Proportional 3D Ornament

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Standards/Curriculum Connections:

Digital Fluency Standards:

4-6.CT.4 Decompose a problem into smaller named tasks, some of which can themselves be decomposed into smaller steps.

4-6.CT.6 Compare two or more algorithms and discuss the advantages and disadvantages of each for a specific task.

4-6.CT.7 Identify pieces of information that might change as a program or process runs.

4-6.CT.9 Explain each step of an algorithm or program that includes repetition and conditionals for the purposes of debugging.

4-6.NSD.2 Model how computer hardware and software work together as a system to accomplish tasks.

4-6.NSD.3 Determine potential solutions to solve hardware and software problems using common troubleshooting strategies.

4-6.NSD.5 Describe that data can be stored locally or remotely in a network.

4-6.DL.4 Use a variety of digital tools and resources to create and revise digital artifacts.

6th Grade Math Next Generation Standards:

NY-6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

NY-6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems.

Target Grade level: 6th grade

Lesson Procedure:

Total Time: (170 minutes)

Pre-class activity (5-10 minutes): Show students a matchbox car (with the original packaging). Tell students the scale on the packaging says that it's a 1:64 scale. As students to chat with a partner about what a 1:64th scale means. If it's 1:64th scale, what would the original (non-scaled) figure be? Allow students 2 minutes to discuss. After you call time, have groups share their thoughts. Discuss with students that the original figure is a real life-size car. Keeping the scale or ratio of 1:64 is important when recreating the car so that all parts of the car are scaled by the same amount and you don't end up with a really large window or tire on a really small car, for example.

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Day 1 (40 minutes): Calculate the dimensions of the original image/car.

- (10 minutes) Opening: Tell students "If the scale says it's a 1:64th scale of the original image and we have a scaled car, can we use those two pieces of information to find the dimensions of the original image? How would we do that?" Have students chat with their partner (elbow partner) for 1 minute about how they may accomplish this task. Have students share and come to the conclusion that they should measure the matchbox car (in inches) and use that information with the scale of 1:64 to create a proportion to find the original dimensions (length, width and height) in inches that the original car would be.
- (25 minutes) Give students remaining time to work together and find original dimensions mathematically. Once students finish finding the original dimensions, if there is time remaining or other groups are still working, have them find another group that is done and compare the dimensions that they found, troubleshooting any potential discrepancies they find. If there is remaining time allowed, they can move on and compare with another group and so on.
- (5 minutes) Closure: Call students back to the whole group and compare the original dimensions found. Discuss the size that they found the original image to be and if that makes sense for a real car size. *Optional: use a tape measure to show dimensions they found.*

Day 2 (40 minute): Creating the name and year portion of the ornament

- (5 minutes) Opening: Have students discuss with their partner (elbow) what a ratio is and give an example of one.
- (10 minutes) Tell students you have a box that has a width that is 2 in. by a length that is 4 in. and it needs to be enlarged so that the new width is 4.4 inches. Can you find the new length? Be prepared to share your solution. Put students in the clock for 5 minutes. Have students share their solution(s).
- (25 minutes) Hand out ⅓ of a blank white sheet of paper and the Proportional 3D Printing Ornament Project packet.
    - Read over the directions with students emphasizing the rules they must follow when creating their image.
    - Students will need their image approved by the teacher.
    - Have students create their images, take a photo and email it to themselves.

Day 3 (40 minutes): Convert, upload and do the math to make it proportional!

- Have students pick up where they left off yesterday.
- After teacher approval, students should convert their image to a **.svg** file using https://www.adobe.com/express/feature/image/convert/svg
    - This is an important step because Tinkercad supports a .svg file.
- Have students open tinkercad and login. They should upload their converted .svg file. They may need to change the scale to 10% in order for it to upload correctly.
- **IMPORTANT: Before** students do any manipulation of the image, have them write down the dimensions given on the workplane on the Proportional Ornament Workpage.

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- Students will create a proportion using the ratio of length to width of the image they uploaded to create the new width given that the new length needs to be 50.8 mm.
- Once students have shown work, have them change the dimensions of the image so it is proportional in the workplane.

Day 4 (40 minutes): Export, print and assemble time!

- Have students pick up where they left off the previous day.
- Once students are all set with the proportional image, they should EXPORT it to a **.stl** file and email it to their teacher.
- The teacher should then use Ultimaker Cura (will need to be downloaded) to convert the .stl file to a .gcode file.
- The .gcode file will need to be put on a micro SD card and then loaded into the 3D printer and printed.
- Once the image is printed, students should string a fishing line through the "loop" on their image and hang it in the ornament. They should also sprinkle some fake snow in the ornament and optionally, you can include a laminated photo of the student as well.

Optional Lesson Extension:

- Students can present their ornament design to the class sharing any issues they ran into and what steps they took to overcome them.

Materials:

- Tape measure
- Proportional 3D Printing Ornament Project packet
- Blank white paper
- Black marker for each student
- Device connected to the internet that is able to take a photo and send that photo via email.
- Chromebook/Laptop/Computer
- 3D Printer with filament (Device used to make 3D image in this lesson is a Creality Ender 3)
- Mini SD Card
- Plastic fillable ornament bulbs
- Fake snow
- Fishing line
- Student photo

Assessment:

- Students will be assessed based on the proportionality of their image.
- (Optional) Students will present their ornament to the class and share any issues they ran into and how they overcame them.
    - Goal: The process is about developing and refining (the engineering design process).

Objectives:

- Students will create a proportional 3D printed image of their name and the current year to put in a Christmas ornament for them to take home!
- Students will be able to follow an algorithm of instructions to create their own 3D ornament.
- Students will be able to calculate a width that is proportional given the

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External References: ● https://www.adobe.com/express/feature/image/convert/svg ○ Convert a JPEG to an SVG file ● https://www.tinkercad.com/dashboard ○ Tinkercad is used to create the 3D image to print. ● Ultimaker Cura ○ Program used by teacher (must be downloaded) to convert from a .stl to a .gcode so the 3D printer will print the file.	original dimensions and a new length.

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