TEACHWITHPORTALS™

Subject: Math

Title: 2-D Nets for 3-D figures and Intro to Puzzle Maker

Author:

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School / Organization, City and State / Province:

Shoreline, WA

Grade Levels: 6 or 7

Common Core Standards Met:

6th: Solve real-world and mathematical problems involving area, surface area, and volume.

6.G.4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. ~Note: the surface area elements appear in a later lesson. ~ Apply these techniques in the context of solving real-world and mathematical problems.

7th: Draw, construct, and describe geometrical figures and describe the relationships between them.

7.G.2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions.

7.G.3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

Time needed for lesson: Approximately two regular length class periods or one block period.

Overarching Question and Objectives:

How can we represent 3-D objects with 2-D images?

- Students will be able to utilize vocabulary associated with 3-D figures
- Students will demonstrate the ability to deconstruct a 3-D figure into a 2-D net
- Students will effectively demonstrate how a slice of a 3-D figure is a 2-D figure
- Students will use the Puzzle Maker to help them visualize and work with 3-D shapes

APERTURE LABORATORIES

Summary of lesson:

In this lesson students are introduced to the idea of 2-D representational nets of 3-D figures and characteristics of 3-D figures and horizontal slices of 3-D figures. Through initial examples of how nets work, students then extend these ideas into the creation of their own nets from images in the game *Portal 2*. They are introduced to mathematical vocabulary related to nets and 3-D figures. Finally, they complete an introductory piece familiarizing them with the Puzzle Maker as they use it to explore the idea of nets.

Vocabulary:

Face – a flat surface of a 3-D figure

Edge – the intersection of faces in a 3-D figure

Vertice– the point where three or more edges come together

Teacher materials needed:

If possible, a computer that will allow you to project the Puzzle Maker for class discussion purposes. Also you may choose to show one of the demo videos from the Think with Portals website (in the media section). Link http://www.thinkwithportals.com/media_06.php

Student materials needed:

* The Puzzle Maker

*Polydrons building materials (or another type of building tool that will allow students to make nets) or paper and scissors and students can create their own nets (this portion is optional)

*Rulers

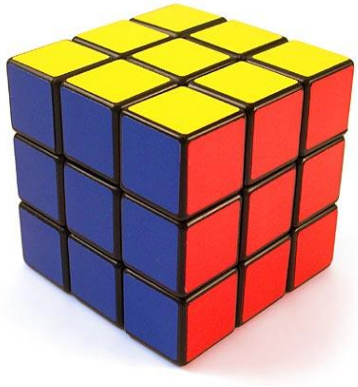
*Copies of the *Portal 2* images included in this lesson

*Markers or Sharpies

Lesson Plan:

First Portion:

Introduce unit by holding up a 3-D object (a Rubik's cube works well). Ask students what they can observe about the cube. Students may not point out that it is a 3-D object. If not, have a picture (such as the one below) handy.



Ask students: What differentiates the picture cube from the actual cube?

When someone suggests that it is "3-D", have students discuss what makes something "3-D". They should mention that it has three dimensions…encourage them to name the 3 different dimensions (depth, width and height).

Explain that when we see a picture or drawing on paper, we are looking at a 2-D image that can represent a 3-D figure. Use the Rubik's cube picture to emphasize this point.

State that we need to get a few common vocabulary words that have to do with 3-D figures: faces, edges, vertices. Use a 3-D object in your room to highlight these vocabulary words.

Faces – a flat surface of a 3-D figure

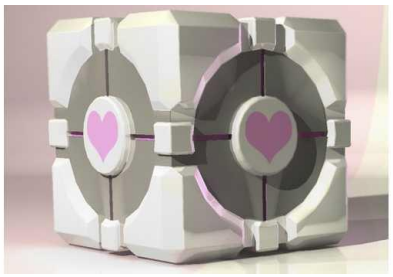
Edges – the intersection of faces in a 3-D figure

Vertices – the point where three or more edges come together

Remind students that work with 2-D and 3-D shapes involves skills in "spatial reasoning." There are lots of ways to study spatial reasoning: by building models, looking at pictures, and by using computer programs that can model shapes and objects.

Find out how many students play video games. Explain that we will be using a special program that is based on a video game called *Portal 2* and it is going to help us improve the way we think about shapes and objects.

Explain to students that now we are going to try something a little bit more interesting. You will be showing them images from the *Portal 2* game. (All pictures in this lesson are in larger size at the end of the lesson.



Ask students how they might create a net for this cube. Let them play around with paper and drawings for a few minutes. If they are stuck, you can show them the image below. If they came up with the image below, ask them to try to come up with a different way to make a net that folds into a cube.

As they finish the cube example, have the example pictures from the game prepared and have students choose a game based picture and have them try to deconstruct the figure back into a net. Using the pens, have them outline on the image the 3-D shape they are envisioning when they see the picture.

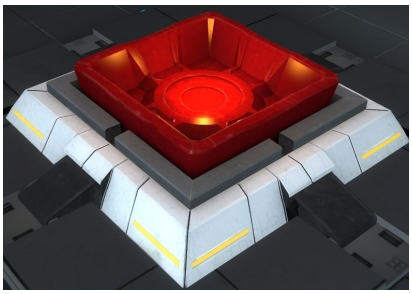
Note: When I did this with my class, after students started brainstorming what their nets might look like, I had them use the internet to help them identify shapes that were similar to see if they could

find nets. For instance, people who chose the elevator decided it was cylindrical and then they looked for nets of cylinders to help them check theirs. Those that chose the more complex polyhedron searched a variety of polyhedra until they found one that seemed similar to theirs and then explored the nets they found online.

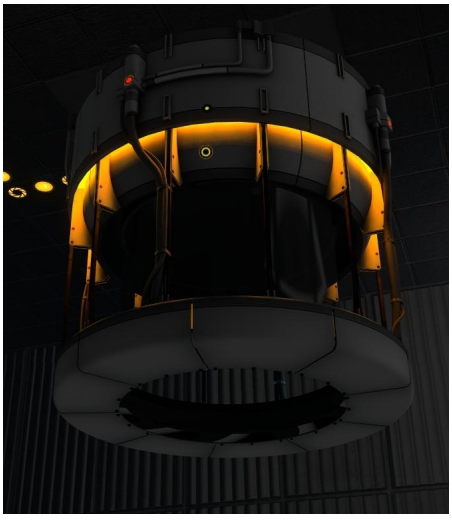
If you wish, students can then try to draw their net out and refold it to see if it mimics the shape seen in the picture. **Or, some of my students found the nets too complex to draw, but printed out examples online and either used Polydron building materials or paper to actually build their figures.**

The purpose of the pictures and drawing nets portion is not for students to be perfect. The idea is to get them thinking about how the nets relate to objects in general and to introduce them to some of the types of objects they will see in the Puzzle Maker.

Below are some images from the game that students might select:



P2 Pressure Plate Students should definitely outline the portions that they are using for their net. They could do an open prism with the red portion or a variety of prisms that are open or closed depending on how the visualize the plate. It was a good discussion point about something that has an open top.



Apparatus Vent It might be helpful for students to think of this shape as more of a closed cylinder. This is a great example that involves thinking about cylindrical shapes in net form. Again, we had good discussions about whether or not this figure has edges and faces.

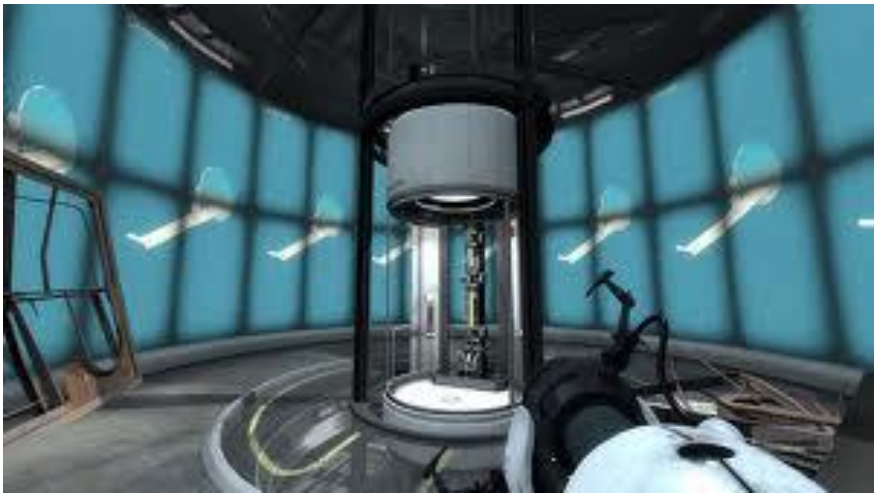
Futbol Another unique shape. It brings in the challenge of making a net that doesn't completely close on all sides.

Edgeless Safety Cube This could be envisioned as a sphere shape (a great challenge shape for students who have not yet seen a net for a sphere).

Room on Test Shaft 9 Students could use the rectangular prisms in the corner, or the vent on the wall.

Button Another example of a rectangular prism (if they use the base of the button); another cylindrical example if they focus on the button.

Structure from Test Shaft 9 A significantly more complex figure. Students might want to use their computers to look at examples of other polyhedra to help them get ideas of what this entire figure might look like. This problem would work best if you actually have building pieces students can work with. I've included some example polyhedra and nets at the end of this lesson.



Portal 2 Elevator Another example of a cylindrical object

When all students have had the chance to do at least one figure, have them identify the number of vertices, edges and faces on their object.

Take a few minutes to have them share-out the picture they selected, their net, and their identification of vertices, edges and faces.

Note: Depending on the length of your class-period, this may be a good place to stop. If you have a textbook or other resource problems that relate to nets it might be good to send those for homework. If you have a block period, you may be able to get through the next portion of the activity as well.

Second portion:

The next piece involves introducing students to the Puzzle Maker. Have the teacher login page from Steam pulled up on a computer or projected in the front of the room.

Pass out login codes for students to use to access *Steam* and walk them through how to access the Puzzle Maker.

Explain that throughout the course of this mini-unit on spatial reasoning we will be using this program to design rooms in the video game *Portal 2.* Give them the introductory worksheet below to help them walk-through the Puzzle Maker on their own (while at the same time drawing their attention to key spatial reasoning ideas).

What do you first see when you open the Puzzle Maker?

Use your mouse to try to rotate the room so you can see it from different viewpoints. How can you do this?

What shape is the room? How many faces does the room have?

Draw a net for the room's shape.

Is there a different way you could arrange the net and still have it fold into the room's shape?

Right click on an area of the room. Experiment with this. Can you change anything about the room itself by using the mouse? If so, what?

Can you change the height of the room? If so, how?

Move your mouse over the left side of the screen. Drag the big tab out. What's there?

Play around with the items on this tab. Can you move them? Can you place them in the room?

What objects appear to already be in the room?

Are there any other things you notice on the main screen in the Puzzle Maker?

Discuss student answers to the above questions as a large group. There is a good chance that some students will notice things that others did not.

This might also be a great time for students to be introduced to the premise of the game. You may not want to give students too much information (so they can just play around with things throughout the lesson) or you might find that giving them some information (such as a short demo video on the Think with Portals website, under media) to get them thinking. The propulsion gel video is a good one.

After students have discussed the shape of the room, ask them to visualize it sliced through the center on a horizontal plane. Ask: What shape would they see if they sliced it? (rectangle).

Have them go back to some of their original pictures used in the beginning of the lesson. Ask: If one were to take a sphere and slice it through the middle horizontally, what shape would they find? A cube?

To wrap up the lesson, have students complete an exit slip highlighting three things: Something they learned about 3-D figures, something they learned about nets, and something that intrigued them about the Puzzle Maker. Use these as discussion points for a future lesson.

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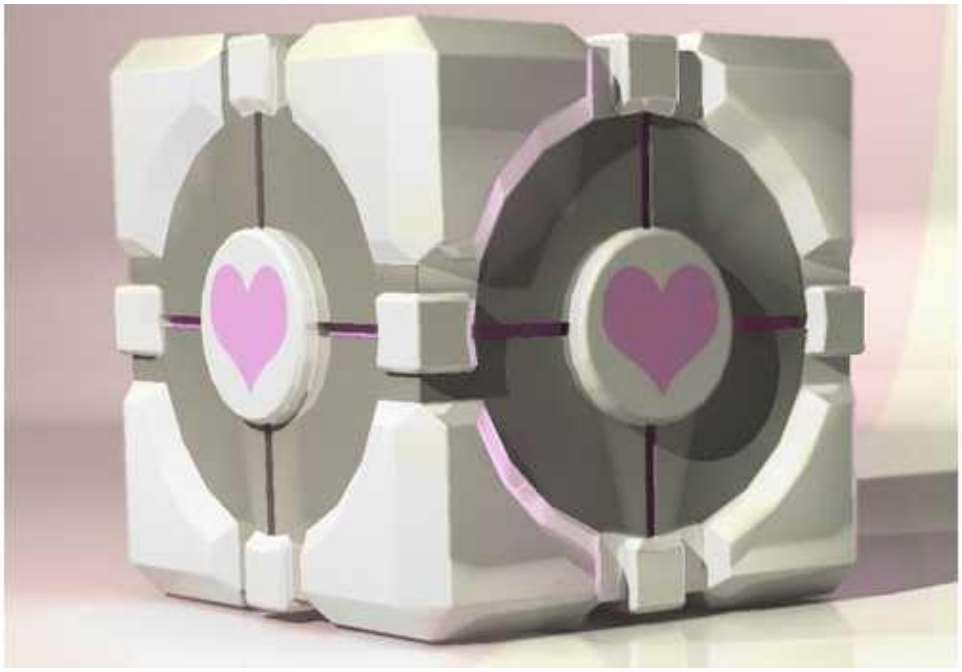

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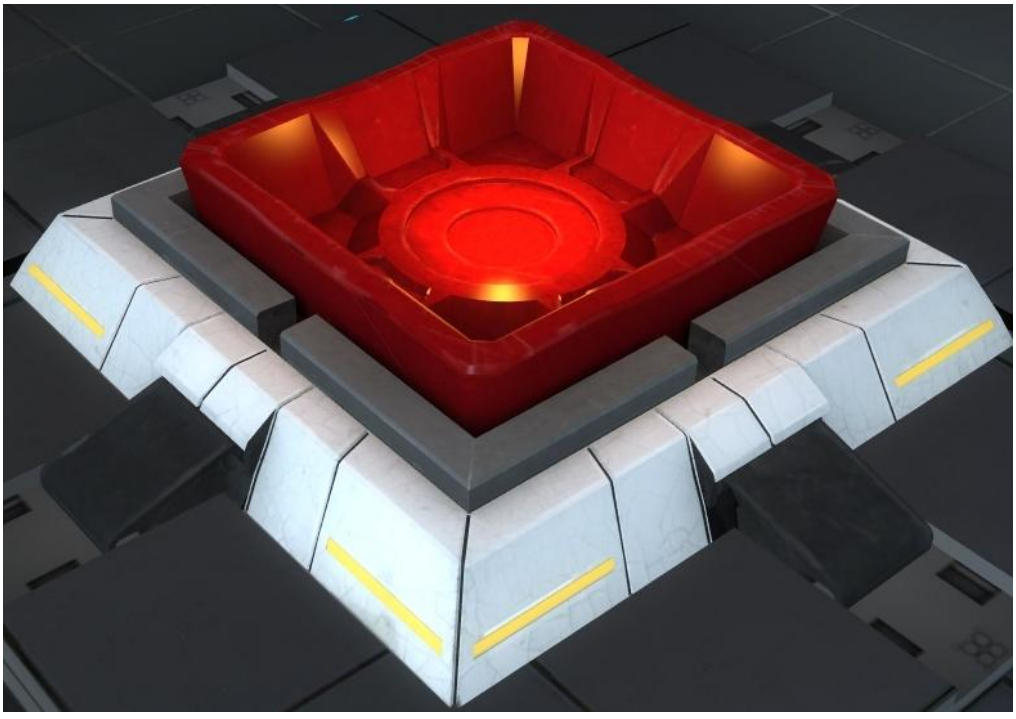
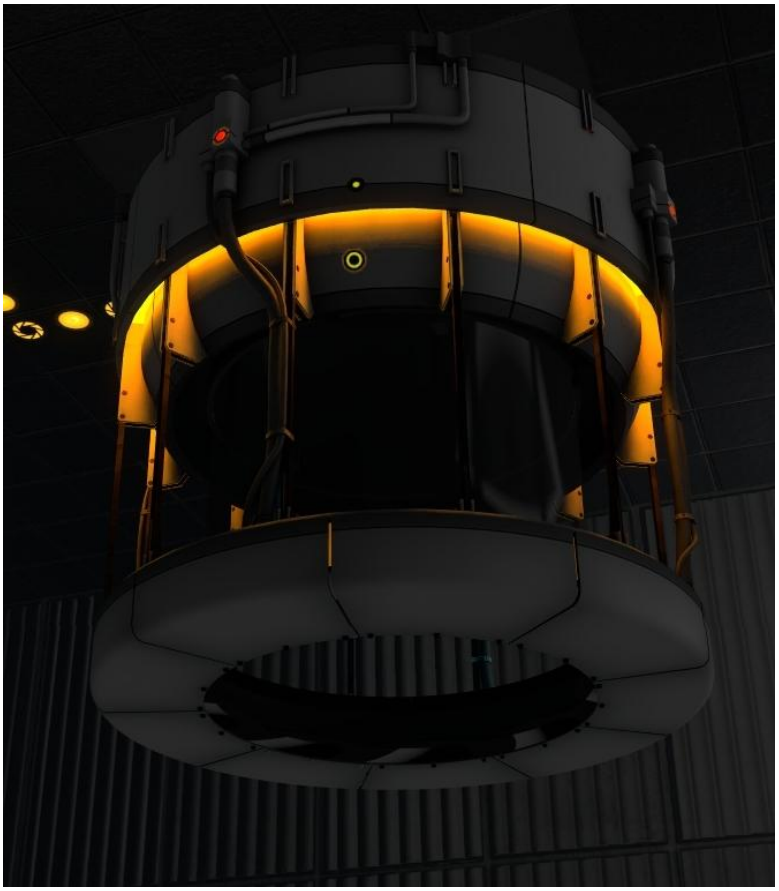
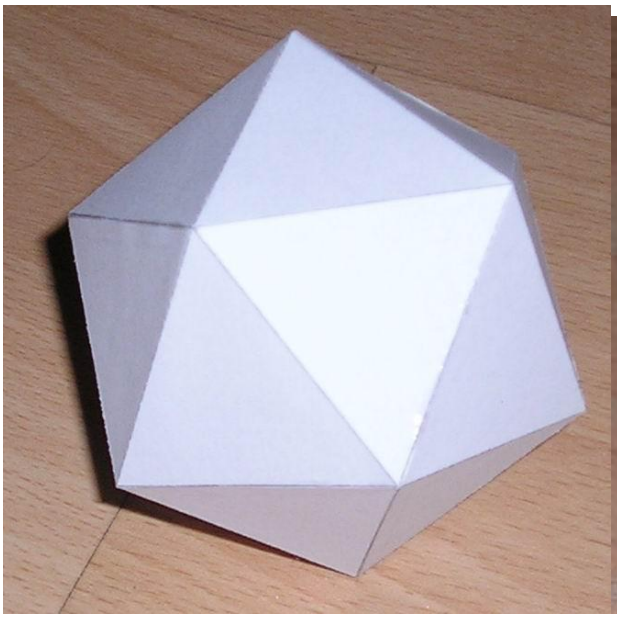
PORTAL 2





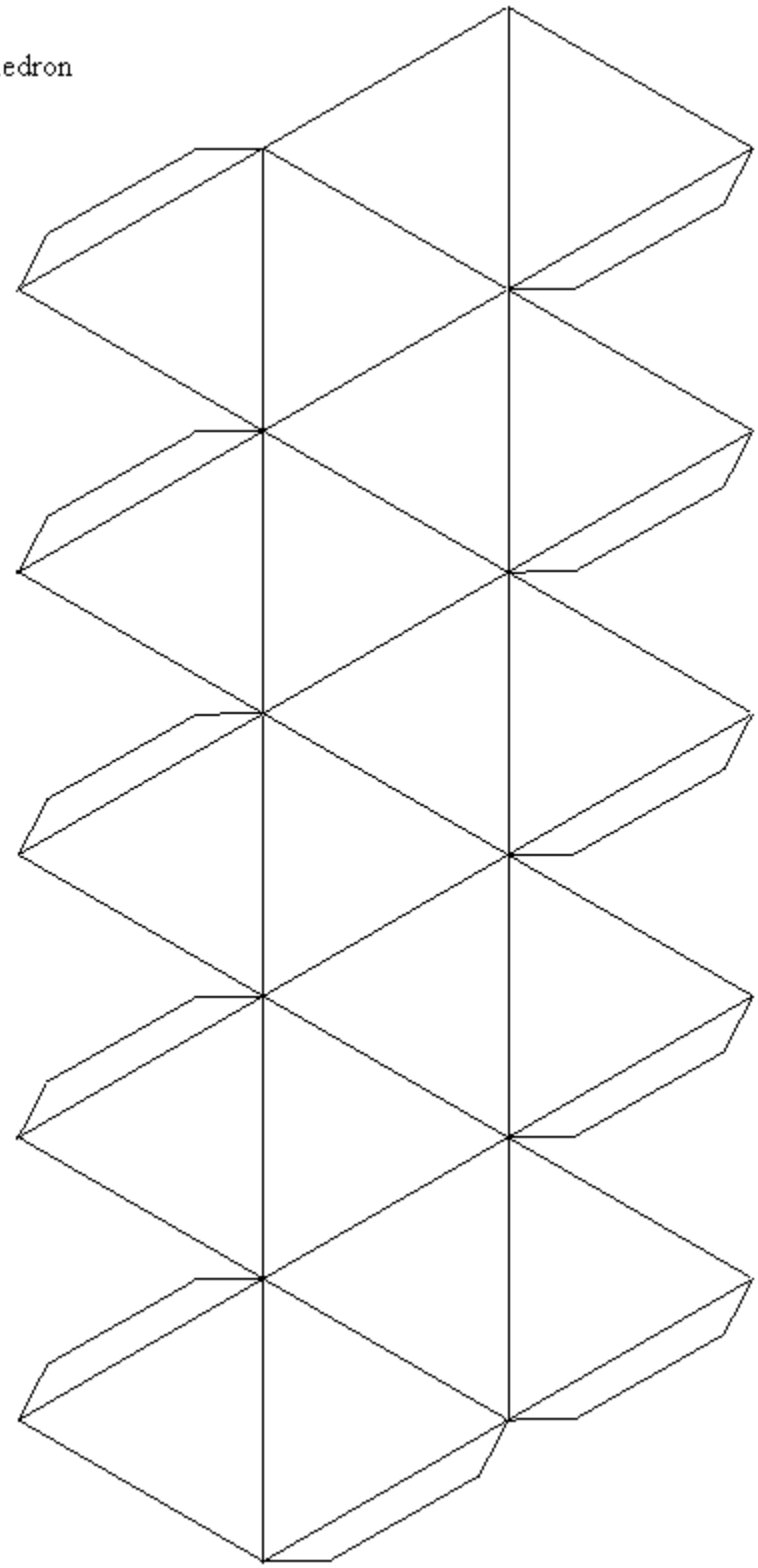

DANGER
IN THE EVENT OF FLOODING,
SEEK AIR POCKETS

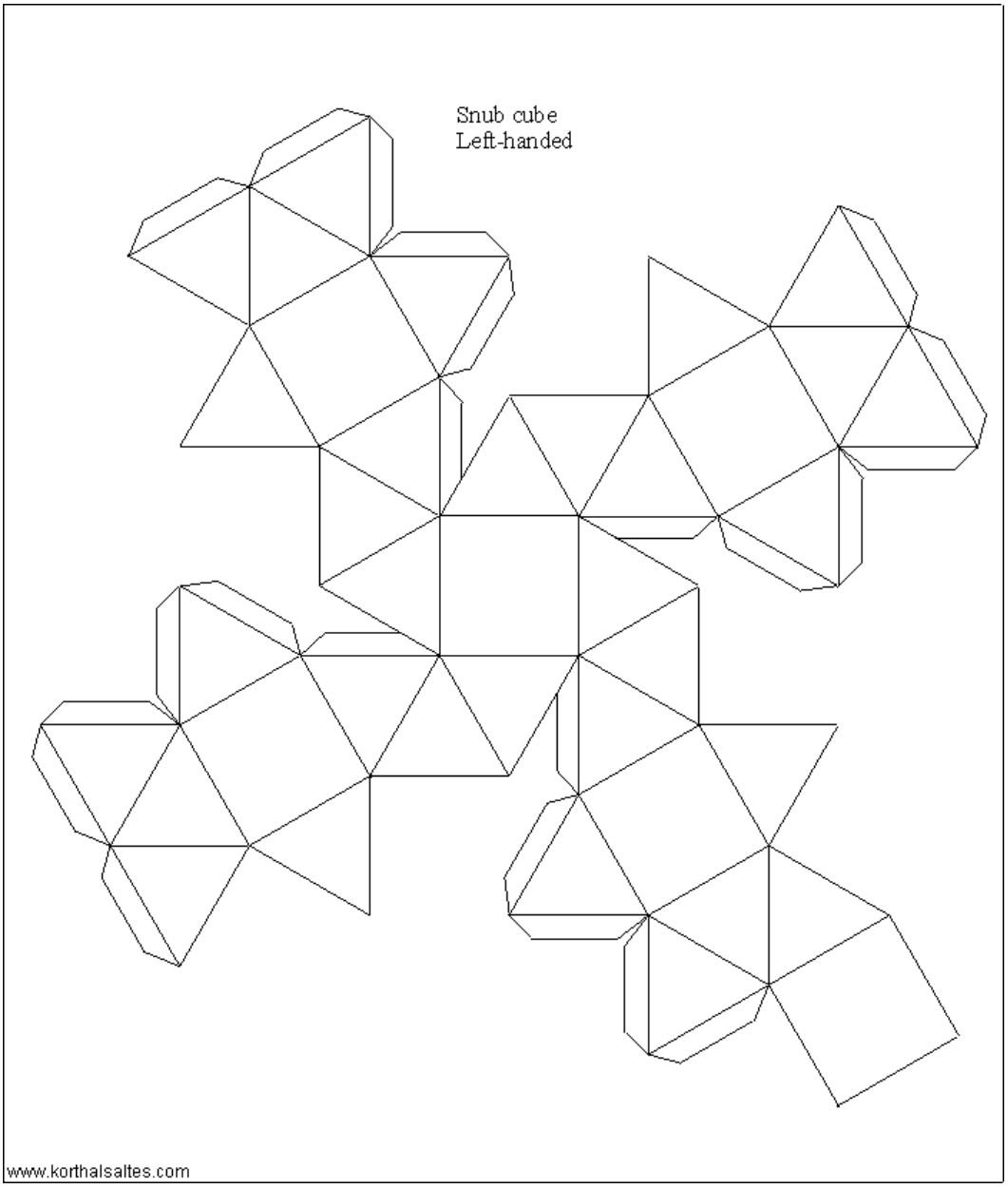


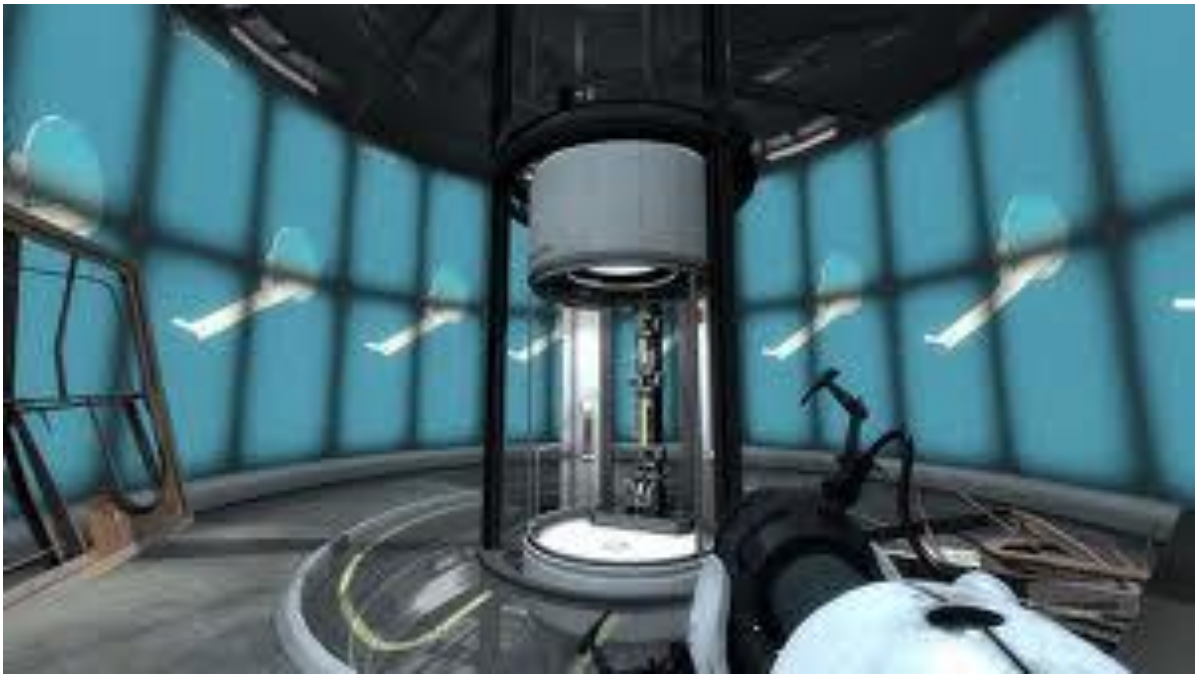
Here are a couple of other ideas students might use to model

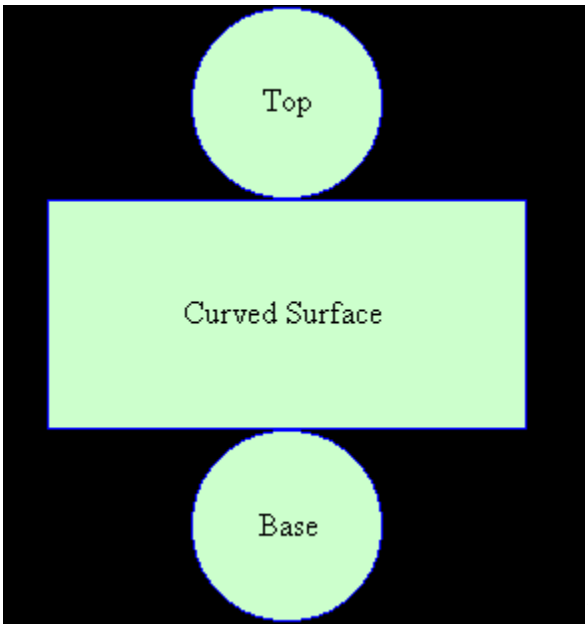
Polyhedra that are loosely structured in the same way.

Icos ahedron




Snub cube
Left-handed
www.korthalsaltes.com





www.mathsteacher.com

Cube nets