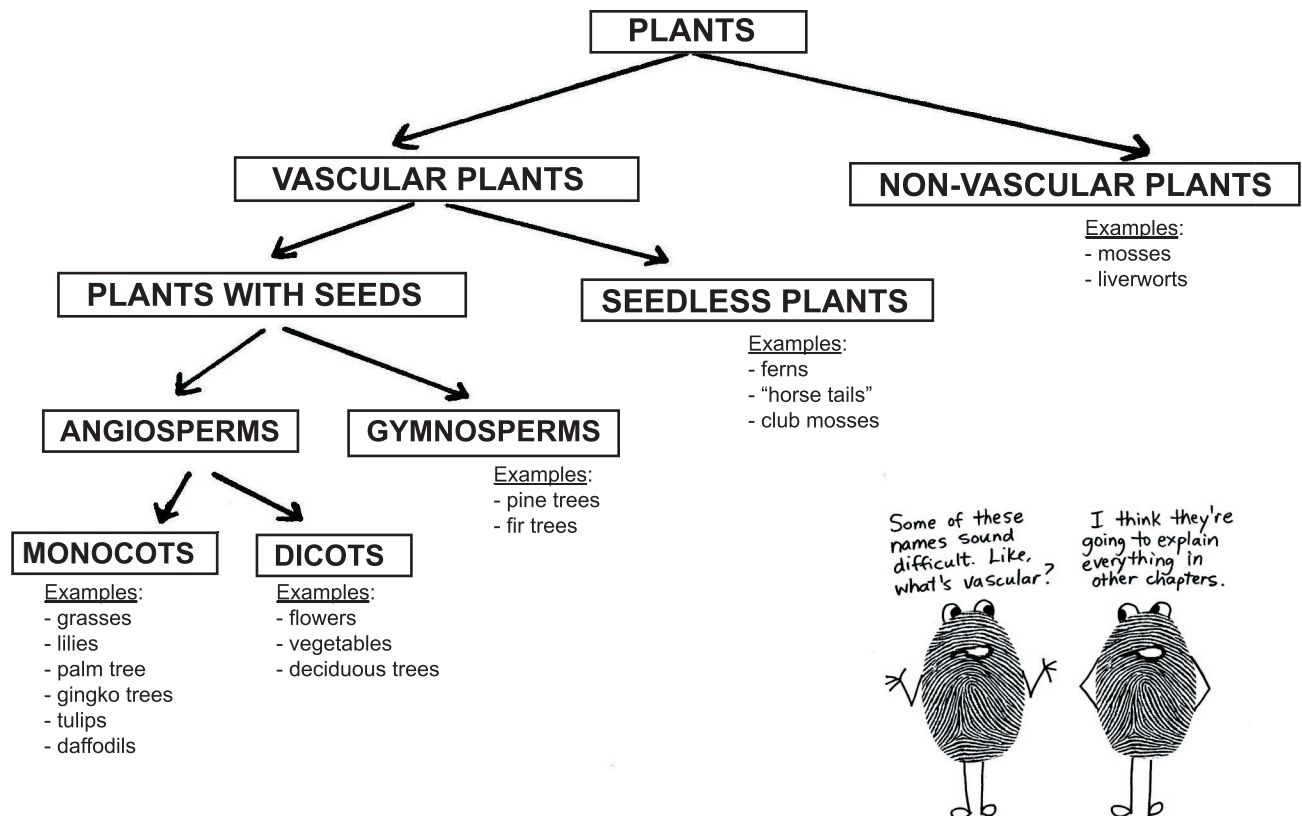


LESSON 2: PLANT CLASSIFICATION

LEVEL ONE

So now you have it firmly in your mind that a plant is an organism that uses the process of photosynthesis. There's one more thing you have to have in order to qualify as a plant. You have to have more than one cell. That may sound obvious, but did you know that there are lots of one-celled organisms that use photosynthesis? For example, some kinds of bacteria use photosynthesis. There are also some types of one-celled protozoa that use photosynthesis, such as the euglena and the volvox. So to be a plant, you can't be a bacteria or a protozoa. You must be made of many cells.

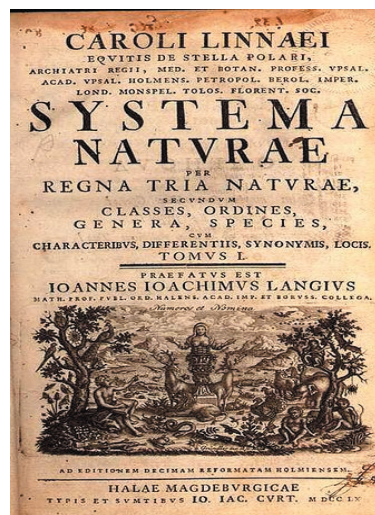
The plant "kingdom" is huge. There are millions of different types of plants. Scientists who study plants (**botanists**) like to sort them into categories (classify them). Without a way to put plants into categories, botanists would feel like their field of science was incredibly disorganized. They'd feel the way you'd feel if you woke up one morning to discover that someone had gathered up all the items in your house, then randomly distributed them into storage areas. If you opened a dresser drawer you'd find a random assortment of objects-- a flashlight, a spoon, a marble, a couple of toys, a pencil, a book, a battery, a plate, a toothbrush and maybe a sock. Open a closet and you'd find a tennis racket, a stack of books, a pair of jeans, a radio, a flower pot, a guitar, a toy car, a stuffed animal... you get the idea. Now if you wanted to get dressed and needed a shirt and a pair of pants, where would you look for them? How long would it take to find a particular toy or book? Way too long! That's why we organize our houses, putting all the similar objects together. If you want a frying pan, you know to go to the kitchen. If you want to play tennis, you know your racket will be in the garage with the sports gear. Botanists feel the same way about organizing plants into categories. (Okay, so they're science geeks.) Here is the way botanists organize the plant kingdom.



You can look back at this chart whenever you get confused by terms like "vascular" or "gymnosperm."

One of the first scientists to tackle the problem of classification was a man named Carl Linnaeus. Carl grew up in Sweden in the early 1700s and had loved plants since he was a small child. When he was learning to talk he wanted to know all the names of the plants in his father's garden. Carl's father loved plants, too. In fact, he changed the family's last name from Ingermarrson, which means "farmer's son," to Linnaeus, in honor of a large linden tree which grew near their house. When Carl was seventeen, he left home to begin his university studies. Back in those days, university students often had people called "patrons" who gave them money while they were in school. Carl was very good at getting patrons who were interested in supporting his studies. Unfortunately, however, as soon as he found a better patron, he dropped the previous one. He made many friends and many enemies this way. Both the friends and the enemies will come back into the story later on.

Even with patrons, Carl never had a lot of money and was always worrying about how to make ends meet. His fretting about money came out in a humorous way one day when he said this: "My hair stands on end and lice bite at its roots when I look at the prices in this catalog!"

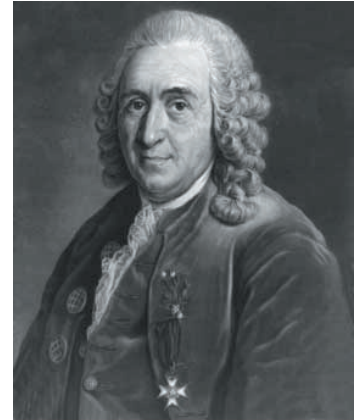


The title page from a 1760 edition of Carl's book *Systema Naturae*.

conditions, and bugs. So Carl just imagined what it would have been like to go there and wrote about it in his journal, faking the details!

At some point in his studies, Carl realized that botanists needed a system of naming plants, a system that would be recognized all over the world. Carl noticed that some plants had very simple, common names like "white oak," and other plants were known by complicated Latin names such as (just try to say this in one breath) *physakis amno ramosissime ramis angulosis glabris foliis dentoserratis*. Carl suggested that each plant should have a two-word Latin name, just like people have first and last names. Latin was best for this because it was already used by scientists all over the world, and because it was a "dead" language (no one actually spoke it as their real language) so it wouldn't change over time. This method of naming plants (and animals) would be called **binomial nomenclature**, which is a fancy way of saying "the two-name naming system" (bi=two, nom=name, nomen=name, clature=call).

Carl would think up a name for a group of plants (what we now call the **genus**), then make up a name for each specific member of that group (what we now call **species**). For example, the group of trees we know as oaks have the genus name *Quercus* (kwer-kus). The white oak is *Quercus alba*, the gray oak is *Quercus grisea*, and the leather oak is *Quercus durata*. The group of plants we call



Carl was a very good scientist, though. He made many discoveries about the life cycles of plants, especially the importance of flowers. Until then, no one knew that flowers have male and female parts. Even before he had graduated from the university, he was being asked by the professors to give lectures on plants.

Before he was 30 years old he had published several books on plants.

Botanists and naturalists of Carl's day were expected to go on long journeys to collect specimens for their studies. Carl went to Lapland (Finland) and hated every bit of the trip. He complained about bad weather, bad food, bad travel conditions and (worst of all)... bugs! He hated bugs. During this trip someone told Carl about a very interesting place in Lapland that he really should see. Carl agreed it would be a fantastic addition to his itinerary (list of places he went). The only problem was that this area was 300 miles inland, which meant several more weeks of bad weather, bad food, bad travel



the honeysuckles are the *Lonicera*. The yellow honeysuckle is the *Lonicera implexa* and the sweet honeysuckle is the *Lonicera japonica*. (Notice that the names are written in italics and only the genus is capitalized.)

Now those friends and enemies come back into the story. Carl had to come up with a lot of new plant names, and often he would use the names of people he knew. Someone once said that you could make a list of Carl's friends and enemies by looking at a list of plants he had named. Plants that were attractive or useful bore the names of people Carl admired. Plants that were prickly or ugly were used as a way to get just a tiny bit of revenge on folks he hadn't gotten along with. For instance, Carl named a species of unpleasant weeds *Siegesbeckia*, after Johann Siegesbeck, the director of a Russian botanical garden who had given Carl a hard time about his books; he thought Carl had talked too much about the "love life" of flowers. The "black-eyed Susan" (a flower) was named after a real person named Susan-- a woman Carl admired. The sheep laurel, with its beautiful bunches of red or purple flowers, was named *Kalmia augustifolia*, after Peter Kalm, one of Carl's botanical students. The *Lonicera* (honeysuckle) was named after Adam Lonicer, a German doctor of the 1500s who studied plants and used herbal medicines.

Eventually, Carl's naming system was adopted by all scientists everywhere in the world. It became more and more complex as more people started adding their ideas to it. Today, there are seven levels in the naming system: kingdom, phylum, class, order, family, genus, species. The full classification of the white oak would be: *Plantae, Magnoliophyta, Magnoliopsida, Fagales, Fagaceae, Quercus alba*. You can find the complete classification of any plant or animal by consulting the Wikipedia article on it (on the Internet).

ACTIVITY 1: LEARN THE CLASSIFICATION SONG

Use the audio track on the CD to learn the seven classification categories. Here are the lyrics:

Kingdom, phylum, (clap, clap), class, order, (clap, clap), family, (clap, clap), genus, species, (clap, clap).
Kingdom, phylum, (clap, clap), class, order, (clap, clap), family, (clap, clap), genus, species, (clap, clap).
Kingdom, phylum, class, order, family, genus, species!
Kingdom, phylum, class, order, family, genus, species!
REPEAT

ACTIVITY 2: PLANTS WITH PLACE NAMES

Some plants are named after places where they grow, or the place where they were first discovered. See if you can identify the place name in each of these plant names.

- 1) The plum tree called *Eriobotrya japonica*: _____
- 2) A flower called *Callistephus chinensis*: _____
- 3) A flower called *Arum italicum*: _____
- 4) A wildflower called *Tradescantia virginiana*: _____
- 5) A desert plant called *Anemopsis californica*: _____
- 6) A tree called *Azadirachta indica*: _____
- 7) A decorative flowering plant called *Dianella tasmanica*: _____
- 8) A desert plant called *Geohintonia mexicana*: _____
- 9) A grass called *Raddia brasiliensis*: _____
- 10) A gray-colored mossy-looking plant called *Raoulia australis*: _____

ACTIVITY 3: PLANTS NAMED AFTER PEOPLE

Some plants were named after people-- either the scientist who discovered the plant, or a friend or family member of the scientist. See if you can guess the last name of the person who these oak trees were named after. (We'll only do a few of these because they're pretty much no-brainers!)

- 1) *Quercus muehlenbergii* _____
- 2) *Quercus engelmannii* _____
- 3) *Quercus michauxii* _____
- 4) *Quercus kelloggii* _____



ACTIVITY 4: USE YOUR "WORD DETECTIVE" SKILLS

See if you can match the scientific names with the common names. All you need to do is use "word detective" skills. Think of words you know that look or sound like the scientific names. Use the process of elimination by starting with the matches that are easier to figure out.

- | | |
|---------------------------------------|-------------------|
| 1) <i>Daucus carota</i> _____ | A) Oriental poppy |
| 2) <i>Solanum tuberosum</i> _____ | B) Cembrian pine |
| 3) <i>Pinus cembra</i> _____ | C) Carrot |
| 4) <i>Acer saccharum</i> _____ | D) Empress tree |
| 5) <i>Juglans nigra</i> _____ | E) Primrose |
| 6) <i>Citrus sinensis</i> _____ | F) Orange |
| 7) <i>Sophara japonica</i> _____ | G) Potato |
| 8) <i>Primula vulgaris</i> _____ | H) Sugar maple |
| 9) <i>Papaver orientale</i> _____ | I) Black walnut |
| 10) <i>Paulownia imperialis</i> _____ | J) Pagoda tree |

ACTIVITY 5: HAVE SOME FUN WITH SCIENTIFIC LATIN

What? Fun with Latin?! Sure, why not?

Use some made-up Latin words to classify yourself, using this guide:

Kingdom: country	Family: neighborhood or street
Phylum: state	Genus: last name
Class: county	Species: first name
Order: city/town	

Use some classic Latin endings such as *-us -um -ae -ica -ii -ius*

Example: *Americanus Pennsylvanicus Alleghenus Pittsburghae Avalonica Smithus Jamesii*
(We know him as Jim Smith from Pittsburgh, PA.)

Your (silly) Latin scientific name: _____

Now make up one for someone else: _____



LEVEL TWO

Not everyone immediately adopted Linnaeus' new naming system. Some botanists resisted change, even if it was for the better. That's just how some people are. A botanist named Johann Dillenius accused Linnaeus of "throwing all botany into confusion." However, when Dillenius went to see Linnaeus and let Linnaeus explain the advantages of this new system, Dillenius realized how ingenious this system was. In fact, he got so emotional over it that he almost cried (or so the story goes). One by one, botanists came to see how superior this new system was and eventually they all began using it.



The work of Carl Linnaeus was only the beginning. Since Carl's time, many organized minds have added to the classification system. As far as we know, all known plants and animals on Earth have been named and classified. (However, there are some disagreements among scientists about certain species or sub-species because they don't fit perfectly into this system.) As soon as any new plant or animal is discovered, it is compared to all similar organisms so it can be put into a kingdom, phylum, class, order, family and genus. Then the discoverer gets to choose a species name for it. All these words must be in Latin-- and even have the correct case endings, such as "ius," "ium," "ae," or "ii." (The ending "ii" means "of." So *jamesii* would mean "of James.")

Kingdom is the most general category. There are basically five kingdoms: plants, animals, fungi, monerans (bacteria), and protists (single-celled protozoa). Sometimes scientists like to get all fancy with the names of the kingdoms and use Latin endings, making the animal kingdom *Animalia* and the plant kingdom *Plantae*. Within each kingdom are large groups called **phyla** (one phylum, two phyla). Now just to make everyone's life difficult, botanists decided that they'd rather called the phyla **divisions**. So don't be confused when you see the word "division." Just think "phyla." (That way the classification song will still make sense for the plant kingdom.)

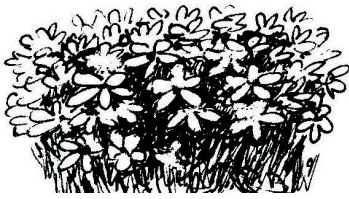
The major plant divisions include **bryophytes** (mosses and some algae), **pteridophytes** (ferns) (and that initial "p" is silent!), **coniferophytes** (conifers), and **anthophytes** (flowering plants). Now, you may want to know why we showed you that chart on page 15 if it doesn't match up with these divisions. Well... that chart is still valid because science books still use those categories when talking about the plant kingdom. The world of science terminology is sometimes confusing because it has evolved over hundreds of years. (And to make things worse, scientists sometimes disagree about terminology or categories.) So the chart on page 15 is still very helpful, even though it doesn't give Latin names of divisions. It gives you a good overall sense of how botanists think of the plant kingdom.

The classes, orders, and families of plants are the least well-known terms among non-botanists. (You can always look them up on the Internet.) You can probably guess that certain types of plants are grouped together, such as grasses, cacti, squashes, or garden flowers. Hobby gardeners probably know more genus and species names (such as *Quercus alba* for the white oak) than they do classes, orders or families.

Every scientific name, no matter how boring-sounding, has a story behind how it got its name. Some of these stories are short and not too interesting. Others have quite a bit of history behind them. Here are some of the more interesting stories:



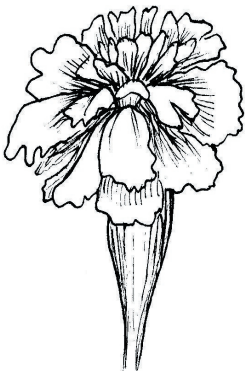
The weeping willow is *Salix babylonica*. All willows are *Salix*, but the weeping willow is *babylonica* as a reference to Psalm 137 in the Bible, where it says, "By the waters of Babylon we sat down and wept. We hung our harps on the willow trees there." The Israelites were taken captive by the Babylonians in 582 B.C. and forced to live out the rest of their lives in Babylon, far from their homeland.



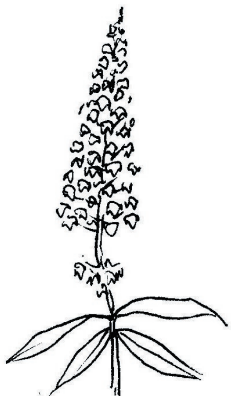
The *Phlox drummondii* was named after Thomas Drummond, a Scottish botanist who came to America in 1831 to study and collect plants. Poor Thomas had a really bad time in America. He tried to survive a northwest winter alone in the wilderness and almost didn't make it. He was attacked by grizzly bears and then almost starved to death, spending weeks chewing on nothing but an old deerskin. Later, he survived a cholera epidemic, lost the use of his arms for two months, and had boils (sores) all over his body that were so severe he couldn't lie down. He went south to Texas and almost starved to death again while stranded on Galveston Island. He finally died during a voyage to Cuba. Whenever he found a new plant, he would send specimens back home to botanists he knew in Britain. The last plant Thomas sent over before he died was a species of white phlox, and his friends decided it should be named in his honor. (The word "phlox" is Greek for "flame," named for its fiery red color.)



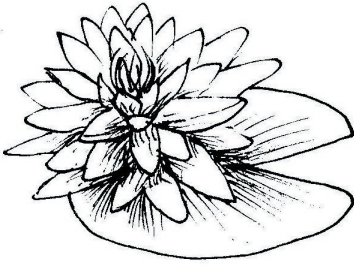
The nasturtium (*na-stur-shum*) comes from the Latin word "nasus" meaning "nose," and "tortus" meaning "twisted." When you smell a nasturtium you wrinkle (twist) your nose because of the strong smell. The scientific name for nasturtium is *Tropaeolum*, from the Greek word "tropeion" meaning "trophy." The leaves of the nasturtium reminded Linnaeus of Greek shields. In ancient Greece, the soldiers would hang the shields and helmets of the defeated enemies on tree trunks. When Linnaeus saw a nasturtium vine growing up the side of a tree, the leaves and flowers reminded him of ancient Greece shields and helmets hung on trees.



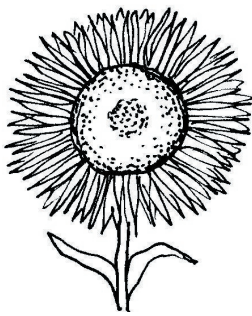
The marigold comes from the phrase "Mary's gold" and was the official flower of the Virgin Mary in medieval times. Church altars were decorated with marigolds almost year-round. Now for the ironic twist-- we go from the heavenly to the earthly. The scientific name for the marigold is *Tagetes patula*, and Linnaeus is to blame for this one. Tages was the grandson of the Roman god, Jupiter. Tages was a god of the underworld who came up out of the dirt in a field one day and taught humans the fine art of fortune-telling by examining the intestines of animals. No kidding: The Romans and Greeks would kill an animal and look at its guts before making major decisions. Was this Linnaeus' idea of a joke? Or maybe he thought marigolds smelled as bad as animal intestines? No one knows. (*Patula* just means "spreading." Marigolds do spread out quickly and grow to be quite large.)



The scientific name for the butterfly bush is *Buddleia davidii*, named after Rev. Adam Buddle of Essex, England, and Père (Father) Armand David, a French Jesuit missionary to China. Rev. Buddle was just a nice amateur botanist whom Linnaeus apparently liked (and who was an expert on mosses, not bushes), but Père David was another one of those crazy, adventuresome botanists who braved countless hardships in order to collect plants. David recorded in his diary that "although it was inconvenient," he was so afraid of the local wolves that he kept his donkey with him in his tent at night. He also said it took great courage to eat the local food. David was lucky, however, and lived long enough to return to France. Some of his Jesuit friends were not so lucky-- they were tortured and killed by the natives. Père David managed to send thousands of Chinese plants back to Europe, many of which are common sights now in both Europe and North America.



The spectacular water lily is *Victoria amazonica*, although the name has been changed several times. When it was first brought to England from the Amazon, a flower was presented to Queen Victoria and she was told the flower would be named *Victoria regina* ("Victoria the queen") in her honor. But, oops-- a bit later they found out that someone had already discovered it and named it ten years earlier. Now what do you tell the queen? Then they did even more research and discovered that the two plants were not identical, so they could still keep the name of the queen, but by then they thought they really should make some reference to the place the flower came from-- the Amazon. However, at that time anything associated with the Amazon was considered to be uncivilized, so putting the queen's name next to the word "amazon" would be unseemly. So the solution they came up with was to go ahead and change the name of the plant to *Victoria amazonica* but just keep the true name a secret until after the queen died.



The sunflower's botanical name is *Helianthus*, from the Greek words "helios," meaning "sun," and "anthos" meaning "flower." There's a reason for this name: these flowers turn so that they are always facing the sun! The Greek myth associated with this plant is that of Clytie, the mortal who was in love with the Titan god Helios, who had been raised to the sky and turned into the sun. Helios never even noticed poor Clytie. (But don't feel too bad for her-- when she found out Helios loved her sister, she buried her sister alive!) The sunflower is native to America, not Europe, so the ancient Greeks never saw this plant. How this myth became attached to this flower is a mystery!

ACTIVITY 1: MATCH THE PLANT NAME WITH ITS ORIGIN

1) Clematis ____

2) Impatiens ____

3) Chrysanthemum ____

4) Foxglove ____

5) Geranium ____

6) Daisy ____

7) Candytuft ____

8) Gladiolus ____

9) Columbine ____

10) Forsythia ____

A) The seeds of this plant pop out as if they are in a hurry.

B) The leaves of this plant look like a Roman gladiator's sword.

C) The name of this flower comes from the Greek word "geranos," meaning "crane" (the bird) because its seed pod looks like the beak of a crane.

D) This plant produces long, thin flowers that resemble fingers.

E) Named after William Forsyth, a rascal of a botanist who sold the British government a secret plant medicine which turned out to be nothing but cow dung, lime, sand, soapsuds and urine.

F) Centuries ago, this plant was said to be the "day's eye" because its flowers opened in the morning and closed at night.

G) If held upside down, this flower looks a bit like a ring of doves. The Latin word for dove is "columba."

H) This name is from the Greek word "klema" meaning "twig."

I) This name comes from two Greek words: "chrysos" meaning "gold," and "anthos" meaning "flower."

J) This name comes from the place of the plant's origin: Candia (the island of Crete)

ACTIVITY 2: WATCH A VERY NICE BUT VERY SHORT BIOGRAPHY OF LINNAEUS

Here's a nice little (professionally made) 4-minute summary of the life and work of Linnaeus.

http://www.youtube.com/watch?v=Gb_IO-SzLgk&feature=related

ACTIVITY 3: WATCH SOME SILLY VIDEOS (CAN YOU DO BETTER?)

Check out these silly videos made by kids learning about the classification system.

These are all videos of school classes:

<http://www.youtube.com/watch?v=xU5O5dH8VD8&feature=related>

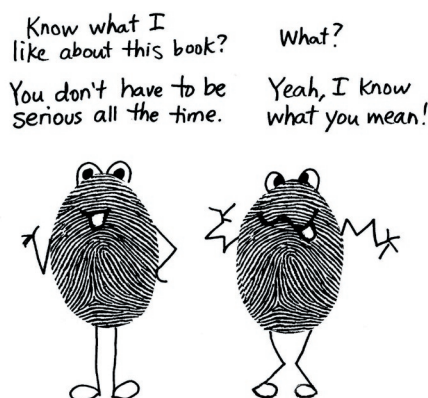
http://www.youtube.com/watch?v=_i4rLM_GLFU&feature=related

<http://www.youtube.com/watch?v=GF-HrAVCggk&feature=related>

This person tried to be more professional but ended up making something way too repetitive.
(Bet you can't watch it all the way to the end!)

<http://www.youtube.com/watch?v=wic5unxEhDA&feature=related>

Can you do better? If you have a digital camera and have access to a program like Windows Movie Maker, why don't you use the sound track on the CD and make your own classification video? Post it on YouTube, then send the link to the email address listed in the teacher's section of this book (ask your parent/teacher for it). Maybe in the next edition of this book, your video will appear in the list of links above!



LESSON 2

1) *Learn how to pronounce scientific Latin*

To learn more about how to pronounce Latin plant names, check out this site by the Florida Department of Agriculture: <http://botanicallatin.org/latinhandout.doc>

2) *Want to hear more stories about how flowers got their names?*

To learn more about the names of flowers, check out this book: 100 Flowers and How They Got Their Names by Diana Wells. (You can find inexpensive used copies on Amazon.com.) There's only about a page per flower-- just enough info to keep you interested but not enough to bog you down. This book isn't intended for a juvenile audience, but literary-type kids might think it's interesting. Read just a couple of flowers per day-- maybe even as a short bedtime story!

3) *Where to send the link if you made a silly Classification Song video (mentioned in activity 3 of level 2)*

Send the link for your video to: ellenmchenry@hotmail.com