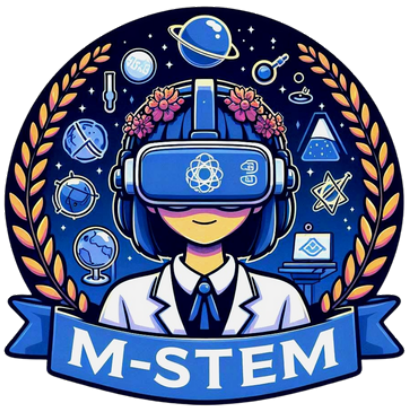

M-STEM

LESSON PLAN - THE IMPORTANCE OF PH IN EVERYDAY LIFE

METAVERSE-BASED STEM EDUCATION FOR A SUSTAINABLE AND RESILIENT FUTURE

2023-1-FR01-KA220-SCH-000151516

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Purpose of the lesson

The aim of the lesson is to develop a **solid understanding of pH** and **its impact** on different areas of life and the environment. The lesson aims to teach students how to **determine pH** through different methods, such as pH strips, chemical indicators or pH meters, to make students **aware of how pH influences** food, health, the environment, agriculture and various household and cosmetic products, which will allow them to **appreciate the relevance** of this concept in their daily lives, to be able to **identify** situations where it is **important to control pH** (e.g. water quality, plant health, correct use of cleaning products) and to know how to **apply solutions** to maintain **pH within appropriate ranges**.

Description of the lesson

This lesson focuses on pH and provides students with **theoretical support** on the notion of pH, the pH scale, and the acidic, basic or neutral nature of solutions. The lesson **combines theory with practical examples** to facilitate understanding of the **applicability** of this concept in everyday life, in fields such as: medicine, food, agriculture, cosmetics, environment, etc. pH determinations will be made using pH strips, chemical indicators, or pH meters, highlighting the advantages and disadvantages of each method. The virtual lab allows students to **interactively explore** key concepts about pH, to conduct experiments, and to obtain **accurate data safely and quickly**, without the need for physical equipment and without the need for consumables. Students will analyze the change in water pH in a virtual aquatic ecosystem to which various pollutants are added and identify the effects of pollution on the aquatic environment and marine life.

Lesson teaching method

This lesson is taught using an **interactive teaching method**, with the educator relying on a PowerPoint presentation to explain the concept of pH and the various methods of measuring it, while students will be invited to answer questions or provide examples of acidic or alkaline solutions. The teaching method is combined with the **discovery learning method**, in which students carry out practical work to determine the pH of different substances used in various fields; the teaching activity can be complemented with a *question-and-answer* session that encourages **critical thinking** and develops argumentation and communication skills.

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Learning objectives

At the end of the lesson, students will be able to:

- **define** the concept of pH and understand the pH scale
- **use** various methods of measuring pH (pH strips, chemical indicators, pH meter)
- **explain** the importance of pH in various fields (food, health, environment, agriculture)
- **identify** the effects of pollution in everyday life (aquatic ecosystem), applying knowledge about pH.

Lesson plan

1. Introduction (10 minutes)

Students will be challenged to answer the question "***What does pH mean and how do you think it influences everyday life?***" and will watch a video clip that illustrates/explains the importance of pH for the health of the human body, for nutrition, for soil quality.

The teacher will explain **the purpose of the lesson and its objectives**
Theoretical explanations:

- Definition of pH
- Explaining the pH scale
- Methods for determining pH
- The importance of pH in different fields

2. Lesson progress (40 minutes)

a). **Methods of determining pH values (5 minutes)**: students will be invited to watch a video showing different ways of determining pH (pH strips, chemical indicators and pH meter).

b). **pH determinations (10 minutes)**: Students will be organized into three groups, each team performing determinations for the same solutions (tap water, bottled carbonated water, cola, vinegar, NaOH , etc.), using one of the methods presented: pH strips, chemical indicators, and pH meter. Students will record the values of the determinations in a predefined table; the determinations can also be performed in a virtual format, using platforms such as *PhET pH Scale Simulation*.

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c). **Reflection activity (10 minutes)**: students will be challenged to participate in discussions about determining and recording pH values, to make small comparative analyses, as well as to highlight the advantages and disadvantages of the methods used.

d) **Interactive activity (15 minutes)**: analyzing the effects of pollution on the aquatic environment and marine life, through an experiment created with Metaverse technology. Students will determine the pH of water in a virtual aquatic ecosystem into which different polluting agents will be introduced: pesticides and fertilizers, detergents, petroleum products, acids, bases, etc.; students will observe the effects of pH changes on the ecosystem.

3. Assessment of acquired knowledge (8 minutes): to assess the knowledge acquired, the teacher can use the following test:

Multiple Choice Questions (one correct answer):

1. What is the pH scale used to measure?
   - A) Temperature
   - B) Density
   - C) Acidity and alkalinity
   - D) Pressure
2. Which of the following pH values is considered neutral?
   - A) 0
   - B) 7
   - C) 14
   - D) 4
3. What is the primary advantage of using pH indicator paper for measuring pH levels?
   - A) It provides precise numerical values.
   - B) It is quick and easy to use.
   - C) It does not require calibration.
   - D) It can measure temperatures simultaneously.
4. What is a potential negative consequence of a high urine pH (alkaline urine)?
   - A) Increased risk of kidney stone formation
   - B) Enhanced absorption of nutrients
   - C) Improved hydration levels
   - D) Reduced risk of urinary tract infections

5. What is the optimal pH range for most fish species in freshwater?
   - A) 6.5 - 8.5
   - B) 4.5 - 5.5
   - C) 9.0 - 10.0
   - D) 7.0 - 7.5

6. Which of the following is a potential consequence of low stomach pH (high acidity)?
   - A) Increased nutrient absorption
   - B) Improved immune response
   - C) Enhanced digestion
   - D) Acid reflux

True/False Questions:

7. True or False: The pH of the skin is typically acidic, helping to protect against pathogens.

8. **True or False:** A higher pH level in the blood indicates acidosis.

9. **True or False:** pH levels have no impact on the solubility of toxic metals in water.

10. **True or False:** Pesticides can alter the pH levels of river waters, potentially making them more acidic and harmful to aquatic life.

Answer Key:

1.C, 2. B, 3.B, 4. A, 5.A, 6. D, 7. TRUE, 8. FALSE, 9. FALSE, 10. TRUE

4. Homework (2 minutes)

Activity 1

Students will be asked to create a material in which they present, synthetically, the optimal pH values for the development of plants commonly found in their area. To complete the task, students can use different sources of information.

Activity 2

In teams of 5 members, students will create a poster, in digital format, presenting solutions for preventing/treating the negative consequences caused by changes in pH on the human body.

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Lesson table

The importance of PH in every day life	
Introduction • Students answer the question "What does pH mean and how do you think it influences everyday life?" • Students watch a video clip • Theoretical explanations: ◦ Definition of pH ◦ Explaining the pH scale ◦ Methods for determining pH ◦ The importance of pH in different fields	10
a). Methods of determining pH values Students watch a video on ways to determine pH	5
b). pH determinations • Organized into three groups, students perform determinations for the same solutions (tap water, bottled carbonated water, cola, vinegar, NaOH , etc.) • Students use one of the methods presented in the video • Students record the values of the determinations in a predefined table	10
c). Reflection activity • Students participate in discussions about determining and recording pH values, • Students make small comparative analyses • Students highlight the advantages and disadvantages of the methods used.	10

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Lesson table

The importance of PH in every day life	
d) Interactive activity • Students analyze the effects of pollution on the aquatic environment and marine life • Students determine the pH of water in a virtual aquatic ecosystem into which different polluting agents are introduced	15
Assessment of acquired knowledge Teacher assesses students' knowledge, using a quiz	8
Homework • **Activity 1** Create a material in which to present, synthetically, the optimal pH values for the development of plants • **Activity 2** In teams, create a poster, in digital format, presenting solutions for preventing/treating the negative consequences caused by changes in pH on the human body.	2

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Lesson resources

Resources needed for the lesson

- PPT presenting theoretical concepts and the importance of pH in everyday life
- Videos to raise awareness regarding the importance of knowing pH and to present methods for determining pH
- Materials needed: pH indicator paper, acid -base indicator solutions, pH meter, watch glass, test tubes, solutions to be analyzed, etc.

Digital resources

- https://www.youtube.com/watch?v=r3hirzlWILM
- https://www.youtube.com/watch?v=dSOFP6LDbXM
- https://www.youtube.com/watch?v=PJCSvGtoglY
- https://www.youtube.com/watch?v=zQowljL8e5E
- https://www.youtube.com/watch?v=9MYviGrhbfs&t=601s
- https://www.youtube.com/watch?v=Ie4wGv4wrgw&t=51s
- https://www.youtube.com/watch?v=hZoImlw3b2o
- https://www.youtube.com/watch?v=Ea-0QV89tf4&t=2s
- https://create.kahoot.it/details/1e5ab6b9-e15f-43d2-a631-4d5449cf2cc4

Evaluation and indicators

Evaluation will be carried out throughout the learning activities; the teacher will assess the degree of involvement of the students in completing the tasks, the application of knowledge in carrying out practical determinations and the accuracy of the results obtained, the identification of the effects of pollutants on the aquatic ecosystem, the provided answers in the assessment quiz. The teacher will provide feedback in a structured manner and will identify areas that require improvement.

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Evaluation and indicators

Criteria	Excellent	Good	Satisfactory	Needs improvement
Knowledge of the pH Scale	Accurately describes the pH scale (0-14), including definitions of acidic, neutral, and basic.	Describes the pH scale with minor inaccuracies.	Mentions the pH scale but has significant misunderstandings.	Does not understand the pH scale or its significance.
Practical skills / abilities to determine pH values	Accurately uses different laboratory utensils to determine pH values (pH indicator paper, solutions of acid-base indicators, pH meter, watch glass, glass rod, test tubes, test solutions)	Manages to use different laboratory utensils to determine pH values, fast but may make minor inaccuracies	Manages to use some laboratory utensils to determine pH values, but not all of them and makes recurrent errors	Cannot use different laboratory utensils to determine pH values and lacks ability to register pH values
Negative Consequences of Inappropriate pH	Identifies multiple negative consequences of inappropriate pH levels on health with concrete examples (eg, skin issues, digestive problems).	Identifies some negative consequences with a few examples.	Mentions a negative consequence but lacks detail or examples.	Fails to identify any consequences of inappropriate pH.
Engagement and Participation	Actively participates in discussions and activities, demonstrating enthusiasm and curiosity.	Participate in discussions and activities, showing interest.	Participates minimally but engages with prompts.	Rarely participates or shows disinterest in the lesson.
Application of Knowledge	Effectively applies knowledge of pH in hypothetical scenarios related to human health.	Applies knowledge to some scenarios but lacks depth in explanation.	Attempts to apply knowledge but does so inaccurately.	Does not apply knowledge to scenarios.

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Overview of the lesson

This lesson plan is addressed to **students aged 13-19** and aims to familiarize them with **basic concepts** related to acidity, alkalinity, the **pH** scale and practical pH determinations for different substances. Students will receive information about how different pH values **influence** us in our daily lives. The lesson provides **knowledge with applicability** in different fields (health, food industry, cosmetics industry, pharmaceuticals, agriculture). This lesson is designed in an **interactive format,** with students being involved in practical pH determinations, as well as in a virtual experiment, using **Metaverse technology**. Thus, participants will understand and appreciate the essential role of pH in biological, chemical and ecological processes.

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