florology 101

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How plants can be—and have—a "moving experience."

Most of us tend to think of plants as stationary beings. Yes, they grow and flower and reproduce, even photosynthesize—it's not as if they aren't *doing* anything—but in general, plants don't display the kind of movement that can be observed by the naked eye, or that could even be documented hour by hour. It's been said that movement is what distinguishes plants from animals.

But many kinds of plants do move, and even some cut flowers seem to defy our notion of what a plant is: namely, something that sits still. Perhaps foremost among these is the infamous Venus flytrap *(Dionaea muscipula)*. With its hair-trigger "jaws" and its lurid red "throat" lined with fierce-looking "fangs," the Venus flytrap has the sinister look of a creature from science fiction, which probably accounts for its notoriety…well, that and the fact that it eats bugs alive.

While the Venus flytrap may be the most dramatic example of movement in plants, there are several other ways in which plants display kinetic energy, from the subtle to the startling.

A good turn

Rooted in one place, lacking eyes or ears or legs to find their way to food and water, plants have had to develop other ways of satisfying their needs. Most plant movements are subtle; they occur gradually over a period of minutes or hours. Consider, for starters, the tropisms, which are various types of plant movement in response to environmental stimuli.

Phototropism, the directional movement of a plant in response to light, helps guide the growing plant toward a source of energy it needs for photosynthesizing. Florists often see phototropism exhibited by fresh cut tulips as they stretch toward light. A type of negative phototropism can be observed in juvenile ivies and vining philodendrons, which, in their natural environments, grow initially toward a shady area such as might exist at the base of a tree that can provide support for the upward-clambering and light-seeking mature forms of the vines.

Unopened sunflower buds follow the sun during the day, from east to west. Once the flowers open, their stems stiffen, typically facing east.

Gravitropism, also known as **geotropism,** is the directional movement of a plant in response to the stimulus of gravity. Positive gravitropism directs roots to grow downward toward the soil to take up water and minerals. Negative gravitropism assures that the growing shoots of a plant will reach upward, away from the soil and toward the life-giving sun. We see it expressed in the tips of such flowers as snapdragons and bells of Ireland as they bend upward, adding a jazzy curve to our floral designs—whether we want it or not. Negative gravitropism is the mechanism by which all those spiral "lucky bamboo" plants are produced: the canes are lain on their sides and are regularly rotated as new growth appears, causing the growing tips to turn back upward as they respond to the rule of gravitropism.

Phototropism and gravitropism are both controlled by growth-regulating plant hormones called auxins. In the case of phototropism, auxins do their job by accumulating on the shady side of a stem, causing that side to grow faster than the sunny side, thereby "bending" the stem toward the light source. In negative gravitropism, auxins accumulate on the underside of shoots, stimulating more cell elongation on that side, which directs the growing tip upward.

Sun lovers

Heliotropism is the daily movement of plants in response to the movement of the sun. It is particularly noticeable in sunflowers, where the orientation of the unopened flower buds actually follows the sun, east to west as it moves across the sky each day, returning to face east again by dawn of the next day. This habit is lost when the flower opens and the stem stiffens; still, nearly all the open flower heads in a field of mature sunflowers will face east.

The leaves of the sunflower also track the sun, turning slowly through the day to keep their broad surfaces perpendicular to (facing) the incoming rays. This positive movement, or diaheliotropism, maximizes the solar radiation available for photosynthesis.

Some plant species, however, such as erythrina (the tropical coral tree, a member of the legume family) seek to avoid heat stress and water loss during the hottest part of the day. They display negative movement, or paraheliotropism, by turning their leaves edge-on to the incoming light. This prevents the leaf surfaces from being damaged by overheating or burning.

Yet another form of heliotropism is exhibited by the prayer plant *(Maranta leuconeura),* which derives its common name from its tendency to fold its leaves upward at night, resembling praying hands. As yet, no one has been able to suggest a reasonable hypothesis as to why this action might provide some benefit to the prayer plant—unless it is to atone for sinful misdeeds in its past. In the meantime, we and our customers can simply enjoy it as a curiosity.

Around and around

If thinking about all these forms of plant movement is making you dizzy—"you ain't seen nothin' yet!" A specialized form of plant movement, reserved mostly for vines and tendrils, is called **nutation,** in which the growing tips of such plants spin in a more or less circular path, occasionally changing direction after a few hours, spiraling until they find some kind of support upon which to grow or tether themselves. Nutation is quite evident in morning glories, nasturtiums, pole beans, passionflowers and similar vines. The movement can be very rapid, with some species able to make a complete revolution in less than 30 minutes—almost fast enough to make your head spin!

Once the shoot or tendril collides with a support, another sort of action kicks in: **thigmotropism,** the directional response of a plant organ to touch or to physical contact with a solid object. This phenomenon is clearly illustrated by the climbing tendrils of certain plants, such as the sweet pea. The tendrils actually "feel" the solid object, such as a pole or a trellis, which results in the coiling response, an expression of positive thigmotropism. Conversely, roots making their way through soil will exhibit negative thigmotropism, turning away from a solid obstacle, like a rock. The thigmotropic response can be so strong that merely stroking or tapping a nutating shoot will cause it to bend or coil in the direction of the stimulus, only to relax and straighten out again after a period of time if no actual support is encountered.

Another type of plant movement may be involved to some degree in the coiling of a tendril around a solid support. This is **turgor movement,** among the most rapid of plant movements. Turgor movements generally are initiated by pressure changes in special plant cells or organs. One of the most well-known and dramatic turgor movements is that of the startling "sensitive plant" *(Mimosa pudica),* whose leaflets will go into near total collapse within 0.75 seconds of being touched, uncontrollably inspiring that "reach out and touch" mentality in our own minds.

Most of the beautiful and graceful trees of the mimosa family regularly "go to sleep" at night, and their feathery leaves then hang down like delicate fringe. But the sensitive plant not only behaves like this when it goes to sleep, it will suddenly do exactly the same thing whenever it is touched. Should a hungry animal attempt to nibble a leaf, not only does the leaf that is nibbled fold right up, but every other leaf on the plant collapses as well, all at once. Gusts of wind, burning heat, drifting grains of sand, or the pattering of rain drops will also cause the sensitive plant to fold up in the same way. The leaves generally recover within 10 to 15 minutes, reabsorbing water and standing full and turgid once again.

Quick on the draw

By far the most rapid plant movement anywhere is to be found in the insectivores, such as that wicked Venus flytrap we mentioned at the beginning of this article. These reactions must be quick enough to trap an alert insect—something even a speedy newspaper-wielding mammal may find difficult.

In the Venus flytrap, the snapping together of its leafy jaws is caused by a release of tension built up inside the leaf. Cells in the upper and lower surfaces of the leaf grow at different rates, causing cells in an inner layer to become compressed. The resulting tension in the plant tissue holds the trap open. Then, mechanical movement of the plant's trigger hairs puts into motion enzyme-driven changes in water pressure within the leaf cells. The cells expand and the trap closes as the plant tissue relaxes.

Two or more trigger hairs must be touched in close succession in order for the trap to close, which it does within half a second. It doesn't close tightly at first, which allows smaller, protein-poor insects to escape. And if the trapped object isn't food but only a leaf or a stick, the trap will re-open and release whatever was trapped. But further movement inside the trap and further stimulation of the trigger hairs causes it to close more tightly, sealing the trap firmly around the prey within so that the digestive process may begin.

So you see, plants move for many different reasons—some because they are hungry, others because they are sleepy, some turning towards the sun, others turning away from it; and some twist and twine because they want to climb up to the light. To enable them to move, plants need something to stimulate or excite them. It may be an increase or decrease of light, a rise or fall in temperature or the lightest touch on a sensitive part. But move they do. Their movements are slow, subtle, and rare, but the plants all around you are definitely not sitting still!