**03.2 Framework of the lesson plan**

**Age group/grade:** 16-17 y. o. / 2nd gymnasium grade

**Lesson title:** Hydrogen

**Key concepts:** Gas relative density, gas solubility, substitution and coupling reactions, detonating gas.

**Objectives:**

* To learn about ways to produce hydrogen gas and write equations for chemical reactions.
* To identify the method of collecting hydrogen gas.
* To identify hydrogen gas.

**Skills developed:**

* Ability to explain methods to produce hydrogen.
* Ability to determine hydrogen gas capture methods based on physical properties.
* Ability to detect hydrogen gas using a flame.
* Skills of writing chemical equations.

**Materials/Equipment needed:** the periodic table of elements, the solubility table of acids, salts and bases in water, VR headsets, video projector, computer.

**Assumptions****:** (Programs for students with special needs, other important information)

Do not write reaction equations, no need to perform calculation tasks.

**Lesson Plan**

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| **Stages** | **Description of activity** | **Time** |
| **Preparation before the lesson** | To prepare the VR experience safety rules.  To prepare presentation on hydrogen collection methods. |  |
| **Introduction** | Introduction of the topic and objectives, the safety rules for working with VR headsets. | 5 min. |
| **Initial Immersive Experience** | Teacher explains the ways in which hydrogen gas can be obtained. During the explanation, students, assisted by the teacher, write equations for chemical reactions.  Teacher reminds gas collection methods. Students calculate the relative gas density of hydrogen, determine the solubility of hydrogen gas in water, and relate physical properties to gas collection methods.  Teacher explains how hydrogen gas is detected, what a detonating gas is. Students write a hydrogen gas detection reaction equation. | 25 min. |
| **Guided Immersive Experience** | Students are watching chemical experiments using VR headsets https://eloquent-ramanujan-887aa5.netlify.app/chemistry-3.html  Students identify which experiment is to obtain hydrogen gas, and which one – to detect it.  It is discussed how hydrogen gas can be collected in practice, why it is important to safely detect hydrogen gas. | 3 min. |
| **Follow up** | Students in groups are writing hydrogen production substitution reaction equations, list the methods for producing hydrogen (3 per group), explain why hydrogen is not used in balloons.  Each group presents the work done. | 10 min. |
| **Formative Assessment** | The work done is discussed within the groups, each group identifies their success and failures and the ones of all other groups.  Questions for self-evaluation:  1. During this lesson I understood the following key questions…  2. Working in the group with other students I learned … | 2 min. |