**O3.2\_Framework of the lesson plan**

**Age group/class: 12-13**

**Lesson title:** Determining the different characteristics of wastewater compared to drinking water

**School Discipline:** Chemistry

**Key concepts:** Drinking water, Waste water, Determination of pH, Salinity

**Aims:** The aim of this learning scenario is to understand how water cycles in nature, what the most important sources of water are, how pollution affects the water and what we can do to preserve the water clean.

**Skills developed**: Students will be able to:

- define and describe the water cycle

- explain the role of water for humans and plants

- apply and demonstrate knowledge and understanding in activities

- explain how water cycles through evaporation, condensation and precipitation

- analyse the results of a filtering wastewater experiment

- learn how to make clean water with natural materials

**Materials/Equipment needed**:

* VR headset
* VR video/link <https://eloquent-ramanujan-887aa5.netlify.app/water-treatment.html>

Resources and web tools:

* <https://www.youtube.com/watch?v=MfCLqCGqe6E> – water cycle
* <https://wordwall.net/resource/415044/science/water-cycle>
* <https://www.youtube.com/watch?v=Om42Lppkd9w> – Water pollution, water contamination
* <https://www.youtube.com/watch?v=MTAFaebdPJI&authuser=0>
* <https://wordwall.net/resource/19342322/water-filtration-experiment-protocol>
* <https://wordwall.net/resource/19342675/water-filtration-observation-sheet>

Materials:

* Erlenmeyer flasks
* Filter paper
* Stirring rods
* Glass funnels
* Dirty water
* used plastic bottles
* small amounts of coal sand and gravel
* cotton disks

**Lesson plan:**

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| **Stages** | **Description of activity** | **Time** |
| **Preparation before the lesson** | If this is a first VR experience for students – go through the safety rules: -  Learners are to sit down whilst using the VR glasses and not hold anything in their hands, unless the experience is of such a nature that it requires you standing, in which case, ensure enough space is allowed around all students.  -  Learners will be told to expect a feeling of vertigo. If it gets worse, students must remove VR glasses.  -  Learners need to know how to adjust the viewing focus before using the headsets.  -  Learners must not use the headset when they are: tired, need sleep, under emotional stress or anxiety, when suffering from cold, flu, headaches, migraines as this can worsen their susceptibility to adverse reactions.  -  Learners should be given the choice to opt out of using VR. |  |
| **Introduction** | The teacher starts the lesson by asking the students the following questions: Why is Earth often called the 'blue planet?' How much of our bodies are composed of water? Can you think of a day in without water? Is it possible for water to disappear from the Earth? Why or why not?  The teacher pairs up the students and engage them in collaborative discussions (teacher-led).  The teacher tells the students that they will learn about the water cycle. For understanding what this phenomenon means, the teacher presents the students the video https://www.youtube.com/watch?v=MfCLqCGqe6E about the water cycle. The video contains an embedded quiz, so the teacher pauses it from time to time to allow students answer the questions or to make predictions. To check students’ understanding, they will do the following interactive exercises: https://wordwall.net/resource/415044/science/water-cycle, in which they will have to label a diagram representing the water cycle. The students then are divided in groups of four and given a handout with a text and a diagram https://www.freedrinkingwater.com/resource-water-cycle-student-guide.htm and https://www.weather.gov/media/jetstream/downloads/hydro2010.pdf. The students read the text and then working collaboratively, will find definitions for the specific terms (water cycle, evaporation, condensation etc.) and write them down in a glossary. | 5 min. |
| **Initial Immersive Experience** | Learners put on the VR headsets and explore the video at their own pace.  Turn the headsets off and bring students back into the classroom. | 3 min. |
| **Guided Immersive Experience** | The teacher starts the lesson by asking questions to students related to the link between water cycle and photosynthesis, the Greenhouse effect and the biogeochemical cycle of carbon, to check how they did their research.  Then the teacher pours water in a glass and asks the students: How do we know we can drink this water? How polluted do you think water on Earth is? And since water is recycled, how can we purify it? The students are paired up and discuss one-on-one (teacher-led). Then the students are invited to watch the video https://www.youtube.com/watch?v=Om42Lppkd9w – Water pollution, water contamination. While still paired up, the students take notes about the causes, the effects and the ways to stop water pollution. They will then have to fill in the gaps in a text about water pollution.  The teacher presents a scale model of industrial water filtration so that students can understand what happens in a water treatment plant. The students, divided in groups of four, use Erlenmeyer glasses, filter paper, stirring rods, glass funnels and dirty water to simulate the real-life process. The students, guided and monitored by the teacher, decant and filter the water until they obtain filtered water. The students use their observation sheets to write the amount of sediments and filtrate resulted after the experiment. Then they have to state their conclusions about the amount of sediments In the wastewater.  For the second experiment, the students have to imagine that they are in the woods, with no drinking water, and they have to improvise a water filtration device. The teacher presents the students the theory behind the filtering process and the required materials: used plastic bottles, small amounts of coal, sand and gravel, and cotton disks. The water they have to filter is dirty. The students have to let the water to sediment and in the meanwhile they prepare the filtering device: the filter consists of a plastic bottle, with the bottom removed, inside which, the following layers are placed: large stones, small gravel, sand, coal, covered with a layer of cotton wool or cotton layers. The water obtained in this way is analysed in terms of characteristics: colour, smell, taste, turbidity. Then the students share their observation with their peers. The observation sheet is presented here: <https://wordwall.net/resource/19342675/water-filtration-observation-sheet>  In the end, the students work in groups and write short paragraphs in which they propose solutions to fight water pollution. | 5 min. |
| **Follow up** | I. Decantation  Decanting is the method of separating the components of a heterogeneous solid-liquid or liquid-liquid mixture, based on their different densities.  Bazine decantoare de apă  II. Filtering  Filtration is the method of separating a solid from a heterogeneous solid-liquid mixture using a filter material.  FILTRAREAFILTRAREAFILTRAREAFILTRAREA  Experiment No. 1: Physical separation methods used for wastewater treatment  **Imagini pentru decantation filtration wastewater**  Experiment no. 2 How do you make a natural filter to get drinking water from dirty water?  Science-U @ Home / Water Filter Experiment | 5 min.  10 min. |
| **Formative Assessment** | Teacher monitors individual, pair and group activities  Students participate in all tasks and activities  Students work autonomously to do research or to conduct experiments  Students interact successfully with partners  Students do self and peer assessment | 5 min. |