

Panel 1: EARLY BOTANICAL BOOKS (1450-1600)

Key Points:

- Theophrastus
- Printing press
- Herbals, first type of botanical books printed
- Exploration and new plant discoveries, changing world views
- Economic value

Pre- and Post-Visit Activities and Discussion Ideas:

- Using a map or globe, locate various countries and regions where explorers traveled to and from in their search for plants. Research the history, culture, and socialization of those countries. Pose to students: If you were armed with the tools to go out and explore the plant world, where would you go? What would you expect the climate to be? How do you think the plants adapted to this climate? What would they look like as a result of these adaptations? Have students explore the cultural, geographical, and historical elements of their home state or region.
- Ask students: How are plants different than other organisms? Review plant parts and functions with students.
- The printing press was invented in 1455. Why was this important? How did it affect peoples daily lives? (This made books/information more available, and fueled the Renaissance.) Even though classical Greek and Roman scholars Aristotle, Theophrastus, and Cicero lived fifteen to seventeen centuries before the printing press was invented, they influenced scholars/thinkers/leaders of the Renaissance. Ask students: Who are important scholars, thinkers, and leaders today? What kinds of contributions have they made to our society? How have books played a role in their accomplishments?
- Theophrastus's manuscript, the *History of Plants*, was brought to Italy from Constantinople and is one of the earliest botanical books ever printed. Pope Nicholas V thought it was so important that he had it translated from Greek into Latin. Ask students: What is Constantinople known as today? (Istanbul) Where is it on a map?
- Theophrastus's book contained the first botanical classification of plants ever *printed* on the printing press in 1483. (The U.S. was not even discovered yet.) This is notable early books were still not widely available to everyone. Printed books were either *religious* works, printed versions of existing *classics*, or had great *practical* importance in people's lives, such as the herbals that doctors needed for their medical practices. Ask students: What would we do without books today? What books do we think of as classics? Why are they considered classics?
- Explore the topic of woodcut pictures. *Dioscorides* was a physician in Roman emperor Nero's armies in the first century A.D. He wrote a bestseller an herbal that contained *practical* information about using plants for everyday remedies, which was of great value to people. In later editions, pictures were added using *woodcut* images. Ask students: What were woodcut images? Why were these the type of image used? Have students make their own woodcut images using bar soap or vegetables instead of wood.
- One of the first categories of botanical books printed was the *herbal*, which contained descriptions and uses of medicinal plants. The printing press made herbals more widely available. Herbals functioned as reference books for physicians who used them to treat patients. They also provided a standard, shared botanical knowledge that could be elaborated upon. Ask students: If you could choose only one book

to print and distribute around the world, what would it be? What problems or issues of society do you think it would need to address?

- While plants had always played a role in people's lives as sources of food, fiber, and medicine, now exotic plants were being discovered that could add new medicines as well as luxuries to people's lives. The new plants could be more widely known because of the increasing availability of printed books. New plants were often seen as desirable for their potential economic value. Ask students: How does plant exploration relate to world exploration? What plants have economic value today? Where do the plants come from?
- Plants became known for their decorative and pleasurable aspects when people had more leisure time as a result of societal advances made during the Renaissance. Ask students: How did this shift in perspective on plants impact people's lives? Was it the same for everyone? (No. The Renaissance created a middle class that had more luxuries, but a lower class still existed.)

Panel 2: A COMMON LANGUAGE FOR DISCOVERY (1600-1750)

Key Points:

- Communication a common language
- World exploration applied science
- Linnaeus and his system of classification
- Latin and binomial nomenclature

Pre- and Post-Visit Activities and Discussion Ideas:

- New World plants were brought into Europe and were appreciated for their practical uses as well as their beauty. Ask students: What does New World refer to? New plants are still being discovered today what medical, economic, practical, or aesthetic value would you hope they could address?
- New places continued to be explored and the Americas were discovered. Europe now had new exotic plants from the New World/Americas, such as potatoes, tomatoes, tobacco, sugar, cocoa and spices, and tea from Asia, as well as ornamental plants, such as tulips, from the Middle East.

Recommended Pre-visit Activity: Using a globe, map, or the Internet, have students research Constantinople. What is Constantinople known as today? [Istanbul] Where is it on a map?

Recommended Pre-visit Activity: Have students research Tulip Mania. Alternatively, research another plant that had great economic impact. What was this mania about? How could a plant have caused such an economic rush? What is a comparison that can be made to today's commodities? Think of the over-valuing of .com companies and why they peaked and then plummeted.

- Between 1450-1600, hundreds of plants were discovered. Later, from 1600 to 1750, thousands of plants became known. With the discovery of so many new plants, there was a lot of chaos in understanding them. A system of organization was needed people in different countries and regions had their own names for plants, therefore it was difficult to communicate with each other about them. Ask students: How could this plant communication problem be solved today? What language would you use? If you wanted to describe a new object to a friend today, what resources would you use?

Recommended Pre-visit Activity: Put a number of items in a bag or box. Ask students to pair up and sit with their backs to each other. Each person needs a piece of paper and colored pencils. Have each student pull an object out of the bag it might be plant-related, such as a number of different leaves, fruits/veggies from the grocery store, or spices or it could be simple household objects, but it should be something unexpected, out of context within the day-to-day school environment. Have students describe the object to their partner, who is trying to draw it without seeing it. They could also make up their own names for the object, as long as they do not give away what it is. The goal of this activity is to enable students to see first-hand how frustrating it is to communicate information but lack the language/technology to do so. How could this problem be solved today? How has communication changed? If you wanted to describe a new object to a friend today, what resources would you use?

- Linnaeus was sent off as a young man to explore Lapland, where he learned about plants from the Sami people. He realized that the Sami called some plants one name, Linnaeus and his colleagues called them another, and his colleagues in other parts of Europe called the same plants something else. A new, easy-to-use system was needed. Using a globe, map, or the Internet, have students research Lapland. What is Lapland known as today? Where is it on a map?

- Linnaeus traveled to Leiden University in Holland to study medicine with a famous physician named Herman Boerhaave. Boerhaave was impressed with Linnaeus and helped him get a job organizing the garden of a prominent Dutch banker named George Clifford. Boerhaave was Linnaeus's mentor. Ask students: Who are your mentors? Remember, plants and doctors were linked because plants were the doctors' pharmaceuticals they used them to make medicines, so doctors needed to be good botanists. Botany did not exist as a profession yet. How are plants used as medicine today?
- Later, Linnaeus published a multi-volume analysis of all of the plants in the world entitled *Species Plantarum*. It was based on Linnaeus's own system of classification that he developed as a result of his experiences exploring in Lapland and caring for a banker's garden in Holland. Experiences accumulate. Ask students: What things are you learning now, in school or at home, that will help you to create new things and ideas in the years to come? What areas/subjects do you want to focus your attention on what do you think needs to be improved/created? What do we need today that you could invent or find a system for? If you could choose only one book to print and distribute around the world, what would you choose? What problems or issues of society do you think it would need to address?
- System of *binomial nomenclature* (bi=two, nomial=name, nomenclature=system of names) uses a two-word name for each organism. The system uses **Latin** at its root because it is a classical language understood worldwide. Binomial nomenclature is still used today. Provide students with a list of Latin nouns, adjectives, and verbs with English translation. Show examples of plants with descriptive names, like *Acer rubrum* (red). Ask students to try to decode the words to try to figure out the name of the plants.
- **Recommended Post-visit Activity:** Create a plant part sampler with a trip through your grocery store (or ask students to bring in a plant part or product, such as spices, t-shirt, rubber tennis shoes, chewing gum, etc.). For each plant used, students can research and chart: what country the plant is native to, what plant part is used, what it is used/known for and where it is grown/produced today. Ask students: What countries do most products seem to come from? Why might this be so? You could give sample plants and countries of origin, such as Ginger (*Zingiber officinale*) from Asia.
- At the end of the nineteenth century, Linnaeus's system was used to organize plants around the world. Having a common *system of classification* that could be used to organize and communicate information about plants was critically important, as it allowed people around the world to communicate through a common language. Linnaeus's system of classification was a result of the discovery of many new plants that needed to be organized, or classified, in some way. With the Linnaean system in hand, scientists tackled the mysteries of the plant kingdom around the world with new energy. Science often works this way research that is conducted to answer one set of questions or issues often leads to new questions or issues.

Recommended Post-visit Activity: Have students research scientific discoveries to find an example of research conducted that either questioned or solved a problem that resulted in new questions and problems, or that led to unexpected solutions to other questions or problems. Have students research NASA inventions that have led to new applications like aluminum foil, the human genome project that has led to many new discoveries about genetic diseases, or aspirin's unexpected use as a blood thinner for heart patients.

Panel 3: EXPLORING THE WORLD (1800s)

Key Points:

- Government-sponsored plant expeditions
- Mungo Park and his travels
- Changing views of plants from practical to ornamental
- Scientific plant illustrations

Pre- and Post-Visit Activities and Discussion Ideas:

- Now that explorer-botanists were traveling the world with the Linnaean system in hand, governments began to see plants as important *politically* as well as *economically*. Plant discovery was now recognized as important and expeditions were conducted around the world, sponsored by governments, to find marketable new products (plants with economic potential). In fact, Columbus wasn't looking for America when he stumbled upon it. He was looking for a shortcut to India, where he was going to look for new spices, which are plants. So, the search for *plants* led to the discovery of America! Have students think of spices that they eat. Research to find out where the plants come from and which part of the plant is used.
- Mungo Park set out to find the source of the Niger River in West Africa and he described the plants, people, and experiences along the way. His book was called the best travel book ever written by novelist Joseph Conrad. Have students use the Internet to research Mungo Park and his contributions.
- There was a growing interest in plants *ornamentally*. Gardens were considered status symbols of a growing middle class that had more money and leisure time than ever before. This is important because plants no longer had to be just for food or medicine. It meant that society itself was changing and that people were not merely concerned with subsistence/survival. Ask students: What other changes spurred this growth in society? (Industrial revolution.) Who benefited and who suffered during the Industrial Revolution? Think of the world today. Which societies are advancing and which are still struggling?
- As a landslide of new plants came into Europe, developing printing technologies made possible the reproduction of *highly detailed, scientific illustration*. This new level of detail enabled botanists to communicate their observations with astonishing accuracy.

Recommended Post-visit Activity: Have students create a plant portrait: Find a plant that appeals to you sketch it, write its name (or make up your own), and describe it in words. Be as detailed as you can in both your picture and your written description. Could someone else recognize this plant from seeing/reading your description?

Recommended Post-visit Activity: Scientific illustration is still a profession today, and it is one way to combine art and science. Ask students: Do you like art as well as science? Scientific illustration may be a career for you! Research the profession of scientific illustration. What kinds of projects/jobs do scientific illustrators have? Does this sound interesting to you?

Panel 4: DISCOVERING AMERICA S PLANTS (1700-1800)

Key Points:

- Thunberg, the Japanese Linnaeus and father of South African botany
- Copperplate engraving
- John Bartram and discovery of North and South Carolina, Georgia, and Florida
- Native Americans
- Plant and seed collection, storage, and shipping
- Venus s fly-trap

Pre- and Post-Visit Activities and Discussion Ideas:

- John Bartram and his son William Bartram were two early American explorers. John Bartram was employed as the botanist of King George III. *Bartram s Travels*, published in 1791, tells of his travels to the exotic lands of North and South Carolina, Georgia, and Florida. These places might not sound very exotic by today s standards, but they were new discoveries at the time. Bartram included descriptions of Native Americans and the Cherokee country, the extensive territory of the Muscogulges (Muskogees) or Creed Confederacy, and the country of the Choctaws. Linnaeus called John Bartram the greatest natural botanist in the world because Bartram was relatively uneducated and self-taught.
- John Ellis, a plant merchant and naturalist, wrote a book giving instructions to sea captains and physicians on how to pack and ship plants so that they could survive long voyages. It was difficult to keep plants and seeds alive on long voyages. Inadequate supplies of fresh water, saltwater spray, drought, and the searing sun killed many of the plants.

Recommended Post-visit Activity: Pose problem to students: Pretend you are a plant collector. Your friend is traveling to a foreign land and you need this friend to return with plants and seeds for you to grow. What instructions would you give her/him on how to pack and ship the plants? See how your solutions for packing or shipping compare to Mr. Ellis s instructions for packing seeds.

Recommended Post-visit Activity: Have students research procedures for shipping plants to different countries. What issues are of most concern today? Look at issues such as USDA regulations, quarantines for insects and diseases, rare species destruction through over-collecting, invasive species being brought in that disrupt native ecosystems, etc.

- Discuss the unique characteristics of Venus s fly-trap. Ask students: Why would Venus s fly-trap need to get its nutrients by trapping? (Carnivorous plants live in places where the soil is wet, boggy, and very poor quality. The insects that they trap are an adaptation for an alternate source of nutrients.)