Hands On Learning
with Reading Museum Service

PATTERN & COLOUR IN NATURE Z163

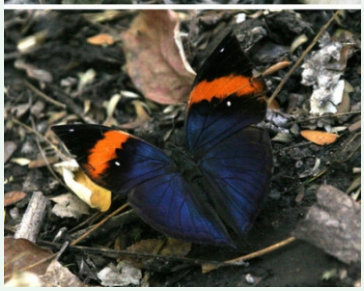
Biologists have become increasingly aware of the ways in which many living things are structured that can be described mathematically. Perhaps the most well-known example is the way in which the spirals that feature in the structure of many shells and plants follow the Fibonacci sequence.

Leonardo Fibonacci was an Italian mathematician who lived in the thirteenth century. He described a sequence of numbers generated when each figure is the sum of the two preceding numbers: 1+1 = **2**, 2+1 = **3**, 3+2 = **5**, 5+3 = **8**, which gives a sequence which runs 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, 6765, 10946, 17711, 28657 … and so on.



The pattern of leaves, needles and seeds of many plants are often organised in spirals which correspond with this sequence. For example, the orange 'petals' of the purple coneflower (*Echinacea purpurea*) shown on the right form spirals curving both to the left and to the right. At the edge of the picture, if you count those spiralling to the right as you go outwards, there are 55 spirals. A little further towards the centre and you can count 34 spirals. Similarly, the sunflower seed-head shown below right has 89 and 55 spirals at the edge. Both of these number sequences correspond with the Fibonacci sequence.







The function of colour in living things has also been explored. It can function as a warning signal; as an identification marker; to attract the opposite sex; for camouflage and so on. Sometimes an animal can combine these functions. The photographs on the left show an Asian butterfly called the orange oakleaf or dead leaf (*Kallima inachus),* which uses camouflage colouration when its wings are closed, but when they are open displays a bright orange stripe, probably as a warning signal.

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Whatever the reasons for the variety of pattern and colour found in the natural world, such features have proved fascinating to artists and craftspeople over centuries and across cultures. Recreating them has provided everything from a challenge to improve technical skills through to a store of symbolic forms and images. The flowing patterns of vegetation, for example, can be seen echoed in both the arabesques of Islamic architecture and the sensuous lines of Art Nouveau posters.



Skeletonised Plant Display Case



A faint note written on the back of the case (now partially covered) contains the name 'M. Milne' and the date '1830'. Each plant specimen has had the cellulose removed to reveal the complex web of veins. Veins function to support the plant and to transport water, minerals and sucrose to places that need them. Each of the specimens has been numbered and originally there must have been a list of contents, although this has been lost. Can you identify any of the plants?

The motive for making such a case was probably a mixture of scientific curiosity and aesthetic delight. The careful labelling of the plants testifies to the former, but at the same time the contents are fairly random and seem to be organised to make an attractive display. In the nineteenth century middle-class young women were often encouraged to take an interest in collecting things from the natural world - ferns, seaweeds and fungi all went through fashionable phases - and also to sketch and draw them. Beatrix Potter came from such a background and her illustrations of fungi can still be found in field guides, although she later turned her talents to producing her famous children's books. This case may well have been prepared by someone from a similar background.

Skeletonised leaves can be found naturally, either by being stripped by caterpillars or by the normal processes of bacterial decay in the autumn. These examples, however, were probably deliberately prepared for display. It could be difficult and time-consuming to produce an attractive result. The leaves had to be boiled in water into which a teaspoon of washing soda had been dissolved. Green material was then carefully removed using a knife. They were then soused in a solution of bleach and finally carefully removed and dried. Mistakes were frequent, so this fine display must have taken hours to prepare.



Banksia Cone



Banksia is a genus of around 80 species of plant that are native to Australia. They can vary from prostrate woody shrubs to trees up to 30 metres tall and occur in all but the most arid areas of the country. This example is probably from the giant banksia (*Banksia grandis*) which may attain heights of up to 15 metres.



Like many other *banksias* it has large flowers which develop on a spike-like structure. In the case of *Banksia grandis* the flowers can reach up to 35cm high and are yellow (see photograph, right). Old flower spikes harden and are commonly referred to as 'cones', although strictly speaking cones only occur in conifers and cycads. The slits all around the cone contained woody follicles in which the plant's seeds developed. The photograph below shows these seed follicles developing after the flowers have faded. In some species the follicles open as soon as the seed is mature, but in most species the follicles open only after stimulated to do so by bushfire.

As with large pinecones, *banksia* cones are often picked up and taken home because of their intriguing shape. This example has had a hook screwed into its base so that it can be suspended as a decoration. Cones are also used by woodworkers to make everything from bowls to koala bear caricatures.



Beetle Display Case



Although beetles repel many people, this small case gives a striking illustration of the complex form, colour and patterning that can be found if common prejudices are overcome. Their order, *Coleoptera* (meaning 'sheathed wing'), has more described species in it than in any other order in the animal kingdom. Forty percent of all described insect species are beetles (about 350,000 species) and new species are regularly discovered. Estimates put the total number of species, described and undescribed, at between 5 and 8 million. This is why J. B. S. Haldane, a geneticist from Scotland, when asked what his studies of nature revealed about God, replied, 'An inordinate fondness for beetles.'

The body colouration of beetles is highly variable and it is impossible to make general statements about its function. Very brightly coloured beetles are often active during daylight and live on flowers or leaves. Many beetles that live on the soil surface and which prefer nocturnal activity and also many beetles living in water are characterised by monotonous and often dark colouration, although sometimes with attractive metallic shades. In some groups bright colouration and loud pattern are a warning for predators that they are poisonous.

Two of the specimens in this box have been identified as members of the 'longhorn' species *Sternotomis imperialis*. Long-horned beetles (*Cerambycidae*) are characterised by their extremely long antennae, which are often as long as or longer than the beetle's body. The family is large, with over 20,000 species described.



The large dull coloured beetle may be a female titan beetle (*Titanus giganteus* - see photograph, right), the largest known beetle in the Amazon rainforest and one of the largest insect species in the world. Adults can grow up to 6 inches (15cm) in length, or 8 inches (21cm) including antennae (although females are smaller than males). Adult titan beetles do not feed, they simply fly around to find mates. They are attracted to bright lights after dark.

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The two green beetles with Y-shaped horns are probably flamboyant flower beetles (*Eudicella gralli*, also called striped love beetles), or a closely related species. This beetle is one of the most brightly colored members of the scarab beetle family. Most examples are distinctively striped (see photograph, above right), but there is a red variant in which this bold striping is missing, being replaced by a red-green monotone, as is the case with these examples (see photograph below right). Their shells have a prismatic quality, refracting the ambient light to give the green of their carapace a rainbow tint. The flower beetle lives in the rainforests of Africa, where it feeds on the nectar and pollen of flowers. The larvae of the flower beetle live in decaying wood, feeding on dead wood and leaf litter. Adults reach lengths of 25-40 mm. Their trademark Y shaped horn is used by males to fight over females. The females have a shovel-like tusk, used for burrowing in wood. The green beetle in the top-left corner of the case is probably a female.

Locust Display Case



Locust is the name given to the swarming phase of short-horned grasshoppers of the family *Acrididae*. There are several thousand species in this group and the exact identity of this example is unknown. Normally the wings would be folded away and the red and purple colouring would not be visible. The bright wings are an example of 'flash colouration', which serves to frighten off predators. When disturbed the insect will take off with a sudden and disorientating flash of colour. This can be disconcerting for humans too, if they try to get too close when observing such insects! On landing, the colour parts are folded away and the creature often seems to disappear into the dull-coloured ground, making it difficult to re-locate.