

STEAM Curriculum: Arts focussed literacy and botany lessons

for K–12 students.

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Use and Application:

- 1. Deep engagement with school gardens and the natural world as a part of classroom instruction
- 2. Prioritize literacy, awareness, and understanding of the natural world
- 3. Integrate arts as an integral part of literacy and STEM instruction
- 4. Apply multi-sensory principles as a part of STEAM instructional models

Botanical Curricular Themes:

- 1. Cellular | Letters & Words
- 2. Plant | Words & Sentences
- 3. Ecology of Plant Life | Words & Sentences in Stories



PRIORITIES and GUIDING PRINCIPLES:

- 1. STEAM (a wholistic pedagogical model)
- The Orton-Gillingham Approach Principles

 (www.https://www.ortonacademy.org/resources/og-approach-principles/)
 (Sensory engagement with plants and botanical language)
- 3. A New Approach to Ecological Education, Engaging Students' Imaginations in Their World, Gillian Judson, Peter Lang Publishing, Inc., New York, 2010.
- 4. Nature Printing as a simple printing technique that creates images of plants which has been historically used by artists and botanists and a manner by which students can work with plants to study their biology and use as a basis of imaginative and scientific literacy lessons.
- 5. Value of reflective writing in STEAM pedagogy. All lessons include an element of reflection. Reflective writing exercises based on prompts that encourage students to think creatively and scientifically about plants.
- 6. An ADAPTABLE CURRICULUM. (Botanography would like to partner with educators and schools to develop lessons meaningful to their curriculums and school culture.)



Botanical Curricular Themes (singular and series of lessons):

- 1. Cellular | Letters & Words: lessons that consider the cellular scale of plants and language (letters, sounds, and words as well as cellular elements of plants)
- 2. Plant | Words & Sentences: lessons that address the meaning of words, the structure of sentences, biological significance of parts of plants, and structure of plants (words and their relationships to sentences, parts of plants and their relationship to the function of plants as organisms)
- 3. Ecology of Plant Life | Words & Sentences in Stories: lessons that address the meaning of words and sentences in imaginative and descriptive stories about the natural world and the significance of plants as a part of urban and natural ecologies



Forms of Introductory Discussion, Preparation, and Reflection to extend lessons

- 1. **Field Trip** (a walk about in the neighborhood to collect and observe plants)
- 2. Field Trip (a visit to a Philadelphia arboretum or garden)
- 3. School Garden Visit (time for observation of plants and a reading of a story that relates to a lesson)
- 4. **Collecting and Sorting Plants** in various categories in preparation for lessons and nature printing
- 5. **Journaling with Photographs, Writing, and/or Drawings** (types of plants worked with in lessons; process of nature printing; observations about plants)



BOTANOGRAPHY (bə'tæn-o-grafee) Tools and Materials Useful in Nature Printing

Tweezers Brayers Bruners Wax paper Masking tape Scissors Student grade paint brushes Linseed oil Ground charcoal Ground pigments Paper towels or cotton rags Student grade cotton printmaking paper *portable printing press (provided by Botanography)

Non-toxic cleaning supplies (ie. Windex vinegar mix)



Models for Nature Printing Workshops

- 1. Workshop(s) for Classroom Teachers (whereby teachers are then able demonstrate nature printing techniques to students in the classroom for use in lessons)
- 2. Workshop(s) for Art Teachers (whereby art teachers in schools are integral to Botanography classroom lessons)
- 3. **Workshop(s) for Students** (whereby Botanography instructors teach nature printing directly to students as a part of lessons or a series of lessons)

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & writing) Phase 4: 40 mins (reflection)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3: Individual

Pennsylvania Common Core: Language and Literacy

K-2 Std 1.4.1: Narrative Create a simple story
K-2 Std 1.4.2: Informational Communicate through writing
K Std 1.5: Quality of Writing
K Std: Writing a Picture Walk
Biological Sciences
K Std 3.1a.1: Characteristics of life
K Std 3.1a.5: Form & Function

K Std 3.1a.9: Science as inquiry 1 Std 3.3 a & b: Living things

BOTANOGRAPHY (bə'tæn-o-grafee)

Cellular | Letters & Words : Forest Creatures Exploration of shapes and forms of parts of plants and an imaginative writing composition of these forms.

Phase 1: Plant Collecting (Small group)

On a 'walk-about' in the school garden or neighborhood ask student groups of 2-3 to collect a variety of plant leaves and blossoms (a total of 10 plant parts each group). (tools needed: scissors)

Phase 2: Plant Sorting (Large group)

In a large class group ask students to collectively sort collected plants into categories: ie. Simple & heart shaped, round, or long and thin; Complex & heart shaped, round, or long and thin. (sorting in a large group sitting in a circle, plants organized in center)

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & writing) Phase 4: 40 mins (reflection)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3: Individual

Pennsylvania Common Core: Language and Literacy

K-2 Std 1.4.1: Narrative

Create a simple story

K-2 Std 1.4.2: Informational

Communicate through writing K Std 1.5: Quality of Writing K Std: Writing a Picture Walk

Biological Sciences

K Std 3.1a.1: Characteristics of life K Std 3.1a.5: Form & Function K Std 3.1a.9: Science as inquiry 1 Std 3.3 a & b: Living things

BOTANOGRAPHY (bə'tæn-o-grafee)

Cellular | Letters & Words : *Forest Creatures* Exploration of shapes and forms of parts of plants and an imaginative writing composition of these forms.

Phase 3a: Printing (Individual work in cooperation with small group)

- 1. Nature Printing workshop (teaching skills of nature printing)
- 2. Student composition of *Forest Creature* with parts of plants (from sorted categories)
- 3. Student printing of *Forest Creature* (two prints generated from process)

Phase 3b: Writing (Individual work)

- 1. Tracing the shapes and forms of *Forest Creature*. (Ask students to overlay trace forest creature in two ways: a. Trace paper over their prints to trace the shapes of individual parts of their creature; b. Trace paper over their prints to trace the overall shape and form of their creature.)
- 2. Writing, invention, and spelling of a WORD that names their *Forest Creature*.

Phase 4: Reflection (Large group work)

- 1. As a class sitting in a circle, ask each student to share and read the name of their *Forest Creature*.
- 2. Teacher display *Forest Creatures* and tracings in the classroom or hallway as a story about the school's garden.

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & writing)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3: Individual

Pennsylvania Common Core: Language and Literacy

K-2 Std 1.4.1: Narrative Create a simple story K-2 Std 1.4.2: Informational

Communicate through writing

Biological Sciences

K Std 3.1a.1: Characteristics of life K Std 3.1a.5:Form & Function K Std 3.1a.9: Science as inquiry 1 Std 3.3 a & b: Living things

BOTANOGRAPHY (bə'tæn-o-grafee)

Plants | Words & Sentences : *Forest Creatures* Creation of and writing about an imagined forest creature from parts of different parts of various plants.

Phase 1: Plant Collecting (Small group)

On a 'walk-about' in the school garden or neighborhood ask student groups of 2-3 to collect a variety of plant leaves and blossoms (a total of 10 plant parts each group). (tools needed: scissors)

Phase 2: Plant Sorting (Large group)

In a large class group ask students to collectively sort collected plants into categories: ie. Simple & heart shaped, round, or long and thin; Complex & heart shaped, round, or long and thin. (sorting in a large group sitting in a circle, plants organized in center)

- 1. Nature Printing workshop (teaching skills of nature printing)
- 2. Student composition of *Forest Creature* with parts of plants (from sorted categories)
- 3. Student printing of *Forest Creature* (two prints generated from process)

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & writing)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3: Individual

Pennsylvania Common Core: Language and Literacy

K-2 Std 1.4.1: Narrative Create a simple story K-2 Std 1.4.2: Informational

Communicate through writing

Biological Sciences

K Std 3.1a.1: Characteristics of life K Std 3.1a.5: Form & Function K Std 3.1a.9: Science as inquiry 1 Std 3.3 a & b: Living things

BOTANOGRAPHY (bə'tæn-o-grafee)

Plants | Words & Sentences : *Forest Creatures* Creation of and writing about an imagined forest creature from parts of different parts of various plants.

Phase 3b: Writing (Individual work)

- 1. Tracing the shapes and forms of *Forest Creature*. (Ask students to overlay trace forest creature in two ways: a. Trace paper over their prints to trace the shapes of individual parts of their creature; b. Trace paper over their prints to trace the overall shape and form of their creature.)
- 2. Writing and invention of a simple action oriented sentence about their *Forest Creature* as an imaginary being.
- 3. Writing of simple sentences that describe each of the different shapes and forms of plant parts used to create their *Forest Creature*. (sentence structure: subject, verb, adjective)

Phase 4: Reflection (Large group work)

- 1. As a class sitting in a circle, ask each student to share and read their descriptive sentence of their *Forest Creature*.
- 2. Teacher display *Forest Creatures*, tracings, and sentences in the classroom or hallway as a story about the school's garden.

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & labeling)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3-4: Individual

Pennsylvania Common Core: Language and Literacy

CC.1.2.6.J: Acquire and use accurately general academic and domain-specific words and phrases

Biological Sciences

3.2.4B: Describe objects in the world using the five senses.

BOTANOGRAPHY (bə'tæn-o-grafee)

Cellular | Letters & Words : Variation and Particularity in Names of Philadelphia Trees

Creation of annotated leaf cards that identify plants by their common and binomial names and their meaning.

Phase 1: Plant Collecting (Small group)

On a 'walk-about' in the neighborhood ask student groups of 2 to collect a variety of leaves from trees in the school's neighborhood (total of 10 different leaves each group). Ask students to photograph the trees that they gather leaves from.

Phase 2: Plant Sorting (Large group)

- 1. Introduce with lesson on "Common Names" and taxonomic "binomial names" (handouts)
- 2. In a large class group ask students to collectively sort collected leaves into categories: ie. variation and particulars (sensory observations like smell, texture, size, etc.) (sorting in a large group sitting in a circle, plants organized in center)

- 1. Nature Printing workshop (teaching skills of nature printing)
- 2. Students will print all 10 tree leaves. (Prints should be printed on cards or paper large enough to leave space for annotation and names.)

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & labeling)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3-4: Individual

Pennsylvania Common Core: Language and Literacy

CC.1.2.6.J: Acquire and use accurately general academic and domain-specific words and phrases

Biological Sciences

3.2.4B: Describe objects in the world using the five senses.

BOTANOGRAPHY (bə'tæn-o-grafee)

Cellular | Letters & Words: Variation and Particularity in Names of Philadelphia Trees.

Creation of annotated leaf cards that identify plants by their common and binomial names and their meaning.

Phase 3b: Writing (Individual work)

- Identify plants and group into like genuses using "I Naturalist" (<u>https://www.inaturalist.org/observations</u>) or "Encyclopedia of Life" (<u>https://eol.org/</u>) (Encourage students to use observation and process of elimination to identify plants in groups of two and three.)
- 2. Annotation of leaf prints, with common names in three languages and their taxonomic binomial names (genus and species). Common names in various languages can be found in the Encyclopedia of Life. Students should hypothesis the meaning of these words based on their investigations, sensory observations, and dictionary definitions of words. Naming in three languages could be extended into a lesson about cognates or culture.

Phase 4: Reflection (Individual work)

- 1. In student journals, ask students to reflect on the difference between "common names" and taxonomic binomial names.
- 2. In student journals, ask students to invent a common name for one tree they studied. They should invent this common name based on observations and feelings about the tree.

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & writing)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3: Individual

Pennsylvania Common Core: Language and Literacy

CC.1.2.7-12.J: Acquire and use accurately general academic and domain-specific words and phrases

Biological Sciences

3.3.7A Similarities and difference3.3.10A structural and functionalsimilarities and difference3.3.12A structure and function atlevels of organization

BOTANOGRAPHY (bə'tæn-o-grafee)

Plants | Words & Sentences : Lexicon of Leaf Shapes and Forms

Creation of a lexicon of a variety of leaf shapes using botanical nomenclature.

Phase 1: Plant Collecting (Small group)

On a 'walk-about' in the school garden or neighborhood ask student groups of 2 to collect a variety of plant leaves (total of 10 plant leaves each group). (tools needed: scissors)

Phase 2: Plant Sorting (Large group)

- 1. Introduce with lesson on complexity in leaf forms using Illustrations from Simpson (2010) *Plant Systematics*. (handouts)
- 2. In a large class group ask students to collectively sort collected plants into categories: ie. likeness of shapes based on initial observations. (sorting in a large group sitting in a circle, plants organized in center)

- 1. Nature Printing workshop (teaching skills of nature printing)
- 2. Students will print a collection of 6 leaf prints, label with correct common, genus, and species, and annotate them with botanically correct vocabulary for the basic parts of leaves and their varying degree of complexity. (Prints should be printed on cards or paper large enough to leave space for annotation and definitions.)

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & writing)

Mode(s) of Instruction:

Phase 1: Small Groups (2-3) Phase 2: Large Group (class) Phase 3: Individual

Pennsylvania Common Core: Language and Literacy

CC.1.2.7-12.J: Acquire and use accurately general academic and domain-specific words and phrases

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BOTANOGRAPHY (bə'tæn-o-grafee)

Plants | Words & Sentences : Lexicon of Leaf Shapes and Forms

Creation of a lexicon of a variety of leaf shapes using botanical nomenclature.

Phase 3b: Writing (Individual work)

- 1. Annotation of leaf prints shape: linear, narrowly oblong, oblong, narrowly elliptic, elliptic, widely elliptic, orbicular/circular, lanceolate, lance-ovate, ovate, widely ovate, oblanceolate, oblance-ovate, obovate, narrowly triangular, triangular, widely triangular, deltate, rhombic, trullate, acicular, ensiform, strap-shaped, cordate/cordiform, falcate, pandurate, reniform, spatulate, subulate. (using Illustrations from Simpson (2010) *Plant Systematics*.)
- 2. Using a dictionary, annotation of leaf prints with definitions of this botanical vocabulary: oblong, elliptic, circular, ovate, obovate, triangular, cordate.

Phase 4: Reflection (Large group work)

- 1. In student journals, ask students to reflect on the shapes and forms of the leaf forms discovered in their school garden or the trees and plants in the neighborhood around their school.
- 2. In student journals, ask students to reflect on the difference between shapes of leaves that they observed and annotated.

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & labeling)

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CC.1.2.7-12.J: Acquire and use accurately general academic and domain-specific words and phrases

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BOTANOGRAPHY (bə'tæn-o-grafee)

Plants | Words & Sentences : Simplicity vrs. Complexity Creation of annotated leaf cards that describe and annotate the basic botany of leaf structure: Simple vrs. Variations of Complexity

Phase 1: Plant Collecting (Small group)

On a 'walk-about' in the school garden or neighborhood ask student groups of 2 to collect a variety of plant leaves (total of 10 plant leaves each group). (tools needed: scissors)

Phase 2: Plant Sorting (Large group)

- 1. Introduce with lesson on leaf shapes using Illustrations from Simpson (2010) *Plant Systematics*. (handouts)
- 2. In a large class group ask students to collectively sort collected plants into categories: ie. degrees of simplicity and complexity. (sorting in a large group sitting in a circle, plants organized in center)

- 1. Nature Printing workshop (teaching skills of nature printing)
- 2. Students will print a collection of at least 6 leaf prints, label with correct common, genus, and species, and annotate them with botanically correct vocabulary for the shapes of leaves. (Prints should be printed on cards or paper large enough to leave space for annotation and definitions.)

Time Required:

Phase 1: 60 mins (plant collecting) Phase 2: 30 mins (plant sorting) Phase 3: 60 mins (printing & labeling)

Mode(s) of Instruction:

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BOTANOGRAPHY (bə'tæn-o-grafee)

Plants | Words & Sentences : Simplicity vrs. Complexity Creation of annotated leaf cards that describe and annotate the basic botany of leaf structure: Simple vrs. Variations of Complexity

Phase 3b: Writing (Individual work)

- 1. Annotation of leaf prints simplicity or complexity: simple, palmately compound, pinnately compound, bipinnately compound. (using Illustrations from Simpson (2010) *Plant Systematics*.)
- 2. Annotation of leaf prints, basic leaf parts: blade, primary vein, secondary veins, petiole, petioulule, leaflet, rachis, midvein. (using Illustrations from Simpson (2010) *Plant Systematics*.)
- 3. Using a dictionary, annotation of leaf prints with definitions of these botanical vocabulary: simple, simplicity, complex, complexity, palmate, pinnate, vein.

Phase 4: Reflection (Individual work)

- 1. In student journals, ask students to reflect on the shapes and forms of the leaf forms discovered in their school garden or the trees and plants in the neighborhood around their school.
- 2. In student journals, ask students to reflect on the difference between simplicity and complexity in the leaf forms that they observed and annotated.