

Teacher's Guide for Odyssey

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See Earth

*Teacher Guide prepared by: Nancy I. Colamussi, Elementary Education, B.S., M.A.
Shoreham Wading River School District, Long Island, New York*

Teacher's Note:

This guide contains project ideas, short answer, extended response, fill-in, and true/false with correction. The variation is designed to have the students think critically, as well as to test their comprehension. An answer key to the short answer sections can be found at the end of the guide.

Extended Response: Comprehension & Critical Thinking

The questions below can be used as written, simply answered in complete sentences or easily transformed into longer essay (ELA) style questions, or even research topics. In any case, have the students support their answers with details from the text or use critical thinking skills to create a thorough and interesting answer. The questions, essays and projects have been aligned with the **Common Core Standards**. Consider the level of your students when deciding how to use the questions.

"Wave to Saturn" p. 7-9

1. What series of stunning photographs was taken on July 19, 2013?
2. How is it possible for a spacecraft one billion miles away to take pictures of the Earth?
3. How is the sun a major obstacle to consider when trying to get a picture of the Earth?
4. Explain why the picture showing all of Saturn had to be a series of hundreds of snapshots.
5. How do the pictures taken by Cassini travel 898 million miles back to Earth?
6. How do the images sent back compare to the actual photograph?
7. Reread Carl Sagan's quote at the end of the article and explain what it means to *you*.
8. Define these terms from the article: *occultation, trajectory, resolution*

"Landsat Love" p. 12-15

1. When did humans see the surface of Earth from space for the first time?
2. What did this sight inspire the director of the United States Geological Survey to do?
3. What are the roles of NASA and USGS in bringing us pictures of Earth?
4. Why do ecologists love Landsat?
5. What are some important things that Landsat helps experts study and manage?
6. Explain the typical 'life of a satellite'.
7. What is a spectral signature and how is it helpful to ecologists?

"Guardians of the Forest: FPO" p. 19-22

1. Why are Dr. Serge Wich and his colleague, Dr. Lian Pin Koh, running a series of tests with unmanned planes, also called drones?
2. Why do they want to know if drones can detect orangutan nests?
3. What are the threats that orangutans face?
4. How fast is the orangutan population decreasing?
5. Describe how orangutans spend their days and nights.
6. How do nest surveys help to estimate how the population is faring?
7. How do Wich and Koh create flight plans?
8. What are some of the drawbacks of drones?

Essay: *Towards the end of the article Wich explains his vision for drones which goes far beyond counting orangutan nests. Write a short essay explaining how drones can be used both positively and negatively in society. In your conclusion state whether or not you believe that the good outweighs the bad.*

"Up in the Sky, Back in Time" p. 23-25

Read the article in its entirety and then fill in the blanks. Refer back to the text if necessary.

1. Dr. Sarah Parcak is a space _____. Her specialty is ancient Egypt.
2. Parcak uses remote sensors mounted on orbiting satellites to search for the remnants of long-ago _____.
3. Satellite data can be used to make _____ maps of landscapes.
4. Microwave radar can even show us things that are buried _____.
5. Good science always goes from the known to the _____.
6. To test a hypothesis, we look at _____ data sets.
7. When professional archaeologists excavate, they make regular, systematic holes. They also backfill their holes when the excavation is done. _____ dig irregularly and leave behind holes with doughnut-shaped piles of dirt around them.
8. Someday there may be a network of _____ that can collect useful archaeological data.
9. A _____ is a proposed idea that is tested by further investigation.
10. _____ are much better at identifying interesting patterns than computers are.

"LiDAR Mapping" p. 26-29

1. Why do we use maps?
2. How old is the oldest map and what does it show?
3. How do mapmakers today chart things that are too complicated understand with the naked eye?
4. Explain what LiDAR is and how it works.
5. Why were scientists using a primitive kind of LiDAR in the 1930's?
6. What was the ruby laser? Why is it considered one of the most important inventions in the history of man?
7. How is the laser light different from the light of a flashlight?
8. What are the different ways that LiDAR equipment can be mounted?
9. Explain the advantages of 3D maps over 2D maps.
10. How do 3D maps help archeologists and other scientists?

"Looking Beneath the Surface - from Above" p. 30-32

1. Why did the geologists ask NASA to help with unmanned aerial vehicles, or UAVs?
2. Why don't researchers like to call UAVs 'drones'?
3. What did magnetic reading already suggest led beneath the surface?
4. How would more knowledge from the UAVs help flag potential risks to groundwater?
5. What are the specs of NASA's SIERRA aircraft?
6. Why did collecting magnetic data and sending it to researchers on the ground prove to be tricky?
7. How did the data revealed by SIERRA fill big knowledge gaps?
8. What are payload-directed flights?
9. What are the benefits of using unmanned aircraft?
10. What challenges need to be addressed when using unmanned aircraft?

ANSWER KEY

"Up in the Sky"

1. *archaeologist*
2. *civilizations*
3. *3D*
4. *subsurface*
5. *unknown*
6. *multiple*
7. *looters*
8. *drones*
9. *hypothesis*
10. *human brains*