

Teacher's Guide for ODYSSEY:

May 2011: The Sun Burns

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Teachers: This Teacher's Guide is designed to be readily reproducible for student use. Please find an Answer Key at the end of the guide.

"The Real Sun? Or an Incredible Simulation?," pages 6–9

1. How far away is the Sun?
2. What is plasma?
3. Astrophysics is a combination of what two areas of study?
4. What are subatomic particles?
5. What was the good news about Asplund's model of the Sun? What was the bad news?
6. With the information from Asplund's model, what is the task now for astrophysicists?

"Staring at the Sun," pages 10–13

- How is the text in this article structured (steps in a process, compare-contrast, descriptive, question-answer) and why? How does it help you understand the information?

"Today's Space Weather Is . . .," pages 17–21

Mark the following statements true (T) or false (F). If false, provide the necessary correction.

1. ___ Extreme space weather caused a nine-hour blackout.
2. ___ The Sun is composed mostly of helium.
3. ___ The plasma of the Sun rotates faster at the Sun's poles than at the equator and can cause the magnetic field to bubble, carrying plasma high into the Sun's atmosphere.
4. ___ Sunspots form when strong magnetic fields cause hot material to rise to the Sun's visible surface.
5. ___ Huge clouds of magnetized plasma from the Sun's corona that shoot out into space are called coronal mass ejections, or CMEs.
6. ___ The Sun is much more active and dangerous at sunspot maximum, when lots of sunspots are concentrated away from the Sun's equator, than during other parts of the solar cycle.
7. ___ The X-rays and gamma rays from solar radiation storms arrive at Earth eight seconds after leaving the Sun, endangering astronauts and some airline passengers.

8. ___ Small CMEs can cause colorful light shows in the sky, disrupt radio communications, and disturb power grids and gas pipelines on Earth.
9. ___ Someday scientists may be able to predict a few days in advance of when severe solar activity is going to occur.

"A Heavenly Dance," pages 22–25

1. How does the language in the first paragraph help you visualize the description? How do the similes help you understand the writing?
2. What is the aurora borealis?
3. Using vivid language, describe the photograph on page 24. Use descriptions that will help paint a picture in the mind of the reader.

"Out the Window: Launching a Career in Science," pages 26–29

1. Why is the field of solar energy so exciting to Jose Luis Cruz-Campa?
2. What did Jose and his team develop?
3. Who will benefit from Jose's work? How will his work affect the environment?
4. What words would you use to describe Jose?
5. What interests or skills do you have that could be turned into a career for you one day?

"Sailing on Sunshine," pages 30–33

1. What is NanoSail-D space probe?
2. What is NanoSail-D testing?
3. What are photons?
4. What is momentum?
5. Why is the sail of NanoSail-D so large?
6. What is NanoSail-D made of and why?
7. Why do you think a solar sail is important?

"Solo Solar Sailing," pages 34–35

- A log entry, like this piece of science fiction, is a great way to keep track of the details of a personal experience. This log entry describes a success story. What is your success story? What accomplishment are you proud of? Maybe you won a sports competition, did well at school, or stood up for a friend. Describe your success in a one-day log entry. Be sure to include a description of the events leading up to your success and your thoughts and feelings along the way.

**“When the Moon Hides the Sun,” pages 36–39 and
“Catch a Pass! (of Venus with the Sun),” pages 40–42**

1. What is a total solar eclipse?
2. What is a transit of Venus?
3. Using the information from the two Upcoming Solar Events Calendar articles, complete the timeline below:

1631—

1639—

1716—

1761—

1769—

1874 and 1882— Black-drop effect foils again

1999— Mercury travels between Earth and the Sun

2004—

May 20, 2012—

June 5, 2012—

4. Why do you think it is important to be aware of astronomical events?

“Staying Healthy: It’s a Science! You are Brighter Than the Sun!,” pgs 44–45

- Why is it important to protect yourself from the Sun, and what are three ways to protect yourself?

ANSWER KEY:

“The Real Sun? Or an Incredible Simulation?”

1. 93 million miles
2. a gaslike state of matter that consists of electrically charged particles
3. physics and astronomy
4. the tiny pieces of matter from which atoms are made, including protons, neutrons, and electrons
5. Possible response: Asplund’s model showed the Sun contained the amount of carbon appropriate for its age and surroundings. Other models of the Sun did not match up and something would need adjusting.
6. Possible response: Astrophysicists must now rethink their calculations to figure out what model shows the correct amount of carbon so that they may do certain experiments to find important information about the Sun.

“Staring at the Sun”

Responses may include more than one text structure if well supported.

Possible response: This article has a question-answer text structure. Though it is not an interview, it provides specific questions and answers about the Sun. The questions and answers help me understand the pictures and characteristics of the Sun and its processes. For example, in photo #4, I can see that plasma is moving along the direction of the magnetic field to make a majestic loop. The question-answer structure helps focus the discussion on specific areas.

“Today’s Space Weather Is . . .”

1. (T)
2. (F) The Sun is composed mostly of hydrogen.
3. (F) The plasma of the Sun rotates faster at the Sun’s equator than at the poles and can cause the magnetic field to bubble, carrying plasma high into the Sun’s atmosphere.
4. (F) Sunspots form when strong magnetic fields prevent hot material from rising to the Sun’s visible surface.
5. (T)
6. (T)
7. (F) The X-rays and gamma rays from solar radiation storms arrive at Earth eight minutes after leaving the Sun, endangering astronauts and some airline passengers.
8. (F) Large CMEs can cause colorful light shows in the sky, disrupt radio communications, and disturb power grids and gas pipelines on Earth.
9. (T)

“A Heavenly Dance”

1. Possible response: Though I have never seen the aurora borealis, I can visualize “rippling curtains” and the familiar colors described. The vivid imagery of “heavens catching fire” and “curtains of green, red, and pink” helps me “see” the display of northern lights. The similes “the curtains shoot up like searchlights scanning the heavens” and “the curtains . . . ripple and dance, like luminous veils” help me understand the writing because they give me images that I can relate to that help paint a picture in my mind.
2. Possible responses include: The aurora borealis is a grand display of colorful light in the sky. Or responses may describe how coronal mass ejections (CMEs) can cause auroras.
3. Responses should vividly describe the “veil of color” captured in the photograph.

“Out the Window: Launching a Career in Science”

1. Possible response: The field of solar energy is exciting for Jose because it gives him an opportunity to discover alternative energy sources that will reduce our reliance on fossil fuels.

2. Jose and his team developed micro-sized solar cells that are as efficient as bigger solar cells, cost less, and can be attached to fabric.
3. Possible response: Hikers, hunters, and soldiers will benefit from micro-sized solar cells by having access to renewable energy in the fabric of their tents or their clothes. Jose's work will help the environment because it will provide us with an alternative energy source that won't deplete our fossil fuels.
4. Possible descriptors include: accomplished, motivated, Earth-conscious, mechanical
5. Responses should include specific interests that could be developed into careers.

"Sailing on Sunshine"

1. The NanoSail-D space probe is the first solar sailing vessel in Earth orbit.
2. The probe is testing how the next generation of spacecraft might use solar sails for propulsion and control.
3. Photons are packets of light energy.
4. Momentum is the ability of an object to move something that it hits.
5. The sail of the probe is large so that it can catch lots of photons to gain momentum.
6. The space probe is made of a shiny polymer that is ultra thin. The shininess causes photons to hit and bounce off the sail, which adds momentum.
7. Possible response: Solar sailing is important because it will not rely on fossil fuels to do work. The spacecraft will rely on the power of the Sun to orbit, change locations, or stay in one position. The craft will never run out of gas!

"Solo Solar Sailing"

Responses will vary but should be written in log entry-form, with a log entry date and time, as shown in the article. Responses should focus on the events of one day, and the thoughts and feelings that lead to the success.

"When the Moon Hides the Sun" and "Catch a Pass! (of Venus with the Sun)"

1. A total solar eclipse is when the Moon completely covers the Sun.
2. A transit of Venus is a rare astronomical event when the planet Venus, on its orbit, travels between Earth and the Sun.
3.
 - 1631— Johannes Kepler's predicted transit of Venus goes unobserved
 - 1639— Jeremiah Horrocks and a friend observe the partner transit to Kepler's predicted transit
 - 1716— Edmund Halley figures out how to measure the size of the solar system
 - 1761— Expeditions went to points around the world to observe transit
 - 1769— Black-drop effect prevents observers from learning the scale of the solar system and the true sizes of the planets
 - 1874 and 1882— Black-drop effect foils again
 - 1999— Mercury travels between Earth and the Sun
 - 2004— Venus travels between Earth and the Sun
 - May 20, 2012— Moon goes across the middle of the Sun
 - June 5, 2012— Venus travels between Earth and the Sun

4. Responses will vary but may include thoughts about understanding how our solar system works or about viewing once-in-a-lifetime natural events.

“Staying Healthy: It’s a Science! You are Brighter Than the Sun!”

Possible response:

It is important to protect yourself from the Sun because sun exposure can damage your skin, causing wrinkles, dark spots, and even cancer. Three ways to protect yourself are to use sunscreen, wear hats and cover-ups, and seek shade.