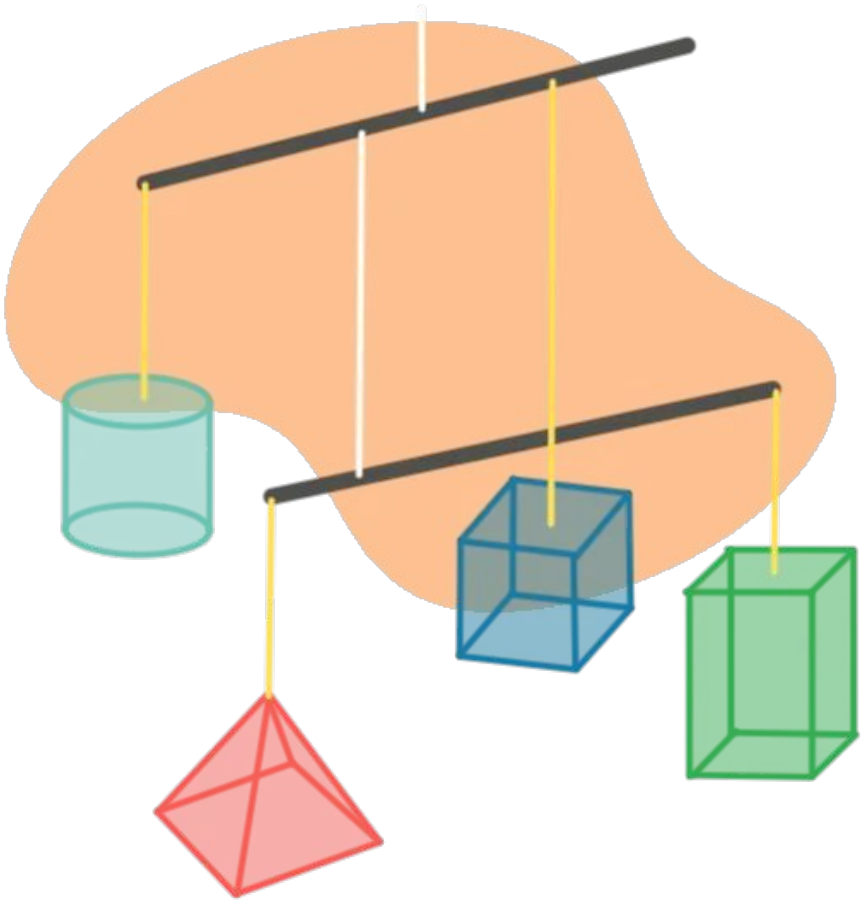
MPACT

Math and Computational Thinking Through 3D Making

Hanging Mobile

MPACT



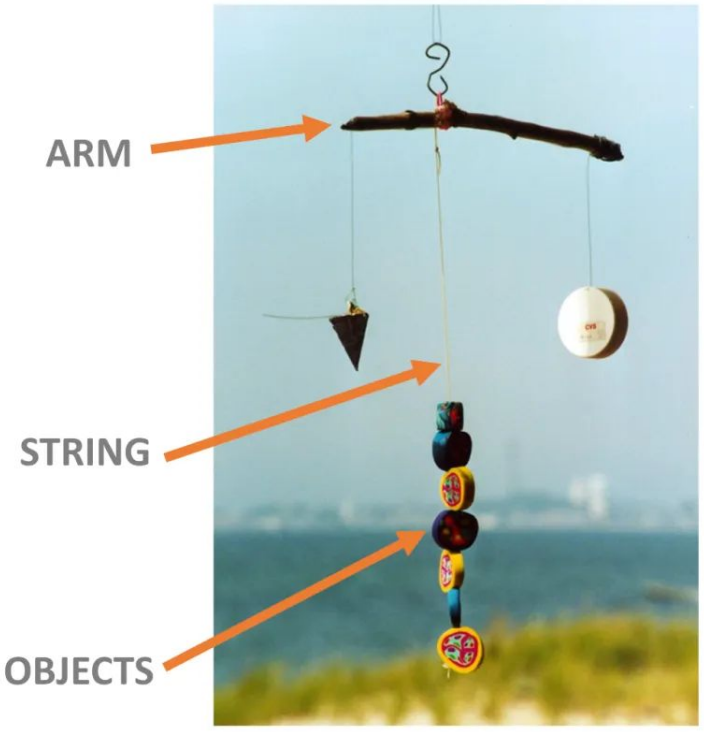
©TERC 2020

Introduction

This hanging mobile activity is designed for families with children in grades 4-7. It includes activities for making and math.

This picture shows the one kind of mobile that you can make. It also show the parts of the mobile. You can make many different mobile designs. You'll make it for a friend, a family member, or a community center.

Just follow the steps in this activity, that lead you through design and making—and learning math along the way.



For Grown Ups

This activity is for you and your kids to do together or for your kids to do on their own. You don't have to know the math in advance. Be open to exploration, and ask questions such as "How did you do that?" and "How do you know?"

For Children

Gather the following materials and get ready to make a set of shapes. Along the way you'll learn a bit of math. If you get stuck on any step, take a breath and try again. It's okay if you need to restart and use more materials. Good luck and have fun!

©TERC 2020

Gather Materials

Tools

- Scissors
- Tape
- Glue
- Pencils or pens
- Small object found in your house to hang on mobile
- Optional: paint, markers, glitter, ribbon, or something to decorate the objects.

For arms – A straight stick about 10-15 inches long. It can be:

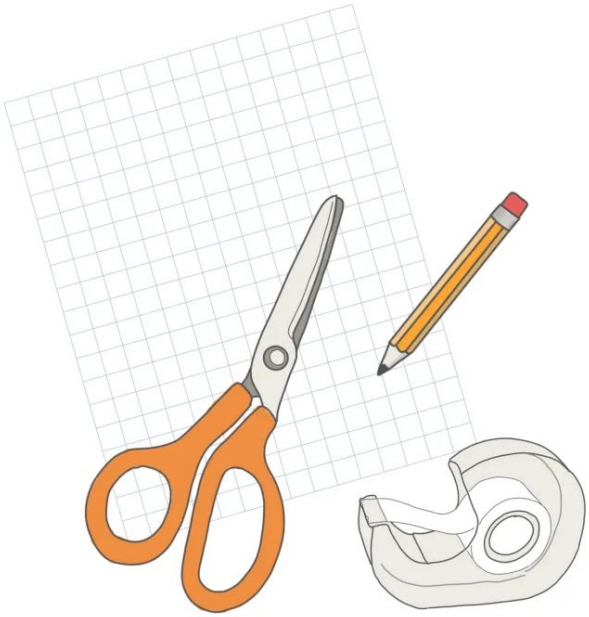
- A twig from a tree, or
- A skewer, or
- An old paintbrush, or
- Anything you can find

Paper for 3D objects

- Stiff paper or thin cardboard. It can be:
  - Cereal boxes
  - File folders
  - Cardstock
- Plain paper. It can be:
  - printer paper
  - decorative paper
- Graph paper
  - You can print the graph paper on the next pages or
  - use a ruler to make your own.

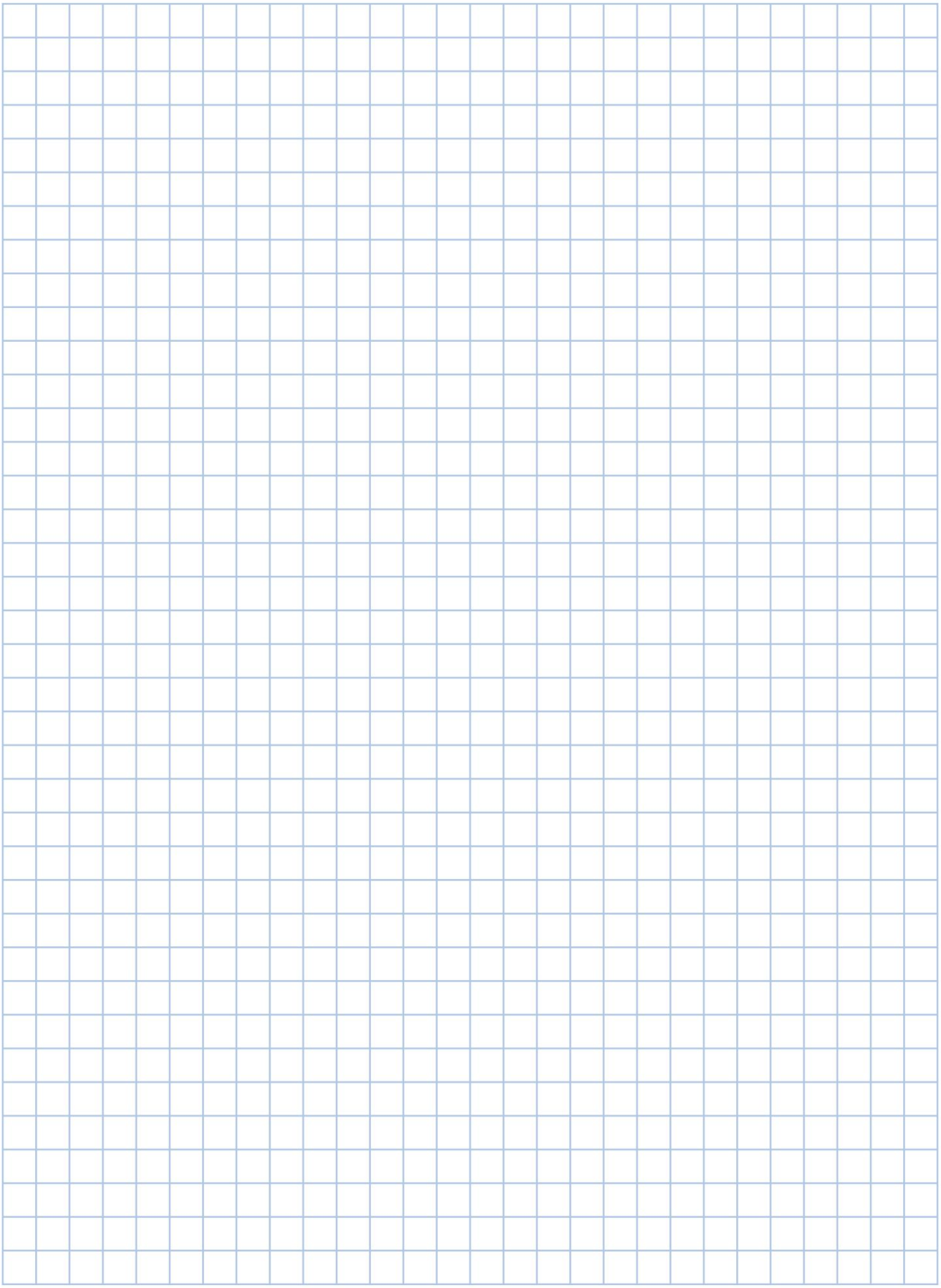
String for attaching parts. It can be:

- String
- Twine
- Yarn
- Anything stringy you can find



©TERC 2020

©TERC 2020



©TERC 2020

Plan and Design

Collect Ideas

- Choose a friend, family member, or community organization to make a mobile for.
- Find out what they like: colors, shapes, animals, or other ideas you have.
- Make notes about what they like, so you can remember this later.

Hanging Mobile Requirements

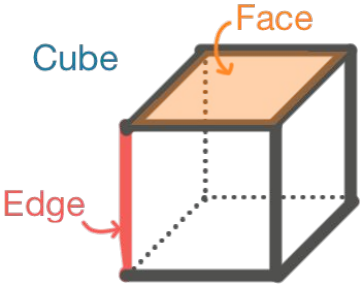
- The mobile must have at least one arm.
- The mobile must have at least three objects hanging from the arm/s.
- Two objects must be geometric shapes made with nets.
- The other objects can be anything about the same size as the shapes (The heavier helps).
- The mobile with all the objects hanging must balance.

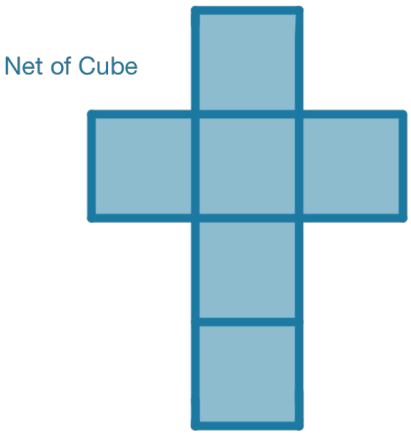
Sketch out a design

- On paper, draw the mobile: arms, string, and objects. Draw two different ideas.
- Check if they meet the requirements.
- Choose the idea you want to use.

Fold Net into a Cube

A cube is a 3-dimensional shape with six square faces. Look for a cube around the house.





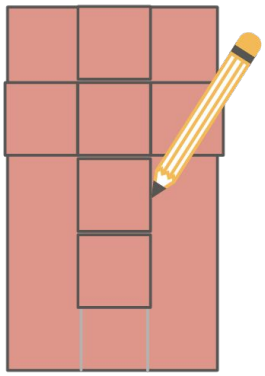
A net is a flat shape you can fold to make a 3D shape.

- On paper, draw the net of a cube you see here. It can be any size that fits on your paper.
- Cut out the net.
- Fold the net to make a cube shape. This is your pattern for making a cube for your mobile.
- Talk about it: How did you know how to fold the net?

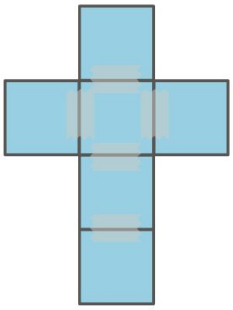
©TERC 2020

Different ways of making a net for a cube

Make a net by tracing a small square

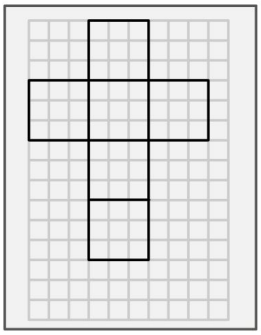


Make a net by taping together small squares



Do this if you have tape

Make a net with graph paper

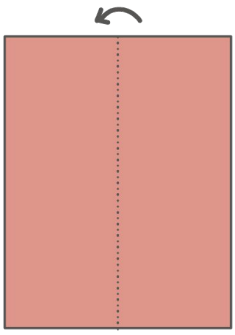


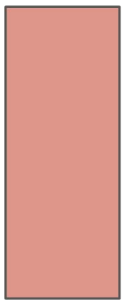
Do this if you have graph paper

Make a net by tracing a small square

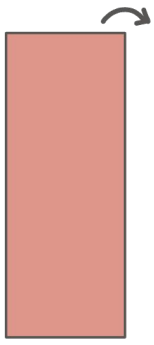
You'll need a sheet of letter sized paper (8.5 x 11 inches), scissors, and a pencil or pen.

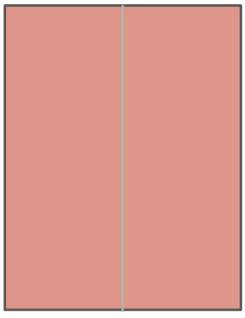
Step 1: Fold in half





Step 2: Unfold

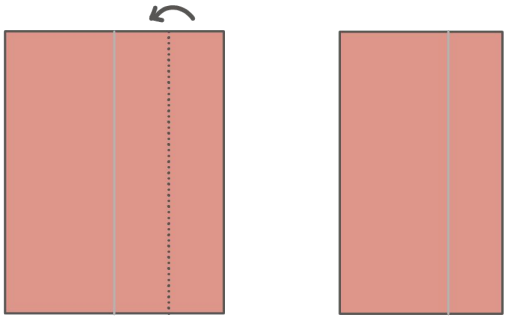




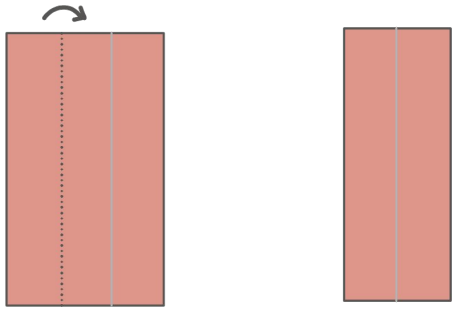
©TERC 2020

Make a net by tracing a small square (cont.)

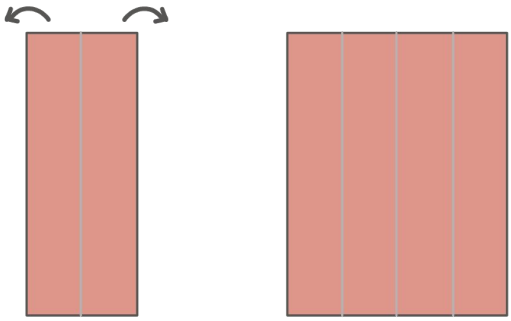
Step 3: Fold to center



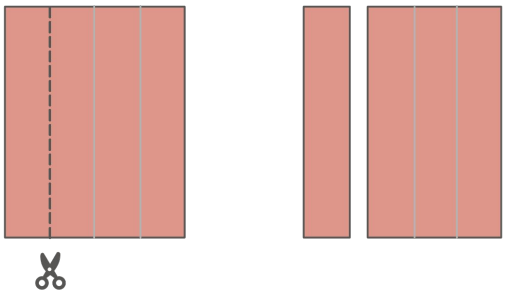
Step 4: Fold to center



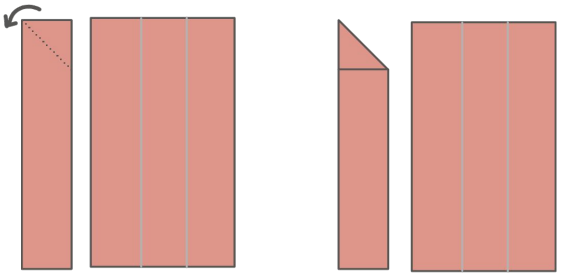
Step 5: Unfold



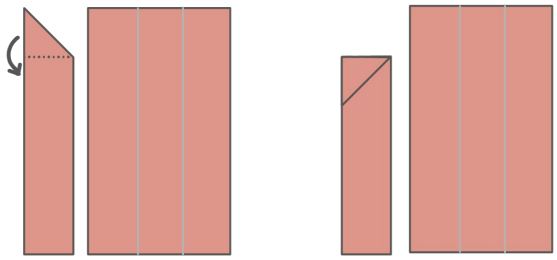
Step 6: Cut out one strip



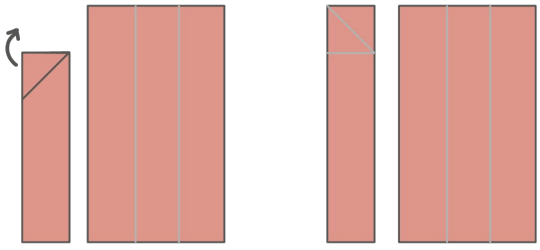
Step 7: Fold diagonal line to make a square.



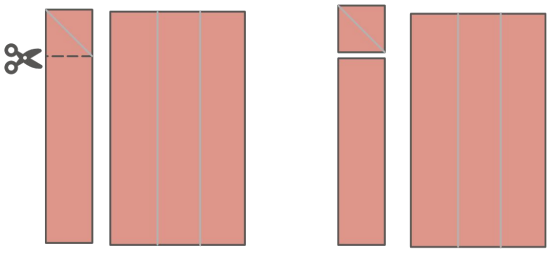
Step 8: Fold down



Step 9: Unfold



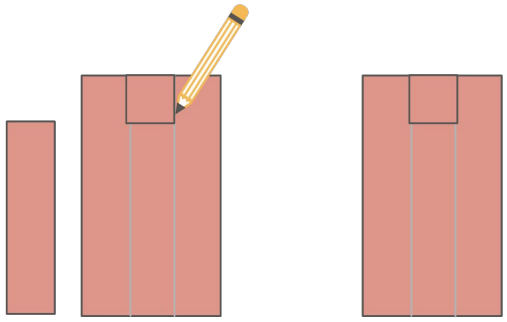
Step 10: Cut out square



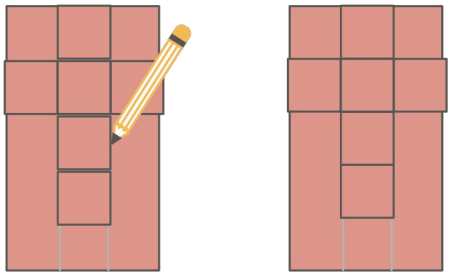
©TERC 2020

Make a net by tracing a small square (cont.)

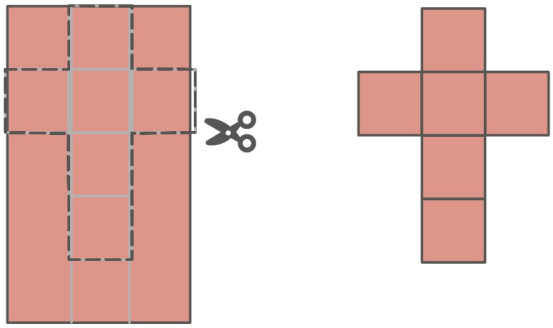
Step 11: Use the square to trace



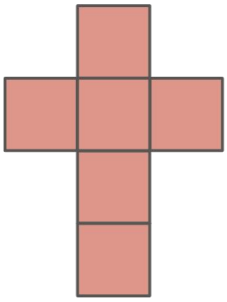
Step 12: Trace the square to make a “t” shape



Step 13: Cut out shape

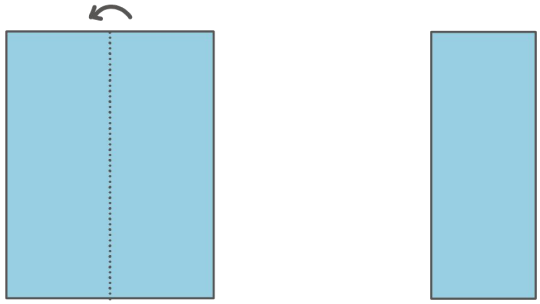


Step 14: Finished net

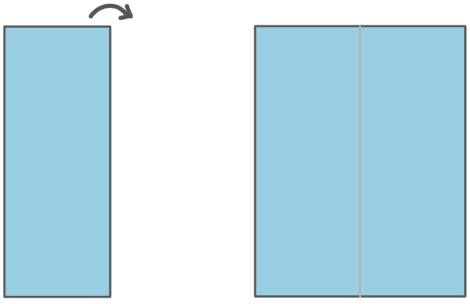


Make a net with squares

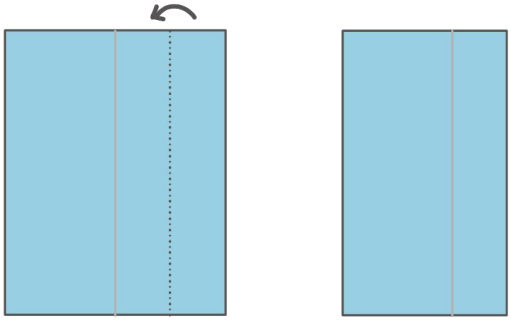
Step 1: Fold in half



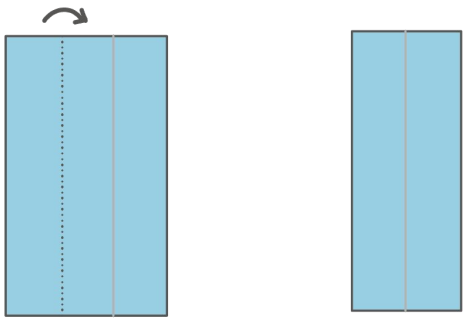
Step 2: Unfold



Step 3: Fold to center



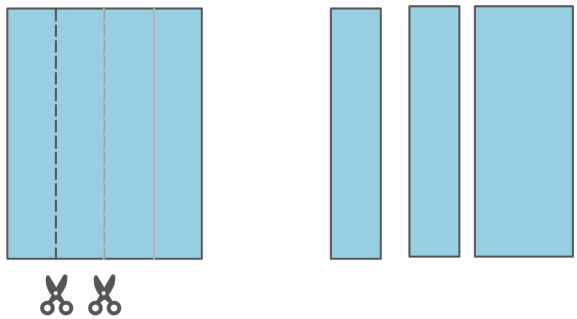
Step 4: Fold to center



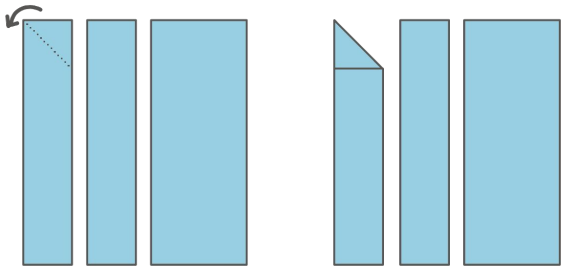
©TERC 2020

Make a net with squares (cont.)

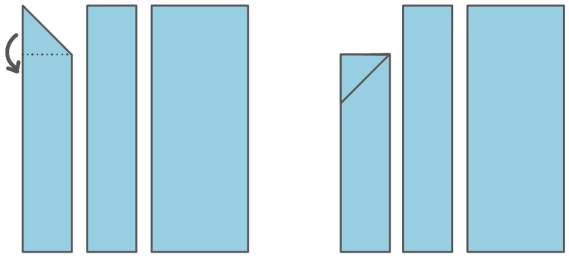
Step 5: Cut out two strips



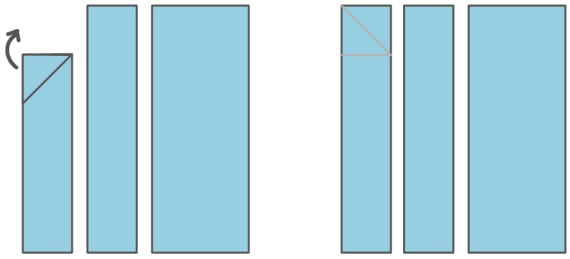
Step 6: Fold diagonal line



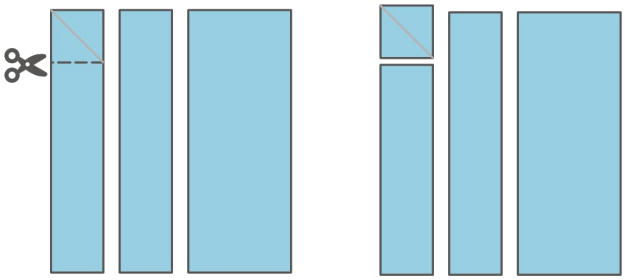
Step 7: Fold down



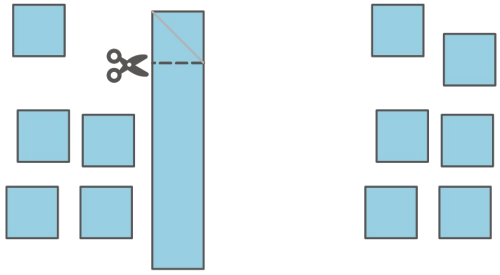
Step 8: Unfold



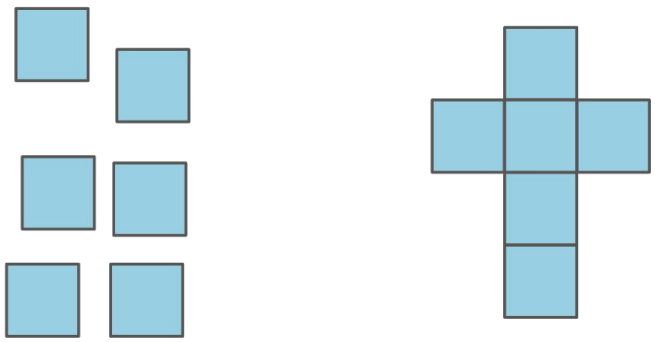
Step 9: Cut out square



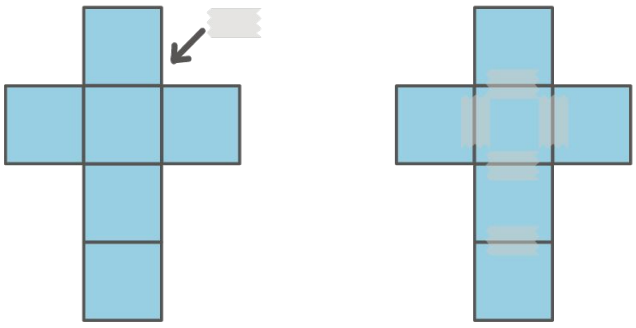
Step 10: Make 6 squares



Step 11: Use the squares to make a "t" shape



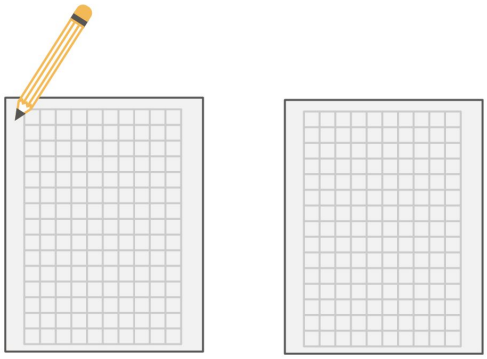
Step 12: Tape the squares together



©TERC 2020

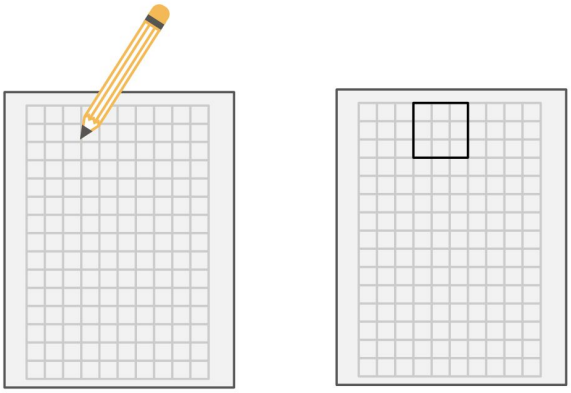
Make a net with graph paper

Step 1: Decide on how many units

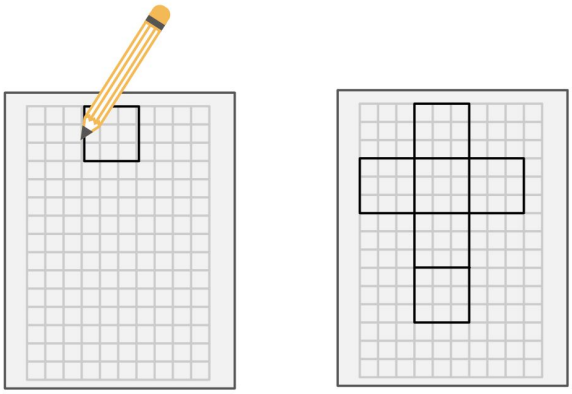


You know that the net must have 4 squares in a row. Count the total number of units of the longest side. What's the length of the side of the biggest square you can make?

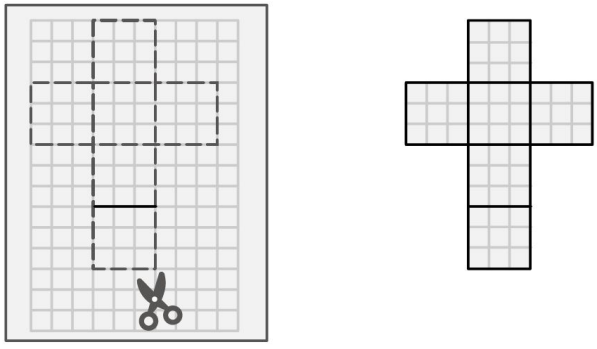
Step 2: Count the units and draw a square



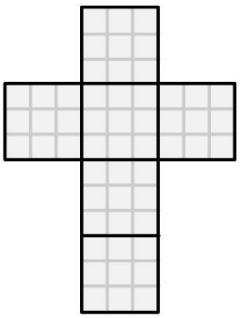
Step 3: Make a "t" shape with squares



Step 4: Cut out around the shape



Step 5: Finished net

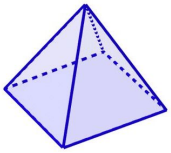


©TERC 2020

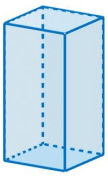
Make a net of another shape

Cylinder

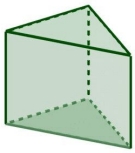
Cube



Square pyramid



Rectangular prism

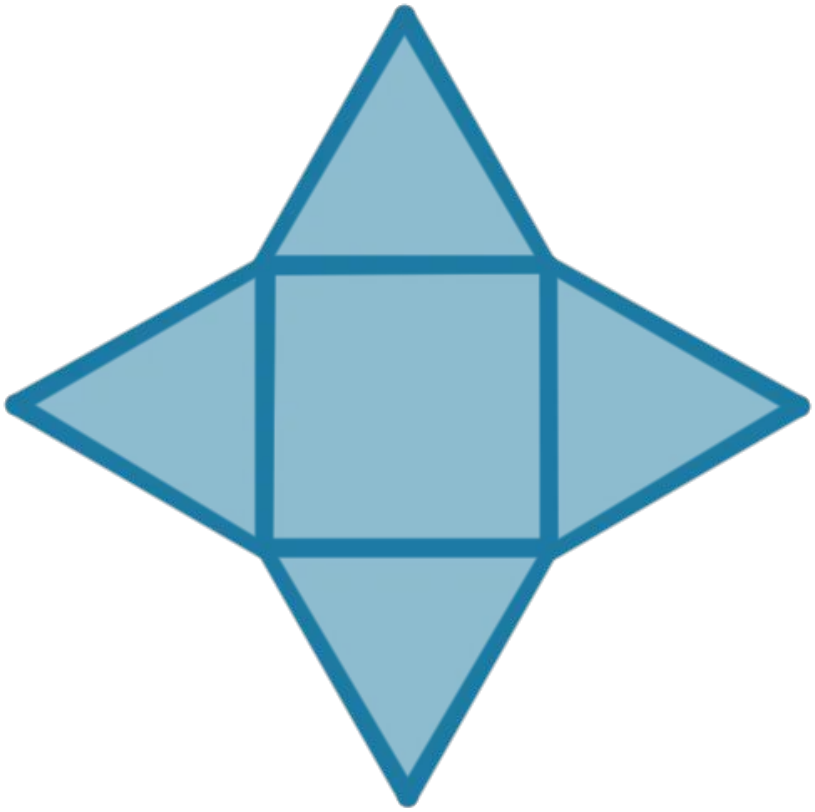


Triangular prism

- Choose another 3D shape to make with a net. (See the shapes in the image to the left.)
- Draw the net on paper. Imagine folding it up. Change the net until you think it will work.
- Cut out the net.
- Test it: Fold it to make your shape. If it works, you will use this net to make more nets. If it doesn't work, fix your net.

Here is an example net.

Talk about it: What 3D shape can be formed from this net?



©TERC 2020

Make the 3D shapes

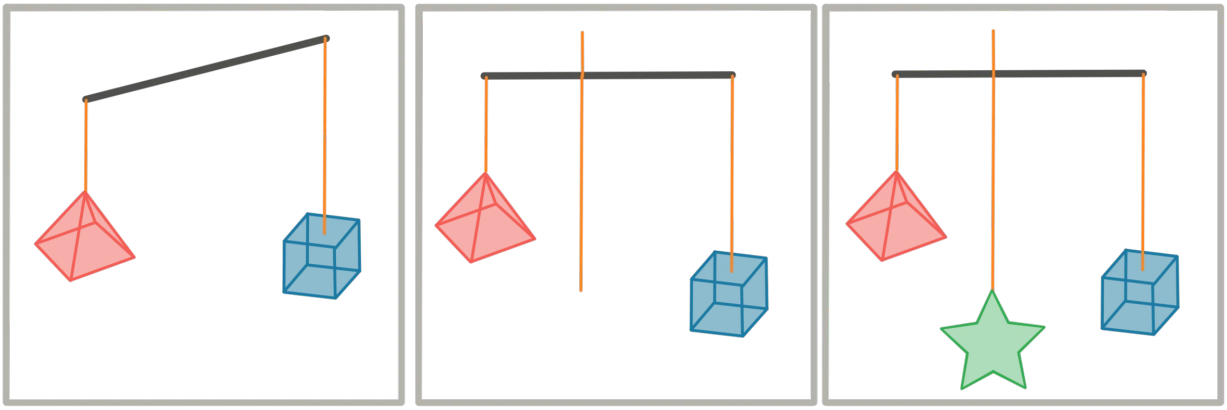
Use the nets you just made.

1. Put the nets flat on thin cardboard or thick paper.
2. Trace around the nets with a pencil to draw the nets on the thin cardboard. Or you can glue your paper net on the thin cardboard.
3. Cut out the cardboard nets.
4. Decorate the cardboard nets with pens or markers.
5. Fold up the cardboard nets into 3D shapes.
6. Attach a string for the shape to hang from.
7. Tape the edges of your net together to make the 3D shape.
8. Add more decorations, as you like.

Put together the mobile

You need the arm, the string, and the objects for your mobile. The objects are the 3D shapes you made and one you found around the house.

1. Hang the two 3D shapes you made at either end of the arm.
2. Balance the arm on your finger. Tie a string to this place on the arm. The string should hang above and below the arm.
3. Hang an object from the middle string.



Give the mobile to the user

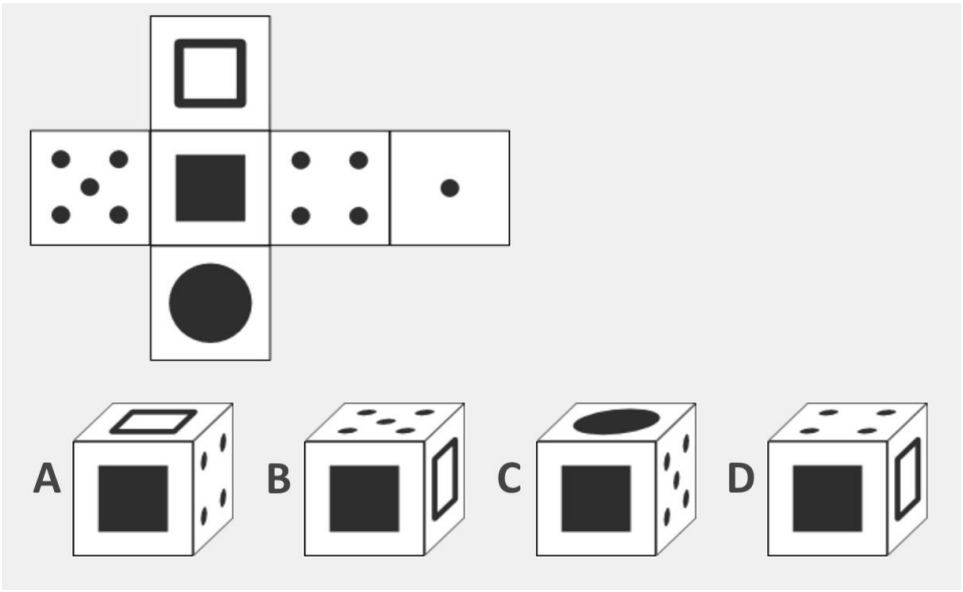
1. Bring the mobile to the person or group you made it for.
2. Hang the mobile for them. Let them watch it moving.
3. Ask if it fits with the ideas they gave you when collecting ideas.

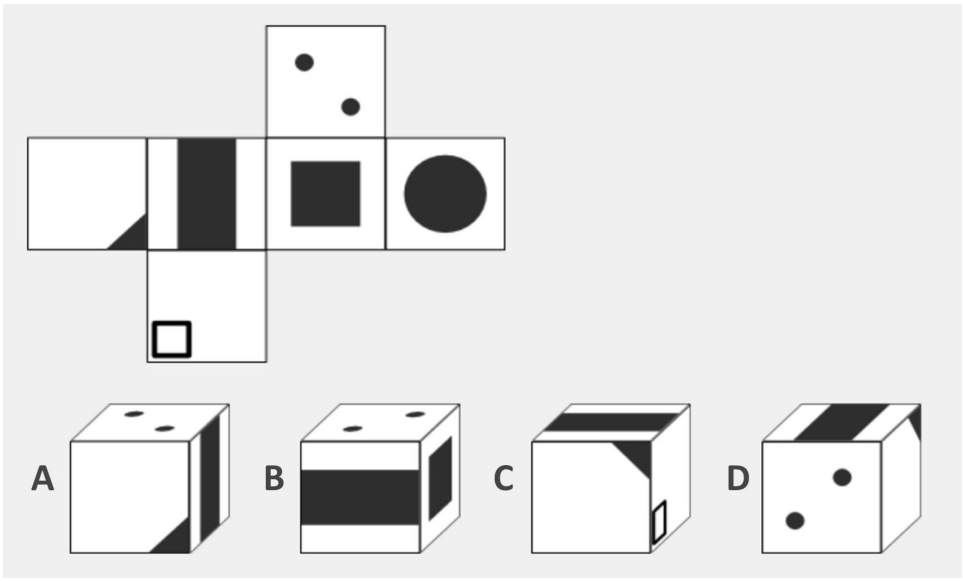
©TERC 2020

Try spatial reasoning with nets

Given a net, which cube is **NOT** possible?

If you are not sure, make the nets below and decorate them the same way. Fold the nets into cubes. Rotate your cubes to help you find the cubes that are possible and the cubes that are not possible.





These spatial reasoning challenges come from 123test.com. For more spatial reasoning challenges, check it out at: https://www.123test.com/spatial-reasoning-test/.

©TERC 2020

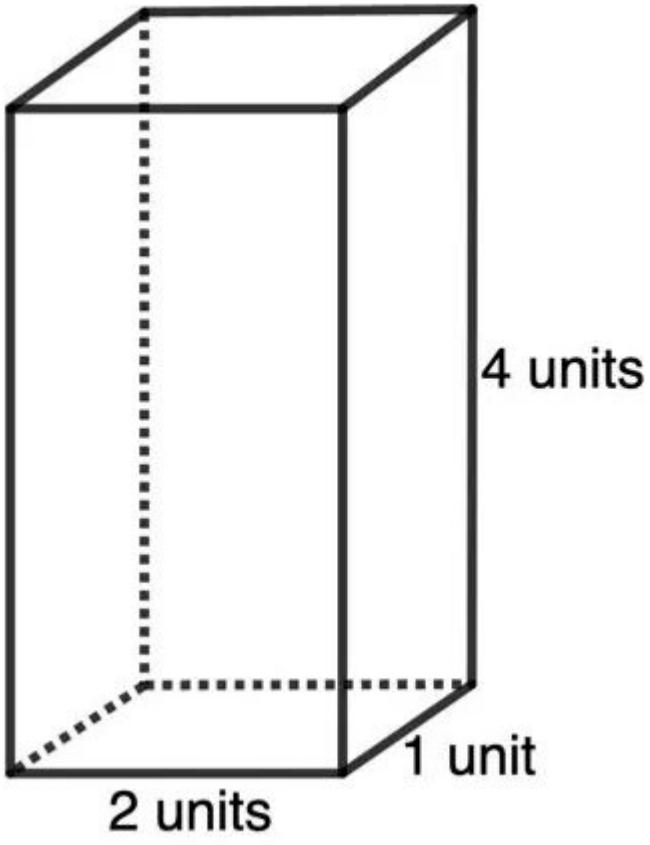
Learn about surface area

You have made two 3D shapes from nets.

Talk about it: Describe how the net is related to its 3D shape. Try to explain it to a younger child.

The surface area of a 3D shape is the sum of the areas of the faces of the shape. These faces make up the net of the 3D shape.

Calculate the **surface area** of this rectangular prism. Sketch a net to help you.



The surface area of a 3D shape is the sum of the area of the shapes in the net.

You can get it by figuring out the area of each face. Some of the faces may be the same shape.

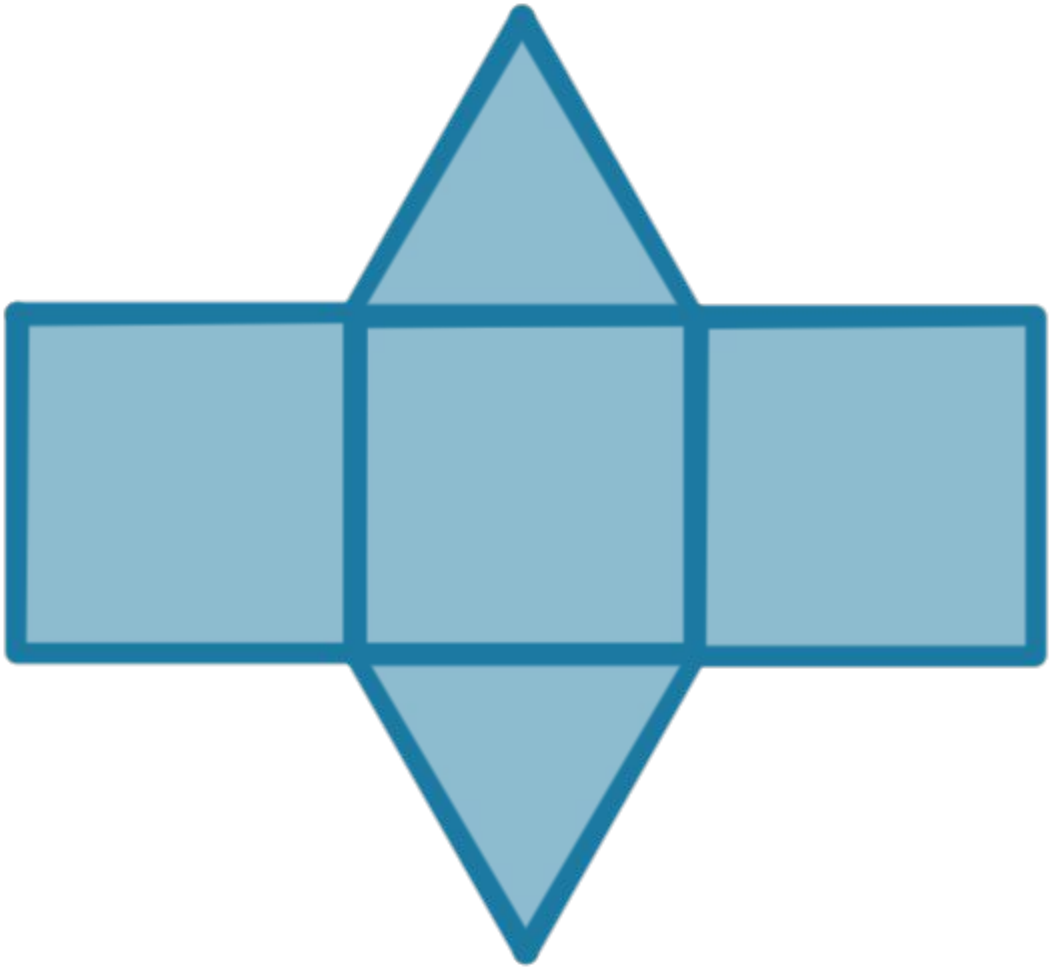
©TERC 2020

Additional Resources

Play this game to learn more about nets of cubes. There are fun animations when you check your answers. https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Cube-Nets/

Take this quiz to boost your spatial reasoning skills. https://www.123test.com/spatial-reasoning-test/

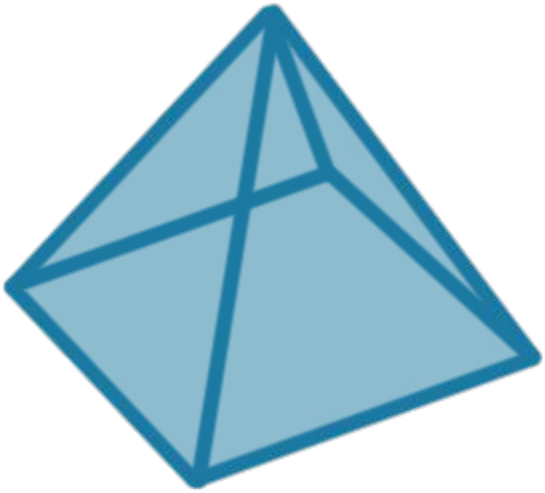
What shape would this net make?



©TERC 2020

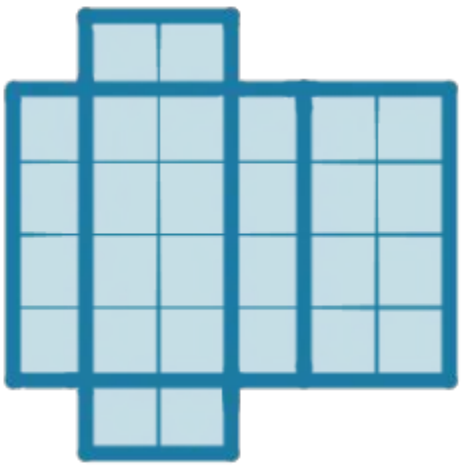
Answer Key

Make a net of another shape, page 12
It is a pyramid with a square at the bottom. So, a square pyramid

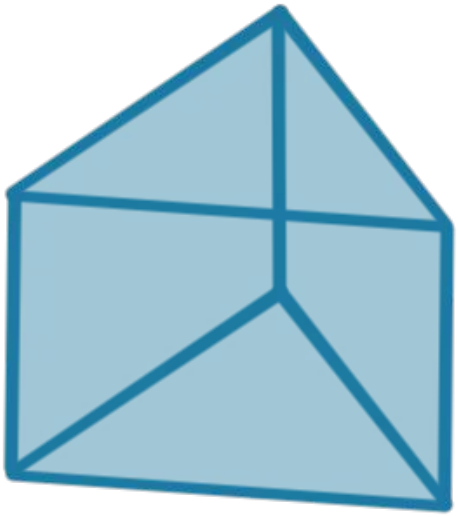


Try spatial reasoning with nets, page 14
Top cube answer: D
Bottom cube answer: B

Learn about surface area, page 15
28 square units



Additional Resources, page 16
It's a triangular prism



©TERC 2020

About MPACT

MPACT is made possible by an Education Innovation and Research grant by the U.S. Department of Education to develop and implement a program bringing the exciting and ever-more-broadly-used technologies of 3D modeling and printing to middle schoolers in 50 classrooms. 90% of MPACT's funding comes from the EIR. 10% comes from our generous donors—including the gift of your time.

About this activity

Instructional Designers:
Hee-Joon Kim, Jennifer Knudsen, Teresa Lara-Meloy, Ken Rafanan

Graphic Design & Illustration:
Ada Ren-Mitchell

Multimedia online version available at:
https://mpact3d.terc.edu/hanging-mobile/

©TERC 2020