Cutting a Cube

Level A

A cube is a very interesting object. So we are going to examine it.

Without holding a cube, try to picture it in your mind. How many sides (faces) does a cube have?

How many corners (vertices) does a cube have?

How many lines (edges) does a cube have?

What can we say about the size of the sides (faces) and the lines (edges)?

When you have made your guess (conjecture), then hold a cube and check (verify) your answers to the questions listed above.

How might you be able to remember the parts (attributes) of a cube?

Explain.

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Level B

A cube is like a box. You might think of it as a special type of cardboard box. We could cut up a cardboard box and make it into one large, flat piece of cardboard. We often do that when we want to recycle the cardboard. The easiest way to cut a cardboard box is to cut along the lines (edges). How many cuts does it take to make the box into one flat piece? In other words, what is the least number of lines (edges) that need to be cut so that the cardboard is in one flat piece? Remember all the sides of the cardboard must remain attached in one single flat piece. What is the least number of cuts that need to be made? Explain how you determined your answer.

Why do you think your answer is correct?

Write a note to a friend to convince your friend that your solution will always work for every cube.

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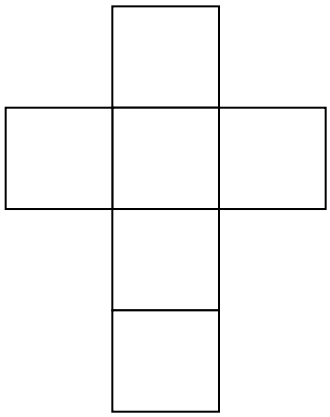
Level C

When you cut a cube into one flat piece, we call that piece a **net**. The reason we call it a net is because we can trace the pattern of the flat piece on a piece of paper or cloth material. If we cut out the pattern, we can fold it back over the cube, surrounding it like a net.

The nets that cover a cube can be cut into different patterns. One net looks like a cross. It has four faces in a column and two more faces on either side of that column. How would you cut the cube (which edges) to make the net into a cross pattern? Is there more than one way to cut the cube to make a cross?



Find some different net patterns that would also cover a cube. Determine how you would have to cut the cubes to make them into new net patterns. Explain your methods.

Are there ways to cut the cube so that it won't make a net? Explain your thinking.

Sometimes you might think two nets are different, but if you move one around, it then looks exactly like the other net. How can you tell if two nets are different? Explain and define the difference.

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Level D

We want to find all the nets that can be folded into a cube. For this investigation, we will define two nets as being the same if we can turn (rotate), move (translate), or flip (reflect) the net and the two nets cover each other exactly.

How many unique nets fold into a cube? Draw all possible nets that can be folded into a cube.

How did you go about determining the number of nets?

How do you know that you have found all the unique nets that fold into a cube?

Convince a skeptic that you have found all the possible nets of a cube.

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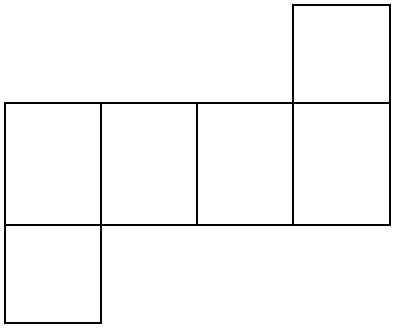
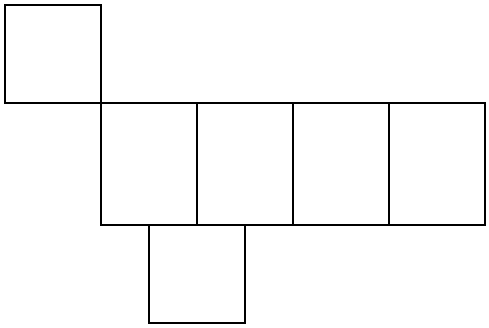
Level E

Patterns of six attached squares are called hexominoes. The word is like dominoes, except it has six squares instead of just two squares. A hexomino has six squares, and all squares must share at least one side with another square, and all the vertices of the squares must coincide. Arrangement A below is a hexomino, while B is not.

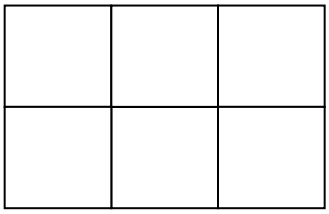
A.



B.



There are some hexominoes that can be folded into a cube. These are called nets. There are other hexominoes that do not fold into a cube. For example, a pattern of six faces arranged in three columns of two squares all attached together cannot fold into a cube.



Find all the configurations of hexominoes. These include all the nets that fold into cubes and all the other hexominoes that can't fold into cubes.

- Draw all unique hexominoes.
- How did you go about determining the number of unique hexominoes?
- How do you know that you have found all the unique hexominoes?
- What percentage of hexominoes are nets that fold into cubes?
- Convince a skeptic that you have found all unique hexominoes.

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Manipulatives