Lesson Two: How we Depend on Plants—Plant Medicines

Objectives: To focus in-depth on one of the core "practical reasons" for conserving plants. To understand why conserving plant diversity is important to finding new medicines.

Introduction to Activity: People rely on wild plants for many things including food, fiber, lumber and construction materials, and medicines. Part One of this activity will briefly introduce your students to these practical reasons for conserving plant diversity. Part Two will focus in-depth on one of them: medicines.

It is estimated that more than 40% of the medicines now prescribed in the United States contain chemical compounds originally discovered in plants. Your students will be introduced to a wide variety of medicines that come from compounds found in plants. They will learn about the interesting effects these compounds have on living things that eat them, and how they are used in medicine. Why do plants produce so many different compounds, and how are they useful as medicines? Your students will uncover the answers to these questions.

Hopefully your students will also begin to appreciate how important it is to protect plant species; of the species already identified, only a tiny percentage (less than 2%) have actually been tested for medical value. Approximately 250,000 plant species are known; perhaps as many as 50,000 remain to be identified and named. To improve our health care in the future, protecting plant diversity is a very important undertaking.

Materials Needed:

- a copy of "Medicinal Plant Brainteaser Challenge" for each student
- a copy of the sheet "Medicinal Plant Brainteaser Challenge Cards" for each student
- scissors
- glue, glue sticks, or tape
- "Medicinal Plant Compound Teacher Answers" sheet
- a copy of the assignment "The Flower" and accompanying worksheet for each student (to be completed at home in preparation for Lesson #3)

Activity:

Part One: Begin this activity by asking your students to think of the various ways wild plants (as opposed to cultivated varieties) are important to us. The purpose of this brief brainstorming session is to help your students see a variety of

practical reasons for preserving plants. List their ideas on the board. The ideas might fall into the following categories:

- wild foods (e.g. various fruits, berries, and nuts; wild rice, quinoa and other wild grains; flower nectar converted to honey by bees)
- plant materials for construction (e.g. a huge variety of trees are used for lumber; thatch for roofs)
- ornamental plants (e.g. orchids, ferns, cycads)
- wild scenery
- cosmetics (e.g. jojoba, aloe, and many others)
- medicines (see Part Two of activity)

Explain to them that humans have relied on plants as medicines for millennia, and even many modern medicines often come from wild plants (an estimated 40%). Part Two of the activity will focus upon plant medicines.

Part Two: Pass out a copy of the "Medicinal Plant Brainteaser Challenge" and the "Medicinal Plant Brainteaser Challenge Cards" sheet to each student. Review the introduction and directions for the activity; you can go over the key points aloud or students can read independently. Then, ask your students to cut the "Challenge Cards" sheet into individual cards, following the lines on the page. Organize the students into teams of 2-4, and allow them to discuss and predict how each of the listed compounds is used for medical purposes. Tell them to place each card on the empty space belonging to the plant/compound they think it matches. They should NOT glue the cards down until you have gone over the correct answers as a class.

Once students have finished making their guesses, go over the answers with the class. Use the teacher answer sheet to provide additional interesting information about each compound.

Finally, relate the activity to the importance of plant conservation by making the following points:

- Why do you think plants produce such a wide variety of poisonous compounds? (Plants use these as defenses against things that might eat them. The compounds might be distasteful to herbivores, and may even make them sick!)
- How can it possible be that modern medicine uses poisons in medicines? (Poisons and medicines are the same thing. The difference is dosage and how the compound is used. A very small amount of poison can help cure many conditions.)
- MANY medicines that people have used in the past, as well as modern medicines, come from plants.
- The vast majority of plants have never been tested for medically helpful compounds (less than 2%). If plants are lost, we may well lose future important sources of medicines.

At the end of the activity, pass out the assignment for the next class, “The Flower” and its accompanying worksheet.

Medicinal Plant Brainteaser Challenge
Student Sheet

Student name: _____ Class/section: _____

Background Information and Directions

All around us, plants are growing, and all around us, a host of insects, rodents, molds, and other living things are trying to eat them. What's to prevent all these predators from eating every plant in sight? How can the plants still survive, stuck where they are and apparently defenseless?

One very effective way plants protect themselves is by producing poisons to repel and even kill the living things that want to devour them. Since a great variety of plant predators exists, plants have come up with an equally huge selection of poisons to drive them away. All these poisons affect living things in an enormous variety of ways. There are a lot of ways to be a poison!

Scientists are very interested in finding and learning about these plant poisons. There are so many that scientists are constantly discovering new compounds that they had never dreamed of. But why should they go to all this trouble? It turns out that poisons can actually serve as medicines. The enormous diversity of plant poisons that exists affects the human body in an equally diverse number of ways. But what might be harmful in one situation can be beneficial in another. Carefully applied in the right circumstances, in fact, plant poisons can help, not harm, us and even save lives. Whether a compound is a poison or a medicine, therefore, depends upon its dosage and how it is used.

The brainteaser challenge below illustrates this. The chart introduces 20 plants, the compounds they make, and what the compounds do to living things. Look the compound descriptions over and try to predict how we use them as medicines. Your teacher may give you medicine cards that provide the answers and ask you to match them with the plant descriptions. Or, your teacher may ask you to come up with the answers on your own. In either case, see how closely you can predict how scientists have figured out how to turn poisons into medicines. Have fun!

Medicinal Plant Brainteaser Challenge
Teacher Answer Sheet

- (Vincristine): A powerful cancer remedy
  Researchers discovered that vincristine reduces large cancerous tumors, which can only grow if cancer cells divide. It provides more than 90% remission in childhood leukemia cases.

- (Taxol): A powerful cancer remedy
  Paclitaxel, a semi-synthetic version, is now used for patients suffering ovarian, lung, and breast cancer, as well as Kaposi's sarcoma.

- (Atropine): Used to open patients' pupils during eye exams

- (Diosgenin): Used in birth control pills
  Mexican yams grow large in a short amount of time, providing large amounts of the compound compared to other species. This gave birth to the contraceptive pill industry. (Today, contraceptive pills in the U.S. are totally synthetic, but use compounds similar to the compound found in yams.)

- (Menthol): Used as a local anesthetic and to treat sore throats
  Menthol is used to relieve localized pain in such products as Solarcaine® and Ben-Gay® It is found in many lip-protection products. Menthol is also a popular ingredient in cough drops used to treat sore throats.

- (Digoxin and Digitoxin): Used to treat heart problems
  The compounds found in the leaves of this plant have saved the lives of millions of heart patients. They help patients suffering from congestive heart failure and irregular heart beats, especially atrial fibrillation in those with heart valve disease.

- (Artemisinin): Used to treat malaria, which is caused by protozoan parasites infesting human blood
  Artemisinin kills the parasite <u>Plasmodium</u> that causes malaria. The <u>Plasmodium</u> parasite lives inside human red blood cells and is transmitted by mosquitoes. Artemisinin is one of two active ingredients in Coartem ®, a highly effective anti-malarial drug. Coartem ® is known to work on the most dangerous form of malaria, <u>falciparum</u> malaria.

- (Colchicine): Used to treat a painful type of arthritis (joint disease) known as gout

Colchicine relieves a very painful form of arthritis known as gout. The joint pain is caused by tiny needle-shaped uric acid crystals accumulating on joints, causing them to become red, swollen, and inflamed.

- (Cocaine): Used as a local anesthetic during surgery
  Though best known as an illegal, addictive drug when taken recreationally, it is also used as a local anesthetic during surgery to the mouth, nose, or throat where pain relief and open airways for breathing are essential.

- (Morphine): Considered the most effective pain reliever of all
  Morphine continues to be the standard against which other painkillers are judged, and it is used in extreme medical cases. It relieves pain, allows patients to sleep, and calms anxiety when patient would typically be in extreme pain. Unfortunately, it is also very addictive, so must be applied very carefully. Used recreationally in the form of heroin, it causes a serious problem in the United States by making thousands of people drug addicts. Morphine and cocaine are classic cases of compounds that can be both valued medicines and serious toxins, depending on how they're used.

- (Tubocurarine): Used to relax muscles during surgery
  In surgery, tubocurarine is combined with anesthesia. Because of its role as a muscle relaxer, it allows surgeons to use less anesthesia than they would have to use otherwise. Machines control the patient's breathing in these situations.

- (Podophyllotoxin): Used to treat warts and some cancers
  Podophyllotoxin is used as a treatment for genital warts, which are caused by the human papillomavirus (HPV). This virus is also associated with cancers of the genitals. The mayapple has several other compounds which are used to treat a wide variety of cancers.

- (Galanthamine): Used to treat Alzheimer's disease, a brain disorder that mainly affects older people
  Used to treat Alzheimer's disease, it is most effective in early stages and can improve behavioral symptoms as well as cognition.

- (Physostigmine): Used to treat an eye disease called glaucoma
  Glaucoma is a leading cause of blindness and visual impairment that results in visual field loss. Open-angle glaucoma is often associated with high pressure in the eye which physostigmine reduces.

- (Quinine): Used to treat malaria, which is caused by protozoan parasites infesting human blood

Quinine kills the Plasmodium parasite that causes malaria (see artemisinin above) and is still the most effective treatment of malaria. Malaria is spread by infected mosquitoes, and still sickens hundreds of millions of people annually.

- (Camptothecin): A powerful cancer remedy
  Camptothecin and synthetic derivatives are used to treat many kinds of cancer including breast, colon, some forms of lung cancer, and leukemia, which is cancer of the blood.

- (Theophylline): Used to treat asthma and emphysema, diseases of the respiratory system that affect how people breathe
  Theophylline is used to treat and/or prevent the symptoms of asthma, chronic bronchitis, and emphysema. It relieves coughing, wheezing, shortness of breath, and troubled breathing. Extracted from the tea plant in 1888, it is now synthesized.

- (Reserpine): Used to treat high blood pressure

- (Dicumarol): Used to remove blood clots
  Dicumarol was discovered in spoiled sweet clover. Scientists discovered it when trying to determine why cattle that had eaten this clover in their hay bled to death!

- (Sennoids): Used as a laxative to relieve constipation

- (Thiarubrine): A promising treatment for bacterial and fungal infections
  Thiarubrine shows great promise as a remedy for fungal and bacterial infections, though it is not yet widely used medicinally. It is particularly interesting because it comes from a very common, indeed despised, North American plant, yet has only recently been extracted and tested. We still have a great deal to discover from the plant kingdom!

Photo: Henri Sivonen

Madagascar Periwinkle

Catharanthus roseus

Plant Facts

Many people have relatives of the Madagascar Periwinkle growing in their yards as ground cover. It is a small plant with showy pink and white flowers. The Periwinkles that provide medicinal value grow in Madagascar.

Medical Compound Found in Plant

Vincrisine

Chemical Formula of this Compund

$C_{46}H_{56}N_4O_{10}$

Effect of the Compound on the Human Body

Many people have relatives of the Madagascar Periwinkle growing in their yards as ground cover. It is a small plant with showy pink and white flowers. Madagascar.

Place the correct Medicine Card here!

Photo: Walter Siegmund

Pacific Yew Tree

Taxus brevifolia

Plant Facts

This splendid tree is native to the Pacific Northwest of the U.S. Almost every part of the tree is poisonous. Taxol is an important medical compound discovered in the 1960s.

Medical Compound Found in Plant

Taxol

Chemical Formula of this Compund

$C_{47}H_{51}NO_{14}$

Effect of the Compound on the Human Body

Normal cells have features called microtubules that break down and reassemble during cell division. Taxol interrupts this process so that cells can't grow and divide efficiently.

Place the correct Medicine Card here!

Photo: UBC Botanical Garden & Centre for Plant Research

Deadly Nightshade

Atropa belladonna

Plant Facts

The berries of Deadly Nightshade are indeed deadly! The shiny black berries are sweet to the taste, but just a few of them can prove fatal.

Medical Compound Found in Plant

Atropine

Chemical Formula of this Compund

$C_{17}H_{23}NO_3$

Effect of the Compound on the Human Body

Causes the pupil in eyes to expand.

Place the correct Medicine Card here!

Photo: C. Ford

Yam species

Dioscorea species

Plant Facts

Yam species are found on several continents. They have tubers in the ground (like potatoes), which have medical value. The Mexican yam is the species that provided the medical break-through.

Medical Compound Found in Plant

Diosgenin

Chemical Formula of this Compund

$C_{27}H_{42}O_4$

Effect of the Compound on the Human Body

Diosgenin allows the female hormone progesterone to be easily synthesized. Certain levels of progesterone inhibit ovulation, the release of an egg from a woman's ovary.

Place the correct Medicine Card here!

Photo: Lexn Ger, flickr.com

Peppermint/Mint species

Mentha species

Plant Facts

Menthol comes from oil of peppermint, and other mint species. It has been used by people for hundreds of years in a wide variety of ways.

Medical Compound Found in Plant

Menthol

Chemical Formula of this Compund

$C_{10}H_{20}O$

Effect of the Compound on the Human Body

Menthol acts upon certain nerve cells that tell the body when it is cold. Menthol "tricks" these receptors into thinking it is cold when it is not. Thus, it makes the body feel cool.

Place the correct Medicine Card here!

Photo: tsc_traveler, flickr.com

Foxglove

Digitalis lanata

Plant Facts

Foxgloves are tall plants lined with bell-shaped flowers of various colors. You can often see them in people's gardens! The common garden variety (Digitalis purpurea) has been used medically, but Digitalis lanata is most commonly used.

Medical Compound Found in Plant

Digoxin and digitoxin

Chemical Formula of this Compund

$C_{41}H_{64}O_{14}$ and $C_{41}H_{64}O_{13}$

Effect of the Compound on the Human Body

Diosgenin allows the female hormone progesterone to be easily synthesized. Certain levels of progesterone inhibit ovulation, the release of an egg from a woman's ovary.

Place the correct Medicine Card here!

Photo: Scott Bauer, USDA

Wormwood

Artemisia annua

Plant Facts

This sweet-scented, bushy plant has been introduced to the Eastern and Central United States, growing in many waste areas throughout. Most of the plants grown for medicine are from China and East Africa.

Medical Compound Found in Plant

Artemisinin

Chemical Formula of this Compund

$C_{15}H_{22}O_5$

Effect of the Compound on the Human Body

Artemisinin kills certain one-celled creatures called protozoans.

Place the correct Medicine Card here!

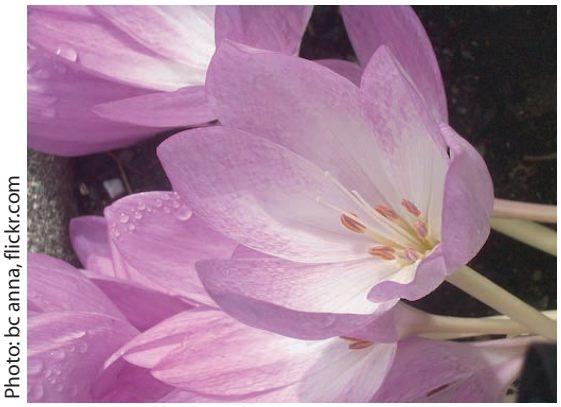


Photo: bc anna, flickr.com

Meadow Saffron

Colchicum autumnale

Plant Facts

This plant looks much like the crocus that blooms in dooryards in early spring throughout the United States.

Medical Compound Found in Plant

Colchicine

Chemical Formula of this Compund

$C_{22}H_{25}NO_6$

Effect of the Compound on the Human Body

Colchicine dissolves uric acid crystals. Uric acid occurs in human blood and is excreted by the kidneys in people's urine. Too much uric acid in the blood can cause tiny needle-shaped crystals to collect on skeletal joints.

Place the correct Medicine Card here!

Photo: Lucy Boynton

Opium Poppy

Papaver somniferum

Plant Facts

The Opium Poppy is the source of several very helpful medical compounds.

Medical Compound Found in Plant

Morphine

Chemical Formula of this Compund

$C_{17}H_{19}NO_3$

Effect of the Compound on the Human Body

Binds to certain nerve cells, preventing them from communicating the feeling of pain.

Place the correct Medicine Card here!

Photo: Peter S. Goltra for the National Tropical Botanical Garden

No English Common name

Chondrodendron tomentosum

Plant Facts

Chondrodendron tomentosum is a vine that grows in South American rain forests. Indians have used this plant as a source for arrow poison when they hunt.

Medical Compound Found in Plant

Tubocurarine

Chemical Formula of this Compund

$C_{37}H_{41}N_2O_6$

Effect of the Compound on the Human Body

Tubocurarine blocks motor nerve transmission, causing muscles to relax so much they actually stop contracting. It first affects toes, ears, eyes, neck, and then arms and legs. Too much can relax breathing muscles so that lungs stop working.

Place the correct Medicine Card here!

Photo: Gregg Marr

Mayapple

Podophyllum peltatum

Plant Facts

The mayapple is a lovely woodland plant, found in Eastern North America. Related species in other parts of the world are used for similar medical reasons. The plant's rhizome (an underground stem from which the roots grow) is the source of poisonous, yet medically helpful, compounds.

Medical Compound Found in Plant

Podophyllotoxin

Chemical Formula of this Compund

$C_{22}H_{22}O_8$

Effect of the Compound on the Human Body

Podophyllotoxin is an antimitotic, meaning it prevents cells from dividing.

Place the correct Medicine Card here!

Photo: color line, flickr.com

Snowdrops

Galanthus species

Plant Facts

Snow drops are small bulbs that emerge with lovely flowers in late winter. Many gardeners plant them in the U.S., and they are found on several continents.

Medical Compound Found in Plant

Galathamine

Chemical Formula of this Compund

$C_{17}H_{21}NO_3$

Effect of the Compound on the Human Body

Galanthamine inhibits the loss of special neurons in the brain, called acetylcholine-producing neurons.

Place the correct Medicine Card here!

Photo: Koehler's Medicinal Plants, 1887

Calabar Bean

Physostigma venenosum

Plant Facts

The Calabar bean is a creeping plant that grows in West Africa. Its seeds are VERY poisonous. These seeds are also the source of the medical compound physostigmine.

Medical Compound Found in Plant

Physostigmine

Chemical Formula of this Compund

$C_{15}H_{21}N_3O_2$

Effect of the Compound on the Human Body

Physostigmine constricts the pupil of the eye. It also reduces the pressure in the eye.

Place the correct Medicine Card here!

Photo: US Geological Survey, Photo by Forest & Kim Starr

Cinchona Tree

Cinchona pubescens

Plant Facts

Cinchona trees grow in the Andes mountains of South America. Quinine is obtained from the bark of these trees.

Medical Compound Found in Plant

Quinine

Chemical Formula of this Compund

$C_{20}H_{24}O_2N_2$

Effect of the Compound on the Human Body

Kills certain one-celled creatures called Protozoans.

Place the correct Medicine Card here!

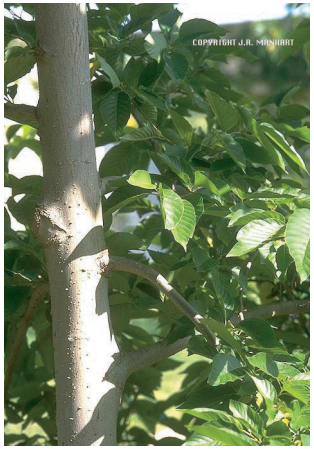


Photo: James Manhart, Texas A&M University

Happy Tree

Camptotheca accuminata

Plant Facts

This medium-sized tree is native to Central China. There, it is known as the "happy tree."

Medical Compound Found in Plant

Camptothecin

Chemical Formula of this Compund

$C_{20}H_{16}N_2O_4$

Effect of the Compound on the Human Body

Camptothecin inhibits a basic enzyme that is needed in the process of DNA replication. The chromosomes can't unwind, and the transcription of the DNA information cannot occur. Ultimately, the cells die.

Place the correct Medicine Card here!

Photo: nchenga, flickr.com

Tea Plant

Camellia sinensis

Plant Facts

This evergreen shrub or small tree is native to mainland South and Southeast Asia. It is now cultivated in tropical and subtropical areas around the world.

Medical Compound Found in Plant

Theophylline

Chemical Formula of this Compund

$C_7H_8N_4O_2$

Effect of the Compound on the Human Body

Theophylline is a broncho-dilator. This means that it works to relax the bronchial smooth muscles, thereby opening the air passages of the lungs, increasing air flow through them.

Place the correct Medicine Card here!

Photo: David Seigler, Dept. of Plant Biology, University of Illinois

Indian Snakeroot

Rauvolfia serpentina

Plant Facts

This perennial shrub grows in Southeast Asia. Other members of its genus supply other important medical compounds.

Medical Compound Found in Plant

Reserpine

Chemical Formula of this Compund

$C_{33}H_{40}N_2O_9$

Effect of the Compound on the Human Body

Reserpine decreases heart rate and relaxes blood vessels so that blood flows more easily through the body.

Place the correct Medicine Card here!

Sweet Clover

Melilotus alba

Plant Facts

Originally from Europe, it is now widespread in North America.

Medical Compound Found in Plant

Dicumarol

Chemical Formula of this Compund

$C_{19}H_{12}O_6$

Effect of the Compound on the Human Body

Dicumarol prevents the blood from making prothrombin, which is essential for blood clotting.

Place the correct Medicine Card here!

Photo: Ben Ostrowsky

Cassia

Cassia angustifolia

Plant Facts

Southern Europe, North Africa, Middle East

Medical Compound Found in Plant

A group of chemicals called Sennoids

Chemical Formula of this Compund

$C_{42}H_{38}O_{20}$

Effect of the Compound on the Human Body

Causes large intestine to increase contractions.

Place the correct Medicine Card here!

Photo: Robert H. Mohlenbrock, USDA-NRCS PLANTS Database

Common Ragweed

Ambrosia artemisiifolia

Plant Facts

Common North American herb, found in yards, fields, and other open places. The chief cause of hay fever in the United States.

Medical Compound Found in Plant

Thiarubrine

Chemical Formula of this Compund

$H_5C_2S_2$

Effect of the Compound on the Human Body

Found to kill a variety of fungi and bacteria.

Place the correct Medicine Card here!

A powerful cancer remedy

Used to relax muscles during surgery

Used to treat heart problems

Used to treat an eye disease called glaucoma

Used as a laxative to relieve constipation

Used in birth control pills

Used to open patients' pupils during eye exams

Considered the most effective pain reliever of all

Used to treat high blood pressure

Used as a local anesthetic and to treat sore throats

A powerful cancer remedy

Used to treat malaria, which is caused by proto-zoan parasites infesting human blood

A powerful cancer remedy

Used to treat Alzheimer's disease, a brain disorder that mainly affects older people

Used to remove blood clots

Used to treat a painful type of arthritis (joint disease) known as gout

A promising treatment for bacterial and fungal infections

Used to treat warts and some cancers

Used to treat asthma and emphysema, diseases of the respiratory system that affect how people breathe

Used to treat malaria, which is caused by protozoan parasites infesting human blood

Assignment: The Flower

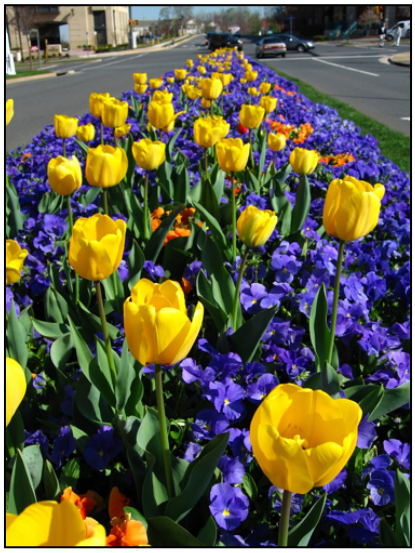


Photo by Diana LeRoi-Schmidt

People like flowers! We spend a great deal of time and money growing them and decorating our homes, gardens, parks, and places of worship with them. We use them in our holidays, parties, festivals, weddings, anniversaries, and funerals. We also enjoy the flowers that grow wild in our neighborhoods, roadsides, and forests. They can brighten up road trips and hikes in the woods. Our world would be much duller and more somber without the colors and aromas that flowers bring to our lives.

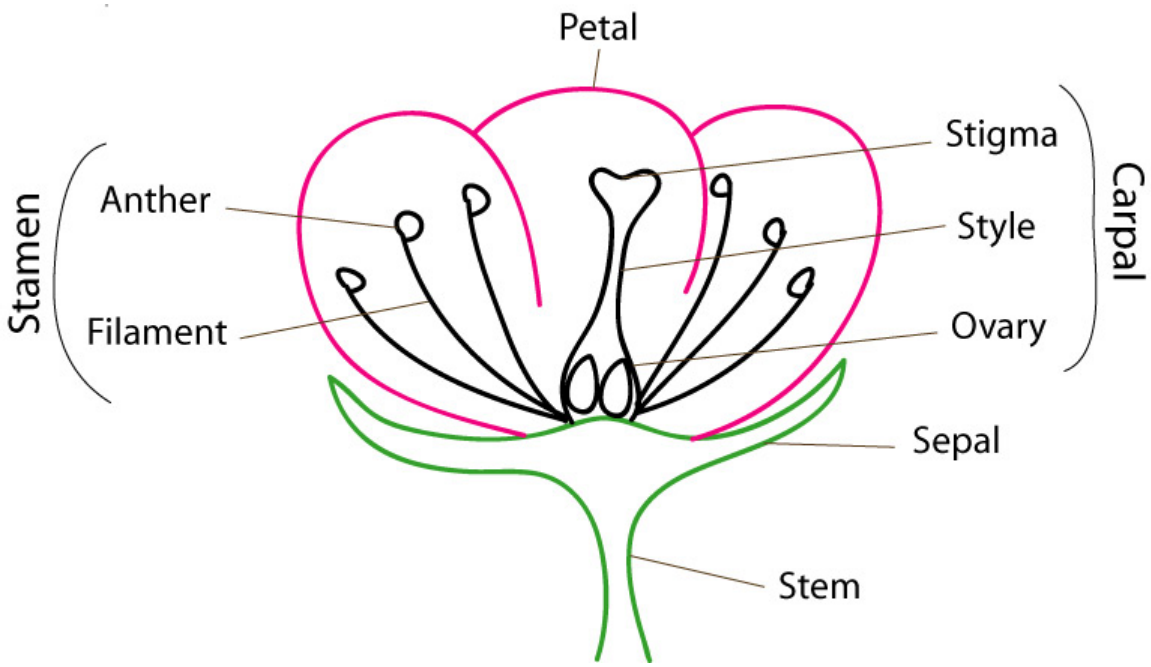
But why do plants bother to make flowers? After all, they have neither eyes nor noses with which to see and smell. The answer is that plants do not grow flowers for our enjoyment. They grow them so they can reproduce. It turns out that flowers are not mere decoration; they are the reproductive organs of flowering plants. Flowers exist to be fertilized so that they can make seeds that will become the next plant generation. Their job is not to be pretty; it is to produce baby plants. Their colors, shapes, and scents are merely tools to enable them to accomplish their task.

Photo by Domenico Salvagnin

Not all plants make flowers. Mosses and ferns, for example, do not produce them. Neither does a group of plants called gymnosperms, most of which have needles, not leaves. Examples include “Christmas trees”: pines, spruces, and firs, as well as junipers, yews, cedars, cypresses, and California’s giant redwoods and sequoias. Most plants, however, are so-called angiosperms, and these all produce flowers. Approximately 270,000 species of angiosperms are known! They include the shrubs and flowers in your garden, almost all of the vegetables and fruits you eat, the grasses and grains in fields, the cacti (plural for cactus) in deserts, and almost all of the leafed trees that make the world’s great forests.

Photo by Koffiekitten

All these flowering plants have created, as you might imagine, an incredible variety of flowers. They can be tiny or several feet across, have a sweet smell or a foul odor or no scent at all, and show off every conceivable shape and color. There is no "typical" flower. There is, however, a basic flower design that you need to know something about before learning how flowers work. Take a look at the illustration below.



Flowers have both "male" and "female" parts. The male parts produce sperm and the female parts produce eggs, just like animals. When sperm meets egg, a seed results, and a new plant generation begins. In flowers, sperm is contained within dust-like specks called pollen grains. In some plant species, flowers with male parts and flowers with female parts are in different flowers, usually on separate, individual plants. With most species, however, both male and female parts occur together in the same flowers. The male part is the stamen; the female part is the carpal (also known as the pistil).

Photo by Janice Waltzer

Stamens consist of two parts: the anther where the pollen is produced and the filament, which simply holds up the anther. The carpal has three parts. The top is called the stigma. It is the plant's objective to have pollen land here, and the

stigma is usually sticky so that it can hold the pollen in place. Once on the stigma, the pollen grain actually burrows a pollen tube through the style of the carpal, until it reaches the ovary. The ovary holds ovules (unfertilized eggs), which the sperm will fertilize.

Photo by Michelle Zlimen

Out of each pollen grain, still perched on the stigma, spill out two sperm cells. They fall down the pollen tube until they reach the ovules in the ovary. One of the sperm cells fertilizes an egg cell in the ovule; the other fertilizes two other cells called polar nuclei. The fertilized egg cell becomes an embryo or baby plant, while the fertilized polar nuclei become food or endosperm to sustain the young plant until it has grown to be able to make its own food. Endosperm and embryo together make up a seed.

Left unexplained are petals, which basically give a flower its shape and color. Thanks to petals, we can instantly tell apart tulips, roses, and daisies. Were it not for petals, almost everything in the plant kingdom would be green or brown. But, why should flowers have such colorful structures? The answer is that petals are used to attract animals so that they will visit the flowers and carry out the process of pollination. This amazing process, upon which so many living things (including humans) depend, will be described in the next reading.

Glossary

Egg: a female sex cell

Fertilize: the meeting of a sperm cell (male) and a female cell (female) in the process of reproduction

Sperm: a male sex cell

Worksheet: The Flower

Name: _____ **Class/Section:** _____

Questions:

A. Please select, from the terms below, the best answer to the following definitions.

Terms: Pollen grain, pollen tube, polar nuclei, embryo, endosperm, stamen, carpal, anther, filament, stigma, style, ovary, ovule or egg.

1. The male part of the flower: _____
2. The female part of the flower: _____
3. This holds the sperm cells: _____
4. This produces pollen grains: _____
5. This holds up the anther: _____
6. Where pollen grains should land: _____
7. A pollen grain drills through this to reach the ovary: _____
8. The plant “eggs”: _____
9. Where the plant eggs are found: _____
10. Sperm cells move through this to reach the ovary: _____
11. This becomes the baby plant in the seed: _____
12. This becomes the food for the baby plant in the seed: _____

B. What is the purpose of flowers? Why do plants have them?

Answer Sheet: The Flower

Name: _____ Class/Section: _____

Questions:

A. Please select, from the terms below, the best answer to the following definitions,

Terms: Pollen grain, pollen tube, polar nuclei, embryo, endosperm, stamen, carpal, anther, filament, stigma, style, ovary, ovule.

1. The male part of the flower: Stamen
2. The female part of the flower: Carpal
3. This holds the sperm cells: Pollen grain
4. This produces pollen grains: Anther
5. This holds up the anther: Filament
6. Where pollen grains should land: Stigma
7. A pollen grain drills through this to reach the ovary: Style
8. The plant “egg”: Ovule
9. Where the plant eggs are found: Ovary
10. Sperm cells move through this to reach the ovary: Pollen tube
11. This becomes the baby plant in the seed: Embryo
12. This becomes the food for the baby plant in the seed: Endosperm

B. What is the purpose of flowers? Why do plants have them?

- Flowers are the reproductive organs of plants. They produce sperm and eggs and are designed to make seeds.