2.3 Slicing Prisms and Pyramids

Pictures of boxes often look like the box shown at the right. But there is more to a box than what you see in a picture.

Think about what you would see if you turned the box, or another rectangular prism, around to show all of its sides.

- How many vertices, faces, and edges does the pastry box have? Would these answers be different for larger or smaller prisms?

Now, think about what you would see if you stood near a very large rectangular prism such as a railroad freight car.

- How many vertices, edges, and faces would you be able to see?
- What shapes would result from making one cut through the pastry box, the freight car, or another rectangular prism?

Many cities in cold climates celebrate winter with a carnival. Ice sculptures are often among the highlights of winter celebrations. Sculptors start with blocks of ice in the shape of rectangular prisms. Then, they use tools to create spectacular frozen works of art.

- What shapes would result from making one cut through a rectangular prism?
- Can you make triangular, pentagonal, hexagonal, and other prisms by carving parts off a rectangular prism?

To figure out strategies for carving polygonal prisms out of rectangular prisms, you can experiment with a block of clay and a wire clay cutter. However, once a cut is made it is hard to put the pieces back together. So it helps to think before carving.

Problem 2.3

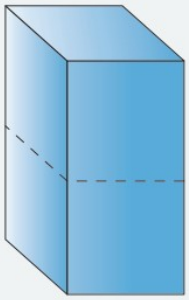
Think about each question and then test your ideas with actual cuts applied to blocks of clay.

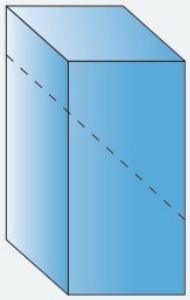
A Start with a square prism. For each part, explain how you could make each prism with a minimum number of cuts into the square prism.

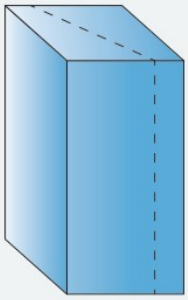
1. A triangular prism
2. A pentagonal prism
3. A hexagonal prism

B Some interesting shapes result when you cut prisms from different angles. Suppose that you start with a square prism like those shown below and make one cut in the directions indicated by the dashed lines. Answer the following questions for each prism.

- What are the shapes of the two resulting figures?
- What are the shapes of the faces of the figures?
- How many vertices, edges, and faces does each figure have?

1. 

2. 

3. 

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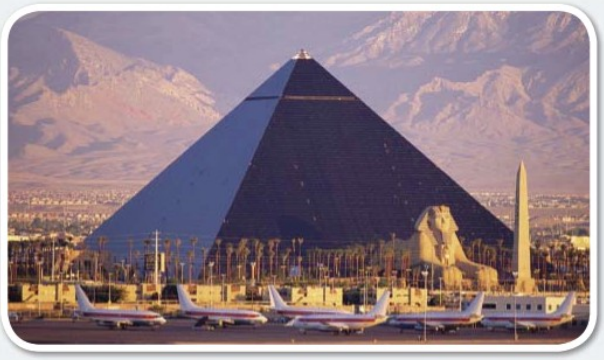
Problem 2.3 continued

C A **pyramid** is a solid figure with a polygonal base and triangular faces that rise to a common vertex. There are many famous pyramids, such as the ancient great pyramids of Egypt. Some modern buildings are also shaped like pyramids.



1. How could you make cuts into a cube to produce a square pyramid with one side of the cube as its base? Sketch your ideas.
2. How could you make cuts into a cube to produce a triangular pyramid—a pyramid that has triangles for all four sides? Sketch your ideas.
3. Suppose you start with a square pyramid and make one slice. Predict the shape of the two solids that result from the cut. Confirm your conjecture by cutting such a pyramid.

ACE Homework starts on page 35.