# Teacher Guide for the Sustainable Energy "*Can Water be the Future Fuel?!*" a Blended Learning Module

**Ahmad Al-Ajlouni/ Professor of Chemistry**
**(e-mail: aajlouni@just.edu.jo)**

**Teacher's Guide:**

The main objective of this lesson is to bring the students' attention to the importance of basic and natural sciences in our life. It will introduce a topic (sustainable energy) that is related mainly to chemistry and not usually covered directly in a high school curriculum. We hope that the lesson will show the students how important and useful natural and basic sciences to our daily life and for sustainable development. We also hope that students will be inspired by some creative ideas, and develop confidence to come up with creative ideas themselves.

**The lesson plan** The lesson should be completed in 50-60 minutes class. In includes 6 segments and a challenging activity for the students between each two segments. These activities will take almost half of the time, approximately 20-25 minutes, with the students working in groups of 2-4. The video component of this lesson is ~ 25 minutes long. The students should discuss the challenging question and exchange ideas with each other, and be ready for the next segment.

**Background on the topic** The topic background is based on fundamental concept in chemistry (mainly), biology, physics and environmental science. During each lessen, we will be building the students' knowledge from well known issues and simple chemical principles. As a practice on chemical concepts, the teacher may ask the students to pay attention to all chemical equations presented in *segment 5* and make sure that each of them is correct and balanced (some equations are not balanced!). Also in *segment 5*, the students can refresh their information on stoichiometric calculations of chemical equations and energy, and compare the efficiency of $H_2$ and gasoline (octane, $C_8H_{18}$) as fuel by doing the following problem:

**Practical problem:**
**Calculate the energy produce when 1 g of $H_2$ or gasoline (use $C_8H_{18}$) is burned in air using $\Delta H$ values for $H_2$ and $C_8H_{18}$: 245 and 5065 kJ/mol, respectively?**

## Video and Timing Details

**Part One: Video segment is 85 seconds. Approximate time for the following activity is 3-5 minutes.**
Students should try to find a relation between kids playground and the video subject "sustainable energy and energy conversion". The teacher may guide students to the fact that there is energy generation here, and how it can be utilized in a useful way?

**Part Two: Video segment is ~ 3 minutes. Pause time is 4-6 minutes.**
Dr. Ajlouni presents Danial Shredian idea of using the energy generated from kids playground in a useful way classify. The main objective here is to enhance students' curious and motivate them to be creative. Then, he introduces the important of energy in our life. At the end of this segment, students should discuss the available energy sources and classify them into *consumable (unsustainable) and renewable (sustainable) sources and* summarize the advantages and disadvantages of each type. The aim of this activity is to pay students' attention to the meaning of sustainable and unsustainable energy sources around us and the disadvantages of major sources that we are using and the advantages of using other clear and sustainable sources, such as winds, waterfalls and sun.

**Part Three: Video segment is 2.5 minutes. Activity time approximately 4-6 minutes.**
Dr. Ajlouni discusses the major current sources of energy and points out that more than 95% of energy we are using is consumable and many problems are facing us while we are depending on these sources. Students should realize that we need to utilize more natural renewable resources, such as winds, waterfalls and sun. In the in-class activity, students will discuss how to utilize the natural renewable sources of energy directly or indirectly, such as generating electricity in some areas like Arabian Sahara. They should give ideas and suggestions about the use of winds, waterfalls, and solar energy directly and/or converting these energy sources to another types of energy, such as electrical and mechanical energies.

**Part Four: Video segment is ~ 4 minutes. The pause approximately 4-6 minutes.**
This part focuses on the solar energy power. It introduces the fact that solar power is much more than the amount of energy we need! However, we use less than 1% of it only. It also presents some examples of solar energy conversions; mechanical, electrical, and thermal energy and light. How can we efficiently use this powerful sustainable source? Who do? Dr. Ajlouni points out to plants as the most efficient users of solar energy in the photosynthesis process. He discusses the process and mentions how biomasses obtained from photosynthesis, and have been used as fuel. Then, students are asked to discuss the idea of producing fuel by using solar energy and to come up with ideas similar to the natural photosynthetic method.

**Part Five: Video segment is ~7 minutes. The pause approximately 3-5 minutes.**
In this segment, the idea of H2 fuel is introduced. It includes background information about hydrogen, and its production, efficiency and suitability as a fuel. It also shows (from the chemical point of view) how the method of $H_2$ production from water splitting by using solar energy is similar to the natural photosynthetic process. Then, we reach the point that this can be done but we need suitable photocatalysts!! Therefore, we leave the students to have thoughts and discuss the main features of a suitable photocatalyst that able to split water by utilizing sun light.

**Part Six: Video segment is ~6 minutes. The pause approximately 4-6 minutes.**
In this final part, the main features of a suitable photocatalyst will be overviewed, and examples of materials and chemical compounds that can be used as photocatalysts will be presented. Then, the whole process of $H_2$ production from water and uses as a fuel for energy generation using fuel-cell will be summarized. Finally, examples of current automobile technology that used $H_2$ fuel and applying the fuel cell technology will be presented. At the end, we leave the students with the major challenges that still facing H2 production and uses as a fuel, and ask them to search more about this topic and any recent developments and innovations in this field.