**Making Money**

**Submitted by: Max Vikhter, STEM**

**Thorp Scholastic Academy, Chicago, IL**

**Target Grade**: 5th-6th Grade, CAD/Engineering

**Time Required**: 90 minutes

**Standards**:

*Common Core Mathematics Standards*

* CCS.6.RP. Understand ratio concepts and use ratio reasoning to solve problems
* CCS.6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
* CCS.6.RP.3.d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

**Lesson Objectives:**

Students will:

* Use Design Thinking to design a prototype of a coin that is representative of their school
  + This can include mascot, colors, motto, slogans, or other thematic material
* Students will measure proportions virtually to meet real-world needs in terms of size of an item

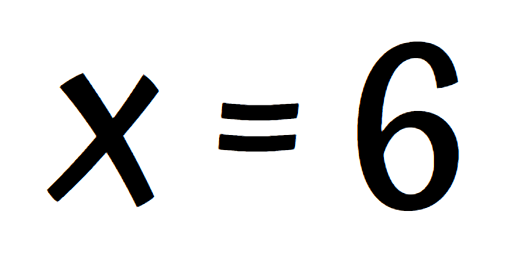
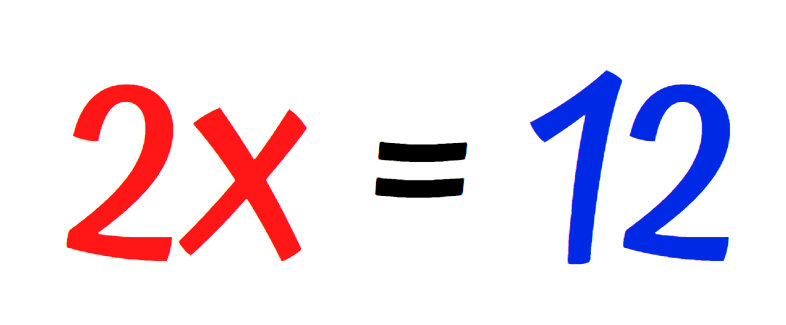
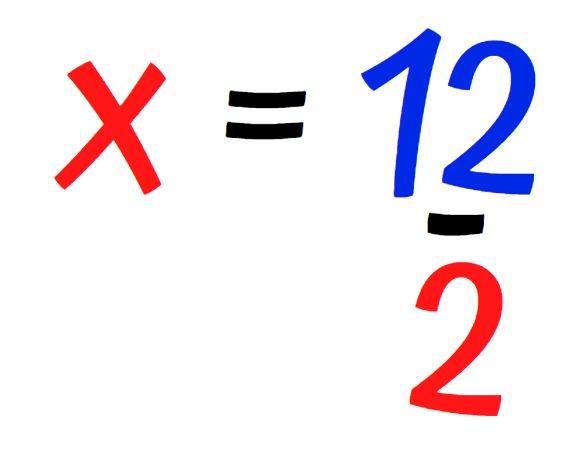
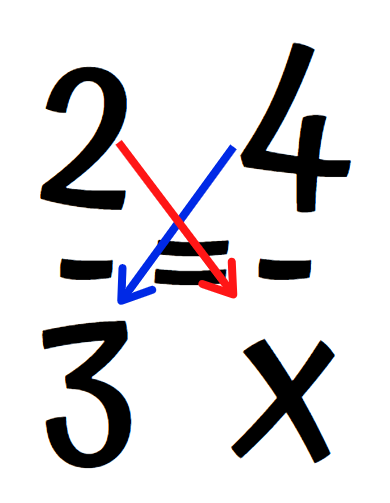
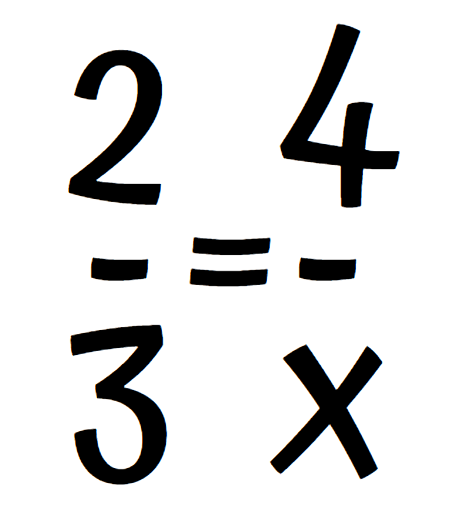
**Central Focus:**

How might we create an item that will be perceived to have value? In this cross-curricular lesson, students will learn about the designing process, proportions and ratios, and the history of currency. Students will use conceptualization, measurements, manipulations, and prototypes to create their own currency on TinkerCAD. This lesson can be designed for students to collaborate and discuss or completed virtually.

Key terms: design, proportion, ratio, virtual, measure, measurement, manipulate, conceptualize, prototype, discussions

**Background Information**:

In this lesson, students will be using proportions to conceptualize how they want their physical item to look based on their measurements. A proportion is a statement of equality between ratios. The images below demonstrate how to solve for x using proportions. In the first image, the ratios are set up as two equal fractions. The fractions are then cross multiplied to create a one-step equation. In this example, the 12 is then divided by 2.



**Materials**

* 3D Printer
* Filament (color depending on school)
* Device with internet connection that can run Google Chrome
* Some coins from around the world and/or tokens (as examples)
* Some rulers (to conceptualize coin size)

**Instruction**

* Begin with a discussion about currency. This discussion could include information on how money came about, its value, and how it differs worldwide. Additionally, the discussion may include conversations on how currency can be made from rare or valuable materials, or simply be used to represent ownership of materials located remotely.
* Have students start by drawing prototype coins. Students should discuss with a partner why they put the phrases and images on the money. They should use rulers to draw with precise measurements that are proportional to the overall size of the coin. Students can start with a large drawing but will use proportions to ‘shrink’ the coin to an appropriate size. Students may start with a top-down view, but with enough time they can try a 3D drawing. This is an opportunity to point out the grooves all around the rim of American currency, as well as a lip or other protruding objects.
* Students will begin on TinkerCAD by placing a pre-generated cylinder onto their screen. The teacher should talk about how much the cylinder should be shrunk down in order to make it more “coin-like” and flat. Students can explore different manipulations and compare their shapes.
* Next, the teacher should show students the location of text and free-form drawing on the tool kit. There is also a “text wrapping” feature further down the bank. Students should have ample time (30-45 minutes) to explore and design their coin. Depending on the class and the groupings of students, they might have the ability to make one that is their own (interest-based) while a group works on the one that will be used by the school for mass production.
* TinkerCAD has the ability to collaborate on the same design. Students are also able to send the link to the teacher. The teacher may choose to have students send the link via a Google Form in order to have a central machine ready for slicing with access to the entire spreadsheet.
  + **Caution:** A common mistake is that students will make is send the URL on their browser. This will not work, they must press a button in the corner to generate a link and send that to you (and each other) in order for others to access the project.

**Differentiation**

* Advanced students may include a discussion on the Gold Standard and how US currency is no longer associated directly with any physical material, but represents a sort of “virtual” value and relies heavily on our confidence in its value.
  + A topic of discussion as students explore currency is how design could influence the economy. What if there was an unpopular image or phrase on the national currency? Might that affect its value? What does the current imagery represent (someone had to design it)?
* Students who struggle to keep track of multiple mathematic variables, can use CTRL and SHIFT keys each time they manipulate their design to ensure that it remains circular.
* Students who struggle with controlling the trackpad may use a mouse or a touch screen.
  + If a mouse or touch screen is not available, consider that a piece of currency can have a different non-traditional shape but still be perceived as valuable. This is an opportunity to discuss “why are coins typically round?”

**Assessment**

*Formative*

* The teacher will walk throughout the classroom and observe student work.
* Student designs displayed on the screen for feedback (from teacher and other students)
* If enough time is available, students may “visit” each other’s’ “worlds” to give feedback on designs. This might require additional setup in terms of procedures, training them not to tamper with designs, as well as materials on which to give feedback.

*Summative*

* If time allows, students should be given the opportunity to give a formal presentation in front of the class. The students should explain their coin design, text, and images. If possible, the teacher can implement a new token economy in the classroom in which students will use their coins/tokens.
* Students will create a video on YouTube demonstrating the process and the finished result. There is an opportunity for a Social Studies connection as students discuss currency around the world, its history and purpose, and implications for people groups. Students who are capable of creating videos (for example on WeVideo) might be able to demonstrate the historical documents, the process of printing a coin, and overlay stock footage to create a video that can be shared