Name _____

Using Math to Build Skyscrapers

Fill in the circle by the correct answer. Then write the answers to numbers 3, 4, and 5.

1. Horizontal beams _____.
   - Ⓐ support the entire building
   - Ⓑ carry the building's weight downward
   - Ⓒ carry the building's weight between columns
   - Ⓓ are forces acting on the building

2. A structural engineer designs _____.
   - Ⓐ the building's support features
   - Ⓑ the building's look
   - Ⓒ software programs
   - Ⓓ the building's rooms

3. What does the writer compare a building's framework to?

   _____

   _____

4. What forces make a building expand and contract?

   _____

   _____

5. How do structural engineers use math to help them do their jobs?

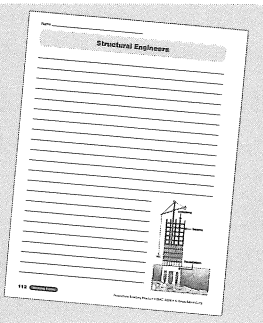
   _____

   _____

Write About the Topic

Use the Writing Form to write about what you read.

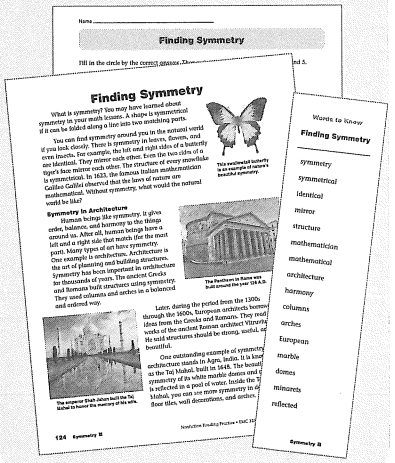
Explain how a structural engineer designs a building to make it stand up.



Symmetry

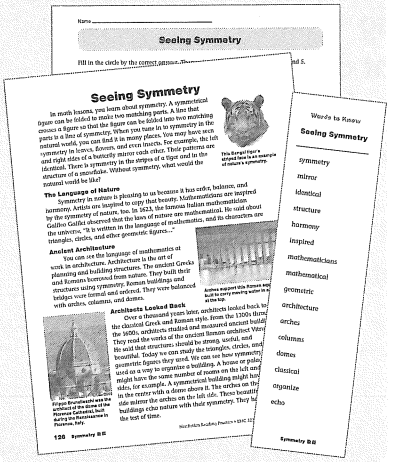
Level 1 ■

Words to Know list, Reading Selection, and Reading Comprehension questions



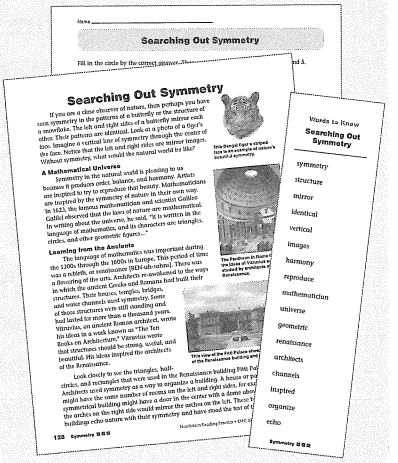
Level 2 ■■

Words to Know list, Reading Selection, and Reading Comprehension questions



Level 3 ■■■

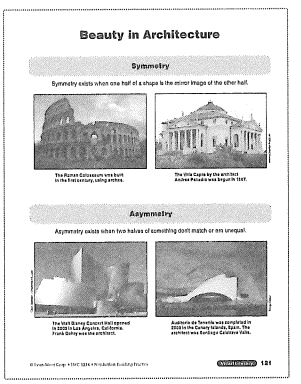
Words to Know list, Reading Selection, and Reading Comprehension questions



Assemble the Unit

Reproduce and distribute one copy for each student:

- Visual Literacy page: Beauty in Architecture, page 121
- Level 1, 2, or 3 Reading Selection and Reading Comprehension page and the corresponding Words to Know list
- Graphic Organizer of your choosing, provided on pages 180–186
- Writing Form: Discovering Symmetry, page 122



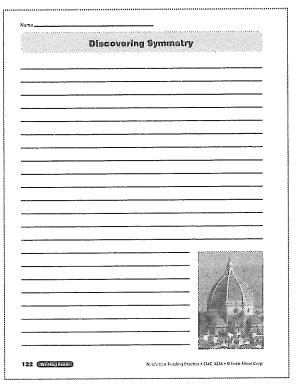
Visual Literacy

Introduce the Topic

Read aloud and discuss the Beauty in Architecture text and pictures. Explain that architects strive to make buildings both useful and beautiful. Tell students that symmetry and its opposite, asymmetry, produce distinct types of beauty. Ask students which they prefer.

Read and Respond

Form leveled groups and review the Words to Know lists with each group of students. Instruct each group to read their selection individually, in pairs, or as a group. Have students complete the Reading Comprehension page for their selection.



Writing Form

Write About the Topic

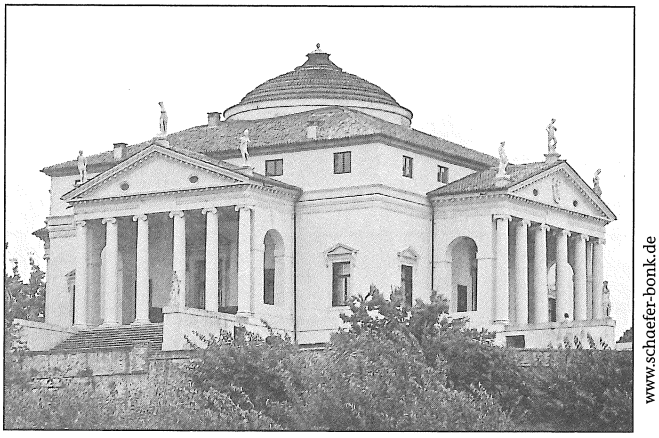
Read aloud the leveled writing prompt for each group. Tell students to use the Graphic Organizer to plan their writing. Direct students to use their Writing Form to respond to their prompt.

Beauty in Architecture

Symmetry

Symmetry exists when one half of a shape is the mirror image of the other half.

The Roman Colosseum was built in the first century, using arches.

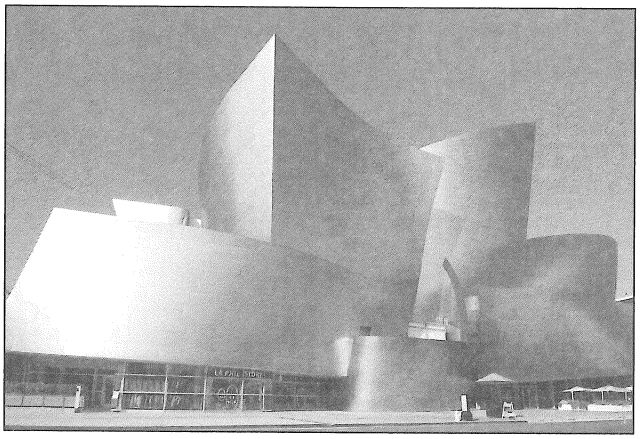


www.schaefer-bonk.de

The Villa Capra by the architect Andrea Palladio was begun in 1567.

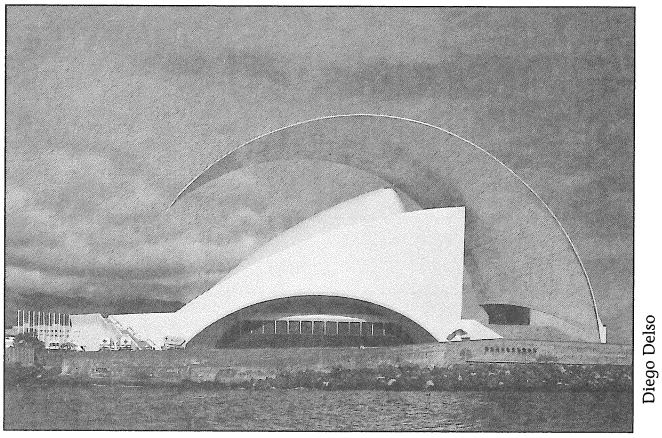
Asymmetry

Asymmetry exists when two halves of something don't match or are unequal.



Chris Rubino / Shutterstock.com

The Walt Disney Concert Hall opened in 2003 in Los Angeles, California. Frank Gehry was the architect.



Diego Delso

Auditorio de Tenerife was completed in 2003 in the Canary Islands, Spain. The architect was Santiago Calatrava Valls.

Name _____

Discovering Symmetry

Words to Know

Finding Symmetry

symmetry
symmetrical
identical
mirror
structure
mathematician
mathematical
architecture
harmony
columns
arches
European
marble
domes
minarets
reflected

Symmetry ■

Words to Know

Seeing Symmetry

symmetry
mirror
identical
structure
harmony
inspired
mathematicians
mathematical
geometric
architecture
arches
columns
domes
classical
organize
echo

Symmetry ■■

Words to Know

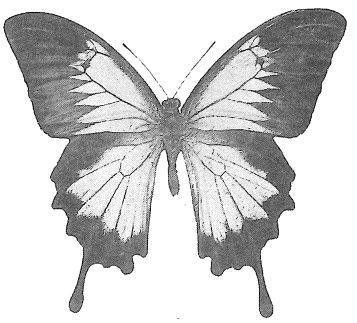
Searching Out Symmetry

symmetry
structure
mirror
identical
vertical
images
harmony
reproduce
mathematician
universe
geometric
renaissance
architects
channels
inspired
organize
echo

Symmetry ■■■

Finding Symmetry

What is symmetry? You may have learned about symmetry in your math lessons. A shape is symmetrical if it can be folded along a line into two matching parts.

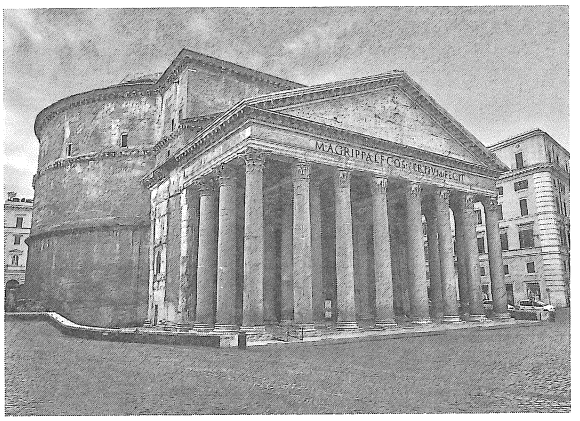


This swallowtail butterfly is an example of nature's beautiful symmetry.

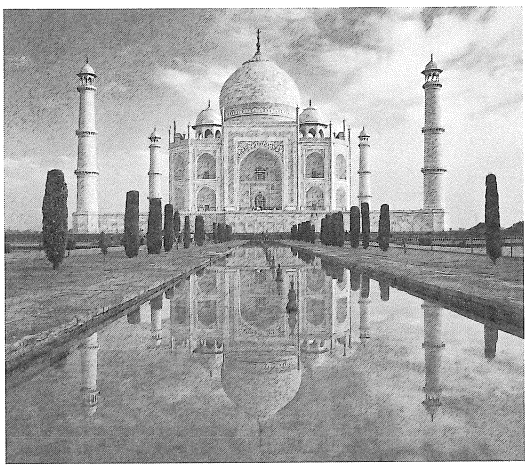
You can find symmetry around you in the natural world if you look closely. There is symmetry in leaves, flowers, and even insects. For example, the left and right sides of a butterfly are identical. They mirror each other. Even the two sides of a tiger's face mirror each other. The structure of every snowflake is symmetrical. In 1623, the famous Italian mathematician Galileo Galilei observed that the laws of nature are mathematical. Without symmetry, what would the natural world be like?

Symmetry in Architecture

Human beings like symmetry. It gives order, balance, and harmony to the things around us. After all, human beings have a left and a right side that match (for the most part). Many types of art have symmetry. One example is architecture. Architecture is the art of planning and building structures. Symmetry has been important in architecture for thousands of years. The ancient Greeks and Romans built structures using symmetry. They used columns and arches in a balanced and ordered way.



The Pantheon in Rome was built around the year 126 A.D.



The emperor Shah Jahan built the Taj Mahal to honor the memory of his wife.

Later, during the period from the 1300s through the 1600s, European architects borrowed ideas from the Greeks and Romans. They read the works of the ancient Roman architect Vitruvius. He said structures should be strong, useful, and beautiful.

One outstanding example of symmetry in architecture stands in Agra, India. It is known as the Taj Mahal, built in 1648. The beautiful symmetry of its white marble domes and minarets is reflected in a pool of water. Inside the Taj Mahal, you can see more symmetry in decorated floor tiles, wall decorations, and arches.

Name _____

Finding Symmetry

Fill in the circle by the correct answer. Then write the answers to numbers 3, 4, and 5.

1. One example of symmetry in architecture is _____.
   - Ⓐ Galileo Galilei
   - Ⓑ an insect
   - Ⓒ Vitruvius
   - Ⓓ the Taj Mahal

2. Another name for a tall, thin tower is _____.
   - Ⓐ arch
   - Ⓑ dome
   - Ⓒ marble
   - Ⓓ minaret

3. Give two examples of symmetry in nature, one from the text and one you have observed.

   _____

   _____

4. What is the main idea of paragraph 5?

   _____

   _____

5. Based on the images you have seen, how do you feel about symmetry in architecture?

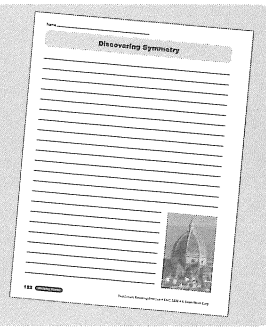
   _____

   _____

Write About the Topic

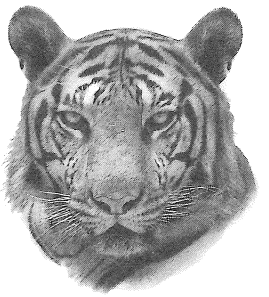
Use the Writing Form to write about what you read.

Explain what you discovered about the symmetry of the Taj Mahal by studying its picture.



Seeing Symmetry

In math lessons, you learn about symmetry. A symmetrical figure can be folded to make two matching parts. A line that crosses a figure so that the figure can be folded into two matching parts is a line of symmetry. When you tune in to symmetry in the natural world, you can find it in many places. You may have seen symmetry in leaves, flowers, and even insects. For example, the left and right sides of a butterfly mirror each other. Their patterns are identical. There is symmetry in the stripes of a tiger and in the structure of a snowflake. Without symmetry, what would the natural world be like?



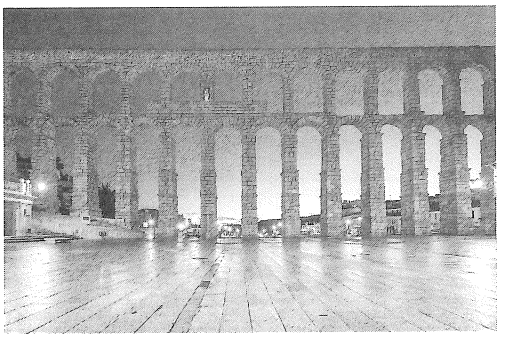
This Bengal tiger's striped face is an example of nature's symmetry.

The Language of Nature

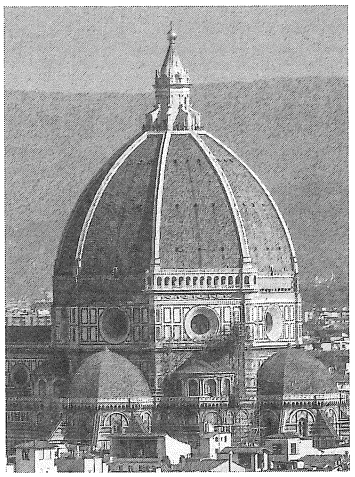
Symmetry in nature is pleasing to us because it has order, balance, and harmony. Artists are inspired to copy that beauty. Mathematicians are inspired by the symmetry of nature, too. In 1623, the famous Italian mathematician Galileo Galilei observed that the laws of nature are mathematical. He said about the universe, "It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures..."

Ancient Architecture

You can see the language of mathematics at work in architecture. Architecture is the art of planning and building structures. The ancient Greeks and Romans borrowed from nature. They built their structures using symmetry. Roman buildings and bridges were formal and ordered. They were balanced with arches, columns, and domes.



Arches support this Roman aqueduct, built to carry moving water in a channel at the top.



Filippo Brunelleschi was the architect of the dome of the Florence Cathedral, built during the Renaissance in Florence, Italy.

Architects Looked Back

Over a thousand years later, architects looked back to the classical Greek and Roman style. From the 1300s through the 1600s, architects studied and measured ancient buildings. They read the works of the ancient Roman architect Vitruvius. He said that structures should be strong, useful, and beautiful. Today we can study the triangles, circles, and other geometric figures they used. We can see how symmetry was used as a way to organize a building. A house or palace might have the same number of rooms on the left and right sides, for example. A symmetrical building might have a door in the center with a dome above it. The arches on the right side mirror the arches on the left side. These beautiful buildings echo nature with their symmetry. They have stood the test of time.

Name _____

Seeing Symmetry

Fill in the circle by the correct answer. Then write the answers to numbers 3, 4, and 5.

1. To Galileo Galilei, the universe was _____.
   - Ⓐ classical
   - Ⓑ mathematical
   - Ⓒ identical
   - Ⓓ a mirror

2. Symmetry is _____.
   - Ⓐ not organized
   - Ⓑ pleasing
   - Ⓒ unnatural
   - Ⓓ not evenly shaped

3. How would you compare the architects of ancient Rome with those of the Renaissance?

   _____

   _____

4. Suppose you were asked to plan and build a palace. Would you include symmetry in your plans? Explain.

   _____

   _____

5. What idea from the text was most interesting to you? Why?

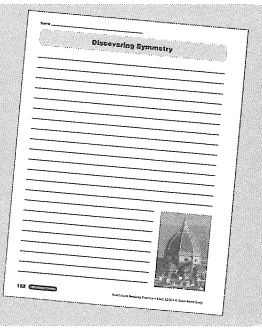
   _____

   _____

Write About the Topic

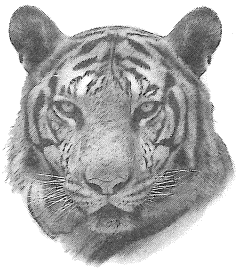
Use the Writing Form to write about what you read.

What did you discover about the symmetry of one of the buildings pictured in the text? Write to explain.



Searching Out Symmetry

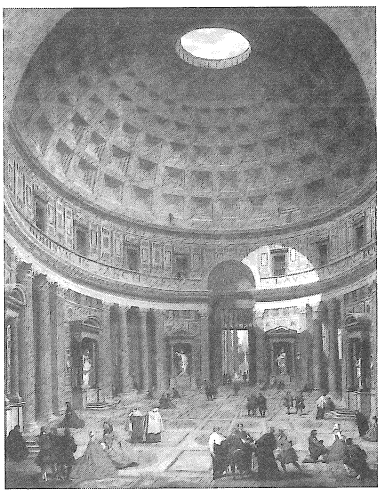
If you are a close observer of nature, then perhaps you have seen symmetry in the patterns of a butterfly or the structure of a snowflake. The left and right sides of a butterfly mirror each other. Their patterns are identical. Look at a photo of a tiger's face. Imagine a vertical line of symmetry through the center of the face. Notice that the left and right sides are mirror images. Without symmetry, what would the natural world be like?



This Bengal tiger's striped face is an example of nature's beautiful symmetry.

A Mathematical Universe

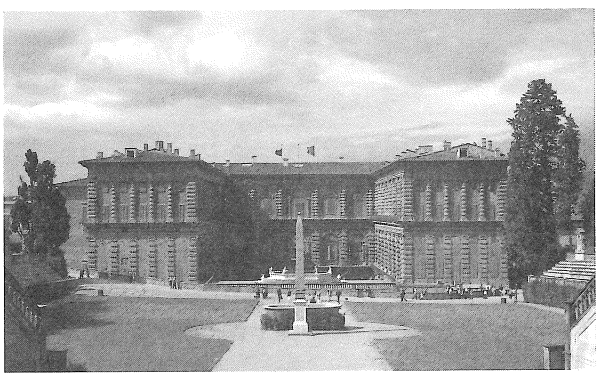
Symmetry in the natural world is pleasing to us because it produces order, balance, and harmony. Artists are inspired to try to reproduce that beauty. Mathematicians are inspired by the symmetry of nature in their own way. In 1623, the famous mathematician and scientist Galileo Galilei observed that the laws of nature are mathematical. In writing about the universe, he said, "It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures..."



The Pantheon in Rome followed the ideas of Vitruvius and was studied by architects of the Renaissance.

Learning from the Ancients

The language of mathematics was important during the 1300s through the 1600s in Europe. This period of time was a rebirth, or renaissance [REN-uh-sahns]. There was a flowering of the arts. Architects re-awakened to the ways in which the ancient Greeks and Romans had built their structures. Their houses, temples, bridges, and water channels used symmetry. Some of those structures were still standing and had lasted for more than a thousand years. Vitruvius, an ancient Roman architect, wrote his ideas in a work known as "The Ten Books on Architecture." Vitruvius wrote that structures should be strong, useful, and beautiful. His ideas inspired the architects of the Renaissance.



This view of the Pitti Palace shows the symmetry of the Renaissance building and gardens.

Look closely to see the triangles, half-circles, and rectangles that were used in the Renaissance building Pitti Palace. Architects used symmetry as a way to organize a building. A house or palace might have the same number of rooms on the left and right sides, for example. A symmetrical building might have a door in the center with a dome above it, and the arches on the right side would mirror the arches on the left. These beautiful buildings echo nature with their symmetry and have stood the test of time.