



Houston, We Have a Problem!

Subject: Earth and Space Science

Grade Level: 6 (5-8)

Time Required: 100 minutes

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Students discover how the innovative science of photovoltaics harnesses the energy of the sun in order to power the world around us by transforming solar energy into useable power, electricity, through the use of photovoltaic cells. The popular 20th Century Fox movie, “The Martian,” released in 2015, highlights the important role of photovoltaics in space exploration, especially as we travel further and further away from home. The science of photovoltaics faces unique challenges when used in the harsh realities of space, and the solutions to those challenges just might help us solve our energy crisis here at home on Planet Earth.

For this activity, students should have a basic understanding that different forms of energy can be converted into electricity, which is then used to provide power to the world around us.

Objectives

After this lesson, students should be able to:

- ➔ *Define the term photovoltaics (PV).*
- ➔ *Define the term photovoltaic cell.*
- ➔ *Define the term solar energy.*

- ➔ Explain that the sun is used as a source of energy for power here on Planet Earth.
- ➔ Explain that the sun is used as a source of energy for power in space.

Standards Correlation

NGSS Standards

MS-ETS1-1: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

CCSS Standards

CCSS.ELA-LITERACY.RST.6-8.1

Cite specific textual evidence to support analysis of science and technical texts.

Word Bank

Photovoltaics Photovoltaic cells Solar cells
 Solar Energy Solar Panel

Introduction

DAY ONE

As class begins, assemble students into groups of 3-4.

I want you to close your eyes and take a journey with me back in time . . . to 6am this morning. The loud beeping of your alarm clock wakes you from the best kind of dream ever, and after hitting the snooze button far too many times, you force yourself out of bed. You flip on the light switch in the bathroom, and take a nice, hot shower, the smell of coffee wafting through the air. You quickly finish getting ready for school, the sound of the TV droning on in the background. The bus beeps its horn and you grab your backpack, cell phone, and breakfast burrito off the table, racing to catch the bus. You put in your earbuds as you settle in for the 30 minute bus ride ahead of you, and check out the latest upload by your favorite YouTuber. As the bus pulls up in front of school, you finish the last bite of your burrito and race to class in order to beat the tardy bell. (Jolt students back to reality with the sound of the tardy bell.)

Ok, class, you may open your eyes. I would like your group to make a list of all of the things you used this morning that required some type of power source, from the moment you woke up until the moment you walked into my classroom. You have five minutes.

As you are explaining the directions, hand each group an individual white board and a dry erase marker. Make sure you circulate around the room in order to keep students focused and on-task, as well as providing support to students who are struggling to come up with ideas.

After the five minutes are up, pull students back together to have a class-wide discussion, allowing students to share their ideas, compiling them into one list on a large whiteboard or chart paper. Once the ideas slow down, ask students to name what power source they used for each item listed.

Now I want you to imagine that you are 238,900 miles away from home, in the vastness of space, and suddenly something goes wrong . . . very, very wrong. "Houston, we have a problem."

Show students the scene depicting the unraveling of Apollo 13's mission to the moon in the 1995 Universal Picture movie by the same name, "Apollo 13."

<https://www.youtube.com/watch?v=kAmsi05P9Uw>.

How did the astronauts onboard Apollo 13 transmit their infamous cry for help from their lunar capsule in outer space to mission control in Houston, TX, over 200 thousand miles away with no electrical outlet in sight?

This movie clip will help students understand the absolute critical system failures that these astronauts were experiencing, and they will be excited to share their ideas! Give students a few minutes to share their ideas with the class, limiting the number of ideas to 3-4 in order to keep everyone focused.)

Believe it or not, the Apollo astronauts transmitted all communication to Planet Earth over radio frequencies.

BUT, what if you are 140 million miles from home, left behind, stranded, and far beyond the reach of radio frequencies . . . what then? How are you going to transmit a message to Earth that you need help, and then stay alive during the four years it takes for that help to arrive???

Show students the trailer from 20th Century Fox movie, "The Martian."

<https://www.youtube.com/watch?v=ej3ioOneTy8>.

After watching the movie trailer, ask students to name a source of power that they saw being used by Matt Damon, aka astronaut Mark Watney. Students should quickly come up with solar power. (If students are struggling to make that connection, show them images from a Google search that capture Matt Damon using solar panels.)

Tell students that they are now going to get to see the power of the sun in action, by safely viewing the surface of the sun. Hand each student a pair of solar glasses and head outside to an area where students will have an unobstructed view of the sun. (It is important to tell students that they must never look directly at the sun. The sun is so powerful that it can cause serious damage to their eyes in just a few seconds.)

Solar glasses can be found here: <http://amzn.to/2niRBBr>. Rainbow Symphony Eclipse Glasses - Safe Solar Viewers - Eclipse Shades.

Instructor Content Background Information

The increasing demand for the fastest, most innovative, technologies is seemingly limited only by the reaches of the imagination; that is, until the sources of electricity used to power that technology create an energy crisis like one that has never been seen before. We are quickly depleting the resources available to us here on Planet Earth, and are destroying our planet along the way. Photovoltaics is a vastly underutilized source of electricity, one that also happens to be reliable, efficient, and friendly to life here on our planet.

The Quantum Energy and Sustainable Solar Technologies Engineering Research Center (QEEST), sponsored by the National Science Foundation (NSF) and the Department of Energy (DOE), is hard at work to further the science of photovoltaics in order to find innovative, new solutions to power our world . . . ones that will ensure we have a home here on Planet Earth for many, many years to come.

It is essential as educators that we teach our students about renewable sources of energy in order to ensure that this next generation of scientists, engineers, and space pioneers, sitting right in our classrooms, will one day be able to make educated decisions regarding the way we power our world as we venture into places that no man has gone before.

As said by President Ronald Reagan, “The future does not belong to the faint-hearted, it belongs to the brave.”



DAY TWO

As students come into class, have students take out their interactive science journals and hand each student a copy of the interactive journal template, Photovoltaics – Defined (located at the end of this lesson.) After students have cut-out, folded, and glued their interactive journal template into their science journals, students take notes from the note-taking guide, also named Photovoltaics – Defined, which the teacher projects onto the interactive white board.

- Students cut along the solid line forming the external edge of the entire interactive journal template.
- Students cut along the solid lines between the words, stopping at the dashed line, creating flaps.
- Students fold along the dashed line.

- Students glue the interactive journal template into their science journals.
- Students should write the definitions provided in the note-taking guide, Photovoltaics – Defined, underneath the tab for each word.

Once students have completed the interactive journal entry “Photovoltaics – Defined,” hand each student a copy of the interactive journal template “Solar Energy Can Become.” One copy of the interactive science journal template should be provided for each student. After students have cut-out and glued their interactive journal template into their science journals, students take notes from the note-taking guide, also named Solar Energy Can Become, which the teacher projects onto the interactive white board.

- Students cut along the solid line forming the external edge of the interactive journal template, which is an image of the sun.
- Students glue the interactive journal template into their science journals.
- Students should write each example provided in the note-taking guide, Solar Energy Can Become, onto each one of the sun’s rays.

Vocabulary

- Photovoltaics - The science of transforming solar energy into electricity, a useable form of power. The word photovoltaic can be broken down into ‘photo,’ meaning light and ‘voltaic,’ meaning electricity.
- Photovoltaic cells (solar cells) - A device that converts the energy of the sun into electricity.
- Solar Energy - Energy that comes from the sun.
- Solar Panel - A panel consisting of many individual solar cells that work together to produce electricity.

Lesson Closure

Play the original audio recording of the astronauts onboard Apollo 13 transmitting their message of distress to mission control in Houston, TX.

https://www.youtube.com/watch?v=eco_xvkEQlg

“Houston, we have a problem.” The astronauts of Apollo 13 sent this now infamous cry for help to NASA, transmitted via radio signals.

However, when spanning a distance of 140 million miles, with the necessity to spend years in space to travel to Mars and BEYOND, radio signals, electrical outlets, and extension cords are simply not an option. Thanks to the super-hero status of the sun, NASA can stay in communication with Astronaut Mark Watney, 140 million miles away, and “Bring Him Home.”

Assessment

Pre-Lesson Assessment

Working in groups, students make a list of all the things they used before coming to school which required some type of power source, from the moment they woke up until the moment they walked into the classroom. As a follow-up question, students will list what source of power they used for each device.

Lesson Summary Assessment

Students will work in groups to develop a meme that will encourage the use of solar energy to save our planet! These memes should be displayed throughout the school in order to encourage energy consciousness. In order to further spread the message regarding solar energy as a solution to our energy crisis here on Planet Earth, these memes should be sent out to the newspapers for publication, as well as to local representatives in both Congress and the House of Representatives. Students must cite textual evidence that supports the content contained in their meme.

Deepen your Knowledge

The video clip below contains the original interview with Matt Damon did while at NASA's Jet Propulsion Laboratory located in Pasadena, California on August 25, 2015. Matt Damon provides an interesting perspective regarding the importance of continued space exploration, as well as the importance of science and engineering to the future of our planet, one that students will respect due to his celebrity status as a well-respected actor.

https://www.youtube.com/watch?v=jgIZRdeMO_I

References

<http://albaenergy.com/2016/02/5-surprising-things-you-can-learn-about-solar-power-from-the-martian/>

<https://www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian>

<https://science.nasa.gov/science-news/science-at-nasa/2002/solarcells>

Acknowledgements

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Solar Energy Can Become (Interactive Journal Template)

Solar Energy Can Become . . .

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This Can Be Used to Provide Useable Power For . . .



Photovoltaics – Defined (Interactive Journal Template)

Photovoltaics
(PV)

Photovoltaic Cell
(Solar Cell)

Solar energy

Solar Panel

Solar Energy Can Become (Note-Taking Guide)

Solar Energy Can Become . . .

- Electricity
- Heat Energy

This Can Be Used to Provide Useable Power For . . .



Photovoltaics – Defined (Note-Taking Guide)

Photovoltaics (PV)	The science of transforming solar energy into electricity, a useable form of power. The word photovoltaic can be broken down into 'photo,' meaning light, and 'voltaic,' meaning electricity.
Photovoltaic cell (solar cell)	A device that converts the energy of the sun into electricity.
Solar energy	Energy that comes from the sun.
Solar panel	A panel consisting of many, individual solar cells that work together to produce electricity.