IOCES 2026 Conference
The 1st International Online Conference on Education Sciences
15–17 June 2026 | Online
MDPI

Integral STEM lesson "Energy in Nature"

Slaveya Petrova[1], Delka Karagyozova-Dilkova[2]

[1] Department of Ecology and Environmental Conservation, Faculty of Biology, Plovdiv University Paisii Hilendarski, Bulgaria
[2] Department of Botany and Biological Education, Faculty of Biology, Plovdiv University Paisii Hilendarski, Bulgaria

INTRODUCTION & AIM

The educational process in the STEM concept is aimed at implementing interdisciplinary learning models (cross-curricular connections), through which students are given the opportunity to discover the logical connection between different "pieces" of knowledge taught in multiple scholarly disciplines. Cross-curricular connections are a way to achieve stable knowledge, refracted through the prism of different scientific fields.

The aim of the study is to present the effectiveness of a new developed STEM lesson "Energy in Nature", which teaches students how the sun, wind, and water create power, and how plants and animals use food for energy. Students explore these concepts through hands-on activities, like building model dams, testing sun ovens, or playing games that simulate food chains. We investigate how direct participation in various activities affects students' comprehensive knowledge on fundamental natural processes.

METHOD

The pedagogical experiment was conducted in the STEM centers of two schools and included the following themes and groups of activities:

- RENEWABLE ENERGY: Power made from natural, unlimited sources like the sun and wind.
- THE CHEMICAL BONDS: energy change in any chemical reaction.
- ENERGY TRANSFORMATION: How plants turn sunlight into chemical energy and stored it.

Lesson Objectives:

- Identify three natural energy sources.
- Explain how plants use sunlight.
- Design an invention to capture natural power.

CONCLUSION

The present study focuses on the big idea of energy flow in nature and integrates biology, physics and chemistry in various experiments, forming one integral unit. The energy from a biological point of view is studied through the series of experiments involving the fundamental processes like photosynthesis, metabolism, movement and action. To study energy like a physical phenomenon, students have to conduct some experiments like the construction of a dynamo, wind turbine, and water turbine, measure the photovoltaic effect and discuss alternative energy sources. The chemical part of the experiments is related to hydrogen energy and how to use the hydrogen cell to move a car.

When the same lesson is presented from different perspectives, we enable students to be flexible, make connections between subjects, and work in a variety of circumstances. They understand concepts, phenomena, and events better when we provide them with different learning contexts and perspectives through which to explore them.

RESULTS & DISCUSSION

PHYSICS MODULE

✓ Conversion of light energy into electrical energy

Light energy is converted into electrical energy primarily through the photovoltaic (PV) effect, which takes place in devices like solar cells. When particles of light (photons) strike the semiconductor material in a solar cell, they transfer their energy to electrons. This kicks the electrons free, allowing them to flow through an electric circuit as electricity.

✓ Conversion of wind energy into electrical energy

Wind energy is converted into electrical energy using wind turbines. Moving air (wind) pushes against the turbine blades, turning them. This spinning movement powers an internal generator, which produces electricity.

CHEMISTRY MODULE

✓ Energy in chemistry bonds

Energy in chemical bonds is a form of potential energy stored between atoms. Breaking chemical bonds requires an input of energy, while forming new chemical bonds releases energy. The total energy change in any chemical reaction depends on the difference between the energy needed to break old bonds and the energy released to form new ones.

✓ Hydrogen energy

Hydrogen energy is the use of hydrogen gas as a clean-burning fuel or energy carrier. When consumed in a fuel cell, it combines with oxygen to produce electricity and water, releasing zero carbon emissions. It is highly efficient and can store large amounts of energy, making it a key player in powering homes, vehicles, and industries.

BIOLOGY MODULE

✓ Observation of photosynthesis in Elodea and demonstration of oxygen release

This experiment exposing a submerged plant stem to light, which triggers it to produce streams of visible oxygen bubbles. This process provides direct, visual proof that plants use light energy to convert carbon dioxide and water into glucose and oxygen.

✓ Microscopic observation of starch grains from different types of flour

Microscopic observation of starch grains from different flours reveals that each plant stores starch in uniquely shaped and sized structures called granules. By analyzing these shapes and sizes under a standard light microscope, you can easily identify the plant source of the flour.