



Name:

Date:

Class:

Michael Grätzel & Artificial Photosynthesis

Green Tech Worksheet Series

Traditional solar panels are made from thick, rigid sheets of silicon. While they are great at generating renewable energy, manufacturing silicon requires extreme heat and expensive factories. In 1991, a Swiss chemist named Michael Grätzel asked a powerful question: Instead of using expensive silicon, could we generate solar power by mimicking how plants do it?

Plants use a process called photosynthesis, capturing sunlight using a green pigment called chlorophyll. Grätzel, alongside researcher Brian O'Regan, invented a new type of solar technology based on this biological process. It is called the Dye-Sensitized Solar Cell (DSSC), more commonly known today as the "Grätzel cell." Instead of silicon, Grätzel cells use a special light-absorbing dye to capture the sun's energy, much like chlorophyll in a leaf.

When sunlight hits the dye, it excites electrons. These electrons are then transferred to a layer of titanium dioxide—a cheap, abundant white powder commonly used in toothpaste and white paint—which acts as a semiconductor to conduct the electricity. Because they are made of such inexpensive materials, Grätzel cells are significantly cheaper and easier to manufacture than traditional solar panels. They do not require the massive, high-heat cleanrooms that silicon panels do.

But the advantages of Grätzel cells go beyond cost. Traditional solar panels drop in efficiency if it is cloudy or if the light hits them at an angle. Grätzel cells, however, perform exceptionally well in low-light conditions, on cloudy days, and even indoors under artificial light. Because the materials can be printed like ink, Grätzel cells can be made flexible, lightweight, and semi-transparent. Imagine skyscrapers where every glass window acts as a quiet, transparent solar panel generating electricity for the building. For this revolutionary step in renewable energy, Michael Grätzel was awarded the prestigious Millennium Technology Prize in 2010.

PART 1: MULTIPLE CHOICE

Circle the letter of the best answer.

1. What natural biological process inspired Michael Grätzel's solar cell design?

- A. Cellular respiration
- B. Photosynthesis
- C. Evaporation
- D. Osmosis

2. What common, inexpensive material serves as the semiconductor in a Grätzel cell?

- A. Rigid Silicon
- B. Gallium Nitride
- C. Titanium Dioxide
- D. Lithium Cobalt Oxide

3. Which of the following is a major advantage of dye-sensitized solar cells over traditional silicon panels?

- A. They generate electricity only at night.
- B. They are significantly heavier and more durable.
- C. They are cheaper to manufacture and work well in low-light conditions.
- D. They require extreme heat to be manufactured.

PART 2: SHORT ANSWER

Write your answers in complete sentences based on the reading passage.

4. How does the manufacturing process of a Grätzel cell compare to a traditional silicon solar panel? Why is one cheaper than the other?

5. Explain one potential real-world application for Grätzel cells that would be difficult or impossible to achieve with traditional, rigid silicon solar panels.

PART 3: CRITICAL THINKING

6. Biomimicry is the practice of solving human problems by imitating nature's models and systems. Grätzel imitated plant leaves to capture solar energy. Think of another problem in modern technology, architecture, or engineering. How might an engineer look to the natural world (animals, plants, or ecosystems) to find a "green" solution to that problem?
