Name: _____ Date: _____ Class: _____

Shuji Nakamura & the Blue LED

Green Tech Worksheet Series

Take a look at the lights illuminating your classroom or the screen of the device you are using right now. Chances are, they are powered by LEDs (Light Emitting Diodes). Today, bright, white LED lights are everywhere, but creating them was once considered a scientific impossibility. The man who solved this puzzle, Shuji Nakamura, sparked a global revolution in green technology.

Red and green LEDs had been around since the 1960s, used mostly as tiny indicator lights on electronics like calculators and VCRs. However, to create pure white light—the kind needed to replace traditional lightbulbs—you must mix red, green, and blue light. For three decades, large technology corporations and prestigious universities poured millions of dollars into trying to invent a blue LED, but they all failed. The crystalline materials required were simply too difficult to grow.

In the early 1990s, Shuji Nakamura was working at a small, obscure Japanese company called Nichia Corporation. Working largely on his own and against the advice of many experts who said it couldn't be done, Nakamura persisted. He developed a special thermal process to grow high-quality crystals of a material called gallium nitride (GaN). In 1993, he stunned the scientific world by successfully demonstrating the first high-brightness blue LED.

Why is this a triumph of green technology? Traditional incandescent lightbulbs are incredibly inefficient; they waste about 90% of their energy as heat rather than light. White LEDs, made possible by Nakamura’s blue LED, require a tiny fraction of the electricity and last up to 100,000 hours. This massive leap in efficiency has significantly reduced global electricity consumption, directly cutting down greenhouse gas emissions from power plants. Furthermore, because they require so little power, LED lights can be hooked up to small, cheap solar panels, bringing safe, sustainable lighting to millions of people in off-grid communities worldwide. For his world-changing invention, Nakamura was awarded the Nobel Prize in Physics in 2014.

PART 1: MULTIPLE CHOICE

Circle the letter of the best answer.

1. Why was the invention of the blue LED so critical?

A. It was the first LED to be completely powered by solar energy.

B. It was the missing color needed to combine with red and green to create white light.

C. It was the only color of light that could be used in modern smartphones.

D. It was much cheaper to manufacture than red or green LEDs.

2. What material did Shuji Nakamura successfully use to create the blue LED?

A. Lithium cobalt oxide

B. Silicon carbide

C. Tungsten filament

D. Gallium nitride

3. How do white LED lights primarily help the environment?

A. They absorb carbon dioxide from the air while they are turned on.

B. They are made entirely from recycled plastic bottles.

C. They use significantly less electricity than traditional bulbs, reducing power plant emissions.

D. They generate electricity that can be sent back to the power grid.

PART 2: SHORT ANSWER

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

4. Before Nakamura's breakthrough in the early 1990s, what was the general attitude of the scientific community toward creating a blue LED?

5. Explain how the invention of the blue LED specifically benefits people living in remote, off-grid communities (areas without access to a large electrical power grid).

PART 3: CRITICAL THINKING

6. Major corporations and top universities spent millions of dollars trying to invent the blue LED and failed. Shuji Nakamura achieved this massive breakthrough while working at a small, relatively unknown company. What does this suggest about innovation and problem-solving? Why might working outside the "mainstream" sometimes be an advantage for a scientist or engineer?