“Slicing Three Dimensional Figures” Classroom Activities

Short description: This animated Math Shorts video describes the two-dimensional figures that result from slicing solid three-dimensional figures.

Long description: In this animated Math Shorts video, see the two-dimensional figures that result from slicing solid three-dimensional figures in plane sections of cylinders and right rectangular pyramids. In the accompanying classroom activity, students create and slice clay figures and then describe the resulting shapes.

Learning Outcomes

Students will be able to

- describe the two-dimensional figures that result from slicing three-dimensional figures

Common Core State Standards: 7.G.A.3

Vocabulary: Three dimensional, two dimensional, cylinder, rectangular pyramid, polygons, cone, right rectangular pyramid, right rectangular cone, cube

Materials: For each student: Play dough, fishing line (or dental floss or a plastic knife); per three to four students: 3D shapes (cylinder, cone, right rectangular pyramid, right rectangular prism, cube)

Procedure:

1. Introduction (5 minutes, small groups)
Distribute the three-dimensional (3D) figures to groups of three to four students. Ask students to record a list of observations about these figures that describe their features and properties, such as shape and number of sides. Record student findings and discuss, facilitating the use of accurate vocabulary and descriptive terms.

2. Slicing Figures Animation (5 minutes, whole group)

Ask students to imagine the various two-dimensional (2D) figures that could be created from slicing the 3D shapes. Ask them to try and visualize whether the planes of these shapes would contain curves. Ask, Which shapes would form slices that are squares? Have more than four sides?

Show students the video. Then ask, What were the resulting 2D shapes after slicing both the cylinder and the rectangular pyramid? With the whole group, create a list of the polygons identified. Ask, What are the names of other polygons that were not identified?

Ask students, What is the relationship between the properties we recorded about these 3D figures and the 2D planes that were the result of slicing these figures?

3. Hands-On Activity (15 minutes, small groups)

Distribute the play dough and fishing line to each student. Direct students to construct out of the clay one of the shapes they observed (cylinder, cone, right rectangular pyramid, right rectangular prism, cube). You may wish to encourage each member of a group to select a different figure. Explain that the dimensions of the 3D figure should be as similar to the actual figure as possible, but do not need to be the exact size.

Using the fishing line, demonstrate and then have students make multiple cuts through the objects at different locations. After observing the resulting planes, have students trace the shapes on paper and label them. Ask them to re-create the original 3D shapes and continue to explore, finding as many 2D possibilities as they can. Ask them to record:

- how the shapes compare and contrast
- the types of polygons created
- the polygons that could not be created (from those listed on the board)

Have students discuss their findings within their groups, providing a rationale as to why the various plane shapes can be created from the corresponding figures.

4. Conclusion (5 minutes, whole group)

Ask several students to present the ways they went about completing the activity and any observations they made. Have them provide a rationale for why some 2D shapes could not be created by slicing certain figures. If possible, have students use a document camera to present their findings to the class.

Activity Extension: Have students think about what would happen if they were to make parallel cuts. Explain that, depending on the solid, the cross-sectional shapes would either be congruent or similar or neither. Then ask, What if you make several cuts parallel to the base of a triangular pyramid? How would you describe the relationship of the cross sections to each other? (Answer: All the cross sections will be similar shapes, so they will be proportional.) A cylinder? (Answer: You would get congruent shapes.)

Next, ask, What if diagonal cuts were made to both the pyramid and the cylinder? (Answer: The situation gets more complicated, but it is still possible to make similar and congruent shapes.)