Biology :: 6-9

MONTESSORI TEACHERS COLLECTIVE (MOTEACO.ORG)

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Introduction to the Five Kingdoms

This work can be given as a simple lesson for younger children as an introduction to living things and then given again in an expanded version to older children before their introduction to the Classification Charts. Refer to the book Parade of Life, published by Prentice Hall, for detailed information you or your children may be seeking on these animals.

Materials:
...Picture of a moneran, protist, fungus, plant, animal

Presentation:

How many living things do you think there are in the world? It would be impossible to say, so to make things easy, biologists have divided them into five big kingdoms.

Moneran:
Bacteria is the oldest living thing on the earth. Bacteria is in the Moneran Kingdom. Bacteria are tiny organisms that can only be seen by a very high-powered microscope. Blue green algae from the Archaic Era 3.5 billion year ago was actually a bacteria. There are helpful and harmful bacteria in the world. Helpful bacteria makes yogurt. One type of harmful bacteria gives you strep throat.

Protists:
Protists are one celled organisms. Like the bacteria, protists are very tiny and still need a microscope to be seen. Protists evolved about 1.5 billion years ago. The diatom, amoeba and algae are protists.

Fungi:
All fungi are organisms that cannot make their own food. They need to find energy and chemicals by growing on a source of food. Then they release chemicals on the food they are eating. This chemical works something like your digestive juices in your stomach. The chemical digests the food and the fungus re absorbs it. Yeast and mushrooms are types of fungus.

Plants:
Plants are organisms that can make their own food. They have lots of cells that are very specialized. There are many kinds of plants from simple to very complex. Some plants that you know are mosses, ferns, algae, flowering plants.

Animals:
Animals are many-celled organisms that have specialized tissues and organs. Animals must search for their own food. Their bodies will not manufacture it. There are many kinds of animals from very simple to very complex. They are divided into animals with a vertebral column or backbone and animals without one.

The Animal Kingdom

Invertebrate - Vertebrate

Materials:
...10 pictures of invertebrate animals
...10 pictures of vertebrate animals
...Labels: **Vertebrate Invertebrate**

Note: suggestions for materials: safari cards, Audubon animals

Presentation:
Imagine how you would look if you didn't have a backbone.

We are all sitting here because of a support system in our bodies called a skeletal system.

Put your fingers on the back of your head and run your fingers down the back of your neck and as far as you can. Continue on down to the bottom of your back.

That is your backbone!

Your backbone is one of the most important parts of your body. It is bone that is covering your central nervous system. This is a network that sends signals from your brain to every part of your body. Most animals have a central nervous system, but not all of them have a backbone. If animals have backbones, they are called a **Vertebrate.** If they do not have a backbone, they are called an **Invertebrate**. We are going to learn to look at an animal and tell if they are a vertebrate or an invertebrate.

To make things very simple, these animals are always invertebrates:

Sponges

Jellyfish , corals and their relatives.

Worms

Snails, slugs, animals with inner or outer shells.

Animals with jointed feet.; insects, lobsters, spiders, etc.,

Spiny skinned animals like starfish and sea urchins.

Animals with a backbone are the **Fishes, Amphibians, Reptiles, Birds,** and **Mammals**.

Lay out the labels: Invertebrate and Vertebrate.

Ask children to place the pictures under the label and check each other's work. As many pictures can be added as they want to do.

Age: from 6-9

Classified Nomenclature of Zoology (External Features)

Materials: For each group of animals in the division of vertebrates to be considered, there is a series of materials consisting of: Wall chart of labeled pictures. Folder with pictures, separate reading labels, definition cards, control booklet of pictures and definitions

All of the external parts are taken into consideration for one species of the fish, amphibian, reptile, bird and mammal.

A live animal should be used for the presentation if possible. If not, a large, beautiful, but accurate poster should be used.

Word level reading

Presentation: The fish is in its tank or bowl on the table.

What kind of fish is this? **A goldfish.**

What do you call that part where you find the mouth and eyes? **The head.**

Look at slits behind the eyes - they are called **the gills.**

What do you call those parts that are moving or sticking out from its body? **fins.** They are used for moving - the fish does not have legs. You use your legs for moving, but the fish doesn't have legs.

The fins on either side closest to the head are called the **pectoral fins** because they are attached to the breast. Your pectoral muscles are like the fish's pectoral fins. They help you swim and lift.

The pair further back are called the **pelvic fins** because they are attached to the pelvis. Your pelvis is here....

The fin on the bottom and in the back is called the **anal fin** because it is attached to the anus. Your anus is your rear end.

The fin at the very back is called the **caudal fin.** The fins on the top at the shoulders are called the dorsal fins. Those are all of the fins.

Not all fish have the same number of fins. It depends on where the fish feeds in the water.

Look at the fish.... there seems to be a line which divides the fish in half. This is called the **lateral line.**

Give three period lesson. Third period of this lesson: What do you call the fin that is attached to the pelvis?

Exercise: In the classified nomenclature folder are the pictures and labels only. The child lines up the pictures, reads the labels and matches. By now the child should be able to do this without direction. The wall chart is used for a control and for sentence level reading.

Age: 3-6 year old.

Aims:
...To identify the fundamental external parts of animals that are familiar to the child.
...To sharpen awareness and observation that is necessary to begin classification.

Sentence Level Reading

Presentation: The child lays out the pictures and matches the labels appropriately. The child knows the parts of the fish by name.

The teacher and children discuss where the fish lives and how it breathes. All living things, even plants need to breathe. Fish need to breathe, too. As we breathe air, the fish breathes air. It is a special kind of air that is dissolved in the water. Instead of lungs, which takes the oxygen and other gasses from the air , the gills take oxygen from the water.

Look at the head of the fish. Look at its special shape for going through the water quickly.

The lateral line lets the fish understand the movement and depth of the water around it. IT can tell whether it is in a current or in still water.

The pectoral and pelvic fins help the fish swim and stop when it needs to . They also give the fish stability.

The dorsal fins help the fish swim and jump.

The anal fins help it swim fast and keep its balance.

The caudal fin helps it swim rapidly and also lets it change direction.

(Look at fish for these movements)

Use three period lesson for this. Which fin helps it jump?, etc.

Exercise: The child takes the definition cards, reads them and matches them to the pictures. The definition book is used for control if necessary.

Activity: The children can draw pictures and write the definitions.

Age: 6

Aims:
...to identify and define the fundamental external parts of animals that are familiar to the child.
...to practice reading sentences.
...to organize thoughts and express them orally and written.

First Knowledge of the Animal Kingdom

Note: This material is preceded by the Classified Nomenclature of Zoology, external features and parallel to the Botany First Knowledge cards.

Materials: Box containing pictures of animals (including all of the animals that will be pictured on The Animal Kingdom Charts), corresponding reading labels with the animals' names, and cards with stories about the animals.

Body Functions of the Vertebrate Classes

Introduction:

This material parallels the Time Line of Life and shows the evolution of the vertebrate classes. This work along with invertebrate studies should go along with the Time Line. This work should be re-presented after the presentation of the Classification charts to show the breakdown of characteristics of these animals. Its format of **movement, protection, support, circulation, respiration, reproduction** will be seen over and over in the study of Montessori Biology in the questions we ask the children to ask themselves.

Materials:
Either: Cards and an illustrated chart, one of each of the five classes, showing the Classified nomenclature: wall chart, folder with pictures, reading labels and definition cards, wall chart **movement, protection, support, circulation,** respiration, reproduction and control booklet.

Presentation: example: Amphibian

Using a chart and possibly a real amphibian, the teacher presents the internal and other parts of the amphibian. The child recognizes the animal, recalls the class: Amphibia and the meaning of the word: two lives. It is also one of the vertebrates.

Put the names **movement, protection, support, circulation, respiration, reproduction** down in front of a group of children. Place each picture one at a time under the correct function.

This is the amphibian moves. Some amphibians, the frog and toad, have very strong back legs.

The amphibian's skin is it's protection. It has to stay wet or it will die.

The amphibian has an internal skeleton. So do all the other animals in this material that we will study.

The amphibian has a three chambered heart. You may remember that a fish only had a two chambered heart. They must need more blood to circulate.

The amphibian has two different kind of respiration. As a tadpole, it has gills, but when it changes shape and craws up onto land, it develops lungs.

The amphibian reproduces by laying jelly-like eggs similar to a fish. It hatches out looking somewhat like a fish with a long tale. It develops legs and can crawl on the land. When it finds a mate, the female lays her eggs back in the water.

Go over the paragraphs describing the movement, skeleton, reproductive system, respiratory system, circulatory system and the skin or protection of the animal. Look at the age of the amphibian on the Time Line of Life and think of the fish that came before. What was different about the frog and fish?

Age: 7-8.

Aim: To learn the characteristics of the five vertebrate classes.

Comparative Study - Five Classes of Vertebrates

Materials : The wall charts of the five vertebrate classes (or one set of function labels from one of the classes) . The names fish (or Pisces), amphibian, reptile, bird ,, and mammal on the side going down.

Presentation:
Have a group of children lay out the loose pictures of the fish in order of their function. Next a group of children can lay out the pictures of the amphibian, then the reptile, then the bird, then the mammal.

The elements are compared, discussing the characteristics of each class and how this contributes to the evolutionary process.

Example: The fish lay many eggs in the water and the young when they are born are abandoned. The same is true for the amphibians. The adult who lives on land, returns to the water to lay many eggs. The young are abandoned and live for a time in the water.

The reptile also lays eggs and abandons them. But reptiles are land animals, so their eggs are laid on land. A damp environment is needed for the egg, so Nature put water inside the egg and a hard shell on the outside. The mother sometimes leaves the eggs on the sand to warm.

With birds, we see the first real caring for the young. The male and female sometimes build a nest together where the eggs are laid. The female keeps the eggs warm by sitting on them. When the eggs hatch, the male or the female goes to find food for the young. The young are taught how to search for food and to escape danger. The mammals do not lay eggs. The female keeps the egg inside her body and the young are born alive. The female cares for the newborn, and changes some of the blood into milk to feed it.

Aim: To examine the process of evolution through animal characteristics. To give children a sense of the process scientist go through in classification).

Classification Game - Animal Kingdom

In what element do they live?
on the ground
in the water
in the air

What do they eat?
plants / herbivorous
animals / carnivorous
plants and animals / omnivorous

How do they move?
by flight
by walking
by swimming
by creeping
in other ways

How do they care for their young?
they provide for their young
they take no care of their young
they suckle their young

How do they reproduce themselves?
born alive / viviparous
by means of eggs / oviparous
in other ways

How are they considered in relation to humans?
useful to humans
neither useful or harmful
harmful to humans

In what climatic regions do they live?
in a hot region / tropical zone
in regions which have changing temperatures / temperate zones
in regions that are very cold / frigid zones

Does this animal live in our region?
It did at one time.
It does not live in our region.
It does live in our region.

First Classification of the Animal Kingdom

Introduction to the Animal Kingdom
Re-introduce the FIVE KINGDOM work that was the beginning of the child's work in Biology.

In biology, we study life. Here we begin to study the animals in relation to the history of life, the story of evolution. Only after the children have understood the history of the past lives of these animals, can they fully understand and appreciate their existence.

Materials: 2 Animal Kingdom charts backed on red (which stands for animals): A blank chart, pictures and word labels. Folders for each of the phylum of the Animal Kingdom.

Presentation:
These are all the kinds of animals that you already know, but now, they are arranged in a special order.. The further up we move on this chart, the more complex the animals become.

This is the Animal Kingdom. If you remember from the time line of life, the sea covered the world for millions of years. Think of yourself floating in a pool of water. Animals in the ocean did not need an inner skeleton when they first evolved. The sea held them up - or the sea provided them with calcium to build their own houses around their bodies. This first group of animals have no backbone. (make sure that with each presentation, you are referring to the time line - showing where the animal developed.

...The **Porifera,** or pore-bearers, are the sponges. They are very primitive animals that are like thousands of Protists all working together as one. They are able to glue onto the bottom of the ocean or on a rock and absorb the water as it washed over them. Organisms wash through them, are absorbed (or eaten) and the sponge squirts the water back out the top. I guess we can't really

say that, as animals, sponges "go out looking for food", but luckily the food finds them because it grows where food is plentiful.

...The **Cnidarians** are stinging jelly-like animals. Cnidarian comes from a Greek word meaning stinging nettles. All Cnidarians have stinging cells called nematocysts. They sting their prey with the tentacles surrounding their mouth. Then it pulls its anesthetized prey into its mouth. The Cnidarians used to be called **Coelenterata** which means "stomach mouth" because they have only one opening into its body. It is all stomach! For the first time, animals seem to have some kind of symmetry or mirror image of itself on its body. The Cnidaria's symmetry is called radial symmetry. Hydras, Corals, Jelly fish, and Sea anemones are Cnidaria.

...When you think about a worm, you think about earthworms. But there are three phyla of worms: flatworms, called **Platyhelminthes**, roundworms, called **Nematodes**, and segmented worms, called **Annelida**. Planarians and tapeworms are examples of Platyhelminthes. Tricinella and hookworms are example of round worms. Earthworms and leeches and seaworms are examples of segmented worms.

...**Mollusks** are soft-bodied invertebrates. They have a thick, muscular foot. Some mollusks have a shell. All mollusks have a soft mantle which covers most of its body. The mantle produces the materials which make up the shell. There are three main groups of mollusks: snails and slugs: two shelled mollusks; and tentacled mollusks.

* At this point, you should do a three period lesson on the animals. You can work with the folders containing the classes of these three phyla. This is enough work for one day. Make sure the children understand about these animals. See if they would like to find out more about them before going on.

...**Arthropods** are the largest group of animals. Arthropod means jointed feet. They include insects, crustaceans, and spider relatives.
...**Echinoderm** means spiny skin. Even through echinoderms are called invertebrates, they do seem to have an internal skeleton of calcium plates. They also all have a five part body, a water vascular system and structures called tube feet.

...The **Chordate** phylum must have three important characteristics at sometime during their lives: a nerve cord, a notochord and a throat with gill slits. There are four subphylum of chordates: Two without a brain: the tunicates and the cephalochordates.
Two with a brain: the Agnatha (no jaws - like the lamprey), and Gnathostomata, (jaws and paired limbs). The Fish, Amphibians, Reptiles, Birds and Amphibians are Gnathostomatas.

*Introduce these animals with a three period lesson and their classes. At this point, when the child is able to understand and give a definition for each animal, she is able to work with the labels for a matching exercise.

The next step is working with the mute chart and folders without looking at the controls.

Aim: to understand the development of animals at a very basic level.

To understand which characteristics are common to these groups.

Age: 7-8

The Plant Kingdom

Classified Nomenclature for Botany

Introduction

Botany for the young child cannot ever be just the nomenclature material., Botany Cabinet or leaf identification from pictures. The work of the child should center around the outdoor work of plants for the four seasons. The child of this age is interested in all kinds of plants and especially experiments having to do with planting and growth.

Materials: Botany classified nomenclature, organized by plant, root, leaf, flower, fruit, seed for class study. Experiments and possibly Vital Functions of Plants can be included in this work.

Classified Nomenclature for Botany

Reading of words

example: The parts of a plant. The plant is alone on the table. The child identifies the parts of the plant. It is living. The child identifies the parts if he knows them. Otherwise, the teacher presents the names: roots, stems, leaves, and axis. The axis keeps the plant standing in the breeze. The concept of equilibrium is shown by the child leaning over and catching himself.

The child is given the cards and reading labels to match and uses the wall chart for control.

Reading of Sentences

example: The parts of a flower. Two flowers are on the table. One flower is broken in its parts. The child identifies the parts one by one attempting to form his own definitions. The teacher supplements these definitions with information on the function of each part.

Three period lesson. Each child within the group should be given the opportunity to form each definition verbally. After they know the names and function of each part, and can give definitions in their own words, they may match the pictures and labels to the definition cards using their own words.

Later the children can bring in their own specimens and identify and compare the parts.

Age 6-8

Note: In the classroom , we hope to give the child keys to explore her world. In math, we give her symbols of the decimal system. In language, we give her the letters of the alphabet and the 9 functions of words. In nature, we must give the child the world of living things.

Classification Game for Botany

Reading of words

The teacher chooses several pictures of animals, those that might be known to the child, and that have simple names. The child identifies any that s/he may know. The teacher presents the names

of the others. Incidental clues and hints are given to help the child remember. The three period lesson is given on those that are new.

When the child knows them all, the reading labels are given and the child may match them. The child may write the names, and draw pictures of the animals.

Reading of sentences

This work is intended for the point when the child reads reasonably well. This time the child puts out the pictures. The teacher reads a story from one of the cards. Upon completion the child guesses the animal that the story refers to. The story card is matched to the picture. When the child is working alone, he reads the stories.

Another nice way of doing this is to have an older child matched up with a younger one who doesn't read past a word level.

Age: up to 8 years.

Material: a box with several series of labels, each series is a different color. Each series contains a question and two or more answers.

Classification Game, first part

The teacher takes a group of 10-12 picture cards and one series of the classifying questions: *What do they eat? How do they nourish themselves?*

The question is read and the three alternative answers are read and placed as the column headings below the question.

The child takes an animal, identifies the animal and asks what do they eat?

If the child doesn't know, the teacher tells him, giving enough details so that he will remember the answer.

The pictures are placed in columns below the answers.

When all pictures have been placed in a column, review: "These animals eat other animals. " The label is turned over. "We call them carnivorous animals, and so on. "

The new words are given in a 3 period lesson.

What do you call animals that eat animals? What is carnivorous?

Classification Game, second part

One animal card is chosen, and all of its characteristics are considered. The animal picture is placed at the top. The child reads each question, finds the right answer, places the two side by side under the picture. The child goes on reading all of the questions and matching the right answers making a column.'

The child may write this down in his notebook or re-word it into a composition. Further research may be encouraged.

Age: 8

First Knowledge of the Plant Kingdom

Classification Game - Plant Kingdom

In what environment do they live?
in a fluid environment
in a rocky environment
in a moist environment
in a dry environment

What is the vital cycle of the plant?
It has to be planted each year (annual).
It grows back every year. (perennial).
It grows every two years. (biennial).

Does this plant grow naturally in our area?
It is natural to our area.
It is not a native plant.

How do humans use this plant?
as food for themselves
for construction and manufacture
as food for animals
for other uses
this plant is poisonous or harmful for humans

How does this plant get its nourishment?
It produces its own food.
It takes its nourishment from others.
It gets nourishment by other ways.

How does this plant reproduce?
by means of spores
by alternation of generation
by cell division
by means of seeds
by other means

First Classification of the Plant Kingdom

It is important - especially in the classification of plants - that you have as many representations of the plants as possible. The scientific names are given here, but it is not necessary to give them unless you know their etymology. The scientific names will be meaningless to the 6-9 child without that. Plants and their classification are not familiar to many American families. It is

important to make them interesting and play up the stories of the plants just as you do the animals.

Materials: Classification Charts with phyla, mute charts, loose pictures, labels, folders with classes.

Presentation: Tell stories from the Prentice-Hall Parade of Life Book about three phyla at a time, just as the animals. Show some of the examples of their classes with each. Have the children do some work or work with that part of the classification chart before they go on to the end. Give them time to get to know the definitions. Finish the work with them when you know they understand. They may work with the material in the sequence of pictures, labels, definitions matching with control - then pictures, labels, definitions with mute charts and folders.

The phyla of the plant kingdom are:

Bryophyta (Mosses, liverworts and hornworts)

Psilophyta (whisk ferns)

Lycopodophyta (club mosses)

Sphenophyta (horsetails)

Filicinophyta (ferns)

Cycadophyta (cycads)

Ginkgophyta (Ginkgo)

Coniferophyta (conifers)

Gnetophyta (Welwitschia,etc)

Angiospermophyta (flowering plants)

Vital Functions of Plants: Adapting Vital Functions for Ages 6-9

Traditionally, the Vital Functions have plants have been a complex series of exercises for the child the child of 9-12. The lessons are applicable for the child of 8 or 9, however, and it is important for the child of this age to be "captured" at the moment of concern for living organisms. These lessons are traditionally divided into four sections for the older children:

...Charts 1-10: Vegetative Functions
Experiments: 1 - 14

...Charts 11-14: Functions of Relationship
Experiments : 15 -18

...Charts 15-17: Preservation of the species , reproduction
Experiments 19 - 21

...Charts 18-19: Synthesis

These lessons can be made lighter and more applicable to the 6-9 year old child by dividing the lessons as the classified nomenclature into The Plant, The Root, The Stem, The Leaf, The Flowers and the Seeds. Experiments can be done that give the lessons for the needs of the plant, the functions of the root, the stem, the leaf, flowers and seed.

Adapting Vital Functions for ages 6-9

Materials:
Place the plant stories on the back of the charts. Cut up the experiment cards and have them in a place on the Botany Shelf or near the planting materials. Tell the stories of the charts in your own words. Make the experiments as interesting and exciting as possible. Use other experiments that explain the needs or functions of the parts of the plant.

Use charts and experiments in this order:

- **The Plant**:
  - Chart 1, Needs of a Plant
  - Experiment #1, respiration of plants
  - Chart 2, The Menu of the Plant
  - Chart 3: From Death to Life: The Nitrogen Cycle
- **The Root**:
  - Chart : Water Seekers
  - Experiment 2: Root Hairs
  - Experiment 3: Formation of Roots
  - Experiment 4: Acid Reaction of Root Hairs
  - Experiment 5: Direction of Roots
  - Chart 4: Boulder in the Way
  - Chart 5: Give Drink to the Thirsty
- **The Stem**:
  - Chart 7: The Piston and the Pump
  - Experiment 6: Ascent of Liquids
  - Experiment 7: Ascent of Liquids
  - Experiment 7a: Capillary action
  - Experiment 8: Transpiration
  - Chart 8: The plant's need for the sun: aspiration
  - Experiment 9: Water is Necessary to the Plant
- **Leaves**:
  - Experiment 10: Demonstration of Chlorophyll in Green Leaves
  - Experiment 11: Demonstration: plants need light
  - Chart 9: The Plant's Need for the Sun
  - Experiment 15: Action of lights on plants
  - Chart 10: The Chemical Laboratory
  - Experiment 12: Formation of Oxygen
  - Experiment 13: Making of Starch
  - Experiment 14: Starch is colored Blue
- **Relationships in the Plant's Environment**
  - Experiment 15: Action of lights on Plants
  - Exp. 16: Action of Heat on Plants
  - Exp. 17 : Roots grow downwards: the stem?
  - Exp. 18: Roots are sensitive to water.
- **Plant movement**:

    - Chart 11: Movement of Seeds: 5 ways to travel
    - Chart 12: How plants cling
    - Use nomenclature for aerial stems
    - Chart 13: Like the Stakes of a Tent
- **Defense of the Plants**:
    - Chart 14: The Defense of Plants
- **Reproduction of the Plant** (Study of the Flower , Seeds and Spores)
    - Experiment 19: Plants grown from roots, stems, leaves
    - Chart 15: Alternate Sexual Reproduction: the fern
    - Chart 16: Love Among Plants
    - nomenclature: the Flowers
    - Chart 17: "Go, My Child"
    - Nomenclature: Seeds
    - Experiment: The seed and its parts
    - Experiment 20: How plants grown from seeds develop and are nourished.
    - Experiment 21: Monocot- and Dicotyledon Plants
- **Cosmic Work of Plants**:
    - Chart 18: Like Hands that Hold
    - Chart 19: Fountain of Cups

The Plant:
THE STUDY OF THE PLANT

Observation of real plant
Nomenclature: The Plant

Chart 1-2

THE NEEDS OF THE PLANT
and The Menu of the Plant

This chart describes the basic needs that all plants have in order to actively participate in life. Plants absorb minerals that are dissolved in water through the roots in the ground. The roots take the minerals and water to all parts of the plant. The leaves of the plant absorb the Carbon Dioxide in the air for the process of photosynthesis, using the sun's energy. The leaves of the plant also breathe in the oxygen from the air.

Experiment 1

RESPIRATION OF PLANTS

MATERIALS: A large mouthed jar or container that closes well. Mustard or radish seeds, cotton batting, a glass, watering can, a long match, a small plate.

COMMAND: Put a number of seeds in a glass of water for 24 hours. Then place them on a little plate covered with cotton
batting. Put the whole thing in a jar which you have prepared by wetting well. Leave the jar open, keeping the seeds well watered until the plants have germinated but also developed well. Now seal the jar well and put it in a very dark place. After 24 hours, raise the lid just high enough to quickly introduce a lighted match.

What do you observe? Write your observations.

Chart 6

FROM THE DEAD TO THE LIVING, THE NITROGEN CYCLE

Nitrogen is essential to the life of a plant. Nitrogen gas, as it occurs in natural air, is not usable. The plant must first obtain nitrogen in a compound in order for it to obtain its full benefit. Lightning, decomposing matter, the roots of legumes, are three important factors in changing the nitrogen gas into a compound that will benefit the plant.

THE STUDY OF THE ROOT

Observation: Real plant roots
Nomenclature: The parts of the root

Chart 3

HOW ROOTS MOVE IN THE DIRECTION OF THE WATER

Since water is essential to the growth of the plant and its basic survival, roots will seek water out in the soil if it is not immediately.

Experiment 2

ROOT HAIRS

MATERIALS:
A small clay flower pot, some radish seeds, water a drinking glass, two small transparent bowls.

COMMAND: Put some radish seeds in a glass and fill it half way with water. Place the flower pot in one of the bowls which is then filled with water. Place the flower pot in one of these bowls which is then filled with water. After 24 hours, remove both the pot and the seeds from the water. Inver the flower pot and try to make the seeds adhere to the bottom of the pot. Then return the up-side-down pot to the bowl of water so that the seeds are out of the water. Use the other transparent bowl up-side-down as a cover. Keep the whole thing in the light.

Observe what happens every day and write down your observations.

Experiment 3

FORMATION OF ROOTS

MATERIALS: A jar with a rather narrow mouth, water, some twigs from a plant.

COMMAND: Fill the jar with water and immerse the twigs. Observe the plants each day adding water if necessary.

Write your observations.

Experiment 4

ACIDIC REACTION OF ROOT HAIRS

MATERIALS: A jar containing germinated radish seeds, blue litmus paper.

COMMAND: Put the litmus paper on the sucking hairs of the plant.

Observe what happens and write your observations.

Experiment 5

DIRECTION OF THE ROOTS

MATERIALS: A glass, ink-blotter paper, black construction paper, a rubber band, sand, bean seeds, water.

COMMAND: Cut the ink blotter paper to fit around the inside of the glass. Place the bean seeds between the blotter paper and the sides of the glass making sure they are positioned differently. Then fill the glass with sand and wet the sand. Cut the black construction paper large enough to wrap around the outside of the glass, holding it in place with a rubber band. The sand must be kept wet. Do the same using other seeds. Observe your glass every day.

Observe what happens and write your observations.

Chart 4

ROOTS OVERCOME ANY OBSTACLE

So strong is that need for the water and the minerals, the plant will not allow anything to be an obstacle. Roots will grow around large objects in order to obtain what it basically needs to survive.

Chart 5

GIVE DRINK TO THE THIRSTY

By observing the leaves of a plant above the ground, we can understand the root system. The width of the leaf system corresponds to the root expansion below the ground. If the plant is long and thin, so is its root system, and so forth.

THE STUDY OF THE STEM

Observation of real stems and their types
Nomenclature of the stem

Chart 7

THE PISTON PUMP

Water will naturally go from an area of greater water content, to an area of less water content. It will naturally equalize its own pressure.

Experiment 6

ASCENT OF LIQUIDS IN THE PLANT

MATERIALS: Flower with stem cut during the experiment, glass jar with a wide mouth, red dye or food coloring.

COMMAND: Fill the jar 3/4ths full of water and color it with a little dye. Then freshly cut the flower and stem from the plant, immediately placing it in the colored water. Then immediately cut the stem again while under the water.

Observe what happens and write your observations.

Experiment 7a

ASCENT OF LIQUIDS IN THE PLANT

MATERIALS: A well-developed corn plant or another plant still growing in the ground, a sharp knife.

COMMAND: Cut the stem of the plant.

Observe what happens and write your observations.

Experiment 7b

CAPILLARITY

MATERIALS: 3 glass tubes of different thicknesses, one of which is a capillary tube, a pitcher of water, red dye or food coloring, an eye dropper, a small glass container.

COMMAND: Fill the glass container with water, 3/4ths. full. With an eye dropper, put a drop of red dye in the water and then immerse the three tubes.

Observe what happens and write your observations.

Experiment 8

FORMATION OF WATER VAPOR

MATERIALS: A flower pot containing a plant with many green leaves, a large transparent plastic bag, a piece of ribbon, a watering can and water.

COMMAND: First water the plant in the flower pot. Then cover the green parts of the plant with a bag and tie the bag around the bottom of the stem. Tie it tightly so that on air can enter. Then place the plant in the light but not the sun. Observe the plant after 24 hours and thereafter. Keep the soil well watered.

Observe what happens and write your observations.

Chart 8

THE SUN'S DRINK

The liquids in a plant automatically proceed to the top of the plant. The full plant seeks out the light since the light is what enables the plant to produce nourishment.

Experiment 9

WATER IS NECESSARY TO THE PLANT

MATERIALS: 3 test tubes, water, oil, three small plants, test tube rack.

COMMAND: Put the water and one plant in one test tube. In another test tube put the oil and a plant. In the third test tube put only a plant.

Observe what happens and write your observations.

THE STUDY OF the LEAF

Observation of leaves
Nomenclature of the leaf

Experiment 10

DEMONSTRATION OF CHLOROPHYLL IN GREEN PLANTS

MATERIALS: A mortar and pestle, some green leaves (geranium is best), a glass, alcohol.

COMMAND: Remove some green leaves from the plant and grind them with a mortar and pestle. Place the resulting pulp in glass containing alcohol.

Observe what happens and write your observations.

Experiment 11

DEMONSTRATION THAT PLANTS NEED LIGHT

MATERIALS: 2 small clay flower pots, radish seeds, loose soil, water.

COMMAND: Place the radish seeds in water for 24 hours. Fill the two flower pots with soil. Place the seeds on top of the soil, or better, push them into the soil. Water them. When the plants have

germinated and have reached a certain height, leave one flower pot in the light and put the other in a dark closet. Keep the pots where they are and observe and record the behavior of each.

Observe what happens and write your observations.

Chart 9

THE SUN WORSHIPPERS

Plants are attracted to light because through this energy they are able to transform their substance into nourishment. Only with the light will chlorophyll work.

Experiment 15

ACTION OF LIGHT ON PLANTS

MATERIALS: A special box whose lid has a window that opens, radish or other seeds, or preferably, already sprouted shoots; potting soil, watering can and water.

COMMAND: In the bottom part of the box, plant the seeds or shoots in the soil. Keep them well watered. When the plants are several inches high, put the special lid on top of the box with the window closed. Open the window and see what happens.

Observe what happens and write your observations.

Chart 10

THE CHEMICAL LABORATORY

Tubes called xylem carry the water to the leaves on the plant. There, the chlorophyll is activated by the sun to work on the water and the carbon dioxide. A chemical change takes place and a simple sugar is formed. Oxygen is also formed and released into the environment. This is called photosynthesis.

Experiment 12

FORMATION OF OXYGEN

MATERIALS: Some aquatic plants, a large cylindrical glass container, a large funnel, a test tube full of water, water, a long match.

COMMAND: Fill the container almost full of water and immerse the plants in it. Then invert the funnel over the top of the plants and empty the test tube full of water over the inverted funnel. Expose the whole thing to strong sunlight. Then observe it after 2-3 hours and you will see that many tiny bubbles have developed. Now light a long match. When it is burning, blow it out. Take the test tube off quickly and put the glowing match in it.

Observe what happens and write your observations. What are the tiny bubbles formed of?

Experiment 13

MAKING OF STARCH

MATERIALS: A geranium plant in full bloom, two pieces of aluminum foil smaller than the leaves, two pins, ethyl alcohol, warm water, three glasses.

COMMAND: In the afternoon, cover both sides of a leaf with aluminum foil, holding it in place with a pin. The next day, expose the plant to strong sunlight, especially the covered leaf. That afternoon, after several hours of exposure, break off the foil covered leaf from the plant and then remove the foil. Immerse the leaf in alcohol and you will see that it becomes yellow. Now immerse in hot water and leave it there for a while.

Observe what happens and write your observations.

Experiment 14

STARCH IS COLORED BLUE

MATERIALS: A potato, some iodine, a knife.

COMMAND: Cut the potato and then drop a bit of iodine on the cut part.

Observe what happens and write your observations.

RELATIONSHIPS in the PLANT'S ENVIRONMENT

repeat Exp. 15: action of lights on plants

Experiment 16

ACTION OF HEAT ON PLANTS

MATERIALS: 2 small plates, cotton wadding, radish seeds, water, a glass.

COMMAND: Put quite a few radish seeds in a glass with water and leave it for 24 hours. Pour out the water and then take the two plates and cover them with the cotton. Scatter the soaked radish seeds on top of the cotton and water both plates well. Leave one plate in the classroom and put the other in a refrigerator. Keep both well watered. Observe them each day and write up your observations.

Experiment 17

ROOTS ALWAYS GROW DOWNWARDS, AND THE STEM?

MATERIALS: A glass, ink-blotter paper, black construction paper, a rubber band, sand, bean seeds, water.

COMMAND: Cut the ink blotter paper to fit around the inside of the glass. Place the bean seeds between the blotter paper and the sides of the glass making sure they are positioned differently. Then fill the glass with sand and wet sand. Cut the black construction paper large enough to wrap

around the outside of the glass, holding it in place with a rubber band. The sand must be kept wet. Do the same using other seeds. Observe your glass every day.

Observe what happens and write your observations.

Experiment 18

ROOTS ARE SENSITIVE TO WATER

MATERIALS: a clear container, wide and straight-sided, radish or bean seeds, soft soil, a watering can and water.

COMMAND: Fill the glass container with the loose soil. Plant the seeds in the soil close to the glass sides and water the soil well where the seeds were sown. After the roots have developed well in depth, begin to water increasingly farther away from the plants.

Observe the container every day and write your observations.

PLANT MOVEMENTS

Chart 11

HOW SEEDS TRAVEL

Seeds travel away from the mother plant in many ways. The wind often moves seeds great distances. Animal carriers also contribute to their relocation. Explosion is another way this mother plant releases the seeds or spores great distances. This enables plants to reproduce their species in other locations than the original environment.

Chart 12

HOW PLANTS ARE SUPPORTED

Some plants do not have a very strong stem, so they develop tendrils which support them by winding around sticks or poles, or the stems of other plants. Other plants which do not have strong stems crawl along the ground.

Chart 13

ROOTS: ANOTHER MEANS OF SUPPORT

This chart shows men holding the plant - anchoring it to the ground, so that when there is a strong wind, the plant is not pulled down.

DEFENSE of PLANTS

Chart 14

HOW PLANTS DEFEND THEMSELVES

Plants also develop special organs to defend themselves. They need to protect themselves from animals - dryness - cold. In order to defend themselves from animals, the leaves and the stem of

some plants are transformed into thorns. Then it is not possible for the animals to eat the plant. Plants which grow in very dry areas transform their leaves and stem into water containers, and they can live without rain for a very long time. For example, a cactus plant.
Plants defend themselves from the cold by developing very thin pointed leaves, like needles, covered with a thick film which protects them from the cold. Plants which are not able to develop leaves like needles lose their leaves during the winter and "hibernate."

REPRODUCTION of PLANTS

the study of flowers, seeds and fruit
Observation: real flowers, seeds, fruits
Nomenclature of Flower, seeds and fruit.

Experiment 19

PLANTS GROW FROM ROOTS, STEMS, AND LEAVES

MATERIAL: several low glass containers of different shapes, strawberry or violet runners , various kinds of tubers, carrot roots, bulbs, shoots of various plants.

COMMAND: Prepare the different containers by filling them with water first and then as much of the above described material as you have been able to obtain. Whether it is a bulb or shoot, make certain that only the lower part is immersed in the water of the glass container. You may also put this material in soil instead of water.

Observe what happens and write your observations every day.

Chart 15

ALTERNATION OF GENERATIONS

This chart pictures the underside of the fern leaf, and the sporangium which opens and releases spores. The spores fall to the ground and germinate. The heart-shaped leaf, the prothallium, forms. In this little leaf, the male and female organs are formed. The female organs each produce one egg. The male organs produce spermatozoa. The spermatozoa join with the egg to form a new little plant.

Chart 16

LOVE IN PLANTS

Flowers are dressed in beautiful colors and give off a sweet perfume, which attract insects. This perfume draws the insect inside the flower where it sucks the sweet nectar. Pollen adheres to the insect's hair is carried by the insect to another flower. When the pollen is deposited on the flower, it develops a tail which grows down and fertilizes the egg. The egg is then transformed into a seed.

Chart 17

GO MY CHILD

This chart depicts a mother plant saying farewell to her child, a seed. The mother has provided the child with food to sustain his life until he is able to make his own. Sometimes the seed is covered with a fruit, which is a protection to the little seed, as well as a means to transport it far from the mother plant. The fruit represents the ovary enlarged. It is not useful to germination of a seed. Its purpose is to attract animals who will take the fruit as food, and the seeds will be carried far from the mother plant.
Experiment: The seed and its parts:

Take a bean seed, soak it over night or let it sprout.
Using the nomenclature for the seed , take it apart and look at the seed and its parts.

Experiment 20

HOW PLANTS GROWN FROM SEEDS DEVELOP AND ARE NOURISHED

MATERIAL: several small plates, various kinds of seeds, cotton wadding, several glasses and water.

COMMAND: Select different kinds of seeds and put them in water in the different glasses for 24 hours. Cove the plates with the cotton and then sprinkle the soaked seeds on the different plates. Keep all the plates well watered. Make a note of when they germinate and of how much they have gown each day.

At a certain point, what happens? Why? Write you deductions.

Experiment 21

MONOCOTYLEDON AND DICOTYLEDON PLANTS

MATERIALS: a terrarium with soil, different seeds: bean, wheat, corn; a watering can with sprinkler and water, several glasses.

COMMAND: Soak each variety of seed in a separate glass of water for 24 hours. Then remove them and sow in straight rows in the terrarium., identifying the different seeds by takes with labels. Water them immediately and always keep them moist, remembering that if seeds aren't kept moist they will die and not germinate.

Observe what happens and make regular notations. The important thing for this experiment is to observe how the plant is formed when it sprouts.

THE COSMIC WORK of PLANTS

Chart 18

ROOTS HOLD THE SOIL

Roots holding the soil is the cosmic work of the roots. Roots are like dikes which hold the earth. The roots form terraces on the hillsides, preventing the erosion of soil. The same work that the roots do is done by farmers when they grow crops on the hillsides, by a method called terracing.

Chart 19

The Fountain of Terraces or Cups

The brown represents the soil and the blue, water. Some water is retained by the roots of a plant, and water filters through, slowed by the network of roots and soil, gradually working its way to streams and rivers. This principle of slowing the descent of water on the mountainside has been used in terraced gardens which work like this fountain of cups.

Description of the Charts

Chart 1-2

THE NEEDS OF THE PLANT
and The Menu of the Plant

This chart describes the basic needs that all plants have in order to actively participate in life. Plants absorb minerals that are dissolved in water through the roots in the ground. The roots take the minerals and water to all parts of the plant. The leaves of the plant absorb the Carbon Dioxide in the air for the process of photosynthesis, using the sun's energy. The leaves of the plant also breathe in the oxygen from the air.

Chart 3

HOW ROOTS MOVE IN THE DIRECTION OF THE WATER

Since water is essential to the growth of the plant and its basic survival, roots will seek water out in the soil if it is not immediately.

Chart 4

ROOTS OVERCOME ANY OBSTACLE

So strong is that need for the water and the minerals, the plant will not allow anything to be an obstacle. Roots will grow around large objects in order to obtain what it basically needs to survive.

Chart 5

GIVE DRINK TO THE THIRSTY

By observing the leaves of a plant above the ground, we can understand the root system. The width of the leaf system corresponds to the root expansion below the ground. If the plant is long and thin, so is its root system, and so forth.

Chart 6

FROM THE DEAD TO THE LIVING, THE NITROGEN CYCLE

Nitrogen is essential to the life of a plant. Nitrogen gas, as it occurs in natural air, is not usable. The plant must first obtain nitrogen in a compound in order for it to obtain its full benefit. Lightning, decomposing matter, the roots of legumes, are three important factors in changing the nitrogen gas into a compound that will benefit the plant.

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Water will naturally go from an area of greater water content, to an area of less water content. It will naturally equalize its own pressure.

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The liquids in a plant automatically proceed to the top of the plant. The full plant seeks out the light since the light is what enables the plant to produce nourishment.

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