3D Printing Design – TinkerCad

Objectives

Students Will:

- Learn the basics of 3D design using the TinkerCad tutorials
- Design a multi-purpose tool that could potentially be used in space
- Design a solution to a real-world problem
- Evaluate the different design solutions

Suggested Grade Level

4^{th} – 12^{th}

Subject Areas

Engineering Design, Technology

Timeline

45 – 60 minutes

Standards

- **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- **MS-ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-3** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering

21^{st} Century Essential Skills

- Learning Skills (critical thinking, analysis, creativity, collaboration, communication)
- Literacy Skills (information, media, technology, environmental)
- Life Skills (flexibility, leadership, initiative, productivity, social, public speaking, global awareness, listening)

Background

"We are entering an exciting era in space defined by a new philosophy: Not everything we use in space must be made on Earth."

- Jeffrey Manber, CEO, Nanoracks

3D printing has moved from the realm of science fiction into the everyday lives of human beings all around the world, impacting the way we live, work, and play along the way. There are many examples of 3D printing in action in today's society. From students designing prosthetic limbs for their limb different peers, to surgeons printing vertebrae for patients with broken backs, to houses being printed in areas suffering from natural disasters constructed completely from concrete, all the way to delicious chocolate bars!

As we prepare to go, 'Back to the Moon, and on to Mars,' astronauts will experience time delays unlike ever before. In fact, the astronauts that will one day walk on the surface of Mars will experience a time delay of 20 minutes for their desperate plea for help to reach Earth, and then another 20 minutes for NASA to send a solution back to Mars! That 40-minute delay in reaction time could mean the difference between life and death for those astronauts that are 93 million miles away from home. With the power of 3D printing, astronauts will be able to design solutions to unexpected problems, so it comes as no surprise that NASA is a major proponent of 3D printing. Believe it or not, there is even a 3D printer in space right now, testing out 3D printing in a microgravity environment on the International Space Station. Just think how differently things may have turned out for Mark Watney, in the movie 'The Martian,' if he had a 3D printer with him on Mars!

Learning is most definitely not a linear process. In fact, it is as much about the process, as it is about the destination. It has been said that, "Mistakes are the portal of discovery," (James Joyce). 3D printing offers a very real opportunity for hands-on engineering, allowing true STEM education to permeate the depths of all content areas. 3D printing allows students to bring their ideas to life. And when those ideas need to be re-considered, they can go back to the drawing board and try again. There is absolutely no better way to introduce students to the engineering design process, then with a trusty 3D printer by your side.

Vocabulary

3D printing, design, evaluate, hatch, multi-purpose, prototype

Materials

- One computer per person
- Examples of 3D printed items (optional)

Lesson

1. Ask student what they know about 3D printing.
2. Create a classroom mind map regarding 3D printing as a class.
3. Share the following article with students regarding 3D printed prosthetics that are being created by students for their limb-different peers. https://3dprint.com/203080/student-3d-prints-prosthetic-hand/

4. Share the following video with students, highlighting the impact of 3D printing on Buttercup the Duck. https://www.iflscience.com/plants-and-animals/3d-printer-makes-prosthetic-foot-duck/
5. Share the following trailer for the movie, 'The Martian.' **(Stop at 1:22)** https://www.youtube.com/watch?v=Ue4PCI0NamI. Discuss how differently things may have turned out for Mark Watney if he had a 3D printer with him on Mars!
6. Have students go to https://www.tinkercad.com/ and create a log-in.
7. Direct students to complete the tutorial lessons by clicking on the 'learn' tab.
8. Allow students to 'tinker' or explore with other programs and tutorials for about 15 minutes.
9. Assign students a design challenge on TinkerCad. Imagine that you were stranded with Mark Watney on Mars. During the storm, the hatch to your Martian habitat was compromised, and your habitat is leaking oxygen. Students must design a multi-purpose tool that will assist in fixing that broken hatch (wrench, screwdriver, HVAC unit). Allow 20-30 minutes for this activity.
10. Have students share their prototypes. If time allows, students can 3D print their prototype.

Extensions

- Students could develop any kind of space-related object using only simple shapes on TinkerCad.
- Have students draw a space-related object, then act as the 3D printer by adding layer after layer of modeling clay to make the object.
- Incorporate the use of ratios and scale as students create a new project.
- Write an expository essay on how to create something on TinkerCad.
- Compare and contrast AR and VR. How are 3D images (AR) different/similar to Virtual images (VR)?
- Design a prototype for a tech-transfer product, designed for use in space but beneficial to life here on Earth.

Visit http://www.discoverspace.org/ for more innovative ideas and resources.

Resources

Andrew, E. (2019, March 11). 3D Printer Makes Prosthetic Foot for Duck. Retrieved from https://www.iflscience.com/plants-and-animals/3d-printer-makes-prosthetic-foot-duck/

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