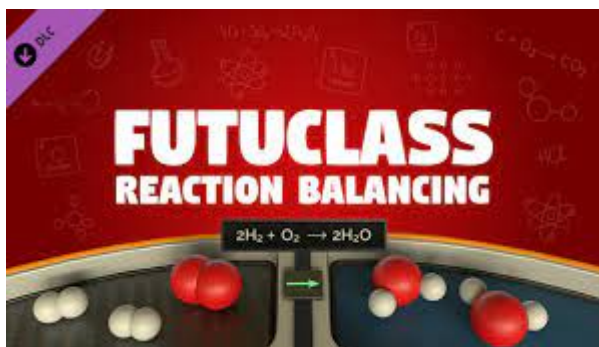




Reaction balancing – VEGA Teaching Scenario



Topic: a scenario based on a game that teaches how to balance chemical reactions

Subject: Chemistry

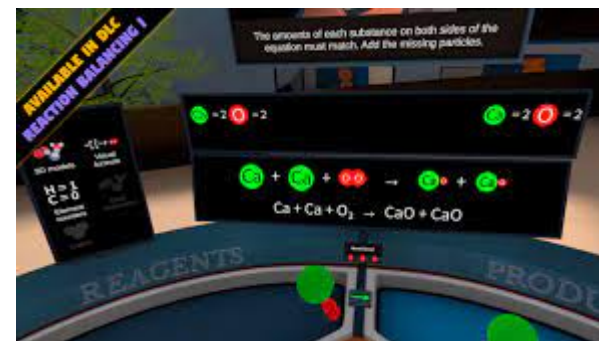
Age / Grade: Age 12-15, Grades 6th - 8th

Short description of the VR application in this scenario:

It's a VR app made for Oculus Link. Learn to balance chemical reactions in the most fun way possible! Throw the molecules onto the table, observe the visual helpers, and pull the lever when you've got it! Beat 8 levels in ascending difficulty at your own pace. When you reach the end, you'll know how to balance chemical equations!

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 which teaches how to balance chemical reactions. The game requires players to get an equal amount of atoms on both sides of the balancing table. The challenge arises from the fact that some molecules have different amounts of atoms on them. The game's difficulty increases depending on the player's performance. The game is still in the 'early access' status on STEAM, which means it is not complete yet. We have checked its functionality on the Oculus Quest with a Rift link and all the activities worked smoothly. Still the developers promise to progress further in the game improvements.



Learning outcomes:

The students are able to:

- Understand the relations between atom indexes and molecule amounts
- Be able to solve reaction equations

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
- Describe the properties of substances and explain the course of simple chemical processes
- Indicate the relationship between the properties of substances and their chemical structure
- Use elemental symbols and apply them to write chemical formulas
- Use the concept of a chemical element as a set of atoms with a given atomic number
- Determine the number of protons, electrons, and neutrons in an atom based on the atomic and mass numbers
- Describe the formation of chemical bonds; write down the summary and structural formulas of these molecules
- Describe and compare a physical phenomenon and a chemical reaction; give examples of physical phenomena and chemical reactions
- Write the equations of chemical reactions in molecular and ionic form
- Calculate the molecular weights of elements in the form of molecules and chemical compounds

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 [Futuclass resources](#)
- 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 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 chemical reactions and why they occur

(45 minutes)

The main requirements for the students to successfully play the game is to understand the basics of chemical reactions and the basic knowledge of the atom structure. The game will bring most benefits in connection with the revision of this material introduced in the course of previous lessons. This lesson can be planned as a summative review in preparation for - not a test (surprise surprise) - but a playful learning experience in the classroom. At least the following topics should be revised:

- Relationship between atom indexes and molecule amounts
- What is reaction balancing
- How to solve reaction equations with pen and paper

Lesson two: balancing using molecule models

(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). In the centre there is a balancing table. The required molecules for the reaction can be taken from the stacks placed on both sides of the table. To advance to the next level, the students have to solve three equations correctly in succession. The task in this lesson is to solve the equations using molecule models.



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 solves at least 3 equations and gets a reward of advancing through the game
- Ensure sufficient time for closure and debrief

Lesson three: balancing using substance cubes

(45 minutes)

In this lesson the students progress to a more demanding mode of solving reaction equations: the molecule models are replaced by grey cubes. The task for the player is to place an equal amount of matter on both sides, as before.

- Divide class into smaller groups (max. 4 students per headset)
- Explain the task and let them play the game in turns
- As the students progress through the game, some features are turned on and some off in line with the increasing difficulty
- It is important that all the students progress from the basic level of the game where one side of the equation is balanced and needs no input from the player to the more advanced level where a written reaction equation is shown on the screen
- Monitor the equation difficulty levels in each sub-group to have an initial overview of the students' progress through the game



Evaluation of the scenario with pupils

The best way to check the learning outcomes is to provide some reaction equations for the students to balance.

- For this lesson you don't need VR equipment
- Solving of the reaction equations can be integrated in regular school testing (digital or with pen and paper)
- Range the reactions in difficulty having in mind the learning content offered in the game
- If the students need more practice, revise the material and organise more playing sessions in VR
- Give the students an opportunity to discuss the learning experience in class and reflect on their progress together