Lesson: "Identifying Angiosperms" By Oksana Hlodan
Source: http://www.actionbioscience.org/newfrontiers/hazen.html

**ActionBioscience.org lesson**

**Identifying Angiosperms** (July 2007)
By Oksana Hlodan
American Institute of Biological Sciences

**Description**
The lesson combines research and photography skills. Handout 1 can serve as an introduction for middle school and high school students to a unit on biological classification or a refresher for advanced high school students about how biological classification works. Handout 2 examines classification, co-evolution, and the mystery of disappearing bees crucial to the pollination of flowers. It is suitable for advanced high school students and college students taking an introductory botany course. Students need to know that species names and groupings are not arbitrary. Taxonomists have developed a way to group organisms that would distinguish one species from another and would reflect the relationships that exist between life forms.

**Grades & Levels:**
- **Handout 1:** middle school – high school
- **Handout 2:** advanced high school levels – college, year 1

**Time Recommendations:**
- Up to three weeks for taking photographs, research, and developing presentations
- One to two class periods for presentation and discussion

**NSES (USA) Content Standards:**
- NSES 2.1. Science as Inquiry: Understanding about scientific inquiry
- NSES 4.3. Life Science: Biological evolution
- NSES 7.3: Science in Personal/Social Perspective: Natural resources
- NSES 8.2. History & Nature of Science: Nature of scientific knowledge

Note: View the NSES content standards on this site to choose other curricular applications for additional activities at http://www.actionbioscience.org/educators/correlationcharts.html

**Lesson Objectives:** Engaging students in scientific inquiry using photographs and research that supports the photographs helps students to:
- develop skills in biological classification
- become familiar with binomial nomenclature
- understand the principles of co-evolution

**Key Words Include:** angiosperm, co-evolution, conservation genetics, ecosystem, hybrids, (species) lineage, gene flow, pollination, polyploidy, symbiosis
Preparation

**Article Discussion:** Several approaches are possible for the questions on page 3:
1. Have students read the article on their own, or distribute questions to groups.
2. Give students copies of the questions and have them do the reading and complete the content questions on their own, perhaps as a short-answer writing assignment. Have them discuss their answers and the more complex questions either as a large group or in small groups.
3. For younger students, you may want to introduce the topic by having them play interactive games or do quizzes on classification. See "useful links for teachers" at the end of the article.

**Handout 1:** Student activities will focus on three tiers of the classification system: family, genus, and species (see chart in student handout). In addition, students will practice binomial nomenclature, the two-word name of species, which will help them classify the flowers they choose to photograph.

**Handout 2:** In addition to the learning elements in Handout 1, students will also explore the concept of order (see chart in handout) and symbiotic relationships.

**Materials Needed:** Computer with digital photography importing and editing software, digital camera(s), screen and projector with computer connectivity (alternately, students can submit assignments on a CD or download their file to a portable flash memory device or other device to transfer to your computer)

**Resources:** See the "Useful links for educators" for resources ranging from instruction in photography to botany and classification basics. The "Useful links for students" will help students with the activities in this lesson.

**Assessment rubric for activities involving photography**

*Note:* The quality of student photos is not assessed. Students are not expected to be professional photographers. Basic photography skills are the only requirement.

<table>
<thead>
<tr>
<th>Skill</th>
<th>Below Average</th>
<th>Satisfactory</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>0-4</td>
<td>5-7</td>
<td>8-10</td>
</tr>
<tr>
<td>Organization</td>
<td>0-4</td>
<td>5-7</td>
<td>8-10</td>
</tr>
<tr>
<td>Creativity</td>
<td>0-4</td>
<td>5-7</td>
<td>8-10</td>
</tr>
<tr>
<td>Written Submission</td>
<td>0-4</td>
<td>5-7</td>
<td>8-10</td>
</tr>
<tr>
<td>Discussion</td>
<td>0-4</td>
<td>5-7</td>
<td>8-10</td>
</tr>
</tbody>
</table>
For Educators: Article Discussion
About the interview with Pamela Soltis, Ph.D.:
Flowering Plants: Keys to Earth's Evolution and Human Well-Being?
http://www.actionbioscience.org/genomic/soltis.html

Article Content Questions

1. Where would you find flowering plants?
2. What do angiosperms do for humans?
3. What is meant by polyploidy and why is it important in evolution?
4. What is hybridization?
5. What is one clue that there is a lot of genetic diversity in polyploid species?
6. What does the Flower Genome Project hope to accomplish?
7. How is the fossil record important to understanding angiosperm lineages?
8. Give an example of a flowering tree that helped medical research.
9. How does understanding evolution help agriculture?
10. What problem are scientists trying to solve in Florida?
11. How is the Florida problem indicative of global problems?

Article Extension Questions

1. Name as many ways as you can that flowers benefit humans.
2. How would human well-being be affected if some angiosperms became extinct?
3. Why do you think angiosperms are the largest group of plants?
4. Why do you think there are so many flowering species of the same genus?
5. Why do you think botanical gardens are important?
6. If you could have a school or home garden, which flowering plants would you choose to add to the garden? Why?

Photo credits:
Chart in Handouts 1 and 2, Honeybee photo: Wikimedia Commons
Flower photos: Oksana Hlodan
Identifying Angiosperms Handout 1

What are angiosperms?

Angiosperm is the botanical name for a flowering plant. When you think of angiosperms, don't think only of ornamental flowers you plant in your garden. Flowering plants include flowering shrubs, flowering trees, and wildflowers.

What are angiosperm families?

Scientists have a special system to organize and name all living things. Every kind of plant belongs to its own group, or "species." Species that are similar belong to a larger group, called a "genus." Then related genus groups belong to the same family. This classification system was created by Carl Linnaeus in the 1700s. He's also the one who gave us the binomial (two-name) way of identifying species. The first part of the name is the genus or "generic" grouping. The second part is the species name or "specific" grouping. As was customary at the time, Linnaeus used Latin for names, e.g., a coyote is Canis lupus (always in italics and a capital first letter of the genus). Canis is the genus and lupus is the species. Fortunately, computers have given us lots of botany databases where you can search by common name to find the scientific name. That's quite helpful since the number of species of flowering plants is estimated to be in the range of 250,000 to 400,000. The minimum number of families of angiosperms is 402 (the number varies slightly, depending on the criteria you use to classify them).

The most diverse families of angiosperms are: Orchidaceae (orchid family), Asteraceae (daisy family), Fabaceae (pea family), Rubiaceae (madder family), Poaceae (grass family), Euphorbiaceae (spurge family), Malvaceae (mallow family), Cyperaceae (sedge family), and Araceae (aroid family). Did you notice that scientific family names end in "eae"? You don't use italics for scientific family names.

What is the assignment?

1. You are to take photos of 2 species/subspecies within the same family. Do the same for a total of 5 families. That's a total of 10 photographs.
2. For each photo, provide the common name and the scientific name and note its family.
3. Submit the assignment in any presentation format you wish. For example: a slideshow using PowerPoint, a web page, a Word doc.
4. The teacher will instruct you how to upload or submit your presentation.
5. After all presentations are uploaded, photos from each submission will be screened in class. Students will be expected to ask questions about the photos, so be prepared to discuss your photos.
"Identifying Angiosperms" Handout 1 cont'd

Example:

Goodeniaceae family

- Blue Fan Flower
  *Scaevola aemula*

Species/Subspecies #2 Photo

- Common name
  Binomial scientific name

Note: You are not required to follow the design of the above example for your presentation. Use your own creative choice for presentation.

Tips for photos:

- All photos must be original, not copied from online or print sources. Look for real, not fake, flowers around your home, school, or neighborhood. Consider hitching a ride with your parents or friends to a commercial plaza that has a garden center. Call the garden center ahead of time. Some businesses do not allow people to take photos at their establishment. Hint: a garden center will likely have labels on their plants that provide the common name, and if you are lucky, the scientific name.
- Take close-ups of plants to highlight the flower(s). Use macro/foliage mode. Sometimes a flash is necessary if the flower is in a dark or indoor location. If you need more help, see the links in the "useful links for student research" at the end of the Soltis interview.
- You can crop photos but do not use any other photo editing techniques.
- Bees and other stinging insects love flowers. If you are allergic to their stings, talk to the teacher. The teacher will set you up with a partner. You can do the research and your partner can take pictures for two assignment submissions, i.e., 20 photographs. Then you can divide the photos into 2 sets of 10 to create your individual presentations.

Tips for research:

- To match your photos of flowers to their scientific genus name or family, start with the links provided in "useful links for student research" found at the end of the Soltis interview. If these fail you, try searching for the common or genus name of the species on the Internet, e.g., in garden web sites.
- In some cases, there are so many varieties of a popular flower, such as the red rose, that only an expert can distinguish species among them. So, if you take a photo of a red rose and you don't know its common name, e.g., Deep Secret tea rose, it is sufficient for this assignment to choose the most likely common and genus names.
Identifying Angiosperms? Handout 2

1. Shutterbug Classification

**Introduction**

Every kind of plant belongs to its own group, or "species." Species that are similar belong to a larger group, called a "genus." Then related genus groups belong to the same family. Further up the system, families are grouped by special characteristics within an order. For example, the red maple, *Acer Rubrum*, belongs to the *Acer* genus, Aceraceae family, the Sapindales order because it is one of the sap-producing angiosperms. Note that in modern classification there may be "sub" or "super" classification levels. For example, varieties of pea plants may be classified as subspecies.

The classification system was created by Carl Linnaeus in the 1700s. He's also the one who gave us the binomial (two-name) way of identifying species. The first part of the species name is the "generic" grouping or genus. The second part is the "specific" grouping or species. Unfortunately, he used Latin for names, e.g., a coyote is *Canis lupus* (always in italics and a capital first letter of the genus). *Canis* is the genus and *lupus* is the species. Fortunately, computers have given us lots of botany databases where you can search by common name to find the scientific name. That's quite helpful since the number of species of flowering plants is estimated to be in the range of 250,000 to 400,000. The minimum number of families of angiosperms is 402 (the number varies slightly, depending on the criteria you use to classify them).

Linnaeus classified species to identify them easily. Today, because of new technology and methods, scientists consider that classification should reflect the Darwinian principle of common ancestry. So, there are efforts underway to rework elements of the classification system.

**Your assignment**

- You are to take photos of 2 species/subspecies within the same angiosperm family. Do the same for a total of 5 families. That's a total of 10 photographs.
- For each photo, provide 1) the common name 2) the scientific name 3) family name, and 3) order name.
- For each family and order write a brief notation about the primary special characteristics.
- Submit the assignment in any presentation format you wish. For example: a slideshow using PowerPoint, a web page, a Word doc, and iMovie, etc.

After all presentations are uploaded, photos from each submission will be screened in class. Students will be expected to ask questions about the photos, so be prepared to discuss your photos.
FYI: The most diverse families of angiosperms are: Orchidaceae (orchid family), Asteraceae (daisy family), Fabaceae (pea family), Rubiaceae (madder family), Poaceae (grass family), Euphorbiaceae (spurge family), Malvaceae (mallow family), Cyperaceae (sedge family), and Araceae (aroid family). Did you notice that scientific family names end in "eae"? You don't use italics for family or order names.

Example:

**Alismatales order (herbaceous, inflorescence cluster, usually aquatic)**

**Araceae family (flowers borne on a spadix)**

- **Peace Lily**
  - *Spathiphyllum wallisii*

- **Species/Subspecies**
  - #2

- **Photo**

- **Common name**
  - Binomial scientific name

**Note:** You are not required to follow the design of the above example for your presentation. Use your own creative choice for presentation.

**Tips for photos:**

- All photos must be original, not copied from online or print sources. Look for real, not fake, flowers around your home, school, or neighborhood. Consider hitching a ride with your parents or friends to a commercial plaza that has a garden center. Call the garden center ahead of time. Some businesses do not allow people to take photos at their establishment. *Hint:* a garden center will likely have labels on their plants that provide the common name, and if you are lucky, the scientific name.
• Take close-ups of plants to highlight the flower(s). Use micro/foliage mode. Sometimes a flash is necessary if the flower is in a dark or indoor location. If you need more help, see the links in "useful links for student research at the end of the Soltis interview.
• You can crop photos but do not use any other editing techniques.
• Bees and other stinging insects love flowers. If you are allergic to their stings, contact the teacher. The teacher will set you up with a partner for the assignment. You can do the research and your partner can take pictures for two assignment submissions, i.e., 20 photographs. Then you can divide the photos into 2 sets of 10 to create your individual presentations.

Tips for research:
• To match your photos of flowers to their scientific genus name, family, or order start with the links provided in "useful links for student research" at the end of the Soltis interview. If these fail you, try searching for the common or genus name of the species on the Internet. Many garden web sites provide scientific information at least up to the family name and sometimes higher in the classification system.
• In some cases, there are so many varieties of a popular flower, such as the red rose, that only an expert can distinguish species/subspecies among them. So, if you take a photo of a red rose and you don't know its full common name, e.g., Deep Secret tea rose, it is sufficient for this assignment to choose the most likely common and genus names.
• If you discover "sub" or "super" classifications of a flower, you may want to add them to your presentation.

2. Flowers and Friends

Co-evolution happens when two species evolve together because they influence each other in some way. This relationship is often called "symbiotic." For example, some insects and flowers have co-evolved because they depend on each other for survival – bees pollinate flowering plants and the plants provide food for the bees. Find one example of a flowering species that has co-evolved with another species for mutual benefit and survival. Write a report or create another type of presentation to explain the evolutionary relationship between the two species. If possible, illustrate your presentation with photographs that you take or find on the Internet. Make sure that any photos from online sources allow free use for educational purposes.

3. Mystery of the Disappearing Bees

Beekeepers throughout the U.S. and elsewhere are perplexed about the disappearance of bees from hives. Sometimes entire colonies vanish. Research the mystery and write a two-page editorial or opinion piece that explains your hypothesis for the disappearance. Provide examples of instances where bees have vanished. Support your hypothesis with references from scholarly studies. Conclude your paper with your views of what might happen if this situation reaches crisis proportions.