**Unit 3 Assessment**

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Directions: Read the following texts closely, and then select the best answer choice for each question.

**How 3-D Printers Work**

by the U.S. Department of Energy

Three years ago, printing three-dimensional objects at home might have sounded like a thing out of The Jetsons. But in just a few short years, 3D printing has exploded -- shifting from a niche technology to a game-changing innovation that is capturing the imagination of major manufacturers and hobbyists alike. 3D printing has the potential to revolutionize manufacturing, allowing companies (and individuals) to design and produce products in new ways while also reducing material waste, saving energy and shortening the time needed to bring products to market.

**WHAT IS 3D PRINTING?**

First invented in the 1980s by Chuck Hull, an engineer and physicist, 3D printing technology has come a long way. Also called additive manufacturing, [3D printing](http://energy.gov/eere/amo/downloads/additive-manufacturing-pursuing-promise) is the process of making an object by depositing material, one tiny layer at a time.

The basic idea behind additive manufacturing can be found in rock formations deep underground (dripping water deposits thin layers of minerals to form stalactites and stalagmites), but a more modern example is a common desktop printer. Just like an inkjet printer adds individual dots of ink to form an image, a 3D printer only adds material where it is needed based on a digital file.

In comparison, many conventional manufacturing processes -- which have recently been termed “subtractive manufacturing” -- require cutting away excess materials to make the desired part. The result: Subtractive manufacturing can waste up to 30 pounds of material for every 1 pound of useful material in some parts, according to a finding from the [Energy Department’s Oak Ridge National Lab](http://web.ornl.gov/sci/manufacturing/docs/AM%26P_March%202013_cvr_w-articles.pdf).

With some 3D printing processes, about 98 percent of the raw material is used in the finished part. Not to mention, 3D printing enables manufacturers to create new shapes and lighter parts that use less raw material and require fewer manufacturing steps. In turn, that can translate into lower energy use for 3D printing -- up to [50 percent less](http://energy.gov/articles/building-american-economy-last-american-competiveness-manufacturing) energy for certain processes compared to conventional manufacturing processes.

Though the possibilities for additive manufacturing are endless, today 3D printing is mostly used to build small, relatively costly components using plastics and metal powders. Yet, as the price of desktop 3D printers continues to drop, some innovators are experimenting with different materials like chocolate and other food items, wax, ceramics and biomaterial similar to human cells.

**HOW DOES A 3D PRINTER WORK?**

Additive manufacturing technology comes in many shapes and sizes, but no matter the type of 3D printer or material you are using, the 3D printing process follows the same basic steps.

It starts with creating a 3D blueprint using computer-aided design (commonly called CAD) software. Creators are only limited by their imaginations. For example, 3D printers have been used to manufacture everything from robots and prosthetic limbs to custom shoes and musical instruments. Oak Ridge National Lab is even partnering with a company to create the [first 3D printed car](http://www.ornl.gov/ornl/news/features/2014/ornl-and-local-motors-sign-crada-to-enable-rapid-design-and-manufacturing-of-vehicles-through-direct-digital-manufacturing--) using a large-scale 3D printer.

Once the 3D blueprint is created, the printer needs to be prepared. This includes refilling the raw materials (such as plastics, metal powders or binding solutions) and preparing the build platform (in some instances, you might have to clean it or apply an adhesive to prevent movement and warping from the heat during the printing process). Once you hit print, the machine takes over, automatically building the desired object. While printing processes vary depending on the type of 3D printing technology, material extrusion is the most common process used in desktop 3D printers.

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Material extrusion works like a glue gun. The printing material -- typically a plastic filament -- is heated until it liquefies and is extruded through the print nozzle. Using information from the digital file -- the design is split into thin two-dimensional cross-sections so the printer knows exactly where to put material -- the nozzle deposits the polymer in thin layers, often 0.1 millimeter thick. The polymer solidifies quickly, bonding to the layer below before the build platform lowers and the print head adds another layer. Depending on the size and complexity of the object, the entire process can take anywhere from minutes to days.

After the printing is finished, every object requires a bit of post-processing. This can range from unsticking the object from the build platform to removing support structures (temporary material printed to support overhangs on the object) to brushing off excess powders.

**CREATING A COUNTRY OF MAKERS**

While 3D printing isn’t new, recent advancements in the technology (along with the rise in popularity of sites like Etsy and Kickstarter) have sparked a creative manufacturing renaissance -- where anyone with access to a printer is a manufacturer and product customization is nearly unlimited.

3D printers and other manufacturing technologies are turning consumers into creators -- or makers of things. This movement, often called the [Maker Movement](http://www.whitehouse.gov/blog/2014/06/13/5-questions-making-and-white-house-maker-faire), is helping spur innovation and creating a whole new way of doing business. Products no longer have to be mass manufactured -- they can be made in small batches, printed on the spot or customized for an individual’s unique needs.

This new way of thinking is also trickling down into the classroom through access to 3D printers. Students aren’t limited to imagining cool, new ideas -- they can make them a reality, and it’s inspiring them to go into STEM (science, technology, engineering and math) fields.

The rise of the Maker Movement -- embraced by both the young and old -- represents a huge opportunity for the United States. It can create a foundation for new products and processes that can help revitalize American manufacturing. To celebrate this potential, President Obama hosted the first [White House Maker Faire](http://www.whitehouse.gov/maker-faire) -- allowing innovators and entrepreneurs of all ages to show what they’ve made and share what they’ve learned.

**THE FUTURE OF 3D PRINTING**

Additive manufacturing isn’t just impacting the Maker Movement, it’s also changing the way companies and federal agencies do business. Companies are turning to additive manufacturing to build parts that weren’t possible before. An example that many point to is GE’s use of 3D printers to create fuel nozzles for a new jet engine that are stronger and lighter than conventional parts. Federal agencies are exploring ways to use the technology to better meet their missions. The U.S. Department of Health and Human Services created the [NIH 3D Print Exchange](http://3dprint.nih.gov/about) to better share biomedical 3D-printable models across the medical community while NASA is exploring [how 3D printing works in space](http://www.nasa.gov/mission_pages/station/research/experiments/1115.html).

Yet, this is just the tip of the iceberg when it comes to additive manufacturing’s potential. For manufacturers, additive manufacturing will enable a wide range of new product designs that can increase industry competitiveness, lower industry energy consumption and help grow the clean energy economy.

As the prices drop and the technology becomes faster and more precise, 3D printing is poised to change the way companies and consumers think about manufacturing -- much in the same way [the first computers](http://energy.gov/articles/photo-week-throwback-thursday-avidac) led to the rapid access to knowledge that we now take for granted.

1. What can the reader infer about the reason 3D printing is also called *additive manufacturing*?
2. 3D printing requires higher-level math skills, such as advanced addition, as the workers create the blueprints and operate the printer.
3. Manufacturing in the traditional way involves cutting away the excess material, and it is called “subtractive manufacturing”.
4. 3D printing involves layers of material being combined into one object as they are deposited onto one another.
5. Manufacturers, or people who work to make products we use, are always trying to come up with new and innovative methods.
6. What is the author’s purpose in writing the selection?
7. To explain what 3D printing is and how it can impact American people and companies
8. To give the technical details behind 3D printers and how manufacturers should use them
9. To persuade regular people to become “makers” and use 3D printers to make their own things
10. To explain how much is wasted using the older processes that are not 3D printing
11. In the sentence below from paragraph 10, what does the word extruded mean?

“The printing material—typically a plastic filament—is heated until it liquefies and is extruded through the print nozzle.”

1. Separated from the other materials that were used to create the plastic
2. Forced through a nozzle, just like Play-Doh through a toy with a specially-shaped opening
3. Changed from one state of matter to another, such as solid to liquid or liquid to gas
4. Appeared out of nowhere, like something in science fiction
5. What might the author have included to help the reader better understand the selection?
6. A map showing the location of companies who are now using additive manufacturing
7. A diagram or drawing showing a 3D printer, with labels explaining the process
8. A bar graph showing the number of American manufacturers over the past several decades
9. A photograph of middle school students looking up STEM careers online
10. How does the “How Does a 3D Printer Work?” section affect the reader’s understanding of the rest of the selection?
11. The problem-solution text structure details changes that the author wants to promote in the manufacturing process of plastic objects.
12. The compare-contrast text structure emphasizes the amount of waste that is created when more traditional methods are used to create 3D objects.
13. The description text structure shows the reader the detailed design process that makes 3D printers too complicated for anyone but professional engineers to use.
14. The sequence text structure, combined with specific examples of the types of objects that have been created with 3D printing, helps clarify how 3D objects can be designed and printed.
15. Which statement gives support to the assertion that 3D printing (additive manufacturing) can save energy?
16. “With some 3D printing processes, about 98 percent of the raw material is used in the finished part. Not to mention, 3D printing enables manufacturers to create new shapes and lighter parts that use less raw material and require fewer manufacturing steps.”
17. “Additive manufacturing technology comes in many shapes and sizes, but no matter the type of 3D printer or material you are using, the 3D printing process follows the same basic steps.”
18. “Companies are turning to additive manufacturing to build parts that weren’t possible before. An example that many point to is GE’s use of 3D printers to create fuel nozzles for jet engines that are stronger and lighter than conventional parts.”
19. “The polymer solidifies quickly, bonding to the layer below before the build platform lowers and the print head adds another layer.”
20. Which quotation summarizes the central idea of the selection?
21. “Though the possibilities for additive manufacturing are endless, today 3D printing is mostly used to build small, relatively costly components using plastics and metal powders.”
22. “The rise of the Maker Movement—embraced by both the young and old—represents a huge opportunity for the United States. It can create a foundation for new products and processes that can help revitalize American manufacturing.”
23. “3D printing has the potential to revolutionize manufacturing, allowing companies (and individuals) to design and produce products in new ways while also reducing waste, saving energy and shortening the time needed to bring products to market.”
24. “Creators are only limited by their imaginations. For example, 3D printers have been used to manufacture everything from robots and prosthetic limbs to custom shoes and musical instruments.”
25. Which is an accurate statement about how the author uses text structure to build the central idea?
26. The problem-solution text structure shows how traditional methods of manufacturing have become so outdated that they should never be used.
27. The description text structure provides details of how 3D printers work to make new inventions using materials like plastics and metals.
28. The cause and effect and sequence text structures used in the text illustrate why American companies need to be creative in order to keep being successful.
29. The cause and effect and sequence text structures used in the text show how 3D printing may help people create things quickly and efficiently.
30. How does the section “Creating a Country of Makers” refine the author’s idea?
31. It shows how advancements in 3D printing are helping people be more creative in making small batches of unique items and helping students be inspired to go into STEM careers.
32. It relates people who like to make things (“makers”) to students who like to create robots.
33. It demonstrates that the United States has always been the leader in new technologies and inventions, and how 3D printing will keep us ahead of the world.
34. It shows that 3D printing allows people to sell their items online or at events at the White House.
35. Based on the sentence below from paragraph 17, how does the figurative language emphasize the author’s point?

“Yet, this is just the tip of the iceberg when it comes to additive manufacturing’s potential.”

1. 3D printing is too expensive right now for most regular people to utilize it.
2. 3D printing has limits to how useful it will become based on the size of products.
3. 3D printing will lead to many more possible products and changes in manufacturing.
4. 3D printing involves hidden dangers, just like the ocean on which the Titanic travelled.

**If You Lived Here, You'd be Home by Now**
by Joe Bowers

1. It was cold. Cold for this time of year anyway. Cold for Louisiana. The wind cut as it blew by. The heat so common to this place, the sticky wet heat and insect buzz that filled most of the year was gone; cold had come and taken its place. But the sky was still overcast. It usually was. The grey was constant.
2. The boy was grey, too. He wore an olive green trench coat (an army cast-off like his boots) over funereal black, greasy hair obscuring his eyes. They must have been grey. He was narrow-shouldered and small, and walked like he was in a trance. I suppose he was. It was trance weather.
3. He wore headphones. He didn't sing along. He turned left after he crossed the railroad tracks and walked down the road. The ground was covered in leaves, wet and thoroughly dead. They were a hundred shades of light to dark brownish-gold, and might have been almost beautiful on warmer days. As it was, all shades hit the eye together, as a variation of a more familiar color, an echo of the sky. He walked past Brewbacher's Grill and The Daiquiri Cafe and into a shop with its shades down.
4. The writing on the front said:

FUST'S COMIC BOOK EMPORIUM

Buy, Sell, and Trade

New and Back Issues

Sports Trading Cards

and More!

1. The boy went inside and stayed there for quite some time.
2. When he came out, he had a brown paper bag with him. He sat down in front of the store, pulled a bright colored magazine from the bag, and began to read. A passerby might have thought the boy was dead. He sat with a blank look on his face, pale and black and green against the vivid paper cover, blasting *Action!*  and *Adventure!*  and sometimes *Terror!*  or *Romance!*  into the atmosphere in lurid red or blue or sharp yellow lettering. He sat still. Very still. Occasionally he would turn a page, with an almost undetectable move of the thumb. He was that way for a long time, breaking his trance every once in a while quickly to exchange the comic in hand for one in the bag. He was never without an open book for long, dropping the used issues on the ground, where they lay swollen with vibrancy on the icy concrete.
3. The daylight was dimmer when he looked up into the real world again and he blinked and shook his head quickly, like one newly awakened, shaking sleep from his mind. He rose slowly, painfully, like an arthritic. He gathered up his books and walked back past the bars, then across the tracks past the Circle K and down the road a ways. He passed a Chinese restaurant, its parking lot filling up for evening business. A group of young people hung around in front of it, getting out of their cars, not much older than he was. They were typical Baton Rouge youth: grinning young men in baseball caps with broad shoulders and cheeks and close-cropped hair. One had his arm around a girl with a painted face and a beautiful scraping false giggle. The boy stopped to watch them in the twilight, hiding himself in the pool of shadow by the side of the building. They shouted good-natured insults at each other in the cold, and went inside. They looked like angels. The boy walked on.
4. It was almost dark when he got to the hobby shop. It was dark when he came back out of it, carrying a plastic bag with model paints and glue.
5. He passed the Chinese restaurant again; the evening rush was in full swing. He took his headphones off.
6. The light was bright and gold through the glass door, and he shaded his face with an arm as he walked by, squinted under it as he passed. God, it looked warm.
7. It was warm, and busy. Had he walked inside he would have heard the low rumble of a thousand conversations, blending till no one word was intelligible. The sounds of people laughing, of small talk and ordering, the sounds of men telling women how beautiful their eyes were, of women telling women how all men were scum, of people complaining about the cold, of people complaining about the food, of people, people, people would all run together into a wonderful life-hum, sweet like night crickets and the rustle of leaves in the wind of summer, sweet like a woman's sigh or the warm beat of her heart. But he passed by the door in the cold and back into the dark, hearing only the wind. There was no sense in warming up if he only had to face the cold again on the way home.
8. He put the earphones back on; walked more quickly back past the Circle K and over the railroad tracks, through the leaf-mud on the side of River Road. The levee came into view, separating the dark road from the Mississippi. He hurried past the entrance to a subdivision and past houses and houses, past people eating dinner behind lit windows. He took three turns (a right and two lefts) and then stopped at one of the houses. He didn't go in. He walked around back.
9. The carport light was on. A bicycle, more rust than dull, chipped red, sat against a moss-covered wall. It hadn't been used since the fall. The moss had frozen to death. He passed through it, stopped when he got to a sliding glass door in the wall. The curtains were down. He opened it and stepped into blackness.
10. He placed his purchases on the floor beside him, keeping his feet planted firmly in place as if there were things on the ground he would rather not upset. He felt the wall for a switch. Then he spoke.
11. He cried, "Let There Be Light!”
12. And there was.
13. And it shown down upon a city and countryside in miniature, a model landscape of houses and green trees spread out on foam grass and dirt over three card tables, a desk and the tops of two dressers. The light was warm and golden, and revealed incredible microscopic detail in brilliant color, down to a tiny orange Circle K sign in front of the convenience store, down to the painted wavelets of a brilliant blue river, down to a shining red bicycle parked outside a tiny Chinese restaurant. The light shown down from a ceiling painted bright, brilliant blue, the same color as his eyes.
14. Read these sentences from paragraph 6.

A passerby might have thought the boy was dead. He sat with a blank look on his face, pale and black and green against the vivid paper cover, blasting *Action!*  and *Adventure!*  and sometimes *Terror!*  or *Romance!*  into the atmosphere in lurid red or blue or sharp yellow lettering.

What is the effect of the sentences on the meaning of the selection?

1. They contrast the boy’s outward appearance with the brilliant worlds he imagines in his head.
2. They emphasize the lack of companionship in the boy’s life.
3. They highlight the exciting stories that were written in the boy’s comic books.
4. They stress the emotion that is missing from the boy’s life but can be found in the comic books.
5. What is the theme of the selection?
6. Beauty can be found in the subtle details.
7. Imagination is the key to being happy.
8. Perception is influenced by the condition of one’ surroundings.
9. Loneliness alters the joy that can be found in life.
10. Which sentence provides evidence to support the theme?
11. “They were a hundred shades of light to dark brownish-gold, and might have been almost beautiful on warmer days.”
12. “The boy stopped to watch them in the twilight, hiding himself in the pool of shadow by the side of the building.”
13. “He sat down in front of the store, pulled a bright colored magazine from the bag, and began to read.”
14. “Had he walked inside he would have heard the low rumble of a thousand conversations, blending till no one word was intelligible.”
15. How does the setting affect the selection?
16. It contrasts with the boy’s warm and nurturing personality.
17. It emphasizes the boy’s quest to escape to warmer, brighter places.
18. It highlights the boy’s attention to the details of the world around him.
19. It stresses the boy’s isolation from other people.
20. How does paragraph 11 affect the plot?
21. It emphasizes the boy’s attention to details.
22. It demonstrates the loneliness the boy is feeling.
23. It highlights the negativity in the world around the boy.
24. It stresses how cold the boy is as he walks through the town.
25. In paragraph #2, what does the phrase “trance weather” mean?
26. It is extremely cold.
27. It is monotonous.
28. It is stimulating
29. It is varied.
30. What is the impact of the last paragraph on the meaning of the selection?
31. The paragraph provides a contradiction to the entire selection, showing that the setting is full of color and detail and not grey and dismal at all.
32. The paragraph reemphasizes the boy’s attention to detail by revealing his hobby of creating models of the places in his town.
33. This is the only time in the story that the boy has been inside, and it is the only time he sees vivid colors in his surroundings.
34. This is the first time the color of the boy’s eyes is revealed, and the reader is given insight into his vivid perception of the grey, cold, isolating world around him.

**Handwriting on the Wall**

|  |  |  |
| --- | --- | --- |
|                         |   | A weary mother returned from the store, |
|   |   | Lugging groceries through the kitchen door. |
|   |   | Awaiting her arrival was her 8 year old son, |
|   |   | Anxious to relate what his younger brother had done. |
|   |   |   |
|   |  5    | "While I was out playing and Dad was on a call, |
|   |   | T.J. took his crayons and wrote on the wall! |
|   |   | It's on the new paper you just hung in the den. |
|   |   | I told him you'd be mad at having to do it again." |
|   |   |   |
|   |   | She let out a moan and furrowed her brow, |
|   | 10 | "Where is your little brother right now?" |
|   |   | She emptied her arms and with a purposeful stride, |
|   |   | She marched to his closet where he had gone to hide. |
|   |   |   |
|   |   | She called his full name as she entered his room. |
|   |   | He trembled with fear--he knew that meant doom! |
|   | 15 | For the next ten minutes, she ranted and raved |
|   |   | About the expensive wallpaper and how she had saved. |
|   |   |   |
|   |   | Lamenting all the work it would take to repair, |
|   |   | She condemned his actions and total lack of care. |
|   |   | The more she scolded, the madder she got, |
|   | 20 | Then stomped from his room, totally distraught! |
|   |   |   |
|   |   | She headed for the den to confirm her fears. |
|   |   | When she saw the wall, her eyes flooded with tears. |
|   |   | The message she read pierced her soul with a dart. |
|   |   | It said, "I love Mommy," surrounded by a heart. |
|   |   |   |
|   | 25 | Well, the wallpaper remained, just as she found it, |
|   |   | With an empty picture frame hung to surround it. |
|   |   | A reminder to her, and indeed to all |
|   |   | Take time to read the handwriting on the wall. |

1. Which line from the poem characterizes the setting as a home?
2. 11
3. 2
4. 18
5. 24
6. Which word correctly captures the overall feeling of the poem?
7. Angry
8. Regretful
9. Resentful
10. Unkind
11. Which theme best fits the story?
12. Be patient with others when they have done something wrong.
13. Do not base your opinion on what others tell you.
14. Make certain that children are monitored at all times.
15. Never judge someone until you know the whole story.
16. Which sound device does the poet use in lines 3-4?
17. Rhyme
18. Alliteration
19. Onomatopoeia
20. Assonance
21. Which line is an example of personification?
22. Line 9
23. Line 18
24. Line 23
25. Line 26
26. Which literary element most significantly affects the meaning of this poem?
27. Character
28. Irony
29. Dialogue
30. Rhyme
31. Which text structure does the author use to express the main idea of the poem?
32. Sequential order
33. Compare/contrast
34. Description
35. Simple cause and effect
36. What is the author’s purpose in writing this poem?
37. To convey the lesson to be patient with others when they have done something wrong
38. To convey the lesson to not base your opinion on what others tell you
39. To convey the lesson to make certain that children are monitored at all times
40. To convey the lesson to never judge someone until you know the whole story

**Constructed Response Choices**

Choose one of the following prompts to answer.

1. How does 3D printing have the potential to impact society and scientific innovation? Write 1-2 paragraphs in complete sentences, giving examples from the text or examples of ways you can infer that it will have an impact.
2. Draw and label an infographic (a visual representation including both words and pictures) that shows the process of 3D printing, or additive manufacturing. Include written details from the text as captions or labels that accompany your drawing. You may either quote or paraphrase steps in the process from the text. Your drawing should be a neat and clear representation of 3D printing, but it is not going to be graded as a creative or artistic product. (It’s a sketch, so stick-figure-type drawing is acceptable.)

**Answer Key**

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| --- | --- | --- |
| Question | Answer | Standard Addressed |
| 1. | C | RI7.1, RI7.4 |
| 2. | A | RI7.6 |
| 3. | B | L7.4 |
| 4. | B | RI7.5 |
| 5. | D | RI7.5 |
| 6. | A | RI7.8 |
| 7. | C | RI7.2 |
| 8. | D | RI7.2, RI7.5 |
| 9. | A | RI7.5 |
| 10. | C | RI7.4 |

Constructed Response Choices:

(Answers will vary. The key consideration in grading is whether or not the student cites details from the text in addressing each prompt.)

1. This response should be written in an informative/explanatory style, explaining how 3D printing will lead to innovation. (Addresses W7.2, W7.9)

Details from the text that could be used to explain the impact of 3D printing on society and scientific innovation include: making manufacturing less wasteful of materials and energy/more efficient in the manufacturing process; shortening the time products take to get to market; inspiring creativity and individualized product creation through the Maker Movement; sparking interest among students in science, technology, engineering, and math careers; solving problems by creating lighter products or products that could not be created before; leading to experimentation and creation of products using other materials.

A well-written response will include an explanation of how the way 3D printing works is part of why it is leading to more creativity and efficiency because it enables anyone to create objects, as long as they have the right equipment.

1. This response should be written in infographic form, with drawings (nonlinguistic representations) in addition to labels, captions, words, and phrases. (Addresses W7.2, W7.9, the highly effective CITW strategy nonlinguistic representations, and 2 of the 4 Cs: creativity and critical thinking)

Details from the text that could be used in the infographic include: Sketches/drawings and written labels of a box, mechanical device, or machine that has a nozzle, from which a substance is being extruded; a product that is being “printed” or created beneath the nozzle; layers being added to the object; a build platform on which the object rests; a person standing nearby who created a blueprint on a computer; a finished 3D object; materials and other manufacturing supplies, such as plastic filament or metal powders ready to be loaded into the printer, brushes to brush off the excess powders, and a small bin for the wasted materials.

A well-written response will include both drawings and words that clearly demonstrate comprehension of the 3D printing process as described in the text. Students might even compare the extrusion process to squeezing toothpaste out of a tube or cake icing through various shaped nozzles to create cake decorations.