Detailed Work Plan

Science Training for Teachers and Students

Central Theme:

"Science, Technology, and Sustainability: Innovation in 21st-Century

Education" Duration: 3 Days

Target Audience: Secondary school teachers and students.

General Objectives

1. **Train teachers** to integrate active methodologies, advanced technologies, and interdisciplinary approaches into science teaching.
2. **Motivate students** to learn science through innovative and contextualized methodologies.
3. Promote the use of **technological and digital tools** in teaching, focusing on experimentation and simulation.
4. **Connect scientific theory to real life**, addressing global and local challenges such as sustainability and innovation.

Specific Objectives by Audience

Teachers

- Develop skills to apply **Phenomenon-Based Learning (PhBL)** and **Inquiry-Based Learning (IBL)**.
- Master the use of **virtual laboratories**, **augmented reality (AR)**, **virtual reality (VR)**, and **programming** as pedagogical tools.
- Create gamified and interactive strategies to actively engage

students. **Students**

- Perform practical scientific experiments and simulations connecting science to real world applications.
- Learn to use digital tools for scientific inquiry while collaborating on interdisciplinary projects.
- Apply concepts from Physics, Chemistry, and Biology to solve everyday

problems.

Action Plan by Day

Day 1 – 02/04/2025

Training: The Movement of Charged Particles in Electric and Magnetic

Fields Session 1 (1h): Introduction to Phenomenon-Based Learning

Case Study Exploration:

- **Topic:** "The Movement of Particles in Electric and Magnetic Fields"
- Interdisciplinary discussion connecting Physics, Chemistry, and Engineering.

Session 2 (1h): Exploration of Online Simulators

Practical Activities:

- Use of **PhET Interactive Simulations** (https://phet.colorado.edu/en/) to explore the following concepts:
  - **Charge and Electric Field:** Interaction of charged particles in electric fields.
  - **Charge Moving in Magnetic Fields:** Effect of Lorentz force on charged particles.
- Use of **SimuFísica** (https://simufisica.com/simulacoes/carga-em-um-campo eletromagnetico/) to visualize the behavior of charged particles in an electromagnetic field.

Break (15 min)

A short break to allow participants to absorb the concepts and refresh before moving on to applications.

Session 3 (1h): Application to the Mass Spectrometer

Practical Exploration:

- Simulation of ion separation based on their masses and charges.
- Reflection on the importance of the mass spectrometer in scientific and industrial research.

Session 4 (1h): Application to the Cyclotron & Collaborative

Discussion Practical Exploration:

- Simulation of cyclotron operation and its application in particle acceleration.
- Discussion on cyclotron applications in medicine and particle physics.

Collaborative Reflection:

- Group discussion on the connections between these concepts and real-world applications.
- Participants share insights on how to implement these concepts in their learning or teaching environments.

Training Objectives:

1. Understand the principles of charged particle movement in electric and magnetic fields.
2. Explore practical applications of these concepts in devices such as mass spectrometers and cyclotrons.
3. Use interactive simulators to consolidate understanding through virtual experiments.
4. Promote interdisciplinarity and phenomenon-based learning for more dynamic and engaging education.

Day 2 – 03/04/2025

Laboratory Training: Determining the Viscosity of a Liquid

Session 1 (1h): Introduction to Experimental Methods

Overview:

- Introduction to viscosity and its importance in physics and engineering.
- Explanation of different methods for determining viscosity.
- Overview of the software tools used: **Tracker**, **Excel**, and **pycnometry technique**. **Practical Setup:**
- Introduction to the experimental setup: falling sphere method and capillary flow method.
- Safety precautions and laboratory best practices.

Session 2 (1h): Data Acquisition Using Tracker

Practical Activities:

- Recording videos of a falling sphere in a viscous liquid.
- Importing and analyzing the motion using **Tracker** (https://physlets.org/tracker/). • Extracting velocity data and determining acceleration.

Discussion:

- Understanding the forces acting on the sphere.

• Initial calculations of viscosity using Stokes' law.

Break (15 min)

A short break to allow participants to reflect on the collected data before proceeding to further analysis.

Session 3 (1h): Density Determination Using Pycnometry

Practical Activities:

• Measuring the density of the liquid using a **pycnometer**.

• Explanation of the technique and calculations required.

• Comparison with reference density values.

Discussion:

• The role of density in viscosity calculations.

• Error analysis and sources of uncertainty.

Session 4 (1h): Data Processing and Viscosity Calculation

Practical Activities:

• Using **Excel** (or Google Sheets) to process collected data.

• Application of Stokes' law and Poiseuille's law for viscosity determination.

• Creating graphs to visualize trends and confirm theoretical predictions.

Collaborative Reflection:

• Group discussion on the results and their implications.

• Exploring online resources such as **HyperPhysics** (http://hyperphysics.phy astr.gsu.edu/) for further learning.

• Suggestions for improving the methodology in future experiments.

Training Objectives:

1. Understand the principles of viscosity and its measurement methods. 2. Develop skills in video analysis using **Tracker**.
3. Accurately determine liquid density using pycnometry.
4. Use **Excel** for data processing and viscosity calculations.
5. Promote critical thinking and collaborative learning through experimental analysis.

Day 3 – 07/04/2024

Third Morning of Training: Consolidation and Future Planning – "From Knowledge to Action"

Objective: Consolidate the learning from previous sessions, encouraging participants to apply the knowledge gained in a practical and collaborative way, while also planning future actions.

Total Duration: 4 hours (with a 15-minute break)

1. Presentation of Results: Science Showcase (1h 45min)

- **Objective:** Participants will have the opportunity to present the projects and experiences they have developed during the program, focusing on solutions for sustainability, innovation, or other practices worked on.

• **Description:**

- Each group will have 10-15 minutes to present their work, using resources such as slides, posters, or live demonstrations.
- During the presentations, dialogue will be encouraged, with questions and suggestions from other participants.
- The focus will be on how each project contributes to the local reality and how it can be replicated or expanded.

Break (15min)

2. Scientific Competition: Final Quiz with Kahoot (1h)

- **Objective:** Assess learning in a playful and dynamic way, reinforcing the concepts covered in the previous sessions.
- **Description:**
  - Participants will respond individually or in groups using the Kahoot platform, promoting healthy competition and engagement.
  - The activity will be a fun way to quickly and effectively review the content.

3. Interdisciplinary Project Planning Workshop (1h)

- **Objective:** Encourage creativity and teamwork, motivating participants to plan interdisciplinary projects related to sustainability, innovation, and the application of street games.
- **Description:**
  - Participants will be divided into groups to plan a project that integrates areas such as science, art, physical education, or others, focusing on sustainability and innovation.
  - Each group will have 30 minutes to structure their project, considering necessary resources, goals, and impact.
  - At the end, each group will briefly present their project to the rest of the participants.

Closing and Final Reflection (15min)

- **Objective:** Conclude the session with a moment of reflection on the learnings and the next steps.
- **Description:**
  - The closing ceremony will be brief, with thanks and recognition for the participants.
  - Certificates of participation will be handed out, emphasizing the value of each contribution.

Adriano Néry

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