Final ***integrated*** **project / lesson plan** (teams-Due: Thursday, August 12th)

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Grade level(s)/Subject taught: **Science/Math/Technology 8**
Objectives: **Math:** Students will derive the formulas for volume of a rectangular prism and a cylinder. They will use the formulas to find volume of actual objects. **Technology:** Students will understand the concepts of mass, volume and density as a result of a series of activities that enable them to work hands on with representative objects. Students will use Geometer's Sketchpad to draw objects to scale +/- 1/16th of an inch in isometric form. Students will redraw the objects on software that generates a DXF (Data Exchange File) version which then will be run on a CNC (Computer Numerically Controlled milling machine, which will cut out the object. The object will then be taken to the science and math class for further scientific analysis **Science:** Students will use a balance to measure mass of previously constructed objects. They will then use water displacement to verify volume calculated when creating these objects. Students will then these measurements to calculate density of the objects.

Describe the *integrated* Mathematical - Science Concepts or “key ideas” that modeling will be used to teach: (e.g. Students use mathematical modeling/ multiple representation to provide a means of presenting, interpreting,

Mathematical - Science Concepts to be integrated:

Math: Standard 3 – Mathematics

4. Students use mathematical modeling/multiple representations to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.

5. Students use measurement in both metric and English measure to provide a major link between the abstractions of mathematics and the real world.

Technology: Standard 5 – technology

2. Technological tools, materials and other resources should be selected on the basis of safety, cost, availability and environmental impact ; technological processes change energy, information, and material resources into more useful forms. Students choose and use resources for a particular purpose based upon an analysis and understanding of their properties, costs, availability, and environmental impact.

Science: Standard 4 – Science Physical setting

3. Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

Using ___Geometers sketchpad__ I plan on having my students…
(software / modeling tool)

Math:

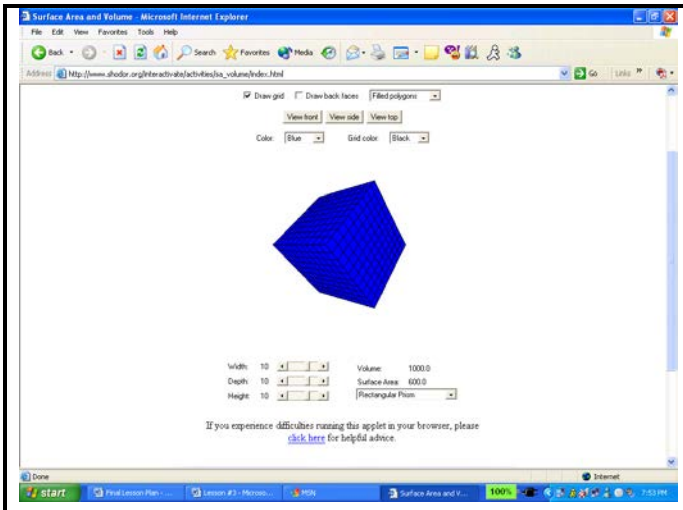
The integrated lesson will start in math class as we are studying three-dimensional geometry. The students will already have knowledge of basic vocabulary of faces, edges and dimensions of length, width, height and radius. Using real life objects as manipulatives like tissue boxes or blocks, the students have also discovered that a cube is a special type of rectangular prism. It's a rectangular prism with all dimensions equal. We will be working out of the *Filling and Wrapping* Connected Math textbook during this unit. As I go through any of the examples, I will be using the graphing calculator and the view screen so that the class can follow the calculations that they are inputting.

To begin the lesson on volume, I would start a discussion on formulas, and I plan on brainstorming a list of formulas we already know. After compiling a list, I would focus on two formulas specifically, area of a circle and area of a rectangle, and how we use them. I would explain some examples and talk about area. The students already know that a rectangular prism is made up of rectangles layered on top of each other. At this point, the students would have time (10 to 15 minutes) to talk with a partner and manipulate a rectangular prism made out of blocks. So given some time for discovery, I will lead the students to discover the formula for volume. The conclusion that the students will come to is that you take the area of the base rectangle and multiply the height for each layer which gives you the volume. Then we would transition to the cylinder. After figuring out the rectangular prism, it should be easier for students to see that a cylinder is made up of a circle layered on top of each other, so the volume formula should be similar to the previous activity. The class would derive the formula for volume of a cylinder. Then I would show examples using the formulas and we would solve each problem as a class. I would leave the solutions on the board for the students to refer to while they are working.

The students will practice using the formulas to solve the following questions:

- page 29 – 31 # 1- 9 as needed
- page 41 – 42 # 1-5 as needed
- any additional questions from the Teacher Edition as needed

If the students continue to find trouble with the concepts, I would direct them for extra practice to the computer lab. The activity, Surface Area and Volume, on Project Interactivate (www.shodor.org/interactivate) would be a visual way of manipulating the dimensions of a rectangular prism. This tool allows the students to change the dimensions of the rectangular prism, and the diagram, volume and surface area of the prism change simultaneously. Here the purpose of the tool would serve as reinforcement for any students that struggle.



Technology:

Using geometer's sketchpad, I plan to have my students design a cube and a cylinder using the isometric drawing technique, which conforms to ISO 2004 standards.

First students start up the software, draw a reference point and a line. They then begin to construct the object, using parallel lines, perpendicular lines and circles.

Students will be assessed on their ability to use the sketchpad program, draw the three dimensional objects, and then print a labeled drawing. Estimates of volume are expected.

After their first labs in math and science, students are shown how to convert their drawings to DXF's which are then sent to the CNC Milling Machine which will mill out the cylinder and the cube.

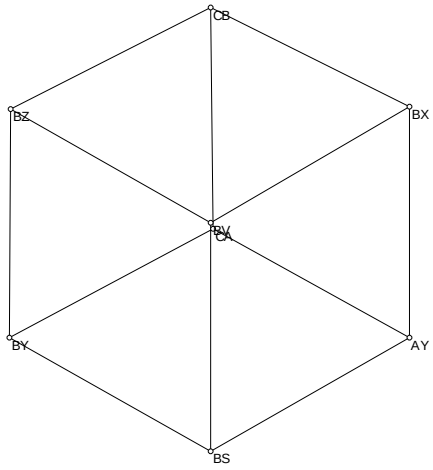
After the product has been produced, students check for accuracy and then take to math and science class for experimentation.

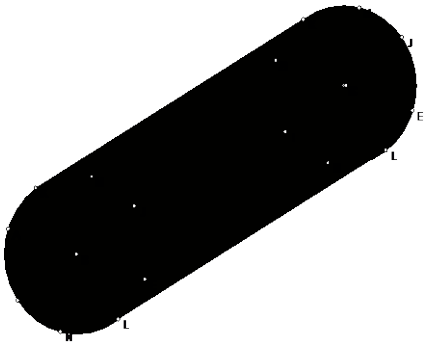
Students integrate their Computer Aided Design and Computer Assisted Manufacturing with math and science lessons. In this exercise, students carry work completed in Technology class, to their science and math classes. They receive a unit grade from each class for their subject related work, and then at the end of the project, they receive an overall grade.

After classroom demonstrations and tutorials, students make isometric (equal measurement) drawings of a cube and a cylinder, using Geometer's Sketchpad (See sample drawings). This lesson is preparatory to their use of an actual CAD program, and here, they learn the importance of angles and length of various segments of the object being drawn.

Once completed, students will add dimensions to the drawings, so they can begin to calculate the volume. This activity will be their initiation to the world of Computer Aided Design.

m $\overline{BSBV}$ = 5.00 cm
m $\overline{AYBX}$ = 5.05 cm
m $\overline{BSAY}$ = 5.00 cm
m $\overline{BXBV}$ = 5.03 cm
m $\overline{BSBY}$ = 5.05 cm
m $\overline{BZBV}$ = 5.02 cm
m $\overline{BYBZ}$ = 5.00 cm
m $\overline{CABY}$ = 5.04 cm
m $\overline{AYCA}$ = 4.90 cm
m $\overline{CBBX}$ = 4.85 cm
m $\overline{BZCB}$ = 4.90 cm
m $\overline{CACB}$ = 4.84 cm





Science:

I will begin the lesson by having students tell me what will happen to blocks of wood, wax, foam and metal, as I drop them into a container of water. Students will then be asked to attempt to explain how huge metal ships are able to float if they have seen that metal sinks in water. We will use the students' answers to this question as a basis for a discussion about buoyancy and density.

Students will then begin the process of calculating the density of the objects they have constructed in technology. They will begin by calculating the volume of the cube using a ruler. The cubes will then be massed using a triple beam balance and density will be calculated using these two measurements. The volume of the cylinder will be calculated next using water displacement. Students will place the object into a large graduated cylinder and will use initial and final measurements to calculate volume of the cylinder. Students will again is the triple beam balance to mass the object and use the measurements of volume and mass to calculate the density.

Students will then make predictions using the density of their objects. They will need to determine if the object will float or sink. After that prediction they will place both objects into a tank of water to test the prediction. Following this test students will be asked to determine what will happen to the object's density if they where to cut the object in half. They will make predictions and then will cut the objects in half and use the same methods used previously to determine the density of the objects. They will then compare the outcome to their prediction.

The final step in this lesson will involve a new substance not brought into the classroom from technology. Students will be given a piece of clay. They will first have to determine the density of the clay. They will be allowed to choose which of the two previous methods will be used to calculate volume and will need to explain the choice before they may proceed. They will use their chosen method along with a balance to determine mass and volume and finally use these measurements to calculate density of their object. They will find from these calculations that the clay has a greater density than water.

The homework assignment will involve each student using what they have learned in class to design an object made of the clay that will float in the water while carrying a cargo of washers. In the following class they will construct these objects using the clay and will have a contest to see which will carry the largest load.

Task	0	1	2
Math: calculate volume of a cylinder and a rectangular prism	Calculations incorrect	Calculations incorrect, Substitutions correct	Calculations and substitutions correct
Technology: GSP drawing	Drawings of both objects are incorrect.	Resembles object but some measurements are inaccurate	Drawings of both objects are accurate
Construction of objects	Objects are not accurately constructed from drawings	One object accurately represents drawing	Both objects are accurately constructed form drawings
Science: Density calculations	All density calculations incorrect	Substitutions correct, Errors in calculation	All density calculations done correctly
Interdisciplinary: Results reporting in oral and visual format.	None of the listed objectives completed	Objectives partially completed.	Accurately completes all listed objectives.

Students will receive a unit grade for their efforts in Math, Science and Technology classes. This grade will be based upon class participation and success at completing tasks outlined in the lesson rubric.

Students then receive an overall project grade based upon their completion of and understanding of the project. This project grade is largely determined by the oral presentation students give at the end of the project.