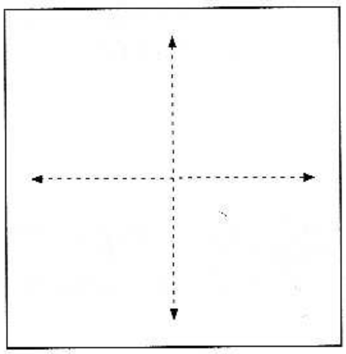
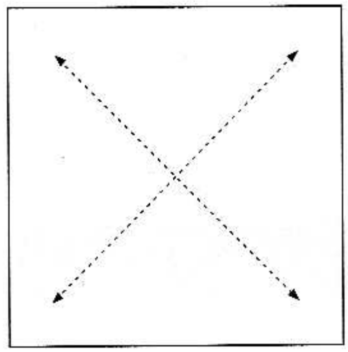
## Types of Two-Dimensional Formats

*Figure 11.27 (a-c) A square consists of four sides of equal length and four equal angles and can have a horizontal, vertical, or diagonal axis.*

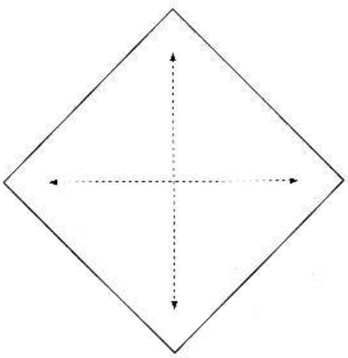
Two- and three-dimensional formats can be any size, shape, or orientation. Each format has a different visual **axis**, stability, and directionality depending on its shape and orientation to the viewer. The most commonly used two-dimensional formats are square and rectangular (see Figures 11.27 and 11.28).



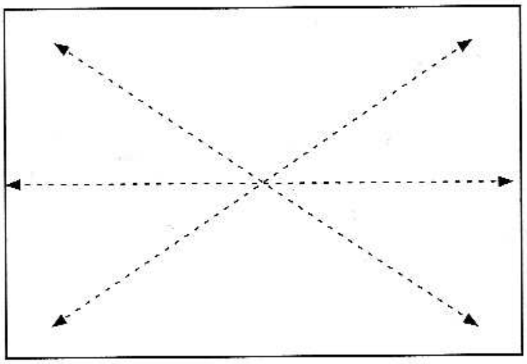
11.27a



11.27b



11.27c

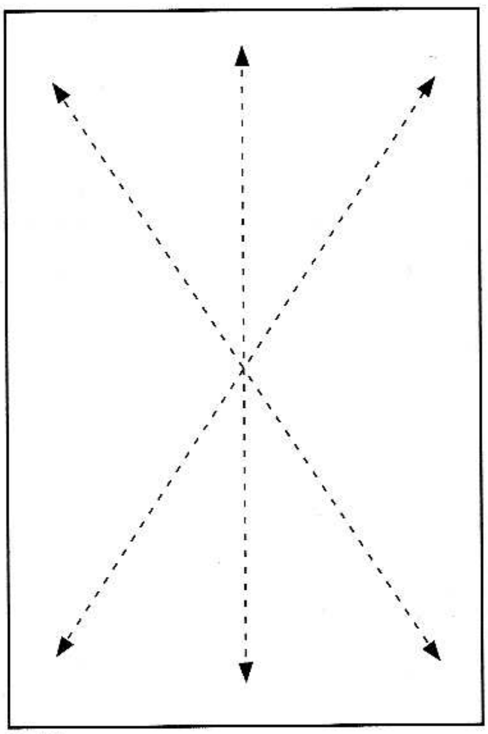


11.28a

*Figure 11.28 (a-b) A rectangle consists of four sides and commonly has a horizontal or vertical axis.*

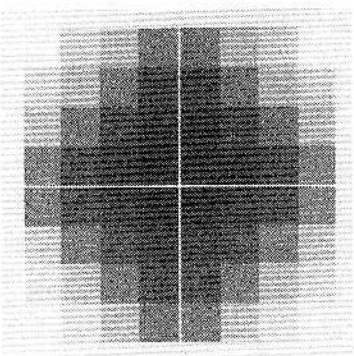
The primary axis of each format can be altered by the placement of the compositional elements. The relationship between the compositional elements and the format, as well as the relationship between the compositional elements themselves affects the overall balance, stability, symmetry, meaning, and unity of the design or work of art.

Square formats can easily accommodate a variety of shapes, sizes, and **directions** of visual elements. Figure 11.29 shows the placement of a combination of square elements within a square format, and Figure 11.30 shows vertical elements (matches) within a square format.

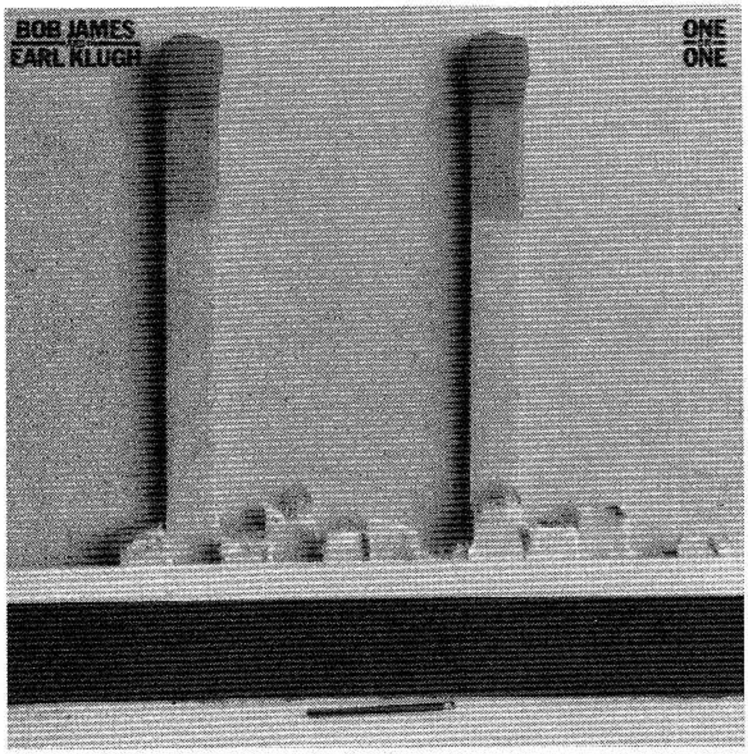


11.28b

The most stable position for a compositional element is in the center of the format. If a relatively large, round compositional element is placed within the center of the format it appears to expand within the area, creating tension between the boundary of the internal shape and the boundary of the format (see Figure 11.31).



11.29




11.30

*Figure 11.29*
***The arrangement and changing value of each of the square elements form a square diamond shape within the format. The horizontal and vertical axes are emphasized.***

*Figure 11.30*
***Parallel vertical elements (matches) illustrate how position and orientation can emphasize one direction or axis more than another. Record cover: Bob James and Earl Klugh,*** **One on One.** ***(Columbia Records © 1979 CBS Inc./® 1979 Tappanzee Records, Inc.)***

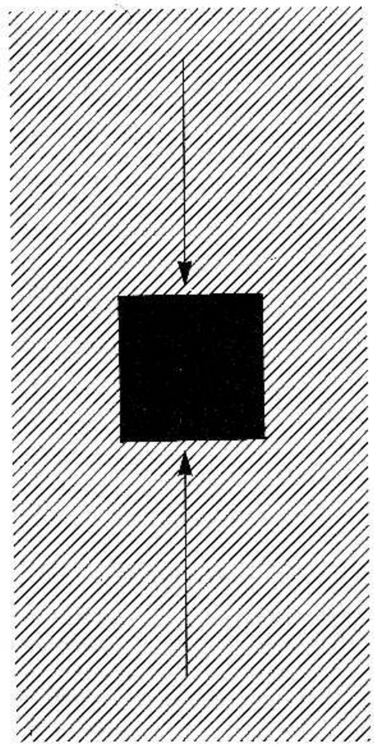
11.31

*Figure 11.31*
***A large compositional figure (Indian head nickel) within a square format creating dominance. Record cover: Bob James,*** **Heads.** ***(Columbia Records © 1977 CBS Inc./® 1977 Tappanzee Records, Inc.)***

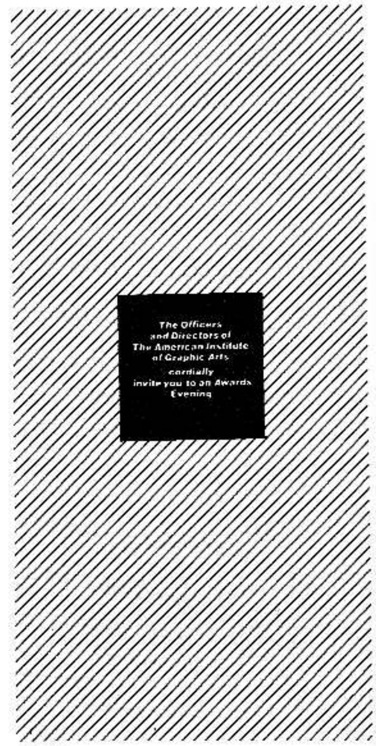
***Figure 11.32 (a-b) The placement of the black square in the middle of the rectangular format draws the viewer's eye to the center, acting as a secondary format where the important information is located (part b designed by David Collie).***

Repetition of the diagonal lines emphasizes the vertical axis in Figure 11.32. The visual weight of the black square in the composition draws the viewer's eye to the center of the format, adding emphasis to the graphic design.

Different formats take on different axis emphases depending on their orientation (horizontal, vertical). Compositional techniques can emphasize or draw attention toward the inherent visual axis of the format (see Figures 11.33–11.36).



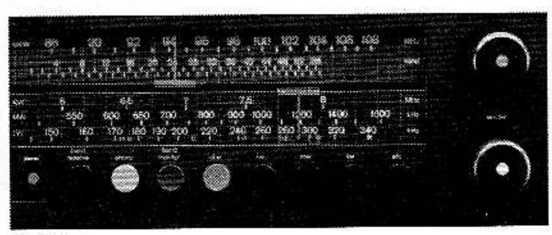
*11.32a*



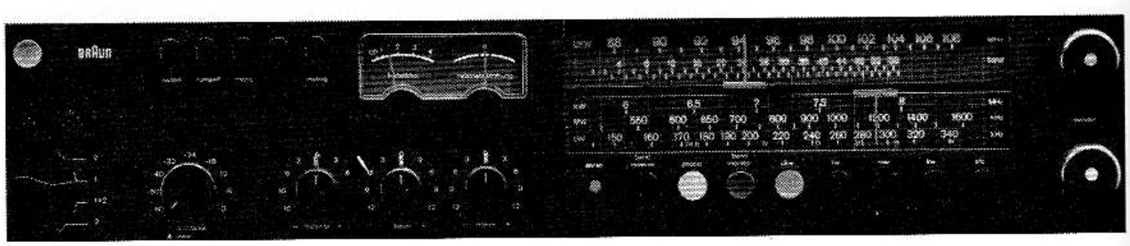

*11.32b*

***Figure 11.33 (a-c) Horizontal format accentuating the associative shape of a stereo system. Brochure for Braun Hi-Fi stereo 520 (Germany).***


*11.33a*

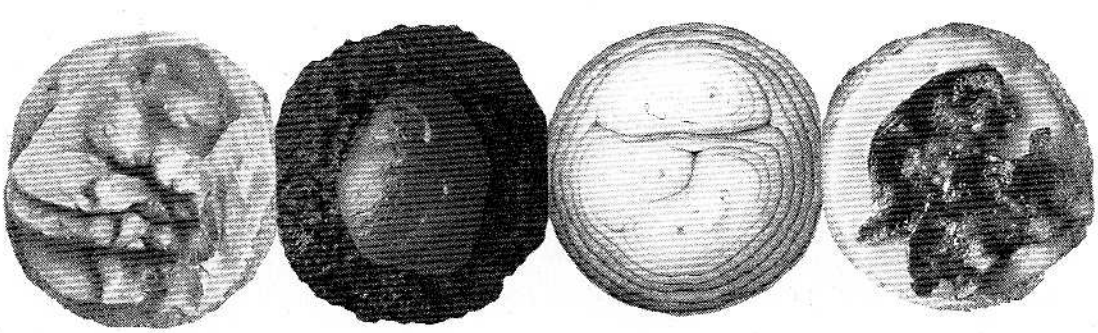


*11.33b*



*11.33c*

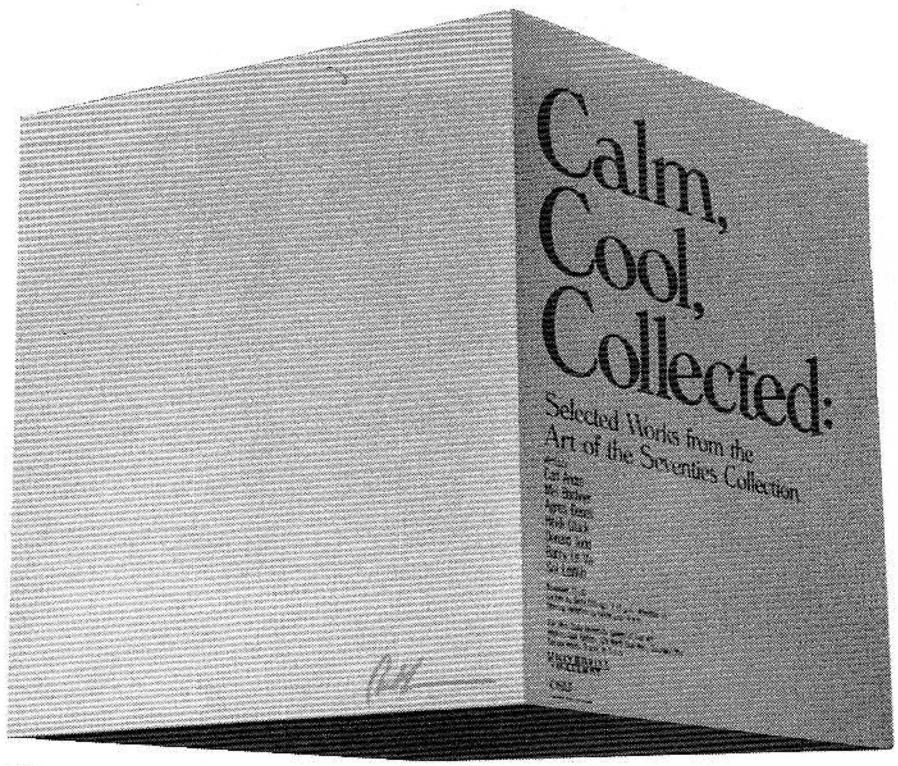

11.34a



11.34b

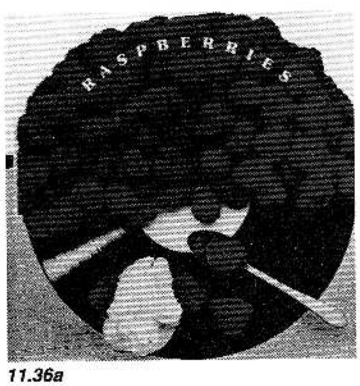
*Figure 11.34 (a-b) A circular format accentuating the associative shape of a hamburger bun. Brochure for Champion Papers (Champion Javelin Coated Offset 18016; designed by Miho).*

***Figure 11.35** Brochure for an art exhibition entitled "Calm, Cool, Collected: Selected Works from the Art of the Seventies Collection," The Ohio State University, College of the Arts. The irregular format creates the illusion of a three-dimensional cube.*

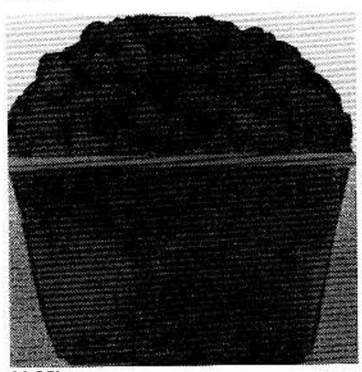



*11.35*

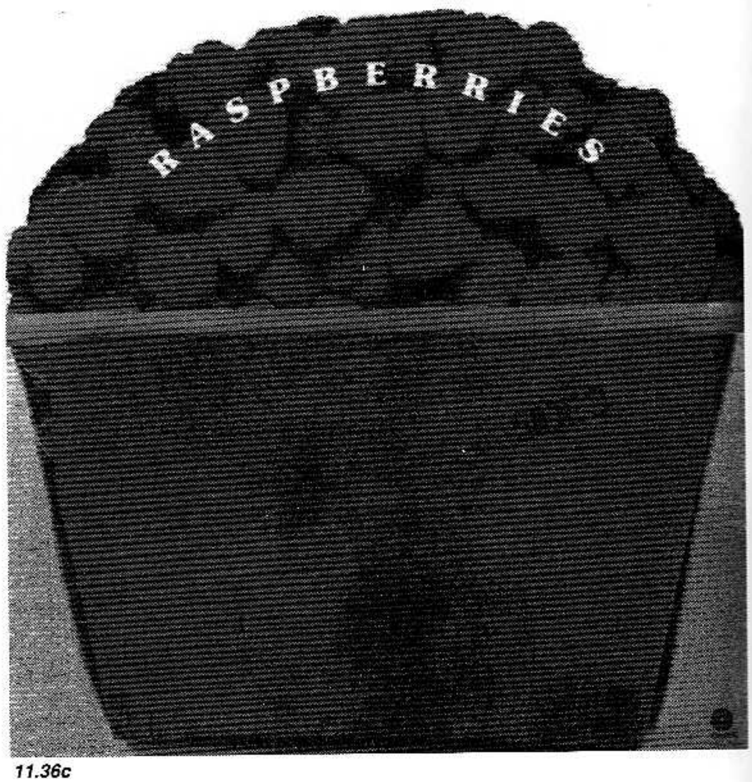
***Figure 11.36 (a-c)** Record cover:* Raspberries, *Side Three, produced by Jimmy Ienner for Capitol Records, Inc. The format takes on the actual shape of the photo illustration (design by Rod Dyer; photography by Bob Gruen and Leandro Correa; art direction by John Hoemle; © 1973, Capitol Records, Inc.).*




*11.36a*



*11.36b*




*11.36c*

## Creating a Visual Message Within a Format

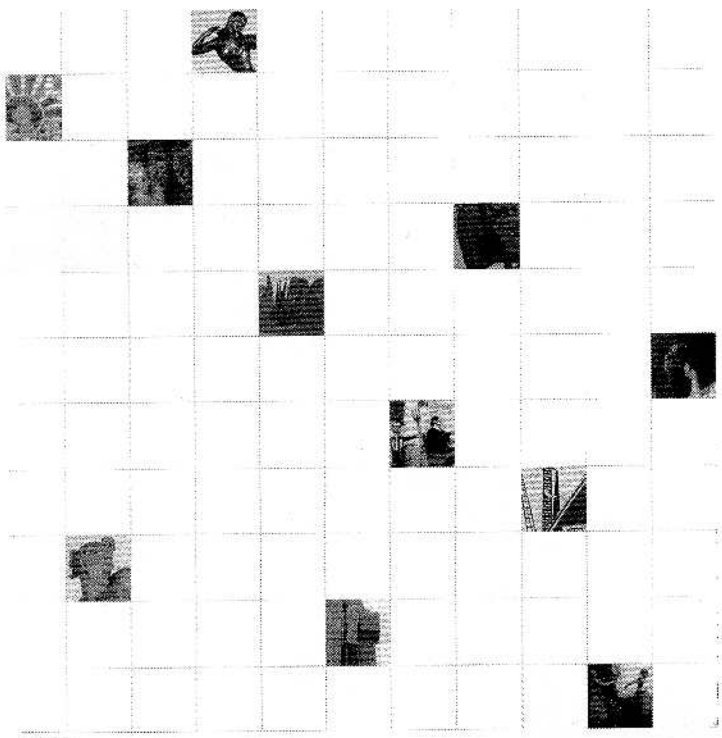
There are several decisions to be made in the visual message-making process. The first consideration is the shape, size, and orientation of the format or picture plane, which can complement the elements, structure, and placement of the message.

## Organizing the Two-Dimensional Format

The format or picture plane can be subdivided into smaller areas; this can influence the message structure and its interpretation. Factors that influence the design of the visual message on a format include the intended reading order or hierarchy, and the compositional structure (see Figure 11.37).

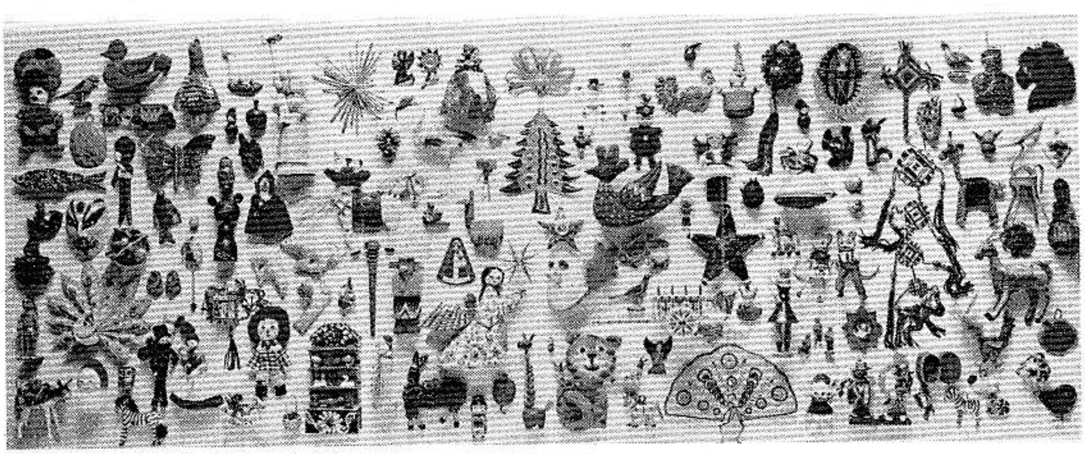
## Grids

The grid is a measuring guide used to help ensure consistency in planning a visual message. A grid shows the type and image area dimensions, trim, and margins, and is used to define constant dimensions of space. By arranging the compositional elements (images and type) within a grid, the visual message can be presented in a logical manner. Many artists, architects, and designers may not use a grid because they rely on other organizational tools and an intuitive sense of visual order, scale, and proportion (see Figure 11.38). However, an understanding of grids and proportion can be helpful in dividing space and organizing visual elements within a format.



11.37

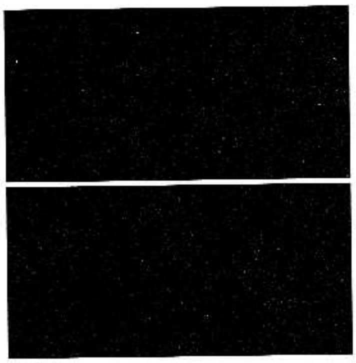
*Figure 11.37 The use of a grid to organize a format area creating a logical and orderly composition (Columbus Museum of Art announcement).*



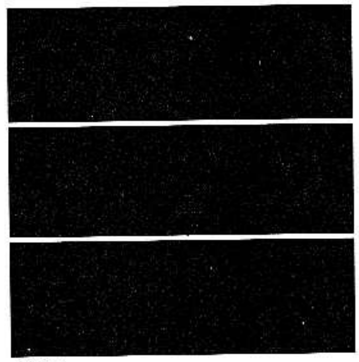
11.38

*Figure 11.38 Visual organization is achieved by arranging the compositional figures according to their size, shape, and physical attributes (designed by Vance Jonson).*

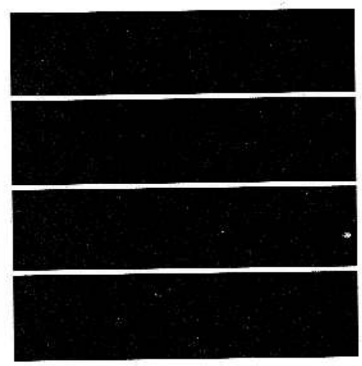
***Figure 11.39 (a-j) A square format can be divided vertically, horizontally, or into smaller, equal areas. Each subdivision allows for the placement of information or compositional figures within the format.***



*11.39a*



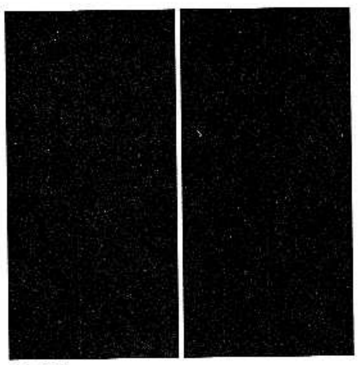
*11.39b*



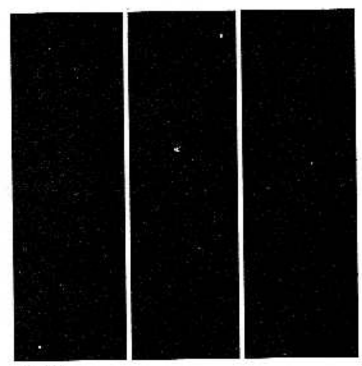
*11.39c*

## Dividing the Format

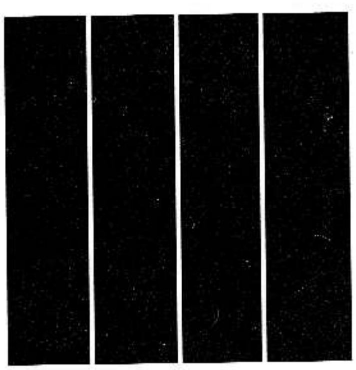
Often the format can be divided into smaller areas to assist in visual organization (see Figures 11.39 and 11.40).



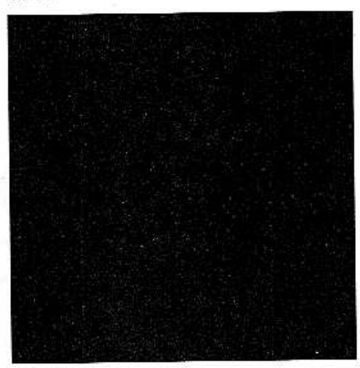
*11.39d*



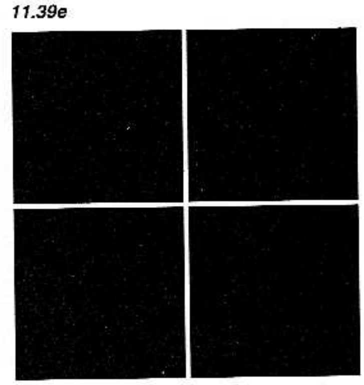
*11.39e*



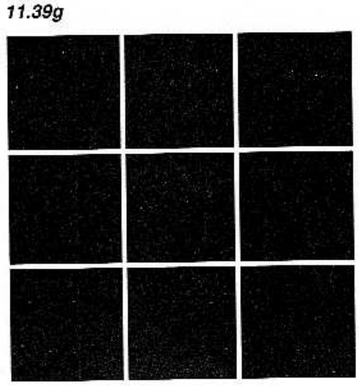
*11.39f*



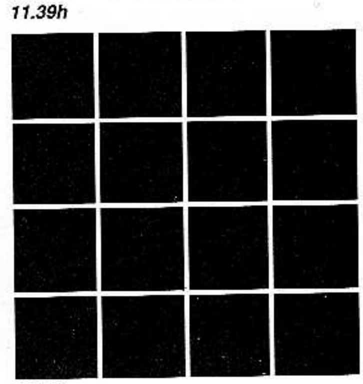
*11.39g*



*11.39h*



*11.39i*



*11.39j*


11.40

*Figure 11.40 Sixteen-page newsprint brochure for the New York City Environmental Protection Administration. The page format uses a grid to indicate columns and consistent margins (designed by Vance Jonson in collaboration with Lawrence Miller).*

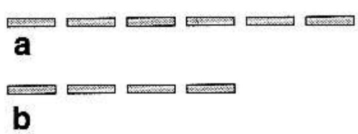
tity between them. For example, a proportion is continuous when the quantities a, b, c, and d have a common number, and a proportion is discontinuous when the quantities a, b, c, and d do not have a common number. Figure 12.88 illustrates the concept of proportion.

## Progression

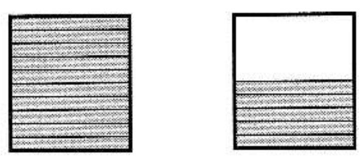
A *progression* is a series of quantities or numbers in which each term is related to its predecessor by a uniform law (see Figure 12.89). In mathematics, there are three kinds of progression: arithmetic, harmonic, and geometric. These are illustrated in Figure 12.90.

An *arithmetic* progression is a series of numbers in which the difference between any two consecutive terms is the same. A *harmonic* progression is a series of numbers in which the reciprocals result from an arithmetic progression. A *geometric* progression is a series of numbers in which the ratio of any two consecutive terms is the same.

Unlike an arithmetic or harmonic progression, a geometric progression results in a proportionality of the terms. Rectangles of the same proportion are created using the geometric progression in two dimensions.

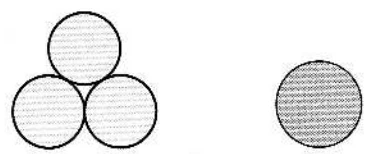



12.87a



10/5 or 10:5

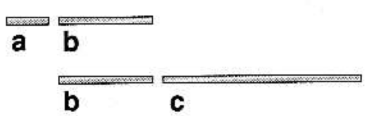
12.87b



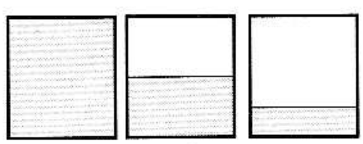
3/1 or 3:1

12.87c

***Figure 12.87** Ratio illustrated as (a) linear quantities, (b) volumetric and weight quantities, and (c) numerical quantities.*

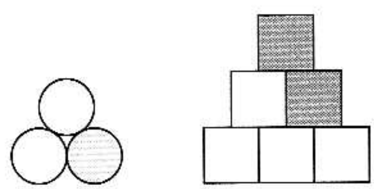



12.88a



40/20 = 20/10

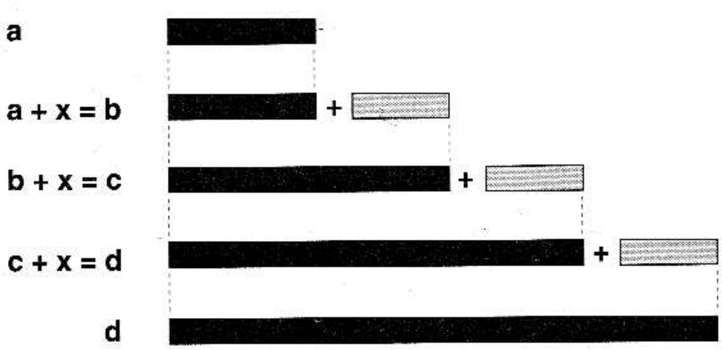
12.88b



1/3 = 2/6

12.88c

***Figure 12.88** The concept of proportion: (a) a is to b as b is to c; (b) continuous proportion; (c) discontinuous proportion.*




12.89

***Figure 12.89** An example of a progression; each new term is related to the previous term.*

1 2 3 4 5 6 7 8 9

12.90a

$$\frac{1}{1}\ \frac{1}{2}\ \frac{1}{3}\ \frac{1}{4}\ \frac{1}{5}\ \frac{1}{6}\ \frac{1}{7}\ \frac{1}{8}\ \frac{1}{9}$$

12.90b

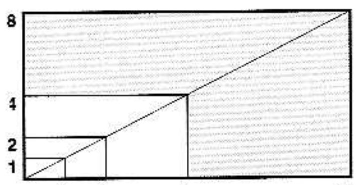
$$\frac{1}{2}\ \frac{2}{4}\ \frac{4}{8}\ \frac{8}{16}\ \frac{16}{32}\ \frac{32}{64}\ \frac{64}{128}$$

12.90c

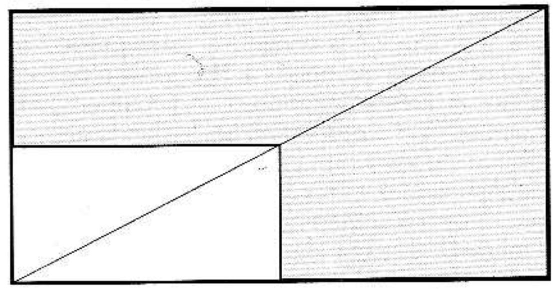
***Figure 12.90** Numerical values illustrating three types of progressions: (a) arithmetic progression; (b) harmonic progression; (c) geometric progression.*

*Figure 12.91 (a) Series of rectangles based on geometric progression quantities; (b-c) similar rectangles have either parallel or perpendicular diagonals.*

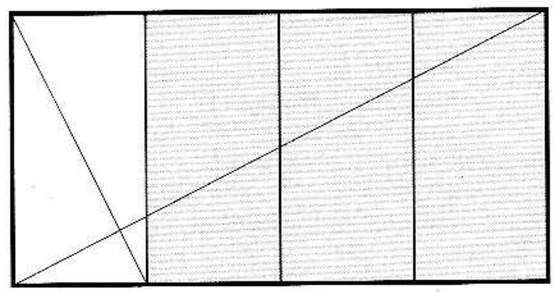
Rectangles are said to be similar when all corresponding angles are equal and all corresponding line segments are proportional. Therefore similar rectangles have either parallel or perpendicular diagonals. Note that any given rectangle can be subdivided into smaller rectangles of the same proportion; however, portions of the rectangle may remain that are not proportional to the original rectangle (see Figure 12.91).




12.91a



12.91b



12.91c

## Root Rectangles

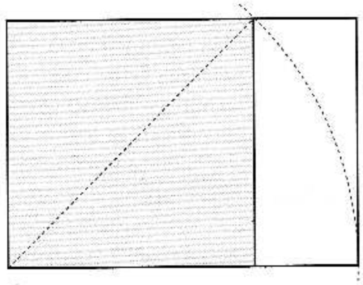
Certain proportional rectangles can be completely subdivided by similar smaller rectangles. These are called square root rectangles and can be derived from a square.

### Constructing Root Rectangles

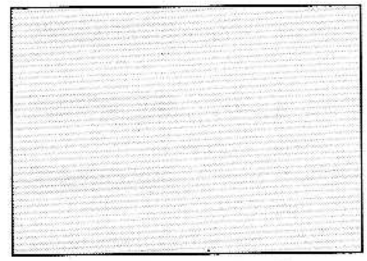
The ratio of a square is 1:1 because the sides are equal lengths. To construct root rectangles, draw a diagonal within a square. The length of the diagonal is $\sqrt{2}$ or approximately 1.414. Using this diagonal as a circle radius, construct an arc that intersects the square's baseline. Enclose this figure with a rectangle. Figure 12.92 illustrates this process. The dimensions of the new rectangle are $1:\sqrt{2}$ and the new figure is called a *root two rectangle* ($\sqrt{2}$).

*Figure 12.92 (a-c) Construction of a $\sqrt{2}$ rectangle from a square.*

12.92a



12.92b



12.92c

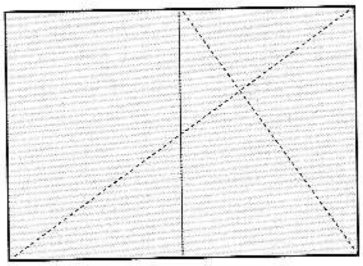
## Subdividing Root Rectangles

According to this definition of root rectangles, the $\sqrt{2}$ rectangle can be subdivided into smaller, similar rectangles that have parallel or perpendicular diagonals. Figure 12.93 shows how to do this.

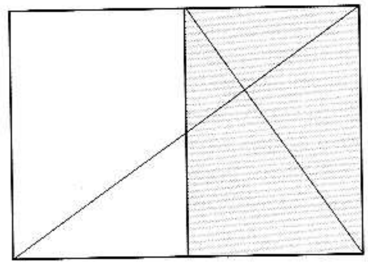
Draw a diagonal line across the $\sqrt{2}$ rectangle. Perpendicular to this diagonal, construct another line. This line intersects a long side of the rectangle and divides it into two smaller similar rectangles. The same procedure can be used for the smaller rectangles, infinitely subdividing the smaller $\sqrt{2}$ rectangles.

## Root Two Rectangle

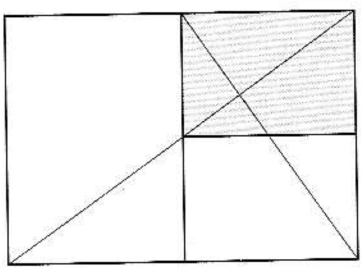
When a root rectangle is subdivided, a gnomon and a reciprocal are created. A *gnomon* is the area remaining after subdivision and the *reciprocal* is the smaller resulting rectangle. The gnomon will always subdivide into an equal number of reciprocals. In the case of a $\sqrt{2}$ rectangle, the gnomon and reciprocal are equal, since the $\sqrt{2}$ rectangle is halved (see Figure 12.94).



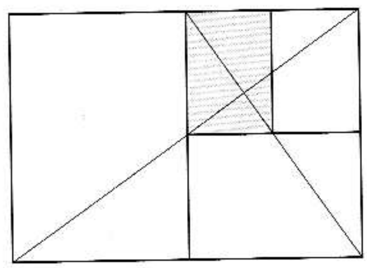
*12.93a*



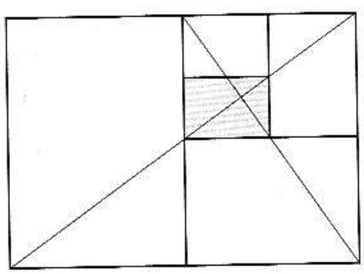
*12.93b*



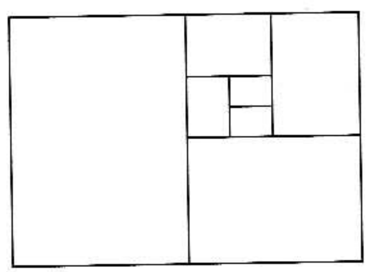
*12.93c*



*12.93d*

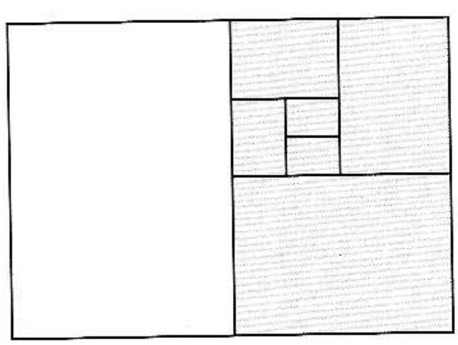


*12.93e*



*12.93f*

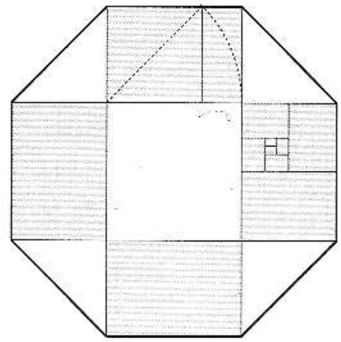
***Figure 12.93 (a-f) Subdivision of a $\sqrt{2}$ rectangle into smaller rectangles.***



*12.94*

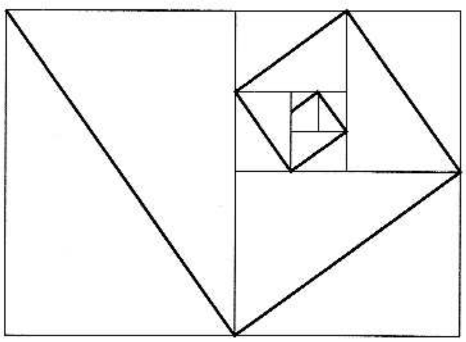
***Figure 12.94 The gnomon (white area) is equal to the reciprocal (gray area) in a $\sqrt{2}$ rectangle.***

Other unique properties of the $\sqrt{2}$ rectangle include the creation of a proportional octagon and of the $\sqrt{2}$ diminishing spiral (see Figures 12.95 and 12.96). The most common use of the $\sqrt{2}$ rectangle is in the European system of paper sizes, called the DIN System (see Figure 12.97).



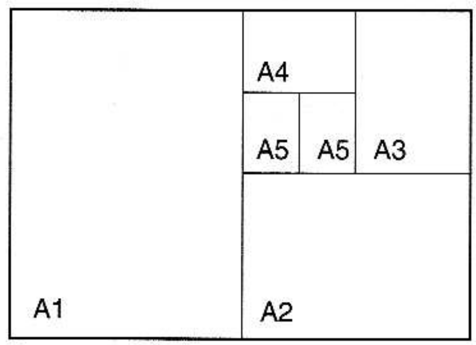
12.95

*Figure 12.95 A proportional octagon created using the $\sqrt{2}$ rectangle.*



12.96

*Figure 12.96 A spiral created by the configuration of the diagonals in a subdivided $\sqrt{2}$ rectangle.*

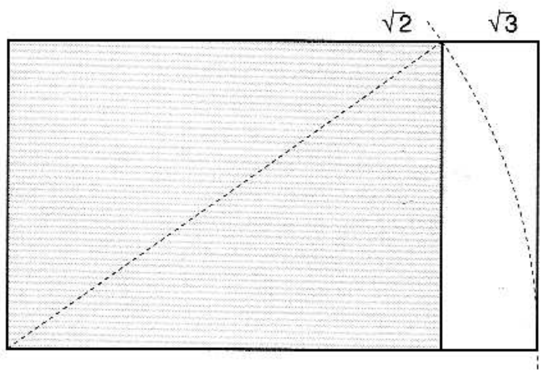



12.97

*Figure 12.97 A construction of the European DIN System of paper sizes, based on $\sqrt{2}$ rectangle.*

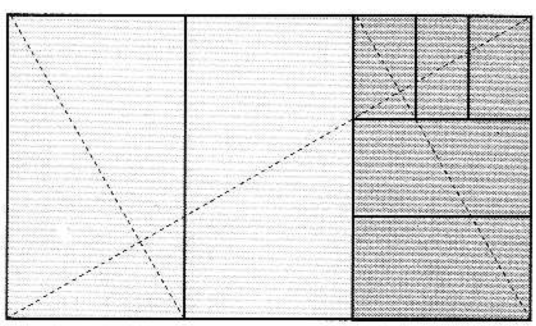
## Root Three Rectangle

The $\sqrt{3}$ rectangle is constructed from the $\sqrt{2}$ rectangle by drawing a diagonal line across the rectangle and striking an arc to its base (see Figure 12.98). Then the $\sqrt{3}$ rectangle is subdivided into three equal rectangles by projecting a line perpendicular to the base. The diagonals are drawn as illustrated in Figure 12.99.




12.98

*Figure 12.98 Construction of a $\sqrt{3}$ rectangle from a $\sqrt{2}$ rectangle.*



12.99

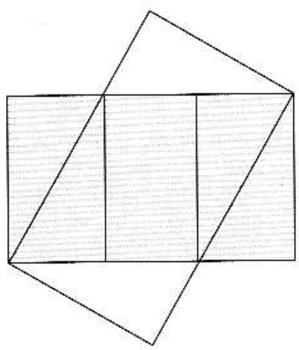
*Figure 12.99 Subdivision of a $\sqrt{3}$ rectangle.*

A regular hexagon can be constructed from the $\sqrt{3}$ rectangle by rotating the $\sqrt{3}$ rectangle about a center axis until the corners meet (see Figure 12.100).

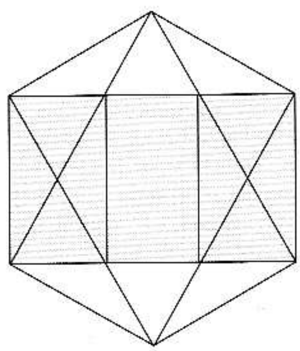
The hexagonal prismatic form is found frequently in nature.

## Root Four Rectangle

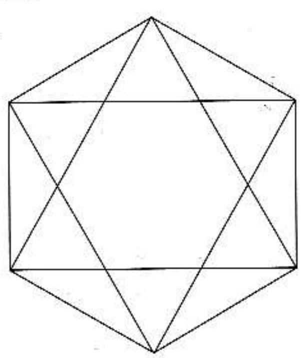
The $\sqrt{4}$ rectangle is known as the "double square" rectangle because its long side is two units and its short side is one unit (see Figure 12.101). It is constructed from the $\sqrt{3}$ rectangle, in the same manner as the $\sqrt{2}$ and $\sqrt{3}$ rectangles, or by placing two squares adjacent to each other. Like all root rectangles, the $\sqrt{4}$ rectangle can be subdivided into an equal number of smaller, similar rectangles, as illustrated in Figure 12.102.



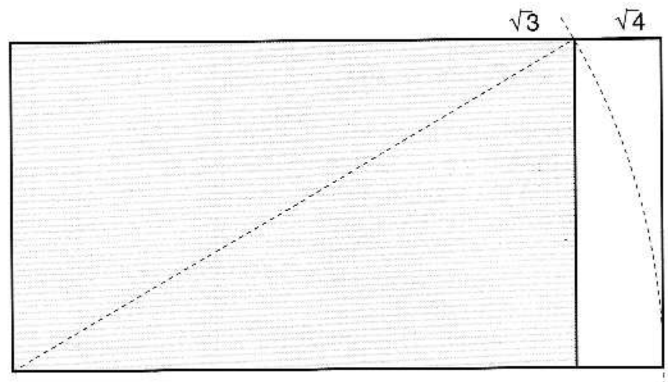
12.100a



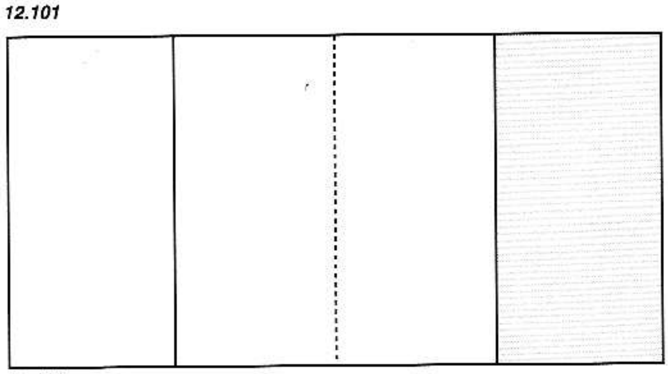
12.100b



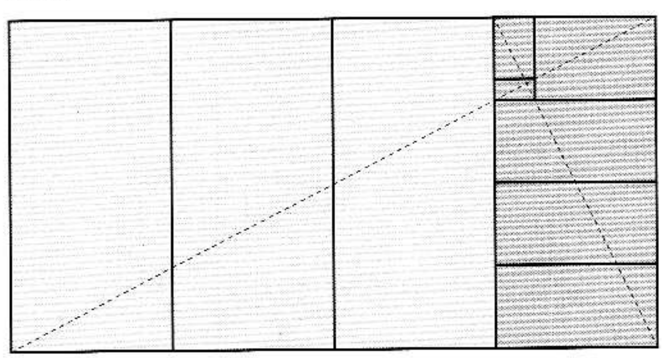
12.100c




12.101



12.102a



12.102b

***Figure 12.100 (a-c) The construction of a regular hexagon by rotating $\sqrt{3}$ rectangles two times around a center axis until the corners meet.***

***Figure 12.101 Construction of a $\sqrt{4}$ rectangle from a $\sqrt{3}$ rectangle.***

***Figure 12.102 (a) When divided, the $\sqrt{4}$ rectangle equals two squares. The $\sqrt{4}$ rectangle equally subdivides into four congruent parts. (b) The $\sqrt{4}$ rectangle is subdivided in the same manner as other rectangles, by first drawing a diagonal, then a perpendicular line through a corner.***

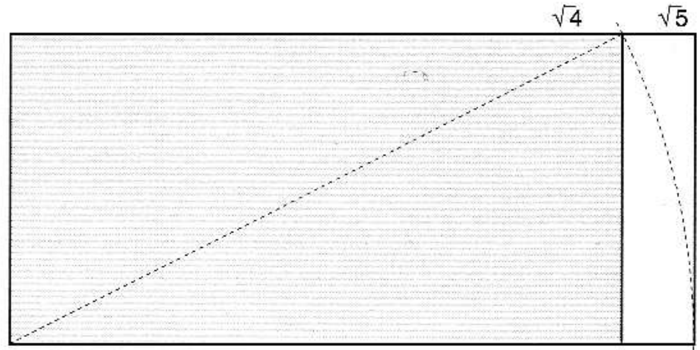
## Root Five Rectangle

The $\sqrt{5}$ rectangle is constructed from the $\sqrt{4}$ rectangle, in the same manner as the other root rectangles (see Figure 12.103).

A $\sqrt{5}$ rectangle can be subdivided into five smaller, similar rectangles. The procedure is identical to the subdivision of other root rectangles. Each rectangle's reciprocal can then be divided into five smaller rectangles, ad infinitum (see Figure 12.104).

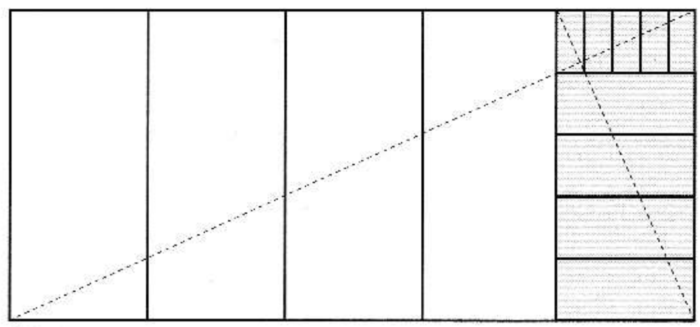
A second construction method for the $\sqrt{5}$ rectangle is based on the square. From the midpoint of the base side, strike a 180° arc through the top two corners. Extend the square on both sides to create a $\sqrt{5}$ rectangle. This procedure is illustrated in Figure 12.105.

***Figure 12.103 Construction of a $\sqrt{5}$ rectangle from a $\sqrt{4}$ rectangle.***



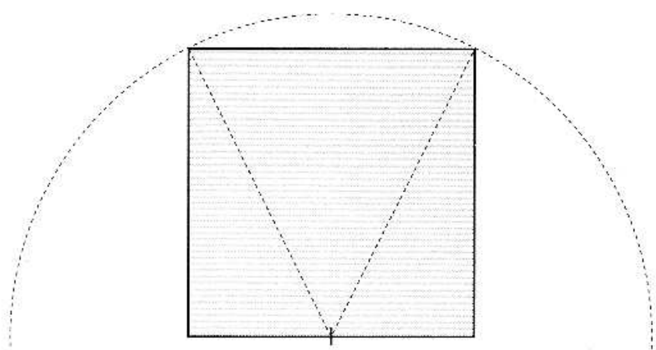

*12.103*

***Figure 12.104 The $\sqrt{5}$ rectangle subdivides into smaller congruent rectangles.***

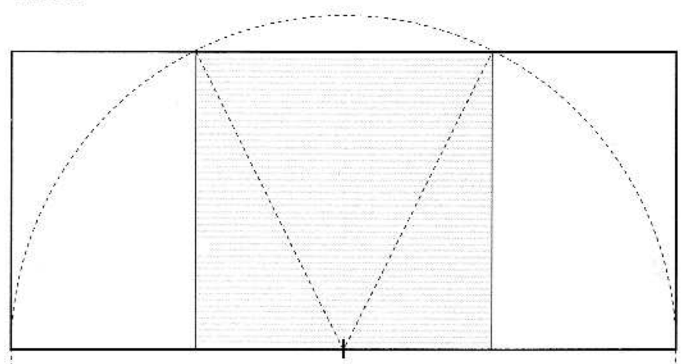


*12.104*

***Figure 12.105 (a-b) Another method of constructing a $\sqrt{5}$ rectangle from a square.***



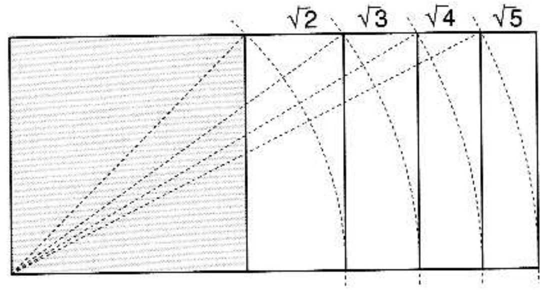
*12.105a*



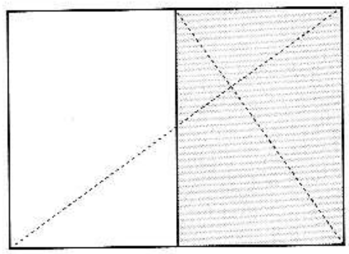
*12.105b*

## Root Rectangle Construction

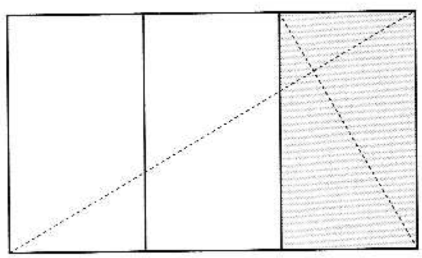
Generating root rectangles from a square illustrates the relationship of the rectangles to each other. Figure 12.106 illustrates how each of the four types of rectangles just discussed can be equally subdivided.



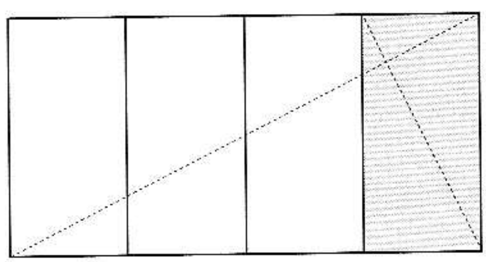

12.106a



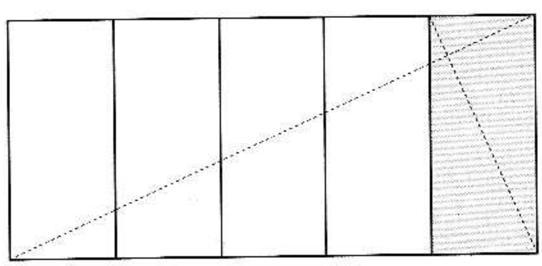
12.106b



12.106c



12.106d



12.106e

***Figure 12.106 (a) Generating the root rectangle from a square, illustrating the relationship of the rectangles to each other. (b-e) $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, $\sqrt{5}$ rectangles and their internal subdivisions.***

***Figure 12.107 (a-h) Sequence illustrating the construction of a regular pentagon from a $\sqrt{5}$ rectangle.***

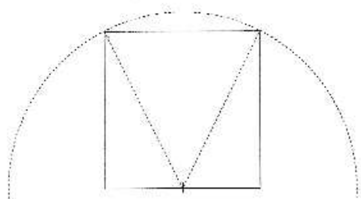
## ✍Practice Exercise 12.3: Constructing a Pentagon from a Root Five Rectangle

The $\sqrt{5}$ rectangle forms the basis for construction of the regular pentagon, which is a figure consisting of five equal sides and angles. This is illustrated in Figure 12.107. Begin this exercise by constructing a square, then divide the base side of the square in half. From this midpoint, draw a diagonal to the top corners of the square. Using a compass, construct a 180° arc tangent to both top corners of the square, and intersect an imaginary line on which the base of the square is established.

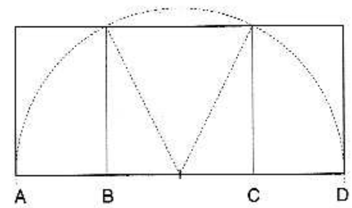
The distance between the two intersecting arc points is a $\sqrt{5}$ rectangle. Measure the distance between point A and C and point B and D. Lines AC and BD should be equal. Draw an arc from point C through point A. Draw another arc from point B through point D.

Point E marks the intersection of the arcs midway over the rectangle and defines the height of the pentagon. Measure the line BC (it should be one unit because it is the dimension of the square). This line is equal to the length of each of the pentagon sides.

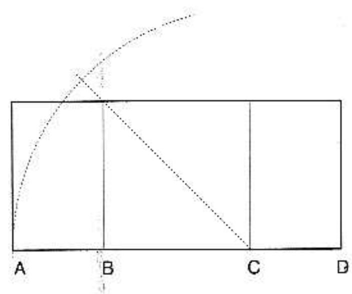
From point B swing an arc of one unit radius. Repeat the procedure from point C. Using the same radius, swing arcs from point E so that they intersect the arcs of equal radius from points B and C. Connecting the intersecting points creates a regular pentagon.



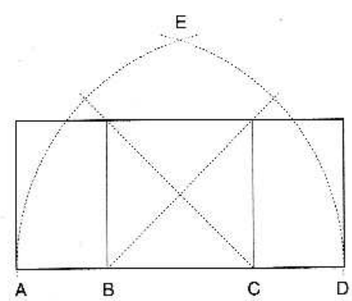
12.107a



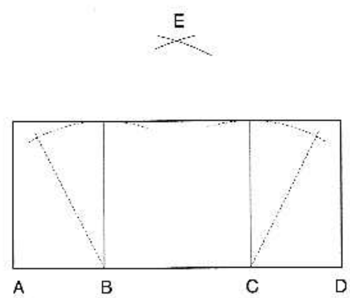

12.107b



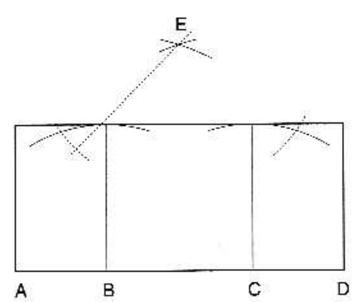

12.107c



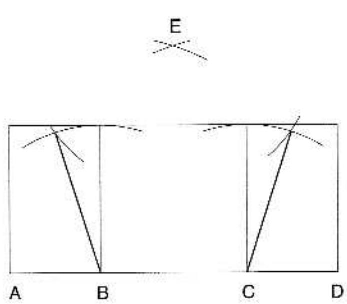

12.107d



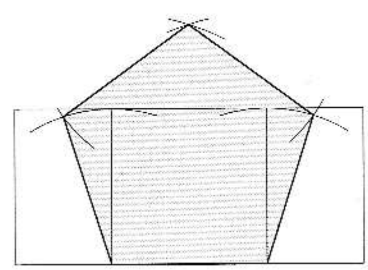

12.107e




12.107f




12.107g



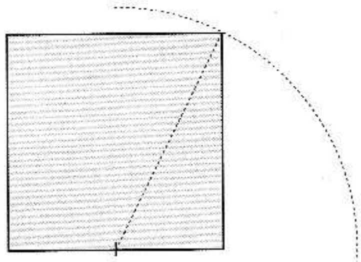
12.107h

## Golden Mean

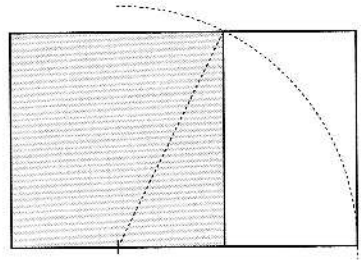
The $\sqrt{5}$ rectangle is closely related to the golden mean rectangle. The golden mean is not a root rectangle because it does not subdivide into an exact number of similar rectangles. What makes the golden mean unique is that its reciprocal is a smaller rectangle and its gnomon is a square. This can best be understood by drawing its construction as shown in Figure 12.108.

The golden mean can be subdivided in the same manner as root rectangles. Note in Figure 12.109 that when subdivided, a golden mean always produces a square and a smaller golden mean rectangle. The golden mean rectangle has a ratio of 1:1.618.

Because of its unique properties the golden mean is sometimes called the "whirling square" rectangle. Proportionally decreasing squares can produce a spiral by using the length of their sides for the radius of a circle as shown in Figure 12.110. Figure 12.111 shows how this technique can result in a proportional spiral.

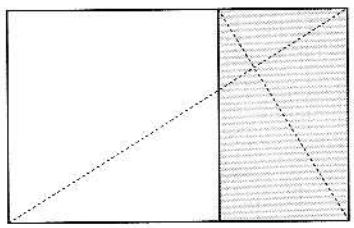


12.108a

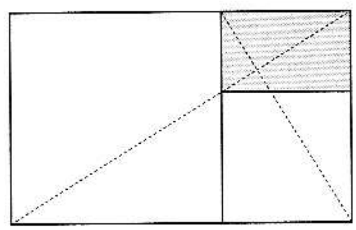


12.108b

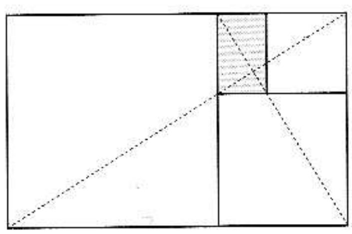
***Figure 12.108 (a-b) Construction of a golden mean rectangle.***



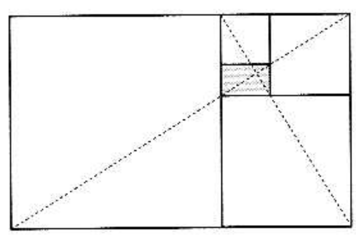
12.109a



12.109b

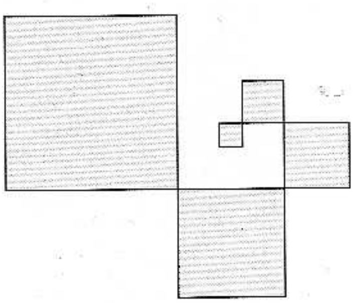


12.109c

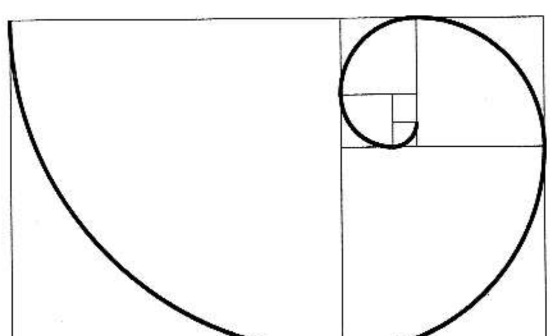


12.109d

***Figure 12.109 (a-d) Subdividing a golden mean rectangle.***



12.110



12.111

***Figure 12.110 Construction of the "whirling square" based on golden mean proportions.***

***Figure 12.111 A proportional spiral drawn using the corners of the squares as center points for the arcs.***