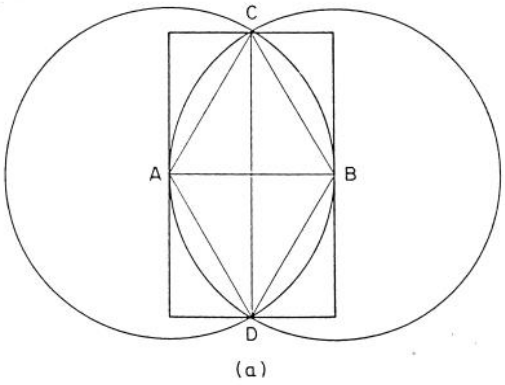
Module 2: Triangle and Square Grids

1. Introduction

It is amazing the power and potential that exists by the simple act of drawing a circle or a square. This was recognized in ancient times where the circle symbolized the celestial sphere and represented the Heavenly domain; the square with its reference to the four directions of the compass represented the Earthy domain. Margit Echols was a quilter who used geometry as the basis of her wonderful quilt patterns. In this module Echols shows how to create triangle and square grids beginning with a circle. The grids then become scaffolding for the creation of a limitless number of repeating patterns. Module 3 goes on to describe how Echols used this approach to pattern-making to create one of her beautiful quilts. This module will lead you through a series of images created by Echols that will help you to construct triangle and square grids along with patterns generated from them. Echol's constructions are labeled starting with page 1. Section 2-5 of this module describes what follows.

2. Circle-triangle and triangle grids

For this exercise, you may use either a compass or a software program such as Corel Draw or Adobe Illustrator to create circles. To create a triangle grid, start with a circle Place the compass point on the circumference and draw another circle. The resulting pair of circles is one of the most fundamental structures in geometry called the Vesica Pisces. This figure had sacred significance in the Christian religion. It is found in many churches where images of Christ were drawn in the central fishlike region as shown in Fig. 1.



(*a*) The Vesica Piscis; (*b*) marble relief of Christ in a vesica.

Fig. 1

On page 3 at the two points where this pair of circles intersect, draw two more circles with the intersection points as centers. Continue adding new circles at new intersection points as shown on page 3, leading up, in step 7, to a triangle-circle grid and then the triangle grid in step 9. On page 4 the triangle grid is obtained in another way. In step 9

you can also see a hexagonal grid appear. Page 5 presents you with some puzzles to find three patterns hidden in the triangle-circle grid. Page 6 asks you to find additional patterns hidden in the triangle grid. On page 7 there are three patterns that you are challenged to find in the triangle grid. Pages 7a and b present you with a triangle grid to experiment with. Page 8 shows 12 additional patterns derived from the triangle grid, and page 9 illustrates 16 more patterns derived from either the triangle grid or the triangle – circle grid.

Construction 1: Use Adobe Illustrator, Corel Draw or simply a compass and straightedge to create a triangle-circle grid and a triangle grid beginning with a circle. After doing this create three of the patterns on pages 5,6,8, or 9. Or you may try your hand at creating your own pattern.

3. Circle-square and Square grids

Page 10 shows how, beginning with a circle, you can create square-circle and square grids. Page 11 illustrates 16 patterns derived from the square grid.

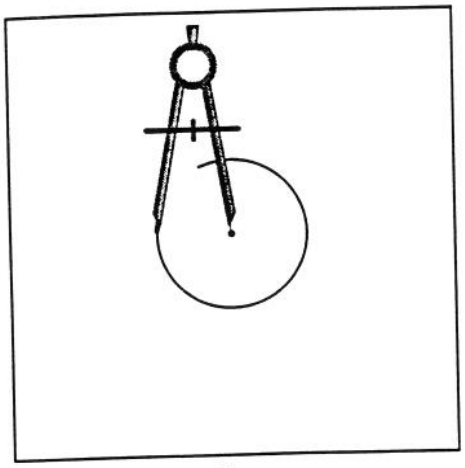
Construction 2: Repeat Construction 1, beginning with a circle, to construct a square-circle or square grid and create three square-circle or square grid patterns as shown on page 11.

4. Star designs based on the tri angle grid

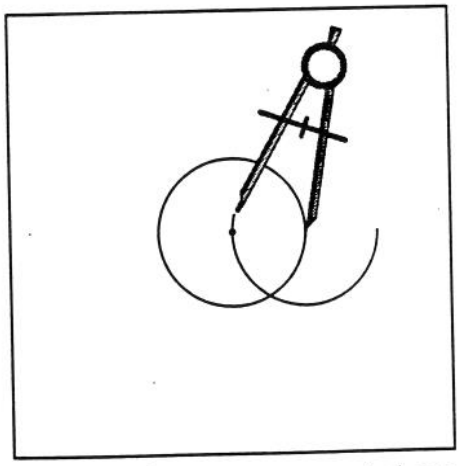
Page 12 shows how 6 and 12-pointed stars can be constructed beginning with a circle. For this exercise you can use also a coffee can cover instead of a compass to carry out the construction in which the center of the cover has the usual marking; you simply place the center of the coffee can cover over point that you would otherwise place your compass point to draw the circle. Page 13 shows how a circle can be used to generate 8 and 16-pointed stars.

Construction 3: Repeat the instructions for Construction 1 and create three star patterns from pages 12 and 13.

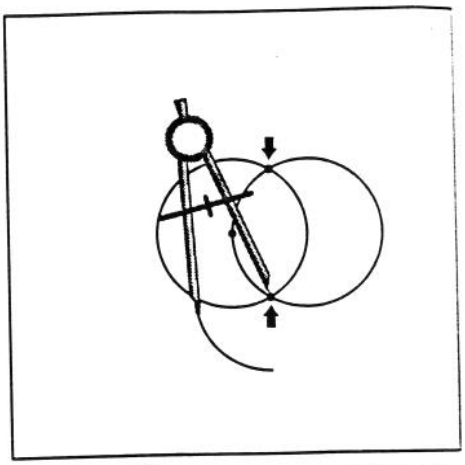
Drawing Circle and Triangle Grids



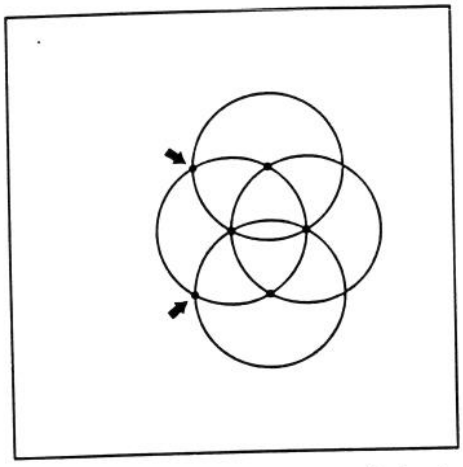
1. Draw a circle.



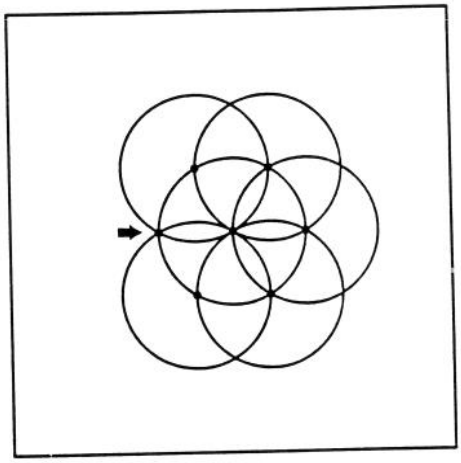
2. Place the compass point on the circumference and draw another circle.



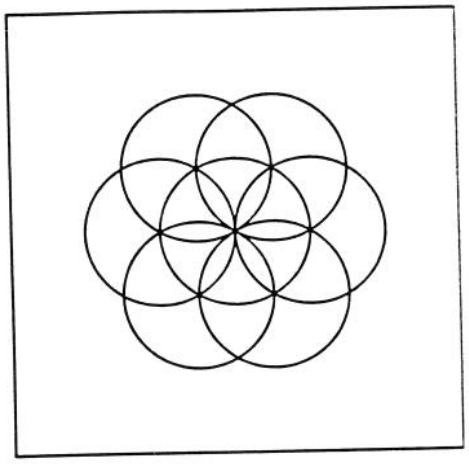
3. Place the compass point at points of intersection and draw 2 more circles.



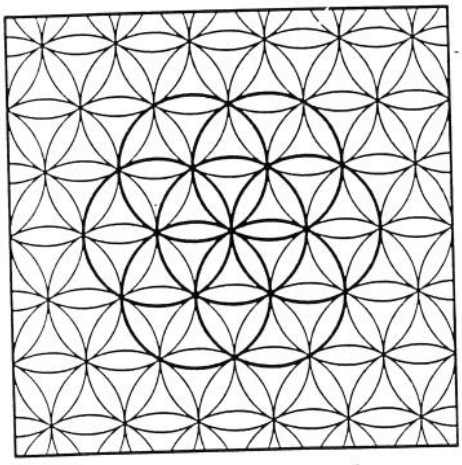
4. Place the compass point at new points of intersection and draw 2 more circles.



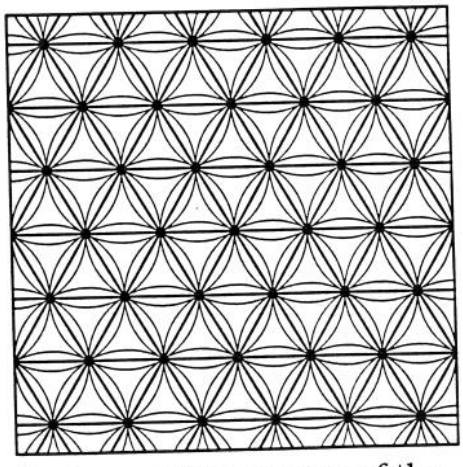
5. Place the compass point at the last intersection on the first circle and draw a circle.



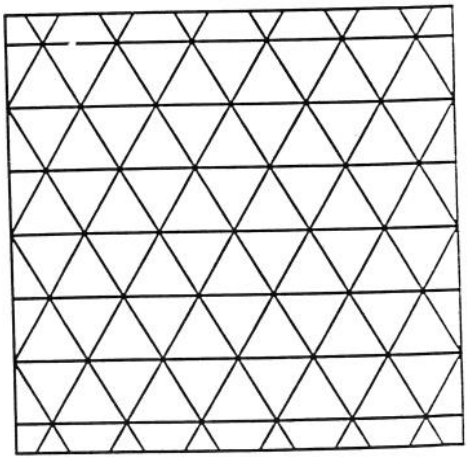
6. The circles divide the first circle into 6 equal parts.



7. To make a circle grid, continue adding circles until the page is filled.

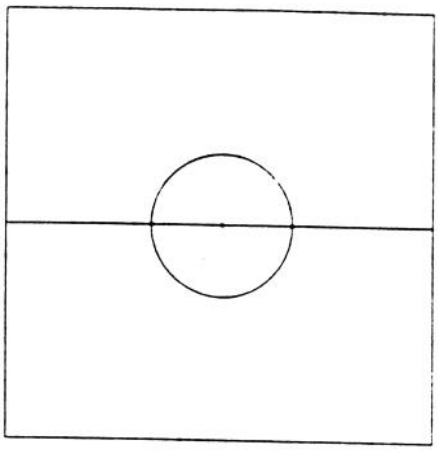


8. Connect the centers of the circles to create a grid of equilateral triangles.

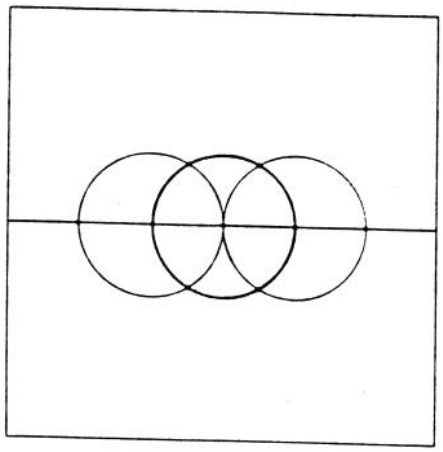


9. Triangle grid.

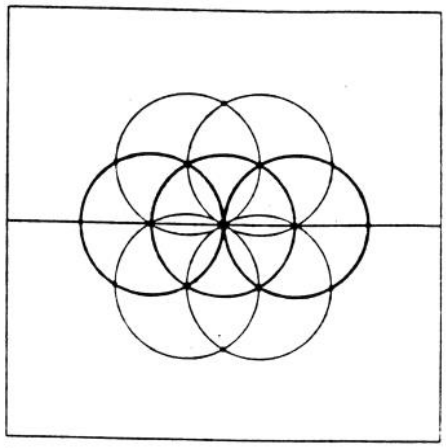
Triangles



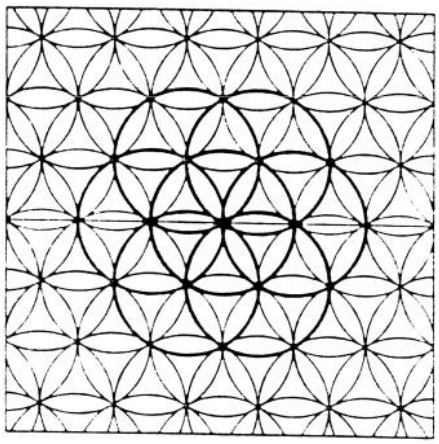
1. Make a circle with compass placed at a point on a line.



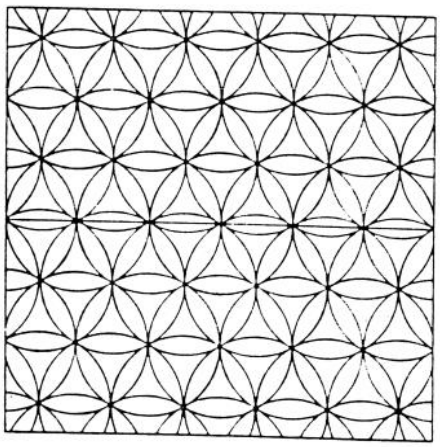
2. Make two circles with compass placed at points of intersection.



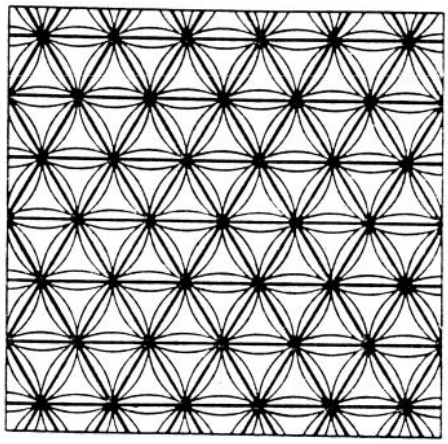
3. Make four circles with compass placed at new points of intersection.



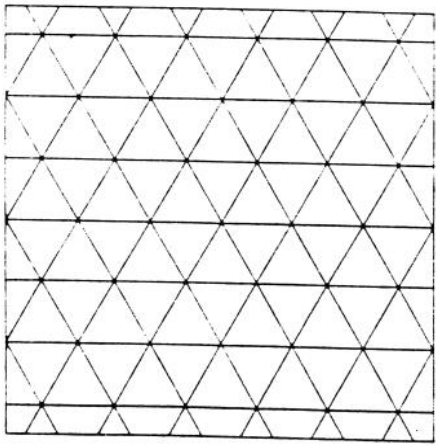
4. Continue outward in all directions.



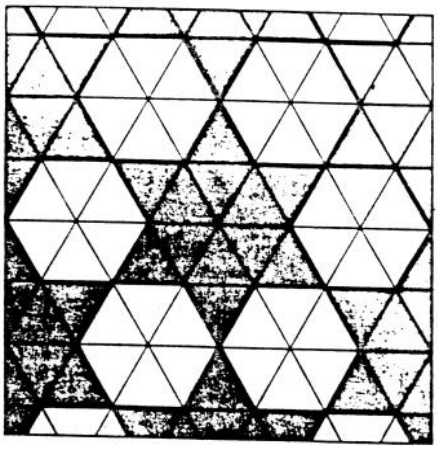
5. The compass produces a network of circles.



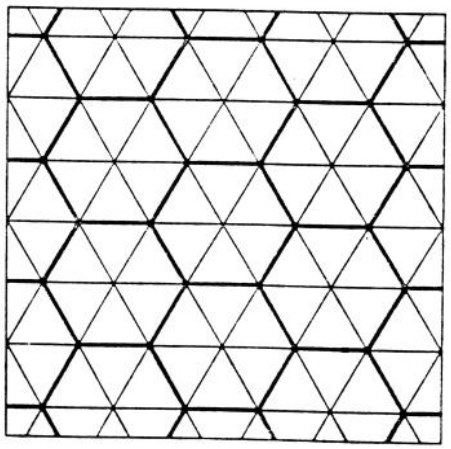
6. Connect centers of circles.



7. A grid of equilateral triangles (equal sides and angles) is the basis for many Islamic designs.

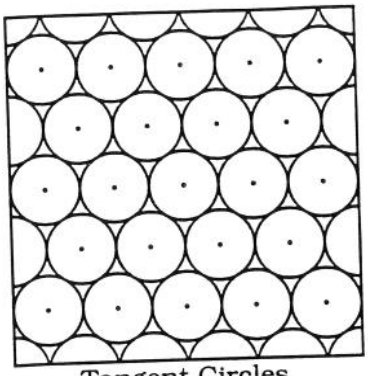


8. Islamic artists designed patterns on the grid from center outward with no gaps and no overlaps.

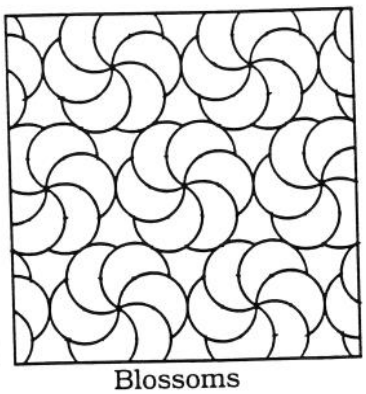


9. A grid of hexagons is embedded in the grid of equilateral triangles.

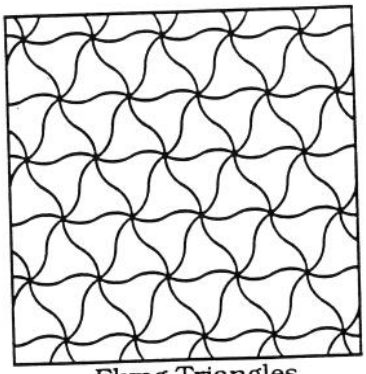
Pattern Puzzle A



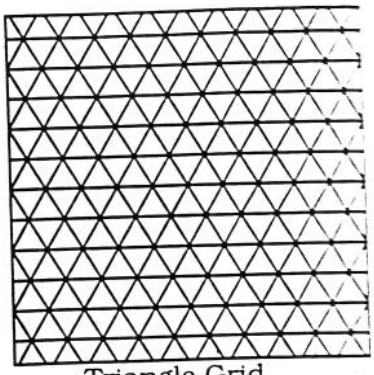
Tangent Circles



Blossoms

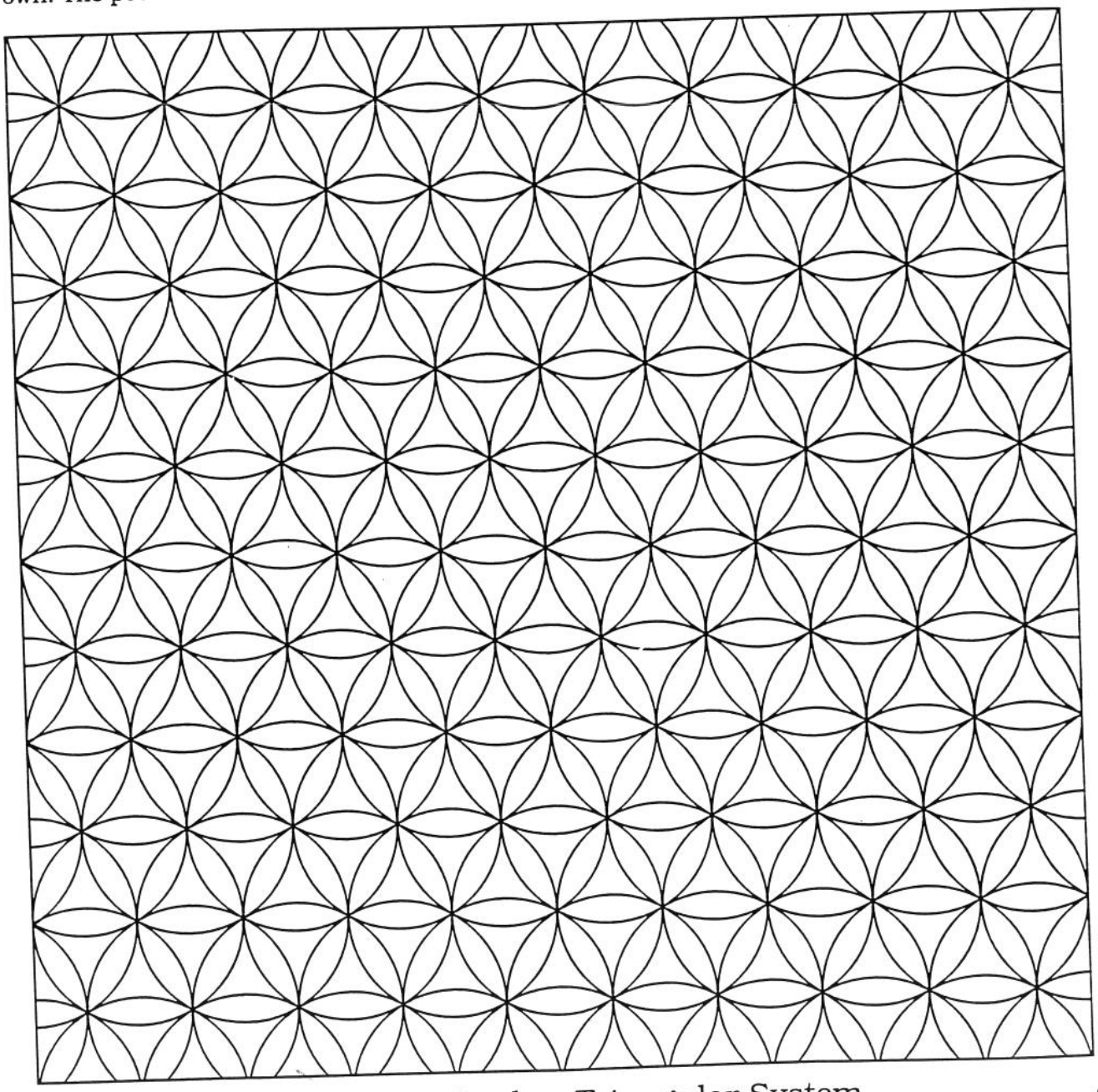


Flyng Triangles



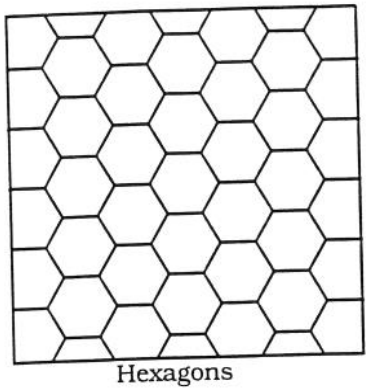
Triangle Grid

Look for the patterns above hidden in the circles below. Draw each one on a sheet of tracing paper using the overlapping circles underneath as a guide. Note that some patterns can be traced directly from the curved lines, while the triangle grid can be drawn using a straight edge to connect points where circles intersect. Many other patterns can be found in the circles that are not on this sheet. Try to find others or invent some of your own. The possibilities are infinite!

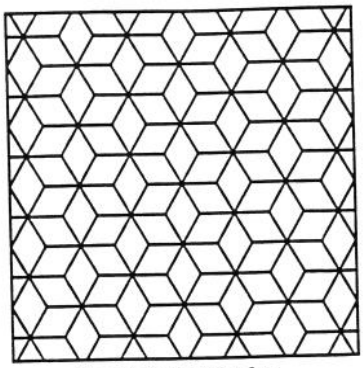


Overlapping Circles: Triangular System

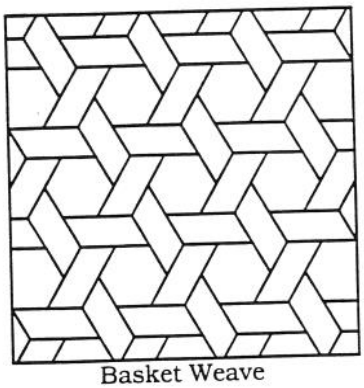
Pattern Puzzle B



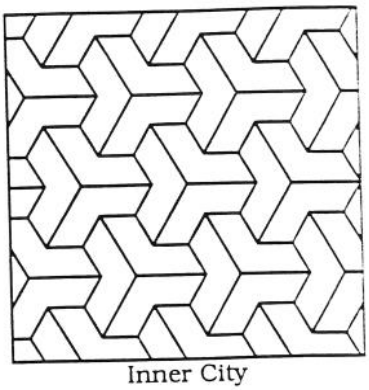
Hexagons



Tumbling Blocks
or Star-Diamond

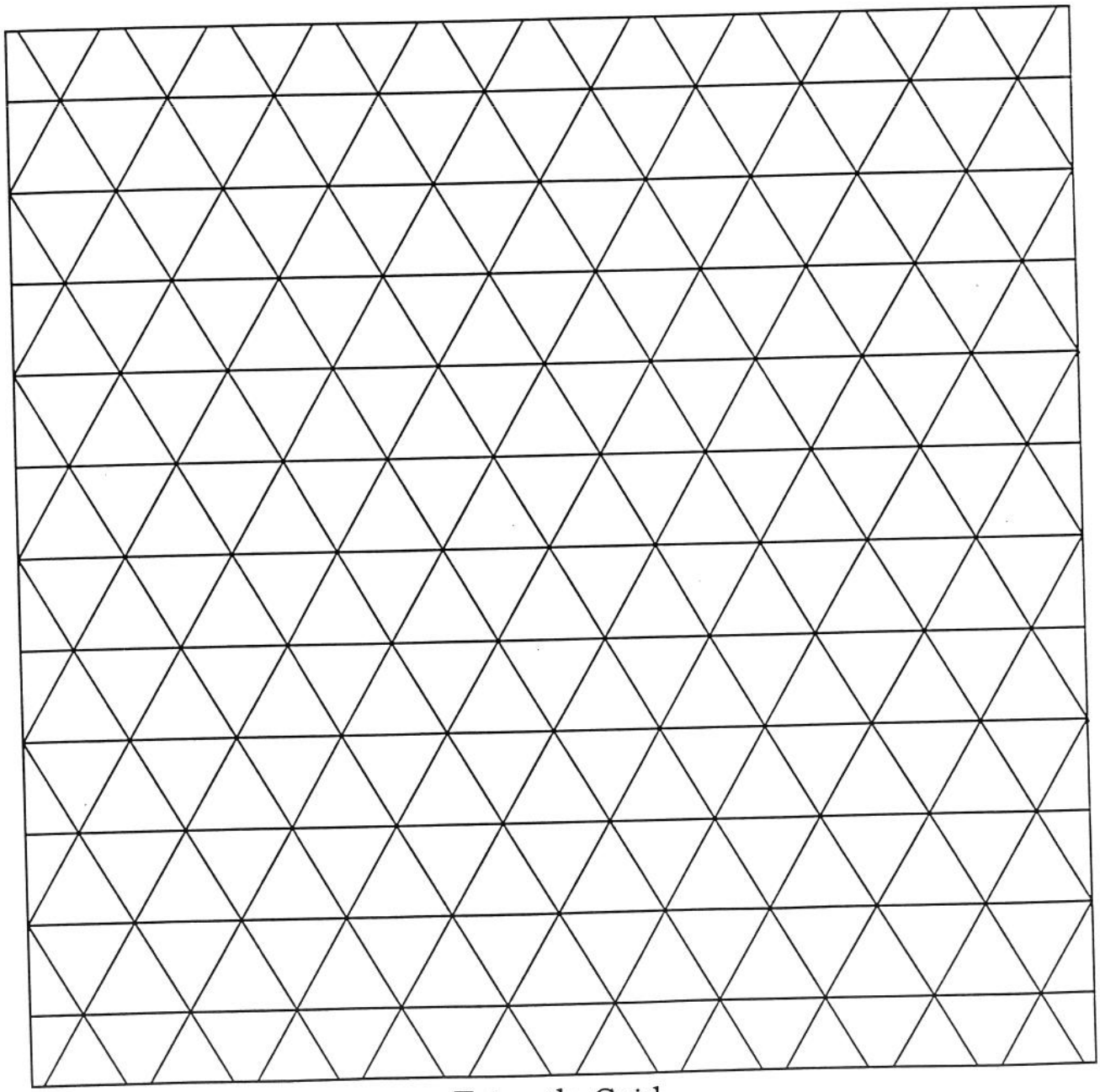


Basket Weave



Inner City

Look for the patterns above hidden in the triangle grid below. Draw each one on a sheet of tracing paper using the grid underneath as a guide. Many other patterns can be found in the triangle grid that are not on this sheet. Try to find others or invent some of your own. The possibilities are infinite!



Triangle Grid

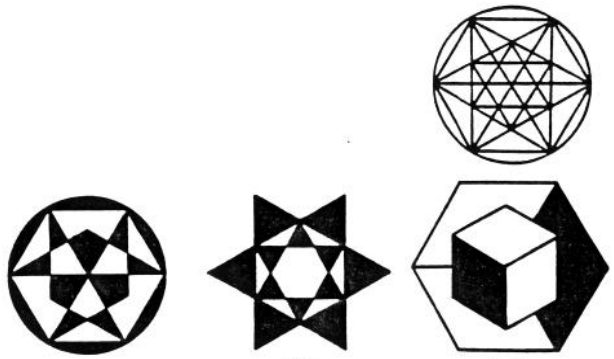
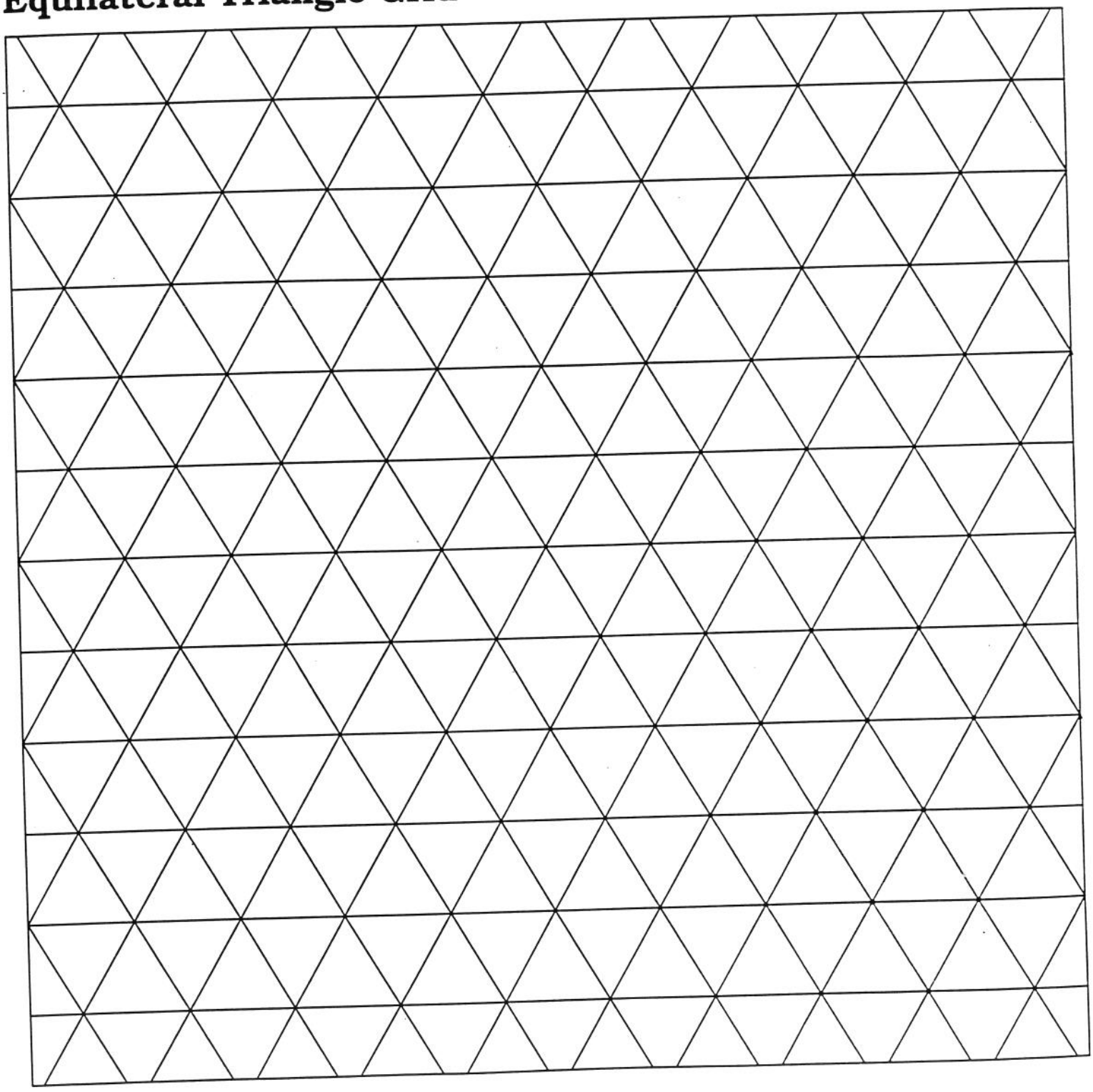


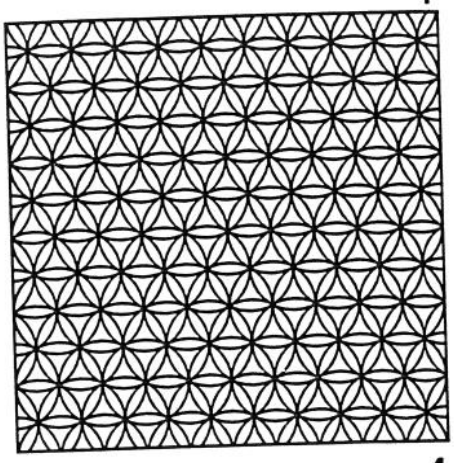
Figure 5.1 The versatility of the triangular grid. These are created by shading a portion of the grid enclosed by the circle.

Equilateral Triangle Grid



A Family of Patterns

1



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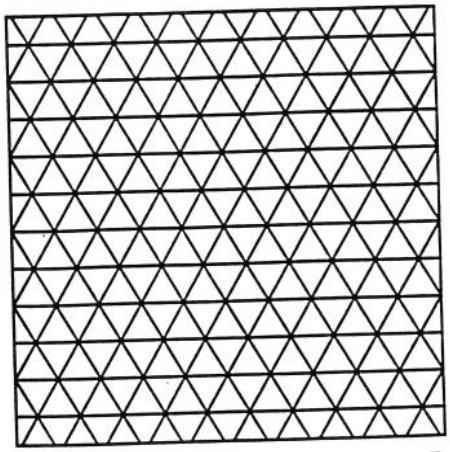

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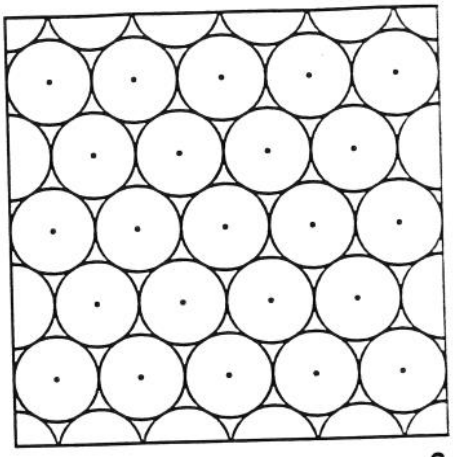

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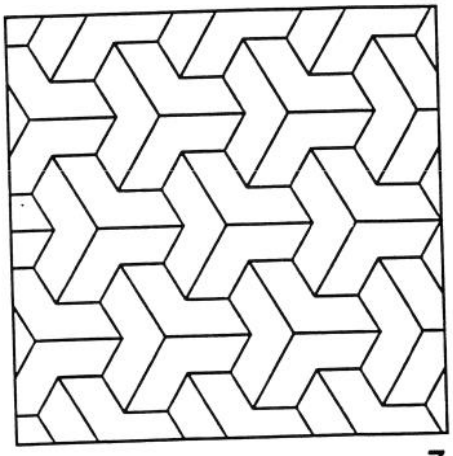

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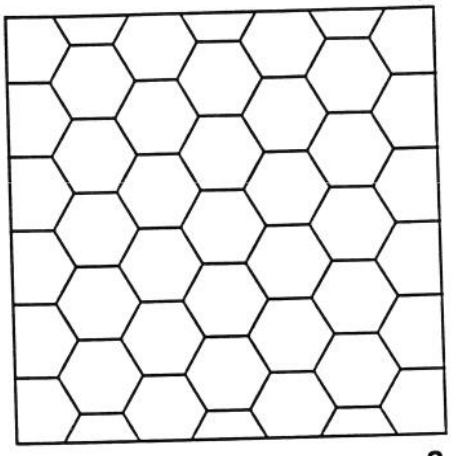

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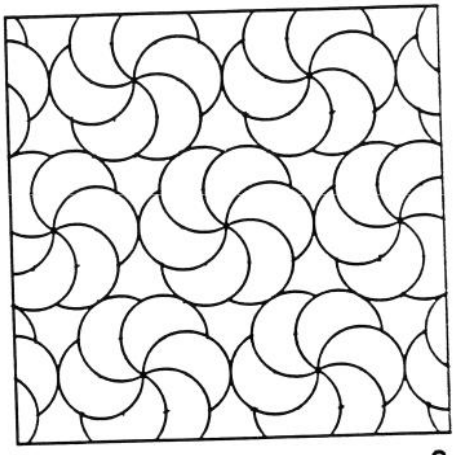

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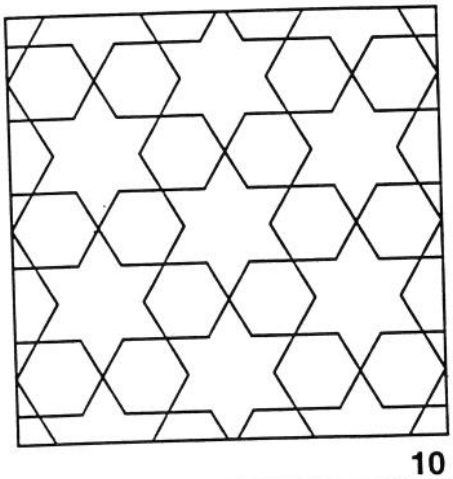

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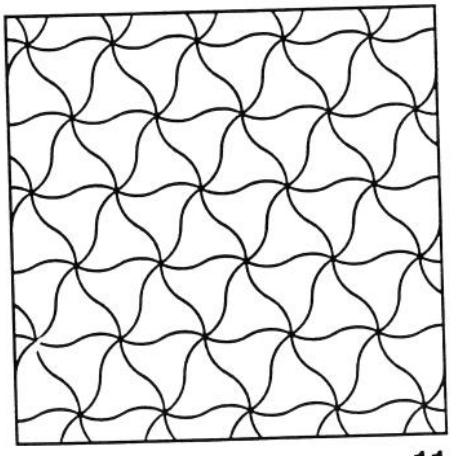

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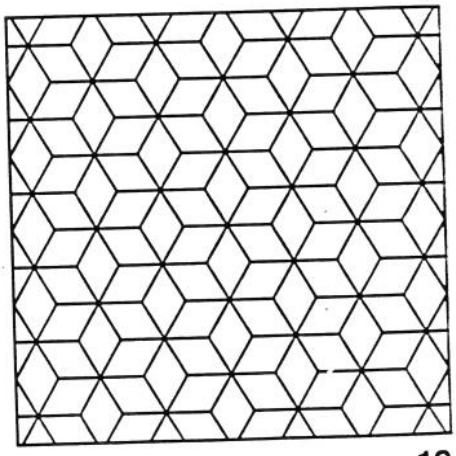

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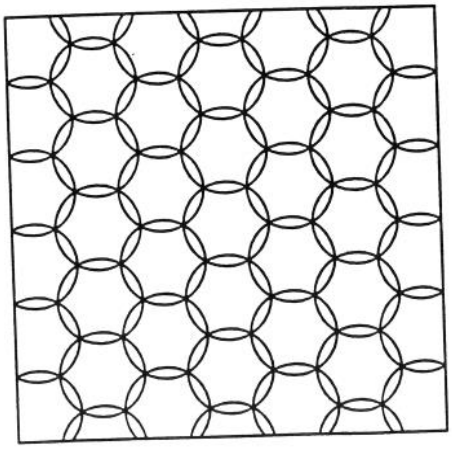

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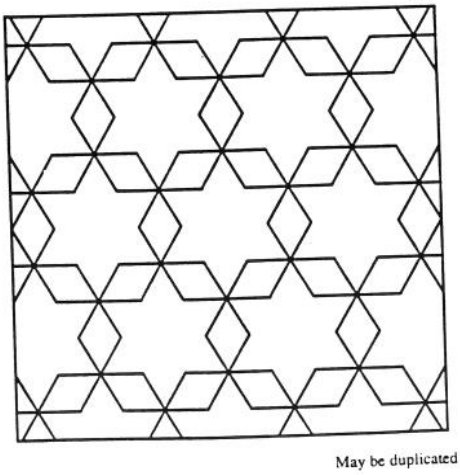

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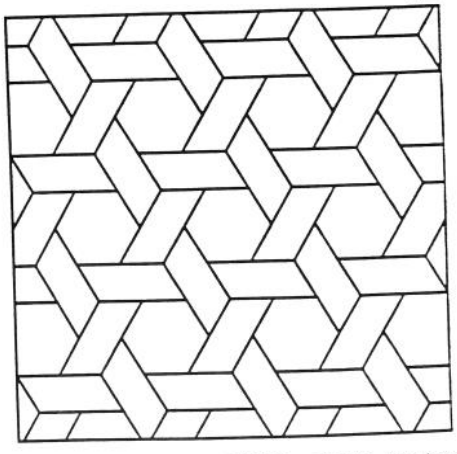
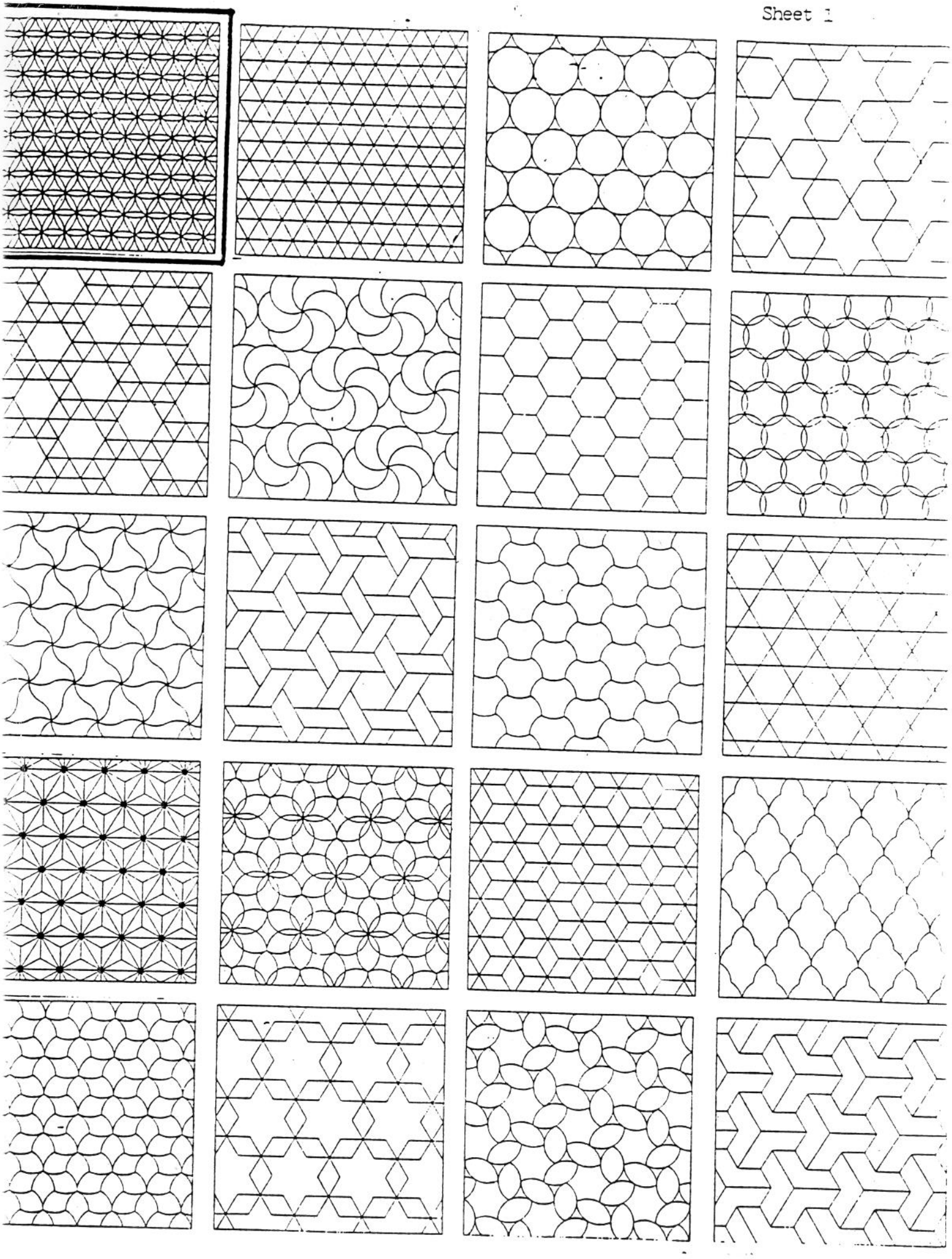
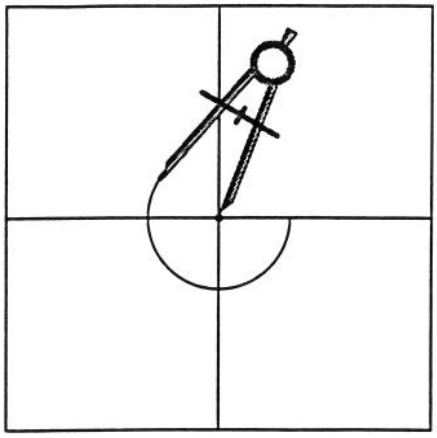
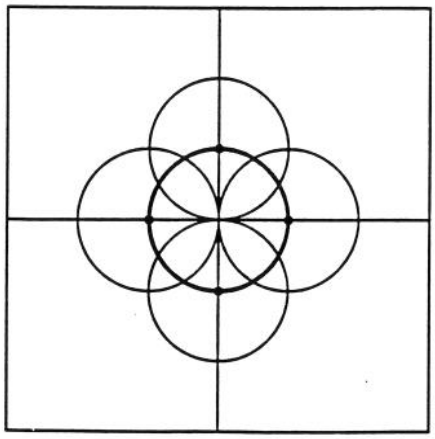




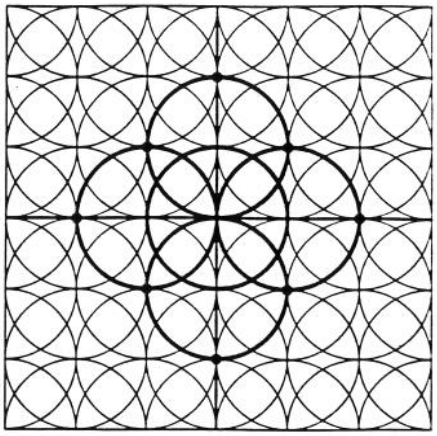
Drawing Circle and Square Grids, and Star-Cross Pattern



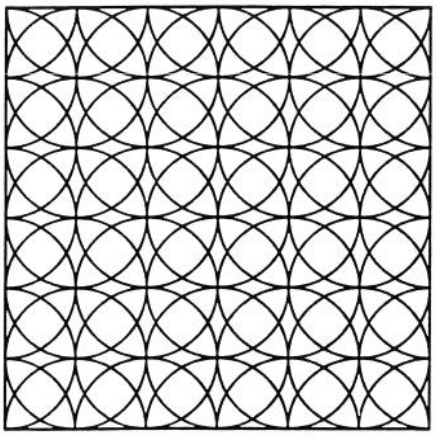
1. Draw a circle with the compass point placed at the intersection of perpendicular lines.



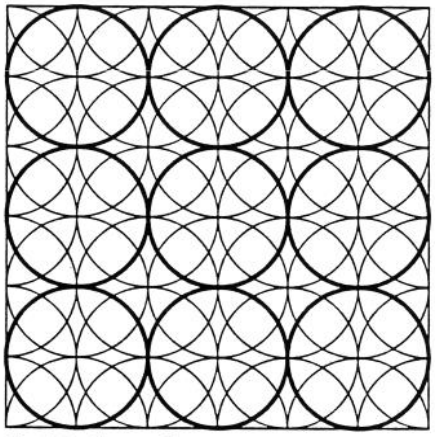
2. Without changing the radius, draw four circles with the compass placed at points of intersection.



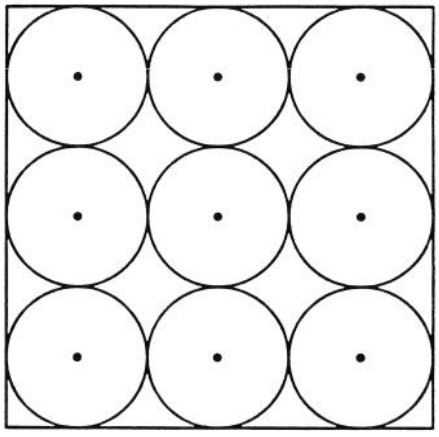
3. Draw more circles at points of intersection, and continue outward in all directions.



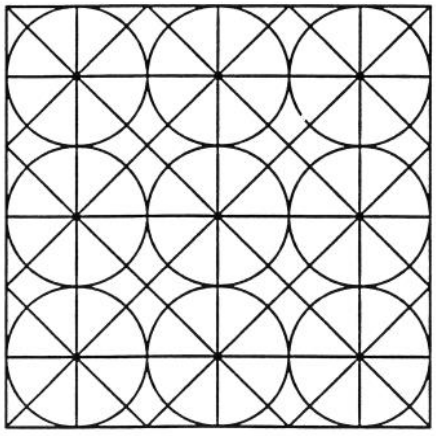
4. The compass produces a network of circles.



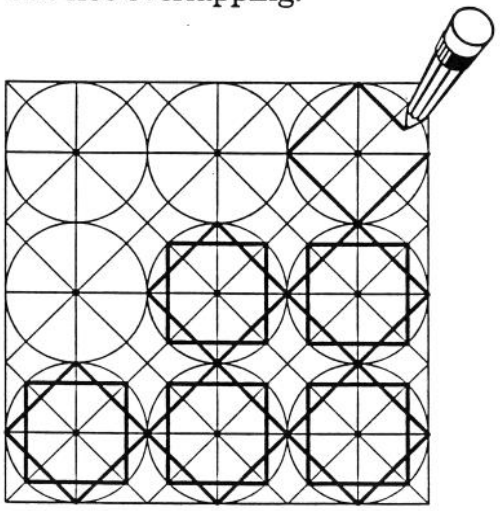
5. Within this network are *tangent* circles - touching but not overlapping.



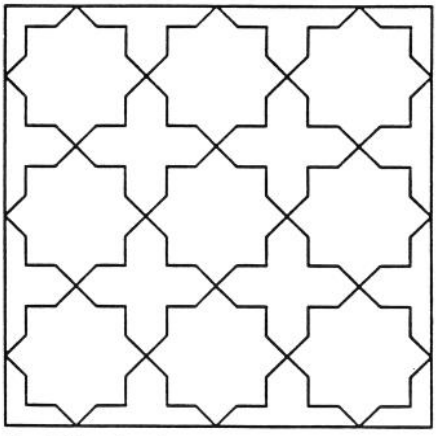
6. Trace these circles, and mark their centers.



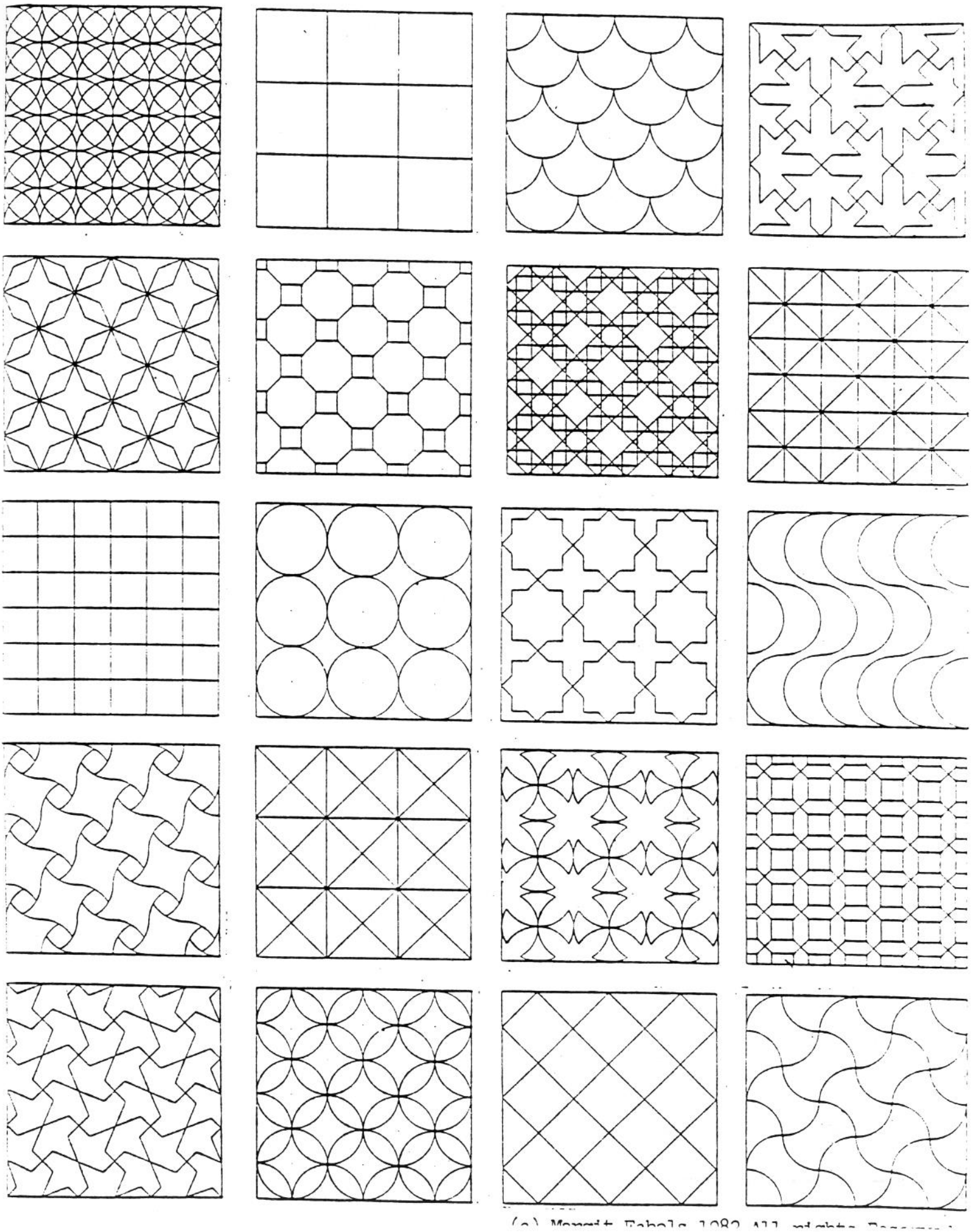
7. Connect the centers to produce a grid of squares intersected by diagonal lines.



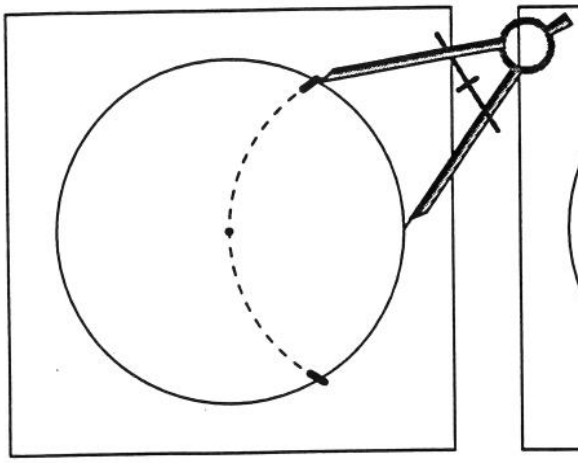
8. Use the grid as a guide to draw overlapping squares in each circle.



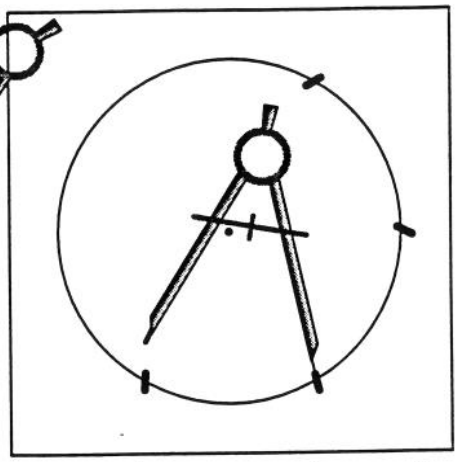
9. Eliminate unnecessary lines to produce the *star-cross* pattern. Discover and draw other patterns using a similar approach.



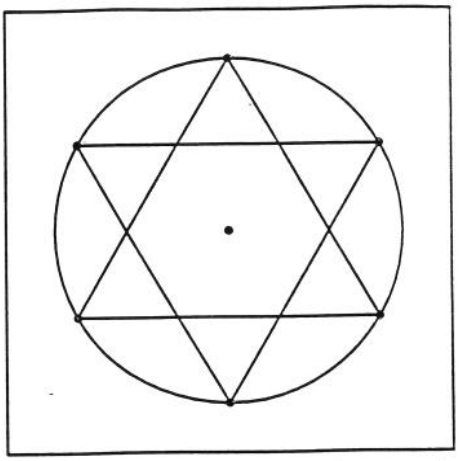
Drawing Six- and Twelve-Pointed Stars



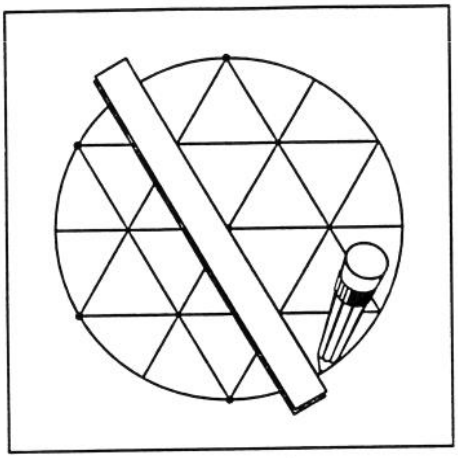
1. Draw a circle. Without changing the radius, place the compass point on the circumference, swing it to each side, and make two marks. These marks *intersect* the circle.



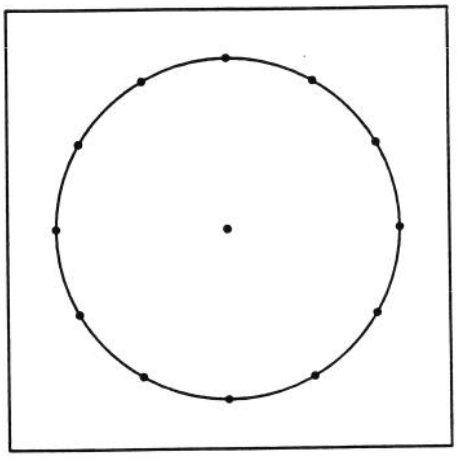
2. Place the compass point at each intersection, swing the compass to each side as before and make two more marks. Repeat until the circle is divided into six equal parts.



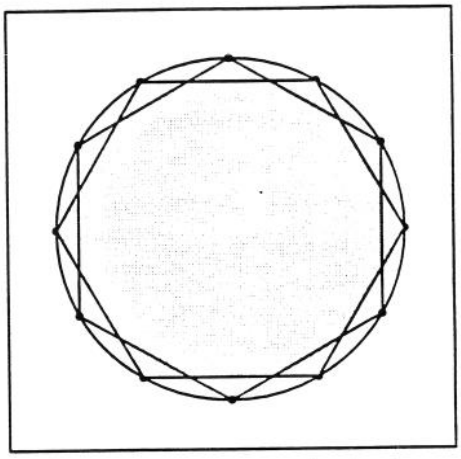
3. Connect every other point to make a six-pointed star. Note the hexagon in the center. How many equilateral triangles does the star contain?



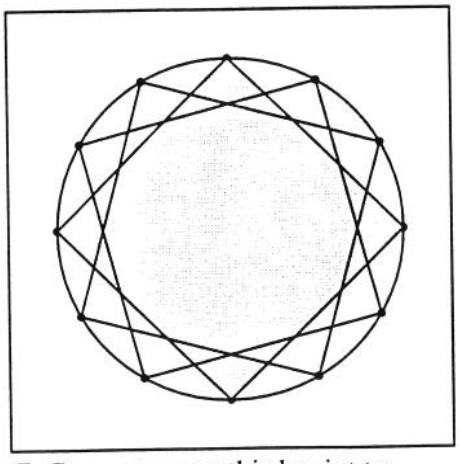
4. Draw lines through the center of the star and opposite vertices of the hexagon...



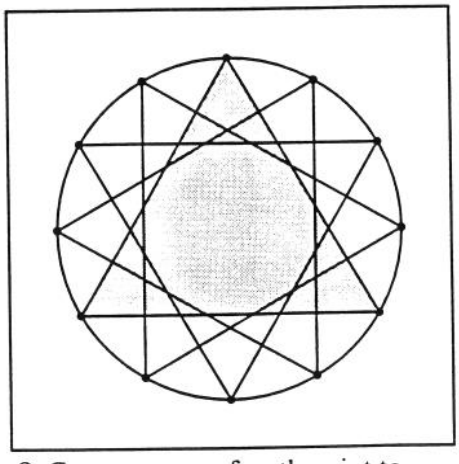
5. ...to divide the circle into twelve equal parts.



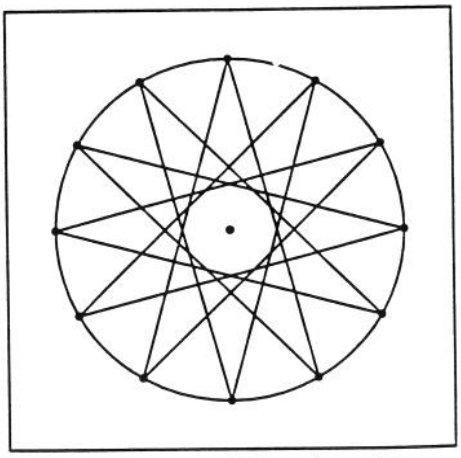
6. Connect every second point to produce two overlapping hexagons.



7. Connect every third point to produce three overlapping squares.

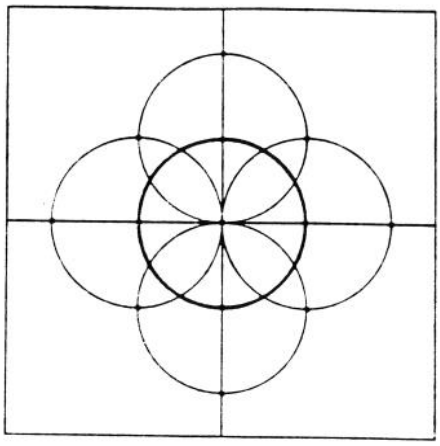


8. Connect every fourth point to produce four overlapping triangles.

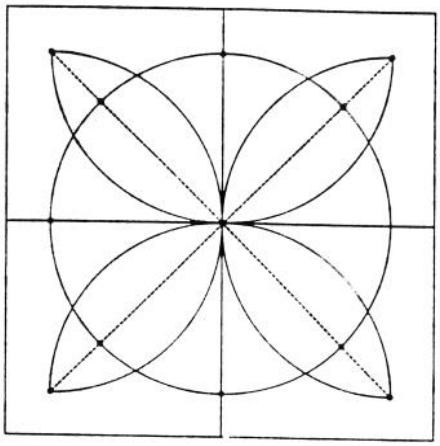


9. Connect every fifth point without lifting the pencil from the paper to produce a "true stellation."

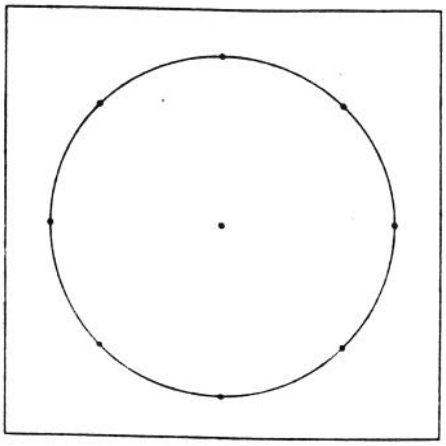
Stars



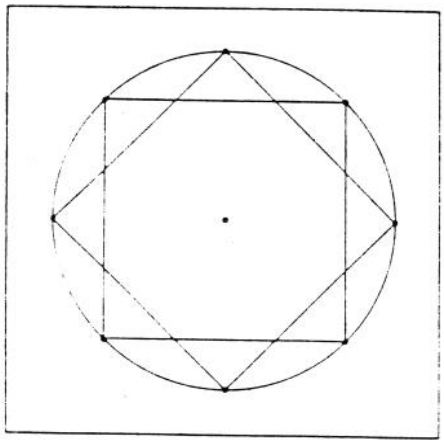
1. Eight-pointed and sixteen-pointed stars are related to the square grid construction. (See previous panel.) Connect the center...



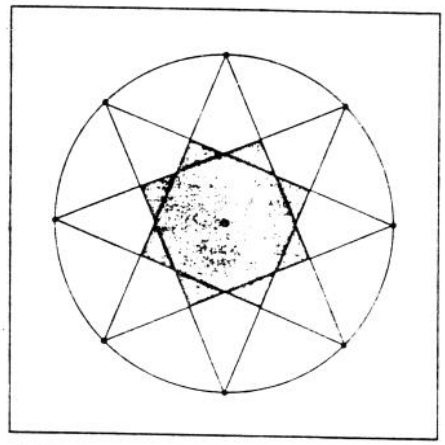
2. ...with points at which the four outer circles intersect.



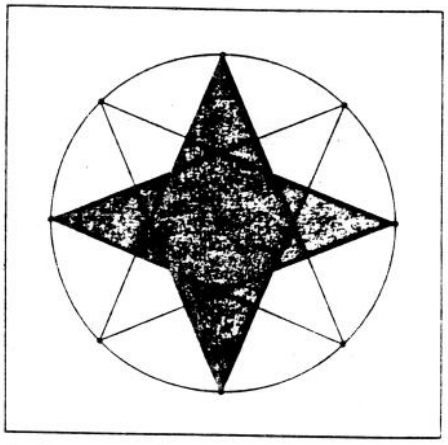
3. This divides the circle in eight equal parts.



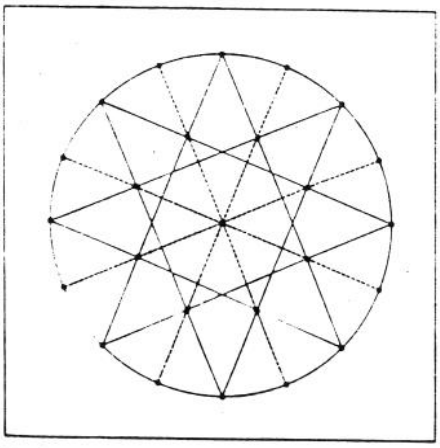
4. Connect every second point to produce an eight-pointed star with overlapping squares and an octagon in the center.



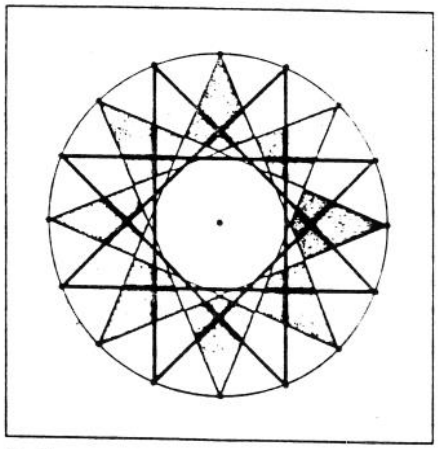
5. Connect every third point without lifting pencil from paper to create a "true stellation." Note that crossing lines produce the 8-pointed star of Fig. 4.



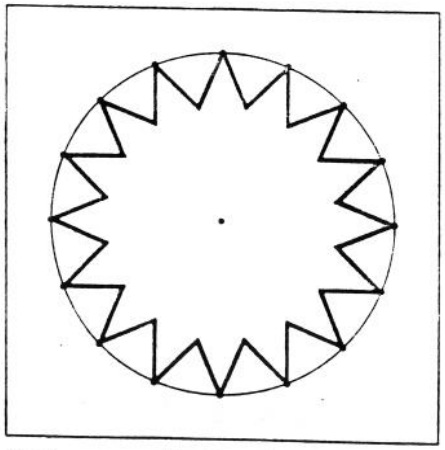
6. A popular four-pointed star is embedded in the eight-pointed star.



7. Connect opposite points in the central eight-pointed star to divide circle into sixteen equal parts.



8. Connect every sixth point to produce a sixteen-pointed star with overlapping eight-pointed stars.



9. Stars were the favorite design element of Islamic artists.