Erasmus+

Oxygen Escape Room – VEGA Teaching Scenario

Topic: a scenario based on a game that teaches differences between partial and complete combustion reactions

Subject: Chemistry

Age / Grade: Age 12-15, Grades 6th - 8th

Short description of the VR application in this scenario:
It's a VR app made for Oculus Link. Escape the room using your chemistry knowledge! Explore the clues lying around. Clear up the poisonous gas blocking your exit. Turn a toxic combustion reaction into a regular combustion reaction. Heat up different liquids to obtain the needed molecules.

Introduction to the scenario

Futuclass teaches the subjects of basic chemistry through gamified experiences in Virtual Reality. This scenario is based on one of the modules of the game in which players have to escape the room using their chemistry knowledge, in particular, the combustion process. In order to do this, they need to explore the clues lying around the room and clear up the poisonous gas blocking the exit through turning a toxic combustion reaction into a regular combustion reaction. The game's difficulty increases depending on the player's performance.

Learning outcomes:

The students are able to:

- Deduce which substances are required for reagents based on the chemical equation
- Know the required conditions for the incomplete and complete combustion to occur
- Balance the reaction equation for the complete combustion of ethan

Curriculum: Chemistry

Polish curriculum: https://podstawaprogramowa.pl/Szkola-podstawowa-IV-VIII/Chemia

- Students obtain and processes information from various sources with the use of information and communication technologies
- Give examples of different types of reactions; indicate substrates and products
- Indicate the influence of the catalyst on the course of a chemical reaction; on the basis of the reaction equation or description of its course, they distinguish the reactants (substrates and products) from the catalyst
- Conduct an experiment consisting in obtaining oxygen; read information about this element from various sources; write the equations of the reaction of obtaining oxygen
- Describe the chemical properties of carbon monoxide; conduct an experiment to obtain and detect carbon monoxide; write the equations of the reaction for the production of carbon monoxide (eg the combustion of carbon in oxygen)

Formative assessment

Number of students, duration (estimated time/number of lessons):

- number of students: depending on the number of VR sets, maximum 15 students in a group
- duration: 3 lessons (3 x 45 minutes); one introduction lesson (can be for the whole class) with two follow-up lessons of playing the game in smaller groups

Prerequisites (necessary materials and online resources):

- Online access to the game
- At least 4 compatible VR headsets (Valve Index, HTC Vive, Oculus Rift, Oculus Quest with a Rift link)
- Sufficient number of PCs with the game installed (depending on the number of students), cf minimal requirements here

Before the program begins (preparatory work for teacher):

- Learn the mechanics of the game yourself
- Ensure sufficient number of computers and VR headsets
- Plan the lessons in a way that both the whole class and smaller group sessions are possible
- Prepare follow-up activities aligned with the curriculum to check the learning outcomes of the gameplay

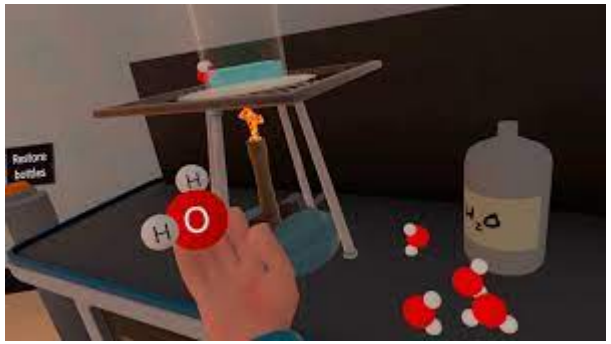
Lesson one: review of combustion reactions

(45 minutes)

The main requirements for the students to successfully play the game is to understand information based on molecular formula, knowing the 3D model of a molecule. They should also be able to explain how reaction equations work and balance simpler reaction equations. If this knowledge is missing or needs revision, the students should first play the module on balancing equations. In this preparatory lesson at least the following topics should be revised:

- How to balance the chemical reaction of complete combustion
- How to obtain molecules of substances required for the reactions
- The different properties of carbon monoxide and carbon dioxide

Lesson two: carrying out decomposition reactions
(45 minutes)



The lesson begins with an overview of the game interface and main functions of the objects visible on the screen (no special introduction to VR is planned here as the students are expected to be familiar with this learning technology, if not additional introductory session/s are needed). Once entering the VR space of the game the player finds himself in a room which is locked because the exit leads through a space filled with poisonous carbon monoxide emitted by an incomplete burning reaction taking place in that space. The players have at their disposal a reaction balancing table with the use of which they can change the reaction from incomplete to complete burning that will start producing carbon dioxide and thus make the space safe to enter. In this lesson, the task for the students is to heat different substances on a Bunsen burner (also available in the locked room) to produce necessary substances for the reaction balancing table. The lesson can be structured in the following way:

- Divide class into smaller groups (max. 4 students per headset)
- Explain the task and let them play the game in turns
- The students in headsets can communicate with the other members of their group, narrating their progress and asking for advice (if some required bits of chemistry knowledge have been forgotten)
- Make sure each student tests heating different substances on the burner so they produce different components for the balancing table
- If time allows, the players can progress to the next step (cf. the following lesson) although it's advisable to focus on decomposition reactions in this session
- Ensure sufficient time for closure and debrief

Lesson three: carrying out combustion reactions
(45 minutes)

In this lesson the students progress to the key stage of the game where they have to escape the locked room. They already know that decomposition reactions produce various products represented in the game with 3D molecular models. Now they have to interpret these representations correctly and experiment with construction of combustion reactions using the molecular models. If they balance the reaction properly, the heater in the locked space starts carrying out a complete combustion reaction, the space becomes safe to enter which unlocks the door.

- Divide class into smaller groups (max. 4 students per headset)
- Explain the task and let them play the game in turns
- Let the students move around the room and carry out the interconnected tasks (they are guided in the game with voice instructions at each step)
- It is important that the students make the connection between the balancing table and the combustion process to replace CO with CO2
- If some players are still locked in the room at the end of the session, design a follow-up revision lesson
- Monitor progress of playing in each sub-group to have an overview of the students' grasp of combustion reactions

Evaluation of the scenario with pupils
The following questions can be used for a feedback round with the students:

- Did you manage to exit the room?
- If not, what prevented you from doing so?
- How can you determine that the air in the room is toxic?
- What explains a high level of CO?
- How can you influence a combustion reaction?
- What do you need for a complete combustion reaction to occur?
- How do you like this form of chemical experiments?