

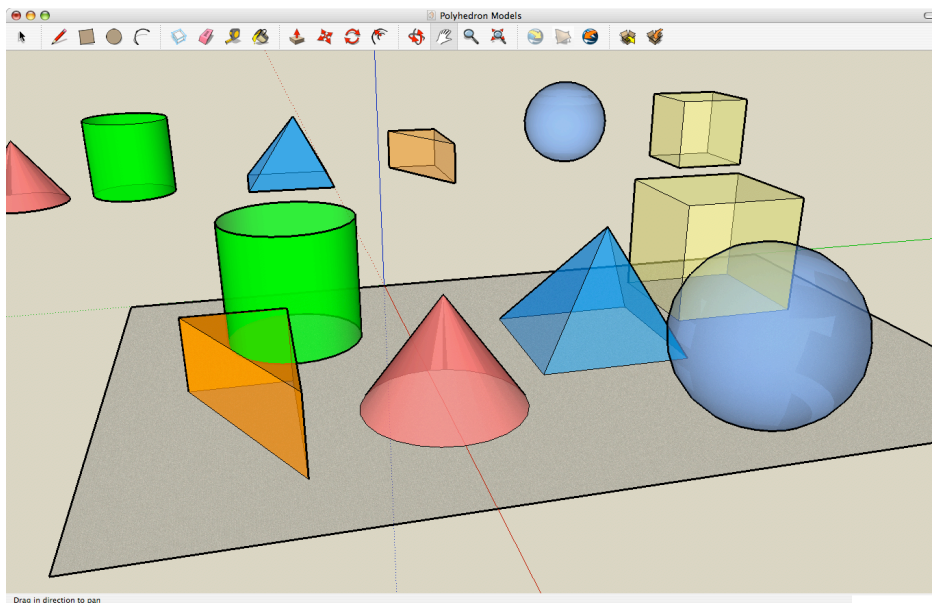
Polyhedrons in SketchUp

Teacher Notes

SketchUp is a 3-D modeling application available from Trimble that allows the user to create designs at various levels of complexity. Using SketchUp comfortably requires practice; it has many features and an impressive assortment of tools. The polyhedron exercises described here will require only a basic knowledge of how to use the SketchUp set of tools. This page will not attempt to instruct you on how to use SketchUp, but rather how SketchUp can be used. SketchUp has an excellent assortment of help guides and tutorials available under the Help menu if needed.

If you do not have SketchUp, a free version is available @

<http://sketchup.google.com>



1. Create polyhedrons

SketchUp can be used to construct polyhedron models ranging from a simple cube to complex star polyhedra. To begin, students need to be able to create cubes, pyramids, and prisms. The curved face polyhedra, the cone and sphere, are more difficult to create, but far from impossible. An assortment of polyhedron model examples are available for download on the Real World Math website.

These files have been made for the *Real World Math* webpage, but you will find a number of examples in the SketchUp – Online Help Center. Enter search terms, such as “how to draw a cone,” and you should find what you are looking for.

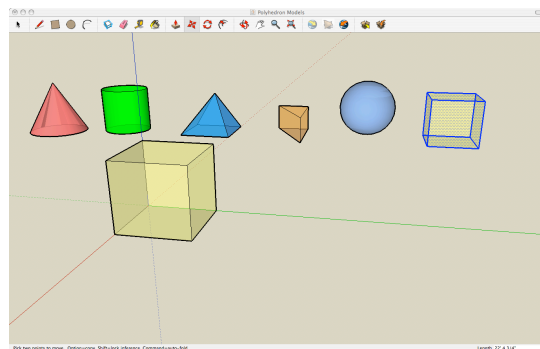
The models students make can be copied and shared in digital files, interacted with, and modified for color, texture, and transparency. The models in SketchUp can be drawn to specific dimensions if needed, cut apart to examine interior properties, or overlapped with another. The suggestions that follow will use these features, but initially, students should learn how to construct the various polyhedron models

2. Draw polyhedron sections

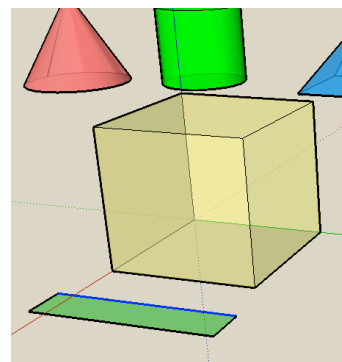
There is usually more than one way to accomplish what you want in SketchUp. What follows is one way students can make and examine cross-sections of their polyhedron.

1) Triple-clicking on a model with the *Select* tool will select the entire object. Using the Polyhedron Model file, triple-click on a solid and select *Copy* and *Paste* from the *Edit* menu.

Paste the solid at the origin or at the green baseline. Note that the original solid remains if needed for a future exercise.

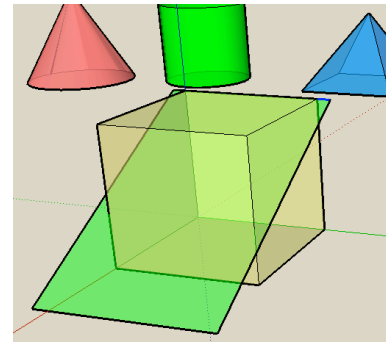


2) Draw a rectangle next to the solid using the *Rectangle* tool. Double-click on it to select, and color it using the *Paint Bucket* tool. Set color to 75% transparency. Note: the rectangle can be drawn at any orientation, shown here lying down, but make sure it is outside of the solid.



3) Use the *Select* tool and select the nearest edge of the rectangle. It will turn blue. Use the *Move/Copy* tool on the selected edge, and pull the rectangle to the desired orientation. You will want to make sure the entire solid is enclosed in the plane as you pull it clear through the solid.

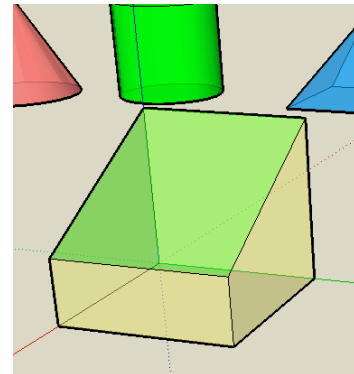
Note: Once the tool is released you won't be able to pull it without pulling the solid as well.



4) Use the *Select* tool and drag a selection box large enough so that it selects the solid and the plane. Both should be highlighted in blue.

Select *Intersect* in the *Edit* menu and choose *Intersect with Model*.

You can now use the Eraser tool to erase the unwanted portions of the solid and plane.

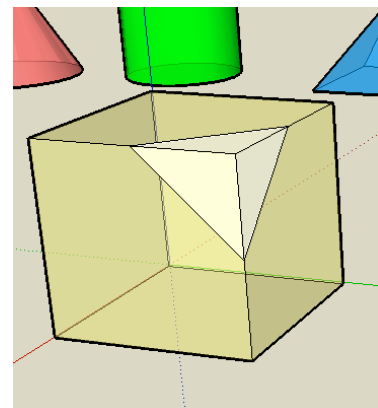


Example question: What polygons can be created by intersecting a Plane with a Cube?

2b. Use polyhedron sections to create a new polyhedron.

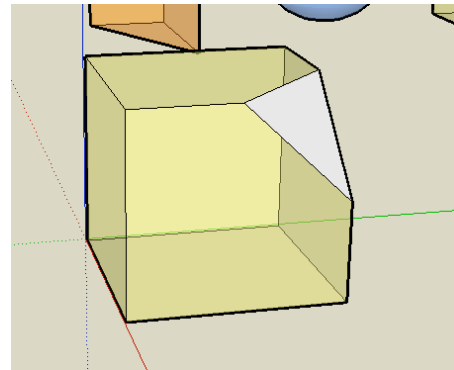
Another way to cut through the solids is by drawing lines. For instance: Create a Cuboctahedron.

1) Use the *Draw* tool to draw lines connecting the midpoints of each edge of a cube. The midpoints will be indicated when the “pencil” is located at the right spot.

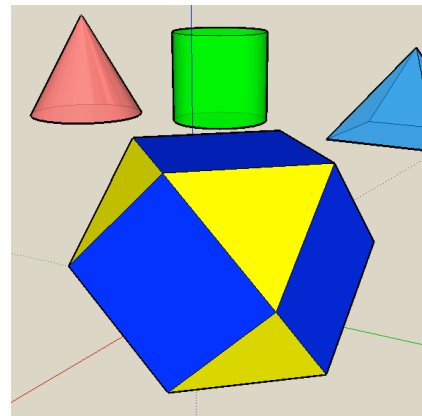


2) Use the *Eraser* tool to erase the corner portions of the cube.

Repeat for all vertices.



3) Use the *Paint Bucket* tool to color each face as desired.



3. Examine formula relations

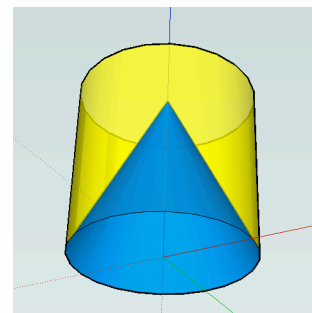
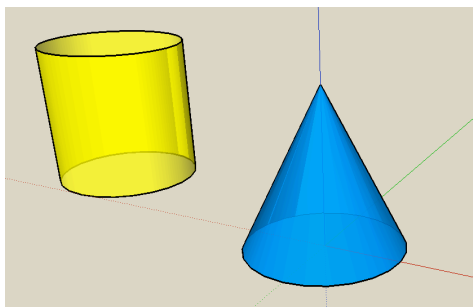
Various solid formulas can be investigated by combining polyhedron.

For example:

$$\text{Volume of a Cylinder: } V = \pi r^2 h$$

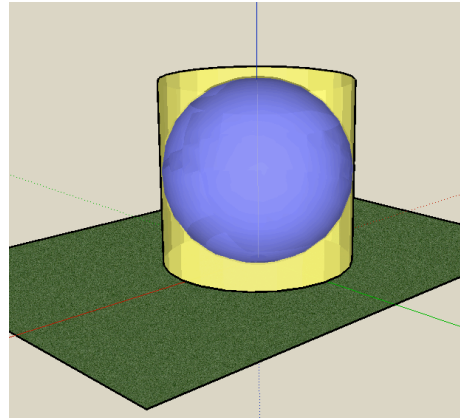
$$\text{Volume of a Prism: } V = 1/3 \pi r^2 h$$

Draw a cylinder and cone, each with the same radius using the *Circle* tool. Color each and set transparency to 75%. Triple-click on one and use the *Move/Copy* tool to drag it to intersect perfectly with the other.



Intersect a sphere and a cylinder with the same radius measure.

Note: Spheres are the most difficult geometric solid to create.



Prism volume formulas can be thought of as extending the area of the base upward to the length of the height.

$$V = Bh$$

