（学校用）

様式 A-1
(FY2024)

2025 年 3 月 3 日

サイエンス・ダイアログ　実施報告書

1. 学校名・実施責任者氏名：兵庫県立川西緑台高等学校 ・ 仲川奈緒、山本和也

2. 講師氏名：Dr. Manisha,
3. 講義補助者氏名：Dr. Syed Shaheen SHAH

4. 実施日時：2025 年 3 月 3 日（ 月 ） 11 : 40 ～ 12 : 40

5. 参加生徒：　年生　人、 2 年生 33 人、　年生　人（合計 33 人）
   備考：（例：理数科の生徒） 総合理数コースの生徒

6. 講義題目：From Water to Power: Exploring Electrllysis and Fuel Cells For a Greener Planet
7. 講義概要：
   - **Problem:** Climate change is accelerating due to our heavy reliance on fossil fuels, leading to increased greenhouse gas emissions. To mitigate this, we need sustainable and clean energy alternatives. Addressing global climate change requires reducing our reliance on fossil fuels, which emit greenhouse gases.
   - **Use of Hydrogen as a fuel:** One promising solution is the use of hydrogen as a clean energy source. Hydrogen can be produced through **water electrolysis**, a process that uses electricity to split water into hydrogen and oxygen. When this electricity comes from renewable sources like wind or solar power, the hydrogen produced is entirely green, emitting no carbon dioxide.
   - **Fuel cell:** This green hydrogen can then be used in fuel cells, devices that combine hydrogen with oxygen to generate electricity, with water as the only byproduct. This technology is already being applied in various sectors, offering a sustainable alternative to traditional fossil fuels.
     a) Fuel cells are being explored for use in heavy-duty transportation sectors, such as trucks and boats, where battery-electric solutions may be less effective.
     b) Hydrogen is also being considered for industrial applications, including steel production and energy storage.
   - By integrating **water electrolysis and fuel cells** into our energy systems, we can significantly reduce greenhouse gas emissions and combat climate change.

7. 講義形式：
   ☒対面 ・ □オンライン （どちらか選択ください。）
   1) 講義時間 50 分　　質疑応答時間 5 分

   2) 講義方法（例：プロジェクター使用による講義、実験・実習の有無など）
      プロジェクター使用による講義

   3) 事前学習
      (有) ・ 無 （どちらかに〇をしてください。）
      使用教材　講師よりいただいた、事前学習単語やウェブサイトのリスト。講義内容の要約文

8. その他特筆すべき事項：

Form B-2
(FY2024)
Must be typed

Date（日付）05/03/2025
（Date/Month/Year：日/月/年）

Activity Report -Science Dialogue Program-
（サイエンス・ダイアログ 実施報告書）

- Fellow's name（講師氏名）: Manisha （ID No. P24071）

- Name and title of the lecture assistant（講義補助者の職・氏名）
Dr. Syed Shaheen Shah (Program-Specific Assistant Professor)

- Participating school（学校名）: Hyogo Prefectural Kawanishi Midoridai High School

- Date （実施日時）: 03/03/2025 （Date/Month/Year:日/月/年）

- Lecture title（講義題目）:
The Road to Net Zero: Sustainable Energy Solutions for Tomorrow

- Lecture format（講義形式）:
◆☒Onsite ・ ☐Online (Please choose one.)(対面 ・ オンライン)((どちらか選択ください。))
◆Lecture time（講義時間） 40 min（分）, Q&A time(質疑応答時間) 10 min（分）
Experiment demonstration 10 min（分）
◆Lecture style(ex.: used projector, conducted experiments)
（講義方法（例:プロジェクター使用による講義、実験・実習の有無など））
Used projector and conducted experiment
- Lecture summary（講義概要）: Please summarize your lecture within 200-500 words.

We (Dr. Manisha Das and Dr. Syed Shaheen Shah) inspired students about scientific advancements, sustainable energy solutions, and the role of nanotechnology in shaping a greener future. The session focused on the importance of curiosity in scientific discovery, emphasizing how science has transformed human life through innovations such as vaccines, desalination, space exploration, renewable energy, and green fertilizers. We encouraged students to develop a questioning mindset, stressing that scientific skills are valuable beyond laboratories and can be applied to various careers.

A significant part of the discussion revolved around the global importance of English as the language of science. The session highlighted how English enables international collaboration, access to academic resources, and global career opportunities. The talk then transitioned to nanotechnology, explaining how materials behave differently at the nanoscale. We introduced the concept of restricted electron movement, which leads to unique material properties, making nanomaterials highly beneficial for energy storage, electronics, and green energy applications. Graphene, for instance, was presented as an example of an incredibly strong and conductive

nanomaterial with potential for revolutionary applications.

The session addressed the growing global energy demand, expected to reach 18-26 terawatts by 2040, and the challenges associated with non-renewable energy sources, including global warming, environmental pollution, and resource depletion. We explained how hydrogen fuel generation through electrochemical water splitting presents a clean and renewable alternative. We described the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER), detailing how water molecules can be split using potential beyond 1.23V to generate hydrogen as a sustainable energy carrier. Fuel cell technologies were introduced, with applications in aviation (Boeing), public transport (hydrogen-powered trams in China), and automotive industries (Toyota Fuel Cell System). The session emphasized that fuel cells offer a viable solution to reduce carbon emissions in transportation.

Expanding on the need for efficient energy storage, we introduced supercapacitors, which provide higher power density and faster charge/discharge rates compared to batteries and explained how electrochemical double-layer capacitance (EDLC) and pseudocapacitance enable supercapacitors to store and release energy quickly. The session explored hybrid supercapacitors, which combine high capacitance, conductivity, and stability, making them suitable for electric vehicles, portable electronics, and renewable energy storage. A notable example was the Sakura-derived carbon supercapacitor, an eco-friendly innovation that utilizes biomass-based carbon for sustainable energy storage.

The session concluded with a call to action for students, emphasizing that science is a powerful tool for solving global challenges. We encouraged students to stay curious, ask questions, and explore scientific possibilities, reminding them that clean energy solutions like solar power, hydrogen fuel, and supercapacitors will play a crucial role in a sustainable future. By combining scientific knowledge with international collaboration, the next generation of scientists can drive innovations that make a real-world impact. The Science Dialogue Program successfully inspired students to think critically about energy solutions and pursue innovative approaches for global sustainability.

◆Other noteworthy information（その他特筆すべき事項）:

Overall, the event proceeded smoothly, with Nao San and the school team being incredibly supportive and cooperative throughout. The school also made thoughtful arrangements by providing some of the essential experimental materials, such as beakers and KOH solution, which facilitated the hands-on demonstration. Additionally, the availability of a multimedia projector ensured an effective and engaging presentation, enhancing the overall learning experience for the students.

- Impressions and comments from the lecture assistant（講義補助者の方から、本プログラムに対する意見・感想等がありましたら、お願いいたします。）:

Our visit to Hyogo Prefectural Kawanishi Midoridai High School was an enriching and fulfilling experience. The school team was highly supportive, ensuring a smooth and engaging session. Our lecture, titled The Road to Net Zero: Sustainable Energy Solutions for Tomorrow, introduced

students to the significance of nanotechnology in energy storage and conversion. We explained key scientific principles behind energy storage devices, particularly supercapacitors made from Sakura-derived carbon, and demonstrated the electrochemical process of water splitting for hydrogen production. The visual aids and real-world applications presented during the session helped in fostering curiosity and a deeper understanding of sustainable energy solutions.

The students showed remarkable enthusiasm throughout the lecture, especially during the hands-on hydrogen production experiment. They asked insightful questions, such as why Sakura was chosen as a carbon source, leading to a productive discussion on material selection and sustainability. Their curiosity and active participation reflected their keen interest in science and its practical applications. A particularly touching moment was the thank-you note from a student, which demonstrated their appreciation and engagement. This session was mutually beneficial, as it provided students with valuable exposure to cutting-edge scientific advancements while offering us, as presenters, the opportunity to inspire young minds. Overall, the visit was a meaningful exchange of knowledge, leaving us with a strong sense of accomplishment and a hope that some of these students may contribute to scientific innovations in the future.


Introduction: Manisha
Hello!