



## What Makes Structures Stand Up?

4.88

*Application of Architectural Concepts*

### Age Level:

Third grade and up

### Subjects:

Math  
Science  
Visual Arts  
Language Arts  
Social Studies

### Time:

One and one-half hours.

### Materials:

- 9" x 12" and 12" x 18" construction paper in a variety of colors. Preferably 80 lb. cover weight or poster-board.
- Cut the 9" x 12" paper in 1" x 12" strips, enough for at least a dozen for each student.
- Cut the 12" x 18" paper into 6" squares-enough for each student to have at least nine.
- Scissors, tape and glue.
- Hand out packets to each student, or have the materials at each table.

### Learning Objectives:

- To develop an understanding of geometric structural forms.
- To understand the concepts of loads and tensions within a structure.
- To learn to listen and follow directions.

### Design Professional:

Most students enjoy this activity very much. It requires a lot of listening and following directions, so your instructions should be as clear and simple as possible. It will be essential that you construct a sample of each example before you introduce it in the classroom, so that you have actually experienced the process.

In introducing this activity in the classroom, one good method is to have all the materials on the shelf of a projector cart. Then, as you start each demonstration on the top of the cart, bring up the necessary materials, exhibit your sample, and do each step with the students.

After each demonstration, go around the room helping the students complete each piece before going on to the next.

### Teachers:

Students usually become pretty involved in making these examples, but it does require careful listening and staying on task. You can be of great assistance to the design professional in making the instructions clear and seeing that the students are working correctly.

### Rationale:

Students love to build things, but often know very little about what makes structures stand up. By constructing the basic structural shapes, combining them and then experimenting with putting loads on them, they see something about how structures work. On a walking tour around the school or the neighborhood, have the students look for examples of these shapes and speculate on how they are carrying loads.

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### Presenting the Activity:

Suggested dialogue...

*“You have had some experiences with using your bodies to actually feel the loads and tensions that exist within a building. When it is very quiet in your house, haven’t you sometimes heard sounds like squeaks, grinds or little thuds? Those sounds are the building feeling the tensions and loads. Buildings can have creaky joints the same as people do!*

*“Remember how a building feels as you make the structural forms we are going to make today. The forms will be models of structural parts of buildings. When you have several models, you can think about how you might put them together in a building or perhaps a city.*

*“What have you learned are the most basic geometric forms in architecture? Right—the circle, the square and the triangle.”*

#### Circle

*“Take one of the strips and bend it into a circle with the ends overlapping about 1/2 inch. Tape or glue the ends together. ”*

#### Column

*“With one of the square pieces, bend it into a circle and overlap the edges 1/2 inch. Tape or glue the edges together. Stand it on end, and you have a column.*

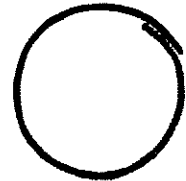
*“These are the easy ones. The next ones will be a little harder, and you will have to listen to the instructions very carefully.”*

#### Square

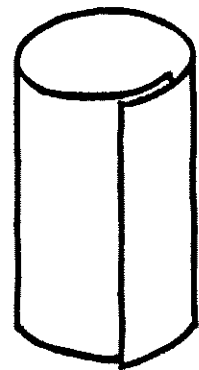
*“Take another strip. This time we will fold it into a square. First, fold one end over 1/2 inch.*

*“Hold that half-inch fold down, and fold the remaining strip in half. Now fold it in half again.*

*“Open the strip. You will need to reverse the fold at the end—that means to fold it back the opposite way from the way it is. Form the strip into a square, overlapping the half-inch fold over the other end of the strip. Tape or glue them together. ”*



CIRCLE



CYLINDRICAL  
POST-COLUMN-TOWER

# What Makes Structures Stand Up?

## Application of Architectural Concepts

### Post

"A post is also a square, so it will be made the same way, except you will make it with one of the squares.

"Fold the edge of the square over 1/2 inch. Hold that fold down and fold the piece in half and then in half again. Open the piece up and reverse the fold on the end. Form it into a square and tape or glue the edge and the fold together.

"Stand this on end, and you have a square post."

### Rectangle

"Take one of the strips and fold the end over 1/2 inch. Now it is going to get tricky!

"Hold that fold and fold the strip in half

"Hold that fold and fold that end over about half the distance to the center fold.

"Measure that fold and measure the same distance from the center fold toward the end of the strip. Fold the strip on the measurement mark.

"Now bring the ends together with the overlap and tape or glue them together."

### Rectangular Post

"With one of the squares, do the same as you just did with the strip.

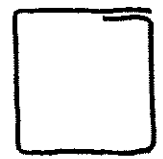
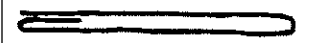
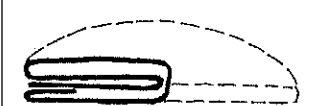
"Fold the edge over 1/2 inch. Hold that fold and fold the strip in half

"Hold that fold and fold the end over about half the distance to the center fold

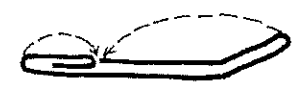
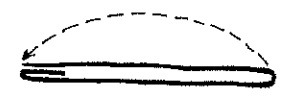
"Measure that fold and measure the same distance from the centerfold toward the end of the square. Fold the square on the measurement mark.

"Bring the ends together with the overlap and tape or glue the edges together.

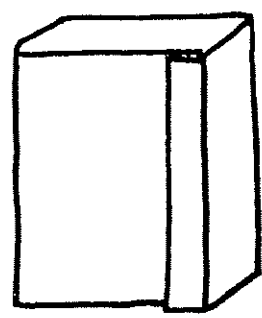
"Stand this piece on end, and you have a rectangular post."



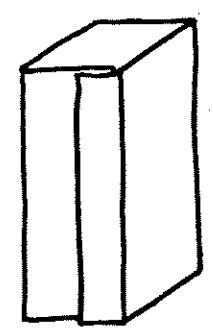
SQUARE



RECTANGLE



RECTANGULAR POST OR BOX



SQUARE POST-COLUMN BOX

# What Makes Structures Stand Up?

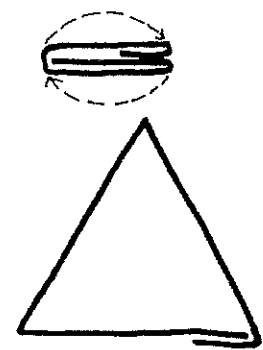
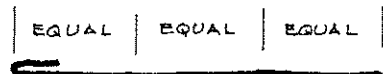
Application of Architectural Concepts

## Triangle

"Take a strip and again fold the end over 1/2 inch.

"Hold that fold and carefully work the rest of the strip until you have it in three equal parts. When the parts look even to you, fold them down.

"Bring the overlap and the edge together, and tape or glue them together."



TRIANGLE

## Pyramid

"Any form that has triangular sides coming to a point at the top is a pyramid. In architecture, it usually means a form with a square base and four triangular sides-like the great pyramids in Egypt.

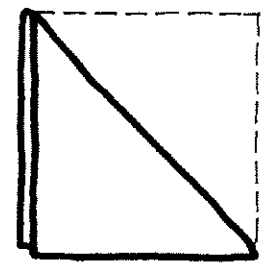
"To make this form, fold a square across the diagonal way. Open it up and fold it diagonally the other way.

"Make a cut in the middle of each of the triangles almost all the way to the center point, but not quite.

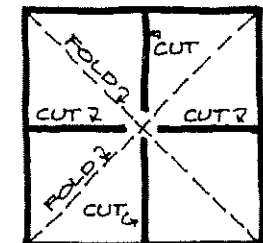
"Overlap each of these cuts just a little bit, and tape or glue them together.

"For a three-sided pyramid, start out the same way, making the diagonal folds. However, this time you will make only one cut in the middle of one of the triangles that goes all the way to the center point.

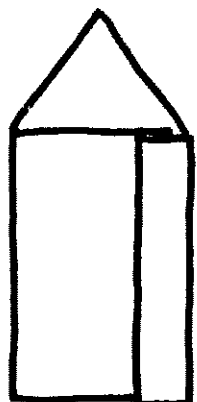
"Overlap this cut completely over the opposite side, so it forms a triangle that is the same size as the other two sides."



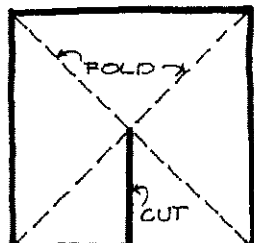
DIAGONAL FOLD



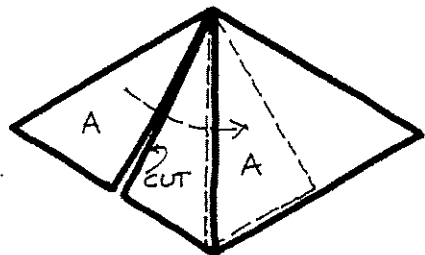
SQUARE PYRAMID



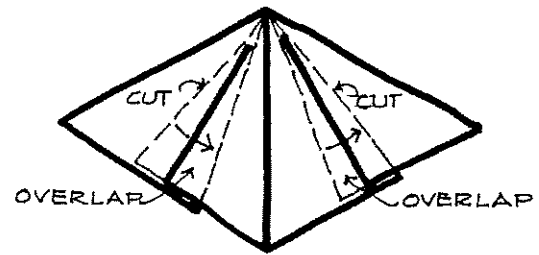
TRIANGULAR STRUCTURAL MEMBER



TRIANGULAR PYRAMID



TRIANGULAR PYRAMID



SQUARE PYRAMID

# What Makes Structures Stand Up?

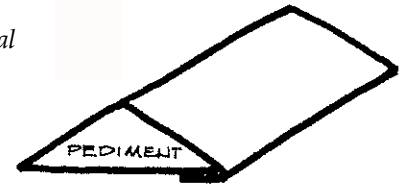
## Application of Architectural Concepts

### Gable

"A gable is the triangle that is formed by a roof that pitches two directions from a top ridge. This is the most common form for a roof or a dormer.

"Fold the edge of a square over 1/2 inch. Work the rest of the square into three equal parts. When you think you have the parts equal, fold them down. Tape or glue the edge to the overlap.

"Now you have a gable roof. The triangle formed at each end is sometimes called a pediment, and is decorated with various designs."



GABLE

### Arch

"Fold over 1/2 inch at the end of a strip. Hold that fold, and fold it over about one third of the way to the opposite end of the strip.

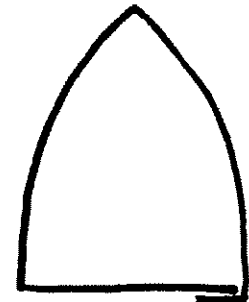
"Form the rest of the strip into a half circle, and tape or glue the end to the overlap.

"You can vary the height and width of the arch by the way you fold the strip.

"If you would like to have a Gothic arch, make the first fold about a quarter of the way over on the strip. Fold the rest of the strip in half and tape or glue the edge to the overlap. This will give you an arch with a pointed top similar to the arches in Gothic cathedrals."



ARCH



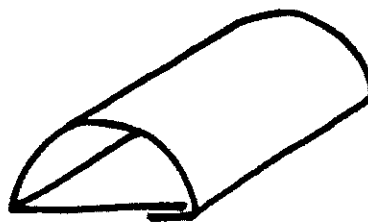
GOTHIC ARCH

### Barrel Vault

"You can make a roof out of an arched form.

"Take a square and fold the edge over 1/2 inch. Hold that fold and work the rest of the piece into three equal parts.

"Fold down just one of the parts, the same as you did with your arched strip. Arch the paper over the flat base, and tape or glue the edge to the overlap."



BARREL VAULT

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## Application of Architectural Concepts

### Cone

“Fold a square in half. Turn it and fold it in half again, in the other direction. With your pencil or compass, draw a quarter circle line on the folded piece. Cut the folded piece on the pencil line.

“If you drew a good quarter-circle line, the piece should now be a nice circle shape. “Now cut a piece of pie out of one quarter of the circle.

“Pull the cut sides together and overlap them. Tape or glue them together. The amount of the overlap will determine whether you have a flat cone or a steep cone.

“Now you have a group of basic architectural forms. These forms are found in many, many buildings. Of course, not all of them would be on one building-that would be a bit too much, probably.

“Architects and designers often make variations on these forms, or put them together in different ways, so you might think about how that could be done.

“However, there are a few basic ways of putting the forms together.

“For instance, if you put a row of columns together, it is called a colonnade. There needs to be something across the top of the columns to hold them together, and to holdup the building or roof above them. A beam like this is called a lintel.

“You can make a lintel the same way you made the square or rectangular posts. Make them longer, so they will go over several columns.”

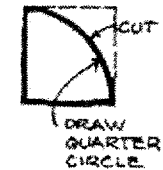
“If you put a row of arches together, the arch takes the place of the lintel, and it supports the wall above.

“Of course, now that you know how to make these forms, you can make bigger ones or smaller ones. You might make a big column and put a cone on top of it. If you make a very steep cone shape, you will have a tower with a witches’ hat roof!

“If you make a bigger post-more like a box-you have a square or rectangular building. You could put a flat roof on it-or a pyramid, a gable, or a barrel vault.

“If you put a series of triangles together, they form a truss, which is a very strong form that will hold up very heavy loads. That is why you so often see trusses on bridges. They are in the roofs of buildings too, but often you can’t see them. See if your gym or cafeteria has an open-truss ceiling.

“Make several pieces of these shapes and experiment with putting them together. You might want to try putting some weight on them. Try small objects at first. Then you might try some books. You could see how many you can put on a truss before it will collapse.”



**What Makes Structures Stand Up?**

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*Application of Architectural Concepts***Classroom Activities**

This activity contains the following Content Standard in The Arts:

**AESTHETICS AND ART CRITICISM**

- Explain, analyze works of art, applying knowledge of technical, organizational, and aesthetic elements.
- Respond to works of art, giving reasons for preferences.

**■ HISTORICAL AND CULTURAL PERSPECTIVES**

- Relate to works of art from various time periods and cultures.
- Describe how historical and cultural contents influence works of art.

**CREATE, PRESENT, AND PERFORM**

- Apply artistic elements and technical skills to create, present and/or perform works of art for a variety of audiences and purposes.
- Communicate verbally and in writing about one's own art work.

**Description of Activity:**

To show historical context of architectural support systems, show photos of column, square post, rectangular post, pyramid. Examples of these can be found in most history books that show Egyptian, Roman and Greek architectural details. Many modern structures can show the same supports. Photos from magazines might demonstrate this too. Also, students could locate these supports in magazines, books, encyclopedia or Internet sites.

**Student Opportunities for Connecting to Content Standards in the Arts:**

Given examples of ancient architectural supports, students will be able to relate to works of art (architecture) from various time periods and cultures.

**What Makes Structures Stand Up?**

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*Application of Architectural Concepts***Classroom Activities**

This activity contains the following Content Standard in The Arts:

**AESTHETICS AND ART CRITICISM**

- Explain, analyze works of art, applying knowledge of technical, organizational, and aesthetic elements.
- Respond to works of art, giving reasons for preferences.

**HISTORICAL AND CULTURAL PERSPECTIVES**

- Relate to works of art from various time periods and cultures.
- Describe how historical and cultural contents influence works of art.

**■ CREATE, PRESENT, AND PERFORM**

- Apply artistic elements and technical skills to create, present and/or perform works of art for a variety of audiences and purposes.
- Communicate verbally and in writing about one's own art work.

**Description of Activity:**

Students make various kinds of geometric structural forms, including column, square, rectangular post, pyramid, gable, arch, barrel vault, cone, following directions from instructor. (See pages 4.89-4.93)

**Student Opportunities for Connecting to Content Standards in the Arts:**

Given instruction and demonstrations in creating various geometric structural forms, the students will understand and be able to demonstrate how these forms support architectural structures. Students will apply artistic and technical skills (cutting, gluing, etc.) to create the geometric artistic forms.



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*Application of Architectural Concepts***Classroom Activities**

This activity contains the following Content Standard in The Arts:

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- Explain, analyze works of art, applying knowledge of technical, organizational, and aesthetic elements.
- Respond to works of art, giving reasons for preferences.

**HISTORICAL AND CULTURAL PERSPECTIVES**

- Relate to works of art from various time periods and cultures.
- Describe how historical and cultural contents influence works of art.

**CREATE, PRESENT, AND PERFORM**

- Apply artistic elements and technical skills to create, present and/or perform works of art for a variety of audiences and purposes.
- Communicate verbally and in writing about one's own art work.

**Description of Activity:**

Students put together geometric structural forms to make new artistic forms of support. Students discuss their own forms emphasizing line, shape, balance, repetition and space. This exercise could easily lead into making a city and could be a "green" activity.

**Student Opportunities for Connecting to Content Standards in the Arts:**

Given the opportunity to build and then discuss their new forms, students will be able to explain and analyze a work of art. Students will also be able to respond to creations giving reasons for preferences.