LESSON 7  PATTERNS

STRUCTURE

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7. **Patterns**

In the last unit of Nature Study-I you studied about different shapes of leaves and their varying structures from plant to plant. Then a variety of flowers, the different forms of flower, their texture and magnificent colours had been discussed thoroughly. We also learned to draw the basic shapes of these leaves and flowers along with the technique of shading and filling. Now in the present Unit of Nature Study-II we will take up more interesting facts and figures of varying patterns of vegetable and fruits and plants and trees in its subsequent lessons.

7.0 **Objectives**

This lesson on patterns will enable you to

- Understand patterns existing in Nature, in leaves, flowers vegetables, and fruits.
- Understand that while things around us may appear random, there is definite structure underlying them.
- Draw a subject with understanding of its structure, and therefore its typical characteristics.

7.1 **Introduction**

In lesson 6, you made a detailed study of flowers. There was a brief mention, as you may recall, of the five petalled structure of the Rose flower. In this lesson you will study drawing of vegetables and fruits as a whole object and in cross section.

Let us have a brief introduction to the structure in these objects in nature. What is seemingly random, and may appear chaotic at first glance, the plants, trees, minerals, animals, humans actually have an underlying structure and pattern. While pentagonal patterns abound in living forms, the mineral world favors two fold, three fold, four fold, and six-fold symmetry.

7.2 **Patterns in Nature**

Patterns govern structure throughout Nature. There are recognizable patterns in plants and trees like:

i) Patterns of Proportion in size

ii) Patterns in placement of leaves
iii) Patterns in the number of leaves, petals, seeds, etc.

iv) Patterns in shape of flowers, vegetables, fruits, seeds etc.

In fact, there is a definite geometry at work where these patterns are concerned.

Let us go through some of these for the wonder that they are, and how basic knowledge of simple structure of the subject can help us to understand the leaf, the flower, the fruit, and the tree better. Remember, drawing is not merely looking. It involves seeing, observing, understanding and then translating them into a representation with a medium onto the paper. What you will now learn will be only indirectly helping you in learning the skill of drawing.

7.2.1 Patterns in number and arrangement of petals

There is in geometry a well recognized Golden Ratio of 1:1.618. This is supposed to be the most economical ratio of growth in configuration of geometrical forms.

In nature, we find that the Golden Ratio is not an absolute, but a proportion that tend towards 1:1.618. If you are asked to draw a rectangle that pleases you, it is most likely that the ratio of its length to width will be a Golden Ratio. A rectangle of the size 5 cm x 8 cm could be one such example. It is also the most aesthetic and pleasing rectangle.

An interesting progression of Golden Ratio is FIBONACCI NUMBERS, that refers to a series of numbers wherein each number is a total of the two numbers preceding it, and the ratio of two consecutive numbers is a Golden Ratio such as 1, 2, 3, 5, 8, 13, 21, 34.

The Fibonacci Numbers and Golden Ratio are widely found in the plant kingdom. In nearly all flowers, the number of petals is a Fibonacci number. Non-Fibonacci Numbers do not occur often. For instance, very few plants have 4 petals, some exceptions being Fuchsia and Mustard. Some plant species, such as Buttercups, are very precise with regard to the number of petals they have, but with others only the average number of petals is a Fibonacci number.

Probably most of us have never taken time to examine very carefully the number or arrangement of petals in a flower. If we were to do so, several things would become apparent. First, we would find that the number of petals on a flower is often one of the Fibonacci Numbers. One-petalled flowers as in White Calla Lily (Fig. 7.1) and two-petalled flowers as in Euphorbia (Fig. 7.2) are not common. Three petals, as in Trillium are more common (Fig. 7.3).

There are hundreds of species, both wild and cultivated, with five petalled flowers (Fig. 7.4). Eight-petalled flowers are not as common as five-petalled, but there are quite a number of well-known species with eight (Fig. 7.5). Thirteen (Fig. 7.6), twenty-one and thirty-four petalled flowers (Fig. 7.7) and are also quite common.

The outer rings of ray florets in the daisy family illustrate the Fibonacci sequence extremely well. Daisies with 13, 21, 34, 55 or 89 petals are quite common. Ordinary field daisies have 34 petals, a fact to be taken into consideration when playing "she loves me, she loves me not". In saying that daisies have 34 petals, one is generalizing about the species - but any individual member of the species,
may deviate from this general pattern. There is more likelihood of a possible under-development than over-development, so that 33 is more common than 35.

7.2.2 Patterns in number and arrangement of leaves

The association of Fibonacci numbers and plants is not restricted to number of petals. Figures 7.8 – 7.12 are schematic diagrams of a simple plant, the Sneezewort. New shoots commonly grow out from the stem from a point in the axil of leaf (Fig. 7.8). If we draw horizontal lines through the axils, we can detect obvious stages of development in the plant (Fig. 7.9). The main stem produces lateral branches at the beginning of each stage. The lateral branches rest during their first two stages, then produce new lateral branches at the beginning of each subsequent stage.

The same law applies to all branches. Since this pattern of development mirrors the growth of the rabbits in Fibonacci’s classic problem, it is not surprising then that the number of branches at any stage of development is a Fibonacci Number (Fig. 7.10). Furthermore, the number of leaves at any stage will also be a Fibonacci Number (Fig. 7.10). The type of growth exhibited by the sneezewort also occurs in simple tree growth, each stage of development lasting one year (Figs. 7.11, 7.12).
The schematic diagrams of the sneezewort tree have been presented as though the plants were flat. This illustrates the development which leads to Fibonacci Numbers, but it suppresses the characteristic of a majority of plants where successive leaves or shoots spiral around the main stem with successive stages of development. Suppose we fix our attention on the leaf at the bottom of a stem on which there is a single leaf at any one point (Fig. 7.13). If we number that leaf as "0" (Fig. 7.14) and count the leaves up the stem until we come to the one which is directly above the starting one, the number we get is generally one of the Fibonacci sequence (Fig. 7.15).

Again, as we work up the stem, let us count the number of times we revolve around it (Fig. 7.16). This number too is generally, a number of the sequence (Fig. 7.17). The arrangement of leaves can then be expressed as a ratio. The number of leaves in our sample plant is 8, and the number of revolutions 5.

The plant is said to have phyllotaxy 5/8. Each species is characterized by its own phyllotaxy. Almost always the ratios encountered are ratios
of consecutive or alternate terms of the Fibonacci sequence (Fig. 7.18).

Fibonacci numbers are often found in the arrangement of branches, leaves, and seeds (phyllotaxy). If we look at a plant from above (Fig.7.19), the leaves are not arranged directly above one another, but in a way that optimizes their exposure to sun and rain. The Fibonacci Numbers occur when counting both the number of times we go around the stem from one leaf to the next, and when counting the number of leaves we meet until we encounter one directly above the starting one. The number of turns in each direction and the number of leaves are usually three consecutive Fibonacci Numbers.

7.2.3 Pattern in arrangement of florets, seeds and fruits

With the scale patterns of pine cones (Fig. 7.20 – 7.23), the seed patterns of sunflowers and even the bumps on pineapple (Fig. 7.28-7.32) we have something rather different. The seed-bearing scales of a pine cone are really modified leaves, crowded together and in contact with a short stem. Here we do not find phyllotaxy as it occurs with true leaves and such like.

However, we can detect two prominent arrangements of ascending spirals growing outward from the point where it is attached to the branch (Fig. 7.21). In the pine cone picture, eight spirals can be seen to be ascending up the cone in a clockwise direction (Fig. 7.22), while thirteen spirals ascend more steeply in a counterclockwise direction (Fig. 7.23).

Figs. 7.20 – 7.23 The pattern of arrangement of scales patterns in a pine cone
In the close-packed arrangement of tiny florets in the core of a daisy blossom (Fig. 7.24), we can see the phenomenon in almost two-dimensional form. The eye sees twenty-one counter clockwise (Figs. 7.25-7.27) and thirty-four logarithmic or equiangular spirals. In any daisy, the combination of anticlockwise and clockwise spirals generally consists of successive numbers of the Fibonacci sequence.

Pineapple scales are also patterned into spirals (Fig. 7.28) and, because they are roughly hexagonal in shape, three distinct sets of spirals may be observed. One set of 5 spirals ascends at a shallow angle to the right (Fig. 7.30), while a second set of 8 spirals ascends more steeply to the left (Fig. 7.31), and the third set of 13 spirals ascends very steeply to the right (Fig. 7.32).
Apple blossoms have five petals; pentagonal indentations are seen at the bottom of the fruit. Cutting an apple in half reveals a star pattern of seeds (Fig. 7.34).

Fig. 7.33 Crossection of the fruits of Banana and Apple

7.2.4 Patterns in vegetables and fruits

Cauliflower

An ordinary cauliflower is almost a pentagon in outline. Looking carefully, you can see a centre point, where the florets are smallest. Look again, and you will see that the florets are organized in spirals around this centre in both directions.

Romanesque Broccoli/Cauliflower (or Romanesque) looks and tastes like a cross between broccoli and cauliflower. Each floret is peaked and is an identical but smaller version of the whole thing and this makes the spirals easy to see.

Have you seen and observed the shape of Ladies-finger (Bhindi)? It has a five sided pentad shape. So does a banana (look at a raw banana). In fact the Banana in cross section has a triad in the centre, i.e. 3 sections (Fig. 7.33). Isn’t it interesting? If you look carefully, there will be many such examples all around you.

While it would be very interesting to actually show and demonstrate these to you, it is advisable that you do some research on this on the internet. You will get to see and study a lot more information and pictures than the time allows here.

As was mentioned earlier, this knowledge will only indirectly help you in Drawing. The main application will be when you consciously draw the underlying structure of the subject in front of you, before drawing the firm contour outlines.

Self-check Questions

1. What are the recognizable patterns existing in nature?
2. What is Golden ratio and why is it called so?
3. What are Fibonacci numbers?

4. Give examples of Fibonacci progression in flowers.

5. Where in vegetables and fruits do we see evidence of Fibonacci progression?

6. What are two different kind of surface texture? State with examples of vegetable and fruits?

7. Give one example of a one-petalled and two-petalled flower each.

8. Fill in the blanks:

   i) The arrangement of leaves can be expressed as a ratio that is called ___________ of that plant species. For example the number of leaves in Sneezewort plant is ________, and the number of revolutions ________. The plant is said to have ____________ 5/8.

   ii) In the pine cone picture, eight _______ can be seen to be __________ up the cone in a __________ direction, while thirteen _______ ascend more steeply in a ________ direction.

   iii) In any daisy, the combination of anticlockwise and clockwise __________ generally consists of successive numbers of the ________ series.

   iv) Fibonacci numbers in cross sections of apple and banana in the form of indentations is ___, and ___ respectively.

7.3 Colour and Texture of Vegetables and Fruits

- Colours are a remarkable feature of vegetables and fruit. There may also be fruits with many colours on the same fruit, sometimes even interblending, for example a Mango or an Apple.

- As with fruits you will notice surface texture is an important element of the vegetables. This is very important to bring out the character of the Vegetable.

- Surface texture may be of two kinds: Visual and Tactile. Visual texture is an element of the skin of the fruit and is visible in various colours on the fruit, maybe as streaks or colour washes.

- Tactile textures are those textures that can be felt on touch, and are 3 dimensional in their form adding to the basic shape of the Fruit or vegetable.

Take 3 different vegetables. For example:

- Brinjal (Baingan) or Bottle Gourd (Lauki) or Tomatoes
- Ladies Fingers (Bhindi) or Beans or Pea pods
• Cauliflower (Gobhi) with leaves or Cabbage (Pattagobhi) or Radish (Mooli) with leaves

• Brinjal or Bottle gourd are voluminous vegetables, whereas Beans or Pea pod are linear.

• The Cauliflower or Radish have volume and there are stems or leaves along with them.

• Draw one set of whole and cross sectional drawing with details, in pencil.

• You will notice that vegetables have their distinct surface textures and colours. In fact the surface textures may be strong enough to have a shape of its own, as in a Cauliflower.

• As with vegetables, surface texture is an important element of fruits. This is very important to bring out the character of the Fruit.

• Your exploration must reflect your understanding of the character of the Fruit through its outline form and its surface texture and mass through shading.

• Study the Fruit and draw the whole fruit and its cross section with Water colours or Poster colours.

Your exploration in two different media of colour will show you how the media are used and how they appear in the representation of the same object.

**Activity**

1. Study three different types of vegetables as a whole and with their cross sections in pencil and pen; give shading also. Study the vegetables in black and white and colour with shading.

**7.4 Assignments**

**7.4.1 Class assignments**

i) Study 3 different types of Fruits; you may choose and draw them with pencil, sketch pen and colour with shading. For example:

• Apple or Plums or Pears or Ber

• Mangoes or Melons or Bananas

• Grapes or Pineapple
• Draw one set of whole and cross sectional drawings with details, in pencil. This time you may work in colour pencils or crayons and not graphite pencils.

• Remember, there is no scope of erasing any part of your drawing. However, by now you must be fairly easy and confident of drawing the curves and the form. You must also be having an idea about studying and observing proportions and the structure of the object, and translating them as representation drawings onto the paper!

7.4.2 Home assignments

i) Draw the other two vegetables as a whole and with their cross sections using pencil, and pen and colour with shading.

ii) Draw the other two Fruits as a whole and with their cross sections as a study using colour pencils, sketch pen and water colours with detailing and shading.

• Your exploration must reflect your understanding of the character of the Fruit through its outline form and its surface texture and mass through shading.

• Study the Fruit and draw the whole fruit and its cross section with Water colours or Poster colours.

• Your exploration in two different media of colour will show you how the media are used and how they appear in the representation of the same object.

7.5 Summing Up

This lesson revealed some of the wonders of nature and compels to accept the truth that as we go on exploring nature it comes out to us be more and more mysterious. This lesson opens up a wide scope in nature drawing as we become aware of the patterns governing the structure of various species of plants and trees. However, by now you must be fairly comfortable and confident in drawing the curves and the form. You must also be having an idea about studying and observing proportions and the structure of the object, and translating them as representation drawings onto the paper!

The salient features of this lesson are:

• Recognizable patterns in plants and trees:

• Patterns of Proportion in size

• Patterns in placement of leaves

• Patterns in the number of leaves, petals, seeds, etc.

• Patterns in shape of flowers, vegetables, fruits, seeds etc.
### 7.6 Possible Answers to Self-check Questions

1. The recognizable patterns that exist in nature are of following kind
   - Patterns of Proportion in size
   - Patterns in placement of leaves
   - Patterns in the number of leaves, petals, seeds, etc.
   - Patterns in shape of flowers, vegetables, fruits, seeds etc.

2. There is in geometry a well recognized Golden Ratio of 1:1.618. This is supposed to be the most economical ratio of growth in configuration of geometrical forms.

3. FIBONACCI NUMBERS are an interesting progression of Golden Ratio, that refers to a series of numbers, wherein each number is a total of the two numbers preceding it, and the ratio of two consecutive numbers is a Golden Ratio such as 1, 2, 3, 5, 8, 13, 21, 34....

4. The Fibonacci progression in Flowers may be seen in
   - Their number of petals. e.g. A 3 petalled Trillium flower, a 5 petalled Temple flower (Champa), a 13 petalled Daisy flower etc.
   - The arrangement of seeds in the center of a Sunflower showing 21 counter clockwise and 34 clockwise spirals.

5. In Vegetables and Fruits the Fibonacci number shows up:
   - In its external form, e.g. a five sided Ladies Finger
   - And in the cross-section, e.g. a 3 sectioned Banana and a 5 sectioned Apple.

6. The two different kinds of surface texture are:
   - Visual Texture, as seen on the skin of Apples, Mangoes, watermelon, Gourds etc.
   - Tactile texture, as seen on the skin of Oranges, pineapple, bittergourd, Cauliflower etc.

7. A White calla lily has one petal and Euphorbia has two petals.

8. Fill in the blanks:
   - i) Phyllotaxy, 8, 5, Phyllotaxy
   - ii) spirals, ascending, clockwise, spirals counterclockwise
   - iii) spirals, FIBONACCI
   - iv) 5, 3

### 7.7 Terminal Questions

1. Discuss the patterns in number and arrangement of petals in a flower.
2. Study some vegetables and make drawings of the whole and the cross section using water colour or pastel crayons

3. Give the pattern of arrangement of scales in a pine cone and pineapple fruit

4. Explain the property of Phyllotaxy with example.

5. Draw sketches of two Fruits as a whole and with their cross sections using colour pencils, sketch pen and water colours with detailing and shading.

7.8 References and Suggested Further Reading


7.9 Glossary

1. Apparent Clear, evident

2. Indentations Pittings

3. Pentagon A five-sided structure

4. Phenomenon Occurrence

5. Progression Patterned advance

6. Romanesque A style of architecture developed in Italy and western Europe between the Roman and the Gothic styles after 1000 AD; characterized by round arches and vaults and by the substitution of piers for columns and profuse ornament and arcades

7. Spirals Round or elliptical rings with free ends

8. Florets A small flower, especially one that is a part of a composite flower

9. Composite A conceptual whole made up of complex, related parts