

GEOMETRIC CONSTRUCTIONS USING A COMPASS AND STRAIGHTEDGE

Grade Levels: 6, 7, 8

Presented by: Lynne Liotta, Elbert County Charter School, Elizabeth, CO
Barbara Murray, Lewis-Palmer Charter Academy, Monument, CO

Length of Unit: 6 lessons

I. ABSTRACT

- A. This sixth, seventh and eighth grade unit will introduce and review the tools needed to perform the ten (10) constructions recommended in the Core Knowledge Scope and Sequence. The first lesson is introductory for grades 6, 7, and 8. Lessons 2 and 3 cover the sixth grade topics for construction of parallel lines, perpendicular bisectors, parallelograms, an angle congruent to a given angle, and different kinds of triangles. Lesson 4 presents the seventh grade topics of constructing parallel lines with a transversal and a circle that circumscribes a triangle. Lessons 5 and 6 present constructions for an equilateral triangle, a square and a hexagon. Constructions will also be presented in order to demonstrate two proofs about triangles.

II. OVERVIEW

A. Concept Objectives

1. Instill an understanding of geometric terms in order to identify them in the study of mathematics.
2. Instill an understanding of linear and circular relationships.

B. Content

1. Construction of parallel lines and a parallelogram (6)
2. Construction of perpendicular bisector (6)
3. Construction of an angle congruent to a given angle (6)
4. Construction of different kinds of triangles (6)
5. Construction of parallel lines and a transversal (7)
6. Construction of a circle that circumscribes a triangle (7)
7. Perpendicular bisectors of the three sides of a triangle intersect at a point which is the center of the circle that circumscribes the triangle (8)
8. Bisectors of the three angles of a triangle intersect at a point which is the center of a circle that is inscribed in the triangle (8)
9. Construction of an equilateral triangle, square and a regular hexagon given its center and one its vertices (8)

C. Skills

1. The student will identify tools needed for geometric constructions. (6, 7,8)
2. The student will use tools necessary for geometric constructions. (6, 7, 8)
3. The student will use a compass and straightedge to construct parallel lines. (6)
4. The student will use a compass and straightedge to construct a perpendicular bisector. (6)
5. The student will use a compass and straightedge to construct a parallelogram.(6)
6. The student will use a compass and straightedge to construct an angle congruent to a given angle. (6)
7. The student will use a compass and straightedge to construct different kinds of triangles. (6)
8. The student will use a compass and straightedge to construct parallel lines and a transversal. (7)
9. The student will use a compass and straightedge to construct a circle that circumscribes a triangle. (7)

10. The student will use a compass and straightedge to construct an equilateral triangle, a square, and a regular hexagon given its center and vertices. (8)
11. The student will use a compass and straightedge to demonstrate that the perpendicular bisectors of the three sides of a triangle intersect at a point which is the center of the circle that circumscribes the triangle. (8)
12. The student will use a compass and straightedge to demonstrate that the perpendicular bisectors of the three angles of a triangle intersect at a point which is the center of the circle that inscribes the triangle. (8)

III. BACKGROUND KNOWLEDGE

- A. For the teacher
 1. Hirsch, E. D. *What Your 6th Grader Needs to Know*. New York: Core Publications, 1995. ISBN# 0-385-31467-1.
 2. Jurgensen, R. C., et al. *Geometry*. Evanston, Illinois: McDougall Littell/Houghton Mifflin, 1997. ISBN# 0-395-77121-8.
 3. Haubner, M. A., et al. *The Mathematics Experience*. Boston: Houghton Mifflin Company, 1992. ISBN# 0-395-49420-6.
 4. In geometric constructions, a compass is used to obtain congruent figures. A figure is constructed without measuring the length of line segments or the degrees of angles. Only a compass and straightedge are used.
- B. For students
 1. Use of protractor
 2. See page 125, VI. Geometry points 1, 2, 3, 4, and 7 from *Core Knowledge Scope and Sequence*, 1998 edition.

IV. RESOURCES

- A. Bolster, L. C., et al. *Exploring Mathematics*. Glenview, Illinois: Scott, Foresman and Company, 1996. ISBN# 0-673-37550-1.
- B. Fennell, F., et al. *Mathematics Unlimited*. Orlando, Florida: Holt, Rinehart and Winston, Inc., 1988. ISBN# 0-03-014424-8 6.
- C. Haubner, M. A., et al. *The Mathematics Experience*. Boston: Houghton Mifflin Company, 1992. ISBN# 0-395-49420-6.
- D. Hirsch, E. D. *What Your 6th Grader Needs to Know*. New York: Core Publications, 1995. ISBN# 0-385-31467-1.
- E. Jurgensen, R. C., et al. *Geometry*. Evanston, Illinois: McDougall Littell/Houghton Mifflin, 1997. ISBN# 0-395-77121-8.
- F. Rhoad, R. Et al. *Geometry for Enjoyment and Challenge*. Evanston, Illinois: McDougal Littell and Company, 1984. ISBN# 0-88343-917-4

V. LESSONS

Lesson One: Introduction to Geometric Constructions (6, 7, 8)

- A. **Daily Objectives**
 1. **Lesson Content**
 - a. Vocabulary and review use of protractor
 - b. Introduction to the tools of geometric construction (compass and straightedge)
 2. **Concept Objective**
 - a. Instill an understanding of geometric tools to be used in the construction of geometric shapes.
 3. **Skill Objectives**
 - a. The student will identify tools needed for geometric construction.

- b. The student will use tools necessary for geometric constructions.
- c. The student will become familiar with vocabulary necessary for geometric constructions.

B. Materials

- 1. Student:
 - a. Compass
 - b. Protractor
 - c. Straightedge
 - d. Paper
 - e. Pencil with eraser
- 2. Teacher:
 - a. Large compass for board use
 - b. Large protractor for board use
 - c. Colored chalk
 - d. Meter stick

C. Background Notes

- 1. See Background Knowledge for students. (III. B.)
- 2. In geometric constructions, a compass is used to obtain congruent figures. A figure is constructed without measuring the length of line segments or the degrees of angles. Only a compass and straightedge are used.

D. Key Vocabulary

- 1. Compass - tool used to make circles
- 2. Protractor - an instrument used to measure angles
- 3. Straightedge - ruler (with or without numbers or units)
- 4. Parallel - lines in a plane that never intersect
- 5. Perpendicular - lines that intersect to form right angles
- 6. Right angle - an angle measuring 90 degrees.
- 7. Acute angle - an angle measuring less than 90 degrees
- 8. Obtuse angle - an angle measuring greater than 90 degrees
- 9. Congruent - figures that are exactly the same shape and size

E. Procedures and Activities

- 1. Insure each student has a compass, a protractor, and a straightedge.
- 2. Review the use of the protractor with students
- 3. Review the types of angles
- 4. Distribute Angle Practice Worksheet (Appendix A) for students to use protractor to measure and draw angles.
- 5. Review all students' work.
- 6. Present terms and symbols: parallel perpendicular and congruent (describe and demonstrate on board)
- 7. Practice using the compass by making circles with different diameters.
- 8. Practice using the compass by constructing a line segment congruent to another line segment (2 inches, 4 inches, 5 1/2 inches)

F. Evaluation/Assessment

- 1. On a permanent evaluative overhead, have individual students come forward and answer prescribed questions in order, while remaining students work on the same questions on their own paper. (Appendix B)

G. Standardized Test/State Test Connections

- 1. Colorado Model Content Standards for Mathematics 4 and 5
 - a. Standard 4: Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.

- b. Standard 5: Students use a variety of tools and techniques to measure, apply the results in problem situations, and communicate the reasoning used in solving problems.

Lesson Two: To construct a parallelogram, parallel lines and a perpendicular bisector

A. Daily Objectives

1. **Lesson Content**

- a. Review the terms: parallel and its symbol
- b. Introduce new vocabulary
- c. Construct a parallelogram, parallel lines, and a perpendicular bisector.

2. **Concept Objective**

- a. Demonstrate proficiency in constructing a parallelogram, parallel lines, and a perpendicular bisector.

3. **Skill Objectives**

- a. The student will use tools necessary for geometric constructions.
- b. The student will become familiar with vocabulary necessary for geometric constructions.
- c. The student will be able to construct a parallelogram, parallel lines, and a perpendicular bisector.

B. Materials

1. Student:
 - a. Compass
 - b. Straightedge
 - c. Paper
 - d. Pencil with eraser
2. Teacher:
 - a. Large compass for board use
 - b. Colored chalk
 - c. Meter stick

C. Background Notes

1. The method for constructing parallel lines is the same as for constructing a parallelogram. A bisector of a segment divides the segment into two equal segments. A bisector of an angle bisects the angle into two congruent angles.
2. Be sure students understand estimation is not acceptable in geometric construction.

D. Key Vocabulary

1. Parallelogram - a four-sided figure with opposite sides parallel and congruent
2. Perpendicular bisector - a line perpendicular to the segment that divides the original segment into two congruent segments.

E. Procedures and Activities

1. Insure each student has a compass, a protractor, and a straightedge.
2. Review term : parallel
3. Present terms: parallelogram and congruent (describe and demonstrate on board or overhead)
4. Demonstrate the construction of a parallelogram.
5. Distribute Practice Worksheet (Appendix C) for students to use protractor to construct parallelograms, parallel lines and perpendicular bisectors. Students will practice Part A at this time.
6. Students will review each other's work.
7. Demonstrate the construction of parallel lines.

8. Have students practice Part B constructing parallel lines using practice worksheet.
 9. Have students check each other's work.
 10. Demonstrate the construction of a perpendicular bisector.
 11. Have students complete Part C of practice worksheet constructing perpendicular bisectors.
 12. Have students check each other's work.
- F. **Evaluation/Assessment**
1. Have individual students come to the board to demonstrate and communicate the process used to perform the constructions presented during this lesson, while remaining students evaluate presenter's proficiency.
- G. **Standardized Test/State Test Connections**
Colorado Model Content Standards for Mathematics 4 and 5

Lesson Three: To construct an angle congruent to a given angle and different kinds of triangles using a straight edge and compass (2 days)

- A. **Daily Objectives**
1. **Lesson Content**
 - a. Review term: congruent, and introduce types of triangles: equilateral, isosceles, scalene, acute, right, and obtuse.
 - b. Construct an angle congruent to a given angle.
 - c. Construct different kinds of triangles.
 2. **Concept Objective**
 - a. Demonstrate an understanding of congruence, of different kinds of triangles, and the construction of different types of triangles as well as the construction of an angle congruent to a given angle.
 3. **Skill Objectives**
 - a. The student will understand the term congruence.
 - b. The student will understand the criteria for naming different kinds of triangles.
 - c. The student will be able to construct an angle congruent to a given angle.
 - d. The student will be able to construct different kinds of triangles.
- B. **Materials**
1. Student:
 - a. Compass
 - b. Protractor
 - c. Straightedge
 - d. Paper
 - e. Pencil with eraser
 - f. Glue
 - g. Scissors
 - h. Magazines
 2. Teacher:
 - a. Large compass for board use
 - b. Large protractor for board use
 - c. Colored chalk
 - d. Meter stick
 - e. Butcher-block paper
 - f. Magazines
- C. **Background Notes**

1. See p. 150 VI. Geometry, point 6 (Triangles) from *Core Knowledge Scope and Sequence*, 1998.
2. A triangle is the figure formed by three segments joining three noncollinear points. The common endpoint of the sides of an angle is called the vertex of the triangle (The plural of vertex is vertices.). The segments are the sides of the triangle. A triangle can be named according to the lengths of its sides or according to the measures of its angles. The sum of the measures of the angles of a triangle is 180 degrees.
3. Be sure students understand estimation is not acceptable in geometric construction.

D. **Key Vocabulary**

1. Equilateral triangle - a triangle with three congruent sides
2. Isosceles triangle - a triangle with two congruent sides
3. Scalene triangle - a triangle with no congruent sides
4. Right triangle - a triangle with one right angle
5. Acute triangle - a triangle with three acute angles
6. Obtuse triangle - a triangle with one obtuse angle

E. **Procedures and Activities**

1. Insure each student has a compass, a protractor, and a straightedge.
2. Review the term : congruent. (show one or two examples of congruent polygons or shapes)
3. Have students draw congruent figures on their paper. Ask volunteers to show their congruent figures.
4. Demonstrate the construction of an angle congruent to the given angle.
5. Have students draw angles with measures of 60 degrees, 90 degrees, and 140 degrees. Students will then construct the angle bisector for each of these angles. Using their protractors, students will then verify their accuracy by measuring each of the new angles.
6. Students, in pairs, will scan magazines (brought by them and/or provided by teacher) for triangular shaped objects and make a triangle collage to be displayed in the classroom.
7. **Student Assignment:** Students will be provided with a paper triangle - different sizes will be distributed to each student in the class. (See appendix F.) From this triangle's measurements, the student will construct 2 triangles - one that has measurements half as long as the original triangle and one having measurements twice as long as the original triangle.
8. Review previous day's lesson and student assignment.
9. Draw different triangles to show how each one is formed.
10. Hold up teacher prepared "flash cards" for the types of triangles and have students name the various types - by side and by angle.
11. Show the construction of several triangles.
12. Distribute Practice Worksheet (Appendix D) for students to practice the construction of different types of triangles.
13. **Optional activity:** Need seven sticks with sizes: 1 foot (1), 2 feet (1), 3 feet (3), 4 feet (1), and 5 feet (1). With these seven sticks have students make several different kinds of triangles.

F. **Evaluation/Assessment**

1. Three products will be evaluated: student collage, student assignment on doubling and halving their given triangle, and Practice Worksheet on constructing triangles.

- G. **Standardized Test/State Test Connections**
Colorado Model Content Standards for Mathematics 4 and 5.

Lesson Four: To construct parallel lines with a transversal and construct a circle that circumscribes a triangle

A. **Daily Objectives**

1. **Lesson Content**
 - a. Construction of parallel lines with a transversal.
 - b. Construct a circle that circumscribes a triangle.
2. **Concept Objective**
 - a. Demonstrate an understanding of the need for accuracy in constructing parallel lines with a transversal and circumscribe a circle around a triangle.
3. **Skill Objectives**
 - a. The student will be able to use a compass and protractor to construct parallel lines with a transversal.
 - b. The student will be able to use a compass and protractor to construct a circle that circumscribes a triangle.

B. **Materials**

1. Student:
 - a. Compass
 - b. Straightedge
 - c. Paper
 - d. Pencil with eraser
2. Teacher:
 - a. Large compass for board use
 - b. Colored chalk
 - c. Meter stick

C. **Background Notes**

1. A polygon is inscribed in a circle if all of its vertices lie on the circle. The center of a circumscribed circle is the circumcenter of the polygon. A given triangle can be an inscribed triangle because a circle can be circumscribed through its vertices. Not all polygons are "inscribable" or "circumscribable". In a polygon, any three vertices determine the circumscribed circle. If the remaining vertices lie on that circle, then the polygon can be inscribed in a circle.
2. Be sure students understand estimation is not acceptable in geometric construction.

D. **Key Vocabulary**

1. Transversal -A line that intersects two or more coplanar lines in different points.
2. Circumscribed circle - A circle is circumscribed about a triangle (or other polygon) when each vertex of the triangle (or other polygon) lies on the circle.
3. Inscribed triangle (or other polygon) - A triangle (or other polygon) is inscribed in a circle if all of its vertices lie on the circle.

E. **Procedures and Activities**

1. Insure each student has a compass, a protractor, and a straightedge.
2. Review meaning of : vertex (plural: vertices)
3. Teach the meaning of the word : transversal.
4. Review the construction of parallel lines.
5. Teach the construction of a transversal through parallel lines.
6. Students will construct 3 sets of parallel lines, then a transversal through each set of lines.

7. Teach the construction for a circle that circumscribes a triangle (perpendicular bisectors of two sides).
 8. Distribute Practice Worksheet (Appendix E) for students to practice circumscribing a circle around a triangle.
 9. Review student work.
 10. **Optional material:** When parallel lines are constructed another lesson may spin off discussing the types of angles formed when a transversal crosses parallel lines.
- F. **Evaluation/Assessment**
1. One product will be evaluated - the Practice Worksheet for circumscribing a circle around a triangle.
- G. **Standardized Test/State Test Connections**
Colorado Model Content Standards for Mathematics 4 and 5.

Lesson Five: Construct an equilateral triangle, a square, and regular hexagon given its center and one of its vertices

- A. **Daily Objectives**
1. **Lesson Content**
 - a. Review the meaning of regular polygons.
 - b. Construct an equilateral triangle given its center and one of its vertices.
 - c. Construct a square given its center and one of its vertices.
 - d. Construct a regular hexagon given its center and one of its vertices.
 2. **Concept Objective**
 - a. Demonstrate an understanding for the need for accuracy in constructing an equilateral triangle, a square and a regular hexagon given the center and one of its vertices.
 3. **Skill Objectives**
 - a. The student will use a compass and protractor to construct an equilateral triangle given its center and one of its vertices.
 - b. The student will use a compass and protractor to construct a square given its center and one of its vertices.
 - c. The student will use a compass and protractor to construct a regular hexagon given its center and one of its vertices.
- B. **Materials**
1. Student:
 - a. Compass
 - b. Straightedge
 - c. Paper
 - d. Pencil with eraser
 2. Teacher:
 - a. Large compass for board use
 - b. Colored chalk
 - c. Meter stick
- C. **Background Notes**
Be sure students understand estimation is not acceptable in geometric construction.
- D. **Key Vocabulary**
1. Regular polygon - A polygon with all sides congruent and all angles congruent
 2. Square - a rectangle with four congruent sides
 3. Regular hexagon - A six-sided polygon with all sides and all angles congruent.
- E. **Procedures and Activities**
1. Review meaning of equilateral triangle.

2. Discuss the meaning of regular polygons including square and hexagon.
 3. Demonstrate the construction of an equilateral triangle given its center and one of its vertices.
 4. Distribute Practice Worksheet (Appendix G). Have students practice the construction of an equilateral triangle on Part A of worksheet.
 5. Demonstrate the construction of a square given its center and one of its vertices.
 6. Have students practice the construction of a square on Part B of Practice Worksheet.
 7. Demonstrate the construction of a regular hexagon given its center and one of its vertices.
 8. Have students practice the construction of a regular hexagon on Part C of the Practice Worksheet.
 9. **Optional Activity:** Have the students work in pairs. Provide each pair with 25 equilateral triangles cut from construction paper or 25 squares cut from construction paper or 25 hexagons cut from construction paper. Ask students to arrange their given shape (triangle, square or hexagon) so that they form one large shape (triangle, square, or hexagon). Have students discover any patterns as additional shapes are added.
- F. **Evaluation/Assessment**
1. Have individual students come to the board to demonstrate and communicate the process used to perform the constructions presented during this lesson, while remaining students evaluate presenter's proficiency (Appendix H).
- G. **Standardized Test/State Test Connections**
- Colorado Model Content Standards for Mathematics 4 and 5

Lesson Six: Demonstrate that the perpendicular bisectors of the three sides of a triangle intersect at a point which is the center of the circle that circumscribes the triangle. Demonstrate that bisectors of the three angles of a triangle intersect at a point which is the center of the circle that inscribes the triangle.

- A. **Daily Objectives**
1. **Lesson Content**
 - a. Review the terms: perpendicular bisector, intersect, circumscribe, and inscribe.
 - b. inscribe.
 - c. Perform the construction that demonstrates that the perpendicular bisectors of the three sides of a triangle intersect at a point which is the center of the circle that circumscribes the triangle.
 - d. Perform the construction that demonstrates that bisectors of three angles of a triangle intersect at a point which is the center of the circle that inscribes the triangle.
 2. **Concept Objective**
 - a. Demonstrate the relationship between the intersection of the angle bisectors of a triangle and the center of the circle that inscribes the triangle, as well as demonstrating the relationship between the intersection of the perpendicular bisectors of the sides and the center of the circumscribed circle.
 3. **Skill Objectives**
 - a. The student will be able to construct, with a compass and straightedge, the construction that demonstrates that the perpendicular bisectors of the three sides a triangle intersect at a point which is the center of the circle that circumscribes the triangle.

- b. The student will be able to construct, with a compass and straightedge, the construction that demonstrates that bisectors of three angles of a triangle intersect at a point which is the center of the circle that inscribes the triangle.

B. Materials

1. Student:
 - a. Compass
 - b. Straightedge
 - c. Paper
 - d. Pencil with eraser
2. Teacher:
 - a. Large compass for board use
 - b. Colored chalk
 - c. Meter stick

C. Background Notes

1. Students are often tempted to estimate the radius of the circumscribed and inscribed circles by sight rather than by constructing a perpendicular segment to one of the sides of the triangles. Be sure students understand that estimation is not acceptable in geometric construction.

D. Key Vocabulary

1. Review from Lesson 3:
 - a. Circumscribed circle - A circle is circumscribed about a triangle (or other polygon) when each vertex of the triangle (or other polygon) lies on the circle.
 - b. Inscribed triangle (or other polygon) - A triangle (or other polygon) is inscribed in a circle if all of its vertices lie on the circle.

E. Procedures and Activities

1. Discuss the difference between inscribed and circumscribed shapes.
2. Review the construction of an inscribe triangle from lesson 4.
3. Demonstrate the construction that shows that the perpendicular bisectors of the three sides a triangle intersect at a point which is the center of the circle that circumscribes the triangle.
4. Distribute Practice Worksheet (Appendix I). Have students practice constructions in Part A.
5. Demonstrate the construction that shows that the bisectors of the three angles of a triangle intersect at a point which is the center of the circle that inscribes the triangle
6. Have students practice this construction on Practice Worksheet Part B.

F. Evaluation/Assessment

Review Practice Worksheet.

G. Standardized Test/State Test Connections

Colorado Model Content Standards for Mathematics 4 and 5.

VI. CULMINATING ACTIVITY

Test over Lessons 1 through 6 (Appendix J)

VII. HANDOUTS/WORKSHEETS

- A. Appendix A - Angles Worksheet
- B. Appendix B - Evaluative Overhead: Lesson 1
- C. Appendix C - Construction Worksheet: Lesson 2
- D. Appendix D - Constructing Triangles: Lesson 3

- E. Appendix E - Construction Worksheet: Lesson 4
- F. Appendix F - Triangle Activity: Lesson 3
- G. Appendix G - Triangle, Square, Hexagon Worksheet: Lesson 5
- H. Appendix H - Evaluative Overhead: Lesson 5
- I. Appendix I - Construction Worksheet: Lesson 6
- J. Appendix J - Unit Test

VIII. BIBLIOGRAPHY

- A. Bolster, L. C., et al. *Exploring Mathematics*. Glenview Illinois: Scott, Foresman and Company, 1996. ISBN# 0-673-37550-1.
- B. Colorado State Standards. 6/8/95
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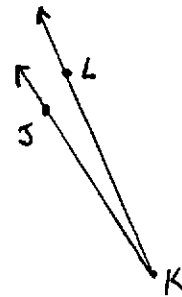
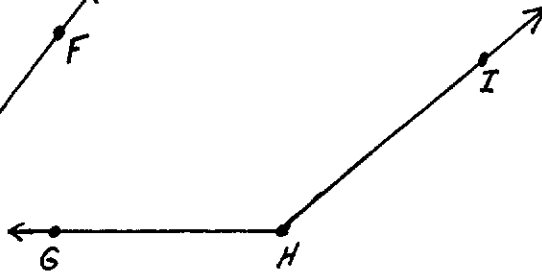
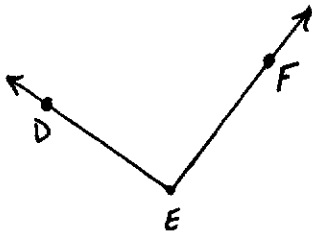
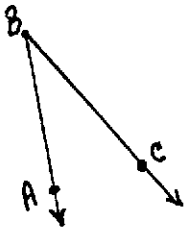
APPENDIX A

Angles Worksheet

Name _____

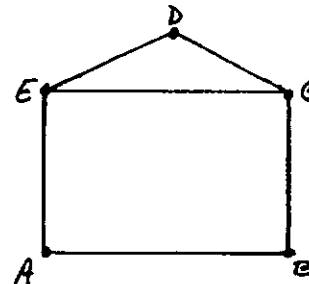
Use a protractor to measure each angle.

1. $m\angle ABC =$ _____ 2. $m\angle DEF =$ _____ 3. $m\angle GHI =$ _____ 4. $m\angle JKL =$ _____



Use the figure at the right to answer the following.

5. Name two right angles. _____
 6. Name one acute angle. _____
 7. Name one obtuse angle. _____

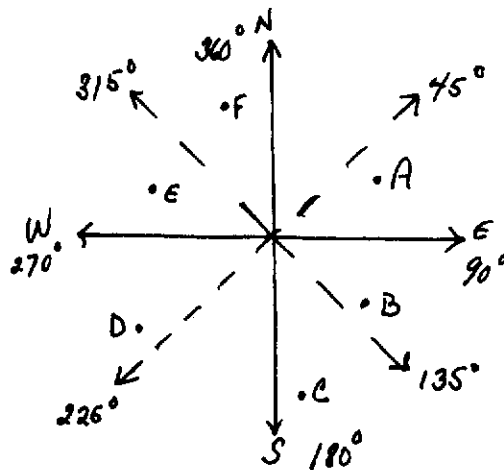


Use a protractor to draw an angle with the given measure.

8. 35° 9. 110° 10. 156° 11. 10°

Estimate the position of each point in relation to North. Use the compass readings.

- A. _____ B. _____
 C. _____ D. _____
 E. _____ F. _____

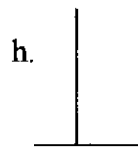
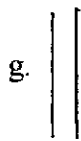
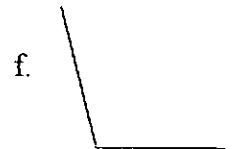
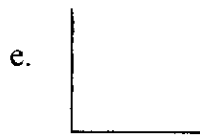
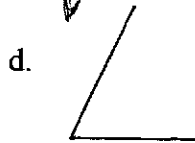
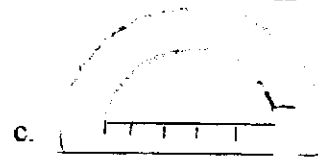
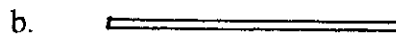
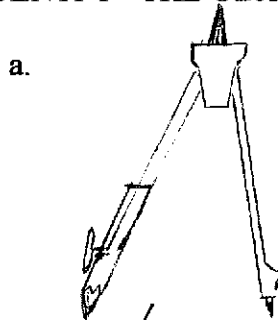


APPENDIX B

Evaluative Overhead

1. A compass is used to make which geometric structure?
2. Right angles measure _____ ?
3. Congruent figures are said to be _____ the same.
4. A protractor is used to measure _____.
5. An angle measuring greater than 90 is called _____.
6. Lines in a plane that never intersect are called _____ lines.
7. An angle measuring less than 90 is called _____.
8. Lines that intersect to form right angles are called _____ lines.
9. What is the name of the tool used to make straight lines ?

10. IDENTIFY THE OBJECT OR SYMBOL



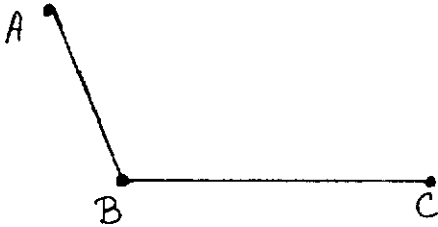
APPENDIX C

Practice Worksheet: Constructing *parallelograms*, parallel lines, and **perpendicular bisectors**.

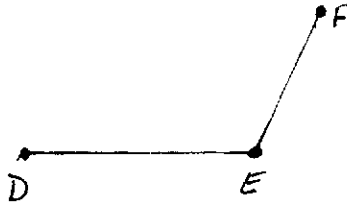
Name _____

Part A. Using the given lines and points to construct *parallelograms*.

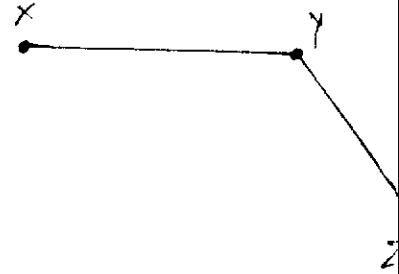
1.



2.

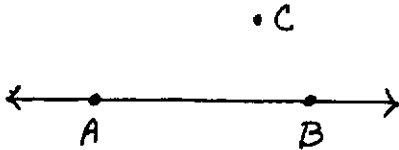


3.



Part B. For each given line and point construct a parallel line.

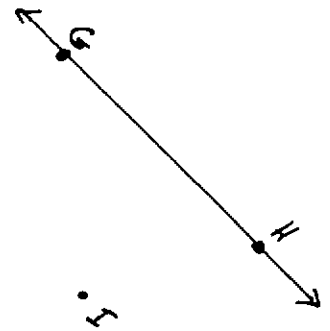
4.



5.



6.



Part C. Construct the **perpendicular bisector** for each line segment given.

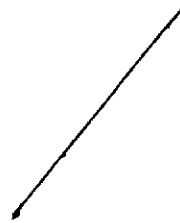
7.



8.



9.



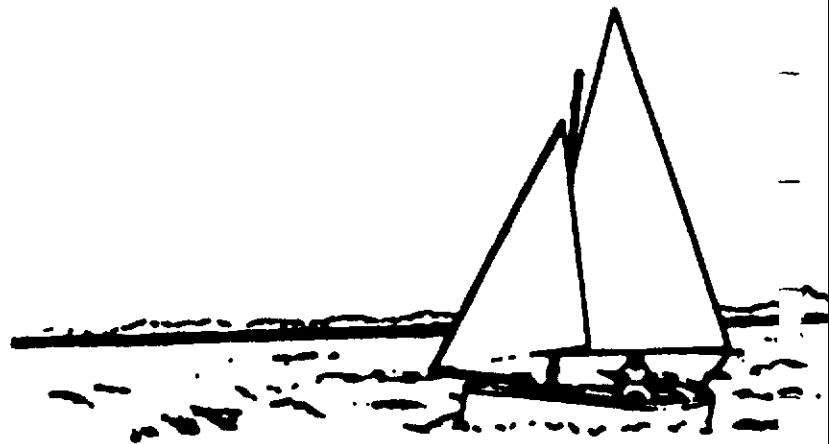
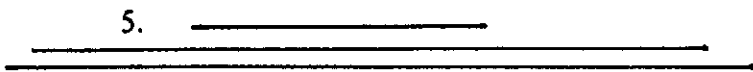
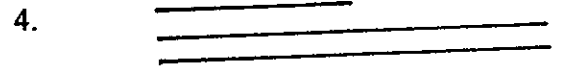
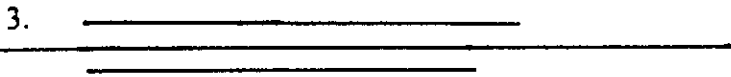
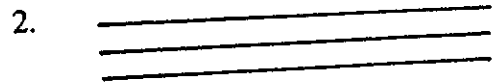
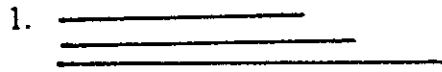
10.



APPENDIX D

Constructing Triangles

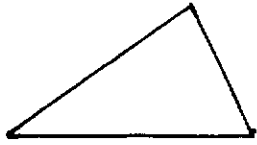
Construct triangles given the lengths of three sides.



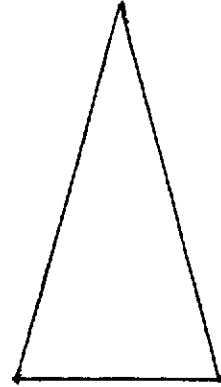
APPENDIX E

Using a compass and straightedge circumscribe a circle around each of the given triangles.

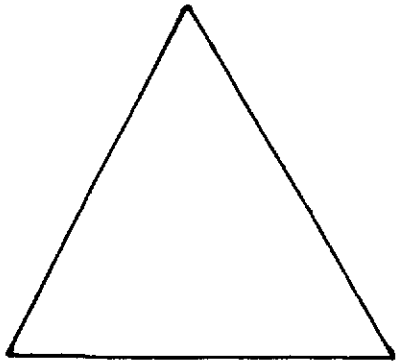
1.



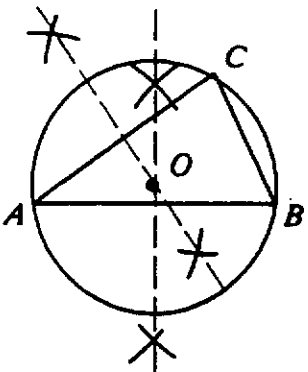
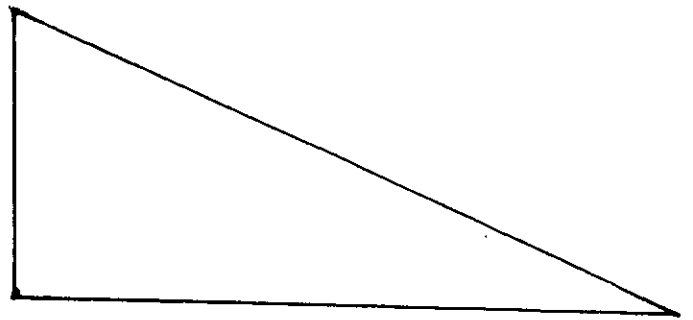
2.



3.

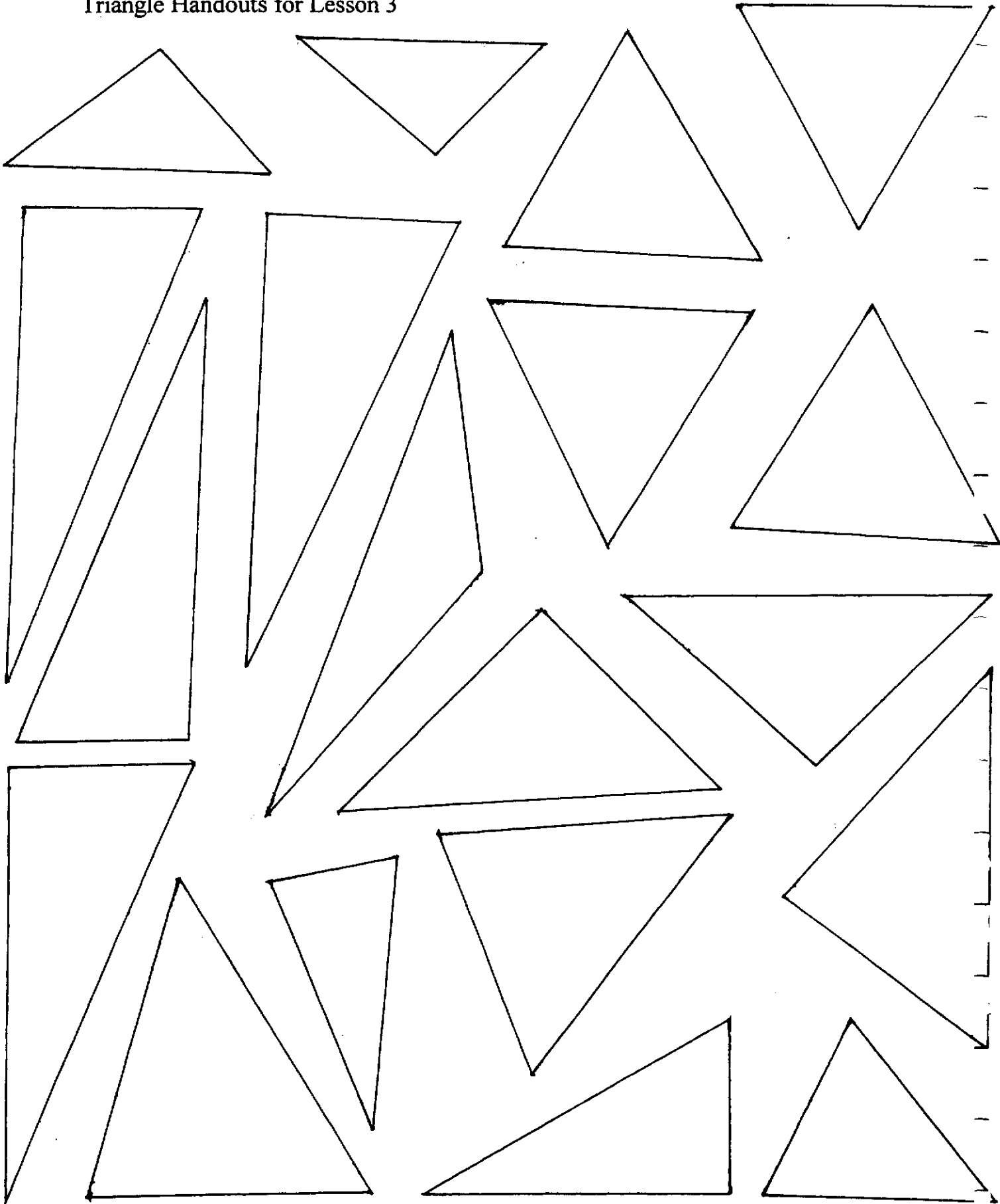


4.



APPENDIX F

Triangle Handouts for Lesson 3



APPENDIX G

Constructing regular polygons.

Part A. Construct equilateral triangles given the center and a vertex.

1.



2.



Part B. Construct squares given the center and a vertex.

3.



4.



Part C. Construct hexagons given the center and a vertex.

5.



6.



APPENDIX H

Evaluative overhead

You are being given the center and one of the vertices for each of these polygons.
Perform the required construction.

EQUILATERAL TRIANGLE



SQUARE



REGULAR HEXAGON



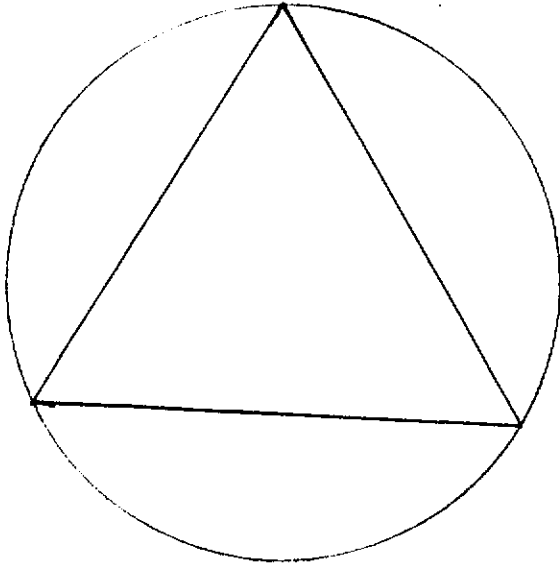
EQUILATERAL TRIANGLE



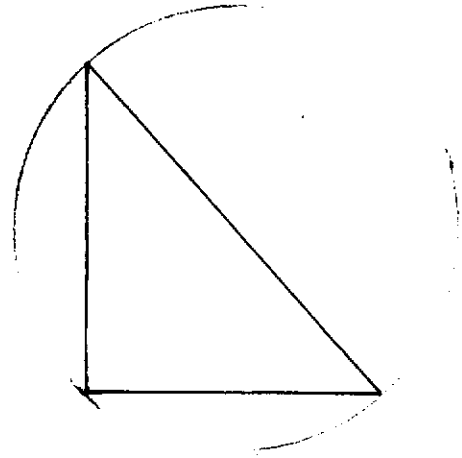
Appendix I

Part A. Construct the perpendicular bisectors of all sides of the circumscribed triangles.

1.

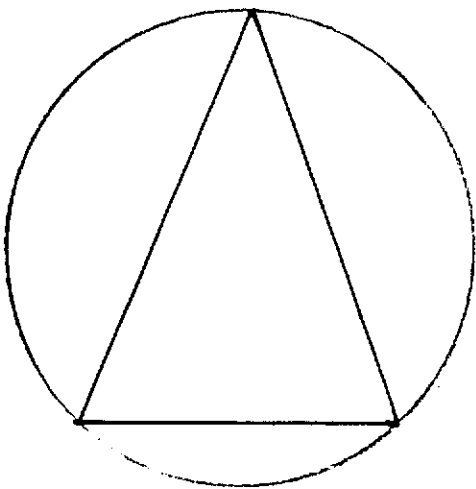


2.

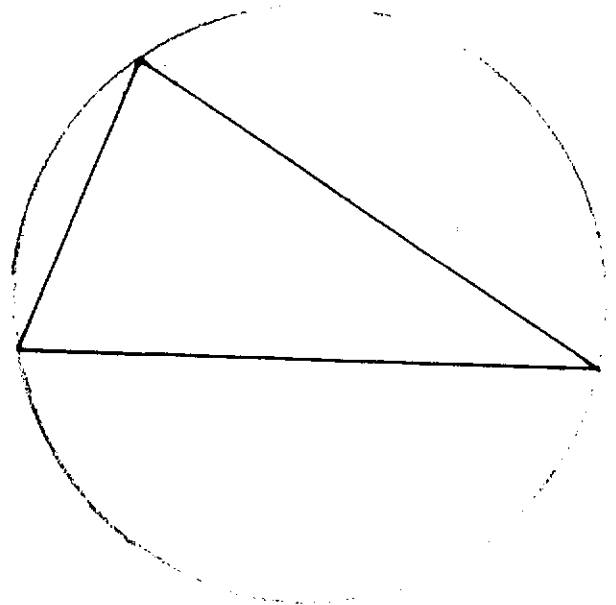


Part B. Construct the bisectors of all angles of the circumscribed triangles.

3.



4.



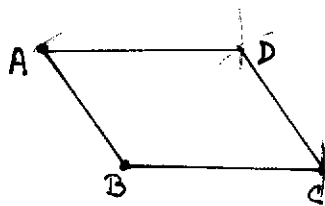
APPENDIX K

Constructions for Geometry Constructions Unit.

LESSON 2

Parallelogram

Given: $\angle ABC$



With compass, measure BC; mark this distance off from point A.

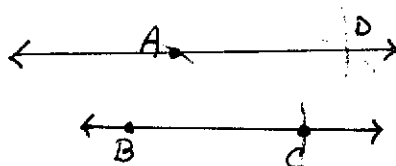
Measure AB with compass; Mark off from point C. Connect new point D to Points A and C.

Parallel lines

Same method as for parallelogram.

Given: a line and a point

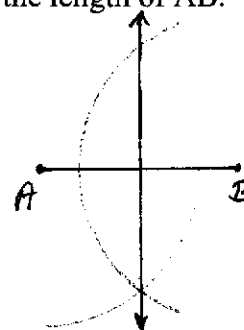
Not on the line.



Perpendicular bisector

Given: line segment AB

From points A and B draw an arc using a compass. The measure must be greater than half the length of AB.

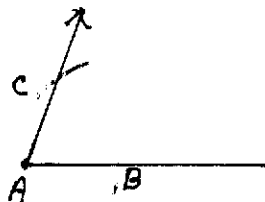
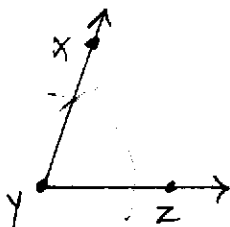


Where the 2 arcs meet, connect the points.

LESSON 3

Angle congruent to a given angle.

Given: angle XYZ.

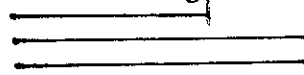


With a ruler, draw a line segment. From Point Y, draw an arc with a compass. Mark that same arc from endpoint A of line segment - label this point B on the line.

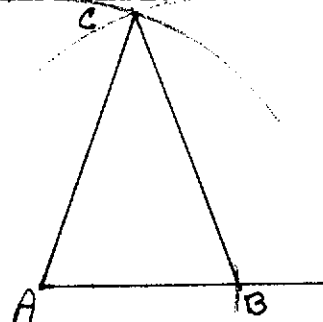
Measure X to Z with a compass. Mark the same distance off from point B. Label the intersecting arcs point C. Connect points A and C.

Different kinds of triangles

Given: 3 line segments.



With a ruler, draw a line segment. Mark off the length of one segment onto the just drawn line segment. Label the endpoints A and B.



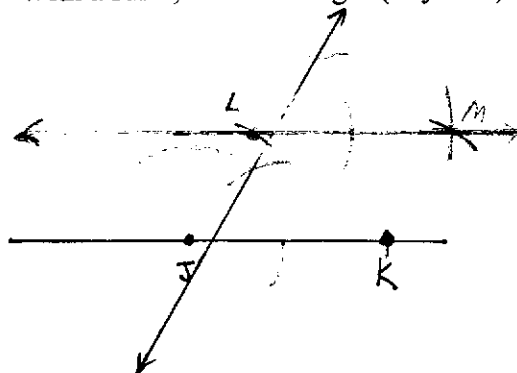
From points A and B mark the measure of each remaining segment. Label the Intersection point C. Connect A and C; Connect B and C.

APPENDIX K (cont.)

LESSON 4

Parallel lines with a transversal

Construct parallel lines (see Lesson 2).
With a ruler, draw an angle (any size).



From points J and L, copy this angle.
Connect the two intersections to form the transversal. NOTE: A perpendicular bisector construction may be used to create a transversal as well.

LESSON 5

Regular polygons (triangle, square, hexagon)

Given: the center and one of the vertices.

The procedure us the same for all three shapes.

Connect the two points (A and B)

With a compass draw a circle with a radius equal to distance AB.

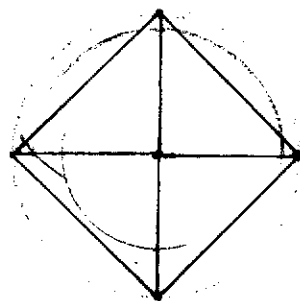
From segment AB construct congruent angles:

For a triangle: 2 120 degree angles

For a square: 3 90 degree angles

For a hexagon: 5 60 degree angles

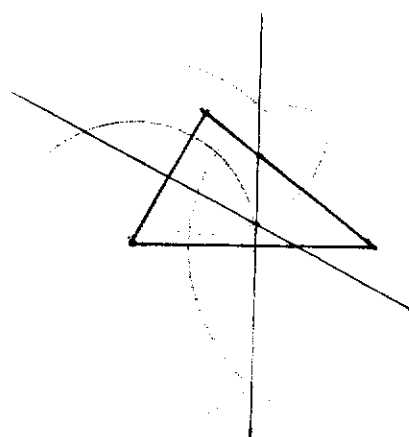
For a square:



Connect the 4 points on the circle to form a square.

A circle that circumscribes a triangle

Given: a triangle.



Construct the perpendicular bisector (see lesson 2) of any 2 sides of the triangle. At the intersection point (P) mark the distance to one of the vertices; with a compass, draw a circle (all vertices of the triangle will be on the circle).

LESSON 6

Proofs.

See Lesson 4 for circumscribing a triangle.

Given: 2 inscribed triangles.

On first inscribed triangle, construct the perpendicular bisector of each of the sides.

On the second inscribed triangle, construct the bisector of each angle.