Native Flags

Native flags is participatory eco-art project by FIU College of Architecture + The Arts Artist-in-Residence Xavier Cortada.

NATIVE FLAGS
Eco-art by Xavier Cortada

Ethnobotany

Sunshine State Standards:
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Background

Career Focus:
- Botanist; Biologist; Archaeologist; Anthropologist; Artist

Objectives:
- Define Ethnobotany
- Identify the importance and roles of plants in human cultures.
- Identify at least 4 native plants species in the hardwood hammock that were used by people for their special properties.

Vocabulary:

- **Ethnobotany:** Is the study of the relationship between plants and people: "ethno" is the study of people and "botany" is the study of plants. The field involves a spectrum of inquiry from archaeological investigation of ancient civilizations to the bioengineering of new crops. Much of ethnobotany deals with intellectual goals similar to those of cultural anthropology: to understand how other peoples view the world and their relation to it.
- **Culture:** From the Latin cultura stemming from colere, meaning "to cultivate". Generally refers to patterns of human activity and the symbolic structures that give such activities significance and importance. Cultures can be "understood as systems of symbols and meanings that even their creators contest, that lack fixed boundaries, that are constantly in flux, and that interact and compete with one another". Culture can be defined as all the ways of life including arts, beliefs and institutions of a population that is passed down from generation to generation. Culture has been called "the way of life for an entire society." As such, it includes codes of manners, dress, language, religion, rituals, norms of behavior such as law and morality, and systems of belief as well as the art.
- **Ethnography:** Is a type of writing that uses fieldwork to provide a descriptive study of human societies. Ethnography presents the results of a holistic research method founded on the idea that a system's properties cannot necessarily be accurately understood independently of each other.
- **Anthropology:** Is the study of humanity.
- **Medicinal Plants:** Are plants which may have medicinal properties. Almost all our present medicines are derived from research on medicinal plants.
- **Herbalism:** Is a traditional medicinal or folk medicine practice based on the use of plants and plant extracts. Herbalism is also known as botanical medicine, medical herbalism, herbal medicine, herbology, and phytotherapy.
- **Pigment–** A pigment is a material that changes the color of light it reflects as the result of selective color absorption. This physical process differs from fluorescence, phosphorescence, and other forms of luminescence, in which the material itself emits light.
- **Dye–** It is a colored substance that has an affinity to the substrate to which it is being applied. The dye is generally applied in an aqueous solution, and may require a mordant to improve the fastness of the dye on the fiber.
- **Color–** Color derives from the spectrum of light (distribution of light energy versus wavelength) interacting in the eye with the spectral sensitivities of the light receptors.
- **Color Spectrum–** The visible spectrum (or sometimes called the optical spectrum) is the portion of the electromagnetic spectrum that is visible to (can be detected by) the human eye.
- **Solubility–**Is the characteristic physical property referring to the ability of a given substance, the solute, to dissolve in a solvent.[1] It is measured in terms of the maximum amount of solute dissolved in a solvent at equilibrium.
- **Colorfast–** Color that is stable and resistant to fading and bleeding.
- **Mordant–** A chemical compound used to set color.

General Information

History of Ethnobotany

Though the term "ethnobotany" was not coined until 1895, the history of the field begins long before that. In AD 77, the Greek surgeon Dioscorides published "De Materia Medica", which was a catalog of about 600 plants in the Mediterranean. It also included information on how the Greeks used the plants, especially for medicinal purposes. This illustrated herbal contained information on how and when each plant was gathered, whether or not it was poisonous, its actual use, and whether or not it was edible (it even provided recipes). Dioscorides stressed the economic potential of plants. For generations, scholars learned from this herbal, but did not actually venture into the field until after the Middle Ages. In 1542 Leonhart Fuchs, a Renaissance artist, lead the way back into the field. His "De Historia Stirpium" cataloged 400 plants native to Germany and Austria.

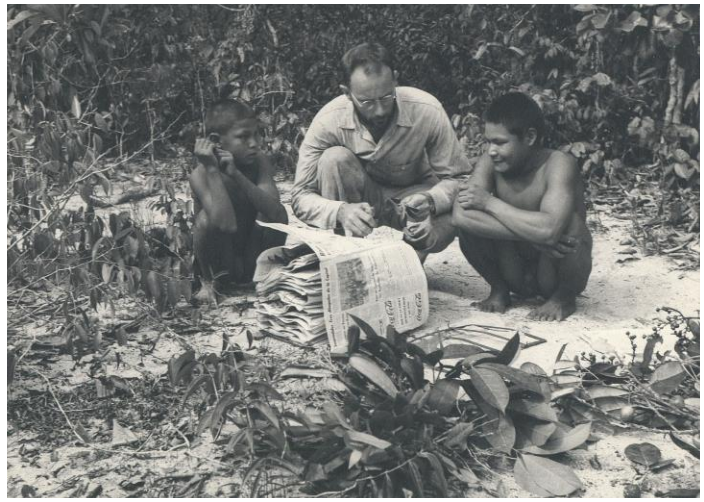
John Ray (1686-1704) provided the first definition of "species" in his "Historia Plantarum": a species is a set of individuals who give rise through reproduction to new individuals similar to themselves. In 1753 Carl Linnaeus wrote "Species Plantarum", which included information on about 5,900 plants. Linnaeus is famous for inventing the binomial method of nomenclature, in which all living things are named according to their genus and species. The 19th century saw the peak of botanical exploration. Alexander von Humboldt collected data from the new world, and the infamous Captain Cook brought back information on plants from the South Pacific. At this time major botanical gardens were started, for instance Kew Gardens of London. Edward Palmer collected artifacts and botanical specimens from peoples in the North American West (Great Basin) and Mexico from the 1860s to the 1890s. Once enough data existed, the field of "aboriginal botany" was founded. Aboriginal botany is the study of all forms of the vegetable world which aboriginal peoples use for food, medicine, textiles, ornaments, etc. The first individuals to study the indigenous perspective of the plant world did so in the early 20th century: e.g. Matilda Cox Stevenson, Zuni plants (1915); Frank Cushing, Zuni foods (1920); and the team approach of Wilfred Robbins, JP Harrington, and Barbara Freire-Marreco, Tewa pueblo plants (1916)

Modern Ethnobotany

Beginning in the 20th century, the field of ethnobotany experienced a shift from the raw compilation of data to a greater methodological reorientation. This is also the beginning of academic ethnobotany.

Today the field of ethnobotany requires a variety of skills: botanical training for the identification and preservation of plant specimens; anthropological training to learn how to ask questions in different cultures and to gain interpersonal skills; linguistic training, at least enough to transcribe native terms and understand native morphology, syntax, and semantics. Full knowledge in all of these areas is not required for a single ethnobotanist; a team approach is often best.

The Father of Modern Ethnobotany
Richard Evans Schultes was widely considered the preeminent authority on hallucinogenic and medicinal plants. He was often called the father of ethnobotany. Over decades of research, mainly in Colombia's Amazon region, Schultes documented the use of more than 2,000 medicinal plants among Indians of a dozen tribes, many of whom had never seen a white man before.



1. Photo Credit: Harvard University Herbaria; Richard Schultes

Ethnobotanical Drug Development
Once the plants have arrived at the company's research site, processing the plants for medicinal purposes begins. The plants are tagged with the information from the field study. The plants are processed and tested in studies completed by ethnopharmacologists, using state of the art laboratory equipment (which may include High Pressure Liquid Chromatography studies and in vivo transgenic animal studies). The objective is to screen the plants metabolites to determine how relevant they are to the therapeutic areas of interest. The most promising initial plant compounds are fractionated to obtain pure samples in milligram amounts. These natural pure compounds are compared to the best available therapeutics by in vitro testing. If the bioassay is successful, the compound is structurally characterized and is subject to a confirmatory biological test. (*Wikipedia)*

Native American Ethnobotany
Native Americans were the first people to utilize plants growing on United States' soil for their medicinal properties. Many of today's medicines were originally derived from plants known to the Native Americans for their curative value.

How did they determine which species were medicinally helpful from those that were potentially harmful or pharmaceutically useless? The patient observation that comes from living in direct connection to the land was their primary tool. This involved paying close attention to how other animals reacted towards various plants, intimately knowing each species' growing season and time of optimum curative strength, and a good degree of experimentation and careful trial and error.

Most of the references to Native American uses noted in the descriptions of the medicinal properties of each species were found in Daniel Moerman's *Native American Ethnobotany*, basically a dictionary of listed uses organized by species. Infusions tend to be the most common means of preparation, though poultices were often made as well.

Ethnobotany in Florida

2 **Photo Credit -** University of Florida; Beauty Berry

Many plants provided important sources of food for Native Americans and early settlers in Florida. Important food plants included fruits, nuts, roots (starch), grains, and greens that varied by habitat, region, and time of year. A few examples of important food plants included fruits from cocoplum (*Chrysobalanus icaco*), pond apple (*Annona glabra*), and saw palmetto (*Serenoa repens*); and starch from coontie (*Zamia pumila*) roots. The "heart" of the cabbage palm (*Sabal palmetto*), commonly referred to as swamp cabbage, was and still is commonly eaten in many rural areas. Generally speaking, ethnobotanical uses of plants can be grouped into six main applications: food, fiber (including dyes), medicinal, housing/construction materials, transportation, and miscellaneous uses (tools, toys, weapons, ceremonial objects, etc.).

0In what is now the southeastern United States including Florida, evidence indicates indigenous tribes traded or exchanged goods throughout eastern North America. Glades Indians were Florida's indigenous people, whose tribes included the Calusa (southwest Florida), Tequesta (southeast Florida), Mayamis (Lake Okeechobee), and lesser known Jaega and Ais. During the Mississippian Culture Period (1000 to 1700 A.D.), the transfer of goods continued and these uses began to be better documented, which provided information currently available about plants and their uses. Spanish explorers, missionaries, and settlers also brought new plants and information to Florida.

Today's Florida Seminole and Miccossuki tribes, although not indigenous Florida peoples, still use traditional herbal remedies passed down by their ancestors. For the majority of Florida's current population, dependence on gathering native plants for food has been replaced by commercial agriculture. Native plants that have been developed into significant commercial crops include pecans, blueberries, and muscadine grapes. Citrus, which was first introduced by the Spanish during the 1500s, currently is one of Florida's most important commercial commodities.

Fiber from various plants was used for many purposes, such as rope making, baskets, clothing, and other everyday materials. Palms were an important source of fiber and construction material for shelters. Other fiber sources included grasses such as wire grass and switch grass, broadleafed plants such as Indian hemp, and the bark of trees such as mahoe and strangler fig.

Dyes played important roles in Native American life, just as they do in modern times. Dyes were used in coloring textiles, in craftwork (pottery, basketry) and in ceremonies (face paints, objects).

(Allen)

Dyes and pigments

Dyes and pigments are substances that impart color to a material. The term colorant is often used for both dyes (also called dyestuffs) and pigments. The major difference between dyes and pigments is solubility (the tendency to dissolve in a liquid, especially water). Dyes are usually soluble—or can be made to be soluble—in water. Once a dye is dissolved in water, the material to be dyed can be immersed in the dye solution. As the material soaks up the dye and dries, it develops a color. If the material then retains that color after being washed, the dye is said to be colorfast.

3. Photo Credit -RACHEL DAMERY/National Geographic Stock

Pigments are generally not soluble in water, oil, or other common solvents. To be applied to a material, they are first ground into a fine powder and thoroughly mixed with some liquid, called the dispersing agent or vehicle. The pigment-dispersing agent mixture is then spread on the material to be colored. As the dispersing agent dries out, the pigment is held in place on the material.

In most cases, dyes are used for coloring textiles, paper, and other substances, while pigments are used for coloring paints, inks, cosmetics, and plastics.

(*Science Clarified)*

History

Many dyes can be obtained from natural sources, such as plants, animals, and minerals. In fact, humans have known about and used natural dyes since the dawn of civilization. Red iron oxide, for example (right), has long been used to color cloth and pottery and to decorate the human body. Today, T-shirts dyed with naturally occurring red dirt (iron oxide) are popular among tourists on Hawaii's island of Kauai. Red dirt imparts a brilliant orangish-red color to cloth that is almost impossible to wash out. Other natural dyes include sepia, obtained from cuttlefish (left), and Indian yellow (right), obtained from the urine of cows that have been force-fed mango leaves.

Some natural dyes are expensive to produce, difficult to obtain, or hard to use. Royal purple got its name because it comes only from the tropical murex snail. So many snails were needed to produce even the smallest amount of dye that only royalty could afford to use it. The dye known as indigo, obtained from the *Indigofera* plant, imparts a beautiful blue color to material, but it is insoluble in water. It must first be converted to a different (reduced) chemical form that is yellow and is soluble in water. In that form, the indigo can be used for dyeing. Once attached to a material and exposed to air, the yellow form of indigo is converted back (oxidized) to its original blue form.

The ability of natural dyes to color textiles has been known since ancient times. The earliest written record of the use of natural dyes was found in China dated 2600BC. Chemical tests of red fabrics found in the tomb of King Tutankhamen in Egypt show the presence of alizarin, a pigment extracted from madder. In more modern times, Alexander the Great mentions having found purple robes dating to 541BC in the royal treasury when he conquered Susa, the Persian capital. Kermes (from the Kermes insect) is identified in the bible book of Exodus, where references are made to scarlet colored linen. By the 4th century AD, dyes such as woad, madder, weld, Brazilwood, and indigo and a dark reddish-purple were known. Brazil was named for the wood found there.

Purple was made from a mollusk and clothing made from it was so expensive only the royal family could afford it. It was extracted from a small gastropod mollusk found in all seas or from a crustacean called a Trumpet Shell or Purple Fish, found near Tyre on the Mediterranean coast. Their body secreted a deep purple fluid which was harvested by cracking the shell and digging out a vein located near the shellfish head with a small pointed utensil.

The mucus-like contents of the veins were then mixed together and spread on silk or linen. Estimates are that it took 8,500 shellfish to produce one gram of the dye, hence the fact this dye was worth more than its weight in gold. This expensive dye was also mentioned in the bible, in Acts, where Lydia is a seller of purple.

By the 15th century, dyes from insects, such as cochineal and Kermes, were becoming more common. By the 17th century, dyeing cloth "in the wood" was introduced in England: logwood, fustic, etc. In the 18th century a method of bleaching linen with kelp was introduced in Scotland, a Swedish chemist discovered chlorine destroys vegetable colors and the French began to recommend chlorine water for commercial bleaching. Indigo began to be grown in England, and Cudbear, a natural dye prepared from a variety of lichens, is patented. Another natural dye, Quercitron, from the inner bark of the North American oak, is patented in 1775.

By the 1800's, Prussian Blue and Sulphuric acid are available commercially. Prussian blue was formed from prussite of potash and iron salt, making it one of the earliest known chemical dyes. In 1856,.

A revolution in colorant history occurred in 1856, when English chemist William Henry Perkin (1838–1907) discovered a way to manufacture a dye in the laboratory. William Henry Perkin, while experimenting with coal tar in hopes of finding an artificial quinine as a cure for malaria, discovered the first synthetic dye stuff which he called "Mauve"That dye, mauve, was produced from materials found in common coal tar. Perkin's discovery showed chemists that dyes and pigments could be produced synthetically (by humans in a lab). It was no longer necessary to search out natural products for use as colorants. The color quickly became a favorite of the royal family, and a new industry was begun.

Today, the vast majority of dyes and pigments are produced synthetically. These products are easier and less expensive to make than are natural products. In addition, their colors are more consistent from batch to batch than the various samples of natural colorants.

Types of Natural Dyes

4. A man using natural vegetable dye on a wooden block. LORI EPSTEIN/National Geographic Stock

Natural dyes can be sorted into three categories: natural dyes obtained from plants (indigo), those obtained from animals (cochineal), and those obtained from minerals (ocher). Although some fabrics such as silk and wool can be colored simply by being dipped in the dye, others such as cotton, require a mordant.

A mordant is an element which aids the chemical reaction that takes place between the dye and the fiber so that the dye is absorbed. Containers used for dying must be non-reactive (enamel, stainless steel.) Brass, copper or iron pots will do their own mordanting. Not all dyes need mordants to help them adhere to fabric. If they need no mordants, such as lichens and walnut hulls, they are called substantive dyes. If they do need a mordant, they are called adjective dyes.

Common mordants are: ALUM, usually used with cream of tartar, which helps evenness and brightens slightly; IRON (or copperas) which saddens or darken colors, bringing out green shades; TIN, usually used with cream of tartar, which blooms or brightens colors, especially reds, oranges and yellows; BLUE VITRIOL which saddens colors and brings out greens and TANNIC ACID used for tans and browns.

Natural dyes obtained from plants

One example of a natural dye obtained from plants is madder (right), which is obtained from the roots of the madder plant. The plants are dug up, the roots washed and dried and ground into powder. During the 19th century, the most widely available fabrics were those which had been dyed with madder. The 'turkey red' that was so popular at that time, was based on madder. This red was considered brilliant and exotic.

The madder plant continued to be used for dyeing until the mid-1800s when a synthetic substitute was developed.

Another example of a natural dye obtained from plants is woad (right). Until the Middle Ages, Europeans used woad to create a blue fabric dye. The woad was a shrub that grew abundantly in parts of Europe. The coloring was in the leaves, which were dried and ground, mixed with water and made into a paste. This dye was supplanted by indigo, an ancient shrub well known to the Egyptians and Indians. Like woad, its color lay in its leaflets and branches. The leaves were fermented, the sediment purified, and the remaining substance was pressed into cakes.
Indigo prevailed as the preferred blue dye for a number of reasons. It is a substantive dye, needing no mordant, yet the color achieved is extremely fast to washing and to light. The manufacture of natural indigo lasted well into the early 1900s.

In 1905 Adolf von Baeyer (the scientist who also formulated aspirin) was awarded the Nobel Prize for discovering the molecular structure of indigo, and developing a process to produce it synthetically. The natural dye was quickly replaced by the new synthetic, ending an ancient and honored botanical history.

Natural dyes obtained from minerals

Ocher is a dye obtained from an impure earthy ore of iron or ferruginous clay, usually red (hematite) or yellow (limonite). In addition to being the principal ore of iron, hematite is a constituent of a number of abrasives and pigments**.**

Natural dyes obtained from animals

A good example is cochineal, which is a brilliant red dye produced from insects living on cactus plants. The properties of the cochineal bug were discovered by pre-Columbian Indians who would dry the females in the sun, and then ground the dried bodies to produce a rich, rich red powder. When mixed with water, the powder produced a deep, vibrant red coloring. Cochineal is still harvested today on the Canary Islands. In fact, most cherries today are given their bright red appearance through the artificial color "carmine", which comes from the cochineal insect.
(Driessen)

A History of Colors

Modern / Mineral

Artists have painted images of the natural and supernatural worlds for more than 30,000 years. For their materials, prehistoric painters reached into the earth. Compounds of iron oxides yield muted colors of red, yellow and brown. Carbon makes a strong black with a bluish tinge, while bone black makes a warmer color. Calcium carbonate (marble dust) is easy to find and make into a pigment. Until the Industrial Revolution, the majority of colors on artists' palettes were lightfast earth colors, which is why the Old Masters' paintings are mostly brown.

During the Industrial Revolution, oil colors were from inorganic pigments that are compounds of minerals, such as cobalt, cadmium, and manganese. These are the mineral colors, and they were developed for every hue on the color wheel. Their intense mass tones complemented earth colors on painters' palettes and replaced paints made from expensive semiprecious stones, fugitive colors, or highly toxic compounds.

Impressionism would have been impossible without this full spectrum of pigments packaged for the first time as oil colors in tubes. While intense in their mass tones, mineral colors grey down when mixed with white. This attribute makes them particularly valuable for painting natural light (landscape, portraiture and still life) because most colors of the natural world have a strong element of grey. Mineral colors are also the most opaque artists' colors.

Modern colors are very similar in masstone to the mineral colors. ("Masstone" refers to the oil color as it comes from the tube.) However modern colors and mineral colors behave differently when mixed with mediums, mixed with white (tinted), or mixed with other colors to produce secondaries. Modern colors are noted for their intense tinting strength and transparency. Most important, they do not grey down when mixed with white.

Innovation in color chemistry throughout the 20th century has presented painters with another full spectrum of colors of modern organic pigments. These pigments are called organic because they are made from chemical compounds with a central carbon atom. They are primarily made for commercial printing, plastics, and auto paints. Among thousands of new colorants made in the twentieth century, only a few, including phthalo, hansa and quinacridone, are lightfast enough to be used in artists' colors. These pigments we call the "modern colors."

Unfortunately, many modern colors were introduced as "hues" or replacements for more expensive mineral colors such as cadmium and cobalt. But the modern colors have their own characteristics. These become obvious when they are thinned or mixed with white or other colors. Unlike the mineral colors, modern colors produce high key colors in masstone, transparency and tint. While their characteristics offer painters more color possibilities, modern colors can disappoint those who use them for natural light effects because they do not grey down.

Mineral colors

Many inorganic pigments are made by heating compounds such as cobalt and aluminum to temperatures more than 2,000 degrees F for long periods of time. High priced raw materials plus the high costs of manufacturing make cobalt and cadmium colors particularly expensive. Colors from a family of mineral pigments shift from light (Cadmium Yellow Light) to dark (Cadmium Yellow Deep).

They grey down when mixed with white which is perfect for capturing light of the natural world. Mineral based pigments have larger pigment sizes and lower tinting strengths than modern colors. They are leaner and naturally more matte. Mineral colors are mostly opaque. Ultramarine Blue and Viridian are exceptions; these are semi-transparent. Most mineral colors have excellent lightfastness rating (I).

Pigments

Pigments are applied to a surface as a mixture that always consists of at least two parts (the pigment itself and the vehicle) and usually many more components. For example, a thinner such as turpentine is often added to a given mixture to make it easier to apply. One of the simplest paints that you imagine, then, might consist of red iron oxide, linseed oil (the vehicle), and turpentine (the thinner).

5. Photo credit: Sewanee University www.sewanee.edu

The purpose of the vehicle in this mixture is to carry the pigment onto the surface, much as motor vehicles carry people and goods. A thinner is often needed because many vehicles are thick, viscous (sticky) materials that are difficult to apply with a brush.
After the pigment/vehicle/thinner mixture has been applied to a surface, two changes occur. First, the thinner evaporates leaving the pigment/vehicle mixture evenly spread on the surface. Next, the vehicle slowly undergoes a chemical change (oxidation) that converts it from a thick liquid to a solid. Since the pigment particles are trapped in the hardened vehicle, a thin, tough skin of colored material becomes attached to the surface.

Utilization

Nearly every industry uses colorants in one way or another. About 7,000 different dyes and pigments exist and new ones are patented every year. Dyes are used extensively in the textile (fabric used in clothing) industry and paper industry. Leather and wood are colored with dyes. Food is often colored with natural dyes or with synthetic dyes that have been approved by a federal agency (proven safe for human consumption). Petroleum-based products such as waxes, lubricating oils, polishes, and gasoline are colored with dyes. Dyes are also used to stain biological samples, fur, and hair. And special dyes are added to photographic emulsions for color photographs. Plastics, resins, and rubber products are usually colored by pigments.

Natural Dyeing in Florida

6. **Photo Credit:** Nikki Shrimpton/Empire State College - State College of New York

The following quote by Emeline Crumb, a Kansas pioneer reflects a reality that probably taken place in our very own backyard, "The native plants and barks were used…Good browns were produced with walnut bark, when properly set. A good dark slate or grey was secured by walnut bark, set in sumac 'bobs'…. Golden Rod was used for yellows-the tint called 'Nankeen'. Rusted iron-or iron filings-set some colors….A bolt of strong unbleached muslin, after passing thru the dyes, made quite nifty dresses…. The Indians used many kinds of roots, barks, and berries, making lasting colors…But they were not inclined to impart their secrets to the Pale Face." (Stratton,1981).

European settler learned about dye plants from Native Americans, who produced reds from native fruits, greens from algae, and yellows from lichens. Minerals also provided an array of earth tones ranging from grays to blacks and from yellows to browns. For thousands of years the earliest natives of Florida, known as "Glades Indians" depended on their environment for their subsistence. Based on archeological information, anthropologists recognize five tribes, these include: Calusa, Tekesta, Mayamis, Jaega, and Ais (Austin, 1997).

Historical and archeological records exist to document fewer than 50 plant species used by the Glades people. That number is about 3% of the native flora, markedly lower than other Native Americans used. This is probably the result of South's Florida's poor recorded usage. Diseases, slavery and wars rapidly took a toll in the native population.
Unfortunately, no Tekesta artifacts that show evidence of the use of plant or mineral pigments survived to this day. However, due to plain luck and right environmental conditions, a small collection of Calusa artifacts remained preserved to this day.
"Pigments were taken from a number of places. Artifacts from Marco Island, buried under the anaerobic seawater for 400-500 years still contained visible pigments of black, white, blue, red-brown, pink, red and gray. Black came from charcoal and, according to some, oxidized rubber from strangler fig sap. Reds and pinks came from the cochineal insects that live on the cacti (Austin, 1997).

Glades Culture Pottery Making

Around 4,000 years ago (2,000 BC), a seemingly independent invention of "pottery making" happened in the Florida-Georgia area. Shredded materials such as palmetto fibers, Spanish moss and other grasses were used to reinforce and hold the clay together, known as temper. This is important because if sand-fired pottery fragments are found, the site is younger than this. Archaeologists noted another change around 1,000 BC. Pottery became rounded and the decorations were changed.

The Glades Period encompasses from750 b.c. to a.d 1500. This period is divided into three periods - I, II, and III. Pottery types characterize the different periods, but there are associated types of tools. By 500 BC, the tradition of adding fibers to temper the clay was largely replaced by the addition of grit, sand, shell and limestone, much as is done today. This is another important date stamp. However, they did not have high temperature kilns to glaze the pottery as potters do today.

7. Photo Credit: Florida Museum of Natural History - University of Florida Ceramic Lab

Among the most significant archeological sites found at the Deering Estate at Cutler is the black dirt midden located near a fresh water spring which undoubtedly served as a source of drinking water to the Tequestas who inhabited the area. A short walk around this area reveals evidence of a long- gone culture. Among the many fragments of oyster and clam shells, conch, fish vertebrae and other animal bones are hundreds of pottery fragments or shards. One can not help but wonder about the people who made the pieces or the uses they were destined for.
(Wilkinson)

Plant Pigment Chemistry:

Fat Soluble Pigments:
These pigments are found in many fruits and vegetables and include chlorophyll and carotenoid pigments. These pigments are not easily released from plant tissues. They will not bleed or leach from plant tissues into water, but pigment will leach into oil-based or hydrophobic solutions.

Chlorophyll:
Green pigment used in harvesting of blue and red light by plants during photosynthesis.

- Found in spinach, peas, lettuce.

Interesting note:
Why is fresh spinach so green but cooked spinach is a drab olive green color?

Chlorophyll is tightly bound to proteins in the plant tissue. The chlorophyll-protein complex denatures during cooking due to the high heat, which releases the magnesium bound to the center of the tetrapyrrole of the chlorophyll molecule. This structural change produces pheophytin (an olive green to brown color) from chlorophyll (bright green color).

Carotenoids:
Yellow to orange to red pigments (tetraterpenes) that function both as accessory light harvesting pigments and as antioxidants that protect plants from the harmful effects of strong sunlight.

- Found in carrots, corn, squash, tomatoes

Water Soluble Pigments:
A large group of phenolic pigments called flavonoids are also found in many flowers, fruits and vegetables. They have a wide range of functions, including attracting insects to plants (e.g. for pollination and seed dispersal). Some flavonoids have been studied for their potential anticancer health benefits (antioxidant effects). These pigments include anthocyanins and yellow flavonoids.

Yellow flavonoids:

- Found in potatoes, yellow onions

These pigments are also pH sensitive. The color turns a deeper yellow in basic pH solutions.

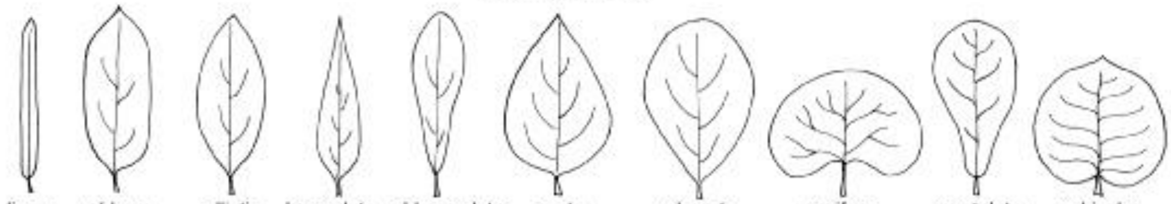
Anthocyanins:
Purple to blue to red pigments that are also flavonoids. The color of anthocyanin pigment is dependent on pH (measure of acids and bases). Anthocyanins are red at low or acidic pH, and are blue to purple at high or basic pH.

- Found in grapes, berries (blueberries),eggplant, red cabbage.

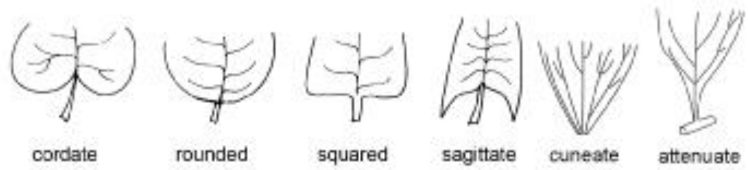
(Calder)

ILLUSTRATED GLOSSARY OF LEAF SHAPES

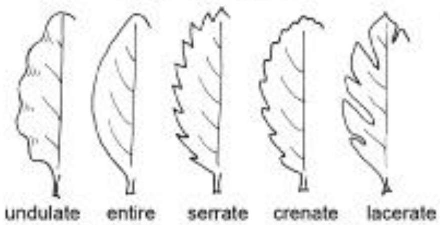
LEAF SHAPES



LEAF BASES

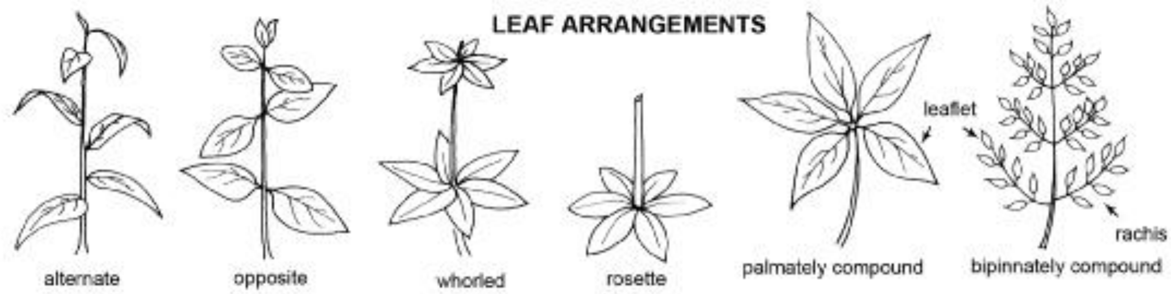


LEAF MARGINS

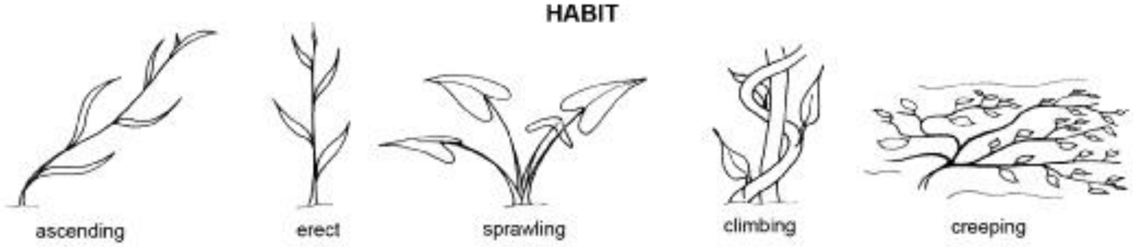


LEAF ATTACHMENTS

LEAF ARRANGEMENTS



HABIT



UF UNIVERSITY of FLORIDA
IFAS Extension
Center for Aquatic and Invasive Plants

http://plants.ifas.ufl.edu

Activity 1: Building a Campsite

Objectives:

- Discover how Tequestas built their homes
- Learn native trees and plants used to construct Tequesta homes

Materials:

- Tequesta artifacts
- Natural supplies needed to build campsite

Procedure:

1. Have all the materials prepared to build the structure depicted below and have students construct it using only the materials provided.
2. Have students
   a. Identify the objects
   b. Guess their use or purpose
   c. What are they made of?

Activity 2: Ethnobotany Hike in Deering’s Hammock

Objectives:

- Identify at least 5 plants used by natives of the area
- Identify uses of at least 5 plants

Materials:

- Laminated pictures and descriptions of the 10 plants to be used
- 1 piece of paper for writing
- 1 Pencil
- 1 Bag of oyster or other bivalve shells per group
- Several Small Zip Lock bags for specimen collection
- 1 A squirt bottle with water
- 1 pair of scissors per pair of students to cut fibers
- White Elmers glue to simulate tree sap to glue ends of rope (cordage)
- 1 bag of small wooden twigs (to simulate paint brush handles)
- 1 bag of thatch palm fibers cut into two inch pieces (to simulate paint brushes hair)
- In the course of the hike collect vines to make rope samples.

Procedure:

Preparation done by the Instructor

The instructor has to become familiar with what plants are in bloom or fruiting prior to the visit. This can be accomplished by doing a quick hike/ inspection prior to the group’s visit. Have all material necessary ready to go.

Recommendation: Choose 4 plants that are used for medicinal purpose

4 plants that are as a food source

2 Plants that are used as construction material

- Working in pairs you will walk and look around the historic grounds and the avocado grove for plants of interest that have an ethnobotanical importance. Once identified, your guide will spot briefly talk about the plant and its uses. He/she might even ask you to collect samples and store them in the baggies for storage.
- Your instructor will hand you some examples to smell and taste. These might include leaves and fruits but could also include bark and roots.
- He/she will collect specific plant specimens that were used as dyeing agents.
- He/she will also collect plants that were used for their fibers including vines and palm fronds.
- After the hike the instructor will sit the group down in an outdoor area and have a discussion of the plants the group collected. The instructor will go over the plants one at the time. Then he/she will engage in a discussion with the group and will ask open ended question.

- Participants will learn how to make a paint brush out of palm fibers and a wooden stick. Participants have the chance to create a tool by the same methods Tequestas did 2000 years ago. By crushing the samples using a stone (pistil) and mixing them with a little water on an oyster half shell (the mortar), participants will have a chance to make pigments.
- By braiding plant fibers extracted from the specimens collected during the hike, your instructor will show you how the Tequestas made rope by showing you the principles of rope making. Use the white glue to simulate tree sap to glue the ends of the rope. Once done use the brush and pigment to paint your rope sample.
- If edible fruit is around and is ripe your instructor will use broad leaves as plates to set the samples up for trying if you are up to it.
- Wrap up and discussion.

Activity 3: Leaf Preservations

Objectives:

- Identify different shapes of leaves
- Understand leave pigments
- Why do leaves change colors?

Materials:

- Leaves collected by instructor or students during hike
- Depending on method of pressing:
  - Wax-paper method:
    - Towel
    - Iron
    - Wax paper
    - Scissors
  - Microwave method:
    - Access to a microwave
    - Paper towels
    - Sealant spray
  - Glycerin method
    - Glycerin
    - Water
    - Baking sheet
  - Book method
    - Book
    - Paper towels

Procedure:

Wax-Paper Method

1. Go on a "leaf walk," and choose the best and the brightest leaves to preserve.
2. Place your fall leaves between two layers of wax paper.
3. Cover with an old towel.
4. Set your iron to a warm setting.
5. Iron the fabric to seal the wax paper. Keep the iron moving all the time so that you don't scorch the leaf.
6. Cut the leaves out, leaving a narrow edge of wax paper around the shape of the leaf to keep it sealed.

Microwave Method

1. Select the freshest, brightest leaves you can find, not fallen leaves that have already started to dry out.
2. Place one or more leaves on top of two paper towels in your microwave oven. Cover leaves with one paper towel.
3. Set your microwave's power to medium or low if you can adjust it.
4. Run the microwave for 30 to 180 seconds. The drier the leaf, the less time it will need.

5. Remove the leaf, and look at it. A leaf that curls is not dry enough, while a scorched leaf has been left in too long.
6. Dry the leaves an additional day or two.
7. Spray the leaves with a sealant such as acrylic craft spray.

Glycerin Method

1. Place a mixture of one part glycerin and two parts water in a flat pan.
2. Submerge the leaves completely in a single layer.
3. Add a weight to keep the leaves covered with the mix.
4. Check leaves after a few days. Within two to six days, the leaves should absorb the liquid and be soft and bendable.
5. Remove the leaves from the pan and wipe them off with a soft cloth.

Book Method

1. Dry out the leaves in a sunny window if the leaves are wet to the touch.
2. Find an old book that is of little value to you, as the leaf-drying process may ruin the pages.
3. Place dry leaves in the book with paper towels in front of and behind the leaf.
4. Place as many leaves as you desire in the book, but allow 15-20 pages in between.
5. Check the paper towels after the third day and change them.
6. Remove the leaves after about 7 days.

Activity 4: Painting with Nature's Colors

Objectives:
- Define pigment and dye
- Identify the importance natural dye has played in human societies
- Identify 4 plants used to extract dyes and coloring
- Use natural pigments in dye applications

Materials:
- 1 pint of fresh or frozen blueberries (Maine blueberries are smaller and easier to strain)
- 3 yellow onions
- 1 can of spinach
- 1 can of beets
- Various wild berries
- Saucepans
- Fine mesh strainer
- Vinegar (an acid)
- Baking Soda (a base)
- Mason canning jars or glass containers
- Disposable bowls and spoons

Procedure:

Prep:
- Simmer 1 pint of fresh or frozen blueberries in ½ cup of water in a small saucepan over medium heat until a deep blue color is leached from the skins. Strain out blueberry skins with a fine kitchen strainer. (A tea strainer works well).
- Simmer yellow onion peels (the yellow papery skins, not the onion flesh) in ½ cup of water over medium heat until the water turns a golden yellow color.
- Pour liquid through a strainer to remove onion peel.
- Simmer cooked spinach in ½ cup of water over medium heat until water turns a dark olive green.
- Strain out spinach. (Fresh spinach greens do not release chlorophyll pigment well and are not recommended for this exercise.)
- Colored pigment solutions can be stored at room temperature in glass containers such as Mason jars.
- Disposable plastic bowls and spoons are best for dying materials in the classroom.

Activity:
1. First, introduce plant pigment chemistry to students.
2. Educators can also relate pigment chemistry to leaf changes. The same pigments (carotenoids, chlorophyll, and anthocyanins) used in this exercise are involved in the changing colors of leaves in autumn. Older students can be more involved in an inquiry-based exercise (such as the effects of pH on the chemical structure of pigments, and/or enhanced spectral characteristics, light absorption, etc.).

3. Second, begin the activity by pouring pigment solutions into disposable plastic bowls containing spoons. Students can dye materials (e.g. cloth, string, eggs, or porcupine quills) suitable for the range of interests in the class.
4. Students/educators should divide the blueberry solution into three bowls.
5. The students can then add vinegar (acid) to one bowl in small amounts until the blueberry solution turns a pink color and add baking soda (base) to a second bowl in small amounts until that blueberry solution turns a dark purple color.
6. Students will then have three separate anthocyanin shades to dye materials over a range of color.
7. After adding vinegar and baking soda to blueberry pigment, the dye will be weak. If dyeing eggs for Easter, use only white eggs. Hard-boiled eggs work well.
8. Beet pigments will not dye eggs well, but are suitable for light colored cloth or string.
9. Please remind students that fruit and vegetable pigments are natural alternatives to the man-made dyes that can be bought at the store. The plant pigments are very subtle dyes.
10. Adding more than 1 dye to materials such as eggs can produce a muddled color, so a 1 or 2 color limit is recommended during the dying process.
11. Students can do this activity from start to finish in the classroom, including preparation of the pigments.
12. The pigments can be prepared in a saucepan over a stove or electric hot plate. Water can be heated from an electric steam kettle and poured onto fruit and vegetable skins to leach out plant pigments, as well. However, boiling water presents a safety issue, so students need careful supervision.

Assessments

- How did natives practice ethnobotany in Florida?
- What would you find in a Tequesta Indian campsite?
- What kinds of leaf patterns help us to identify leaves?
- What kind of roles do plants play in the importance of our lives today?
- What has been used in the past and present for natural dyes?

Accommodations

Accommodations: Notebook Quick List

A general list of accommodations designed for lesson plan books

Instructional methodology and materials

- ☐ Needs alternate format to obtain information—Braille, large print, oral, simplified text
- ☐ Needs assistance with note taking – copy of notes, outline, note taker
- ☐ Needs concrete objects, pictures, or graphics
- ☐ Needs appropriate assistive technology: ________________________
- ☐ Needs advanced organizers or study guides
- ☐ Needs adapted materials—uncluttered, fewer items, highlighted
- ☐ Other: ____

Assignments and assessments

- ☐ Needs to use alternate response mode—tell, draw, write, point
- ☐ Needs appropriate assistive technology: _______________________
- ☐ Needs guides or prompts for specified tasks: ___________________
- ☐ Needs extended access to instructional resources and equipment
- ☐ Needs personal assistance – teacher, aide, peer, volunteer, interpreter
- ☐ Other: ____

Learning environment

- ☐ Needs adapted environment—acoustical treatment, lighting, barrier-free
- ☐ Needs preferential seating or study carrel
- ☐ Needs individual system for behavior management
- ☐ Needs to have instruction in small groups or one-to-one
- ☐ Needs individual planner or assistance with organization
- ☐ Other: ____

Time demands and schedules

☐ Needs additional time to complete course or grade

☐ Needs additional time to complete assignments and tests

☐ Needs to have independent or group work sessions in short time segments

☐ Needs reduction in number of required practice or assessment items

☐ Other: ____

Communication systems

☐ Uses Total Communication

☐ Uses American Sign Language, Finger spelling, or Signing Exact English

☐ Uses augmentative communication system: _____________________

☐ Needs instruction in home language other than English:

☐ Other: ____

Source: Beech, M., McKay, J. P., Frey, N., & Ward, T. (2000). Dealing with differences: Strategies that work! Trainer notebook, Tallahassee, FL: Florida Department of Education.

Resources

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