Teacher's Guide for ODYSSEY

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Making the Future

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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.

"The Art of 3D Printing" p. 6 - 7

1. Explain the two distinct ways that direct 3D printers differ from ordinary inkjet printers.
2. How are 3D printers affecting the world of music?
3. How is the technology of 3D printers affecting high fashion?

Essay: *In the future, as 3D technology progresses and becomes more affordable, how can you imagine it becoming useful in the average person's everyday life? Support your answer with details.*

"Wedding Cakes and Cookie Cutters" p. 8 - 9

1. Compare and contrast the additive manufacturing process with the subtractive process.
2. Why does the subtractive process leave a lot of waste?
3. Why is 3D printing an additive process?
4. In what cases are scaffolds necessary for some 3D printing?

"Good Enough to Eat?" p. 15 - 17

1. What is Foodini? How does it work?
2. Why isn't Foodini perfect for every meal?
3. What are some benefits of Foodini?
4. How is it possible to print 3D fruit?
5. What are some of the problems with 3D printing food?

Essay: *How do you feel about the idea of eating 3D printed food in a time in society when many people are trying to eat more holistically? Give some examples to support your answer.*

"Digital Detectives" p. 18 -21

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

1. "Capturing Dinosaurs" is the first time the museum has tried to use _____ fabrication to teach young people about science.
2. Part of the puzzle the students were trying to solve included looking at the _____ that they were scanning and trying to figure out which dinosaur it came from.
3. The student-scientists took up the challenges of modeling the _____, making reproductions, and fitting them together to figure out the type of dinosaur they were working with.
4. Students visited and talked with staff researchers to see how real artifact _____ is done.
5. A 3D printer works a lot like an inkjet printer. A printing program directs an ink cartridge to specific _____ where the nozzle deposits a small drop of ink. Eventually, the drops accumulate to form _____.
6. 3D printers differ from inkjet machines in three important ways: Their cartridges use heated _____ instead of ink, they deposit the plastic on a platform, and they send the cartridges over the same points again and again.
7. Like many museums around the world, the _____ _____ of _____ _____ is using scanning and printing tools to preserve valuable artifacts.
8. _____ can preserve details down to a fraction of an inch.
9. Scanning and printing can provide access to rare collections without the risk of _____ or _____.
10. Digital scanning and 3D printing are also finding their way into classrooms, as teachers learn the value of using high-tech tools to make _____ and _____ more engaging and more relevant.

"Coming soon to a Hospital near You!) p. 22 - 25

Activity: *Compare and contrast medical 3D printing to regular 2D printing. You may use words or a Venn diagram. Be as thorough as you can.*

1. Describe the Talon and Hawthorn's motivation for creating it.
2. What is e-NABLE?
3. What is 'bioprinting' and what exciting science is being performed with it?
4. Explain the Skin Bioprinting project.

"Blast Off" p. 28 - 31

Define the following terms and use each word in your own original sentence:
parabolas ***microgravity*** ***habitats*** ***micronutrients***

1. How can 3D printing be helpful to astronauts aboard the International Space Station?
2. What is the cost per pound of material launched into space?
3. What specific problems could a 3D printer in space address?
4. How could a 3D printer also make space travel safer?
5. Explain how 3D printers could make more nutritious space food.

"Superheroes and Stars" p. 32 -35

Define the following terms and use each word in your own original sentence:
licensors ***prototype*** ***micron*** ***resin*** ***paint master***

1. What does Gentle Giant in Burbank California do?
2. What are other uses for the digital data that is stored on computers?
3. Why are pose and expression so important for the final desired image?
4. How do most digital sculptors start their work?
5. What is 3D sculpting?
6. Explain why classical skills are such an important foundation for this work.
7. What are some of the virtual programs that 3D sculptors use? How do they help the artist?
8. Explain the process of building 3D prototypes.
9. How has 3D printing and digital design affected the average person?

"Tools of the Trade" p. 40 - 43
Mark the following statements TRUE or FALSE. Provide the correct answer if false.

1. _____ Twenty-first-century diggers take to the field with the latest technologies, as modern tools transform how we explore - and protect - the past.
2. _____ The first task of archaeologists is to map the site they intend to explore.
3. _____ Drones are portable "eyes in the night": small, unmanned aircraft that can fly over an area at low level and bring back information about prospective dig sites.
4. _____ Equipped with global positioning systems and the right sensors, drones can map topographic features as small as half a foot, using preprogrammed flight paths.
5. _____ Technology in the sky can now map the most rugged places on Earth.
6. _____ Modern archaeologists appreciate the scientific value of "excavation" or the need to collect exact information about where and how artifacts were discovered.
7. _____ Smart phones and tablets are becoming important archaeological assistants because apps can reproduce many functions of more complex equipment.

8. _____ Recently, a young fossil hunter took digital site recording to a whole new level. Aki Watanabe, a student at the American Museum of Natural History's Richard Gilder Graduate School, used his iPad to take both video and audio notes of his explorations in the Gobi Desert.
9. _____ Archaeologists call it the Principle of Reversibility: Avoid doing things that cannot be undone.
10. _____ Portable x-ray fluorescence uses low-level x-rays to determine the age of a material.
11. _____ When scientists want to study the inner parts of an artifact without physically opening it, they often turn to computerized tomography.
12. _____ Archaeologists use 3D printing to physically reconstruct almost anything that can be modeled by digital data.

ANSWER KEY

"Digital Detectives"

1. *digital*
2. *bones*
3. *fossils*
4. *preservation*
5. *locations, patterns*
6. *plastic*
7. *American Museum of Natural History*
8. *scanning*
9. *loss, damage*
10. *science, math*

"Tools of the Trade"

1. *True*
2. *True*
3. *False, sky*
4. *False, inch*
5. *True*
6. *False, context*
7. *True*
8. *False, google glasses*
9. *True*
10. *False, chemical properties*
11. *True*
12. *True*