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Plant Morphology: An activity program for use in therapeutic recreation, horticultural therapy, adult education, and youth activities

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This program provides:

- Explanations of plant structure that will enhance enjoyment of indoor and outdoor gardening, flower arranging, nature walks, and plant identification
- Recreational activities centered around botany
- Resource information and practice exercises about making drawings of plants that are botanically accurate (useful for a garden or nature journal)
- Suggestions of video programs about botany, related to the lessons

The program is designed for group activities with an instructor, who can be a staff person or volunteer as appropriate. The botany lesson and the drawing lesson can have different instructors. This activity workbook can also be used for independent study or intergenerational activities. A senior citizen and a young person can do the workbook together side-by-side, or remotely in a pen-pal relationship. There will be free supplemental resources online.

Booklet One. *Exploring the growth and form of plants: a six-week syllabus for beginner botanists of all ages*

Foreword by Margaret (Meg) Lowman, PhD, California Academy of Sciences

Each Topic of Booklet One is divided into:

A botany lesson. The botany lessons include “the Socratic method” — participants have plant material in front of them and compile a list of salient and differentiating features (as a group).

An experiment. A simple activity to illustrate the botany lesson.

A botanical drawing lesson. Instructions and examples will be provided by the instructor (see list of art supplies). The participants will learn by doing — each one will have a spiral-bound sketchbook and tracing paper. The program provides specific references for each lesson (four options of published material, with page numbers of specific lessons). For books on botanical art with pen-and-ink, graphite pencils, colored pencils, watercolors, gouache, and other media, see the list of Recommended Reading: Botanical Art How-To Books.

A video. This segment has suggestions for video programs, including some of the excellent David Attenborough productions such as *The Private Life of Plants* and *Kingdom of Plants 3D*. The instructor can select other video material as appropriate. The workbook includes tips about how to borrow the suggested videos.

Topic One: **From the First Plants to the Age of Dinosaurs.** This week's lesson covers algae, ocean plants, diatoms, fungi, lichens, mosses & liverworts, ferns, lycopodiums, cycads, equisetums, and ginkgos (including the first land plants and the first vascular plants).

Topic Two: **Gymnosperms and Angiosperms.** This section discusses the beginning of flowering plants and the interaction between flowers and pollinators such as insects and other animals. It also describes the co-evolution of seeds and fruits that attract animals in order to spread the seeds. Another topic is the defense systems that plants use against insects and other animals that eat plants. This chapter includes some brief notes about biogeography, paleobotany, and palynology.

Experiment #2: a dried flower or dried weed arrangement.

Topic Three: **Monocots and Dicots.** This lesson covers the two main types of flowering plants (monocotyledons and dicotyledons). The former are grasses (including maize, sugarcane, and small grains), sedges (including papyrus), rushes, palm trees, banana trees, onions, garlic, leeks, chives, asparagus, ginger, lilies, daylilies, hostas, irises, flowering bulbs, orchids, bromeliads, and many indoor plants. The dicotyledons include most of the flowering plants we see every day. The plant with the greatest structural strength is not the mighty oak or a titan of the rainforest, but bamboo, which is a group of grass species (monocots).

Experiment #3: propagation of cuttings of mint (dicot) and 1) growing papyrus (monocot), 2) forcing paperwhite narcissus (monocot), 3) growing a pot of chives (monocot), or 4) sprouting a ginger root (monocot).

Topic Four: **Root, Stem, and Meristem.** Subjects covered include the germination, growth, and development of vascular plants. There are three areas of growth (three meristems in gymnosperm and dicot plants: shoot tip, root tip, and cambium around the

circumference of the stem). The instructor can provide tree and shrub twigs cut in half, showing the pith — hollow, solid, diaphragmed, or chambered. Samples should be color-coded by species, with the names of the species revealed at the end of the lesson. This topic also includes revelations about prehistoric Ireland from the discipline of dendrochronology, a fascinating application of plant morphology.

Experiment #4: sprouting beans and other seeds.

Case Study #1: The swing on the tree. There is a famous magazine cartoon that shows a child's swing hanging from a branch of a tree – the swing has been neglected for a number of years and the cartoon shows the seat of the swing hanging six feet above the ground. That is not how a tree grows. A tree adds growth to the top like adding bricks to the top of a wall. If a branch is ten feet from the ground now, it will still be ten feet from the ground ten years from now, although it will be thicker, longer, and may hang down a bit lower.

Topic Five: **Complex Structures**. This lesson discusses leaves and bracts, rhizomes and stolons, roots and tubers, leaf buds and branch buds. A tremendous variety of forms have evolved in the Plant Kingdom. Each participant can select a different type of specialized plant structure to study or draw (the instructor will provide living examples or cuttings).

Experiment #5: a small bonsai project with scented pelargoniums.

Topic Six: **Flowers and Fruits**. This week's lesson covers buds, petals, sepals, stamens, pistils, seeds, embryos, and cotyledons. Pollination and seed development are key factors in the evolution of flowering plants. Plant genetics and breeding are also covered. Look up these plant breeders and plant hunters in Wikipedia: Gregor Mendel, Nikolai Vavilov, Frank Meyer, Erna Bennett, Bent Skovmand, and Mark Shepard.

Experiment #6: plants of the genus *Hoya* (propagation from cuttings).

Case Study #2: Botanical detail in the work of Albrecht Dürer — *The Large Piece of Turf* (1503) and *Columbina* (c. 1505 – a columbine plant, *Aquilegia vulgaris*)

Booklet Two. Four botanical activities

Activity One: **Jack and the Beanstalk**. From your local public library, the instructor will check out as many different versions as possible of *Jack and the Beanstalk* so you can review the illustrations of the magic bean plant. What do you think of the “botanical accuracy” of the drawings?

Drawing lesson: This folk tale is from England, and the agricultural beans of the Old World are fava beans (also called broad beans, scientific name *Vicia faba*). Draw a

fava bean plant as accurately as possible, and then re-draw it as a huge magic plant. Can the magic plant retain some botanical detail? What are the logical consequences of rapid growth? Enjoy!

Activity Two: **The Shape and Structure of Large Plants.**

Example #1: Sugar maple tree in winter

Example #2: Sugar maple tree in summer

Example #3: A tuliptree with “elbows” (in winter)

Example #4: An indoor palm tree

Example #5: An outdoor palm tree

Drawing lesson: Free-hand drawing exercises. This is the fun part of putting your botanical knowledge to use. As you take pen or pencil in hand, think about how the tree actually grows. If you have taken drawing lessons before, then use what you know about perspective, tone (shading), light source (shadows), and things like that.

Case Study #3: Examples of how impressionist and post-impressionist painters captured the effect of sunlight coming through the leaves of a tree.

1. Claude Monet *Bazille and Camille* 1865
2. Claude Monet *The Picnic* 1866
3. Pierre-Auguste Renoir *Picking Flowers* 1875
4. Pierre-Auguste Renoir *On the Terrace* 1881
5. Claude Monet *Bordighera* 1884
6. Georges Seurat *A Sunday Afternoon on the Island of La Grande Jatte* 1884-1886
7. Claude Monet *The Japanese Footbridge and the Water Lily Pond, Giverny* 1899
8. William Chadwick *Country Road in Summer* 1918

The William Chadwick painting is a dining room panel in the Florence Griswold house (now a museum) in Old Lyme, Connecticut.

Activity Three: **Plant Identification.** Plant identification is a course in itself, but what you have learned in this class can help you get started. It is possible to teach yourself plant identification with a hand lens and some botanical keys or polyclaves (either printed or online). Participants will have a chance to practice using several different kinds of keys and samples of plant material.

Activity Four: **The Wide World.** The learners using this program may have an interest in the world as a whole. Botany, horticulture, and agriculture can be a window into interacting with issues, projects, and charities that play a significant role in our world. One of the authors worked as a volunteer in the Geriatric Extended Care Unit of the VA Medical Center in West Haven, CT, where we established a successful pen-pal relationship with an agricultural missionary in Peru.