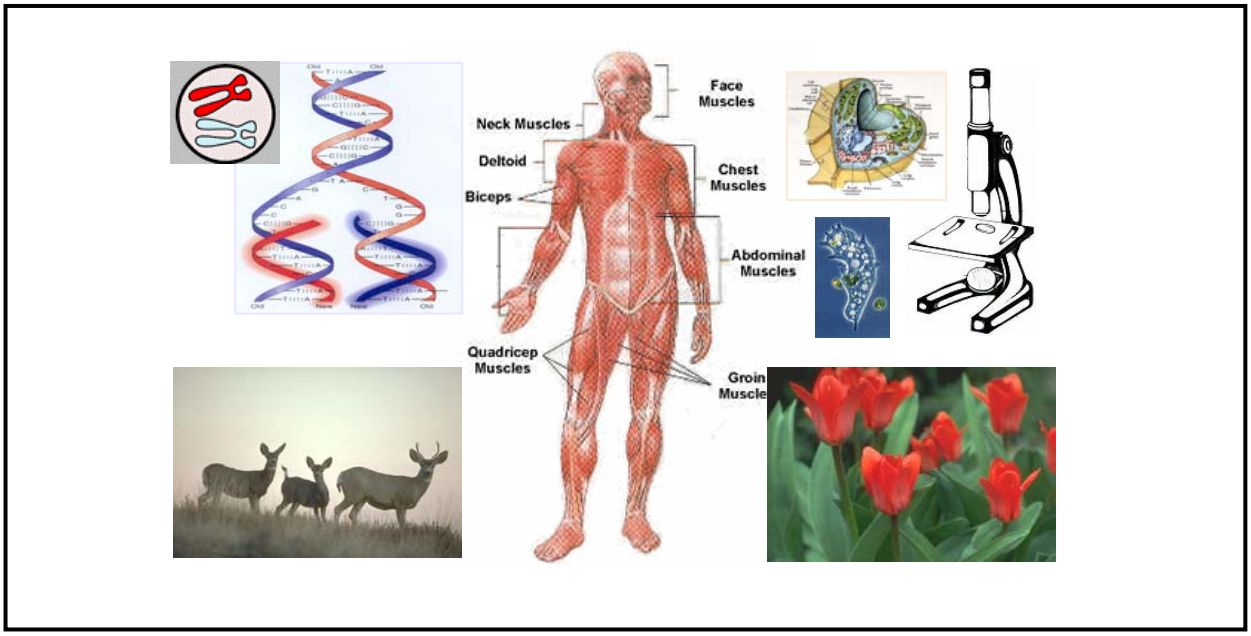
Project EASE

(Effective Alternative Secondary Education)

BIOLOGY



MODULE 16

The Diversity of Plants

BUREAU OF SECONDARY EDUCATION
Department of Education
DepED Complex, Meralco Avenue
Pasig City

Module 16
The Diversity of Plants

What this module is about

This module will take you to the wonderful world of plants. It aims to familiarize you with the different groups that comprise the Plant Kingdom and with how plants are classified. Plants make up one of the dominant organisms on earth. Since plants are found almost everywhere in a tropical country like the Philippines, we are familiar with many of its species.

This module has five (5) lessons:

- **Lesson 1 – Classification of Plants**
- **Lesson 2 – Non-vascular Plants (Bryophytes)**
- **Lesson 3 – Vascular Plants (Ferns and Fern Relatives)**
- **Lesson 4 – Vascular Plants (Cone-Bearing Plants)**
- **Lesson 5 – Vascular Plants (Flowering Plants)**

What you are expected to learn

After going through this module, you are expected to:

1. Discuss the importance of classifying plants.
2. Describe how plants are classified.
3. Compare non-vascular from vascular plants.
4. Explain how the different groups of plants differ from each other.
5. Describe some representative plants from the different groups.

How to learn from this module

In order to achieve the objectives of this module, you are expected to:

1. Read and follow the instructions carefully.
2. Answer the pretest first.
3. Take down notes and record points for clarification.
4. Follow the instructions in the activity, so you can perform them very well.
5. If specimens are necessary, try to look for them.
6. Take the posttest and check your answers with the key to correction at the end of the module.

What to do before (Pretest)

Multiple Choice. Choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. What do you call the process of grouping or ordering plants based on structural similarities or evolutionary relationships?
   a. classification
   b. collection
   c. identification
   d. preservation

2. There are seven major biological levels of classification. The species level is the smallest unit. What is considered as the largest unit of classification?
   a. class
   b. family
   c. kingdom
   d. order

3. Who was the first Swedish naturalist to classify living things? This man is regarded as the father of Taxonomy.
   a. Anton Van Leuwenhoke
   b. Carolous Linnaeus
   c. Charles Darwin
   d. Robert Hooke

4. What do you call the type of classification that is based on similarity of structures?
   a. natural classification
   b. artificial classification
   c. superficial classification
   d. phylogenetic classification

5. Vascular plants produce the tallest and biggest trees in the world. Non-vascular plants are small and cannot grow as tall as vascular plants. What could be the reason for this?
   a. absence of water
   b. absence of leaves
   c. lack of vitamins
   d. absence of vascular bundles

6. Plants are classified for the following reasons:
   a. to avoid confusion
   b. to store things
   c. to create chaos
   d. to find things fast

7. What is the type of vascular arrangement in monocot plants?
   a. alternate
   b. circular
   c. oval
   d. scattered

8. Plants maybe classified as vascular and non-vascular. Which of the following are vascular bundles?
   a. endodermis and pericycle
   b. parenchyma and collenchyma
   c. sclereids and scherenchyma
   d. xylem and phloem

9. Strobili are reproductive structures found in:
   a. fern
   b. cactus
   c. pine trees
   d. club mosses

10. Plants are found in almost all types of habitat. Which among the following habitats is **NOT** favorable for the growth of mosses?
   a. damp soil
   b. moist rocks
   c. dry, unshaded places
   d. trunks and branches of shaded trees

11. How many cotyledons does a dicot plant have?
   a. one cotyledon
   b. two cotyledons
   c. four cotyledons
   d. three cotyledons

12. Vascular bundles help in the transport of substances in plants. What vascular bundle transports water and minerals upward in plants?
   a. collenchyma
   b. parenchyma
   c. phloem
   d. xylem

13. Which of the following plants has a parallel type of leaf venation?
   a. coconut
   b. gumamela
   c. peanut
   d. pilinut

14. Which of the following plant is **NOT** a gymnosperm?
   a. ginkgo
   b. gumamela
   c. oliva
   d. podocarpus

15. Which plant exhibits the taproot type of root system?
   a. bamboo
   b. carrot
   c. orchid
   d. palay

Key to answers on page 28.

Lesson 1. Classification of Plants

Have you ever experienced walking in a park, or a garden where different plants are found? Or have you walked down the yellow trail in Camp John Hay? The trail sides has many grasses, ferns, and trees, which are all members of the plant kingdom. What do all these plants have in common? How are they grouped? What are their differences? Similarities? Find out as we discuss the topic on the classification or grouping of plants.

Now, examine the figure on the right. It is the evolutionary tree of plants. Try to note the similarities and differences of these plants. These are the plants that you will study in this module.

The diagram shows the evolutionary relationship of the different groups of plants. All these plants will be discussed in the lessons included in this module.

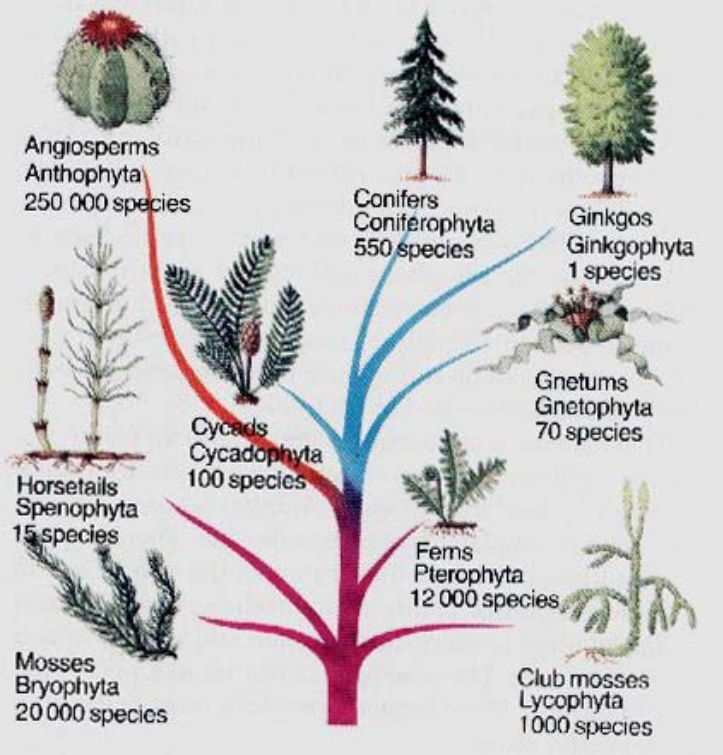


Figure 1
Evolutionary tree of land plants

Merrill Life Science (1994)

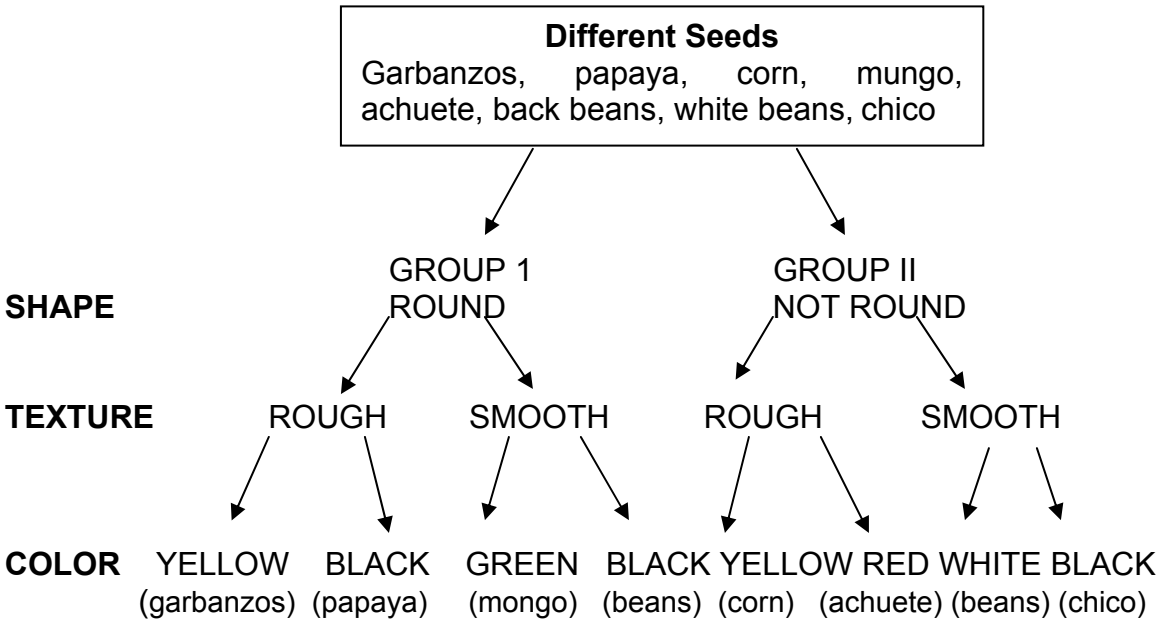
What you will do

Activity 1.1 Classifying Seeds

Try this simple activity:

Get 8 different kinds of seeds such as garbanzos, achuete, mongo, white bean, black bean, corn, chico, and papaya seeds. Divide the seeds into two groups **I** and **II**. The seeds in each group must have at least one thing in common. For example, seeds that are **round** must be under **Group I** and seeds that are **not round** in **Group II**. Now, examine the seeds in Group I as to **texture.** Group them into **rough** and **smooth**. Rough seeds should be under **Group Ia** and smooth seeds under **Group Ib**. Now move on to **Group II** and do the same. Divide the seeds as to texture. Rough seeds will be **Group IIa** and smooth seeds under **Group IIb**. Once you are through with the texture, divide or separate each seed in the subgroup as to **color.** Let's say, **black**, **yellow, green, red** or **white**.

Was it easy? Well, if you have doubts, you can use this diagram below as your guide:



Now, answer these questions:

1. What are your bases for classifying the seeds?
2. Based on your classification, how many different seeds do you have?
3. What is the advantage of classifying the seeds?

Why Classify?

In science, the grouping or ordering of living things is called **classification.** This concept of grouping things can be useful in your life, in your studies and in your home. For example, you use a classification system to organize your books on a shelf and your clothes in a cabinet. Even in business and industry, classification systems are used. Classification is actually a lifetime skill that you will practice every day in your life.

Try This:

Go to a grocery store or a supermarket nearby. See for yourself how the goods are grouped. Most grocery stores group similar items together. Examples of these are the dairy products, meat, canned goods and laundry items. Do they follow a systematic way of arranging the goods? How could you apply this to your everyday life?

The system of classification we use today was developed by a Swedish.

It was **Carolous Linnaeus,** an English naturalist, who pioneered the science of classification or **Taxonomy.** His classification was mainly based on similarity of **structure.** A structure is a feature just like the type of leaf, type of venation, type of fruit, etc. Presently, we have approximately **550,000** different species of plants that have been described and many more are still being discovered. You can just imagine what will happen if no system of classification was followed. There will be a total confusion and disorder in the living world. Always remember this:

Classification helps you to:

1. Organize things
2. Store things
3. Find things fast

Applying concepts

In what way is classification useful in libraries? In your home? In a sari-sari store? In supermarkets?

If you answered - in libraries, it facilitates an easy way of finding books and references, at home, saves time to locate things, and sari-sari / groceries for convenience and fast action, you are right!

Levels of Classification

There are **seven** major biological groupings or levels of classification that we follow. The **kingdom** is the largest group in the system of classification. This is divided into **phyla** in the animal kingdom. However, in plants this is equivalent to the **division.** Each **division** is divided into **classes;** these **classes** are divided into **orders** and orders into **families,** then family into **genera** and so on down to the smallest unit, which is the **species.** The species is the basic unit of classification. As you move from kingdom down to the species level, classification becomes more specific.

Originally, C. Linnaeus set up a two–kingdom system. The **Plant** and **Animal** kingdoms. After his time, many more biologists reclassified living things into more than two kingdoms. Now we are following a 6-kingdom system and actually there are already more than 8 kingdoms discussed in some books. The six kingdoms are as follows: Kingdom **Animalia**, **Plantae**, **Protista, Fungi, Achaebacteria and Eubacteria.** Animals are the multi-cellular, heterotrophic (using other living organisms for food) organisms without cell walls in their cells. Plants on the other hand are the multi-cellular, photosynthetic organisms with cell walls in their cell membranes. Protists are organisms that exhibit both plant and animal characteristics. The **eubacteria** and the **archaebacteria** composed of cells without a true nucleus and mitochondria. Fungi are plant-like organisms without chloroplasts.

Challenger Question

Suppose you discovered a new multi-cellular organism. This organism has a nucleus, mitochondrion, and a big chloroplast in its cells. In what kingdom, would you place this organism? Why?

If you answered – plant kingdom, because all the characteristics mentioned are exhibited by plants, you are correct!

An easy way to understand the descending nature (largest to smallest) of scientific grouping is to compare it with the general to specific information on where a person lives. For example:

Country: Philippines	**Kingdom**: Plantae
Region: IV	**Division**: Magnoliophyta
Province: Palawan	**Class**: Liliopsida
City: Puerto Princesa	**Order**: Liliales
Barangay: Sta. Lucia	**Family**: Liliaceae
Street: Chico	**Genus**: Allium
House #: 45	**Species**: cepa

If you examine the analogy of classification to where a person lives, you will find out that as you move from kingdom to species, things become more specific. It is just like locating the place where a person lives. In the given example, you start with the name of the country, the region where the person resides and the specific province in the region; the town or city in the province; and so on until you finally get the street and house number of the person. In science, the same principle is followed to make things easier, because we are grouping not only hundreds or thousands of living organisms but millions of them!

There are two systems of classification, the **artificial** and the **natural system.** The **artificial system** of classification used in plants is based on size, water requirement, ability to manufacture food, habitat, habit and life span. In other words, classification under this system is based on similarities. The **natural system** of classification is based on the structural and evolutionary relationships among the organisms.

The following gives more details on the bases of artificial system of classifying plants:

1. **Size** – plants may be **microscopic** or **macroscopic**. Microscopic plants are those that are not visible to the naked eyes, while macroscopic plants are those that can be seen with the naked eyes. The plants that you see around you are mostly macroscopic.

2. **Water requirement**
   a. xerophytes – live in places with little amount of water as in deserts. Examples of these are cacti, acacia and makahiya.

b. mesophytes – require a moderate amount of water supply as those found in your garden. Examples are santan, rose, and sampaguita
c. hydrophytes – those that live in habitats of abundant water supply. Examples: quiapo, water hyacinth, and digman.

3. **Ability to manufacture food**
   a. autotrophic – those that manufacture their own food through photosynthesis. Examples: all green plants.
   b. heterotrophic – those that depend on other organisms or dead organic matter for food. Examples: all the carnivorous plants.

4. **Habitat** – environmental location of the plants.
   a. aquatic plants – those that live in water. Examples: lotus, water hyacinth and water lily.
   b. terrestrial – those that live on land. Most of the plants we have in our garden are terrestrial in habitat.
   c. aerial – those that live above the ground on other plants or are attached to other objects for support. Examples are the orchids, bird's nest and pocket ferns.

5. **Life span** (duration of life)
   a. annuals – live for one growing season or within the year (e.g onions, garlic, patola)
   b. biennials – those that complete their life cycles in two years (e.g. carrots, papaya, potato)
   c. perennials – those that live for many years. Most of the trees that we see around are perennial.

6. **Habit** – refers to body appearance.
   a. trees – tall, woody, perennial plants with a single stem or trunk (e.g narra, mahogany, santol).
   b. shrubs – short, woody, perennial plants with several main stems arising at or near the ground (e.g. gumamela, santan, rose).
   c. herbs – with soft stems (e.g. oregano, sabila, mayana).
   d. vines – climbing plants (e.g. are squash, patola, beans.)

Now, try to apply what you learned from this lesson on classification by doing the activity below. You need to go to a place where many plants are found.

What you will do

Activity 1.2

Look for a garden nearby and get 8 samples of plants from a body of water, damp soil, garden soil, and moist rock. Notice what the plant body is composed of. Are all the

plants composed of the same parts? Do they all have leaves, stems, and roots? Did you find all of them in one place? Are they all of the same size? Do they all have flowers? Into how many groups could you classify them?

Fill-out the table below with the different kinds of plants that you have collected. Classify the plants by checking the category to which they belong. Review pages 7-8 before you start filling out the table.

Name of Plant	Microscopic	Macroscopic	Xerophyte	Mesophyte	Hydrophyte	Autotroph	Heterotroph	Terrestrial	Aquatic	Aerial	Tree	Shrub	Herb	Annual	Biennial	Perennial

Answer the following on the basis of your observations:

1. According to habitat, what kind of plant is the most common?
   _____
2. What kind of plant is not found in your garden?
   _____
3. How many plants did you observe climbing the trees or other objects? Name them.
   _____

Key to answers on page 28.

An example of a natural system of classification is the classification of plants into ***vascular*** and ***non-vascular***. Non-vascular are those plants without the vascular tissues or tissues where water, minerals, and food pass through such as the ***xylem*** and the ***phloem.*** The next two lessons of this module will be about the grouping and ordering of plants based on morphological and anatomical characteristics.

What you will do

Self-Test 1.1

Direction: Identify what is being described.

_____1. The highest level of classification
_____2. Plants with vascular bundles
_____3. Plants that need only a small amount of water
_____4. The basic unit of classification
_____5. Plants with soft and green bodies

Key to answers on page 28.

Lesson 2. The Non-Vascular Plants (Bryophytes)

Have you ever slipped on what you thought was smooth, solid ground? You got up, started to walk only to slip again? You looked around and saw that the ground was covered with something like green carpet. Do you know what that was? Well, they are called **"bryophytes**" or **"lumot"** in Tagalog**.** This collective term is composed of mosses, hornworts and liverworts. They differ as to structure. You see them in many places, especially in wet and moist places.

Do you know what else is special about these plants? They **do not** have **true roots, stems** and **leaves**. Isn't that interesting? All along, you probably thought that all plants have roots, stems and leaves. But not these plants! And you know one more thing? These plants don't grow from seeds unlike other plants that you know. They grow from **spores,** which are tiny seed-like bodies from which new mosses can grow. Spores are equivalent to seeds in the higher forms of plants.

Try to perform this simple activity. You can do this even in your backyard if bryophytes are available.

What you will do

Activity 2.1

Walk around the neighborhood or in your backyard and look for moist or damp places. Observe tiny green plants attached to the soil or to the rocks and stones. Individually they are not readily seen. They grow in masses and look like mats on the soil.

With the scalpel, scrape the tiny plants together with a portion of the surface, on which they are growing. Place them in plastic bags and upon reaching home lay them separately on the newspaper. Now, examine the plants closely, if possible with a handlens, and make a simple diagram of the plants on a bond paper. You can compare these with the diagram found in Figure 2. Are they similar to what you have?

www.scenicviewsstudio.com/natur...

www.mybitoftheplanet.com/wildli...

www.ucmp.berkeley.edu/plants/an...

Figure 2. Bryophytes

The **bryophytes,** as they are commonly called, are composed of the mosses, liverworts and hornworts. They are considered as the first land plants. They do not have the vascular tissues or tubes that will facilitate transport of substances. This is the reason why they are called **non-vascular plants**.

Have you heard?

… that the bryophytes are called the **"amphibians**" of the plant world? They are similar to the frogs and toads of the animal world in the sense that they can survive in water, too. Amphibian or amphibious refers to any organism that can live on land and in water. Just like the frogs and toads, bryophytes need water to complete their life cycle.

Liverworts

The term liverwort can be divided into two words - liver, which means that the plant is "liver-shaped" and wort, which simply means **plant** or **herb.** In the past, it was believed that this plant was useful in treating ailments of the liver. However, no proof was found that it was effective. Until now this plant is still universally called liverwort.

Examine closely the diagram on the next page. Notice the flattened, leaf-like plant bodies attached to the ground by "**rhizoids**" instead of a root. The tips of the leaf-like structure are lobed or shaped like the liver, thus the common name liverwort. A closer examination also reveals that there are two types of gametophyte plants, the male and female. Gametophytes are haploid plants that will produce the sex cells. The male contains the **antheridium**, the male reproductive organ, while the female contains the **archaegonium**, the female reproductive organ.

Male Liverworts

Female Liverworts

www.mybitoftheplanet.com/wildli...

Figure 3. Liverworts

Hornworts

These plants received their common names from the resemblance of the **sporophyte** or the "spore-bearing" plant, to small cattle's **horns**. They seldom exceed 2 centimeters in diameter and are usually found in moist soil and shaded areas or may be attached to trees. The hornworts are the smallest in size and in number compared to the liverworts and mosses. There are only about one hundred species of hornworts distributed around the world.

www.ucmp.berkeley.edu/

Figure 4. Hornworts

Examine the diagram on the right. Each is called anthoceros, a representative of the hornworts. Do they look like cattle's horn?

Can you make predictions?

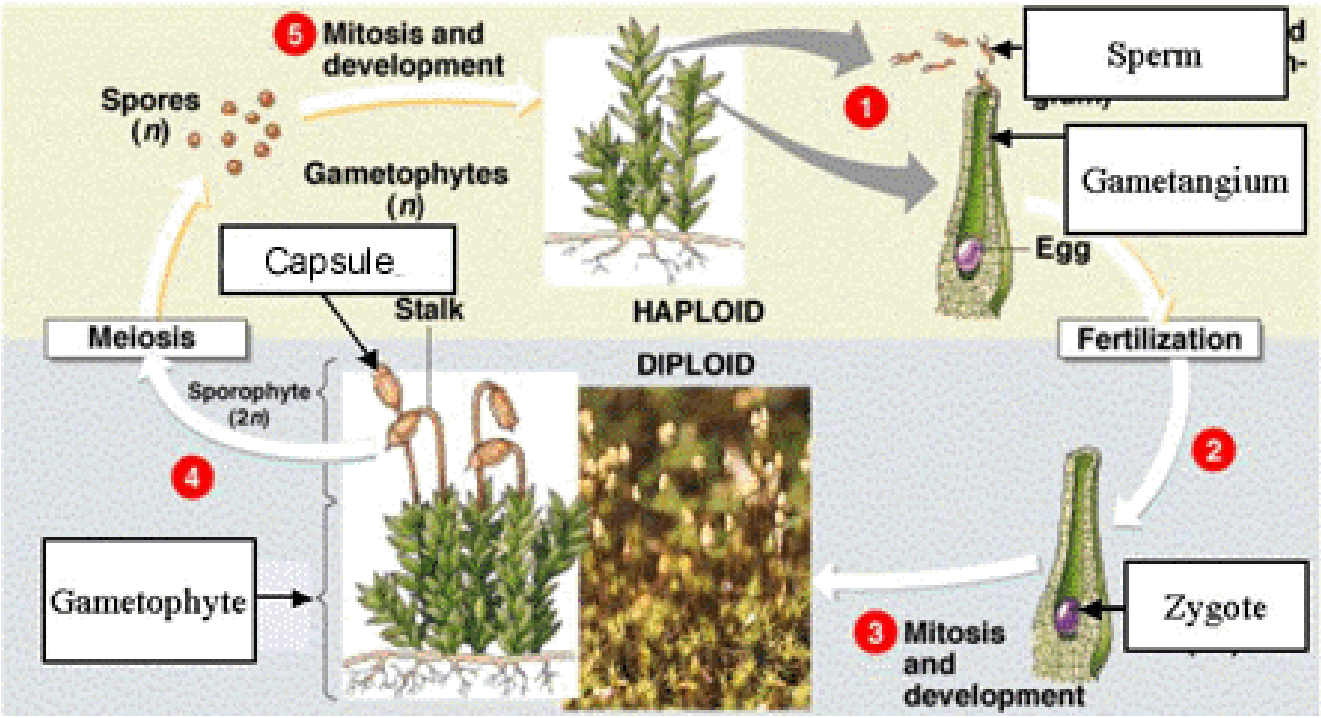
A friend of yours lives close to the Sahara desert in Africa. She wants to grow a garden of bryophytes. Is this a good idea? What will probably happen to her garden?

Compare your answer with this: I will advise her that it would be useless since bryophytes will not grow in dry and hot places.

Mosses

Just like the other bryophytes, mosses have also two kinds of plants. The **sporophyte** and the **gametophyte** plants. The gametophyte plant produces the reproductive cells or the egg and the sperm cell. Try to locate each plant using the diagram of the life cycle of a moss below. The gametophyte looks like any other leafy plants that we have. They differ from more complex plants because of the absence of mesophyll tissue,

stomata and veins. Notice that the sporophyte is attached to the gametophyte and is different. It has a **stalk** and **capsule**. The capsule is visible from the outside with numerous "**spores**" or reproductive bodies inside the capsule. Refer to the diagram below for the detailed parts of the plant.



http://courses.washington.edu/biol101/david/specimen_quest.html

Figure 5. Life Cycle of a Moss

What you will do

Self-Test 2.1

Matching type. Match column A with column B. Write the letters only.

A	B
1. Sporophyte with horn-like structures	a. spores
2. Where the sperm cells are found	b. moss
3. With a sporophyte found growing on the gametophyte	c. archegonia
4. The specific structure that houses the egg cell	d. hornwort
5. The reproductive bodies inside the capsule	e. antheridia

Key to answers on page 28.

Lesson 3. Vascular Land Plants (Ferns and their Relatives)

This is the second lesson of the module on **Plant Diversity**. You may work on this lesson only if you are through with the module on **Non-Vascular Plants**. You will be introduced to the ferns and their relatives. Like the bryophytes that we have discussed in the last lesson, ferns are also land plants. They are the first **vascular land** plants, meaning, the first group of land plants with conducting tubes through which water and food substances pass. They do not produce seeds, but instead, they produce **spores** for reproduction. Members of this plant group are described and discussed with diagrams to reinforce the concepts.

Look at the diagram on the right and study very well the members of this plant group. Are you familiar with them? They are very common along the roadsides and flower shops. They are mostly ornamental plants.

www.home.aone.net.au/.../bpenmar.html

Figure 6. Ferns and Fern Allies

Do you know?

…that more than 300 million years ago, during the **Carboniferous Age** a great number of ferns lived? This age is referred to as the Age of Ferns. The carboniferous forest contained many more species of club mosses, spike mosses, horsetails and ferns than are alive today.

What you will do

Activity 3.1

Examine the diagram of a fern and fern allies on Figure 6. Are they familiar to you? Do you observe them while walking along the roadsides in open and shaded areas? Try to recall the plants that you have seen and get samples of these plants. Compare them with the illustrated ones. By comparing them, you will be able to identify the kind of fern that you have. Since fern allies are not common, your collection might all be true ferns. They can be distinguished by their showy leaves, with tiny brown spots on the undersurface, the sori (sing. sorus) *See figure 11b*.

Answer the following:

1. How many kinds of ferns did you collect? _____
2. Are they all common ferns? _____
3. In what part of your garden did you collect your specimens? _____
4. Do they have mature leaves? _____

Key to answers on page 29.

A Survey of Fern Allies

In this group of plants, we will concentrate more on the ferns. The ferns are more common compared to the other groups. We will just make a simple survey of all its relatives using diagrams or illustrations with short description. So let's now start our survey of the fern relatives before we move on to the ferns.

Whisk Ferns

Look at the figure on the right. Is this plant familiar to you? Well, this is the whisk fern. The members of this group are small with "fork–like" branches that look like a broom. They are considered the simplest of all living vascular land plants. There are only two surviving genera in this group of plants, the ***Psilotum*** and ***Tmesipteris***. The illustration of these plants are found below.

Figure 7. Psilotum and Tmesipteris

www.herbs2000.com/herbs/herbs_**club_moss**.

Club Mosses

The second group of fern relatives in the illustration are the club mosses. There are around **1,000 species** of club mosses. They maybe familiar to you especially if you live in the province. They are just along the roadsides. They just grow wildly and plentifully along the roadsides especially during rainy season. However, in summer, they wilt only to germinate again during the rainy season. Club mosses are so called because their tips are club-shaped.

They are usually used in decorating chapels in the provinces especially in some parts of the Bicol region during holy week.

Figure 8. Club Moss

www.herbs2000.com/herbs/herbs_**club_moss**.

Horsetails

Figure 9. Horsetail
www.herbs2000.com/herbs/herbs_**club_moss**.

There used to be 15 species of horsetail plants but now there is only ***one*** existing genus. The genus is ***Equisetum.*** All the other members of this group are already extinct. The plants are commonly called ***horsetail*** or "scouring rush". Look at the illustration. It resembles a horsetail and this was how the plant got its name. Its stems are rough with silica crystals, no wonder then that in the past, people used this in scrubbing pots and dirty kettles. Take a closer look at the picture. Have you seen one? Perhaps you haven't because they are not a common ornamental plant.

Ferns

Figure 10
A tree fern ***(Cyathea)***

Figure 11a
Fern with fiddlehead

Figure 11b
Fern with sori

This is the largest and the first group of seedless vascular plants. There are around **12,000** living species. It is believed that like the other vascular plants, many more species have been identified from fossils. During the Carboniferous period of the Paleozoic era, most ferns grew much larger than the fern species living at present. Species of fern trees found today in tropical areas may reach 3-5 meters in height but ancient tree ferns grew as high as 25 meters. The difference in plant size before and at present could be attributed to the change in the climatic condition. The genus of the common tree fern that exists today is ***Cyathea.***

Ferns have true vascular tissues and strong roots. They may be creeping or underground called ***rhizomes.*** The large leaves are called ***fronds.*** When fronds mature, **sori** are formed on its underside. Inside these are sporangia where spores are formed.

They undergo alternation of generation just as any other member of this group. The leafy fern is the sporophyte. When leaf ferns are young, they are coiled and are called ***"fiddleheads"*** or ***croziers.*** You can see this in figure 11. After a few days, little by little they uncoil into leafy fronds. Observe this yourself. This might take you a week to monitor. Examine the fiddlehead in the given illustration.

Observe this:

Look for ferns growing in your garden and take note of the appearance of "fiddleheads" or croziers. These are young, coiled fronds of the ferns. Consider this as day 1. Record the height, and appearance of the crozier. The next day do this again until after the whole leaf or frond is fully opened and uncoiled. This time describe how the leaf or frond look like.

What you will do

Self-Test 3.1

Direction: Answer the following questions briefly.

1. Which among the fern relatives looks like a tail of the horse? _____
2. Which among the fern relatives is comparable to the broom in shape? _____
3. In what part of the fern is the sori usually found? _____
4. Why do ferns reproduce very fast? _____
5. What are the economic values of ferns? _____

Key to answers on page 29.

Lesson 4. Vascular Plants (Cone - Bearing Plants)

What trees do you usually associate with the Christmas season? Is it narra, acacia, mahogany or pine tree? I'm sure your choice is pine tree. Really, pine trees are very popular during the Christmas season. Almost everybody wants a decorated Christmas tree in the house. What makes a pine tree ideal for the season? Well, most probably it is the shape of the tree, the needle–shaped leaves and of course the cones. The cones are highly decorative. They can be varnished and converted into beautiful Christmas decors. This lesson is focused on conifers or the cone-bearing plants. Pine trees are only one of the examples under this group of plants.

What you will do

Activity 4.1

Use diagrams in this lesson to be familiar with the plants mentioned, or if possible, try to check if these plants are found in your place. Cone-bearing plants include Cycads, Podocarpus, Pinus, (or pine tree) and many more. Compare these three common plants. Be guided by the following characteristics:

a. height of the plants
b. habit
c. leaf characteristics

Key to answers on page 29.

Cone–bearing plants are grouped under ***Division Gymnospermae***.

The name came from the Greek word "***gymnos"*** meaning naked and ***"sperma"*** seed, thus naked seed. Cone-bearing plants have well-developed stems, leaves, and roots as well as vascular tissues. They grow very well in temperate regions. Gymnosperms consist of only around 550 different species but they rank high among the economically important plants.

Have you heard?

…that the oldest living tree today is a Gymnosperm? It is found in Eastern California and is more or less 4,997 years old.

Look at the illustrations on the following pages. Are you familiar with all the plants illustrated? Examine the plants more closely. Which among the four is found in your locality?

There are four groups of cone-bearing plants but not all of them are found here in our country. They are as follows:

Ginkgos

Originally Ginkgos have 16 species, but now there is only one surviving, species, ***Gingkgo biloba*** or maiden hair as it is popularly called. This is a large tree with numerous spreading branches. Leaves are fan-shaped with parallel type of leaf venation. The female plant forms seeds that give off a pungent odor, similar to rancid butter. This plant is abundant in China and Japan. An illustration of ***Ginkgo biloba*** is found at the right.

Figure 12. Ginkgo biloba

www.cccmkc.edu.hk/~kei-kph/.../**Gymnosperms**.htm

Gnetums

These plants resemble the flowering plants more closely. ***Gnetums*** are believed to be the ancestors of the flowering plants. They have cones that resemble flowers. They are usually smaller compared to ***Ginkgos*** that form large trees. Their leaves are with parallel venation similar to the compound leaves of cycad or "pitogo" plant. These plants are not common here in our country. Examples of these are ***Gnetum, Ephedra*** and ***Welwitschia*** (found only in the deserts of South Africa). Since these plants are rare, just study Figure 13 and do the simple activity that follows.

Figure 13. Gnetum

www.cccmkc.edu.hk/~kei-kph/.../**Gymnosperms**.htm

Do this:

Since the plants under the first two groups, the ***Ginkgos*** and ***Gnetums*** are not common and available, just examine closely the diagrams on pages 18 and 19 and compare them as to:

1. shape of leaves
2. type of venation

Cycads

These are cone-bearing palm-like trees with thick stems. The leaves are large and "***compound"*** or composed of several small leaf–like parts. These are the plants that are usually used during palm Sunday together with the young leaves of coconut trees. Female plants are distinct from the male plants. Male and female cones look different and may be found in two separate plants. They grow well in tropical countries like ours. All plants belonging to this group are called cycads. Examples of these are pitogo and oliva or peace plant. Look at the samples of male and female cycad plants on the next page. Take note of the size of the cones.

Figure 14. Male and Female Cycads

www2.junglemusic.net/show_cycadlist.asp

Pine Group

This represents the biggest group of gymnosperms found in many parts of the world. Just like all the other plants we discussed, they all bear cones. Here in our country, the most common ones are the pine trees. There are only two species of pine trees found in our country. They are ***Pinus insularis*** and ***Pinus merkusii***. Some of these pine trees are found not only in Baguio but in other parts of the Philippines like Zambales, Mindoro and in

some parts of Mindanao. The conifers are large, tall trees with highly branched stems. The leaves are usually scaly and needle-like. Since only pine trees are available here in our country, we will focus on this plant.

Examine carefully the two types of pine cones:

Try this:

Compare the male and female pine cones. How do they differ? Do you have these at home? You can buy these in department stores especially during the Christmas season. Or, if you live in Baguio City or in places with pine trees, you can see them on the branches or pick them up when they fall to the ground. Try to detach some of the seeds or scales. They are hard. Each of the seeds can grow into another young pine tree. Locate the seeds in the diagram and notice how they look like.

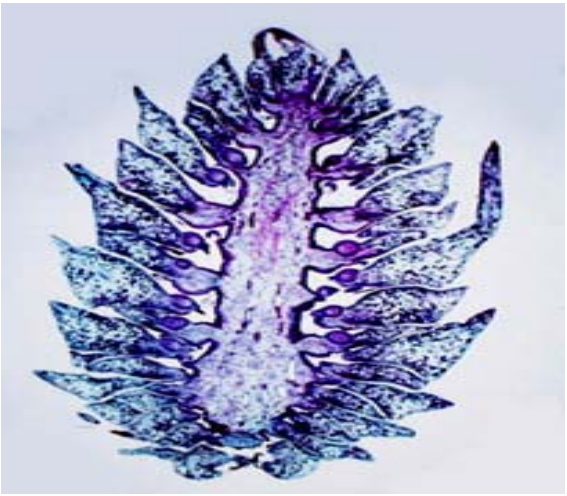


Figure 15
Female Cones (Seeds Exposed)
www.naturalsciences.org/.../pinecones.html

Do you know?

…that the biggest and tallest trees in the world are found in California, USA? One tree in Humboldt County, California with a height of 111.6 meters or 366.2 feet is believed to be the tallest conifer in the world. The other species usually referred to as "big tree" or giant red wood is confined at California's Sierra Nevada. The scientific name is ***Sequoiadendron giganteum*** or simply called as **sequoia.** The tree is enough to build 75 five-room mansions or enough to make 20 billion toothpicks.

Remember:

Cone-bearing plants are vascular plants.
Cone bearing plants produce seeds from where the embryo originates.
Cone–bearing plants are divided into 4 groups: the cycadophyta, ginkgophyta, gnetophyta and coniferophyta.

What you will do

Self-Test 4.1

Direction. Answer the following questions briefly:

1. Why are gymnosperms referred to as plants with naked seeds?

   _____

2. Where do you find the tallest tree in the world? How tall and big is it?

   _____

3. Which among the cone-bearing plants are very common in Baguio City?

   _____

4. Which species of pine trees are found in the Philippines?

   _____

5. What are the economic importance of cone-bearing plants?

   _____

Key to answers on page 29.

Lesson 5. The Flowering Plants

When you bite into a chico or guava you are eating part of an ***angiosperm***. Angiosperms or flowering plants are vascular plants with seeds usually found inside a fruit. There are around **250, 000** different species of flowering plants. Recall that cone-bearing plants like the pine trees are the opposite, their seeds are usually found outside.

Find out!

Get an uncooked peanut still in its shell. Open the shell. Remove the thin covering of the seed. Carefully open the seed and look for a small hump on half of the seed. This is the embryo or the baby plant. If you examine this closely you will note the future leaves, root and stem.

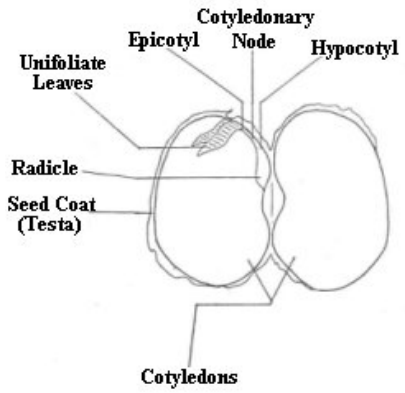


Figure 16. Peanut seed

explanationguide.info/meaning/**Peanut**.html

There are two kinds of flowering plants based on the number of seed leaves or cotyledons: the ***monocot*** and the ***dicot.*** Monocot and dicot are shortened forms of ***monocotyledon*** and ***dicotyledon***. A ***cotyledon*** is a seed leaf inside a seed. It is called the baby food for the baby plant. Monocots have one seed leaf inside a seed while dicots have two.

Let us examine further the differences between a monocot and a dicot plant. Work on another activity below.

What you will do

Activity 5.1 Comparing Dicot and Monocot Plants

Get a branch of a gumamela plant with flower and an orchid plant with flower (preferably *Dendrobium*). Start your study with the gumamela. Closely examine the plant. Start with the leaf. Observe the veins. How are they arranged? Now, focus on the flower. The flower is composed of five colored petals. Look at the sepals. They are the green leaf-like parts at the base of the petals. Try to count them. How many are there? Look at the stigma. There are five of them in the flower. The stigma is located at the tip of the flower. The anther and other parts of the flower are also visible. In case you have difficulty locating the parts, refer to the drawing below. If you are through with the gumamela, shift to the orchid plant that you have and do the same as you did with the gumamela plant.

Answer this:

1. Compare the type of leaf venation or arrangement of veins in the two plants. Do they differ?

   _____

2. How many petals are there in the gumamela flower? In the orchid?

   _____

3. How many stigma did you find in each flower?

   _____

Key to answers on page 29.

Figure 17. Monocot plant and dicot plant

www.ezd-inc.com/.../pages/**gumamela**.html

Let us now look at Table 1 for the differences between a monocot and dicot plant. Note that differences could be external or internal.

Table 1

Type of flowering plant	Type of flower	Number of cotyledon	Arrangement of vascular bundles	Type of leaf venation	Type of root system
Monocot	Floral parts in 3's (e.g no. of petals)	one seed leaf	Scattered vascular bundles	Parallel leaf veins	Diffused or fibrous
Dicot	Floral parts in 4's or 5's	Two seed leaf	Vascular bundles in rings or circular arrangement	Netted leaf veins	Taproot system

Assignment:

Collect at least 10 flowering plants with complete plant parts and examine them carefully. Make sure that your collection will include the two types of flowering plants. Compare them as to:

a. Arrangement of veins
b. Root system
c. Number of petals
d. Number of cotyledons

Write your observations using this table.

Name of plant	Type of leaf venation	Type of root system	No. of petals	No. of cotyledons

Let's Summarize

1. Plants are classified into non-vascular and vascular plants.
2. There are seven major categories of classification.
3. Kingdom is the highest level with species as the smallest.
4. Bryophytes refer to a group of non-vascular plants; the first non-vascular land plants.
5. Ferns are the first vascular land plants.
6. Fern allies include the whisk ferns, club mosses, and horsetails.
7. Gymnosperms are plants that bear naked seeds; or plants with seeds found outside.
8. The biggest and tallest tree is a gymnosperm.
9. Gymnosperms are cone-bearing plants.
10. Pine trees, yew, cedars, firs are examples of gymnosperms.
11. The reproductive cells of gymnosperms are found in the cones.
12. Flowering plants usually have seeds inside a fruit.
13. There are two types of flowering plants, the dicot and the monocot.
14. Dicots have 2 cotyledons, while monocots have only one.
15. Dicots also have a taproot system, netted venation, and flowers of multiples of 3's or 5's.

Did you enjoy it? The module is quite long, you see, there are many plants, and to cover everything will take time. Anyway congratulations for a job well done! Now let's see how much you have learned from the lesson. Answer the posttest below.

Posttest

Multiple Choice. Choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. It refers to the branch of science that deals with the grouping, ordering, and naming of living things.
   a. Anatomy
   b. Ecology
   c. Embryology
   d. Taxonomy

2. There are seven major biological levels of classification. Which is the biggest unit of classification.
   a. family
   b. genus
   c. kingdom
   d. species

3. Who was the first Swedish naturalist to classify living things? This man is regarded as the father of Taxonomy.
   a. Anton van Leewenhoek
   b. Carolous Linnaeus
   c. Gregor Mendel
   d. Robert Hooke

4. What do you call the type of classification that is based on similarity of structures?
   a. artificial
   b. classical
   c. natural
   d. superficial

5. Vascular plants produce the tallest and biggest trees in the world. Non-vascular plants are small and cannot grow as tall as vascular plants. What could be the reason for this?
   a. absence of roots
   b. absence of water
   c. deficient nutrients
   d. absence of vascular bundles

6. Vascular plants are plants with tissues for transport of water, minerals and food for the plant. What are these transport tissues?
   a. Collenchyma and sclerenchyma
   b. parenchyma and collenchyma
   c. sclereids and sclerenchyma
   d. xylem and phloem

7. Plants are found in almost all types of habitat. Which among the following habitats is **NOT** favorable for the growth of mosses?
   a. damp soil
   b. moist rocks
   c. dry and unshaded places
   d. trunks of trees in a forest

8. All of the following are vascular plants **EXCEPT**:
   a. fern
   b. liverworts
   c. mango
   d. teak

9. What reproductive structures are found in the female cones?
   a. anther
   b. ovule
   c. pollen
   d. spores

10. What type of vascular arrangement do find in a dicot plant?
   a. alternate
   b. circular
   c. scattered
   d. triangular

11. How many cotyledons are there in a peanut seed?
   a. 1 cotyledon
   b. 2 cotyledons
   c. 3 cotyledons
   d. 4 cotyledons

12. Vascular bundles help in the transport of substances in plants. What vascular bundle transports water and minerals upward in plants?
   a. collenchyma
   b. parenchyma
   c. phloem
   d. xylem

13. Parallel type of venation is shown in which of the following plants?
   a. coconut
   b. gumamela
   c. peanut
   d. pilinut

14. Which of the following plant is not a gymnosperm?
   a. fern
   b. ginkgo
   c. gnetum
   d. oliva

15. The taproot type of root system is exhibited by which plant?
   a. grass
   b. orchid
   c. palay
   d. radish

Got a perfect score? Check it out!

Key to answers on page 30.

Key to Answers

Pretest

1. c
2. d
3. b
4. b
5. d
6. c
7. b
8. b
9. d
10. c
11. b
12. a
13. b
14. c
15. a

Lesson 1

Activity 1.1

1. The bases for grouping the plants are shape, color and texture.
2. 8
3. To be more systematic in identifying the seeds.

Activity 1.2

1. Possible answer – terrestrial are the most common plants.
2. Possible answer – aerial and aquatic plants
3. Possible answer – few.

Self-Test 1.1

1. kingdom
2. vascular plants
3. xerophytes
4. species
5. herbaceous

Lesson 2

Self-Test 2.1

Matching Type

1. d
2. e
3. b
4. c
5. a

Lesson 3

Activity 3.1

1. Possible answer – few-to many
2. Possible answer – mostly common
3. Possible answer – mostly shaded places
4. Possible answer – some have mature leaves or fronds

Self-Test 3.1

1. The horsetail.
2. Psilotum.
3. Undersurface of leaves.
4. They produce thousands of spores.
5. They are used as medicine, food and ornamentals.

Lesson 4

Activity 4.1

Possible answers:

Name of plant	Height	Habit	Leaf characteristic
Cycad	Around 1-1.5 m	Upright	Bipinnately compound
Podocarpus	Around 2 meters	Bushy	Simple
Pine tree	Around 5 meters or more	Bushy and tapering	Needle-shaped

Self-Test 4.1

1. It is because the seeds are not located inside the fruit, they are outside.
2. In California, USA
3. Benguet pine.
4. ***Pinus insularis*** & ***Pinus merkusii.***
5. They can be used for building houses, ornamentals and household materials.

Lesson 5

Activity 5.1

1. Gumamela have the netted type of venation, while Dendrobium have the parallel type of venation.
2. There are 5 petals in gumamela while there are 6 in Dendrobium.
3. There are four stigma in gumamela while there are six in lilies.

Posttest

1. c	6. a	11. b
2. d	7. c	12. b
3. c	8. d	13. a
4. d	9. d	14. a
5. d	10. a	15. a

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