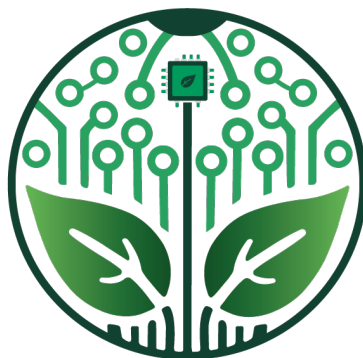




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LESSON PLAN

Green Chemistry in Action: Designing a Sustainable Product with Artificial Intelligence

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1. Green Chemistry in Action: Designing a Sustainable Product with Artificial Intelligence

2. GRADE LEVEL

ISCED Level 3 – Upper Secondary Education (ages 15–18)

3. SUBJECT AREA

Chemistry

- ☒ Sciences
- ☒ Environmental Studies
- ☒ Computer Science

TYPE

Lesson Plan

4. DURATION

2 x 45-minute classes

5. LEARNING OBJECTIVES

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

O1: Explain basic principles of Green Chemistry and their role in sustainable development.

O2: Identify ways in which Artificial Intelligence can support environmentally friendly chemical production and decision-making.



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O3: Design a simple sustainable chemical product concept using Green Chemistry criteria.

O4: Present and justify a green business idea based on scientific and environmental arguments.

6. Key Competences Developed

Mathematical competence and competence in STEM

Digital competence

Personal, social and learning to learn competence

Citizenship competence

Entrepreneurship competence

7. Prior Knowledge / Prerequisites

Basic Chemistry knowledge from lower secondary education (states of matter, mixtures, basic chemical substances).

No prior knowledge of Artificial Intelligence is required

8. Lesson/Project Outline

Phase 1 – Introduction (Engage & Contextualize)

Purpose: Activate prior knowledge and introduce the concept of sustainable chemistry.

Activities:

Short video (2–3 minutes) presenting environmental problems caused by conventional chemical products (e.g. detergents, plastics).

Guided class discussion using questions such as:



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Can chemistry be environmentally friendly?

Where do we encounter chemical products in everyday life?

Expected Outputs:

Students identify environmental impacts of chemical products.

Initial understanding of the need for Green Chemistry solutions.

Resource (name)	Link (to the folder on Teams)
American Chemical Society – What Is Green Chemistry?	https://www.acs.org/greenchemistry/what-is-green-chemistry.htm

Phase 2 – Exploration (Investigate & Compare)

Purpose: Introduce Green Chemistry principles and the role of AI.

Activities:

Teacher presentation on selected Green Chemistry principles (waste prevention, safer materials, energy efficiency).

Short explanation of Artificial Intelligence with real-life examples related to sustainability.

Group discussion comparing conventional products with greener alternatives.

Expected Outputs:

Students understand how chemistry, sustainability and AI are interconnected.

Students analyze advantages of green solutions.

Resource (name)	Link (to the folder on Teams)
American Chemical Society – Green Chemistry Principles	https://www.acs.org/greenchemistry/principles.html



Phase 3 – Application (Hands-On Practice)

Purpose: Apply knowledge to a real-life sustainability challenge.

Activities:

Students work in small groups to design a green chemical product (e.g. eco-friendly cleaner).

Groups define:

Purpose of the product

Main ingredients (non-toxic, biodegradable)

Environmental benefits

Students use an AI tool (e.g. chatbot) to receive suggestions for improving sustainability.

Expected Outputs:

A completed worksheet describing the green product concept.

Evidence of AI-supported decision making.

Resource (name)	Link (to the folder on Teams)
European Commission – Safe and Sustainable Chemicals	https://environment.ec.europa.eu/topics/chemicals/safe-and-sustainable-chemicals_en

Phase 4 – Reflection & Consolidation (Present & Connect)

Purpose: Reflect on learning and connect it to sustainability and Industry 4.0.

Activities:



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Group presentations of product ideas.

Class discussion on feasibility and environmental impact.

Individual reflection note (½ page): What did I learn and how was AI used?

Expected Outputs:

Improved communication and reflection skills.

Clear link between chemistry, AI and green entrepreneurship.

Resource (name)	Link (to the folder on Teams)
European Commission – Industry 4.0 and Sustainable Industry	https://single-market-economy.ec.europa.eu/industry/industry-40_en

9. Assessment Criteria

Assessment is based on:

Group project quality

Scientific accuracy

Sustainability criteria

Reflection quality



10. Teaching Materials

Name	Type (Developed/Existing)	Link	Role in the lesson
Green Chemistry Principles Infographic	Existing	https://www.epa.gov/greenchemistry/basics-green-chemistry	Visual understanding of the 12 Principles of Green Chemistry
AI for Sustainability – Short Video	Existing	https://www.oecd.org/ai/ai-and-environment.htm	Engagement & context
Green Chemistry – Introduction Slides	Existing	https://www.acs.org/greenchemistry/what-is-green-chemistry.html	Conceptual understanding

11. External Resources and References

This section includes optional references for students who wish to explore the topic beyond the scope of the lesson.

Resource (name)	Link (external or to the folder on Teams)
European Commission. (2020 / ongoing). Chemicals Strategy for Sustainability – Towards a Toxic-Free Environment.	https://environment.ec.europa.eu/strategy/chemicals-strategy_en
UNESCO. (n.d.). Artificial Intelligence for Sustainable Development (Synthesis Report).	https://unesdoc.unesco.org/ark:/48223/pf0000370308