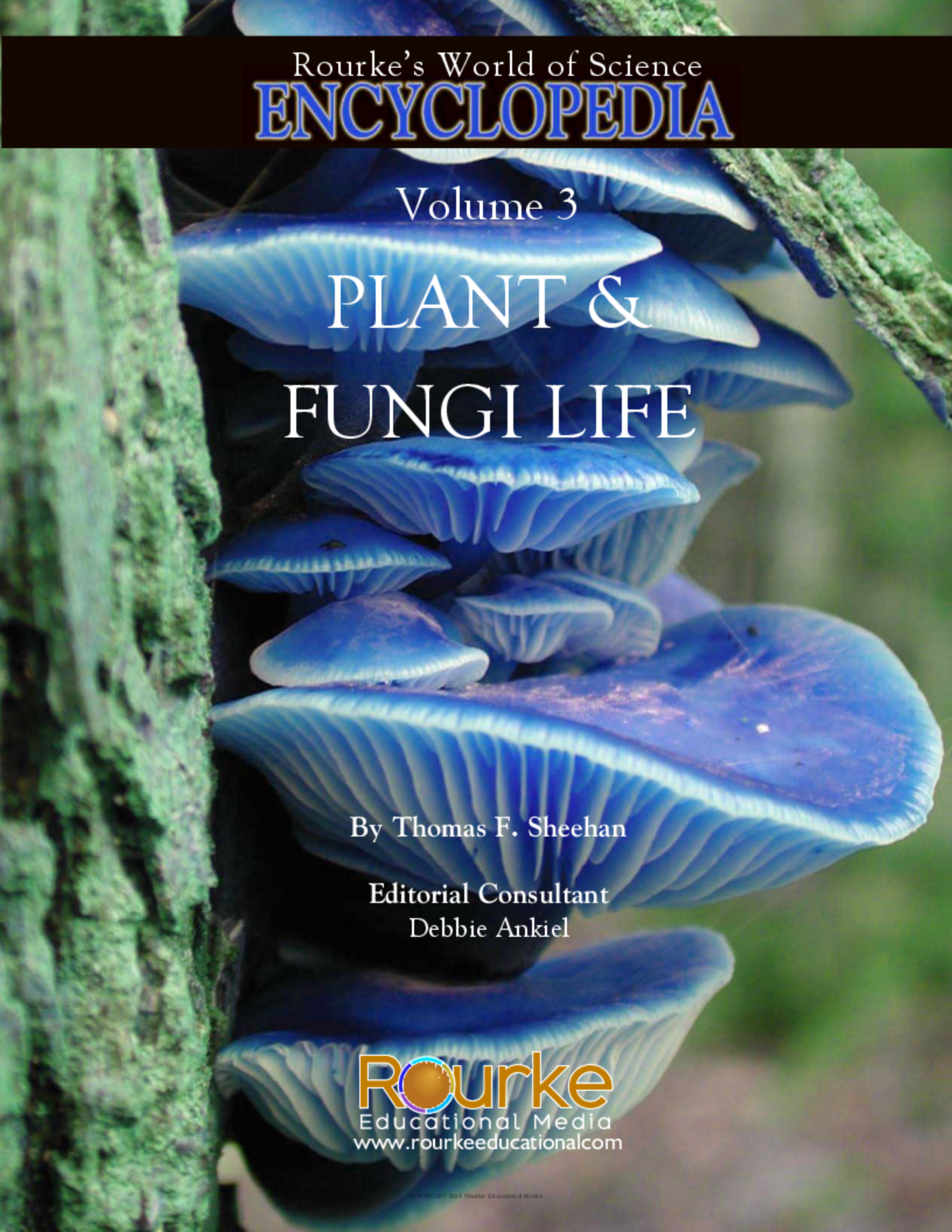
Rourke's World of Science

ENCYCLOPEDIA

Volume 3 - Plant & Fungi Life



Rourke's World of Science

ENCYCLOPEDIA

Volume 3

PLANT & FUNGI LIFE

By Thomas F. Sheehan

Editorial Consultant
Debbie Ankiel

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Editor: Debbie Ankiel

Cover design by Rhea Magaro

Library of Congress Cataloging-in-Publication Data

Rourke's world of science encyclopedia / Thomas Sheehan ... [et al.].
v. cm.
Includes bibliographical references and index.
Contents: [3] Plant life --
ISBN 978-1-60044-646-7
1. Science--Encyclopedias, Juvenile. 2. Technology--Encyclopedias, Juvenile. I. Sheehan, Thomas F.
Q121.R78 2008
503--dc22

2007042493

Volume 3 of 10
ISBN 978-1-60044-649-8

Printed in the USA

CG/CG

Rourke Educational Media

rourkeeducationalmedia.com

customerservice@rourkeeducationalmedia.com • PO Box 643328 Vero Beach, Florida 32964

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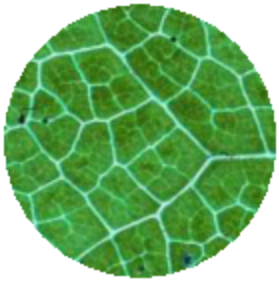
What Is a Plant?

Plants and animals are living things, or organisms. Plants make it possible for all the other living things to exist on planet Earth. While plants are similar to animals in some ways, they are unlike animals in many more ways. Plants, like animals, are made up of cells.

Most plant cells contain a green pigment, called chlorophyll. Animal cells do not. Chlorophyll makes it possible for most plants to absorb energy from sunlight. Using a cell process called photosynthesis, plants use that energy (along with water and carbon dioxide molecules) to make food substances and release oxygen. Plants provide all the food and oxygen that animals, including people, depend on.

Fungi are not considered to be plants. They have no chlorophyll. They digest dead things and absorb nutrients from them. These saprotrophs are nature's recyclers.

Plants also need water to carry out photosynthesis.

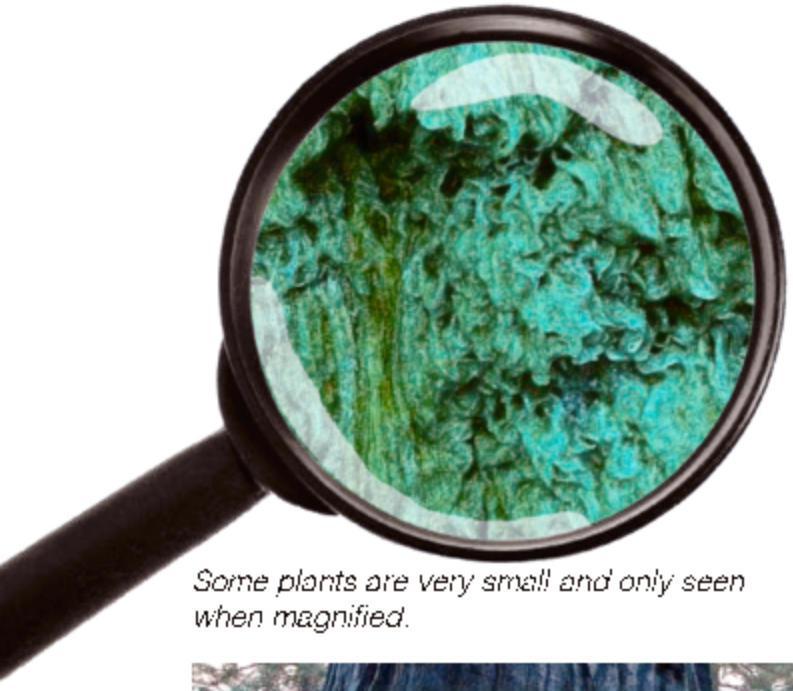


Plant cells are more angular in shape than animal cells.

While mushrooms resemble plants, they are actually in the fungi kingdom.

The Size of Plants

Unless you use a microscope, some tiny plants, such as some algae, are invisible. Other plants, such as giant Sequoia trees, are hundreds of feet tall. Enormous groves of Aspen trees are hundreds of feet wide.



Some plants are very small and only seen when magnified.

Sequoias can grow up to 379.1 feet (115.5 m) in height and 23 feet (7 m) in diameter at the base.

How Plants Live

Many types of plants grow together in forest, grassland, desert, or aquatic ecosystems. Mosses hug the ground in dense mats. Vines climb up and over other plants and objects.

More than half of the world's plant species live in the rainforest.

Molds and fungi prefer dark, moist places where there is dead stuff for them to digest and absorb. Soil is loaded with them. So are your sneakers. You may even see them in your refrigerator, on food that has been in there too long.

Mold is used to produce some of our foods.

PLANT LIFE

Some aquatic plants live in watery places with their leaves floating on the surface. Desert plants live for long periods without any water at all.

The lily pad's long stem anchors it to the bottom of the pond.

Flowering plants are the most common, but many, such as mosses and ferns, do not have flowers. Evergreen trees (pine, spruce, fir, hemlock, and cedar) all have cones instead of flowers.

The seeds of an evergreen tree are produced in its cones.

Though most plants grow in the wild, people all over the Earth grow and cultivate a large variety of plants. Some are food plants, like rice, wheat, and corn.

Some of the rice we eat might be grown in this field in Bali, Indonesia.

We grow other crops for the beauty of their forms and colors of their flowers. We also value plants for the healthful substances they produce, or just the comfort of having them around.

Words to know

organism (OR-guh-niz-uhm): a living plant or animal

chlorophyll (KLOR-uh-fil): the green substance in plants that uses light to make food from carbon dioxide and water

photosynthesis (foh-toh-SIN-thuh-siss): a chemical process, in green plants that makes food and releases oxygen, from carbon dioxide, water, and sunlight energy

Classifying the Plant World

There are many organisms on Earth with similar characteristics. The plant kingdom has many divisions. We call each division a phylum. The kingdoms Protista and Fungi also contain organisms with plant-like characteristics, but they are not considered plants. A class is a division of a phylum.

Further division of the plant kingdom follows the groupings of Carolus Linnaeus, used for all organisms. Classes of organisms are divided into groups called orders, followed by families, and finally the genus and species.

The genus and species is the first and last name of an organism. They are Latin names. Every known organism on Earth has a scientific name, in Latin. The Latin name for human is Homo sapiens.

When we think of plants, we often think of plants belonging in the Coniferophyta or the Anthophyta phylums.

Carolus Linnaeus (1707-1778)

Getting to know...

Carl von Linné was born in Sweden in 1707. We know him by his Latin name, Carolus Linnaeus. Linnaeus was interested in nature and plants. He taught himself about biology and botany, the study of plants.

He devised a system to classify all the plants and animals known at that time. He described living things and grouped them by their shared physical characteristics. For instance, he put animals with backbones, or vertebrae, in one group and those without a backbone in another. He put animals that laid eggs in one group and those that had live young in another.

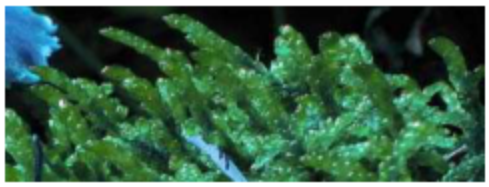
Linnaeus gave each group and each kind of living thing a Latin name made up of two descriptive words. Scientists refer to this system as the binomial (two names) system of nomenclature (naming).

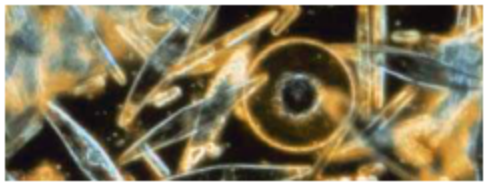
In 1735 he published a series of books, *Systema Naturae*, which described and named all the animals and plants known at that time. Scientists today still use his binomial classification system to organize and understand all living things.

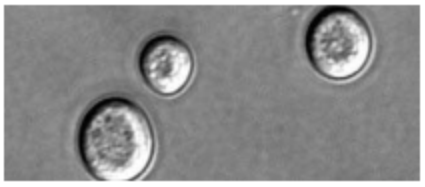
PLANT LIFE

Coniferophyta are cone-bearing plants. The cones contain the plants seeds. Some common examples of conifer trees are pines and bald cypress trees. We cut down many conifer trees for lumber.

Angiosperms are seed-bearing vascular plants. Their reproductive structures are flowers in which the ovules are enclosed in an ovary. Angiosperms are found in almost every habitat from forests and grasslands to sea margins and deserts. Angiosperms display a huge variety of life forms including trees, herbs, submerged aquatics, bulbs and epiphytes. The largest plant families are Orchids, and Compositae (daisies) and Legumes (beans). There are an estimated 352,000 species of flowering plants or angiosperms.

The Plant Kingdom Phylum		
Bryophyta		Mosses
Hepatophyta		Liverworts
Pteridophyta		Ferns
Lycopophyta		Club moss
Coniferophyta		Cone-bearing plants
Angiosperms		Flowering plants

The Protista Kingdom		
Protista	 *Marine diatoms as seen through a microscope.*	Algae and Diatoms

The Fungi Kingdom Phylum		
Zygomycota		Black molds
Ascomycota		Green molds,blue molds, yeasts, mildew
Basidiomycota		Mushrooms, puffballs

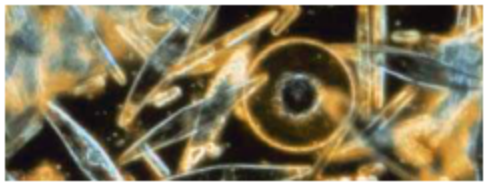
The Parts of Plants

Plant Cells

All living things are made up of small parts called cells. Plant and animal cells are similar. Animal and plant cells have a nucleus that contains genetic substances, such as DNA. Around the nucleus there is jelly-like cytoplasm.

Both plant and animal cells have special structures in their cytoplasm, called organelles. Mitochondria use nutrients to release energy for the cells. The endoplasmic reticulum is a folded membrane that makes proteins and fat molecules.

A noticeable difference between plant and animal cells is their shape. Plant cells have rigid cell walls around them. This causes plant cells to be rectangular and blocky. The walls are made of a tough material called cellulose.

The Protista Kingdom		
Protista	 *Marine diatoms as seen through a microscope.*	Algae and Diatoms

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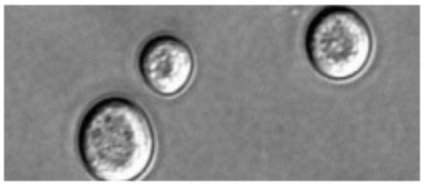
Ascomycota		Green molds,blue molds, yeasts, mildew
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Robert Hooke (1635-1703)

Getting to know...

Robert Hooke was born in England in 1635. He went to Oxford University in 1653. He later became the chief scientist for the famous Royal Society of London, a gathering of the foremost scientists of that time. The society had a meeting every week. Hooke performed three or four new experiments at each meeting.

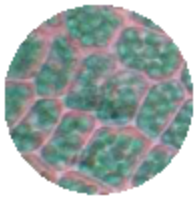
Hooke was curious about living things. He used an instrument called a microscope to look at objects up close. Hooke looked at insects, plants, hair, and fossils.

He became the first person to see cells when he looked at a piece of bark under his microscope. Hooke made drawings of what he saw. In 1665, he published his studies in a book called *Micrographia*.

An illustration from Hooke's **Micrographia**

Words to know

- **chloroplast** (KLOR-uh-plast): a plant cell structure that contains the green pigment, chlorophyll
- **mitochondria** (mitt-oh-KAHN-dree-uh): a cell structure that takes energy from nutrients and makes it available for other cell processes
- **phloem** (FLOW-uhm): tubular cells in plants that carry food from leaves to roots
- **xylem** (ZIE-luhm): tubular cells in plants that carry water and nutrients from roots to leaves

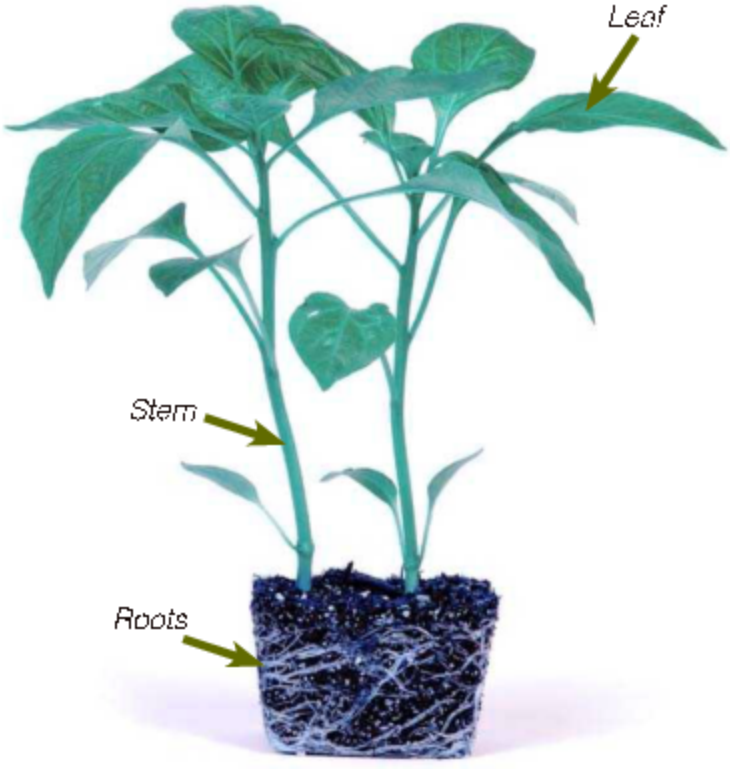


Magnified plant cells have a blocky appearance.

Vegetative Parts

Plants have many parts, or organs. Each plant organ has a particular use, or function. Roots, stems, and leaves are the vegetative organs of plants.

Some organs are underground. Roots absorb water and nutrients from the soil.



Leaves are above ground. They absorb the energy from sunlight and carbon dioxide from the air for photosynthesis.

Stems hold up the leaves. Stems also transport substances between the roots and leaves.

Roots

Roots are the underground parts of plants. Plants need a large, branching root system to perform several functions. By branching and re-branching, plant roots create many surfaces to absorb with and hang on to the soil.

Plants, such as dandelions, grow long roots called taproots that reach water deep in the ground. Other plants, such as witch grass and black spruce trees, grow and spread their roots near the surface.

Functions of Roots

- **Roots connect plants to the soil.** Millions of microscopic root hairs cover their growing tips. The root hairs absorb water and nutrients from the soil.
- **Roots anchor, or hold a plant in the ground.** Plants with strong, branched roots will not wash away in a storm.
- **Roots store nutrients.** People eat the roots of many plants such as carrots, turnips, beets, and radishes.

Stems

The stem of a plant usually grows above the ground surface. Stems can be short, or very long. We find buds, leaves, flowers, fruits, or cones on the stems. Some plants have thorns and tendrils on their stems, too.

When seeds germinate, or sprout, a part called an epicotyl, or leafy shoot, develops into stems and leaves.

Some plants have soft, green stems called herbaceous stems. They usually live for one season. Woody stems are harder and live for many years. Stems may start out as herbaceous and become woody as they grow.

Irises, ferns, and other plants have special underground stems called rhizomes. Tubers are thick underground stems with buds called "eyes". Potatoes are tubers.

These iris rhizomes will grow into beautiful plants.

Potatoes are structures called tubers.

An epicotyl develops into leaves and a stem

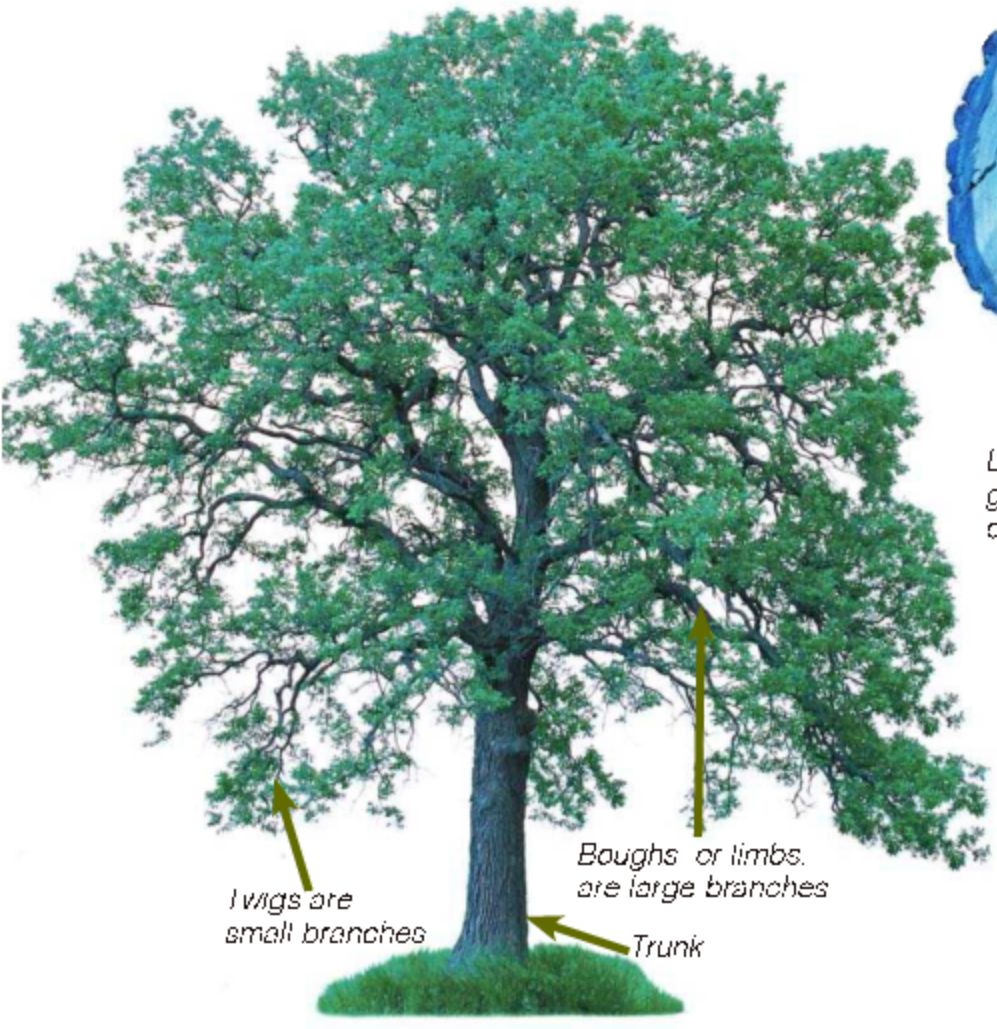
Branches form as the stems of trees grow and divide. Twigs are small branches. Boughs or limbs are large branches.

Trunks are the large single base of a tree. Tree trunks vary from tree to tree. They may be long and bendy or short and sturdy.

Trunks that grow for many years produce a ring of wood each year called a growth ring. When a tree is cut down, you can count the growth rings in the trunk to figure out the tree's age.

Bark is the hard covering of the trunks and stems of woody plants. It protects the plant from insects and injury. Some desert plants, such as cacti, have chlorophyll in their bark and use it for photosynthesis.

On smooth, young stems you can see tiny dots, called lenticels, which allow air to get into the stems.



Look closely and you can see the growth rings in this cross-section of a tree trunk.

Lenticels allow air to get into the stem.

Functions of Stems

- **Stems hold up the leaves to get energy from the sun.**
- **Stems support the flowers, and the fruits and seeds, that grow from them.**
- **Stems permit the flow of water and nutrients between roots and leaves.**

Find out more

Some of the most common desert trees around Tucson, Arizona are Yellow Paloverde trees. Paloverde means "green stick" in Spanish and refers to their distinctive green bark.

Most plants have chlorophyll in their leaves. Paloverde bark is green because it contains the chlorophyll the plant needs for photosynthesis. Three-quarters of the photosynthesis in Yellow Paloverde trees takes place in their green bark instead of in their tiny, rather sparse leaflets.

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Leaves

Leaves grow from stems and are usually flat, thin, and wide to absorb a lot of sunlight for photosynthesis. Bulbs are underground leaves that store food. Onions and garlic are plants that grow from bulbs. Tulips, daffodils, and gladiolas are flower garden plants that grow from bulbs.

Did you know that for each leaf, there will be a ring of onion? The larger the leaf, the larger the ring will be.

Shapes, Sizes, Colors, and Pigments of Leaves. There is great variability in the shapes, colors, textures, and size of leaves among plants. They can be needle shaped, rounded, pointy, smooth, or wrinkly.

It is easy to see the vein pattern on these ivy leaves.

Palm trees have leaves six feet (1.83 m) long, or bigger. The tiny leaves of duckweed (an aquatic plant) are only about one eighth of an inch (2.5 mm) long.

This magnified photo gives a close-up view of duckweed leaves.

● ← *Actual size of duckweed leaves.*

Leaves can be pink, purple, green, and white. But most leaves are green because their cells contain a green substance, or pigment, called chlorophyll, for photosynthesis.

The same leaf can be different shades of green.

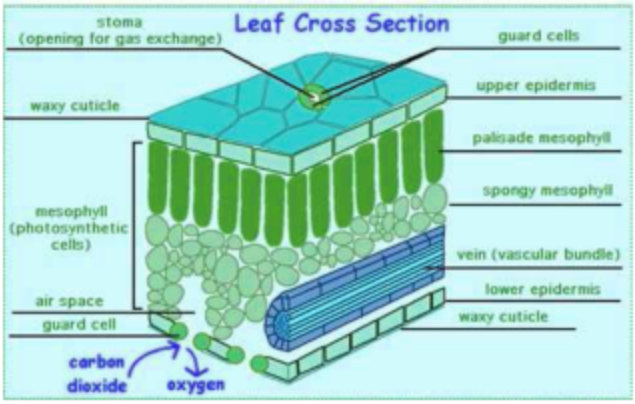
In the fall you can see other pigments contained in leaves. When cool temperatures and short days cause the breakdown of chlorophyll, the red, yellow, and orange colors become visible. Deciduous trees lose their leaves in the fall.

Vein Patterns of Leaves

The parallel pattern is common among grasses, such as lawn grass, wheat, rice, and corn. Their veins run side-by-side from the base of the leaf to its tip.

The pinnate pattern resembles the branching pattern of a Christmas tree. Birch, alder, elm, and beech trees have pinnate veins.

The palmate pattern of maple trees has several large veins that spread out like your fingers from the palm of your hand.



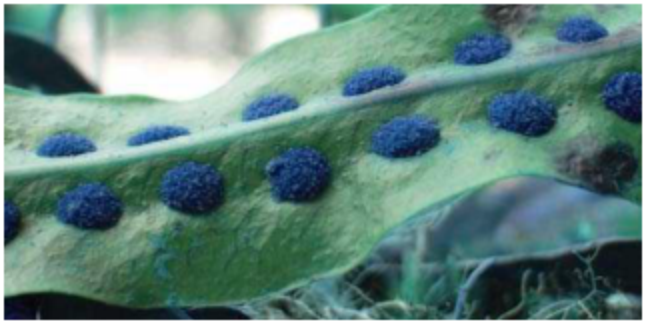
Leaves are the powerhouse of plants. In most plants, leaves are the major site of food production for the plant. Structures within a leaf convert the energy in sunlight into chemical energy that the plant can use as food. Chlorophyll is the molecule in leaves that uses the energy in sunlight to turn water (H_2O) and carbon dioxide gas (CO_2) into sugar and oxygen gas (O_2). This process is called photosynthesis.

Leaf Structure

A leaf is made of many layers that are sandwiched between two layers of tough skin cells (called the epidermis). The epidermis also secretes a waxy substance called the cuticle. These layers protect the leaf from insects, bacteria, and other pests. Among the epidermal cells are pairs of sausage-shaped guard cells. Each pair of guard cells forms a pore (called stoma; the plural is stomata). Gases enter and exit the leaf through the stomata.

Most food production takes place in elongated cells called palisade mesophyll. Gas exchange occurs in the air spaces between the oddly-shaped cells of the spongy mesophyll.

Veins support the leaf and are filled with vessels that transport food, water, and minerals to the plant.



Each of the dots on this leaf contains thousands of spores.

Reproductive Parts

Plant reproduction results in new generations of plants. Flowers, cones, fruits, and seeds are the reproductive parts, or organs, of plants. Flowers and cones are for making new plants. Fruits and seeds contain the undeveloped baby plants, called embryos. Special cells called spores, eggs, sperms, and pollen are part of the process in different plants, also.

Words to know

herbaceous (hur-BAY-shus): non-woody plants

nutrient (NOO-tree-ehnt): a necessary substance found in foods

These female cones are much larger than the male cones from the same evergreen tree.

Spores

Some living things without flowers can use cells called spores to reproduce. These kinds of cells can grow into new plants. Algae, fungi, mosses, and ferns use spores for reproduction. The organisms release huge numbers of spores because most of the spores do not survive long.

Released spores travel by wind and water to spread out away from the parent organisms. Insects and animals can also trigger the release of spores and end up carrying them to other places, too.

Cones

A cone is a special type of reproductive structure with spiraling rows of hard, woody scales. Conifers are trees with cones. Pine, spruce, cedar, cypress, hemlock, fir, and tamarack trees are conifers. The cones on juniper trees and yews resemble berries.

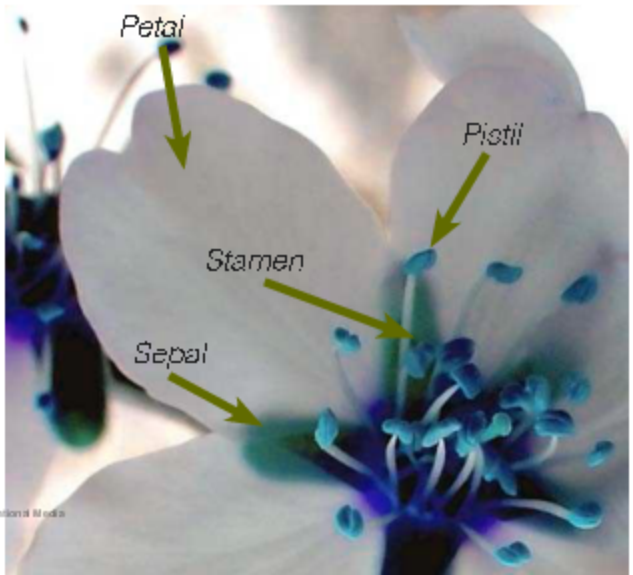
Conifers have two types of cones. Male cones produce pollen grains. Female cones make egg cells. When egg cells are joined with pollen they develop into seeds. The seeds form at the base of each cone scale.

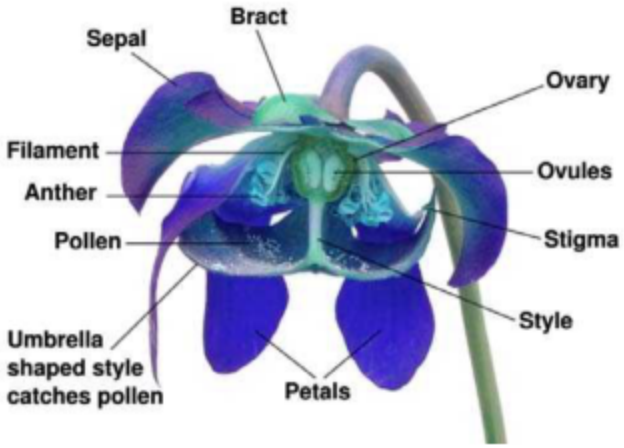
Flowers

Flowers are the reproductive parts, or organs, of most kinds of plants. Flowers produce fruits with seeds in them. New plants grow from the seeds.

Petals and sepals make up the outer part of a flower. Petals are usually soft and brightly colored. The sepals are greenish scale-like structures, which protect the flower while it is developing.

The male stamens are inside the petals and produce the pollen. The female pistils occupy the center of a flower. Egg cells are produced in the ovary at the base of each pistil. The top of each pistil has a sticky surface area, called the stigma, where pollen grains land.





Shapes, Sizes, Colors, and Pigments of Flowers Flowers occur in many colors, forms, and arrangements on plants. Their colors range from shades of red, orange, yellow, blue, purple, and white. Many are multi-colored. Flowers may be cup-shaped, trumpet-like, or starry.

Some flowers are tiny, such as forget-me-nots. Sunflowers are enormous in comparison. Do you enjoy the fragrances, or smells, of flowers, such as roses or lilacs?

The shapes, colors, and fragrances are also very important to the plant because they attract insects, birds, and bats. These animals help to spread pollen from flower to flower.

Fruit

Fruit is actually the ripened part of the plant ovary that contains seeds. Some fruits are hard and dry. Other kinds are soft, sweet, and juicy. Both kinds protect the seeds inside and help to spread, or disperse them in the environment.

Gourds are tough or hard fruits with shells. They contain seeds and pulpy flesh. Plant relatives of gourds include pumpkins, melons, cucumbers, a nd squash.

In the fall, we enjoy many seasonal gourds.

Edible dry or hard fruits are nuts and beans. Acorns, produced by oak trees, are important wildlife food for bears, deer, squirrels, and birds. Long ago, some Native Americans used acorns as food, too.

Words to know

anther (ANN-thur): the male flower structure that produces pollen cells

ovary (OH-vur-ee): the female structure that contains egg cells

pistil (PIS-tuhl): the female structure at the center of a flower

pollen (PAH-lehn): the male cells of flowering plants

stamen (STAY-mehn): the male flower structure that is composed of an anther at the tip of a long, thin filament

Fleshy Fruit

Drupes: Some fruits, such as avocados, cherries, plums, and peaches are called drupes and have a hard seed known as a pit.

Berries: Soft, often brightly colored fruits, containing many seeds are berries. Grapes and tomatoes are actually berries. Oranges and other citrus fruits are actually modified berries with a tough skin, or rind.

Pomes: Soft fruits with a papery core and seeds in the middle are pomes. Apples and pears are pomes.

Aggregates: Raspberries and blackberries are aggregate fruits. Aggregates are clusters of tiny drupes.

Multiple: Pineapples and mulberries are multiple fruits. Multiple fruit develops from a cluster of flowers.

Accessory: Strawberries are accessory fruit. Accessory fruit have tiny hard seeds scattered all over their surface.

Sometimes plants produce fruit that have no seeds. These plants cannot reproduce naturally (because they have no seeds). Plant scientists have figured out different ways to reproduce these kinds of fruit.

Find out more

Many people prefer eating seedless varieties of fruits such as watermelon, grapes, grapefruit, and oranges. Grafting is one way to reproduce the seedless varieties of fruit trees.

Grafting is the process of taking small stems and buds from a seedless tree and putting them into a cut in the bark of another tree of the same kind that has seeds. The bud or twig is covered with wax and tape to protect it until it begins to grow and the cut heals.

Later, that bud or twig will produce flowers and fruit that are seedless.

Seeds

A seed consists of an embryo and a cotyledon. The embryo is a baby plant, and the cotyledon is a stored food structure. The seeds of plants may be as small as dust particles or as big as a coconut. Nuts and grains are seeds. Seeds germinate, or sprout, and grow into new plants.

Gymnosperms, are seed-bearing vascular plants, such as cycads, ginkgo, yews and conifers, in which the ovules or seeds are not enclosed in an ovary. The word "gymnosperm" comes from the Greek word gymnospermos,

Coconuts are large seeds.

meaning "naked seeds". Gymnosperm seeds develop either on the surface of scale or leaf-like appendages of cones, or at the end of short stalks.

Angiosperms, or flowering plants, produce their seeds within the female ovary of their flowers.

Two Types of Seeds

Monocotyledon seeds have one cotyledon and come from plants such as corn.

Dicotyledon seeds have two cotyledons and come from plants such as beans.

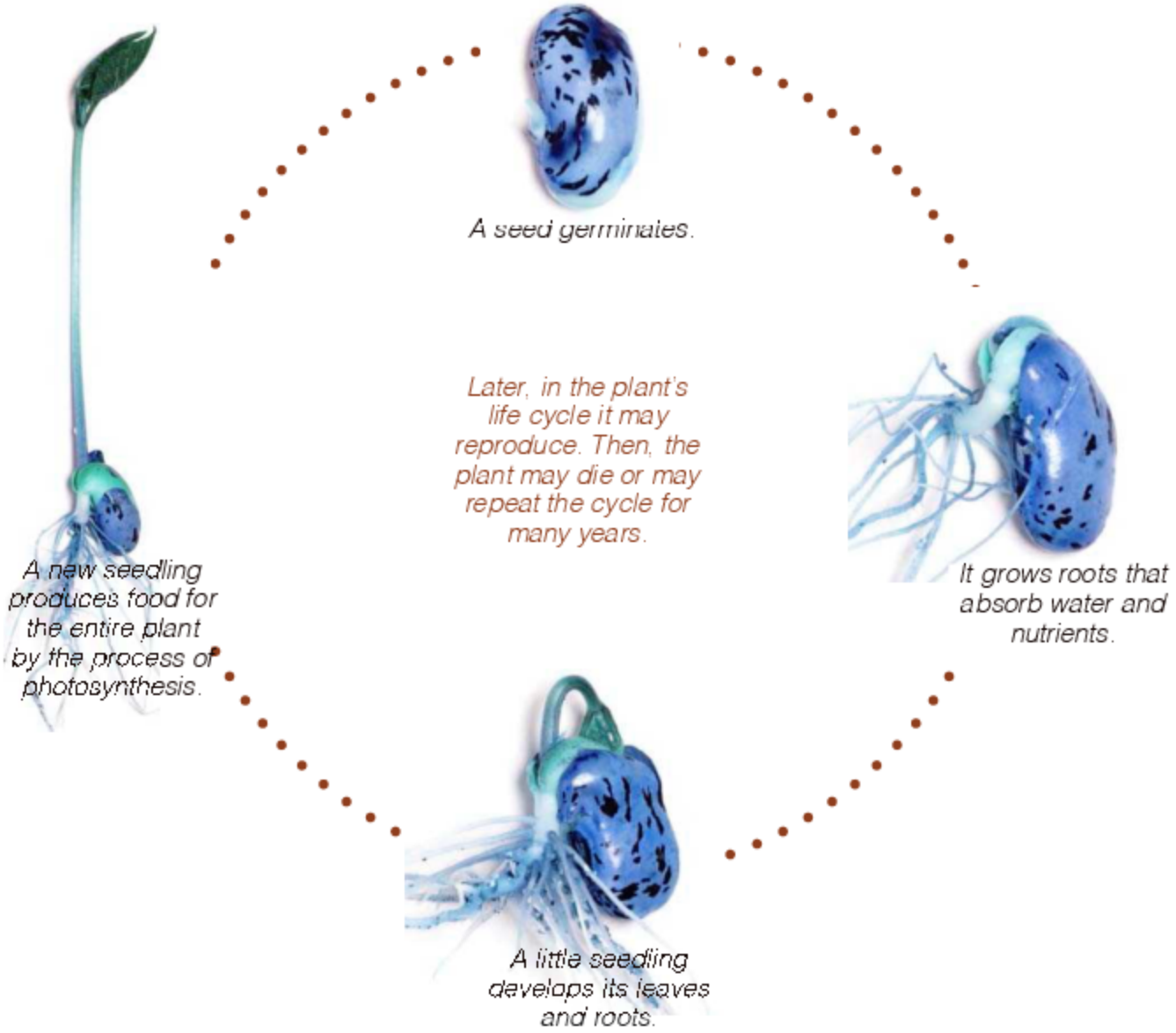
Comparison of monocot (left) and dicot (right) sprouting.

How Plants Grow

The Life Cycle of Plants

Plants grow and develop in stages called a life cycle. Most plants begin life as a spore or a seed. Some plants make spores that grow into new plants. Other plants make seeds.

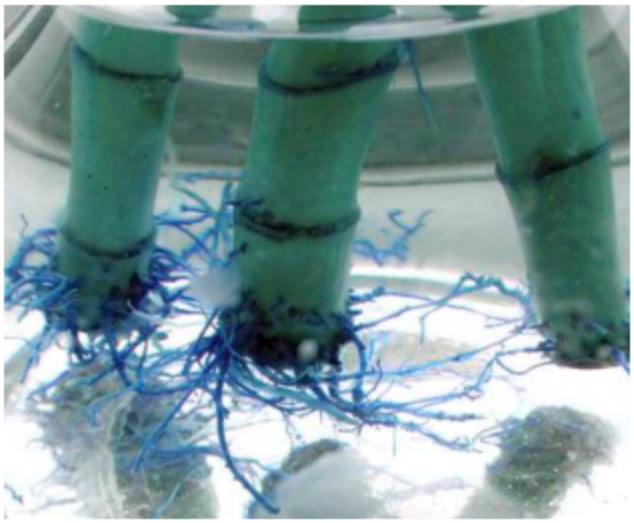
Flowers make seeds from egg cells fertilized by pollen. Wind, water, insects, and animals disperse spores to new places where they can grow.



Plant Reproduction

All plants must make new plants for their kind to survive. Reproduction is the name of this process.

Plants reproduce in several ways. Fragments, or pieces, of plants can sometimes grow into new plants. Gardeners make cuttings of stems or leaves and put them in containers of water or wet peat moss to grow them. Since this kind of reproduction does not involve male or female cells, we call it asexual reproduction.

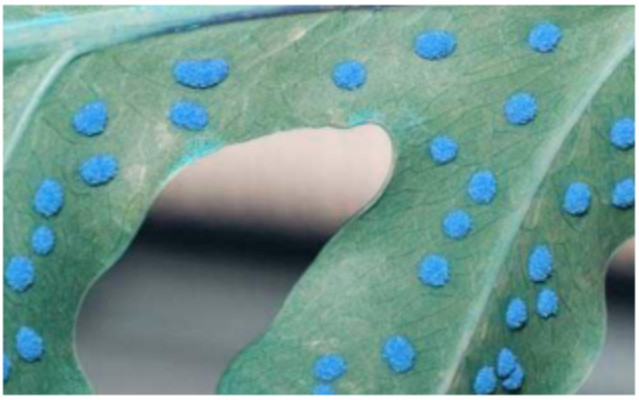


Cut stems will sprout roots when placed in water. This is asexual reproduction.

Sexual reproduction, among plants, relies on eggs and pollen. Most plants use sexual reproduction and reproduce by making seeds.

Mosses, Ferns, and Fungi Reproduction

Some plants, such as mosses and ferns, reproduce by releasing spores.

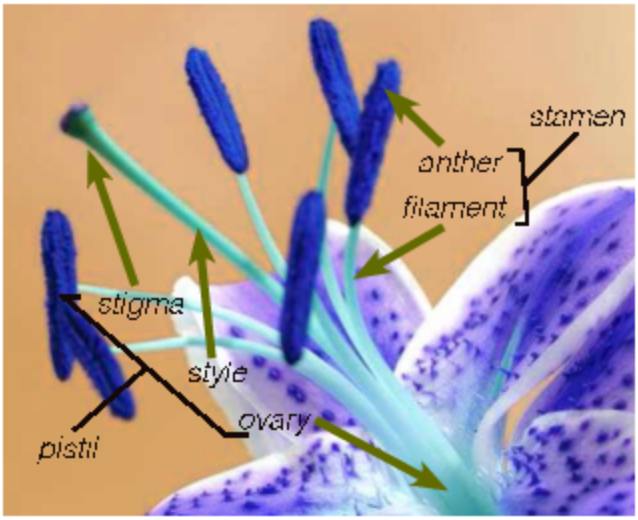


These fern sporangia will produce spores that wind, water, and animals will carry away.

Mosses and liverworts can also reproduce with male and female cells called sperm and eggs. Sperm are cells that must swim to the egg, or ovum. A fertilized egg develops into a chamber called a sporangium that grows from the tip of the moss. This sporangium later makes and releases spores that grow into new moss plants. Alternation of generations is reproduction using eggs and sperm, and then spores.

Flowering Plant Reproduction

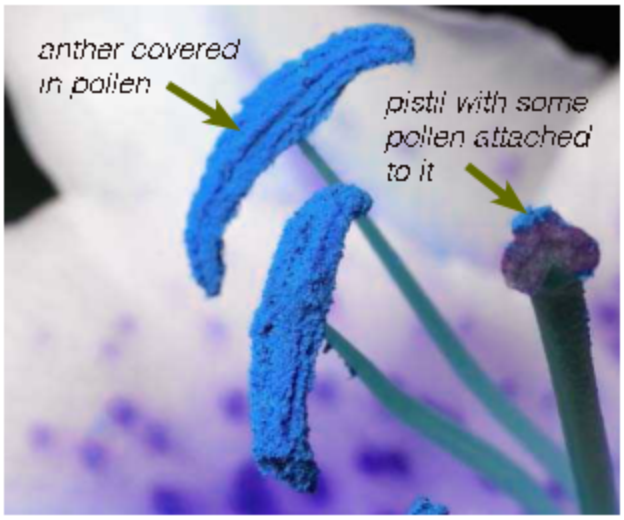
Flowering plants use flowers for reproduction. In flowers, anthers on the stamens make the pollen. In cone-bearing plants, a microsporangium makes the pollen.



A pollen grain and an egg cell must combine to produce a seed. In flowering plants, the pollen must get to the top of the pistil of a flower. In cone-bearing plants, pollen enters an egg at a structure called a micropyle.

A hummingbird pollinating a flower.

Fertilization is the name of the process that combines eggs and pollen in the ovary of a flower. The fertilized egg, or ovule, then develops into a seed.



Pollination is the name of the process by which pollen gets to the egg bearing structure. Wind, water, insects, and animals pollinate flowers.

Find out more

Ears of corn are female flowers. The tassels at the top of the corn plant are the male flowers.

Pollen is shed from the tassels and is carried by the wind to the corn silks at the ends of the ears. Corn silks are long tubes leading to the corn kernels where the egg cells are located.

The pollen cells that land on the silks have to go all the way down the silk tubes to fertilize the eggs.

After fertilization, the egg cells develop into the corn that you love to eat!

Seed Dispersal Reproduction

When seeds are fully formed they are usually dispersed, or spread out, from the parent plant. The wind carries away some small seeds and seeds with special wing-like structures. Maple tree seeds are winged and flutter to the ground like little helicopters.

Each maple tree that grows was once a tiny winged seed.

Seeds, like those of the burdock plant, have hook-like structures and can hitch a ride on an animal by sticking to its fur.

Words to know

asexual (ay-SEX-you-uhl): reproduction without eggs and sperm

feces (FE-seez): excrement from bowels

fertilization (fur-till-eye-ZAY-shun): the joining, or union of and egg and a sperm cell

pollination (pah-luhn-AY-shun): the transfer of pollen from one flower to another

sexual (SEX-you-uhl): reproduction with eggs and sperm, or pollen cells

Some birds carry seeds and drop them far away.

Animals eat some seeds and carry them away in their digestive systems. The animals drop the seeds in a new location when they get rid of waste (feces).

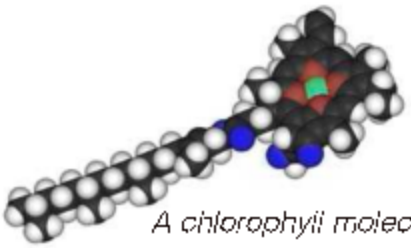
Many squirrels bury seeds.

Photosynthesis

Photosynthesis is the chemical process in plants that feeds all living things on the Earth. It would be impossible for animals or humans to survive without the food and oxygen produced by plants.

About Photosynthesis

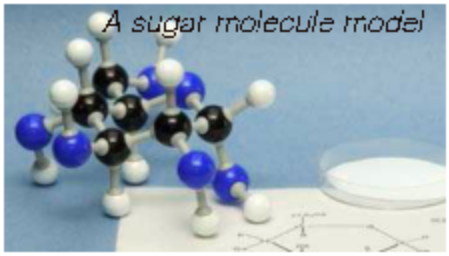
Photosynthesis occurs in the green leaves of plants, in cell structures called chloroplasts. Chlorophyll is the sunlight absorbing pigment that powers the process.



A chlorophyll molecule

Photosynthesis is the process that produces food substances in green plants. Carbon dioxide, from the air and water, and sunlight are all part of the process.

Some carbon, hydrogen, and oxygen atoms combine to make food molecules, such as sugars. The plant releases leftover oxygen molecules into the air.

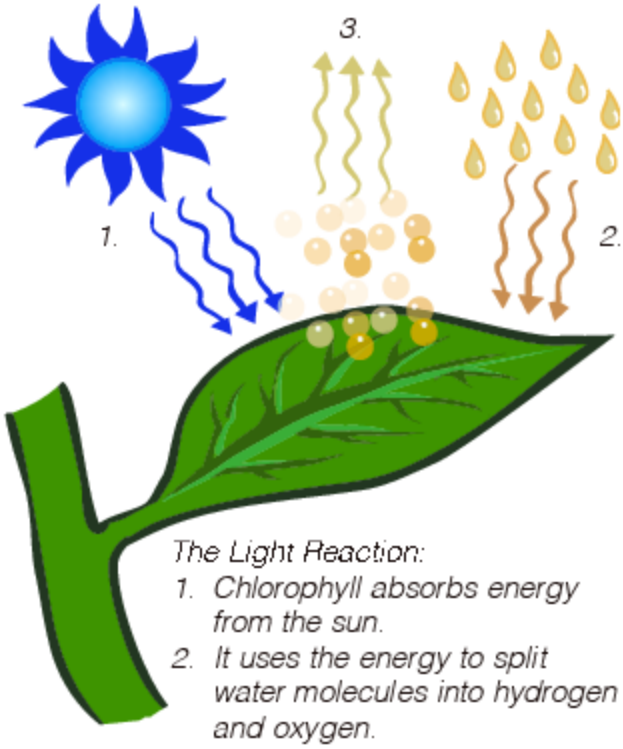


A sugar molecule model

There are two parts, or stages, in photosynthesis known as the light reaction and dark reaction.

The Light Reaction is the first stage and needs sunlight, water, and chlorophyll. During the light reaction water molecules split into hydrogen and oxygen.

This process depends on the chlorophyll in the plant, which can absorb the sunlight energy needed to split the water. The oxygen is released into the air (that's where we get our oxygen). The second stage of photosynthesis uses the remaining hydrogen and energy.



The Light Reaction:

1. *Chlorophyll absorbs energy from the sun.*
2. *It uses the energy to split water molecules into hydrogen and oxygen.*
3. *The oxygen is released into the air.*

The Dark Reaction is the second part of photosynthesis. It needs no sunlight and goes on all of the time. Another name for it is the Calvin Cycle.

This process takes carbon dioxide from the air and combines it with the hydrogen and energy from the light reaction. In this way, plants can make carbohydrates, such as sugars and starches, they need for food. The plant reuses some of the substances produced during the cycle. The cycle repeats as long as the plant lives.

Plant Sugars and Carbohydrates

The Dark Reaction:

1. *Carbon dioxide (CO_2) from the air is combined with the carbon compound and energy from the light reaction.*
2. *The plant uses this to make the sugars and carbohydrates it needs to live.*

Words to know

carbohydrate (kar-boh-HIGH-drait): a food substance produced by the plant process called photosynthesis

chlorophyll (KLOR-uh-fill): a green pigment used by plants to absorb sunlight energy during photosynthesis

meristem (MEH-reh-stem): plant cells at the tips of roots and stems, and under the bark, where growth can occur

Find out more

Plants are key to mitigating the effects of climate change as they are a major sink of carbon from the atmosphere via photosynthesis. However plants are also a major source of atmospheric carbon via human actions such as burning fossil fuels, deforestation, which accounts for 1.1x1015 grams of carbon per year and also via their use in agriculture, which is estimated to constitute approximately 10-12% of all greenhouse gas emissions.

Fossil Fuel plant.

Karl von Nageli (1817-1891)

Getting to know...

Karl von Nageli was born in Switzerland in 1817. He first studied medicine, but became interested in plants and switched his studies to botany, which is the study of plants.

Nageli began to wonder how plants grow and reproduce. After discovering the spores of ferns, he studied mosses, which are simple plants. Nageli also noticed that there are two kinds of tissues in plants. They are structural tissue that has stopped growing and formative tissue that is always growing. He discovered that the formative, or meristem tissues, were located at the growing tips of stems and roots, and under the bark of trees.

Today, wilderness survival trainers know that if you become lost in the woods, you can scrape the meristem tissue from the inside of the bark of some living trees, and survive by eating it. Meristem tissues contain many nutrients, such as proteins and sugars.

Types of Plants

Bryophytes are small, non-vascular plants, such as mosses, liverworts and hornworts. They play a vital role in regulating ecosystems because they provide an important buffer system for other plants, which live alongside and benefit from the water and nutrients that bryophytes collect.

Some bryophyte species are amongst the first to colonize open ground. Bryophytes are also very good indicators of habitat quality as many plant species in this group are sensitive to levels of moisture in the atmosphere, which are lower in disturbed habitats because there is less shade.

Bryophytes do not have seeds or flowers. Instead they reproduce via spores.

There are around 20,000 species of Bryophytes.

Many different kinds of plants grow in a rainforest, including mosses and ferns.

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Annual Plants

Annual plants complete their life cycles in one growing season.

Peas are one kind of annual plant.

Perennial Plants

Perennial plants repeat their life cycles and live for many years.

Day lilies are one kind of perennial plant.

Algae

Some algae are part of the Kingdom Protista, and others are part of the Kingdom Eubacteria, and thus are not really plants. We classify common algae by the pigments that they contain. Algae have been around for many years. Fossils show that blue-green algae were among the first living things on Earth.

Algae are made of cells like other plants but have no roots, stems, or flowers. Common green algae live in water or on wet soil, rocks, and other damp surfaces, such as cellar walls, tree bark, and the sides of flowerpots.

Algae cells can be like bacteria cells with no nuclei. Other algae are one-celled, such as many of the ocean's plankton. Some plankton are photosynthetic algae, capturing energy from sunlight and converting it into useful food for all sea life.

You may also see algae growing on stone steps.

Some ice cream contains agar, which comes from red algae.

When you eat ice cream, you might be eating agar, a jelly-like substance produced by red algae. Agar gives ice cream a smooth texture.

Algae can also cause harm. The rapid growth of blue-green algae in small, polluted lakes can use up so much oxygen that fish suffocate.

Sometimes algae covers the surface of a lake.

Lichens are symbionts composed of blue-green algae cells and fungus cells living together. They are grayish-green and you can sometimes find them on apple tree branches and evergreens. Hummingbirds use them to build their tiny nests.

Different Kinds of Algae

Spirogyra, a green algae, lives in groups of cells called colonies.

Irish Moss grows on rocks along the shores of the North Atlantic Ocean, and is edible.

Seaweed and kelp are brown algae that live in the ocean. Kelp can grow to 100 feet (30.5 m) in length.

Silica shells enclose the cells of diatoms.

Blue-green algae cells have no nuclei in their cells.

Words to know

agar (AH-ger): a jelly-like substance produced by some algae

diatom (DYE-uh-tahm): one-celled algae that have shells of silica

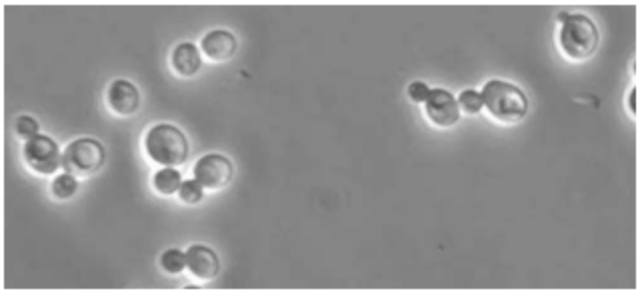
lichen (LYE-kuhn): plant composed of a fungus and an algae

plankton (PLANK-tuhn): microscopic algae and protozoa that live in the ocean

Fungi

Fungi resemble plants in some ways. Their cells have walls like plant cells. They reproduce with spores, like mosses, liverworts, and ferns. But, unlike plants, they have no chlorophyll and can't make their own food.

The structure of a fungus consists of tiny thread-like cells that grow in moist, dark places, such as the soil, dead plants and animals, and other organic substances. Some fungi, such as mushrooms, produce a large, visible, spore-bearing structure, but many are microscopic.



Yeast cells can be seen under a microscope. Yeast is a fungus.

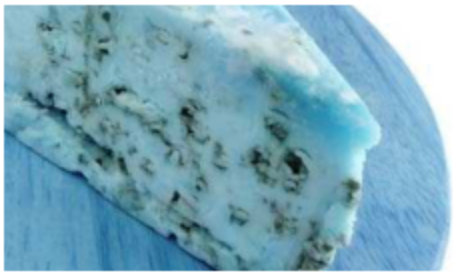
Fungi get their food by digesting and absorbing dead plant and animal substances. They are decomposers and recyclers of dead things. We call them saprophytes.

Common fungi are molds, mildews, yeasts, mushrooms, slime molds, bracket fungi, and puffballs.

Helpful Fungi

Molds are fungi that sometimes can grow on spoiled foods. Penicillium is a common green mold, which grows on spoiled food.

Penicillium produces a substance which is used as an antibiotic. Antibiotics kill bacteria and are important to fight against diseases.



Special molds are used to create the flavors of cheese, such as Roquefort and other blue cheeses.

Helpful Fungi

Yeasts are fungi that decompose fruit. They create alcohol and carbon dioxide bubbles when they digest sugars, and are used to make wine and beer. We call this process fermentation.

Yeast also releases carbon dioxide bubbles when placed in bread dough. The dough rises up and becomes light and spongy when baked.

Some yeasts act as germs, or pathogens, creating infection.

Fungus Diseases

Some fungi cause diseases in plants and animals. Dutch elm disease kills elm trees. Chestnut trees, which were once very common in North America, have almost been eliminated by a blight fungus.

Dutch elm disease is caused by a fungus.

Horses and cattle also suffer from a disease called hoof-rot, caused by a fungus.

Wheat, rye, and other grain crops become infected by Ergot fungus. The bread made with flour from ergot-infected grain is toxic, or poisonous, to humans.

This ergot-infected grain stalk needs to be removed from our food supply.

Edible Fungi

Mushrooms are familiar fungi because people eat them in salads, pizza, and other foods. In nature, they grow on organic matter, such as dead leaves, bark, and in rich soils. They have a great variety of colors and shapes, which are of interest to mycologists, who study them.

Many are edible but some are very poisonous. It's best not to eat mushrooms you find growing outside.

Example of an Edible Mushroom

Example of a Poisonous Mushroom

Other Fungi

Out in the woods you are likely to see bracket fungi, growing like shelves on dead trees.

Bracket fungi form spores shaped like wooden clubs.

Puffballs pop up after a warm rain on lawns. They look like ping pong balls when they are young. If you step on them when they are mature and dried out, they puff out a cloud of spores.

If you look inside of a puffball, you can see its spores.

Words to know

decomposer (dee-cahm-POZ-er): an organism, such as a fungus, that digests dead material and absorbs nutrients to live

fermentation (fur-men-TAY-shun): a chemical process used by some bacteria and fungi to digest sugars

organic (or-GAN-ick): carbon-containing substance remaining after living thing has died

Find out more

FUNGI CAN BE HUGE

The largest living things are not plants or animals. They are fungi. Some fungi weigh thousands of pounds. They live underground and cover areas of many square miles.

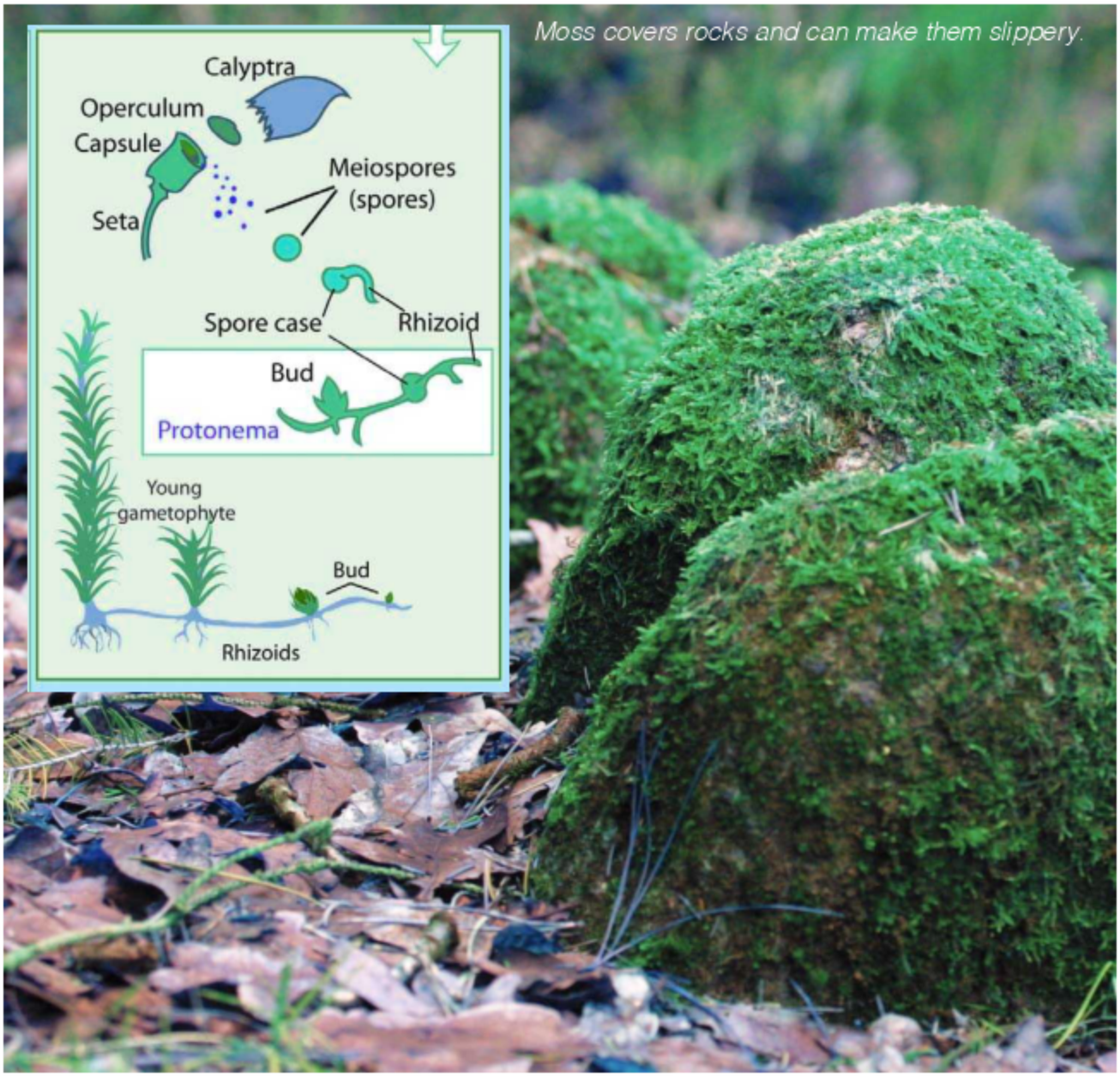
In the cool, wet, coastal rainforests of the northwestern United States, these fungi destroy large areas of trees.

Mosses and Liverworts

Mosses and liverworts are small, simple, green, flowerless plants. They grow in moist, shady places all over the Earth. They attach themselves to cool and damp surfaces with root-like threads, called rhizoids.

Mosses grow in dense carpets made up of thousands of individuals. Mosses contain chlorophyll and are green.

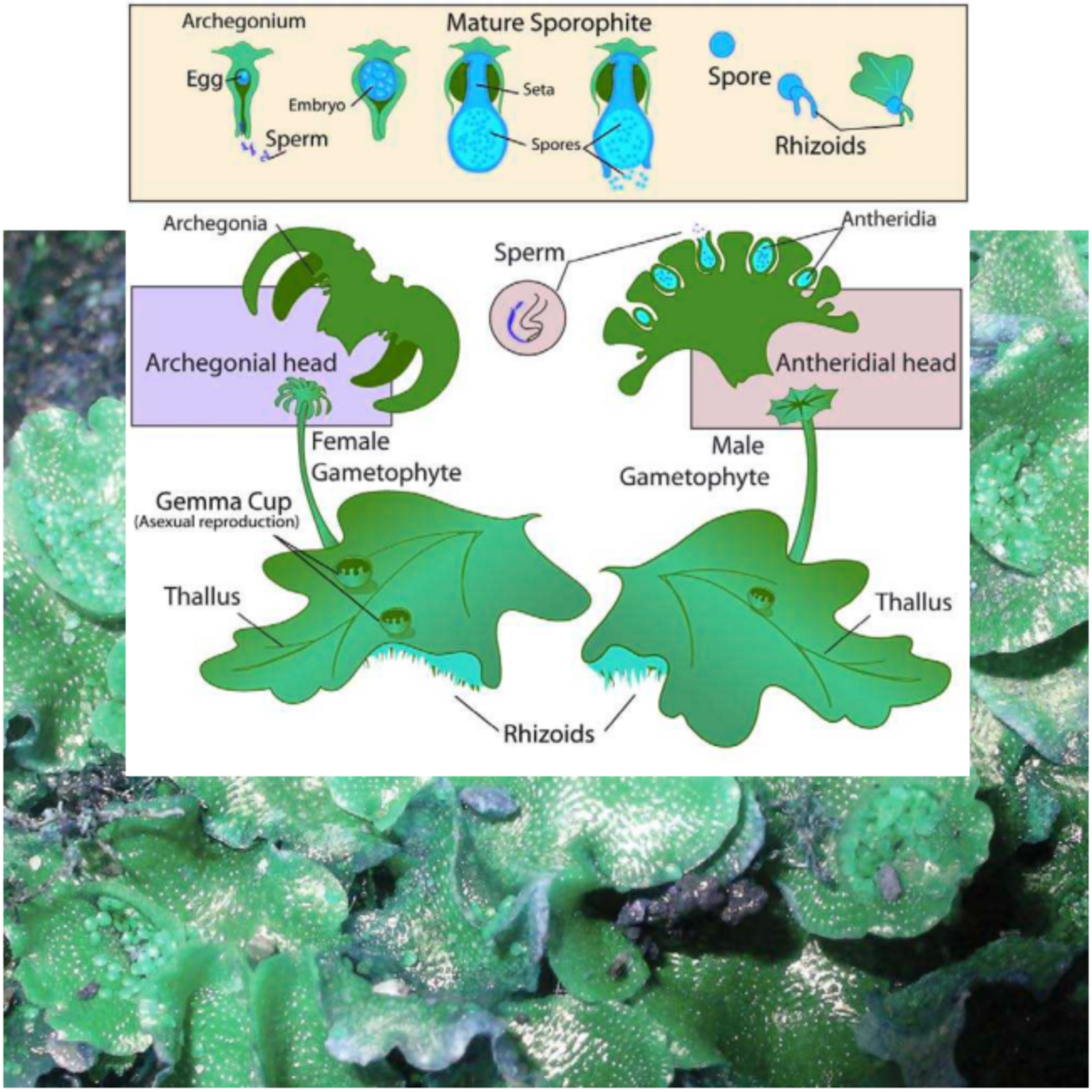
They reproduce by spores released from tiny capsules at the tips of the plant. At another stage they produce eggs and swimming sperm to continue their life cycle.



Moss covers rocks and can make them slippery.

Liverworts are like mosses in that they attach themselves by hair-like rhizoids. Unlike mosses, they have no leaves or stems. Their bodies are wide, flat, branching, green ribbons growing on wet rocks and soil near shady, cool woodland streams.

Like mosses, liverworts reproduce with spores and, at another stage, with eggs and sperm during their life cycle. Mosses and liverworts must live in wet places to complete their life cycles.



Liverworts grow in wet places.

Ferns

Ferns have been on Earth for millions of years.

They are flowerless plants. Like mosses and liverworts, they prefer wet and shady places. Most live on the ground but some can live on rocks and tree bark. A few types live in open, sunny places and a few others live completely in water.

Ferns prefer shady places, like forests.

Ferns range in size from tiny rock ferns that look like moss, to giant tree ferns, 40 feet (12.2 m) tall

Fern leaves, called fronds, are leafy. They grow on stems in a branching pattern resembling an evergreen tree. The leaves sprout from underground stems called rhizomes, uncoiling as they grow. In this stage, they look like the curled end of a violin. That is why we call them fiddleheads.

The fiddlehead on this fern will unroll as the plant matures.

Edible Ferns

In Maine and eastern Canada, fiddleheads are springtime delicacies that many people eat. Native American and Canadian Indians taught early white settlers to pick and cook fiddleheads during colonial times.

Ferns also alternate between producing spores and making eggs and sperm to reproduce. Sporangia produce the spores. They look like dots on the underside of fronds. A few types of ferns, called seed ferns, reproduce with seeds produced from pollen and egg cells.

Words to know

fiddlehead (FID-uhl-head): a coiled, immature fern that resembles the upper end of a violin, or fiddle

frond (frahnd): the green leaf-like part of a fern

rhizoid (RYE-zoyd): tiny, hair-like structures that hold mosses, ferns, and liverworts to the rocks, logs, or soil that they grow on

Flowering Plants

Flowering plants outnumber all other kinds of plants. Some scientists estimate there are over 450,000 species of flowering plants on Earth with more being discovered all the time.

They grow wild in deserts, forests, meadows, and on mountains. People cultivate them inside and around their homes.

Tulips are grown in regions where the winters are cold.

Flowers that are mostly small and not noticeable are usually wind-pollinated plants. Birds and insects usually have a role in the pollination of flowers that are showy and noticeable. The bird of paradise flower is an unusually shaped flower. It has a perch for birds to sit on and drink the nectar. The pollen collects on the bird's neck and the bird carries the pollen from flower to flower.

Can you see how the bird of paradise got its name? It looks like a beautiful bird in flight.

Simple or Composite

Flowers may be simple or composite.

Simple Flowers

A simple flower is a single blossom with one set of sepals, petals, stamens, and pistils.

Lilies, violets, poppies, tulips, and morning glories are simple flowers.

Composite Flowers

A composite flower is hundreds of tiny flowers clustered together. Petal-like ray flowers surround a button-like cluster of tiny disk shaped flowers in the center. The disk flowers in the center have multiple stamens and sepals. Daisies, asters, chrysanthemums, and sunflowers are composite flowers.

Lilacs grow clusters of flowers.

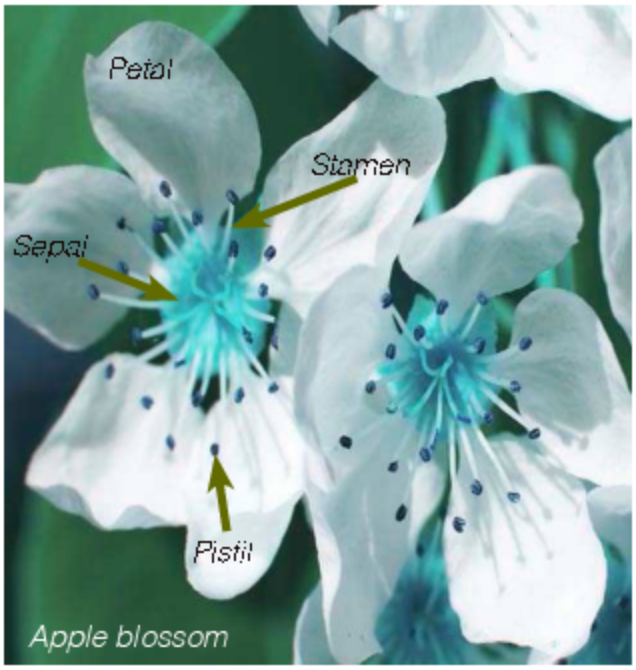
Complete and Incomplete Flowers

Complete flowers have a set of sepals, petals, stamens, and pistils. Apple and cherry blossoms are complete flowers.

Flower Arrangement

Flowers are arranged on plants in various ways. On some, the flower arrangement is in groups, or clusters. Other plants have single flowers.

Morning glories grow single flowers.



When the pollen from the stamen fertilizes the ovum in the pistil, an apple will develop.

Incomplete flowers lack one of the four major parts of a flower. These plants usually rely on the wind to pollinate them. Birch and willow trees have incomplete flowers.

Flowering vines sometimes have separate male and female flowers. Cucumbers, pumpkin, squash, and watermelon plants all have female flowers that develop into vegetable fruits after pollination by separate male flowers.

Pumpkin plants have female flowers.

Words to know

- **complete** (kom-PLEET): a complete flower has petals and sepals
- **composite** (kom-POZ-itt): a composite flower is made up of ray flowers surrounding a central area of disk flowers
- **incomplete** (inn-cuhm-PLEET): flowers that lack one or more of the four main flower parts
- **pollinate** (POL-uh-nate): to carry or transfer pollen from the stamen to the pistil of the same flower or another flower

Sometimes the female flowers are on one plant and the male flowers on others.

The flowers of a pussy willow are called catkins. You can see the yellow pollen on the tips of this catkin.

Shrubs

Shrubs are woody plants with tree-like branches without a main trunk. The branches grow from the base of the shrub, or from below ground level. Shrubs range from a few inches in height up to 16 feet (4.9 m) tall. Some shrubs are flowering evergreens, such as Rhododendrons.

Shrubs are known by many names, such as scrub, bushes, brush, thickets, and hedges.

Shrubs Grow in Many Different Ways	
Bushes are low shrubs, such as roses.	
Scrub is used to describe an area with dense or tangled growth of shrubs.	
Wild areas of shrubs are called brush.	
Thickets are wild areas where shrubs grow very close together.	
Hedges are shrubs used as fences or borders around houses, buildings, and parks. When hedges are trimmed, more side branches develop, causing the hedge to thicken. Topiaries are hedges trimmed into shapes of animals or other forms.	

Vines

Vines are plants that climb up other plants or structures. Some vines grow across the ground between different plants. Some vines simply wind around other things to receive the sunlight that they need.

The climbing vines of tropical rainforests grow to the tops of tall trees to get sunlight. Climbing plants use other plants for support because they are not as sturdy or strong.

Climbing Vines Get Support in Many Ways

Tendrils are little branches that can wrap around the stems of other plants for support.

Ivy vines grow roots into the surfaces that they hold onto. They have special little pads that can attach them to walls or other surfaces.

Thorny vines entangle themselves with the supporting plants that they climb on.

Some vines produce edible fruits and vegetables, such as tomatoes, melons, squash, and cucumbers. Other vines have pretty flowers and lots of decorative foliage. Many people enjoy growing these vines for houseplants or in flower gardens.

Cucumbers grow on vines.

Words to know

foliage (FOH-lee-ij): the leaves of a plant

rainforest (RAYN-foh-rest): a lush, moist forest with many kinds of plants and animals

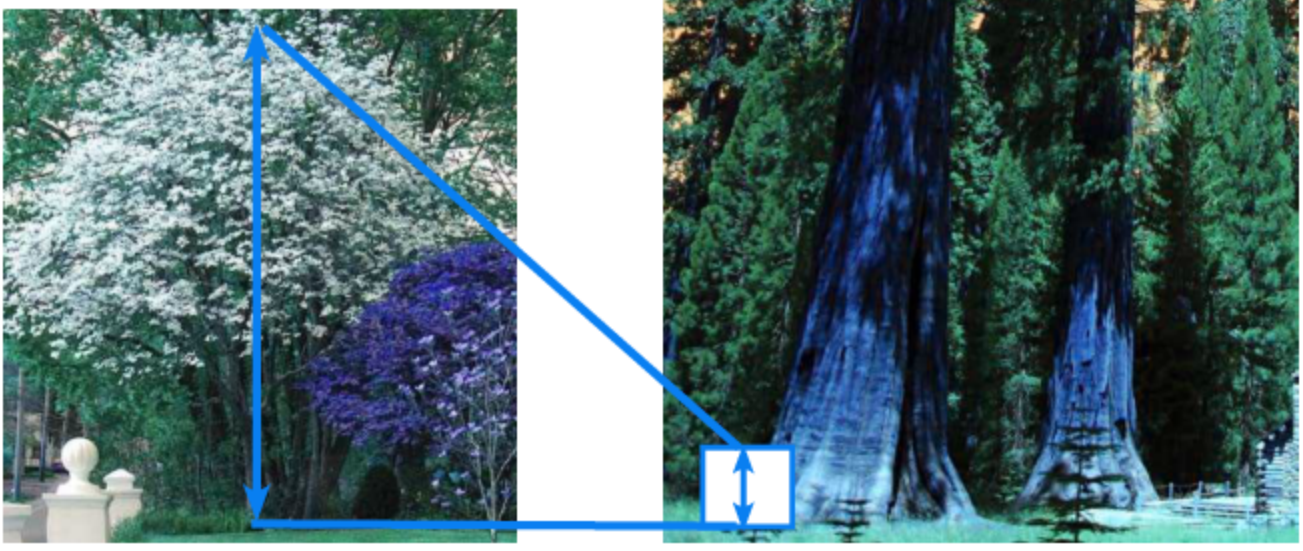
topiary (TOH-pee-air-ee): a hedge that is trimmed in the shape of some object or animal

Trees

Trees grow to various sizes and shapes according to their species. Like people, they grow to a particular size and then stop growing.

An oak tree can live 200 or more years.

Small flowering trees, such as dogwoods, grow only 10 to 20 feet (3 to 6 m). The tallest cone-bearing redwood trees are about 367 feet (111.9 m) tall.



An approximate height comparison of a twenty foot dogwood to a 367 foot redwood.

People grow some tiny trees, called bonsai, in plant pots and trim them to keep the trees little.

Bonsai can be created from almost any tree or shrub.

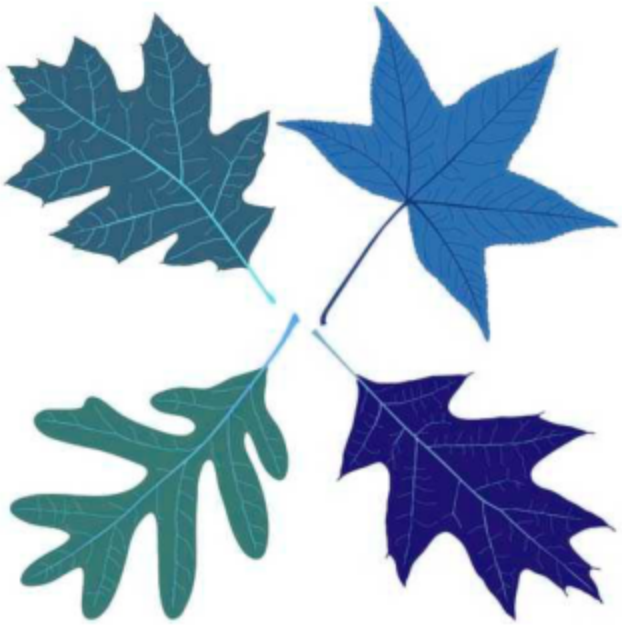
Some large plants, such as bananas, are treelike but are not trees. Their trunks are not woody and are made of leaves tightly rolled. Yuccas are plants with trunks made of tough fibers and leaves that are blade-like. They grow quite tall, but are not trees either.

Bananas grow in hanging clusters, called hands.

Deciduous trees are trees that shed, or drop their leaves in the fall. The leaves of deciduous trees are usually flat, thin, green leaves. Maple, oak, birch, dogwood, beech, aspen, and many fruit trees are deciduous.

Deciduous trees lose their leaves in the fall.

Some trees, such as the red maples, have dark red leaves. Tree leaves vary in size and shape, too. The shapes of the leaves and other characteristics help us identify trees.



Trees produce lots of oxygen through photosynthesis and provide food for wildlife. Many animals, including birds, feed on the nuts and other fruit produced by trees. Tropical rain forests are particularly productive and support large numbers of animal species.

Trees provide food and homes for a variety of animals.

Food products, such as maple syrup, come from deciduous trees. In the spring, the watery sap of maple trees drips from small holes drilled into the trunks. Then we boil down the watery sap to make the sweet syrup.

Sap is collected in February, March, and April, when freezing nights and warm days aid its flow.

Citrus trees, such as orange, lemon, and grapefruit, grow in groves in mild climates. Other orchard fruits, including apples, peaches, mangos, cherries, plums, and olives, also grow on trees. Dates and coconuts grow on palm trees. Trees also produce nuts, such as walnuts, pecans, and almonds.

Trees provide many nutritious fruits and nuts.

Evergreen trees have green leaves all year long. Eucalyptus trees are evergreen trees. They can grow as tall as 300 feet (91 m). The Australian koala is an animal that feeds on eucalyptus leaves and bark.

Koalas live most of their lives in eucalyptus trees, rarely coming to the ground.

Palm trees are evergreen trees. They live in warm tropical places. Their large leaves are shaped like fans or feathers. Large ridges on their bark are the scars that form when their leaves break off. Some palms have large, bushy clumps of dead leaves at their tops.

The coconut palm's leaves can be used to make baskets and thatched roofs.

Conifers are evergreen trees that bear their seeds on cones. Their leaves are needle-shaped. Conifers grow on mountainsides and in northern forest ecosystems, called Taiga.

Conifers grow in both cold and warm climates. Pine, spruce, and fir trees grow in cold, northerly regions of the Earth. Cedar and tamarack grow in cool, northern bogs. Cypress trees grow in warm, watery swamps, such as the Florida Everglades.

Cypress swamps are found in the southern United States, including the Florida Everglades in the southern tip of Florida.

Conifers grow with boughs that slant downward. This helps them shed heavy snow in winter. Their needle-shaped leaves resist cold temperatures.

Some conifers are more suited to growing at higher altitudes than other types of trees.

The conifer's shape helps protect its branches from breaking.

Find out more

The widest trees in the world are banyan trees. They grow in a region called the East Indies. They sprout new shoots from their branches that reach to the ground, take root in the soil, and become new trunks. One tree can create a whole forest!

Herbs

Herbs are non-woody, or herbaceous, flowering plants. Plants such as tulips, marigolds, asters, and other garden flowers and weeds are herbs.

We call some spices, such as basil, thyme, sage, pepper, and oregano, herbs. Some of them have woody stems, though, and are not really herbs. Herbaceous plants are mostly flowering plants.

Perennial herbs have tops that die at the end of a growing season, but sprout again from the underground roots the following year. The roots are dormant, or inactive, in winter. Some herbs are annuals, which grow from seeds each year and live one growing season.

Culinary herbs are plants that are edible and often used to flavor foods. You may be tasting sweet basil or dill when you eat tomato sauce. Chives are grass-like herbs that taste like onions.

Chives, spearmint, and sage are some of the culinary herbs that add flavor to our meals.

Words to know

- **deciduous** (di-SIJ-you-uhss): trees that shed their leaves every year
- **evergreen** (EV-ur-green): a shrub or tree that has green leaves throughout the year
- **botanist** (BOT-uhn-ist): one who studies plants
- **culinary** (KUH-lin-airy): having to do with cooking foods

Various Herbs and Spices and Their Uses

Bay Leaf

Fresh or dried bay leaves are used in cooking for their flavor and fragrance. The leaves are not usually eaten, but left to simmer in soups and stews.

Catnip

Catnip is named after the effect it has on cats. Cat owners buy catnip to entertain their pet cats. Cats will rub on it, roll over it, paw at it, chew it, and lick it.

Cinnamon

Cinnamon is a spice mostly used to flavor desserts, cereals, and hot chocolate. Cinnamon comes from the bark of a small evergreen tree native to Sri Lanka and Southern India.

Echinacea

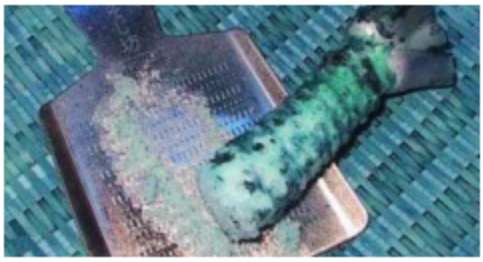
Echinacea is an herb native to prairie habitats in the United States. Some people believe it can boost the body's immune system and ward off infections like the common cold.

Patchouli

The oil from a patchouli plant has been used for centuries in perfumes and is grown in the East and West Indies.

Wasabi

Wasabi is a member of the cabbage family. Its root is used as a spice and has an extremely strong flavor that can leave a burning sensation on the tongue and in the nasal passages.



We use the leaves of many kinds of herbs to make herbal teas. Some herbal teas help people sleep and some keep them awake. Caffeine is a substance in some teas that keeps people awake.

Some herbs, such as mint or sage, have very pleasant aromas and are used in cooking, aroma therapy, and many other products.

The large roots of some herbs, such as carrots, beets, and radishes, are used as food. Many herbs also contain substances that are useful medicines.

Grasses

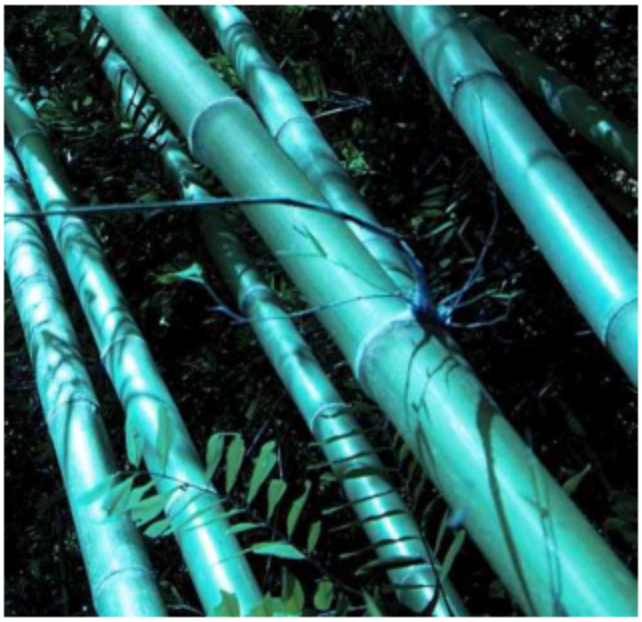
Grasses are flowering plants with tiny flowers, arranged in clusters, on the tips of long stems, or stalks. Grasses are low-growing plants with long, thin leaves. Most have very fine, thin roots that bind them to the soil. Tube-shaped stems hold the narrow leaves, or blades of grass, growing very close together.

The leaves and stems of grasses wither and die at the end of a growing season. Water and nutrients remain in the roots so that the grass can regrow when conditions improve in the springtime. Healthy grasses grow new stems and blades throughout a growing season.

There are many varieties of grass. Corn, rice, wheat, oats, rye, barley and millet are all grasses. The grains from these grasses are used for food, including cereal.

Ordinary grasses, such as Timothy, a common hay plant, usually grow a few feet tall. Hay, or dried grasses, is what many farm animals eat.

Some grasses are used for landscaping, lawns, and athletic fields.



Bamboo is a type of grass that can grow over 100 feet tall.

In nature, grasslands are regions that receive too little rainfall to grow trees. Grasses require less water than trees.

Grasslands of the World

In Africa grasslands are called savannahs.

In North America grasslands are called prairies.

In South America grasslands are called pampas.

In Europe and Asia grasslands are called steppes.

Plant Movements and Adaptations

Plant Movements

Plant reactions usually are slower than those of animals. Some plants, such as jewelweed, have seed pods that pop open when touched, flinging their seeds in all directions. Mimosa trees have leaves that wilt and collapse when touched.

Carnivorous bog plants, such as the Venus flytrap, have special leaves that close up on insects when they touch them.

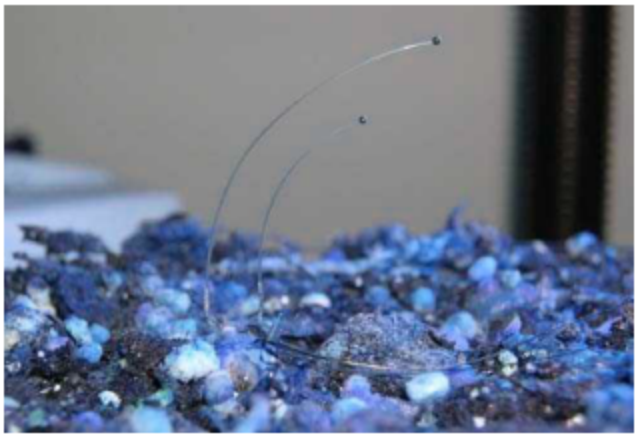
The speed at which a Venus flytrap closes on its prey depends on the humidity, light, size of the prey, and even the health of the plant.

Tropisms

Tropisms are plant growth movements. They help plants grow closer to the things they need and away from things that might harm them.

Have you ever noticed how some plants bend toward light?

Sunflowers move to face the sun from sunrise until sunset. Light makes some parts of the plant grow faster than others. This bending or growing toward the light is called phototropism.



The fungus phycomyces exhibits phototropism.

Plant growth reactions, or tropisms, can be positive or negative. A positive tropism is growth toward something, such as a leaf facing the Sun. A negative tropism is growth away from something, such as a stem growing upward, away from the Earth.

Roots grow toward the Earth, a positive geotropism. Tendrils of a vine touch an object and grow around it, a positive thigmotropism.

Find out more

AUXINS

Auxins are chemicals produced by plants that control growth.

A stem grows toward the light because the auxin moves to the shady side of the stem. The cells on the shaded side grow longer, making the stem bend toward the light. This can happen within minutes, or may take hours.

Plant Adaptations

Plants are threatened by many dangers in their environment. Some plants live in saltwater oceans and must resist salt poisoning. Others live in dry deserts and struggle to get water.

Plants also must compete with other plants for sunlight, water, and soil. Insects and other animals damage them. So plants have developed many adaptations, or changes, to survive all these threats.

Words to know

auxin (AUX-in): plant substance that may speed up or slow down growth

carnivorous (kar-NIV-uhr-uhss): meat eating

tropisms (TROP-izmz): plant growth movements

Plants are damaged by many creatures.

Water Plants

Water plants live in water and have special problems. Saltwater plants must prevent too much salt from killing their cells. Freshwater plants must keep too much water from entering their cells, causing them to burst.

Water lilies use air filled sacs to keep their leaves on the surface helping them get air and sunlight. Giant Amazon water lilies can be 6 feet (almost 2 m) across and can support the weight of large birds.

Kelp beds create an underwater forest off the coast of California.

Desert Plants

Desert plants have adapted to live in hot, dry places. They remain dormant for many months, until it rains. They complete their entire life cycle, producing flowers and seeds, in a few weeks or months.

Desert plants, such as cacti, adapt to the dryness by being leafless. Leaves have large surfaces that lose a lot of water. Cacti are also succulent plants with fleshy stems that hold in water. After a rain, each cactus rapidly blooms and produces seeds.

Large spines on cacti repel desert herbivores (animals that try to eat them). This keeps animals from biting into the cacti, causing it to lose water.

A cactus blooms after a desert rain.

Many other plants, such as rose bushes, have thorns. Thorns protect them from being eaten, too.

Spines keep most animals from biting or eating a cactus.

Epiphytes

Epiphytes are plants that grow on trees. Plants must have sunlight. Forests are crowded with trees and other plants that shade the forest floor. Some ferns, mosses, and even small, flowering plants survive by growing on the taller trees to get the light they need. Mistletoe is an epiphyte.

Mistletoe can be harmful to its host tree, but it helps provide many animals with food and a habitat.

Find out more

PLANTS THAT EAT ANIMALS

Some plants get the nitrogen they need from insects rather than soil. They are carnivorous, or meat-eating. Plants such as Venus flytraps, sundews, and pitcher plants capture flies and other insects and digest them.

Flytraps have leaves that fold together and grasp whatever lands on them. Chemicals called enzymes digest the insect.

A Venus flytrap

A sundew plant

A pitcher plant

Words to know

- **adaptation** (ad-ap-TAY-shuhn): a change that a living thing goes through, so that it fits better into its environment
- **desert** (DES-urt): a dry, often sandy area where hardly any plants grow because there is so little rain
- **enzyme** (EN-zime): a chemical that causes chemical reactions to occur in living things
- **herbivore** (HER-buh vor): a plant-eating organism
- **parasite** (PAIR-uh-site): an animal or plant that gets its food by living on or inside another animal or plant

Parasitic Plants

Parasitic plants do not have chlorophyll. They are parasites on other plants. This means that they take food substances from others by growing into their stems or roots. Beech drops are odd looking little plants that grow attached to the roots of beech trees. They are very pale, almost colorless, because they have no chlorophyll. They absorb the nutrients that they need from the beech roots.

How We Use Plants

Humans use plants in many ways. We build structures with them. We plant them in and around our homes to enjoy their colors, forms, and fragrance. We study them to learn from them. We eat them and use them to make food products and drinks. We even make our clothes from their fibers. Some of them provide medicines and cosmetics.

Shelter and Decoration

People have always made homes from plants. Grasses, logs, and bamboo poles have been useful building materials throughout our history.

This log cabin was made from the wood of nearby trees.

Axes, handsaws, and eventually sawmills, made it possible to create planks and boards. Today, many people live in houses with wooden frames covered with plywood sheets, wooden shingles, and clapboard siding.

People cut down trees for their wood. People plant trees to decorate, or landscape, yards and parks.

Flowers are pleasant to look at, and fruits and vegetables are delicious to eat. That is why so many of us plant them in our gardens. People even grow houseplants, such as ferns, palms, orchids, and geraniums to brighten up their homes and apartments.

Many people enjoy taking care of their indoor and outdoor plants, feeding them a mixture of nutrients called fertilizer. They must make sure their plants get enough water and sunlight, too.

Plant Facts and Tips...

- Plants give oxygen and recycle air.
- The more plants you have the better.
- Plants evoke serenity and circulate healing energy.
- In feng shui, plants bring new opportunities. With specific placement plants enhance health, love, success and wealth.
- Plants neutralize the harmful effects of electromagnetic fields from appliances and electronics.
- Plants raise energy in stagnant corners and slow energy down in long corridors and stairwells.
- Wherever you need more energy, add a plant!
- The best types are upward growing plants with round leaves.
- Don't get plants with droopy leaves, or stiff spiky plants.
- Throw out all dead plants, dried flowers, and potpourri, they are dead energy.

Scientific Exploration With Plants

Scientists find many things that plants and animals have in common by studying and experimenting with them. The way plants and animals inherit and pass down physical traits, or heredity, was discovered in this way.

A researcher examines the roots of a plant.

Cross-Pollination

Plant breeders cross-pollinate plants to improve the next generation of plants. The seeds produced by cross-pollinated plants may have bigger, more colorful flowers. These young plants, called hybrids, may also produce bigger and more nutritious fruit.

Cross-pollinating means that you put the male pollen cells from a plant with a good characteristic on the female pistils of another plant that has a good characteristic. The seeds that are produced from cross-pollination grow up to have both of the good characteristics.

Plant Genetics

In the 1860s, a man named Gregor Mendel (1822–1884) studied and experimented with the colors and shapes of pea plants.

He noticed that certain traits were passed down from plant to plant in certain ways. By counting and using mathematics, he figured out how plants inherited traits and created the science of genetics.

Later, scientists discovered the genes that control the inheritance of traits. Other scientists have figured out the chemical structure of the chemical substances, the DNA, that genes are composed of.

Find out more

THE NOBEL PRIZE

The Nobel Prize is an award that honors men and women... "who, during the preceding year, shall have conferred the greatest benefit on mankind."

The Nobel Prize started in 1895 when Alfred Nobel, a Swedish chemist, engineer, innovator, and inventor of dynamite, wrote his last will, leaving much of his wealth to set up the prizes.

Since 1901, the prize has honored men and women for outstanding achievements in physics, chemistry, medicine, literature, economics, and for work in peace.

Plant science can help to build the adaptive capacity to emerging problems by increasing our understanding of the effects of climate change on agriculture, biodiversity and whole ecosystems and using this knowledge to generate more resilient crop varieties such as those with increased drought resistance, water use efficiency and increased disease resistance. This knowledge can also be used to promote the use of alternative and orphan crops, perennial crops, preservation of crop diversity and good agronomic practice. Plant based solutions can also help reduce global emissions of GHG for example by producing crops that make better use of nitrogen to reduce fertilisers use, reducing deforestation via the promotion agro-forestry and tree cropping systems and increasing the efficiency of land use for both food and energy via second generation biofuels and the use of crop waste for biomass.

Plant science is important to our environment.

Barbara McClintock (1902-1992)

Getting to know...

Barbara McClintock was born in Connecticut in 1902. As a child, she loved nature and spent a lot of time in the countryside.

She studied biology at Cornell University, in New York, and earned a PhD in 1927. Because women at that time were not hired as college professors, she could not find a job at a college. She continued studying genetics, working with Indian corn, or maize, that has seed kernels of many colors.

She discovered genes could move, or "jump", from one chromosome to another, changing their genetics. Other scientists later discovered jumping genes in bacteria, flies, and other animals.

McClintock was awarded the 1983 Nobel Prize in Medicine for her work.

Plants as Food

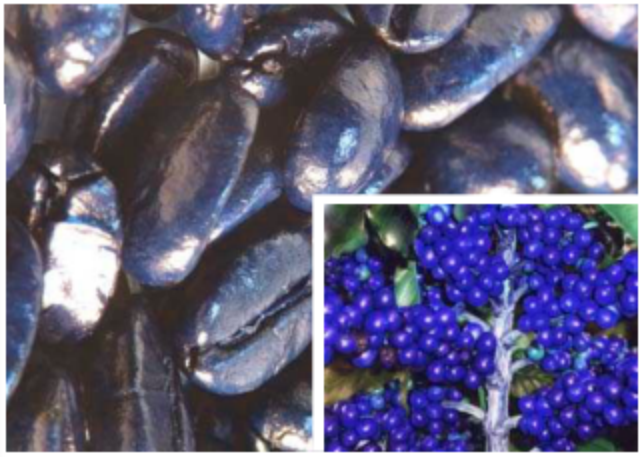
People eat many kinds of plants. We eat all the parts of plants. We eat roots, stems, and leaves...flowers, fruits, and seeds.

A tall, strong grass called sugar cane is the source of most of our sugar. The flavoring cocoa, or chocolate, comes from the ground up beans of cacao plants. Coffee comes from the ground beans of the coffee plant. Agar, a gel, used to thicken ice cream, comes from seaweed (red algae).

Each cacao pod can contain 20 to 60 cocoa beans.

Coffee plants growing on a plantation.

Heavy machines help farmers harvest sugar cane.



Coffee fruit is red when it's on the plant, but turns brown when roasted.

Words to know

- **chromosome** (kroh-muh-sohm): the part of the cell that contains the genes that gives living things their characteristics
- **fertilizer** (fur-tuh-lize-ur): a substance, such as animal manure, compost, or a chemical that promotes plant growth
- **genetics** (juh-net-iks): the study of the ways that personal characteristics are passed along from one generation to another by genes

Plants and the Parts That We Eat

Roots

Roots that we eat include carrots, beets, turnips, parsnips, and radishes.

Stems

Stems, such as celery and rhubarb, are tasty and nutritious.

Leaves

The leaves of lettuce, cabbage, spinach, collards, chard, and others are common foods, too.

Flowers

Flowers, such as broccoli and cauliflower, are good cooked or eaten raw.

Fruits

Fruits, including apples, oranges, cherries, grapes, kiwis, and others are sweet and juicy. Vegetable fruits, such as tomatoes, cucumbers, squash, and eggplant add to the variety that is available to people.

Seeds

Seeds are eaten by people and make up the bulk of most of our nutrition. Corn, wheat, rice, and all the other grains we make into breads and pastas contain important nutrients.

George Washington Carver (birth unkown-1943)

Getting to know...

George Washington Carver was born to black slave parents in Missouri in the 1860s. His mother was taken away to the South when he was a baby. His mother's former owners raised him and helped him get an education.

A college in Kansas originally accepted Carver but then rejected him when they saw that he was an African American. At a college in Iowa, he studied botany and agriculture, the science of farming.

He went on to teach at the Tuskegee Institute in Alabama. Insects called boll weevils were destroying cotton plants at that time. Carver convinced farmers to grow peanuts instead of cotton.

Carver developed over 300 products made from peanuts. He made inks, dyes, makeup, medicine, glue, soap, and even peanut milk.

Other Plant Products

Today, plants are used to produce many things. One product is ethanol made from corn and used to fuel engines. Dyes come from plants, as do other chemicals, such as rubber, turpentine, and shellac.

We make clothing from cotton fibers twisted into thread and then woven into cloth. Hemp rope is made of plant fiber.

Milky juices of some tropical trees are the source of natural rubber. The juice, or latex, is cooked and it thickens to become the elastic, or stretchy material we call rubber.

Many newer model cars can run on E-85 ethanol.

Words to know

agriculture (AG-ruh-kul-chur): farming

ethanol (EH-than-all): an alcohol produced by yeasts from the fermentation of sugar

gel (gehl): a thick, jelly-like substance

latex (LAY-teks): the milky juice of the rubber tree

People Learn From Plants

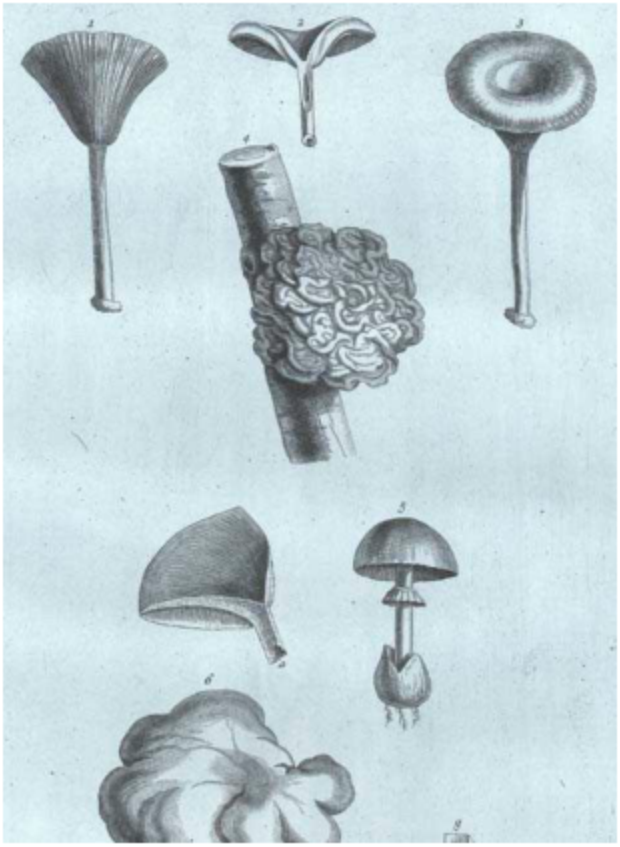
Why Study Plants?

Knowledge of plants has always been useful to people. Wild fruits, vegetables, and nuts first became food sources thousands of years ago. They still are.

Plants have always been a food source for humans.

When people discovered how to grow their own plants, farming began. Edible plant crops made more food available to more people.

People long ago discovered the value of plants in making medicines such as pain killers.



Plant drawings by Sebastian Vaillant in the 1700s.

Today we understand and depend on the use of plants and plant products. Plant scientists are discovering more and more about plants.

Young people can learn about plants and, someday, work at interesting and important jobs all over the world.

Botany is the branch of biology that studies plants. There are many people who work with plants including botanists, or plant scientists.

PEOPLE WHO WORK WITH PLANTS

Specializes in...

Arborist

the science of tree growing.

Aroma-therapist

knowing scents, or smells, of plants that relax, calm, and comfort people.

Bryologist

studying mosses.

Herbalist

using herbs to treat illnesses.

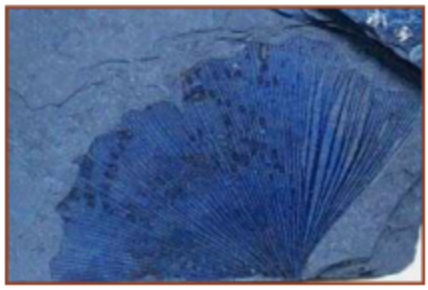
Horticulturist

having knowledge of the varieties of plants used in landscaping and ornamental gardening.

PEOPLE WHO WORK WITH PLANTS

Specializes in...

Paleobotanist



studying plant fossils.

Phytopathologist

studying plant diseases.

Pomologist

working with orchard plants, such as apple trees and others.

Plant growers, or farmers, require knowledge of the planting, cultivation, and harvesting of a wide variety of plant crops.

Farmers must learn about farm chemicals, too. Fertilizers and pesticides are important chemicals that farmers use, but they can also be dangerous.

Farmers examine the health of their crops.

Agricultural engineers invent machines used in farming and show farmers how to use or repair them.

An agricultural engineer explains how a farm machine works.

Other people who study and work with plants include gardeners, who take care of private and public gardens.

A gardener tends his flowers.

Words to know

ancient (AYN-shunt): very old

engineer (en-juh-NIHR): a person who builds structures

pesticide (PESS-tuh-side): a chemical used to kill pests, such as harmful insects

Landscape architects design plans for arranging plants around homes, buildings, parks, and highways.

Landscapers use grass, herbs, and trees in attractive combinations.

Florists grow and sell plants and need to know ways of keeping them fresh and healthy.

Florists sell many different types and arrangements of flowers.

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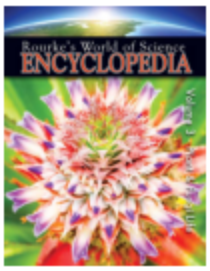

Rourke's World of Science Encyclopedia

Rourke's World of Science Encyclopedia *Thomas F. Sheehan. Vol. 3: Plant & Fungi Life. 2nd ed. Vero Beach, FL: Rourke Educational Media, 2016. 64 pp.*

Teaches the essential concepts for elementary school science instruction. Topics include the basic objects in the sky, life-cycles, and properties of earth materials to the more advanced, structures of living systems, forces and motion and science technology. This volume covers plant and fungi life.

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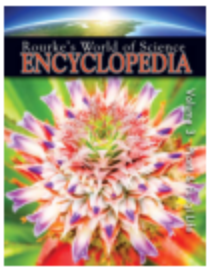

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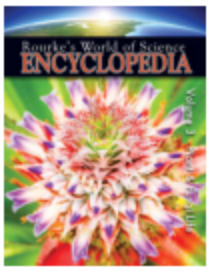

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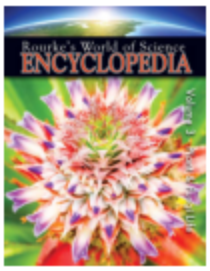

Rourke's World of Science Encyclopedia

Rourke's World of Science Encyclopedia *Thomas F. Sheehan. Vol. 3: Plant & Fungi Life. 2nd ed. Vero Beach, FL: Rourke Educational Media, 2016. 64 pp.*

Teaches the essential concepts for elementary school science instruction. Topics include the basic objects in the sky, life-cycles, and properties of earth materials to the more advanced, structures of living systems, forces and motion and science technology. This volume covers plant and fungi life.

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