the Multiple subgame where they will have to match the symbol with the name of a chemical element.
- Once all teams finish with the first subgame, they will continue with the Quiz where they will have to write the name of the element when they are given its symbol. They will use the letters that are shown in a mixed order right under the symbol.



- The next subgame will be the Time Game. They will be given a minute to match chemical symbols with chemical elements.
- The last subgame will be the Atomic where they will have to match the number of atoms with the correct chemical element. They can use the periodic table as a guide to find the right match.

Debriefing:

The last 15 minutes of the lesson the teacher will discuss with the students how they worked in each game as a team, how their collaboration was, and if the game facilitated their learning and comprehension of the chemical symbols.

Lesson 4:



- In this lesson students will use the second game, ATOMAS, to further enhance their knowledge of the number of atoms that each chemical element has.
- The teacher will explain the game to the students.
- Then, students will be grouped into teams according to the number of available devices. The maximum number is advised to be four per group.
- The students will play the game for 20 minutes.
- Ensure that all team members will have the chance to play the game.

Debriefing:

In the last 15 minutes of the lesson, the teacher will discuss students' views on the game, how they collaborated in their teams, and in what way the game improved their knowledge on the chemical elements' number of atoms.

Summative assessment:

Grades 5-10	5	6	7	8	9	10
Activity and engagement	The student has had challenges to get the task finished. The student hasn't shown signs of engagement neither at school nor at home.	The student has only occasionally shown interest in the work and has had difficulty finding motivation.	The student has mostly shown interest in the work both at home and at school.	The student has shown interest and commitment to the work both at home and at school.	The student has shown great interest and commitment both in lessons and at home.	The student has shown great interest, responsibility and commitment both in lessons and at home.
The overall picture of the work when completed.	The student misses several parts of his work and several points are not checked in the list.	The student lacks several parts of the checklist in his work.	The student lacks certain parts of the checklist, but it is largely complete.	The student has done all the parts on the checklist.	The student has done all the parts on the checklist and you can see that the student has made an effort to include all the parts.	The student has done every single part on the checklist and it can be seen that the student has processed the content.

<p>Showing responsibility for the completion of the work. Cooperation and peer response</p>	<p>The student had difficulty cooperating with his group and did not listen to his classmates. The student did not give a peer response and did not take into account what the group gave in response.</p>	<p>The student had some difficulties in cooperating with his group and listening to his classmates. The student gave peer feedback without following the instructions. The student did not take into account the response given by the group.</p>	<p>The student mostly cooperated well with his group. The student received and gave feedback from his group almost always according to the instructions. The response was mostly constructive.</p>	<p>The student showed responsibility and mostly a good ability for cooperation. The student received and gave feedback from his group. The response was constructive.</p>	<p>The student showed evidence of good responsibility and a good ability for cooperation. The student gave a versatile response and took the response he / she received from his / her group into account.</p>	<p>The student showed evidence of excellent responsibility and an excellent ability for cooperation. The student made an effort to formulate himself in a constructive and valuable way for the task in order to help his group further in his work. The student received a response from his group and took it into account in his own work.</p>
<p>Skills</p>	<p>The student shows obvious shortcomings in the understanding of the subject.</p>	<p>The student shows some shortcomings in the understanding of the subject.</p>	<p>The student shows evidence of a certain understanding and some learned knowledge of the subject. .</p>	<p>The student shows evidence of a good understanding and has assimilated the most important content in the subject.</p>	<p>The student shows of an excellent understanding and has assimilated the most important content in the subject but lacks some knowledge.</p>	<p>The student shows evidence of an excellent understanding and fully masters the content.</p>
<p>Language learning/English</p>	<p>The student has big difficulties in learning the English words.</p>	<p>The student struggles with and has some challenges with the English words.</p>	<p>The student knows the most important concepts and words in English.</p>	<p>The student shows evidence of understanding most parts In</p>	<p>The student has a good understanding and has learned most of</p>	<p>The student masters all concepts and words in English.</p>

				English.	the concepts and knows all the words in English.	
The VR part and the app use	The student presents obvious difficulties in understanding how the Chemistry Game and Atomas work. Shows a lack of interest and is careless in the use of equipment needed.	The student presents some difficulties in understanding how the Chemistry Game and Atomas work. Trying to do according to the instructions, but can not keep the interest up all the time. The student is sometimes careless in the use of equipment needed.	The student understands the main features of how the Chemistry Game and Atomas work. Mostly follows the instructions, but sometimes lacks perseverance. Is usually careful with the equipment.	The student shows a good understanding of how the Chemistry Game and Atomas work. The student always follows the teacher's instructions and is careful with equipment.	The student shows an excellent understanding of how the Chemistry Game and Atomas work. Always follow the teacher's instructions and is very careful with the equipment.	The student masters the use of the Chemistry Game and Atomas. Always follow the teacher's instructions and help their classmates. Always be careful with technology.