I can Make a Difference: Earth Day Water Ecology 3D Printing Projects

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Target Grade: 6th grade

Time Required: 5, 80 minute lessons

Standards:

- CCSS.MATH.CONTENT.6.RP.A.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- CCSS.MATH.CONTENT.6.RP.A.2: Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship
- CCSS.MATH.CONTENT.6.RP.A.3: Use ratio and rate reasoning to solve real-world and mathematical problems
- CCSS.MATH. CONTENT.6. NS.A.1: Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions,
- CCSS.MATH. CONTENT.6.NS.B.2: Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem
- CCSS.MATH. CONTENT.6.NS.B.3: Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation
- CCSS.MATH. CONTENT.6.G.A.1: Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
- CCSS.MATH. CONTENT.6.G.A.3: Draw polygons in the coordinate plane given coordinates for the vertices;

Lesson Objectives:

Students will:

- Use math to create their own 3D object through printing
- Understand and work collaboratively with others to problem solve through model making.

Central Focus:

Lessons will be taught during math, in collaboration with Language Arts, social studies and science lessons on current and ancient civilizations' systems of freshwater ecology. 3D printing can provide students with opportunities to collaboratively use 21st Century skills in order to become civically engaged in solving local and global problems. Open source 3D printing plans can be used to create products that provide usable resources. Additionally, in conjunction with 3D printing, students can make a difference in the world by innovatively using the Design Thinking Process to Define, Ideate, Prototype and Create their own 3D printed products.

Background Information:

For this lesson, students need to be aware of what makes water safe to consume and how much water a human needs to survive. This information includes knowing that different treatment is used depending on the source of your water such as groundwater, surface-water, and water from holding pond/container. Groundwater taken from wells has been filtered through rocks, so it is usually quite free of particles. It can still contain chemicals and organic matter that must be taken out. If your water comes from a surface-water source (lake or river) work should be done to get rid of it. Often water is withdrawn and pumped into holding ponds or containers, where solids and particles can settle to the bottom. Filters and sand beds can be used to screen out matter and is important to note that a minimum amount of chlorine is added to kill bacteria.
In order for students to be successful in this lesson, they will need to be skillful about working with iMovie and 3D printers.

Materials

- Clear water bottle - empty
- Clear water bottle - full of dirty water Laptops (1 per group)
- Internet Access 3D Printer
- 3D Printing Software 3D Printer Filament
- iPads with iMovie (1 per group) Paper
- Pencils
- Rulers (1 per group)

Instruction

Opening Hook prior to start of lesson:

Teacher will stand at the front of the class and act like he/she is going to drink from a water bottle. However, the water bottle will be empty. The teacher will hold the bottle upside down and shake it to demonstrate there is no water remaining in the water

bottle. Teacher will state, "Looks like I'm out of water. I wonder how long I can go without water? How long do you think a person can live without water?" (Correct answer: 8-21 days)

Continuing, teacher will ask, "Can it be any kind of water?" The teacher will ask while picking up another nearby water bottle full of dirty water and making a face to show lack of appeal. (Correct answer: freshwater)

Teacher asks, "How much of our body weight is made up of water?" (children ~75% & adults ~60%) This discussion should drive home the importance of freshwater. Shaking the dirty water bottle the teacher inquires, "How many people do you think live without what we consider clean or "safe water?" Teacher asks 1 in 9 students to stand up to demonstrate the fact that 1 in 9 people in the world do not have "safe water."

Teacher asks, "How important is clean or safe water?"

Day 1

Teacher will explain, "We just talked about my brief issue with running out of safe, clean water. That's not a big issue for me, because I can find other safe water resources. However, that is not true for everyone. Now I would like you to investigate a global the water crisis by going to: https://water.org/our-impact/water-crisis/ so you can investigate some important questions".

- What is the water crisis?
- Using a fraction, demonstrate who is affected by the water crisis?
- How is the education of kids impacted by the water crisis?

Day 2-4

Students will be asked to create a product with the 3D printer that can solve a current freshwater issue for someone else. Students will be given 3 days to investigate, design and create their product. As a differentiation strategy, open source projects will be shared and allowed as noted in the resources below, including the 3D printed water filter and hydroponics water system.

Day 5

Students will create a 2-5-minute iMovie video (Summative Assessment) summarizing their final product and the process of creating it. During their video, students are encouraged to share their challenges, mistakes and redesigns as part of their product creation.

Differentiation

For differentiation purposes, students will be allowed to work in groups of 3 and have designated space at dry erase board areas to write about or draw pictures of their findings. Once finished, students will be encouraged to find at least one story to read and also write or draw about from: https://water.org/our-impact/all-stories/

Assessment

Formative Assessment

Teacher will check for understanding during the dry erase board activity, product investigation/creation, and sharing of the design engineering process.

Summative Assessment

A student created video will demonstrate the design process, final product and mathematical challenges/successes. See rubric below

Rubric for project

Grading criteria:

4: Student showed/demonstrated the description during presentation. It was clear the student put forth effort and thought into the project.

3: The student moderately demonstrated the description in their presentation, but it is clear more thought could have been put in planning and editing.

2: The student completed the activity/description, but it was clear little to no effort was shown.

1: No evidence of the description was shown during the presentation

Description	Write 4, 3, 2, 1 based on the student's performance	Notes
Student's iMovie was clear and professional		
Student's expressed challenges		
Student's expressed solutions		
Students work collaboratively with each other.		

Teacher resource options

Earth Force. ***Watershed Health: The Global Rivers Environmental Education Network.*** **Retrieved from: https://earthforce.org/watershed-health/**

Water.org. The Water Crisis. Retrieved from: https://water.org/our-impact/water-crisis/

(2018, January 16). Silver, N. ***How Long Can You Live Without Water*****?**

Retrieved from:
https://www.healthline.com/health/food-nutrition/how-long-can-you-live-without-water

(2017, May, 8). Kiran M P. ***Smart Home Gardening System Using Raspberry Pi.*** **Retrieved from:**

https://www.hackster.io/mtechkiran/smart-home-gardening-system-using-raspberry-pi-1570a7

(2016, April, 22). Kira. www.3ders.org. ***Earth Day 2016: 10 3D Printing Projects Contributing to a Greener Planet.*** **Retrieved from:**
http://www.3ders.org/articles/20160422-earth-day-2016-10-3d-printing-projects-contributing-to-a-greener-planet.html

(2016, February, 16). Kira. www.3ders.org. ***Faircap Project: Open Source 3D Printed Water Filter Aims to Solve Global Crisis for Just $1.*** **Retrieved from:**
http://www.3ders.org/articles/20160212-open-source-3d-printed-water-filter-aims-to-solve-global-crisis.html

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http://www.3ders.org/articles/20150202-3dponics-3d-printable-hydroponics-system-becomes-makerbot-ready-app.html

(2014, November, 21). Krassenstein, Brian. ***The Great Globe Project: 10.5 Million Piece, 420 ft Wide, 3D Printed Model of Earth.*** **Retrieved from:**
https://3dprint.com/26236/great-globe-3d-print-earth/

(2014, November, 13). www.3ders.org. ***3DPrinterOS and 3Dponics Team Up to Offer 3D Printable DIY Hydroponics System.*** **Retrieved from:**

http://www.3ders.org/articles/20141113-3dprinteros-and-3dponics-team-up-to-offer-3d-pr intable-diy-hydroponics-system.html

(2013, April). Kapitan, E., Lyttle, S. & Williams, R. N. *Discovering the Watershed*. Retrieved from:

https://www.extension.purdue.edu/extmedia/FNR/FNR-476-W%20Discovering%20the%2 0Watershed%2013.pdf

(2012, July, 16). Slivka, Kelly. *A Mayan Water System With Lessons for Today*. Retrieved from:

https://green.blogs.nytimes.com/2012/07/16/a-mayan-water-system-with-lessons-for-toda y/