

# Supplemental Material

*CBE—Life Sciences Education*

Kirchoff *et al.*

## Supplemental Material 1: Taxa studied with *VL-PI*, by set

Set A			Set B			Not in a Set		
Family	Genus	Common Name	Family	Genus	Common Name	Family	Genus	Common Name
Apiaceae	<i>Daucus</i>	Wild Carrot	Apocynaceae	<i>Asclepias</i>	Milkweed	Alismataceae	<i>Sagittaria</i>	Arrowhead
Araceae	<i>Arisaema</i>	Jack in the Pulpit	Apocynaceae	<i>Vinca</i>	Periwinkle	Arecaceae	(family only)	Palm family
Aristolochiaceae	<i>Aristolochia</i>	Dutchman's Pipe	Aspleniaceae	<i>Asplenium</i>	Spleenwort	Asteraceae	<i>Taraxacum</i>	Dandelion
Aristolochiaceae	<i>Asarum</i>	Wild ginger	Asteraceae	<i>Coreopsis</i>	Tickseed	Cucurbitaceae	family only	Gord Famiy
Berberidaceae	<i>Berberis</i>	Barberry	Asteraceae	<i>Erigeron</i>	Fleabane	Cycadaceae	<i>Zamia</i>	Coonite
Berberidaceae	<i>Mahonia</i>	Oregon grape	Asteraceae	<i>Helianthus</i>	Sunflower	Cyperaceae	<i>Cyperus</i>	Flatsedge
Berberidaceae	<i>Nandina</i>	Nandina	Betulaceae	<i>Betula</i>	Birch	Droseraceae	<i>Dionaea</i>	Venus fly trap
Caprifoliaceae	<i>Lonicera</i>	honeysuckle	Betulaceae	<i>Carpinus</i>	Hornbean	Droseraceae	<i>Drosera</i>	Sundew
Caprifoliaceae	<i>Viburnum</i>	no common name	Brassicaceae	<i>Brassica</i>	Mustard	Dryopteridaceae	<i>Polystichum</i>	Christmas Fern
Caryophyllaceae	<i>Dianthus</i>	Pink	Brassicaceae	<i>Cardamine</i>	Bittercress	Ephedraceae	<i>Ephedra</i>	Mormon-tea
Caryophyllaceae	<i>Silene</i>	Campion	Cactaceae	<i>Opuntia</i>	Prickley Pear	Geraniaceae	<i>Geranium</i>	Geranium
Caryophyllaceae	<i>Stellaria</i>	Chickweed	Commelinaceae	<i>Tradescantia</i>	Dayflower	Heliconiaceae	<i>Heliconia</i>	Heliconia
Cornaceae	<i>Cornus</i>	Dogwood	Crassulaceae	<i>Sedum</i>	stonecrop	Iridaceae	<i>Crocus</i>	Crocus
Cycadaceae	<i>Cycas</i>	Sago Palm	Cupressaceae	<i>Juniperus</i>	Juniper	Isoetaceae	<i>Isoetes</i>	Quillwort
Equisetaceae	<i>Equisetum</i>	Horsetail	Cupressaceae	<i>Sequoiadendron</i>	Giant Sequoia	Malvaceae	<i>Gossypium</i>	Cotton
Ericaceae	<i>Kalmia</i>	Mountain Laurel	Cupressaceae	<i>Thuja</i>	Arborvitae	Moraceae	<i>Ficus</i>	Fig
Ericaceae	<i>Rhododendron</i>	Rhododendron	Cycadaceae	<i>Cycas</i>	Sago Palm	Musaceae	<i>Musa</i>	Banana
Euphorbiaceae	<i>Euphorbia</i>	Spurge	Cyperaceae	<i>Carex</i>	Sedge	Nymphaeaceae	<i>Nymphaea</i>	Water-lily
Fabaceae	<i>Cercis</i>	Redbud	Fabaceae	<i>Trifolium</i>	Clover	Orchidaceae	(family only)	Orchid family
Fabaceae	<i>Wisteria</i>	Wisteria	Fabaceae	<i>Vicia</i>	Vetch	Pinaceae	<i>Pinus</i>	Pine
Fagaceae	<i>Fagus</i>	Beech	Ginkgoaceae	<i>Ginkgo biloba</i>	Maidenhair Tree	Platanaceae	<i>Platanus</i>	Sycamore
Fagaceae	<i>Quercus</i>	Oak	Hamamelidaceae	<i>Fothergilla</i>	Witch Adler	Portulacaceae	<i>Dodecatheon</i>	Shooting Star
Iridaceae	<i>Iris</i>	Iris	Hamamelidaceae	<i>Hamamelis</i>	Witch hazel	Rosaceae	<i>Fragaria</i>	Strawberry
Juglandaceae	<i>Carya</i>	Hickory	Hamamelidaceae	<i>Liquidambar</i>	Sweetgum	Rosaceae	<i>Prunus</i>	Plums etc.
Juglandaceae	<i>Juglans</i>	Walnut	Juncaceae	<i>Luzula</i>	Woodrush	Rosaceae	<i>Pyrus</i>	Pear
Lamiaceae	<i>Lamium</i>	Henbit	Lycopodiaceae	<i>Lycopodium</i>	Clubmoss	Rosaceae	<i>Spirea</i>	Spirea

Liliaceae	<i>Hemerocallis</i>	Daylily	Magnoliaceae	<i>Liriodendron</i>	Tulip tree	Selaginellaceae	<i>Selaginella</i>	Spikemoss
Liliaceae	<i>Lilium</i>	Lily	Magnoliaceae	<i>Magnolia</i>	Magnolia	Zingiberaceae	(family only)	Ginger family
Liliaceae	<i>Narcissus</i>	Daffodil	Malvaceae	<i>Hibiscus</i>	Hibiscus			
Moraceae	<i>Morus</i>	Mulberry	Malvaceae	<i>Tilia</i>	Basswood, Linden			
Oleaceae	<i>Forsythia</i>	Forsythia	Ophioglossaceae	<i>Botrychium</i>	Grape Fern			
Oleaceae	<i>Fraxinus</i>	Ash	Papaveraceae	<i>Argemone</i>	Pricklypoppy			
Ophioglossaceae	<i>Ophioglossum</i>	Adder's Tong	Papaveraceae	<i>Papaver</i>	Poppy			
Pinaceae	<i>Abies</i>	Fir	Papaveraceae	<i>Sanguinaria</i>	Bloodroot			
Pinaceae	<i>Cedrus</i>	Cedar	Poaceae	<i>Poa</i>	Blue Grass			
Pinaceae	<i>Tsuga</i>	Hemlock	Poaceae	<i>Uniola</i>	Sea oats			
Portulacaceae	<i>Claytonia</i>	Spring beauty	Polemoniaceae	<i>Phlox</i>	Phlox			
Psilotaceae	<i>Psilotum</i>	Whiskfern	Polygonaceae	<i>Polygonum</i>	Knotweed			
Pteridaceae	<i>Adiantum</i>	Maidenhair Fern	Polygonaceae	<i>Rumex</i>	Sheep Sorrel			
Ranunculaceae	<i>Aquilegia</i>	Columbine	Polypodiaceae	<i>Polypodium</i>	Polypody			
Ranunculaceae	<i>Caltha</i>	Marsh Marigold	Ranunculaceae	<i>Delphinium</i>	Larkspur			
Ranunculaceae	<i>Clematis</i>	Clematis	Ranunculaceae	<i>Hepatica</i>	Hepatica			
Sapindaceae	<i>Acer</i>	Maple, Box Elder	Ranunculaceae	<i>Ranunculus</i>	Buttercup			
Sapindaceae	<i>Aesculus</i>	Buckeye	Salicaceae	<i>Populus</i>	Aspen			
Saxifragaceae	<i>Heuchera</i>	Alumroot	Salicaceae	<i>Salix</i>	Willow			
Saxifragaceae	<i>Saxifraga</i>	Saxifrage	Scrophulariaceae	<i>Paulownia</i>	Princess tree			
Typhaceae	<i>Typha</i>	Cattail	Scrophulariaceae	<i>Veronica</i>	Speedwell			
Ulmaceae	<i>Ulmus</i>	Elm	Solanaceae	<i>Solanum</i>	Tomato			
			Violaceae	<i>Viola</i>	Violet			

## Supplemental Material 2: List of scripts, by week

This appendix gives the parameters of the weekly scripts, including the taxa included in each week's assignment. Items that were newly assigned are listed first. Items that were included for review (and not learned for the first time) are listed next. In some weeks, there were no new taxa as all of the plants were reviewed. The number of scripts is given at the end of each description, followed by the range of image display time in that week's scripts. Each script produced a response, grading file, were graded separately. A set number of points was awarded for each script on which a student received a score 90% or better. The taxa assigned in the scripts were keyed to each week's laboratory. No taxa were required in either of the first two laboratories. The scripts can be downloaded from the Metis LLC website ([www.metisllc.com](http://www.metisllc.com)), along with *VL-PI ver. 1.0*, which was used in the experiment.

**Week 3: Set A. New:** *Psilotum, Equisetum, Ophioglossum, Adiantum*. **Set B. New:** *Lycopodium, Botrychium, Polystichum, Asplenium* - **8 scripts, display times 3 – 4 seconds**

**Week 4: Set A. New:** *Cycas, Cedrus, Tsuga, Abies*. **Reviewed:** *Psilotum, Equisetum, Ophioglossum, Adiantum*). **Set B. New:** *Ginkgo, Juniperus, Thuja, Sequoiadendron*. **Reviewed:** *Lycopodium, Botrychium, Polystichum, Asplenium* - **7 scripts, display times 2 – 3 seconds for new taxa, 1.0 – 1.5 seconds for reviewed taxa**

**Week 5: Set A. Reviewed:** *Psilotum, Equisetum, Ophioglossum, Adiantum, Cycas, Cedrus, Tsuga, Abies*. **Set B. Reviewed:** *Lycopodium, Botrychium, Polystichum, Asplenium, Ginkgo, Juniperus, Thuja, Sequoiadendron* - **4 scripts, display times 0.8 – 1.5 seconds for reviewed taxa (all taxa were reviewed this week)**

**Week 6: Set A. Reviewed:** *Psilotum, Equisetum, Ophioglossum, Adiantum, Cycas, Cedrus, Tsuga, Abies*. **Set B. Reviewed:** *Lycopodium, Botrychium, Polystichum, Asplenium, Ginkgo, Juniperus, Thuja, Sequoiadendron* - **4 scripts, display times 0.5 – 0.8 seconds for reviewed taxa (all taxa were reviewed this week)**

**Week 7, Midterm Week Review:** The students were told to repeat as many of the old scripts as they wanted and to turn in the response files for those scripts. The number of scripts that were repeated varied widely among students.

**Week 8: Set A. New:** *Asarum, Aristolochia, Aquilegia, Caltha, Clematis, Mahonia, Berberis, Nandina*. **Set B. New:** *Magnolia, Liriodendron, Delphinium, Hepatica, Ranunculus, Sanguinaria, Argemone, Papaver* - **9 scripts, display times 1.5 - 2 seconds for new taxa (all taxa were new this week)**

**Week 9: Set A. New:** *Stellaria, Dianthus, Silene, Claytonia, Saxifraga, Heuchera*. **Reviewed:** *Aquilegia, Silene, Caltha, Clematis, Claytonia, Saxifraga, Berberis, Cycas, Cedrus, Caltha, Clematis*. **Set B. New:** *Hamamelis, Liquidambar, Fothergilla, Polygonum, Rumex, Sedum*. **Reviewed:** *Hamamelis, Liriodendron, Liquidambar, Delphinium, Hepatica, Ranunculus, Papaver, Sequoiadendron, Thuja, Juniperus, Ginkgo*) - **9 scripts, display times 1.2 – 2.0 seconds for new taxa, 1.2 – 1.5 seconds for reviewed taxa**

**Week 10: Set A. New:** *Euphorbia, Ulmus, Morus, Cercis, Wisteria*. **Reviewed:** *Tsuga, Abies, Dianthus, Silene, Cercis, Wisteria, Equisetum, Adiantum, Saxifraga, Heuchera, Nandina,*

*Saxifraga, Caltha, Clematis.* **Set B. New:** *Viola, Salix, Populus, Vicia, Trifolium.* **Reviewed:** *Liriodendron, Liquidambar, Sequoiadendron, Juniperus, Hepatica, Ranunculus, Papaver, Polygonum, Rumex, Sedum, Argemone, Hamamelis, Fothergilla, Ginkgo* - **11 scripts, display times 1.2 – 2.0 seconds for new taxa, 1.0 – 1.5 seconds for reviewed taxa**

**Week 11: Set A. New:** *Quercus, Fagus, Carya, Juglans, Acer, Aesculus.* **Reviewed:** *Psilotum, Equisetum, Ophioglossum, Adiantum, Cycas, Cedrus, Mahonia, Berberis, Aquilegia, Aristolochia, Ulmus, Morus, Cercis, Nandina.* **Set B. New:** *Betula, Carpinus, Brassica, Cardamine, Tilia, Hibiscus.* **Reviewed:** *Lycopodium, Botrychium, Polystichum, Asplenium, Juniperus, Thuja, Magnolia, Delphinium, Sanguinaria, Papaver, Populus, Liquidambar, Hamamelis* - **13 scripts, display times 1.2 – 2.0 seconds for new taxa, 0.8 – 1.0 seconds for reviewed taxa**

**Week 12: Set A. New:** *Cornus, Rhododendron, Kalmia, Forsythia, Fraxinus, Lamium, Daucus, Lonicera, Viburnum.* **Reviewed:** *Daucus, Dianthus, Silene, Viburnum, Lonicera, Aristolochia, Clematis, Lamium, Saxifraga, Asarum.* **Set B. New:** *Phlox, Solanum, Vinca, Asclepias, Veronica, Paulownia, Coreopsis, Erigeron, Helianthus.* **Reviewed:** *Hepatica, Vinca, Sanguinaria, Papaver, Coreopsis, Helianthus, Paulownia, Populus, Salix, Tilia* - **12 scripts, display times 1.2 – 2.0 seconds for new taxa, 0.5 – 1.5 seconds for reviewed taxa**

**Week 13: Set A. Reviewed:** *Silene, Stellaria, Claytonia, Lamium, Dianthus, Caltha, Clematis, Aquilegia, Cornus, Heuchera, Saxifraga, Equisetum, Psilotum, Adiantum, Ophioglossum, Kalmia, Rhododendron, Euphorbia, Morus, Cercis, Wisteria, Fagus, Quercus, Carya, Juglans, Fraxinus, Aesculus, Abies, Cedrus, Tsuga, Cycas, Berberis, Mahonia, Nandina, Forsythia, Daucus, Viburnum, Acer, Ulmus, Lonicera, Aristolochia.* **Set B. Reviewed:** *Asplenium, Polystichum, Lycopodium, Botrychium, Hibiscus, Argemone, Papaver, Sanguinaria, Juniperus, Sequoiadendron, Thuja, Ginkgo, Phlox, Viola, Hepatica, Ranunculus, Magnolia, Tilia, Populus, Salix, Coreopsis, Erigeron, Helianthus, Solanum, Fothergilla, Hamamelis, Liquidambar, Liriodendron, Trifolium, Vicia, , Delphinium, Sedum, Asclepias, Vinca, Paulownia, Veronica, Brassica, Cardamine, Polygonum, Rumex, Betula, Carpinus* - **11 scripts, display times 0.3 – 2.0 seconds for reviewed taxa (all taxa were reviewed this week)**

**Week 14: Set A. New:** *Arisaema, Lilium, Narcissus, Hemerocallis, Typha, Iris.* **Reviewed:** *Carya, Juglans, Cornus, Viburnum, Morus, Ulmus.* **Set B. New:** *Tradescantia, Cyperus, Carex, Poa, Uniola, Luzula.* **Reviewed:** *Betula, Carpinus, Coreopsis, Helianthus, Argemone, Papaver* - **9 scripts, display times 1.2 – 2.0 seconds for new taxa, 0.3 seconds for reviewed taxa**

**Review Before Final: Set A. Reviewed:** *Silene, Stellaria, Claytonia, Lamium, Dianthus, Caltha, Clematis, Aquilegia, Cornus, Heuchera, Saxifraga, Equisetum, Psilotum, Adiantum, Ophioglossum, Kalmia, Rhododendron, Euphorbia, Morus, Cercis, Wisteria, Fagus, Quercus, Carya, Juglans, Fraxinus, Aesculus, Abies, Cedrus, Tsuga, Cycas, Berberis, Mahonia, Nandina, Forsythia, Daucus, Viburnum, Acer, Ulmus, Lonicera, Aristolochia, Arisaema, Narcissus, Lilium, Hemerocallis, Iris.* **Set B. Reviewed:** *Asplenium, Polystichum, Lycopodium, Botrychium, Hibiscus, Argemone, Papaver, Sanguinaria, Juniperus, Sequoiadendron, Thuja, Ginkgo, Phlox, Viola, Hepatica, Ranunculus, Magnolia, Tilia, Populus, Salix, Coreopsis, Erigeron, Helianthus, Solanum, Fothergilla, Hamamelis, Liquidambar, Liriodendron, Trifolium, Vicia, Delphinium, Sedum, Asclepias, Vinca, Paulownia, Veronica, Brassica, Cardamine, Polygonum, Rumex,*

*Betula, Carpinus, Tradescantia, Luzula, Cyperus, Carex, Poa, Uniola* - **13 scripts, display times 0.3 seconds for reviewed taxa (all taxa were reviewed this week)**

# Supplemental Material 3A: Final Exam

## Biology 354, Plant Systematics Final Exam 2013

**Only the identification portions of the exam are included here.**

1. Place the correct **genus** name in the blank next to each description. (7 pts)

- A. *Asarum*:** Low-growing herbs with kidney-shaped leaves that grow from creeping rhizomes, and bear small, axillary brown or reddish flowers. [Set A]
- B. *Betula*:** Medium sized trees with alternate, singly or doubly serrate leaves. Bark with long, horizontal lenticels. Staminate catkins pendulous, pistillate flowers in pendulous or erect catkins. Fruit a samara with two wings. [Set B]
- C. *Cercis*:** Small trees; simple, round to heart-shaped leaves. Small red flowers appearing before the leaves are born in clusters on the stems. Flowers are vaguely pea-like (papilionaceous), but the uppermost petal is the smallest; stamens diadelphous, 9 + 1; fruit a legume. [Set A]
- D. *Sedum*:** Succulents varying from annual and creeping herbs to shrubs. Sepals 4 or 5; petals same number as sepals, white, pink or purple typically twice as many stamens as petals; pistils 4 or 5. [Set B]
- E. *Platanus*:** monoecious, wind pollinated trees of wet habitats. Reduced flowers borne in globose heads; fruit a ball-shaped aggregate of several hundred achenes. The mature bark peels off or exfoliates easily in irregularly shaped patches, producing a mottled, scaly appearance. [No Set]
- F. *Lilium*:** Perennial herbs from scaly bulbs; leaves alternate or whorled; flowers perfect, sepals, petals and carpels 3, stamens 6; sepals and petals separate, orange to red and spotted with purple; ovary superior; fruit a capsule. [Set A]
- G. *Psilotum*:** Herbs with a enations and dichotomous branching, no true leaves; three-lobed synangia borne in the axils of enations; homosporous. [Set A]
- H. *Delphinium*:** Herbs with leaves deeply 3-7 palmately lobed; flowers zygomorphic, with five petal-like sepals that form a spurred hollow pocket; 4 inconspicuous petals with the long spur of the upper sepal enclosing the nectar-containing spurs of the two upper petals; stamen numerous, carpels 1-3. Fruit an aggregate of follicles. [Set B]
- I. *Musa*** -Tree-like herbs with simple leaves that often tear; inflorescence emerging from the leaf sheaths as a drooping spike bearing flat "hands" of flowers; flowers unisexual, zygomorphic, 3-merous, ovary inferior; fruit a leathery berry. [No Set]

- J. *Quercus*:** Trees or shrubs with spirally arranged, often lobed leaves (a few with entire or serrate margins); buds clustered at twig tips; flowers in catkins, fruit a nut (called an acorn) borne in a cup-like cupule. [Set A]
- K. *Vinca*:** Herbs with slender trailing stems; leaves opposite, simple, broadly lanceolate to ovate; flowers salverform, of five usually violet petals. Fruit a follicle, sometimes. [Set B]
- L. *Berberis*:** Evergreen or deciduous shrubs; shoots dimorphic with thorns on the long shoots and short shoots bearing simple leaves; flowers orange or yellow and 6-merous with sepals often the same color as the petals. Fruit a small berry. [Set A]
- M. *Liquidambar*:** Large, deciduous trees with palmately 3- to 7-lobed leaves; flowers small, arranged in a dense globular inflorescence; multiple fruit of woody capsules, each capsule surmounted by two woody styles giving the fruit a spiny or prickly appearance. [Set B]
- N. *Hibiscus*:** Shrubs or herbs with unlobed to palmately lobed or dissected leaves; large, conspicuous trumpet-shaped flowers; sepals 5; petals 5 or more; stamens numerous filaments fused into a tube; fruit a dry capsule. [Set B]

2. Place the correct **family** name in the blank next to each description. (5 pts)

- A. *Pinaceae*:** Trees or shrubs; leaves evergreen, needle shaped or narrowly linear; plants usually monocious; pollen borne on microsporophylls; ovules borne on woody cone scales. [No Set]
- B. *Magnoliaceae*:** Trees or shrubs with large, conspicuous, actinomorphic flowers with numerous stamens and carpels. \*, 3, 6-∞, ∞, ∞ [Set B]
- C. *Caprifoliaceae*:** Shrubs or vines with opposite leaves; inflorescence a flat-topped corymb; flowers 5 (-4) merous and epigynous, with a multi-carpellate gynoeceium. \* (+), 5, (5), 5, 2-8 carpels in an inferior ovary. [Set A]
- D. *Violaceae*:** Herbaceous plants with stipulate leaves and a bilaterally symmetrical 5-parted corolla; lower petal with a spur; superior ovary of 3 united carpels; fruit a capsule that can be explosive. [Set B]
- E. *Oleaceae*:** Trees or shrubs with opposite simple or compound leaves; perianth commonly 4-parted, stamens 2; fruit a capsule, drupe, or samara. [Set A]
- F. *Ulmaceae*:** Trees or shrubs; leaves alternate, simple, stipulate, with oblique leaf bases; flowers zygomorphic; calyx of 4-8 sepals, corolla absent, stamens 4-8, gynoeceium superior of 2 carpels; fruit samara, nut or drupe. [Set A]



- G. Cupressaceae:** Gymnospermous trees or shrubs with small opposite or whorled leaves; wood lacks resin canals; ovulate scales either woody or fleshy and fused to subtending bract, bearing 2-15 ovules on their adaxial surface; seeds usually without wings. [Set B]
- H. Lycopodiaceae:** Herbaceous non-flowering plants with microphylls, ligules lacking; sporangia eusporangiate, on the adaxial surface or in the axils of sporophylls, sporophylls that either resemble ordinary foliage leaves or are quite different and grouped in definite strobili; plants homosporous. [Set B]
- I. Cucurbitaceae:** Coarse, tendril bearing vines with often yellow unisexual flowers; ovary inferior, fruit a pepo. staminate: \*, 5 (5), 5, 0; pistillate: \*, 5 (5), 0, 3 with an inferior ovary [No Set]
- J. Araceae:** Herbs in the temperate zone, typically of wet sites; leaves leathery, often pinnately veined; inflorescence a spadix surrounded by a spathe. \*, 0 or 2-3, 0 or 2-3, 4-10, 2-4 gynoecium syncarpous, ovary sometimes embedded in the spadix and inferior. [Set A]

Identify the plants whose pictures are displayed on the screen (1/2 pt each, 15 pts).

1. What family and genus is this?– Fagaceae, *Fagus* [Set A]
2. What family and genus is this?– Typhaceae, *Typha* [Set A]
3. What family and genus is this?- Aristolochiaceae, *Aristolochia* [Set A]
4. What family and genus is this?- Caryophyllaceae, *Stellaria* [Set A]
5. What family and genus is this?– Salicaceae, *Salix* [Set B]
6. What family and genus is this?- Cyperaceae, *Carex* [Set B]
7. What family and genus is this?- Oleaceae, *Forsythia* [Set A]
8. What family and genus is this?- Juncaceae, *Luzula* [Set B]
9. What family and genus is this?– Solanaceae, *Solanum* [Set B]
10. What family and genus is this?- Poaceae, *Uniola* [Set B]
11. What family and genus is this?- Magnoliaceae, *Liriodendron* [Set B]
12. What family and genus is this?- Hamamiliaceae, *Hamamilis* [Set B]
13. What family and genus is this?- Cornaceae, *Cornus* [Set A]

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14. What family and genus is this?- Euphorbiaceae, *Euphorbia* [Set A]
15. What family and genus is this?- Apocynaceae, *Asclepias* [Set B]
16. What family and genus is this?- Commelinaceae, *Tradescantia* [Set B]
17. What family and genus is this?- Cycadaceae, *Cycas* [Set A]
18. What family and genus is this?- Ophioglossaceae, *Ophioglossum* [Set A]
19. What family and genus is this?- Alismataceae, *Sagittaria* [No Set]
20. What family and genus is this?- Apiaceae, *Daucus* [Set A]
21. What family and genus is this?- Betulaceae, *Carpinus* [Set B]
22. What family and genus is this?- Moraceae, *Morus* [Set A]
23. What family and genus is this?- Caryophyllaceae, *Silene* [Set A]
24. What family and genus is this?- Papaveraceae, *Argemone* [Set B]
25. What family and genus is this?- Polygonaceae, *Polygonum* [Set B]
26. What family and genus is this?- Ericaceae, *Kalmia* [Set A]
27. What family and genus is this?- Papaveraceae, *Sanguinaria* [Set B]
28. What family and genus is this? – Ephedraceae, *Ephedra* [No Set]
29. What family and genus is this? – Geraniaceae, *Geranium* [No Set]
30. What family is this?- Arecaceae [No Set]

**Biology 354: Plant Systematics**  
**Final Exam - Part II: Identifications and keying – 14 pts total – KEY**  
(Living Plants – 1/2 pt each = 10 pts total)

1. What family and genus is this? - Berberidaceae, *Nandina* [Set A]
2. What family and genus is this? – Caprifoliaceae, *Lonicera* [Set A]
3. What family and genus is this? – Asteraceae, *Helianthus* [Set B]
4. What family and genus is this? – Scrophulariaceae, *Paulonia* [Set B]
5. What family and genus is this? – Cupressaceae, *Thuja* [Set B]
6. What family and genus is this? – Sapindaceae, *Acer* [Set A]
7. What family and genus is this? – Equisetaceae, *Equisetum* [Set A]
8. What family and genus is this? – Ranunculaceae, *Ranunculus* (lawns) [Set A]
9. What family and genus is this? – Juglandaceae, *Carya* [Set A]
10. What family and genus is this? – Polemoniaceae, *Phlox* [Set B]
11. What family and genus is this? – Moraceae, *Ficus* (near library) [No Set]
12. What family and genus is this? – Asteraceae, *Erigeron* [Set B]
13. What family and genus is this? – Polypodiaceae, *Polypodium* [Set B]
14. What family and genus is this? – Droseraceae, *Drosera* [No Set]
15. What family and genus is this? – Ginkgoaceae, *Ginkgo* [Set B]
16. What family is this? – Lamiaceae, *Lamium* [Set A]
17. What family and genus is this? – Iridaceae, *Iris* [Set A]
18. What family and genus is this? – Fabaceae, *Wisteria* [Set A]
19. What family is this? – Cactaceae, *Opuntia* [Set B]
20. What family is this? - Orchidaceae [No Set]



# 1. What genus and family?







2. What genus and family?





# 30. What family?



## Supplemental Material 4: Verbatim student comments

1. [no comments]
2. Using the software increased my visual recognition of the plants tremendously in this class. [positive]
3. It is a fantastic tool for improving plant identification ability, from my experience. [positive]
4. Overall enjoyed the program, it helped me better learn the required material. [positive]
5. It is a good program to use to get to know plants or any other identification of organisms. It probably will come to an advantage in other courses. [positive]
6. Instead of telling me that I correctly identified the plant restate the family + genus. [neutral]
7. It would be helpful to have more but grouped by family, at first, and then mixed more. It would also be helpful to have one script per session like the last ones. Overall a very helpful program. [positive]
8. [no comments]
9. Biggest problem was identifying pictures that contained more than one plant or where the picture was of a plant in the distance. Program did not allow enough time to focus eyes on picture before it produced to the next page. [equivocal]
10. [no comments]
11. It was very unfair that the software rounded up numbers to a whole percentage when in reality the actual percentage was different. Other than that one thing the software was VERY VERY Helpful. [positive]
12. I liked using the program, it made it a lot easier to learn so many plants. [positive]
13. Needs to be more user friendly. Where you don't have to upload scripts. [negative]
14. I enjoyed it but there are some edges to trim still feel is in beta. Two easy things to fix would be not allowing an answer to be entered unless it's a y/n in case another letter is accidentally hit. Or when nothing is in you [unintelligible] hit enter. [positive]
15. [no comments]
16. This software has the potential to be beneficial to class quizzes material but not all plans are in scripts being studied. The [unintelligible] was not helpful b/k it makes us identify to the same pic's over & over and not really familiarizes use w/ the plant. [equivocal]
17. The program was very helpful. [positive]
18. Only complaint: When 0.3 second show-time, it felt as if I was memorizing a background, not identifying a plant. I felt longer times were more beneficial to learning characteristics. [negative]
19. Very helpful and retentive form of visual identification that could be improved even more with additional genera pictures. [positive]
20. Nice program. I would have liked to use the other parts. [positive]
21. [no comments]
22. Suggestions: - Text that gives "affirmative" "you got it" – change to re-iterating family & genus etc. – tested on genus-had difficulty connecting visually to family. [negative]
23. [no comments]



24. I really felt that the plants I learned through the scripts really locked into my brain. I wish I would have had access to other unassigned scripts so that I would have known all the plants by site. [positive]
25. It helped me recognize the plants a lot easier. [positive]
26. Great program that helped me better identify all plants taught to us in class. [positive]
27. It was very useful though [unintelligible] at times especially when there were problems and the screen froze (thought it was great when it worked properly). [positive]
28. I think sometimes I memorized a picture rather than the plant and its characteristics. [negative]
29. I really found the program helpful. The repetition of distinctive features really reinforced key ID characteristics. I believe I would have benefited even more if I had had access to all of the scripts. Overall the program is awesome . . . In my experience at least. I did find it quite difficult initially to upload scripts, submit homework, etc., but other than that, no issues with the program itself. [positive]
30. I love the image naming as a study tool. I think the image comparison is pointless, and the image verification is a little helpful. Script assignments were unnecessarily tedious, however. I would prefer an option to type the genus names to find them to study, rather than having to search and select by family. [equivocal]
31. I thought it was helpful. Would have been better if able to use for all plants. [positive]
32. Never would have been able to learn the plants this semester without it. Excellent study tool!! [positive]
33. Loading the scripts and recording grades must be improved to make the program more user friendly. Other than that it helped me learn. [positive]
34. It was about to learn and identify the plants I were assigned. It was helpful with identification. [positive]
35. Great learning experience. It would be better if submission method was clearer. [positive]
36. It helped to identify plants, but took a long time to get through. [equivocal]
37. Without a doubt the program really did help a lot. [positive]
38. The program was a little difficult to install and I had trouble at first transferring the scripts into the proper files. However, I enjoyed the program very much. The homework was fun and I find that rare when taking a Biology course. [positive]
39. It was a great experience. Very helpful when trying to identify plants. [positive]
40. It was not helpful, and very time consuming. [negative]
41. I thought it was very helpful. Downloading and getting started was a little frustrating, but overall an important part of the class. [positive]
42. It helped a lot w/ memorizing different plants. [positive]
43. It was helpful but I feel I did more memorization than learning. [positive]



**Supplemental Material 5: Retest answer  
key**

Question	Family	Genus	Set
1	Ericaceae	<i>Kalmia</i>	A
2	Berberidaceae	<i>Mahonia</i>	A
3	Salicaceae	<i>Populus</i>	B
4	Apocynaceae	<i>Vinca</i>	B
5	Cornaceae	<i>Cornus</i>	A
6	Scrophulariaceae	<i>Veronica</i>	B
7	Sapindaceae	<i>Acer</i>	A
8	Malvaceae	<i>Tilia</i>	B
9	Polygonaceae	<i>Polygonum</i>	B
10	Papaveraceae	<i>Argemone</i>	B
11	Araceae	<i>Arisaema</i>	A
12	Aspleniaceae	<i>Asplenium</i>	B
13	Cyperaceae	<i>Carex</i>	B
14	Aristolochiaceae	<i>Asarum</i>	A
15	Papaveraceae	<i>Sanguinaria</i>	B
16	Fabaceae	<i>Cercis</i>	A
17	Oleaceae	<i>Forsythia</i>	A
18	Ophioglossaceae	<i>Botrychium</i>	B
19	Fabaceae	<i>Trifolium</i>	B
20	Ranunculaceae	<i>Hepatica</i>	B
21	Pteridaceae	<i>Adiantum</i>	A
22	Poaceae	<i>Uniola</i>	B
23	Hamamelidaceae	<i>Fothergilla</i>	B
24	Saxifragaceae	<i>Saxifraga</i>	A
25	Ophioglossaceae	<i>Ophioglossum</i>	A
26	Magnoliaceae	<i>Magnolia</i>	B
27	Euphorbiaceae	<i>Euphorbia</i>	A
28	Liliaceae	<i>Narcissus</i>	A
29	Ranunculaceae	<i>Delphinium</i>	B
30	Moraceae	<i>Morus</i>	A
31	Liliaceae	<i>Hemerocallis</i>	A
32	Juncaceae	<i>Luzula</i>	B
33	Cycadaceae	<i>Cycas</i>	A
34	Pinaceae	<i>Cedrus</i>	A
35	Ranunculaceae	<i>Caltha</i>	A
36	Lycopodiaceae	<i>Lycopodium</i>	B
37	Ericaceae	<i>Rhododendron</i>	A
38	Pinaceae	<i>Abies</i>	A
39	Brassicaceae	<i>Brassica</i>	B

