Pull-Up Polyhedra

The objective of this activity is to encourage educators to playfully explore how two-dimensional nets can be transformed into three-dimensional shapes. A net is what a three-dimensional shape would look like when opened and laid flat.

In this activity, educators will create two-dimensional nets and use yarn attached to the net's corners to "pull" it into a polyhedron (pronounced: pol-ee-hee-druhn). Polyhedra are three-dimensional shapes with flat faces, straight edges, and corners (for example, a cube, prism, or pyramid).

Key Concept

- Visualize and manipulate a two-dimensional net into a three-dimensional shape.

Materials and Setup

- Paper
- Single-hole punch or blunt needle
- Scissors
- 12 inches of yarn or string
- Recycled cardboard
- Glue or tape

30 minutes

Individually, in pairs

In-person or virtual professional learning

Activity Instructions

Cube Net - Cross

Use the **Cube Net – Cross template** for the following steps:

1. Cut around the outline.
2. Create a fold along each of the five lines in the cross as shown in Figure 1. Fold each line in both directions.
3. Punch a small hole in each of the six black dots.
4. Glue the bottom square of the cross to a piece of cardboard.

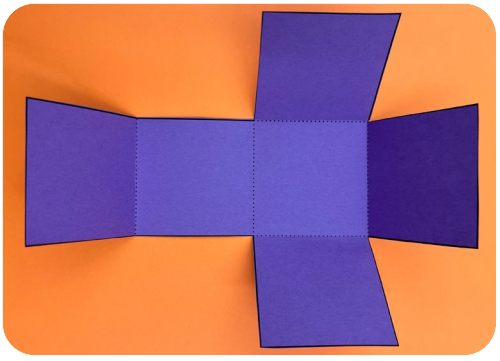

Figure 1. Cube net with folds along the five lines.

5. Punch a hole through the cardboard in the same location as the two holes on the bottom glued-down square.
6. Weave the yarn through the holes, as shown in Figure 2. Notice that the two ends of the yarn will end up underneath the cardboard.
7. Now you are ready to make your three-dimensional shape! Before you begin, what three-dimensional shape do you think you will create? How many faces, edges, and vertices will it have?

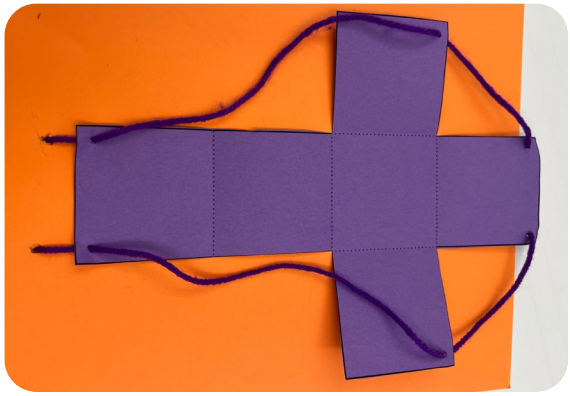

Figure 2. Cube net with yarn woven through the holes.

8. Lay your two-dimensional cross flat on a table. Hold the cardstock in one hand and grasp the yarn in the other.
9. Slowly begin to pull the yarn and watch carefully what happens to your cross.
    a. What do you notice as you pull?
    b. What kind of three-dimensional shape or polyhedron did you create? Is it what you expected?
    c. Could you weave the yarn a different way for the same result?

Tetrahedron Net

Use the **Tetrahedron Net template** for the following steps:

10. This template creates a pull-up tetrahedron. The instructions are the same as above, except for how you weave the yarn. The location of the holes are on the template, it is up to you to decide how to weave the yarn through the holes to get the net to transform into a three-dimensional tetrahedron.

Cube Net – Staircase

Use the **Cube Net – Staircase template** for the following steps:

11. This staircase template will also create a cube but has a different net. This template is like the others, except the locations of the holes have not been provided. It is up to you to decide where to put the holes and how to weave the yarn so that when it is pulled, it creates a three-dimensional polyhedron.

Reflect and Discuss

Reflect on and discuss these questions with a partner or in a small group.

1. What did you notice about your object when you pulled the yarn?
2. Could you weave the yarn through the holes in a different way to create the same object?
3. What other polyhedra could you create using this method?
4. What features of a two-dimensional net help you predict what three-dimensional polyhedron will be created?

In the real world, we constantly interact with two-dimensional and three-dimensional shapes, such as cardboard packaging that holds products like toothpaste, cereal, pasta, or mail.

5. Where else do you see three-dimensional shapes that were created from a two-dimensional flat object?

Child Activities

For activities that support children's learning about shapes and spatial thinking, explore the books below and related activities.

- 0 to 3 years: What Will Fit? by Grace Lin and the activity Storytelling Structures
- 3 to 5 years: Color Farm by Lois Ehlert and the activities Shape Scavenger Hunt or Yarn Shapes
- 6 to 8 years: Thank you, Omu! (or ¡Gracias, Omu!) by Oge Mora and the activity Omu's Town (or Ciudad de Omu in Spanish)

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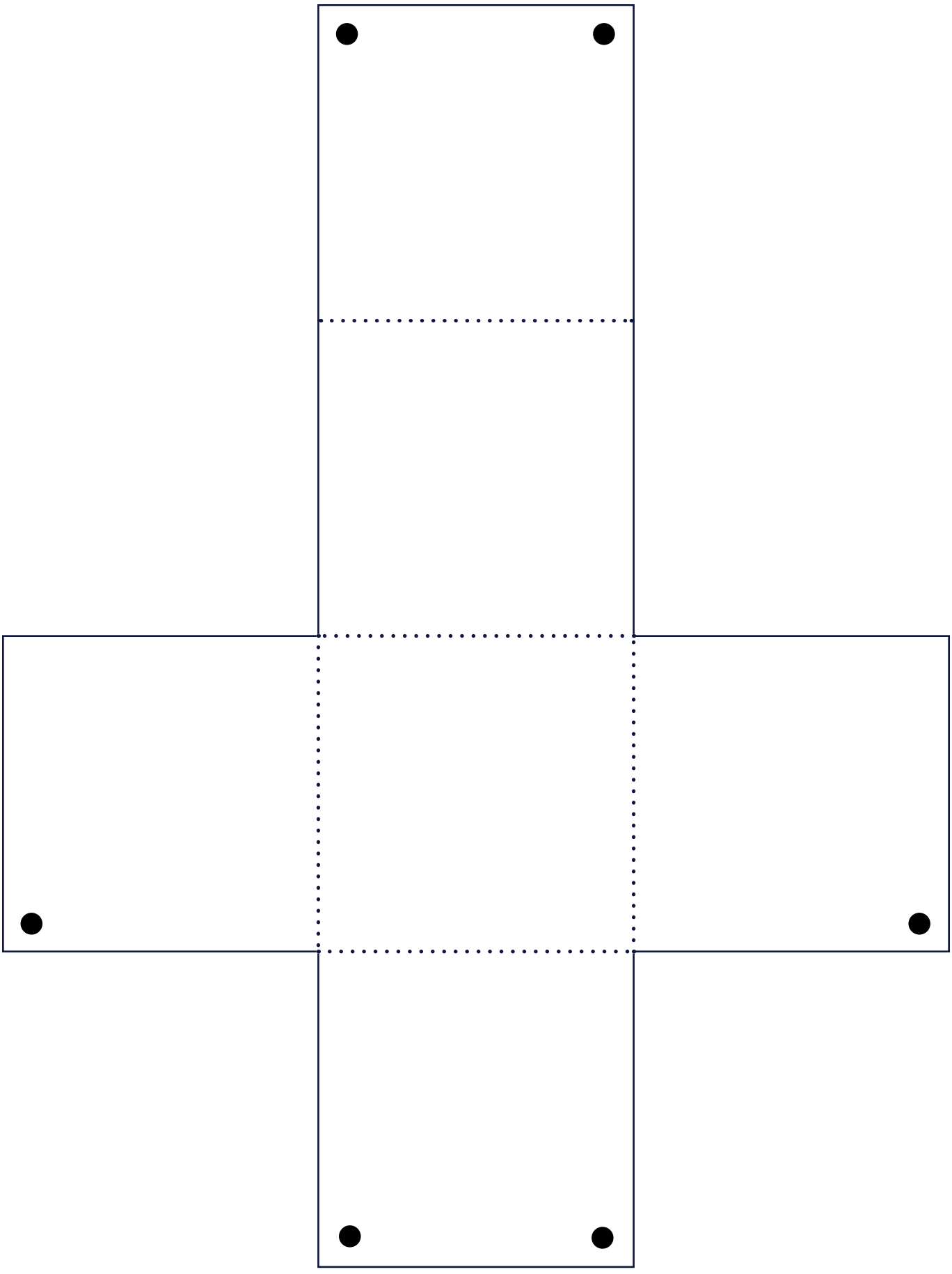
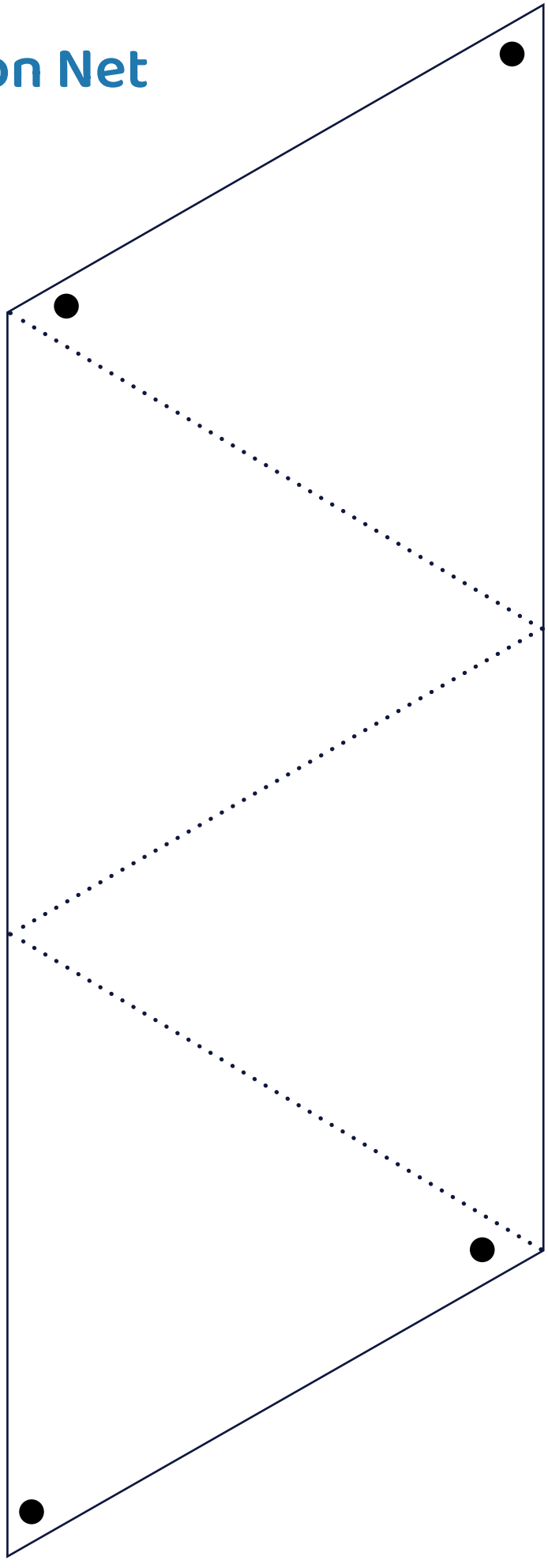
Cube Net – Cross



Tetrahedron Net



Cube Net – Staircase