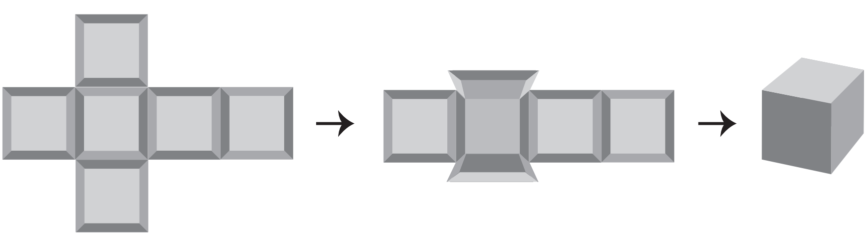
TEACHING WITH Omnifix® CUBES

BY ART JOHNSON

Introducing Omnifix Cubes

Omnifix Cubes are a new and exciting manipulative that can be used by students to strengthen their understanding of mathematics topics, which range from basic knowledge of place value to spatial relationships between similar solids. Omnifix Cubes can also be used to introduce various geometric topics such as surface area and volume. Omnifix Cubes are an improvement over wooden cubes because they can be fastened together to form stable figures. Any face of an Omnifix Cube can be attached to any face of another Omnifix Cube. No special orientation of the cubes is required. Omnifix Cubes can also be easily taken apart and reconfigured with other Omnifix Cubes to form a different figure.



Omnifix Cubes come “unfolded” in the form of a net, which is easily folded up to form a cube.

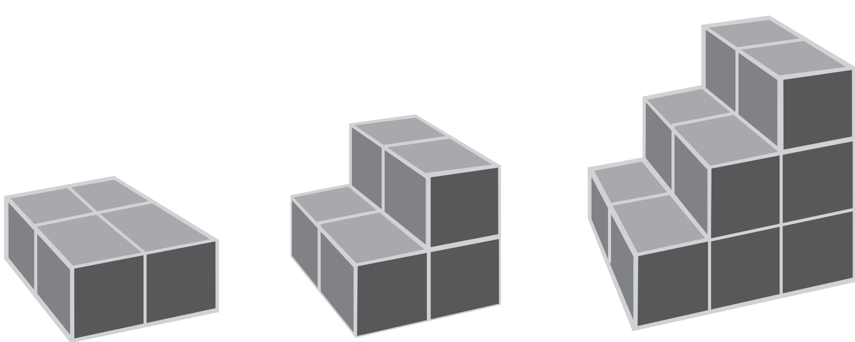
Students can benefit from the simple activity of folding up the nets to make the Omnifix Cubes. Your students might be challenged to draw other nets that will fold up to form a cube. When properly folded, the Omnifix nets will “click” into an Omnifix Cube. On rare occasions, a cube will come apart. When this happens, simply fold up the net again into a cube.

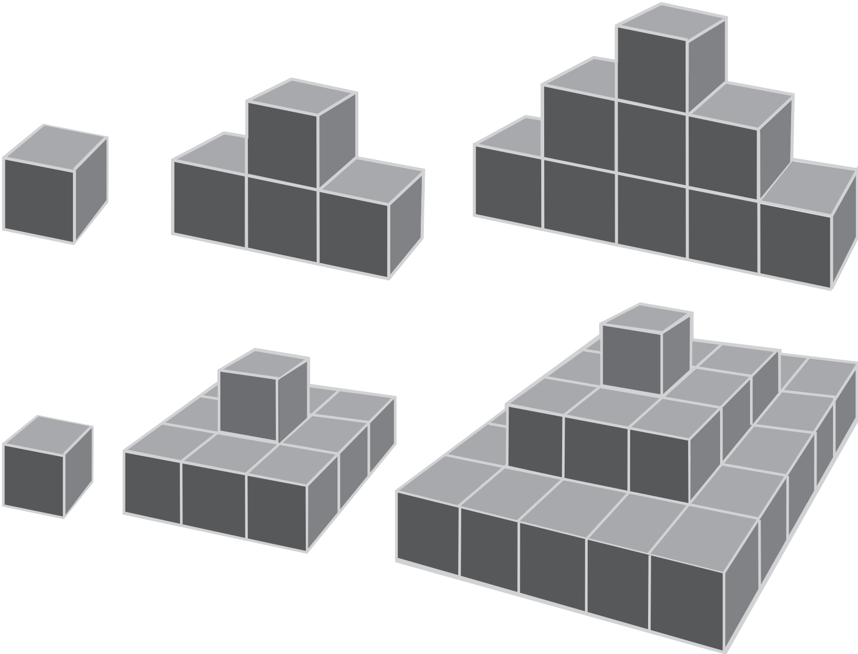
The four colors of the Omnifix Cubes are used for some of the activities described here, while in other activities the colors are unimportant. Be sure your students understand what role, if any, the colors of the Omnifix Cubes are to play in any activity.

The use of Omnifix Cubes is a logical next step after students have used Unifix structural materials.

Three-Dimensional Patterns

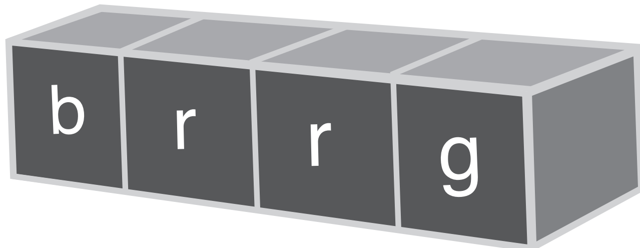
Omnifix Cubes provide students with the opportunity to build three-dimensional structures that illustrate growth patterns, as in each of the following structures. Students should be encouraged to build several stages of each structure and then make a conjecture about how many Omnifix Cubes would be required for subsequent stages in the pattern.

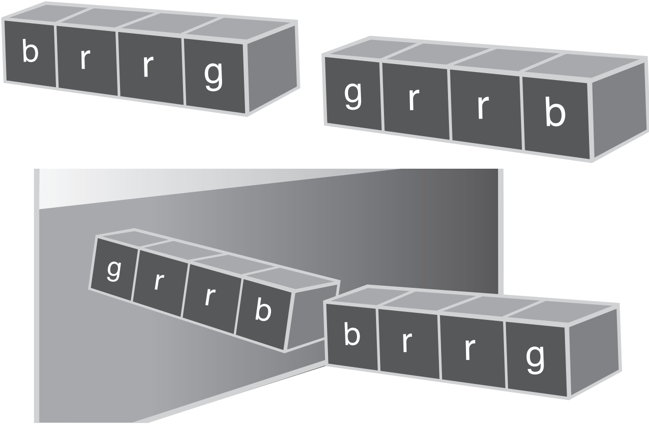




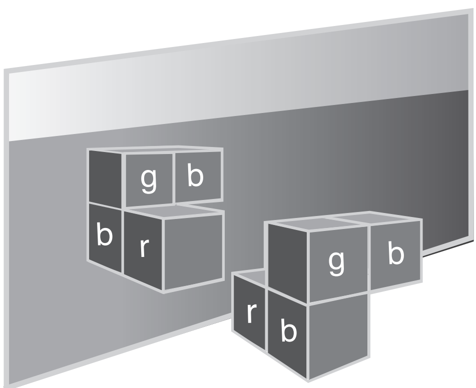
Omnifix Cubes Symmetry

The concept of symmetry can be illustrated by using a variation of color trains. For example, one student builds a color train as shown below and a second student builds the mirror image. Attaching the first color train to its mirror image results in a color train whose ends are symmetrical. A mirror can be used to verify the solutions.





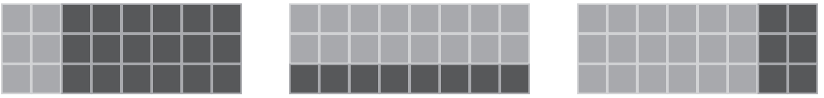
Omnifix Cubes can also be used to show symmetry in three dimensions. For example, one student might construct the following figure:



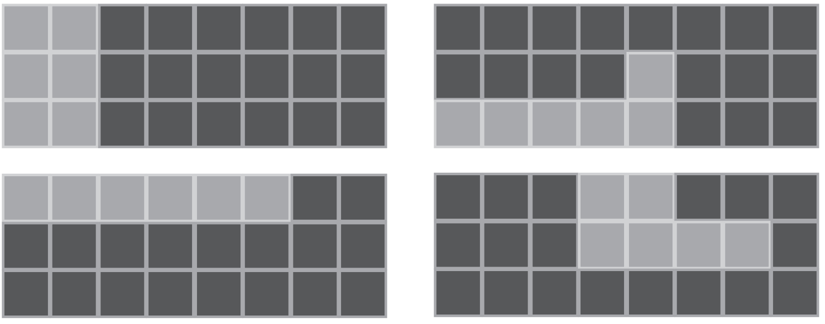
The challenge is to build a symmetrical, or mirror, image of the figure. Hold a mirror in front of the original figure and display the second figure next to the mirror to verify that it is symmetrical with the first figure.

Omnifix Fractions

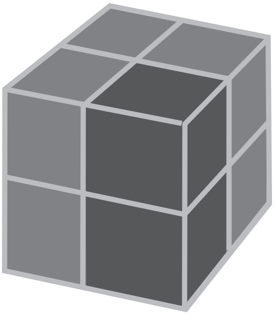
Omnifix Cubes can be used to represent fractions in two different ways. The different colors may be used to represent fractions in a rectangular grid. For example, in the rectangle below, the fractions $\frac{1}{4}$, $\frac{2}{3}$, and $\frac{3}{4}$ can be shown by using blue cubes to represent the fractional portion in the 8 x 3 rectangle.



Students should be challenged to represent the same fraction, $\frac{1}{4}$, in different ways in the same rectangle. Some representations of $\frac{1}{4}$ in the 8 x 3 rectangle are shown below.

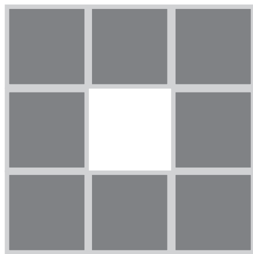


Fractions can also be represented as parts of rectangular prisms, strengthening students' spatial visualization while building their understanding of fractions. In the cube below, students show $\frac{1}{4}$ and $\frac{3}{4}$ by using different color Omnifix Cubes.



Frame-Up

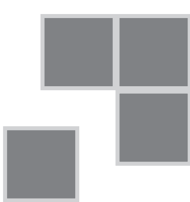
Omnifix Cubes can be used to help students explore the mathematics of frames. How many Omnifix Cubes are needed to build a 3 x 3 frame? Most students would answer that 12 Omnifix Cubes are needed. They would be wrong! Only 8 Omnifix Cubes are needed.

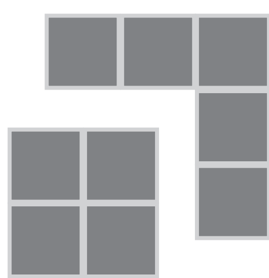


How many Omnifix Cubes are needed to build a 4 x 4 frame? Again, the intuitive answer of 16 is wrong. Have students explore the relationship between the number of Omnifix Cubes needed to build various square frames and then look for a pattern. Students might be asked to “frame” their pattern in the form of an equation that can be applied to frames of any size.

Gnomons

A gnomon is a standing stone or other object that casts a shadow for a sundial. In mathematics, a gnomon is used to make a larger square from a smaller one. For example, the gnomons for a 1 x 1 square and for a 2 x 2 square are shown below.





Students can use Omnifix Cubes to construct squares and the gnomons that will create larger squares. Ask students to investigate the pattern for determining gnomons and explain how the pattern works.

Back-to-Back

For this activity, two students sit back to back as one student builds a geometric figure with the Omnifix Cubes. The student describes the construction step to his or her partner, and the partner tries to duplicate it. The partner is allowed to ask for a repeat of directions, but may not ask any clarifying questions. After six steps, the students compare figures. The figures should match. If they do not, have students try to determine the reason.

Omnifix Cubes Morphing

This activity makes students think of geometric figures in a different light—morphing. To illustrate the concept of morphing, ask students to deconstruct a 4 x 4 x 4 cube and then reassemble it into a 2 x 8 x 4 prism. The challenge is to use as few steps as possible for morphing the cube into the prism. Any action that changes the figure is considered a "step," no matter how many cubes are involved in the action. You can learn a great deal about your students' spatial conception by observing the different methods they use to complete the morphing activity.

Color Cubes

In this activity, the color of the Omnifix Cubes is important. Each Omnifix Cube color is assigned a specific position on a larger cube. For example, the red Omnifix Cubes have no faces on the surface of the larger cube, the blue Omnifix Cubes have a single face on the surface of the larger cube, the yellow Omnifix Cubes have two faces on the surface of the larger cube, and the green Omnifix Cubes have three faces on the surface of the larger cube. The task is to predict how many cubes of each color are needed to build a 2 x 2 x 2 cube, a 3 x 3 x 3 cube, etc. Once students have made their predictions, they can then build the cubes to verify their answers.

Surface Area of Cubes

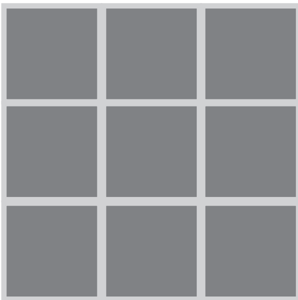
The surface area of a single Omnifix Cube is 6 square units. Suppose the length of the cube's edges are doubled. What is the surface area of a 2 x 2 x 2 cube? Many students will simply double the surface area of a single Omnifix Cube and suggest the surface area of a 2 x 2 x 2 cube is 12 square units. Of course, this is easily shown to be incorrect by building a 2 x 2 x 2 cube. Students should examine other cubes and record their surface areas. Once they have collected their data, they should try to express the relationship between the length of a cube and its surface area.

Volume of Cubes

Many students will suggest that if a single cube (with dimensions 1 x 1 x 1) has a volume of 1 cubic unit, then a 2 x 2 x 2 cube has a volume of 2 units. Have students construct cubes of various sizes and make a chart comparing the ratio of the length and width of a cube to its volume. Then have students compare the volume of a cube that is 1 x 1 x 1 to a cube that is 2 x 2 x 2, and so on.

Squared Away

How many squares are formed within a 3 x 3 square? As shown below, there are 14 squares.



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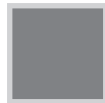

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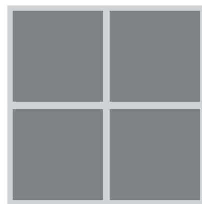

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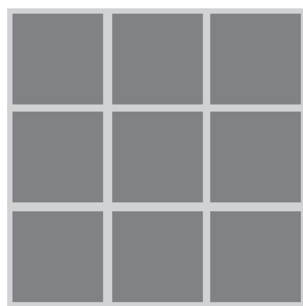
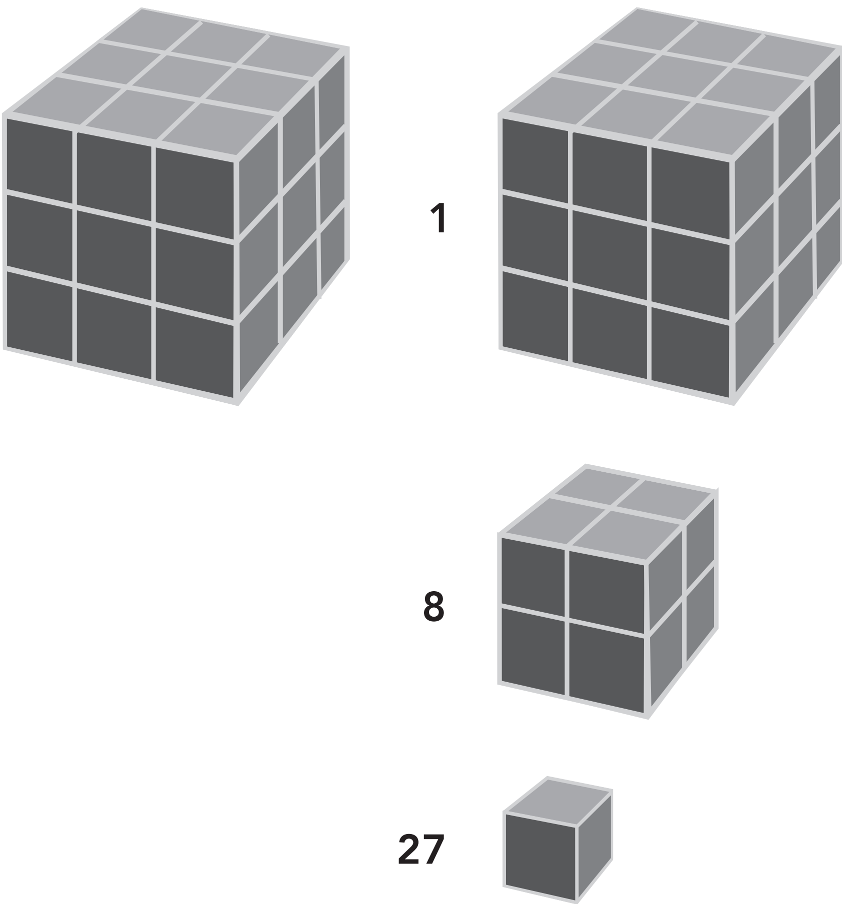


Have students build squares of different sizes with their Omnifix Cubes and count how many squares are contained within the original square. As they are counting the squares, students will build their spatial visualization skills and improve their ability to perceive figures in different orientations. Ask students to make up a rule for determining the total number of squares within a given square. It is helpful if students organize their data in a chart similar to that shown above.

Cubed Out

Once students have had the experience of Squared Away, they might try this activity, a three-dimensional counterpart to Squared Away. In this case, students try to determine how many cubes are found in a given cube, for example a 3 x 3 x 3 cube.

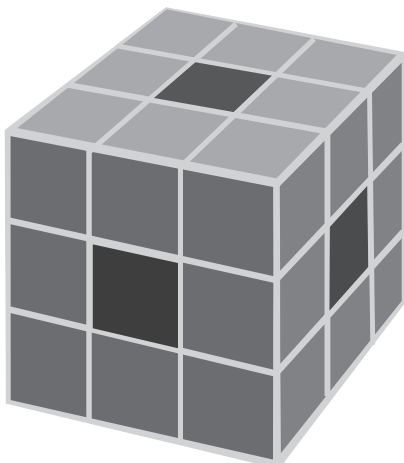
There is a formula for determining the total number of cubes in this activity. Have students collect and display their data about the cubes in a diagram similar to that shown below. Have students discuss the diagram to discover the formula.



Hollow Cubes

To construct a 3 x 3 x 3 cube, one needs 3^3 or 27 Omnifix Cubes. To construct a 4 x 4 x 4 cube, one needs 4^3 or 64 Omnifix Cubes. How many cubes are required to build a hollow cube that is composed of Omnifix Cubes only along its edges, such as this 3 x 3 x 3 cube?

Have students construct hollow cubes of various sizes and collect data about the number of Omnifix Cubes required to build each one. Once they have collected their data, they should look for a pattern for determining how many Omnifix Cubes are needed to build a hollow cube of any size.

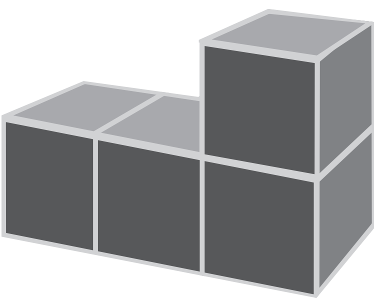


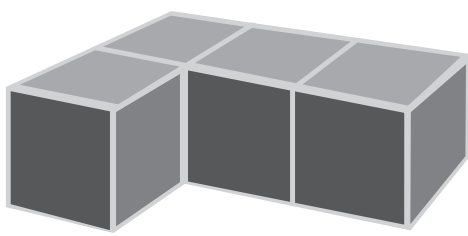
Shape Up

This activity will help students build spatial orientation skills. The task is to combine cubes so that they have a single face in common while forming various types of figures. For example, by combining two cubes, one is able to form only one type of figure.

What about 3 cubes, or 4 cubes? How many different types of figures can they form? Have students build all the various types of figures that can be formed by 3 cubes and then by 4 cubes. Often, students will build duplicate figures, but orient them differently. As a result, they will not recognize they have constructed identical figures.

The challenge here may not be to find all possible solutions, but to avoid duplicating figures.





Didax Education
395 Main Street
Rowley, MA 01969
(800) 458-0024
www.didax.com