PROBLEM SOLVED
MAKING SENSE OF MATHEMATICS

# Geometric Nets
## A Closer Look at the Video

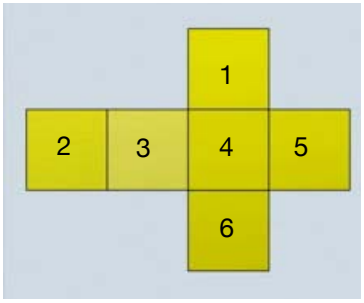
After watching the *Geometric Nets* video, make sense of the mathematics by reading through the problem situation and solution. Use the comments and questions in bold to help you understand geometric nets.

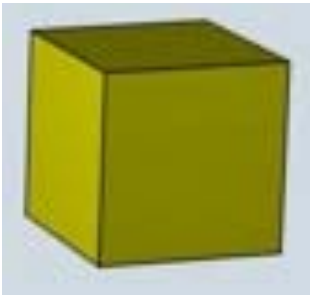
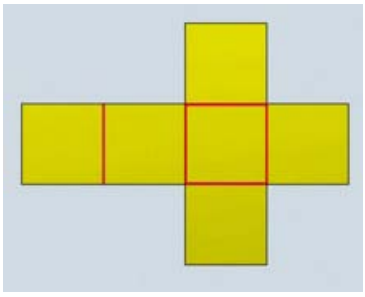
**Problem:** Charnae is at Hawkeye Corrugated Box Company. The company produces and designs boxes for every kind of product imaginable from funny looking little boxes to huge boxes big enough for a car. You use boxes every day but probably never stop to think about how they're made. It's all about math. In fact, the construction of boxes relates to a topic in geometry called nets. Help Charnae determine which of the patterns below are nets.

**At Hawkeye Box they design boxes, print boxes, construct boxes, and ship boxes. What does the company need to consider when making a new box for a client?**
When working on a new box for a client, the company has to consider several things. What the box is used for will determine its shape and dimensions. If it is too big, it wastes material and will cost too much; if it is too small, the product will not fit inside. Sometimes there are other considerations such as how boxes will be displayed and stacked, the size of each face for advertising, and the function of the box.

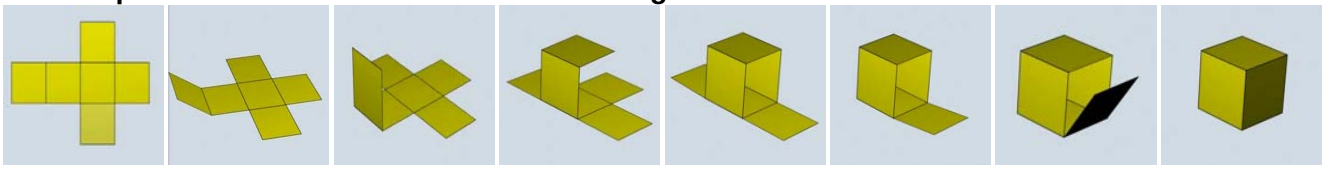
**Regardless of size or shape, each box starts out as a pattern or net. What is a net?**
A net is a two-dimensional figure that you can fold into a three-dimensional shape.

**We can use a cube to make sense of nets. How many and what type of faces does a cube have? How does this relate to the cube's net?**
A cube has six square faces, so the net is made of six squares. Each square shares a full side with at least one other square.

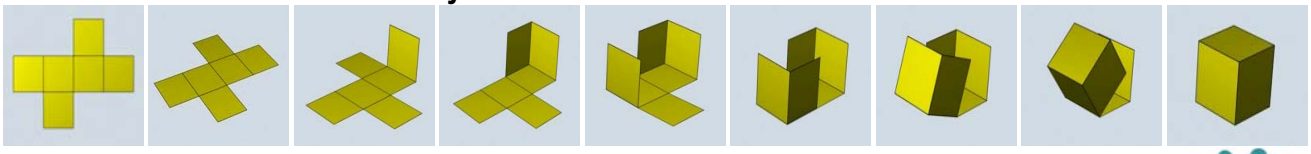


**Here's a pattern for a cube. See how it comes together?**



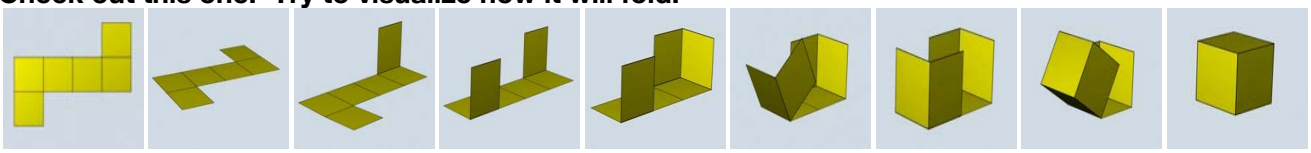
**Here is another net for a cube. Try to visualize how it will fold.**





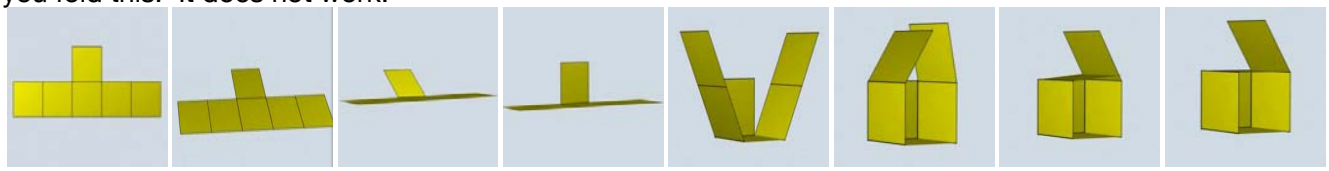
MakingSense

**Check out this one. Try to visualize how it will fold.**



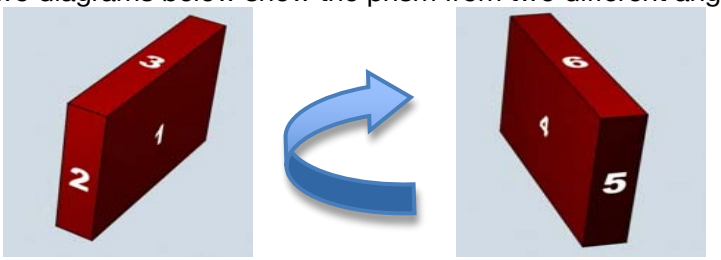
**Is every arrangement of six squares a net for a cube?**

No, you cannot fold every arrangement of six squares into a cube. Try to visualize what happens when you fold this. It does not work.

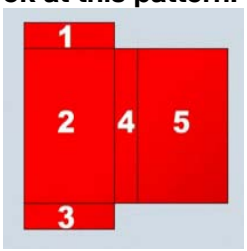


**Most boxes are not cubes, but they are rectangular prisms. There are four important factors when working with rectangular prisms. The first factor involves the number of rectangles in a net and the number of faces on the prism. How are the number of rectangles and the number of faces related?**

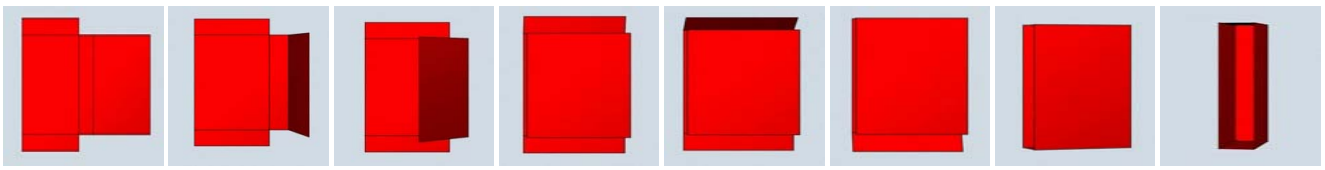
The net must have the same number of rectangles as faces on the prism. For example, this prism has six rectangular faces. The two diagrams below show the prism from two different angles.




**Now, look at this pattern. Is it a net for a rectangular prism?**

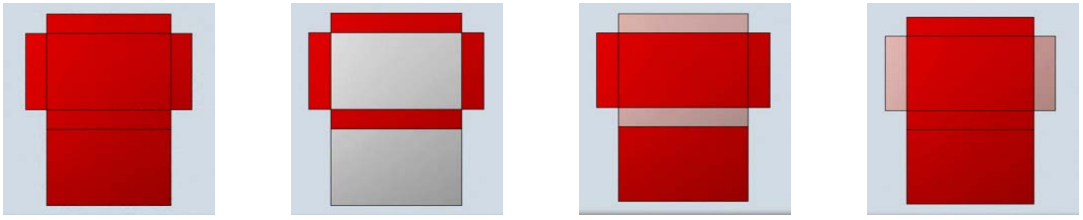



No, there are only five faces, so it won't work. When you fold it, one end is missing.

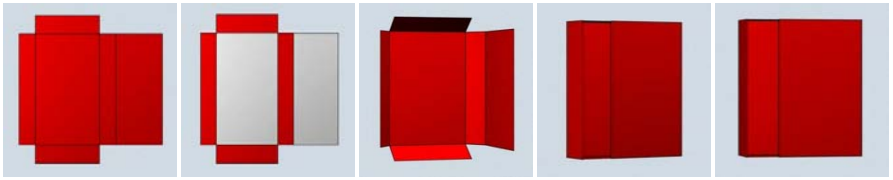


**The second important factor considers the size and shape of the rectangles. What is important about the sizes and shapes of the rectangles in the net for a rectangular prism?**

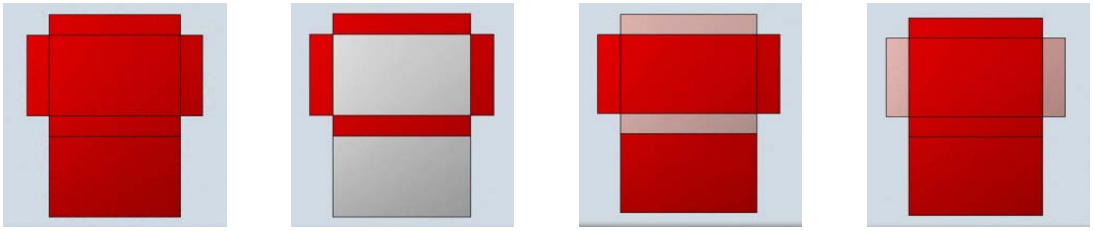
The nets for rectangular prisms must have three pairs of congruent rectangles. The top and the bottom are congruent, which means they are exactly the same size and shape. The front and the back are congruent, and the two ends are congruent. Pairs of congruent faces are a lighter color on the net shown below.



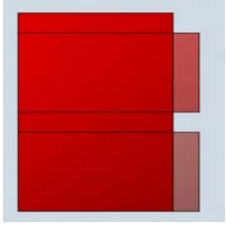
**Does the first diagram below show a net for a rectangular prism?**
It only has two pairs of congruent rectangles. The second diagram shows that the two light-colored rectangles are not the same size and shape. The remaining diagrams show what happens when you fold the pattern. One face is too small so there is a gap or opening in the box. This pattern is not the net for a rectangular prism.



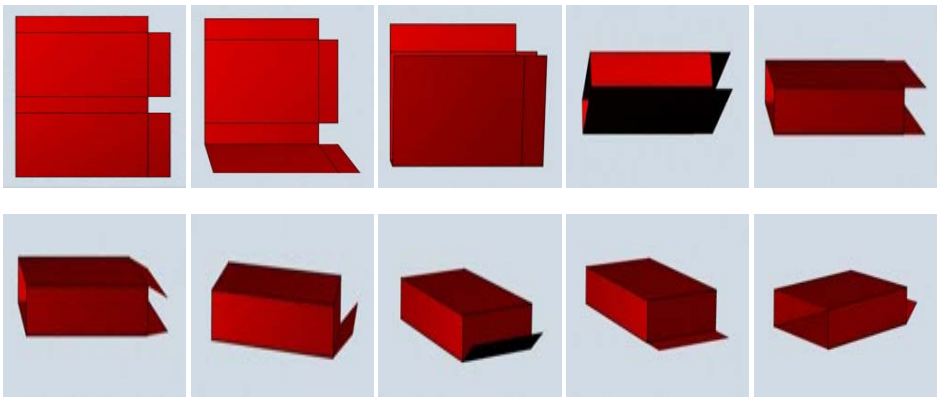
**The third important factor considers the location of the congruent rectangles on the net. What should we remember about the location of congruent rectangles in the nets for rectangular prisms?**
When they are folded, the congruent rectangles are opposite faces. Remember, the top and the bottom, the front and the back, and the two ends are pairs of congruent rectangles. Pairs of congruent faces are a lighter color on the net shown below.



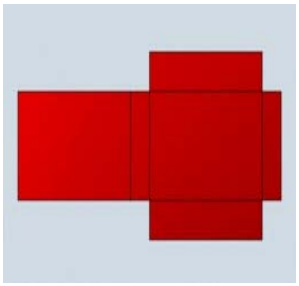
**This looks like a net for a rectangular prism. It has six faces and three pairs of congruent faces, but it will not work. Why?**



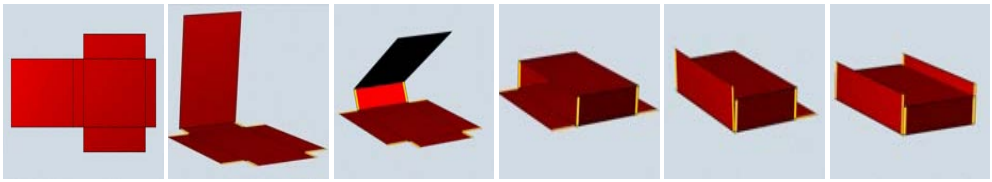
One of the two congruent rectangles is not in the correct position. The diagrams below show what happens when you fold it. Notice that the end result is an extra face on one end and a hole on the other end of the box.



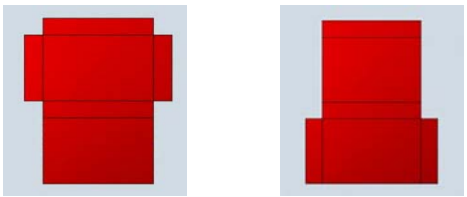
**The fourth important factor considers the edges. Look at this following pattern. There are three pairs of congruent rectangles, and it looks like the congruent rectangles will be opposite each other when folded. Can you tell what's wrong?**



Look at the edges highlighted in yellow. When the pattern is folded, the edges just don't match. The fourth important factor is that the connecting edges must be the same length.

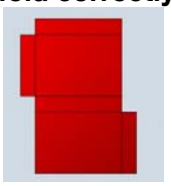


**There are many different nets that could work for rectangular prisms, but sometimes the nets can be a little complicated. It's important to be able to visualize how they will fold. The first diagram below shows a net for a rectangular prism. Will it still fold into a rectangular prism if we move two faces to the position shown in the second diagram?**

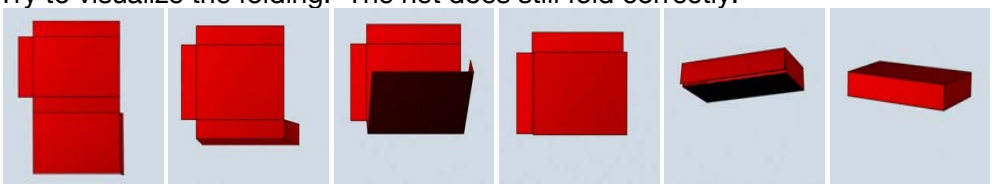


Try to visualize folding the pattern. It does fold into a box.

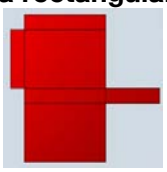
**If you move one face back to the original position as shown in the diagram below, does the net still fold correctly?**



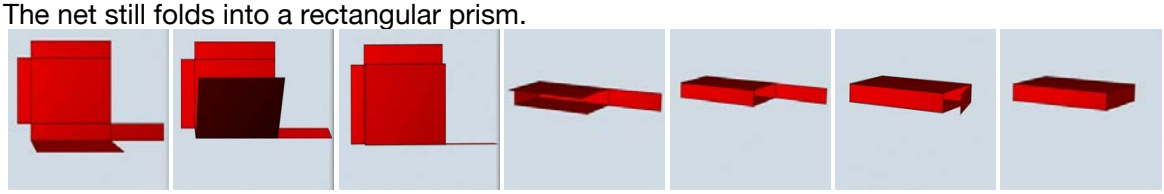
Try to visualize the folding. The net does still fold correctly.



**Visualize what would happen if we move and rotate one face as shown below. Does it still fold into a rectangular prism?**



The net still folds into a rectangular prism.



**What are the four key requirements for nets of rectangular prisms?**

- Nets must have the same number of rectangles as faces on the prism.
- Nets for rectangular prisms must have three pairs of congruent rectangles.
- When folded, the congruent rectangles are opposite faces.
- Connecting edges must be the same length.

We've looked at cubes and rectangular prisms. Any three-dimensional shape or box has a net. It's important to be able to visualize folding nets in order to understand how to use two-dimensional patterns to make three-dimensional shapes.