

Lines and Designs

Grade Level: Third

Presented by: Garrett Threet and Ann Wilson, Marked Tree Elementary, Marked Tree, Arkansas

Length of Unit: 5 Lessons: 10 days

I. ABSTRACT

This unit contains lessons that focus on geometric shapes and figures. Students are exposed to hands-on activities to enhance their understanding of geometry, as well as, observe and compute the geometric shapes and figures through art and in their everyday environment. The class will discuss shadows, silhouettes, tangrams, and symmetry.

II. OVERVIEW

1. Concept Objectives

1. Students will develop an awareness of the properties of geometric shapes and spatial sense to connect geometry with problem solving situations and their relationship in the visual elements of art.
2. Students will develop an awareness of shapes and shadows through artwork.
3. Students will develop an awareness of geometric lines and planes through literature and artwork.
4. Students will demonstrate spatial awareness and sense of congruent shapes and symmetry.

2. Content from the *Core Knowledge Sequence*

1. Lines as horizontal, vertical, perpendicular, or parallel
2. Lines and line segments
3. Polygons, vertex, pentagon, hexagon, octagon
4. Angles
5. Congruent figures, line of symmetry, symmetric figures
6. Identify solid figures: sphere, cube, rectangular solid, pyramid, cone, cylinder

3. Skill Objectives

1. Sort, classify, and construct geometric shapes and objects. (GS.1.1)
2. Describe, model, draw, construct, compare, and classify shapes. (GS.1.2)
3. Determine the relationship between shapes/figures using congruence and similarity. (GS.1.3)
4. Use manipulatives to demonstrate geometric concepts. (GS.1.6)
5. Demonstrate geometric and spatial sense through written communication. (GS.1.7)
6. Illustrate geometric and spatial sense through written communication. (GS.2.4)
7. Construct and explain geometric patterns using concrete and pictorial models with one or more attributes. (GS.2.2)

III. BACKGROUND KNOWLEDGE

A. For Teachers (Complete Listing in Bibliography)

1. *Math through Children's Literature*
2. *What Your Third Grader Needs to Know*
3. *Everything You Need To Know About Math*

B. For Students

1. Topics and information introduced previously are found at kindergarten, first, and second grade. These topics include basic plane figures, congruent shapes and designs, lines and line segments, and lines of symmetry. Also included are symmetric figures.
2. Hokusai's drawings are made with lines both straight and curved. The artists who design quilts also use geometric shapes in their artwork.

IV. RESOURCES

1. Blume, Raymond. *Mathamusements*. 1997
2. Braddon, Kathryn L., Hall, Nancy J., and Taylor, Dale. *Math Through Children's Literature*. (1993)
3. Burns, Marilyn. *Math For Smarty Pants*. (1982)
4. Burns, Marilyn. *The I Hate Mathematics! Book*. (1975)
5. Sheffield, Stephanie. *Math and Literature (K-3) Book Two*. (1995)
6. Vecchione, Glen. *Math Challenges Puzzles. Tricks and Games* (1997)
7. Kelly, Kate and Zeman, Ann. *Everything You Need to Know About Math Homework*. (1994)
8. *A Handbook of Performance Activities*. The psychological Corporation. HBJ, Inc. (1991)

V. LESSONS

Lesson One: Shadows

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will develop an awareness of shapes and shadows through artwork.
2. Lesson Content
 - a. Lines and line segments
 - b. Identify solid figures: sphere, cube, rectangular solid, pyramid, cone, cylinder
3. Skill Objective(s)
 - a. Describe, model, draw, construct, compare, and classify shapes. (GS.1.2)
 - b. Demonstrate geometric and spatial sense through written communication. (GS.1.7)

B. Materials

1. Chart paper
2. Markers
3. Examples of shapes: square, triangles, rectangles, and circles for display.
4. Book, *The Shape of Me and Other Stuff*.
5. Water or other liquids
6. Different shaped containers
7. Transparency (Appendix A)
8. Overhead projector
9. Construction paper (contrasting colors)
10. Scissors
11. Journals
12. Pencils

C. Key Vocabulary

1. Shapes- outline of specific form or figure
2. Square- rectangle having all four sides of equal length
3. Triangle- a three –cornered, three- sided figure
4. Rectangles – parallelogram having four right angles
5. Circles- a set of points within a plane where all points on the circle are all the same distance from a common point inside the circle, called the center.
6. Shadows- dark shape cast on a surface or ground by intercepting light.
7. Form- shape of a thing or person
8. Reflection- to give back or show an image of
9. Distortion- to make crooked or deformed
10. Silhouette- dark image outlined against a lighter background

11. Profile- face viewed from one side
- D. Procedures/Activities*
1. Introduce with KWL chart on shapes.
 2. Review basic shapes: square, triangle, rectangle, and circle.
 3. Read and discuss the book, *The Shape of Me and Other Stuff*.
 4. Discuss with students the possibilities of things that do not have a shape. Show students how liquids can take the shape of a container.
 5. Present an enlarged transparency of Jon Vermeer's painting, "Milkmaid" p.171 *What Your Third Grader Needs to Know*. Stress the artist's use of light to create shadows and forms. (Appendix A.)
 6. Discuss shadows and reflections with students. Students will go outside and have free exploration with making shadows, making changes and distortions using classroom objects and their bodies. Have students discover how to make their shadows larger or smaller.
 7. Using overhead projector as a light source, demonstrate that shadows form silhouette shapes.
 8. Children work in pairs to make a silhouette of their profiles. Using the overhead projector to shine on a piece of construction paper, one child will stand between the light and paper. The other child will trace the shadow. Students cut out and mount on contrasting colored paper.
 9. Compare the difference between shapes and geometric shapes on the human body.
 10. Review KWL, listing what they have learned about shapes.
 11. Choose one geometric shape and use only that shape to draw a profile of their body. Label each profile of their body. Repeat the exercise using a different geometric shape to draw the same subject. Write a descriptive paragraph comparing the two drawings.
- E. Evaluation/Assessment*
1. The teacher will assess the students by their oral and written participation in the activities.

Lesson Two: Lines

- A. Daily Objectives*
1. Concept Objective(s)
 - a. Students will develop an awareness of geometric lines and planes through literature and artwork.
 2. Lesson Content
 - a. Lines and line segments
 3. Skill Objective(s)
 - a. Sort, classify, and construct geometric shapes and objects. (GS.1.1)
 - b. Describe, model, draw, construct, compare, and classify shapes. (GS.1.2)
- B. Materials*
1. Linking games –Appendix B
 2. Sprouts – Appendix C
 3. "Turning the Samisen" Appendix D
 4. Sidewalks Game – Appendix E
 5. Book, *Flat Stanley* by Jeff Brown
 6. Book, *What Your Third Grader Needs To Know*, by E.D. Hirsch
 7. Disappearing Line Trick –Appendix F
- C. Key Vocabulary*
1. Rectilinear – Straight lines
 2. Curvilinear – curved lines

3. Line – extend in opposite directions and go on without ending
4. Line segments – parts of lines defined by two endpoints along the line
5. Parallel lines – lines in the same plane that never intersect
6. Angle – the creation that is formed when two lines meet at the same point
7. Intersecting lines –all lines in the same plane that meet and pass through one another at one point

D. Procedures/Activities

1. Teachers will give overview of key vocabulary. Draw examples on chalkboard and label the points. (Example: line AB, segment CD)
2. Disappearing Line Trick- (Appendix F.)
3. Students will play linking games connecting the dots with line segments.
Appendix B
4. Teacher will read from book, *What Your Third Grader Needs to Know*. PP. 172-173.
5. Stress lines and shapes in the painting, “Turning the Samisen” (Appendix D)
6. Students will choose a partner to play the game “Sprouts”. (Appendix C)
7. Discuss with students ways of dividing the sidewalks from least to the greatest parts. (Appendix E)
8. Teacher will read book, *Flat Stanley*.
9. Teacher will explain to students the term planes and discuss how the character “Flat Stanley” is a plane.
10. Students will identify different planes in classroom and surrounding area.
11. Teacher will define open and closed figures and show examples.

E. Evaluation/Assessment

1. The students will demonstrate knowledge of lines by drawing examples of line segments, intersecting lines, and other key vocabulary terms as requested by the teacher. Teacher will observe completion of games.

Lesson Three: Triangles

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will develop an awareness of the properties of geometric shapes and spatial sense to connect geometry with problem solving situations and their relationship in the visual elements of art.
2. Lesson Content
 - a. Lines as horizontal, vertical, perpendicular, or parallel.
 - b. Polygons: triangles to decagon
3. Skill Objective(s)
 - a. Sort, classify, and construct geometric shapes and objects. (GS.1.1)
 - b. Describe, model, draw, construct, compare, and classify shapes. (GS.1.2)
 - c. Use manipulative to demonstrate geometric concepts. (GS.1.6)
 - d. Demonstrate geometric and spatial sense through written communication. (GS.1.7)
 - e. Illustrate geometric and spatial sense through written communication. (GS.2.4)
 - f. Construct and explain geometric patterns using concrete and pictorial models with one or more attributes. (GS.2.2)

B. Materials

1. Chart paper
2. Markers
3. Overhead projector
4. Index cards

5. Book: *The Greedy Triangle*.
6. Toothpicks
7. Answer key to Tooth Picks Triangle Game- Appendix G.
8. Triangle design: Appendix H.

C. *Key Vocabulary*

1. Polygon – a many-sided plane figure
2. Horizontal line – a line that runs straight across from left to right; it is parallel to the earth’s surface or to the bottom of a piece of paper
3. Quadrilateral – a polygon with four sides
4. Pentagon – five- sided polygon
5. Hexagon – six- sided polygon
6. Heptagon – seven- sided polygon
7. Octagon – eight- sided polygon
8. Nonagon – nine- sided polygon
9. Decagon – ten- sided polygon
10. Vertical line – a line that runs straight up and down; it is perpendicular to a horizontal line
11. Perpendicular lines or angles – when two lines intersect to form four angles having the same size, also called right angles

D. *Procedures/Activities*

1. Introduce the lesson with a KWL chart about polygons, horizontal, vertical and perpendicular lines and angles. Record answers on chart paper.
2. Discuss key vocabulary with examples on overhead.
3. Students will write definitions of vocabulary words on index cards.
4. Read and discuss book, *The Greedy Triangle*.
5. List the names of shapes that the triangle in the book turns into: quadrilateral, pentagon, hexagon, heptagon, octagon, nonagon, and decagon. Make chart noting the prefixes and what they mean.
6. “Toothpick Triangles” Give each student twelve toothpicks to make six triangles. (Not all triangles need to be the same size.) Appendix G. (answer key) Extension: use nine toothpicks to make five triangles, etc.
7. Students will use toothpicks as teacher directs lesson on the overhead projector displaying horizontal, vertical, and perpendicular lines as 90 degree angles.
8. Students will model horizontal, vertical, and perpendicular lines in triangles using toothpicks with teacher observation.
9. Complete KWL chart listing what they have learned about polygons, horizontal, vertical, and perpendicular lines.
10. Students will outline triangles with perpendicular lines green, outline all horizontal lines blue and vertical lines red. (Appendix H.).

E. *Evaluation/Assessment*

1. Students will complete a written description of key vocabulary, along with an illustration.
2. Teacher will evaluate completed Appendix F for accuracy.

Lesson Four: Polygons

A. *Daily Objectives*

1. Concept Objective(s)
 - a. Students will develop an awareness of the properties of geometric shapes and spatial sense to connect geometry with problem solving situations and their relationship in the visual elements of art.
 - b. Students will develop an awareness of shapes and shadows through artwork.

- c. Students will develop an awareness of geometric lines and planes through literature and artwork.
 - 2. Lesson Content
 - a. Polygons, vertex, pentagon, hexagon, octagon.
 - 3. Skill Objective(s)
 - a. Sort, classify, and construct geometric shapes and objects. (GS.1.1)
 - b. Describe, model, draw, construct, compare, and classify shapes. (GS.1.2)
 - c. Use manipulative to demonstrate geometric concepts. (GS.1.6)
 - d. Construct and explain geometric patterns using concrete and pictorial models with one or more attributes. (GS.2.2)
- B. *Materials*
 - 1. Book *Grandfather Tang's Story* by Ann Tompert.
 - 2. Construction paper, tangram patterns (Appendix I.)
 - 3. Chart paper
 - 4. Geometry patterns (Appendix J., Appendix K.)
- C. *Key Vocabulary*
 - 1. Tangrams puzzle – Seven-piece puzzle that can be put together to make hundreds of different shapes and figures.
 - 2. Trapezoids – quadrilaterals that have one pair of parallel sides
 - 3. Quadrilaterals – polygons that have four sides and four vertices
 - 4. Hexagons – polygons that have six sides and six vertices
- D. *Procedures/Activities*
 - 1. Teacher will review vocabulary from previous lessons with students.
 - 2. Teacher will read book, *Grandfather Tang's Story*
 - 3. Discuss the shapes and angles that Grandfather Tang and little Soo used in creating fox fairies.
 - 4. Have students make their own tangram pieces out of construction paper. (Appendix. I.)
 - 5. Have students try to put the seven pieces back together to form a square.
 - 6. Read story again slowly and have students make the shapes described in story with the tangrams they made.
 - 7. The students create their own designs.
 - 8. Using all the seven tangrams, students will make initial of their first name.
 - 9. Game: Geometric Patterns-Using patterns from Appendix J. & K. Cut the shapes and sort by A. B. C. D. Divide students in groups of four and give each person a set of letters. The object of the game is for the students to create a hexagon.
- E. *Evaluation/Assessment*
 - 1. Students will be observed making geometric shapes such as a square, triangle, rectangle, and trapezoid.
 - 2. Students will identify the shapes they created.

Lesson Five: Symmetry

- A. *Daily Objectives*
 - 1. Concept Objective(s)
 - a. Students will demonstrate spatial awareness and sense of congruent shapes and symmetry.
 - 2. Lesson Content
 - a. Congruent figures, line of symmetry, symmetric figures
 - 3. Skill Objective(s)
 - a. Sort, classify, and construct geometric shapes and objects. (GS.1.1)
 - b. Describe, model, draw, construct, compare, and classify shapes. (GS.1.2)

- c. Determine the relationship between shapes/figures using congruence and similarity. (GS.1.3)

B. *Materials*

1. Transparency of Appendix L
2. Transparency of Appendix M
3. Student copies of Appendix M
4. Student copies of Appendix N
5. Copies of Appendix L,M,N,O
6. Transparency of Appendix P
7. Transparency of Appendix Q
8. Student copies of Appendix P and Q
9. Overhead projector
10. Apples
11. Kitchen knife
12. Transparency of

C. *Key Vocabulary*

1. Congruent – refers to two shapes of exactly of the same size and shape; they are always similar
2. Similarity – objects which have the same shape but are not always exactly the same size
3. Symmetry – exact matching of shapes or figures on opposite sides of dividing lines or around a center point.
4. Axis or line of symmetry – the dividing line of symmetry

D. *Procedures/Activities*

1. Introduce the lesson with congruent figures display on the overhead projector. Explain to students why they are congruent. (Appendix L.)
2. Use the overhead projector to match congruent sets of rectangles. (Appendix L.)
3. Use the overhead projector to explain similarity in figures. (Appendix L.)
4. Distribute a copy of (Appendix M.) Display a transparency on the overhead projector. Explain that they will draw a figure similar to figure the teacher draws. Teacher will observe student drawing.
5. Before class, teacher will slice apple halves, making sure that half of the apples are cut vertically and the other half are cut horizontally. Distribute apples to students and have them match their half with their peer's similar half, both vertically and horizontally. Teacher will use this activity to define symmetry.
6. Students will cut out hearts, (Appendix N.), and fold in half in such a way that both sides match. Teacher will explain that the fold is the "line of symmetry". Have students find other ways to fold for a line of symmetry. (Only one line of symmetry in a heart) Stress that the fold is a vertical line.
7. Discuss that the leaf patterns are not symmetrical. (Appendix O.)
8. Teacher demonstrates four lines of symmetry in a square and infinite number of lines in a circle using the overhead projector.
9. Teacher will read and discuss from *What Your Third Grader Needs to Know*, pp.174-177. Stress the symmetrical aspects, lines, and shapes in quilts.
10. Teacher will display (Appendix P. and Q.) on the overhead projector. Students will identify symmetry, locate lines of symmetry, and the use of geometric patterns in individual copies made of Appendix P. and Q.
11. Teacher will review with students Appendix H. and how the design resembled a quilt pattern and contained symmetry.

E. *Evaluation/Assessment*

1. Students will make a list of all the capital letters of the alphabet that can be divided with a line of symmetry. (Identify the method used [or provide the actual

assessment used] to assess learning in this lesson. Provide any follow-up activity by which the children can demonstrate their mastery of the lesson.)

VI. CULMINATING ACTIVITY

Students will design their own quilt blocks using skills learned in the unit. Each student will decorate a 12" by 12" pastel, large gingham fabric square with markers. They will use markers to make symmetrical designs and incorporate geometric shapes on their fabric's squares. Teachers will assemble or connect the squares to make a banner for display.

I. HANDOUTS/WORKSHEETS:

A. Appendices A – Q (Appendices A & D distributed at session only]

I. BIBLIOGRAPHY

Blum, Raymond. *Mathamusements*. New York: Sterling Publishing Co. Inc., 1997. ISBN 0-8069-9783-4 (Trade) ISBN 0-8069-9784-2 (Paper)

Braddon, Kathryn L. Hall, Nancy J. and Taylor Dale. *Math Through Children's Literature*. Englewood, Colorado: Teacher Ideas Press, 1993. ISBN 0-87287-932-1

Brown, Jeff. *Flat Stanley*. U.S.A. Harper Trophy Publishers. 1992. ISBN 0-6-442026-4
Burns, Marilyn

Math For Smarty Pants. New York: Little, Brown and Company, 1982. ISBN 031611738-2.

Burns, Marilyn. *The I Hate Mathematics! Book*. New York: Scholastic Inc., 1975. ISBN 0-590-48014-6.

Burns, Marilyn. *The Greedy Triangle*. 1975. ISBN 0-590 New York: Scholastic Inc., -48991-7.

Seuss, Dr. *The Shape of Me and Other Stuff*. New York: Random House, Inc. 1973. ISBN 0-394-82687-6

Sheffield, Stephanie. *Math and Literature K-3*. New York: Math Solutions Publication, 1995. ISBN 0-941355-11-X

Tompert, Ann. *Grandfather Tang's Story*. New York: Crown 1990.

Zeman, Ann and Kelly, Kate. *Everything You Need to Know About Math Homework*. New York: Scholastic Inc., 1994. ISBN 0-590-49359-0

Vecchione, Glenn. *Math Challenges*. New York: Sterling Publishing Co. 1997. ISBN 0-8069-8114-8

Appendix B

Linking Game

Two players will take turns linking any two dots that are next to each other, side-by-side (above or below). A dot may be linked to only one other dot. The winner is whoever makes the last link possible.

Game

Game

Winner's Name _____

Winner's Name _____

Game

Game

Winner's Name _____

Winner's Name

Appendix C

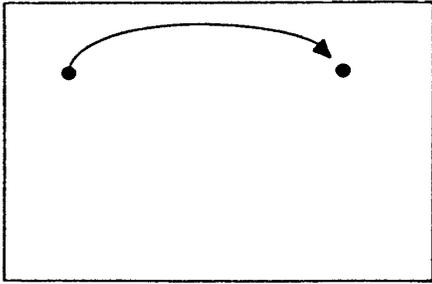
Directions:

Sprouts

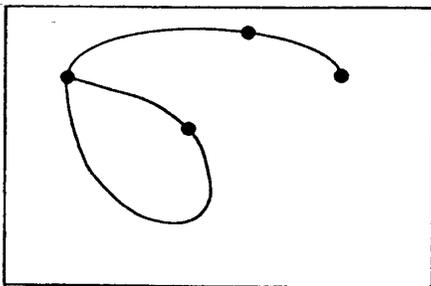
Two players start with two points and take turns drawing according to the following rules:

A line must start and end at a point.

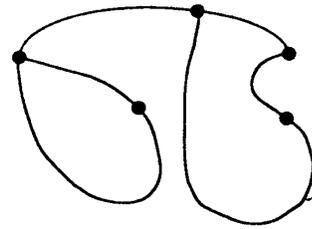
You can use curved lines, and you can start and end at the same point if you want.



After you draw a line, you must mark a new point somewhere on it.

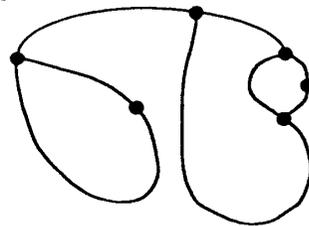


No line can cross itself or another line, nor pass through any point.



No point can have more than three lines ending at it.

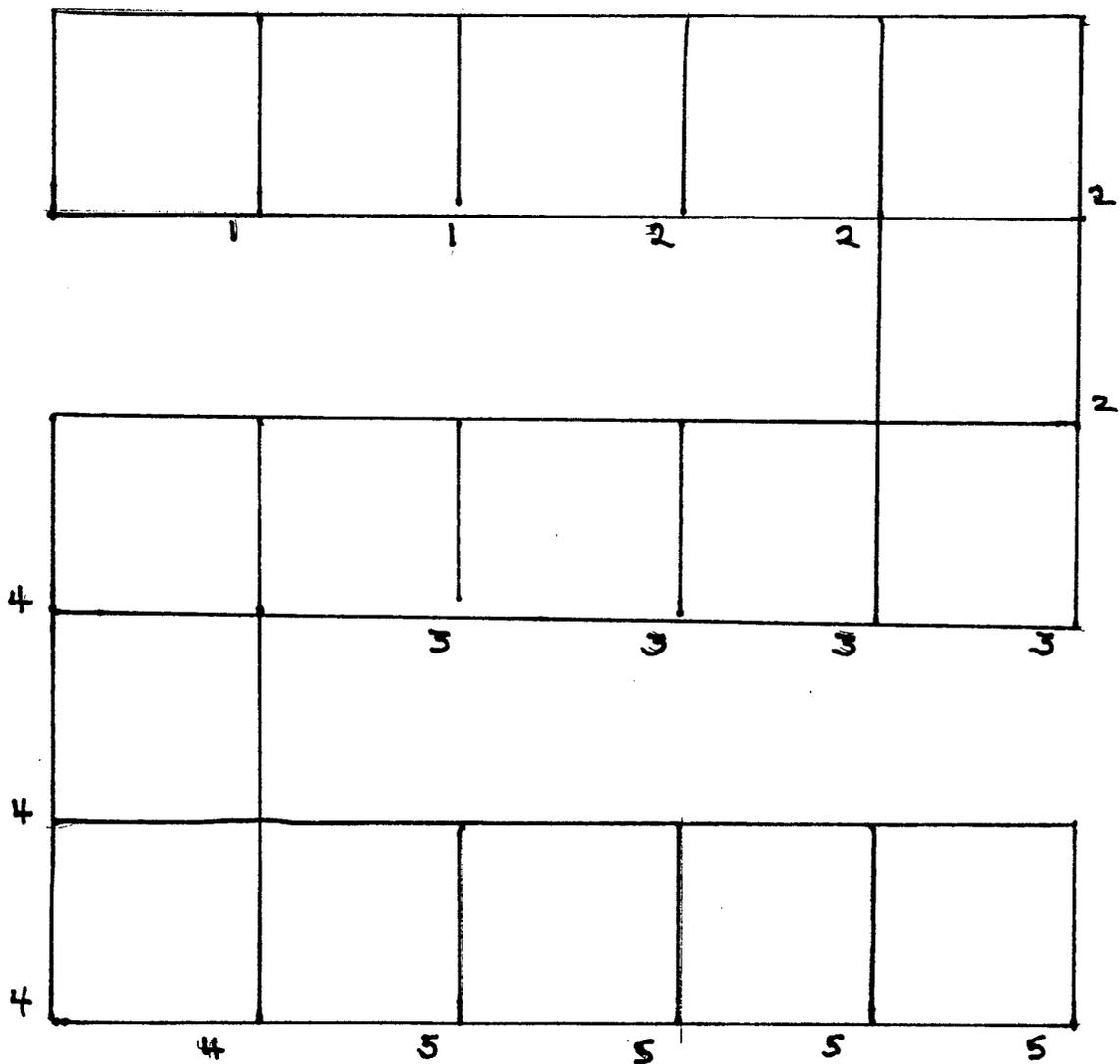
The winner is the last person able to play.



Appendix E

Cutting Sidewalks

In The sidewalk sections below, draw one strait line. You will always get two parts no matter where you draw the line. Now, draw two lines. How many parts can you get? Try again. Can you find a way to have more parts? Now try three lines. Continue with more lines. Circle the section with the smallest number of parts for each number of cuts with a red color. Circle the largest with a blue color.

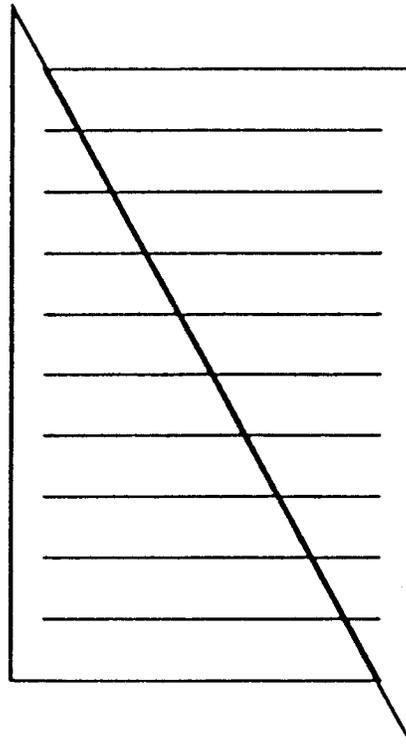
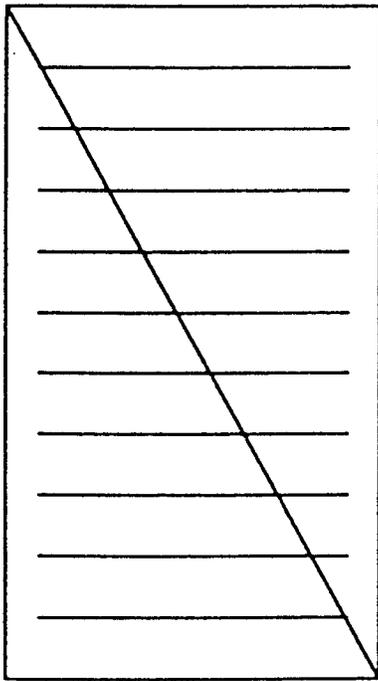


Appendix F

THE DISAPPEARING LINE

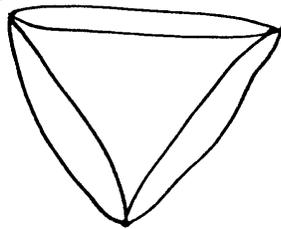
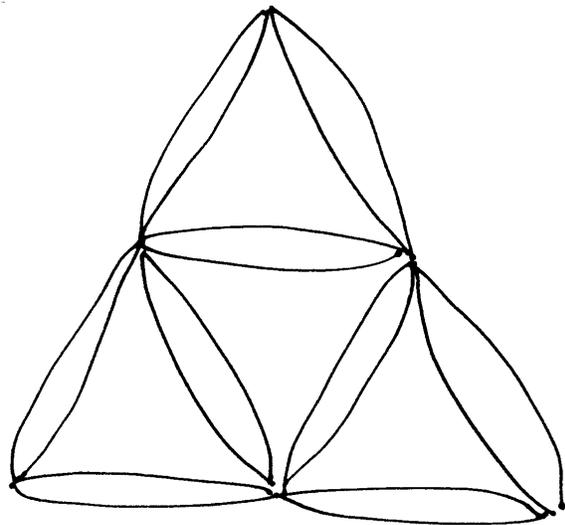
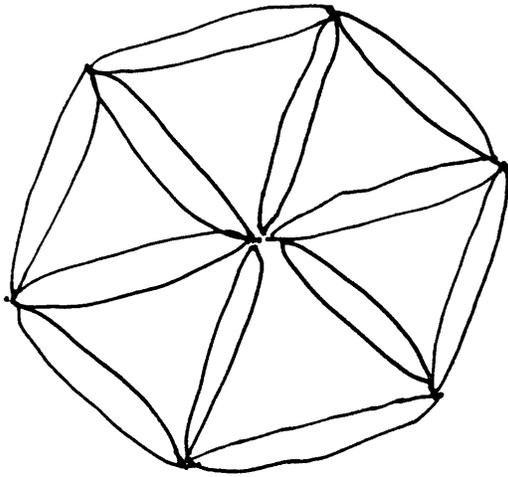
Cut the card in half along this line.

Now slide one half of the card along the other half just far enough so that the ten lines turn into nine lines. Where did the tenth line go?

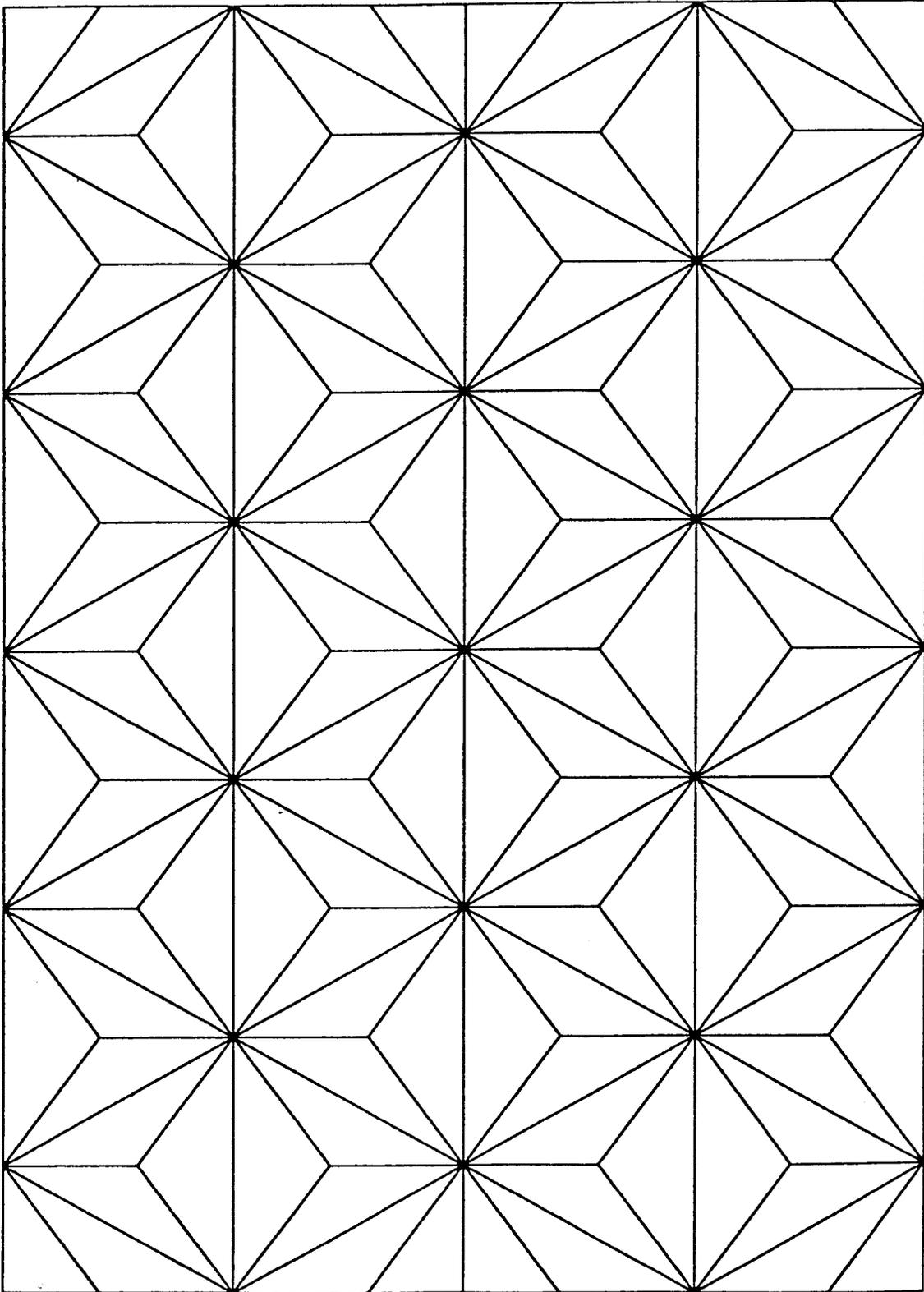


Appendix G

**“Toothpick Triangles”
Answer Key**



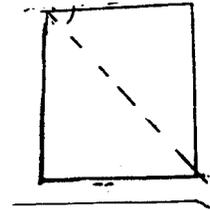
Appendix H



Appendix I

Making Your Own Tangram

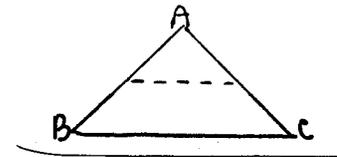
Step One: Begin with a square piece of paper. Note: (Show students how to make a square piece of paper from a rectangular one. Discard the “extra piece.”) Fold and cut into two congruent triangles.



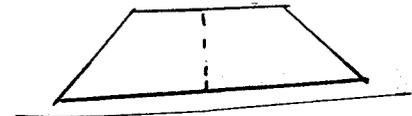
Step Two: Fold and cut one of the two large congruent triangles into two smaller congruent triangles.



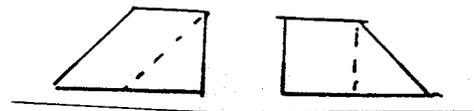
Step Three: Take the other large triangle and fold vertex A to the midpoint of segment BC. Then, cut along the folded line. You will form a middle-sized triangle and a trapezoid.



Step Four: Fold the trapezoid along the dotted line and cut into two congruent trapezoids.



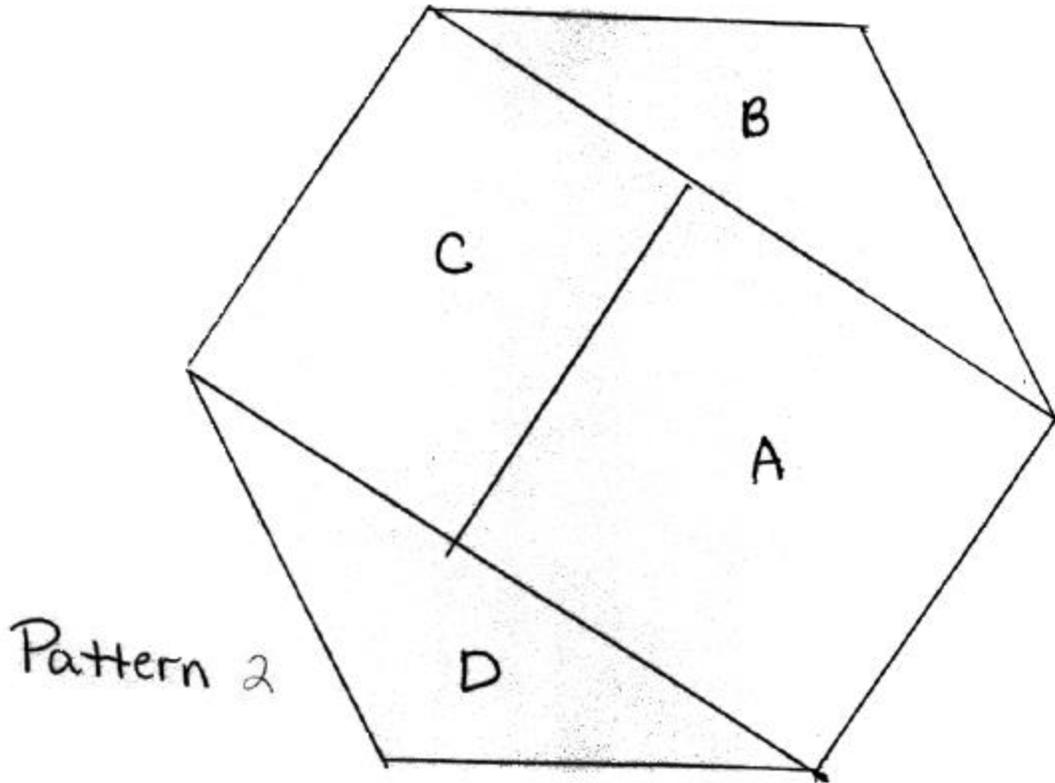
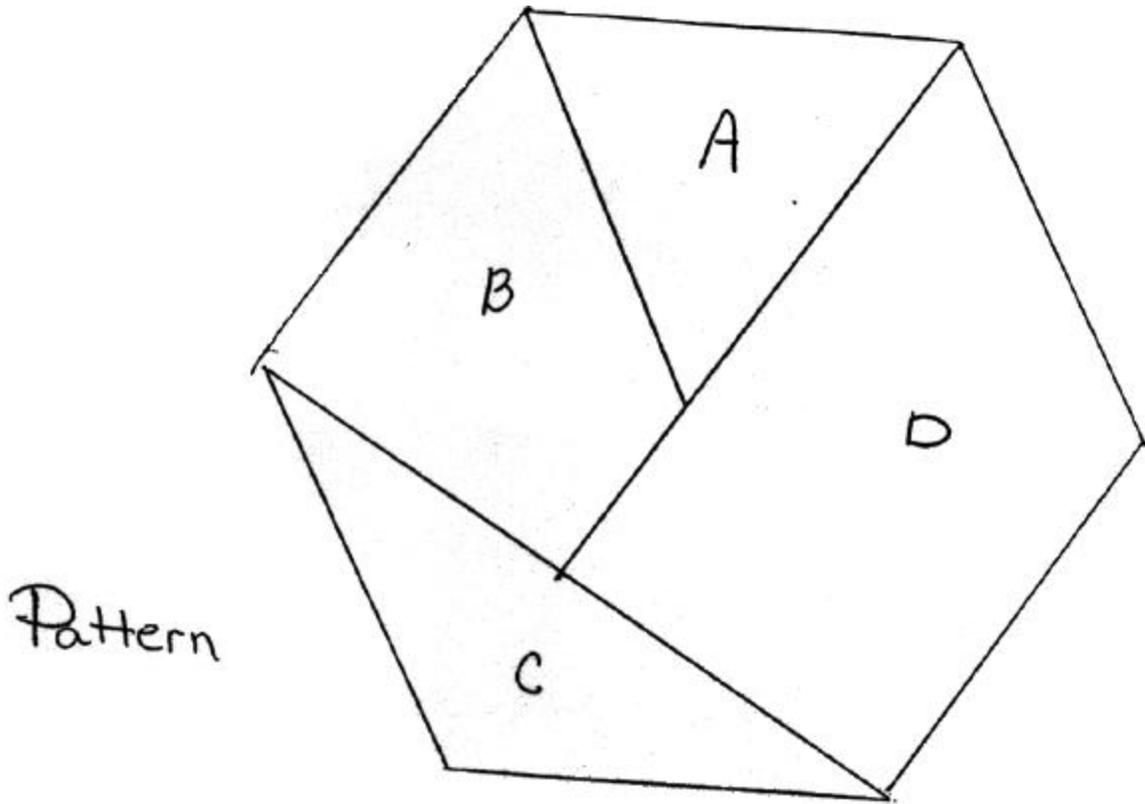
Step Five: Fold and cut each of the two trapezoids along the dotted lines.



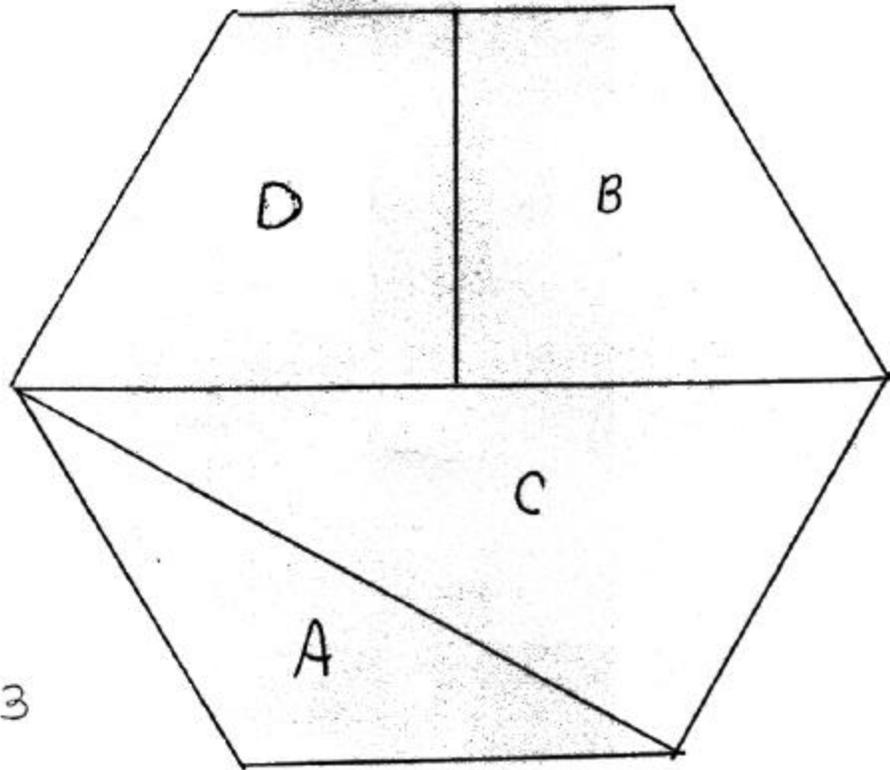
You should have seven pieces:

- 2 large congruent triangles
 - 1 middle-sized triangles
 - 2 small congruent triangles
 - 1 square
-

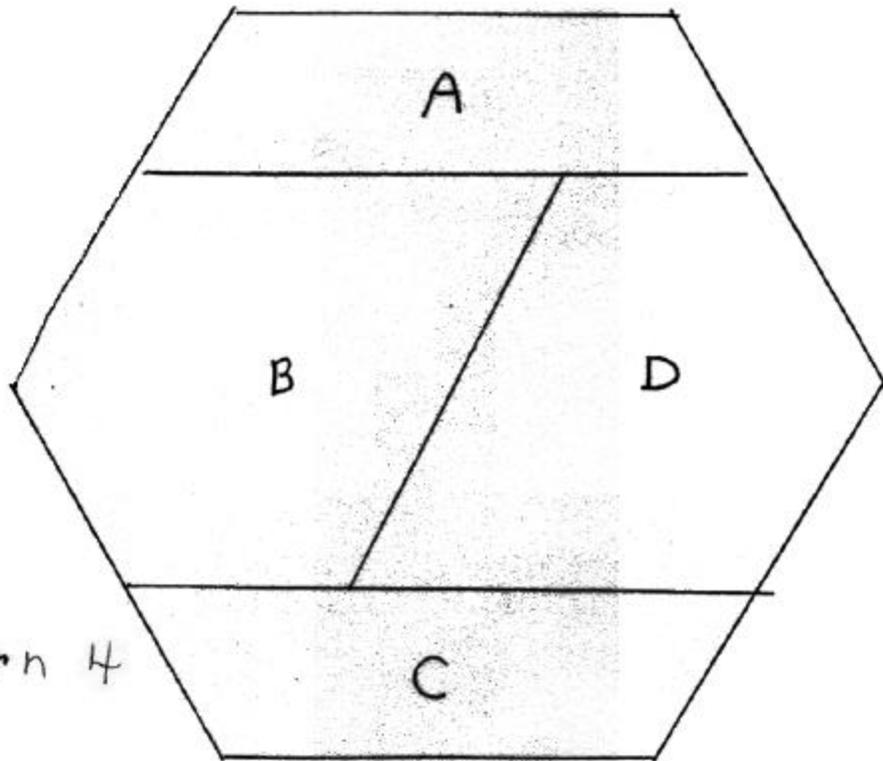
Appendix J



Appendix K

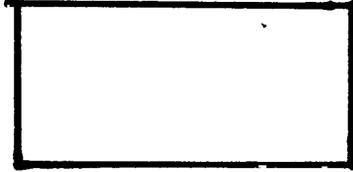
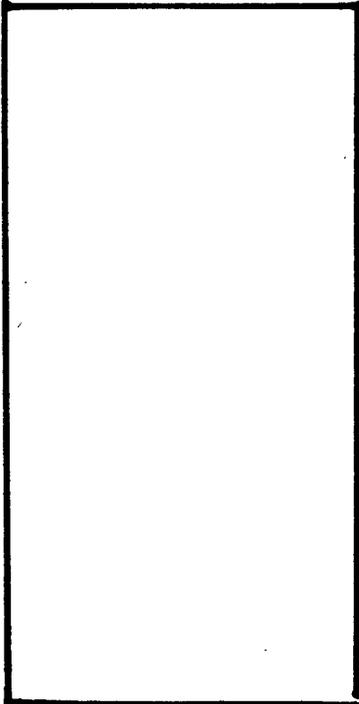
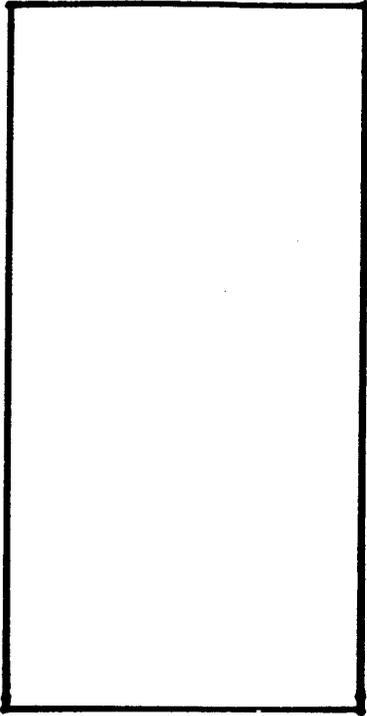


Pattern 3

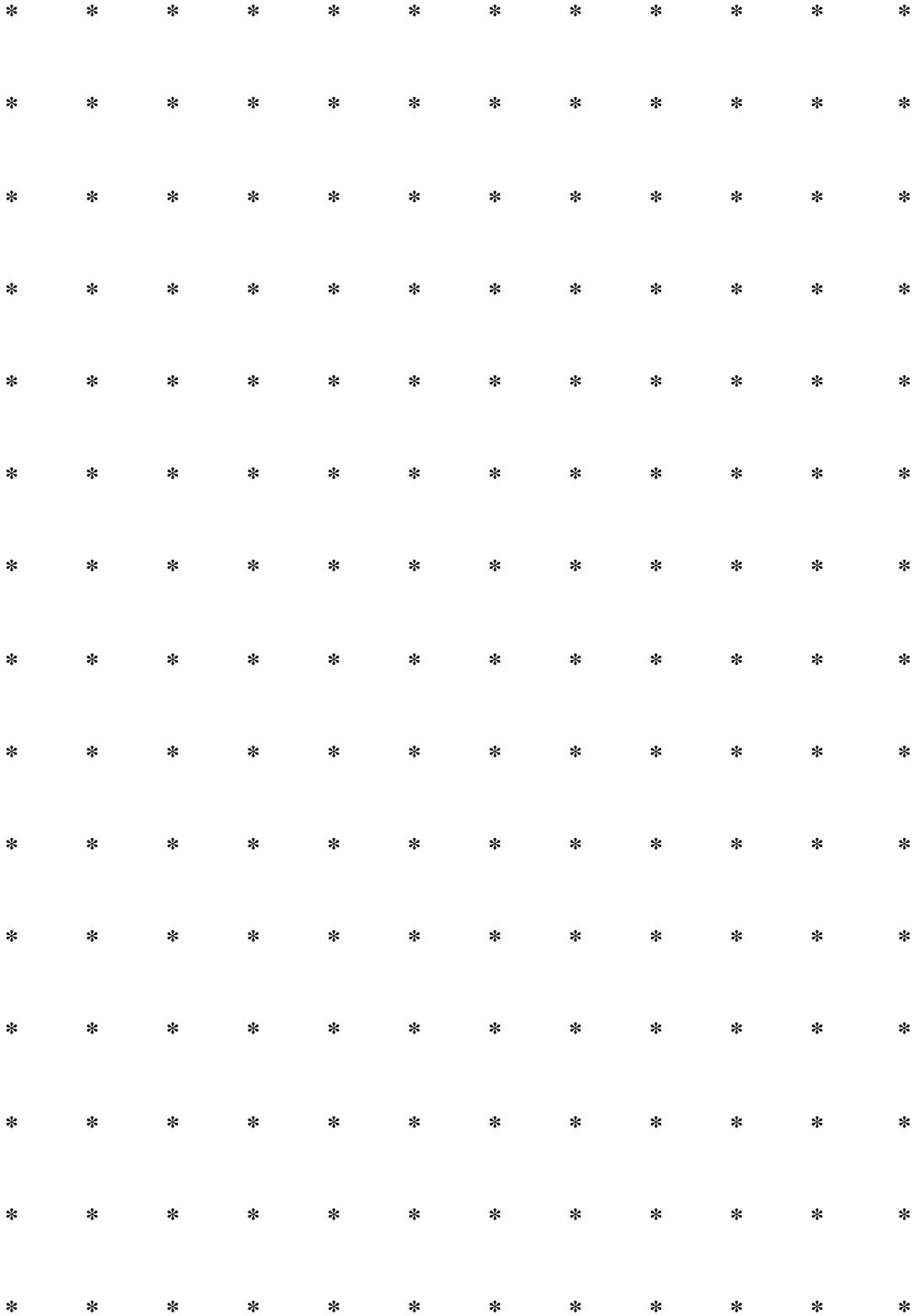


Pattern 4

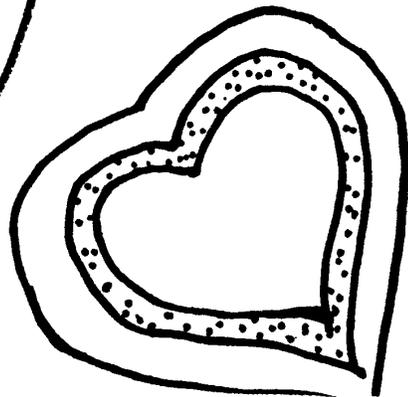
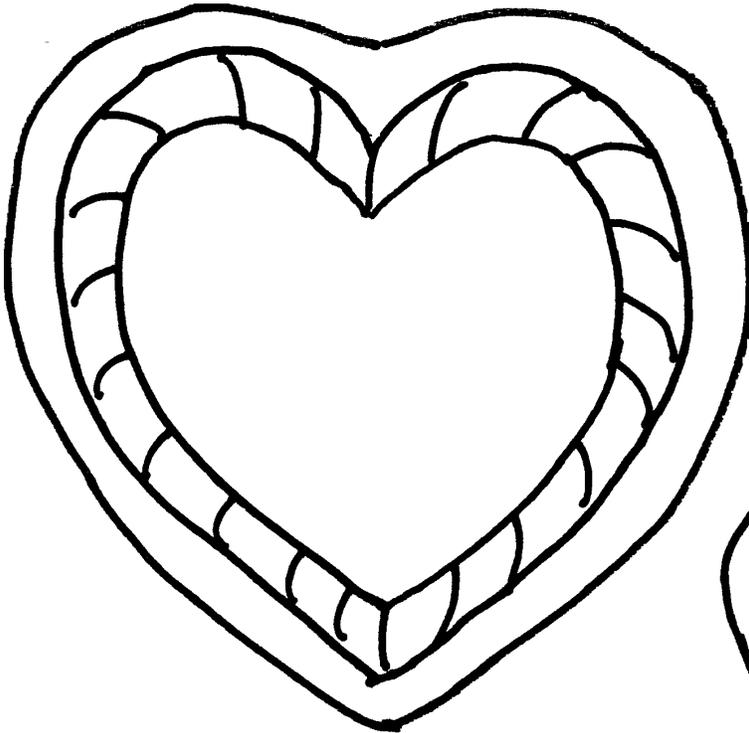
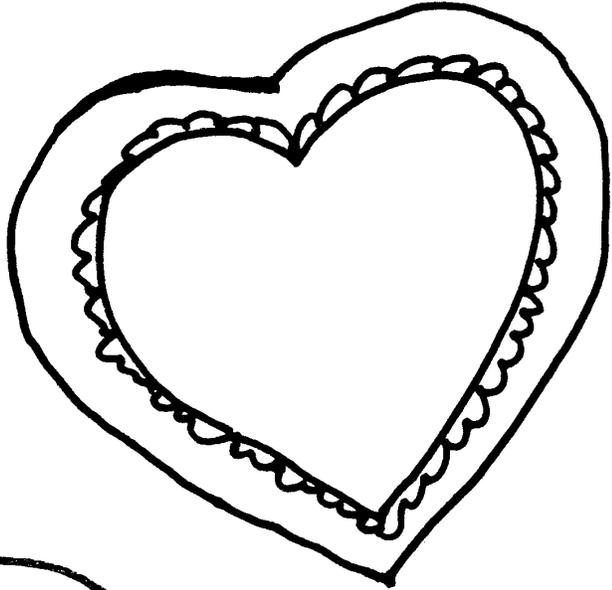
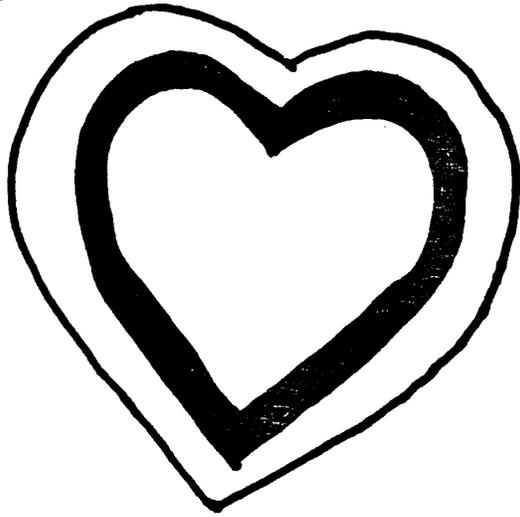
Appendix L



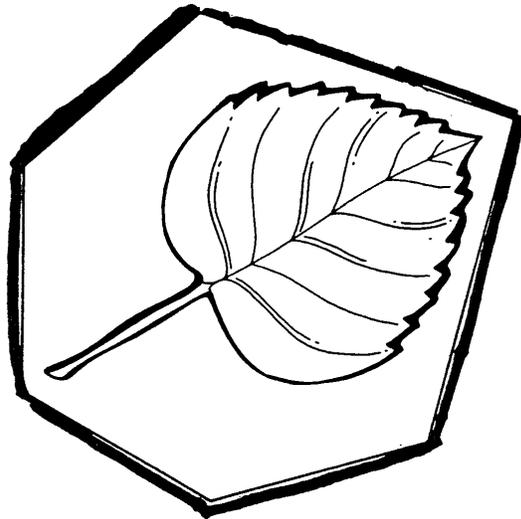
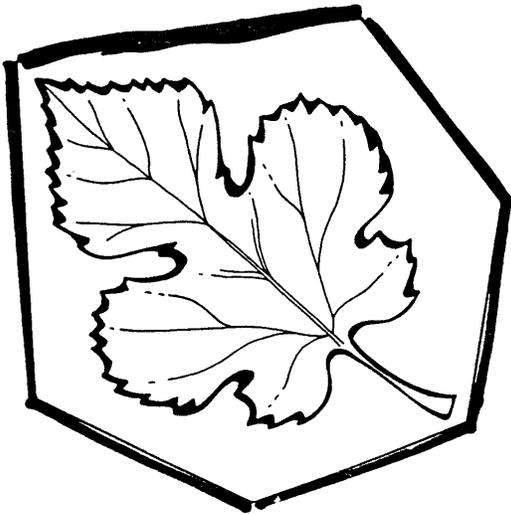
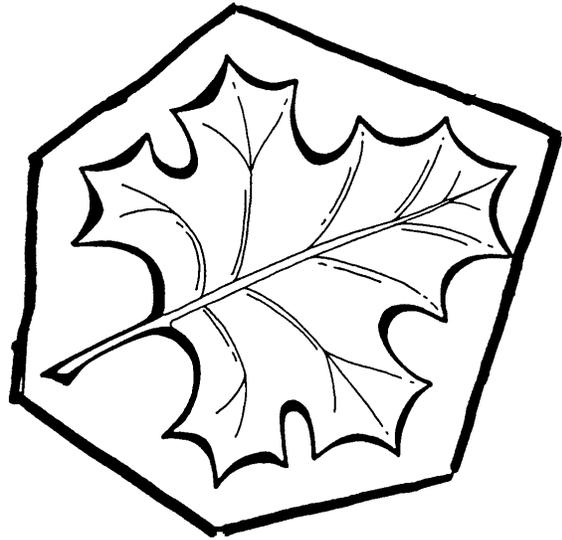
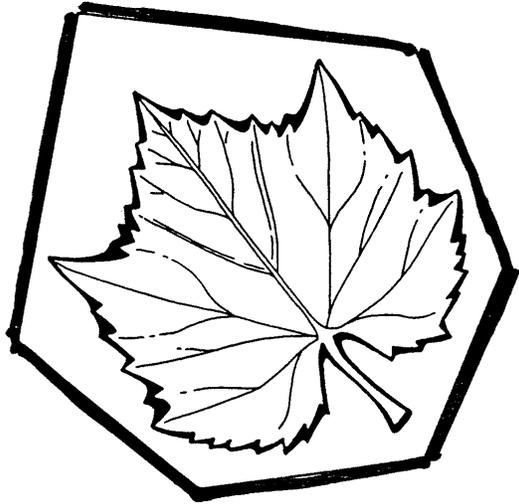
Appendix M



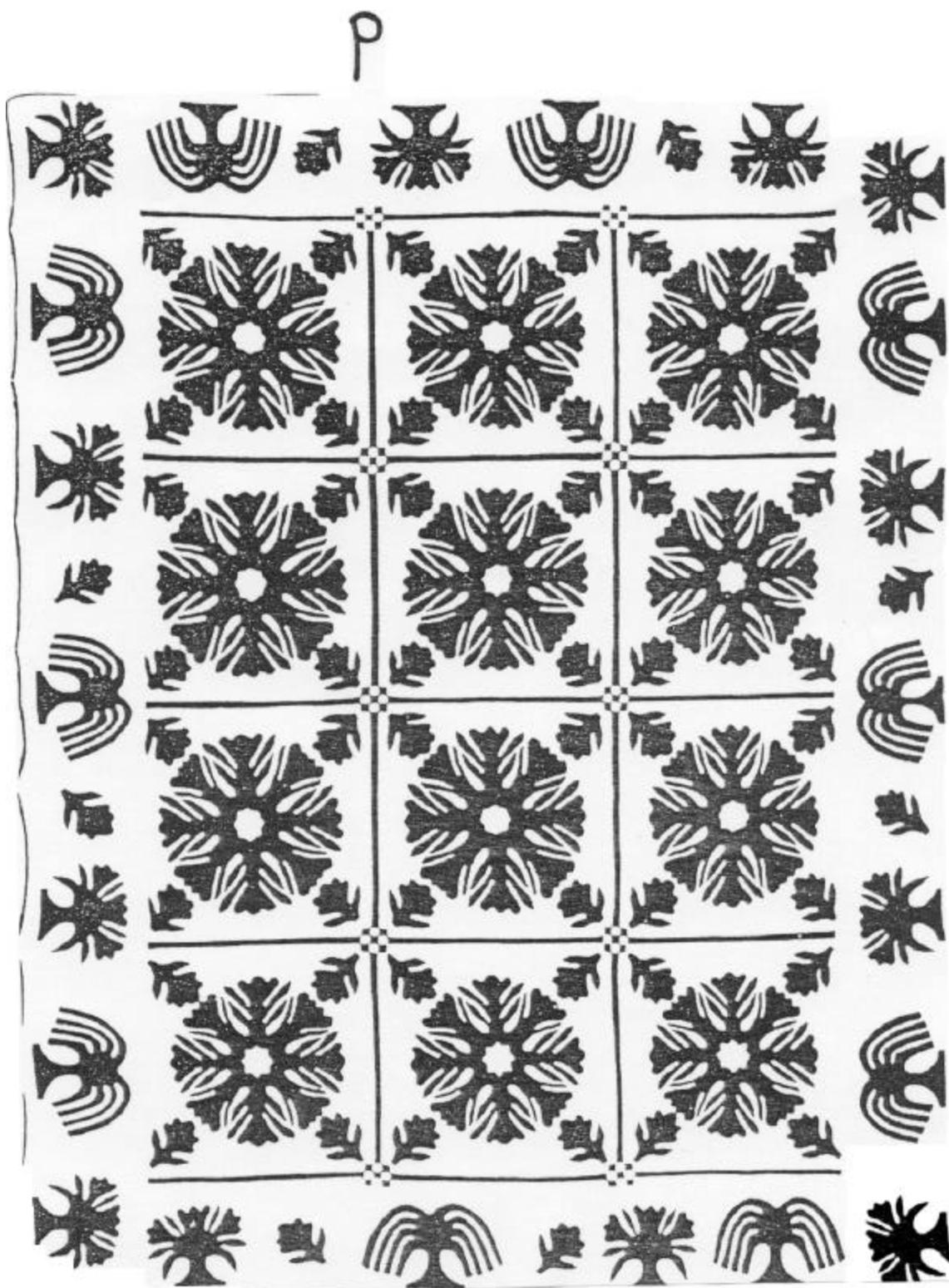
Appendix N



Appendix O



Appendix P



Appendix Q

Early American Quilt Pattern

