LEVEL TWO

We now turn to the macabre (dark and spooky) side of plant adaptations — plants that eat

animals, make poisons, and parasitize other plants. We’ll meet several of the strangest plants on

earth.

What would cause a plant to be carnivorous? (“Carn” means “flesh or meat,” and “vor” means

“eat.”) Plants use photosynthesis to make all the food they need. They don’t need an outside source

of food energy. What else does a plant need besides carbon dioxide, water, and sunlight? Think

about a chlorophyll molecule. Where does a plant get those nitrogen and magnesium molecules?

As mitosis occurs and plants make new cells, they have to get the raw ingredients needed to

manufacture more chlorophylls, plus many other types of molecules. Some of these molecules

contain atoms such as sodium, phosphorus, potassium

and calcium. Carbon dioxide and water only provide

carbon, oxygen and hydrogen atoms.

Under normal conditions, plant take these minerals

from the soil. Plants don’t “eat” dirt, but they do take

minerals out of it. If the soil doesn’t contain enough

minerals, the plants won’t be able to grow there unless

they have some alternate means of getting minerals. One

alternative is to get the minerals from the bodies of animals

(mainly insects and spiders).

The most famous of the carnivorous plants is the

***Venus flytrap***. It’s not uncommon to find these flytraps

for sale in greenhouses in many parts of the world, but

if you want to find a “wild” flytrap growing in its natural

environment, you will have to go to the American state of

North Carolina and find a bog within 60 miles of the city of

Wilmington. Bogs are places that are wet and soggy all

the time. The bogs where the flytraps grow have very little

nitrogen and phosphorous in the soil. The flytraps are one

of the few plants that thrive in these bogs. They get very

little competition from other plants because of this lack of

minerals in the soil. The flytraps appreciate not having any

rivals in the area. In fact, Venus fly traps appreciate an

occasional wildfire once in a while, too, just as a back-up to remove other plants from the area!

The leaf of a flytrap is the snappy trap on the end. The long flat part that looks like a leaf is

actually the petiole. The petioles are the primary site of photosynthesis. As we mentioned in the

opening paragraph, flytraps don’t eat flies to get energy. They use photosynthesis just like all plants

do. The flytrap is a flowering plant, as you can see in the picture. It’s even a dicot. So in some ways,

it’s a very normal plant.

The hinged leaf on the end has two unique features that work

together to catch flies. The first is a set of three trichomes (“hairs”)

on the inside of each lobe, which function as motion detectors.

These triggers will cause the trap to close suddenly if one of the

hairs is touched twice very quickly, or if two separate hairs are

touched within 20 seconds. The second feature is the abilty of the

two lobes to snap together in about 1/10 of a second.

Plants don’t have muscles, so how is the flytrap able to do

this? Scientists are still investigating, but it seems that the answer

involves the sudden flow of water into and out of cells. Protons are

a key to this rapid movement of water molecules. A sudden increaseor decrease in the amount of water in a cell changes its shape. An overall change in shape can be

seen in a flytrap leaf after it closes. While the leaf is open, the lobes curve outward; after closing they

are bent inward.

Once the lobes have closed and the prey is trapped, digestive glands on the surface of the

lobes begin to make digestive enzymes. Basically, the closed leaf becomes a stomach! The leaf

stays tightly shut for about ten days. During this time the body of the prey is reduced to a puddle

of molecules, with maybe some bits of outer shell left over. After the trap opens, the rain will wash

away the remains of the meal. If the prey is too small and manages to escape, the trap will re-open in

about 12 hours.

Almost as well-known as the flytraps are the ***pitcher***

***plants***. Their leaves are shaped in such a way that a “pitcher”

is formed. Like water pitchers, these plant pitchers can collect

and hold water. Pitcher plants attract their prey using colors,

odors, and nectars. The unsuspecting bugs crawl along the

slippery edge of the pitcher and inevitably slip and fall into the

water pit below. If they manage to swim over to the edge of

the pitcher and try to climb out, they find the walls of the pitcher

extremely slippery or covered with downward-pointing hairs that

prevent them from escaping. The bugs drown in the water and

their bodies eventually dissolve with some help from digestive

enzymes secreted by the plant cells.

The pitcher plants shown in the illustration above are the kind

you find growing in the warm, humid parts of the American continents.

A very different type of pitcher plant grows in Indonesia, south China,

and northern Australia. The scientific name (the genus) for these

pitchers is ***Nepenthes***. This name can be traced back to a book

written by Carl Linnaeus in 1737. It comes from Greek mythology

(Homer’s Odyssey), in a story where an Egyptian queen gives Helen

a magic potion that causes her to forget all her sorrows. (“Ne” means

“not,” and “penthe” means “grief.”) Carl Linneaus explains his choice

of this name for this plant:

*If this is not Helen’s Nepenthes, it certainly will be for all botanists.*

*What botanist would not be filled with admiration if, after a long journey,*

*he should find this wonderful plant. In his astonishment past ills would be*

*forgotten when beholding this admirable work of the Creator!*

The Nepenthes does not have to rely on rain to fill its traps. It

produces a thick fluid that makes escape impossible for the unlucky victims

that fall into it. Even small lizards and mammals can drown in Nepenthes

pitchers. However, a few species have managed to outwit the Nepenthes

and are able to steal some of its food. Carpenter ants like to nest inside

the tendrils from which the pitchers hang. The tendrils are hollow so this

does not harm the plant. The ants able to swim in the pitcher fluid and will

work together for hours to pull dead prey out of the trap. (Yes, the ants

are carnivorous, too!) The plant actually benefits from this living situation

because the ants clean up after themselves and leave the edges of the

pitcher spotless. Pitchers inhabited by ants survive longer than those that

are not.

In some parts of the world, the Nepenthes is called the “monkey cup.”

Monkeys and large apes are known to drink from these cups. (Ants? Yum, yum!)

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Another large family of carnivorous plants is the

***sundews***. The sundews have trichomes on their leaves that

produce droplets of clear sticky liquid. They look a bit like

water droplets, as if dew droplets had formed on the tips of

the trichomes. The droplets sparkle in the sun. (The “sun”

part of the name could also come from the fact that the

sundews are said to have flowers that turn towards the sun.)

The droplets produced by the sundew’s trichomes

are both sweet and sticky. Insects are lured in by the

sweetness and trapped by the stickiness. After the insectis stuck, the trichomes begin to coil

around it, trapping it even further. The

motion can occur quickly, with the trichomes reacting in a matter of seconds.

Within several minutes, the whole leaf can be completely curled up. Digestive

glands on the leaves then release enzymes that dissolve the bodies of the

insects, even their tough outer shell.

Other than their ability to trap and dissolve insects, the sundews (like all

carnivorous plants) are normal flowering plants. They do photosynthesis and

transpiration, they make flowers that get pollinated by insects (different species

than the ones that get trapped) and make seeds that grow into new plants.

The last carnivorous plant on our list is the ***bladderwort***.

This plant has double adaptations. Not only is it carnivorous,

it is also aquatic. In most bladderworts, the only part of the

plant that sticks up above the water is the stem that has

flowers on it. The flowers are shaped a bit like snapdragons

and come in a wide variety of bright colors.

The bladders are tiny little sacs that grow among the

underwater leaves. How tiny? On average, they are only

about 1/4 inch (1/2 cm) in diamenter. The word bladder is a

very general term that means a water-filled or air-filled bag.

The correct name for the bladder in your body is the urinary

bladder. The word bladder itself doesn’t have any connection

to urine. In the bladderwort, the bladders are pouches that act

as high-speed traps. They catch aquatic animals small enough

to fit inside the trap. Pond water is usually filled with semimicroscopic

crustaceans (related to crabs) and insect larvae.

The bladders have a design that allows them to

temporarily force their shape to curve inward, causing

structural tension that is a bit like pulling back a spring.

(Remember, plants don’t have msucles, so this movement

is caused by water and minerals flowing in and out of cells.)

The trap has some trigger hairs around the opening. When a

small animal bumps into the trigger hairs, the shape of the trap

suddenly pops back to its

normal open state, causing water to rush in. The animal is swept

along with the mini-current and is sucked into the trap. The trap

can snap shut in only 1/10,000 of a second!

As you might guess, there are digestive glands inside the

trap that dissolve the animal’s body. When digestion is finished,

the trap can eject the remains and reset itself, pulling its shape

inward again. Some botanists think of a plant’s ability to make toxins (poisons)

as an adaptation because it helps the plant survive. Plants have

very few ways to protect themselves from getting eaten. Remember,

plants “want” to survive, too, just as much as animals do. Plant DNA

is engineered to cause them to try to reproduce as much as possible,

and to adapt the best they can in order to thrive in their environment.

(In fact, in a past chapter, we accused them of being bent on world

domination!)

Toxins are a very effective way for a plant to make itself less

likely to be eaten. A plant’s primary enemies are insects, so the

toxins are really targeted at them, not at animals or humans. Since

insects are very small, it takes only a small dose of the toxin to kill them. The dose that kills a bug

won’t do much damage at all to a large animal or a person. However, there are some plants that

produce toxins strong enough to damage even a large mammal.

It would be very boring (or perhaps a little scary) for you to read a list of toxic plants, so we’ll

just look at two plants that played a part in Greek and Roman history.

Perhaps the most famous poisonous plant in history is the hemlock. The

Greek philosopher Socrates was forced to drink a cup of poison hemlock as

punishment for his “impiety” (meaning he was teaching young people to think for

themselves instead of just accepting whatever the members of the ruling class

told them). This hemlock plant is not related to the tree called the hemlock.

They are entirely different. The scientific name (genus) for Socrates’ hemlock

is *Conium*. This word comes from the Greek word “konas,” meaning “to whirl.”

Apparently, being dizzy (feeling like you are whirling) is one of the symptoms of a

mild case of hemlock poisoning.

The scientific name of this plant, *Atropa belladonna*, sounds beautiful, but

it’s common names tell you all you need to know about it: “devil’s berries,” or

“devil’s herb.” More recently, it has been called “deadly nightshade.” It belongs

to the same family of plants as the tomato and the potato (*solanaceae*, the

“nightshades”). The name “belladonna” comes from Italian and means “beautiful

woman.” When the juices of this plant are used as eye drops, they cause the

pupils to dilate. Ancient Italian women liked to have their pupils dilated when they

met an attractive young man. They thought this made them look more beautiful.

When ground up and mixed into a potion, this plant does more than dilate your

pupils — it kills you. The wives of the Roman emperors Augustus and Claudius

are known to have used this plant to poison their enemies. Before they died, the

victims would have experienced not only dilated pupils but also mental confusion, rashes, headache,

loss of balance, blurred vision, racing heart, sweating, hallucinations and convulsions. Not fun.

Interestingly enough, cows and rabbits can eat this plant and have no ill effects. For the rest

of us, a handful of these berries can kill us. Since the berries look pretty and taste sweet, this is a

danger for small children. Fortunately, treatment is available if you get to a medical facility quickly. A

chemical produced by the African calabar bean plant can reverse the effects of the belladonna toxin.

But don’t take too much of this bean chemical, because in high doses this cure can be toxic, too.

The calabar bean’s toxin is considered to be one of the most potent in the plant kingdom.

**A GENERAL GUIDELINE FOR AVOIDING POISONOUS BERRIES:**

Don’t eat any berries you find growing in the wild if they have a

simple, round shape. Berries that are lumpy, like raspberries, are never

poisonous. Some smooth berries are okay, but lots of them are toxic.

Don’t take chances — just stay away from smooth berries! Our tour of the creepy side of botany ends with a look at plants that have become ***parasites***.

A parasite is any organism that must live in or on another organism. Many parasites end up harming

their host to some degree, but not so much that they kill their host — or at least not until the parasite

has had a chance to reproduce. We tend to have very negative feelings about parasites, but as we

will see, some parasitic plants can be beneficial to the ecosystem they live in.

The most well-known parasitic plant is the mistletoe, the plant that has been

part of Christmas celebrations in western cultures for hundreds of years. A branch

of mistletoe is hung at the top of a doorway or suspended from the ceiling. Couples

who “happen” to cross each other’s paths under the mistletoe are permitted a kiss.

For each kiss, a berry is plucked off the branch. When the berries run out, so do the

kisses.

You didn’t know mistletoe was a parasite? Most people

don’t. The name “mistletoe” (originally “mistiltan”) most likely

comes from the Anglo-Saxon words “mistel” meaning “dung,”

and “tan” meaning “twig.” So that makes the real name for

this plant “dung-on-a-twig.” The dung in question comes from

birds. Birds eat the berries, and some of their dropping fall on

tree branches. Mistletoe seeds happen to be very sticky, so

they quickly adhere to the branch. When the seeds germinate,

they can grow for a while in the bird dropping, as if it was dirt.

As quickly as they can, though, the baby mistletoe plants start

putting out special “roots” called ***haustoria*** *(hoe-STORE-ee-ah)*. The haustoria somehow grow their

way through the tree’s bark and get into the sapwood where the living xylem and phloem tubes are.

They put their thin root-like tubes into the tree’s xylem and phloem, as if putting a drinking straw into

someone else’s glass. The mistletoe slurps away, sucking water, minerals and sugars from the tree’s

vascular system. Thus, the mistletoe is permanently attached to a tree, instead of growing in the

ground.

The mistletoe is what botanists called a ***hemiparasite*** (“hemi”

meaning “halfway”). The leaves can still do photosynthesis, so it is not

completely reliant on the host tree. At first, the tree hardly notices the

mistletoe and isn’t especially bothered by it. If rainfall is adequate, there

is enough water for both plants. However, as the mistletoe grows larger

and larger, there is a greater possibility that the tree won’t be able to keep

up with the increasing demands the mistletoe places on it. Some trees

do eventually die from mistletoe invasion, and, in general, gardeners see

mistletoe as a threat. They usually prune off any tree branches that show

mistletoe infestation.

Only recently have researchers discovered that in some places (Australia

being a notable example) some species of mistletoe are quite a benefit to

the natural environment. Though mistletoe berries are mildly poisonous to humans, birds love them.

Areas with a lot of mistletoe will have a dense population of nesting birds. Also, the leaves and young

shoots of mistletoe are a favorite snack for certain types of animals. Thus, areas with mistletoe tend

to have more wildlife than areas without mistletoe. ***Biodiversity*** (the presence of many different

forms of life instead of just a few) is considered to be a good thing. Ecologists all over the world are

in agreement that it’s healthy for an ecosystem to have lots of different species living together.

Other parasitic plants are what scientists call ***obligate parasites***. The word “obligate” is

related to the words “obliged” and “obligated.” These paraites are completely dependent upon their

host plant. In fact, these plants have lost the ability to do photosynthesis. Umm... well, how else can we classify them? They’re not fungi, bacteria, animals or singlecelled

organisms. They make flowers with pistils and stamens — that’s plant-like. Botanists guess

that once upon a time these plants did do photosynthesis. Once they started feeding on other plants,

their need for photosynthesis disappeared. The cells somehow sensed this and stopped making

chlorophyll. This is just a guess, of course, as no one was there to witness this when it happened.

It’s just a theory. However, the possibility that this could have happened gives us license to go ahead

and classify obligate parasitic plants as plants.

The most famous obligate parasite grows on the islands

of Borneo and Sumatra. Its scientific name is *Rafflesia,* (and

many people use this name)*,* but it is also commonly called the

“carrion flower.” “Carrion” is a polite name for dead animals.

Yes, this flower stinks like rotting animal carcasses. Why?

Because any insect can pollinate a flower. It doesn’t have to be

cute little butterflies and bumblebees. In this case, the stinking

flower draws flies. The flies are fooled into thinking that there is

rotting meat inside the flower, and pollination is accomplished.

The Rafflesia holds the world record for being the largest

flower in the world — which is kind of funny when you learn that

the flower is the only part this plant really has. It has no leaves,

no stems and no roots! (At least you knew that those parts

aren’t included in the definition of what makes a plant a plant.)

The only other part the Rafflesia has is a network of haustoria.

The haustoria are embedded into the veins of a vine plant, and

are invisible from the outside. The only time you can be sure the Rafflesia plant is there is when it

puts out a flower bud. Otherwise, you never see this plant!

Our second and last obligate parasite is the

“snow flower.” (The buds often pop up early in the year,

poking up through the snow.) Like Rafflesia, this type of

plant has no leaves, no stems and no roots. It consists

of nothing but haustoria threads living inside a fungus

that lives on other plants. Since these plants live on a

fungus, some people like to call them “fungus flowers.”

The snow flower takes its nourishment from a fungus

that is taking its nourishment from a plant. So indirectly,

the snow flowers are feeding on a plant, but through the

fungus. Very strange, indeed.