

# “The Sunflower Project”

## Nebraska Roots: Botany, Art and Culture



### Interdisciplinary Curriculum for Grades 8-12 From the Nebraska Statewide Arboretum

The Nebraska Statewide Arboretum has been promoting school gardens, “Nebraska-style” landscaping and plant science literacy for nearly three decades.

A comment made by a teacher in western Nebraska continues to challenge us... “They don’t even know the plants out their own backdoor.” With that in mind, we turn to a plant common throughout the state to help connect students to the beauty and wonder of plants. It is a weed to some, to others a symbol of what we are—adaptable, hardy, varied and either beautiful or common, depending on your perspective.

In this curriculum, you will find opportunities to draw your students’ attention to one of the plants out their own backdoor—to look at it, talk about it, ask their parents and grandparents about it, draw it, study it botanically, think about how it responds to environmental cues, consider its impact on the economy, the culture and the environment... and hopefully both lose themselves and find themselves in the process.



[arboretum.unl.edu](http://arboretum.unl.edu)  
Karma Larsen 402/472-7923



[www.unl.edu/artsarebasic](http://www.unl.edu/artsarebasic)  
Rhea Gill 402/472-6844



[www.nebraskaartscouncil.org](http://www.nebraskaartscouncil.org)

“Wherever humans have gone, sunflowers have followed. The sunflower is the consummate American plant: tenacious, brash, bright, open, varied, optimistic, and cheerful, it might well be considered the true American flower. The impressive physiological characteristics of the sunflower and its very long association with mankind are worthy of a lifetime of study... From its complex natural history, its persistence, its great appeal as a symbol of the sun, and its usefulness, we gain insight not only about this plant but the plant kingdom as a whole.”

Lady Bird Johnson, *Wildflowers Across America*

“The Sunflower Project” Interdisciplinary Curriculum for High Schools  
and Arts Curriculum for K-12 were created by the staff of the  
Nebraska Statewide Arboretum

Acknowledgements:

Arts Are Basic

Nebraska Arts Council

Nebraska Department of Education—Jim Woodland, Director of Science Education

University of Nebraska-Lincoln

Institute of Agriculture and Natural Resources

UNIVERSITY OF  
**Nebraska**  
Lincoln



The CD “Sunflowers of Nebraska: A Practical Guide to Identifying Sunflowers”  
was created by Kay Kottas, UNL Research Specialist in Agronomy & Horticulture

For more information, contact the Nebraska Statewide Arboretum

402/472-2971

[arboretum.unl.edu](http://arboretum.unl.edu)

[schoolgardens.unl.edu](http://schoolgardens.unl.edu)

# **“The Sunflower Project” Interdisciplinary Curriculum**

## **Table of Contents**

NOTE: All of the projects in this curriculum are “stand alone” projects that can be completed without reference to previous ones. Subject matter tie-ins are listed in parentheses after the project, but overlapping interdisciplinary goals can be found throughout the curriculum.

1. Ethnobotany—The Uses of Plants (Science, Reading/Writing, Environmental Studies)
2. The Heritage of Plants (Interview and Oral Presentation—Writing/Speaking)
3. The Botany of Sunflowers (Science)
4. Plants in the Physical Environment (Life Science, Writing, Environmental Studies)
5. Plants in the Cultural Environment (Writing/Speaking, Social Studies)
6. Plants in the Economy—Local and Global (Social Studies)
7. Phototropism in Plants (Life Science)
8. Native to This Place (Science, Life Science)
9. Plants and Landscapes as Inspiration for Visual Art (Reading)
10. Plants and Landscapes as Inspiration for Writers (Reading/Writing/Speaking)

Appendix A. Ethnobotany: The Uses of Sunflowers

Appendix B. Botany of Sunflowers

Appendix C. Economic Impact of Sunflowers

Appendix D. Phototropism: A Case Study on Sunflowers

Graphics Appendix A. Primary Sunflowers of Nebraska

Graphics Appendix B. Sunflower Details

Graphics Appendix C. Botany of Sunflowers

Graphics Appendix D. Artistic Interpretations of Sunflowers

## 1. Ethnobotany—The Uses of Plants

(Science, Reading/Writing, Environmental Studies)

Define the term “ethnobotany.” Use a variety of references to define the term: dictionary, encyclopedia, internet search, etc.

Summarize or simplify the meaning by putting it in your own words.

What are the primary uses for plants?

What plants immediately come to mind in terms of usage?

Which usage do you believe was the most important in previous generations?

In today’s world?

What might account for a change in usage?

What plants were used in the past for medicinal purposes? By what regional or ethnic groups?

What plants are currently used for medicinal purposes?

Has Native American knowledge of medicinal properties been accepted/used by contemporary culture?

What plants, and what uses for plants, might grow in importance in the future?

**Research the use of plants to remove toxic wastes** from the environment and write a paper about an instance in which plants were used to clean up wastes. **Phytoremediation.** “The use of plants to absorb pollutants from air, water and soil.”

**Select a plant** other than sunflowers and compile information about all the ways in which that plant has been used or could be used.

### RESOURCES:

APPENDIX A—The Uses of Sunflowers, “Sunflowers as Medicine” and “Sunflowers for Agriculture and Industry”

*Science News* July 20, 1996 (vol. 150 No. 3, page 42) “**Botanical Cleanup Crews...** Rafts with sunflowers growing on them float on a small pond at the Chernobyl nuclear accident site in the Ukraine. No, it’s not some touching monument to the 1986 disaster. The plants are helping to clean the pond; their roots dangle in the water to suck up the radionuclides cesium 137 and strontium 90....”

STATE STANDARDS: SCIENCE “Role of science in local or global challenges” 12.7.6 and 12.8.3  
READING, WRITING “Using primary and secondary resources” 12.1.2 and 12.2.2

## **2. The Heritage of Plants**

(Interview and Oral Presentation—Writing, Speaking)

Using the questions from “1. Ethnobotany—The Uses of Plants,” interview at least three people, preferably your parents, grandparents or other older individuals in your community. Try to include individuals from different ethnic groups—Native, Hispanic, or Asian Americans, etc. You will need to have their answers in writing but, if you like, you can tape the interview and record it in writing later.

What comes to their mind when they think of the word sunflower?

What memories do they have of sunflowers?

Do they think of them as occurring in cultivated landscapes or in the wild?

How different are their associations from your own?

If they are different, why?

What changes in the environment or the culture might account for differing perspectives?

Think of at least five other questions about the environment they lived in and its impact on their lives.

### **ORAL PRESENTATION**

Give an oral presentation of the interviews either to the classroom or to a small group within the classroom.

After the presentations have been made, discuss as a group whether their responses were different than the responses of students in the classroom.

Of all the individuals whose responses you heard, was there a particular culture, age group or vocational perspective that had a stronger connection to sunflowers or other plants native to the region?

What might account for that difference?

STATE STANDARDS: WRITING “Different audiences and purposes” 12.2.4 and “Self-generated questions and note-taking” 12.2.5

SPEAKING “Oral presentations” 12.3.2

### **3. The Botany of Sunflowers** (Science)

What is the definition of a sunflower?

Define taxonomy. Who is credited with creating the method we use today?

Define binomial nomenclature.

Why do plants have both common and botanical names?

What family are sunflowers in? What other plants do you think might be in the same family?

What genera are “true” sunflowers in? What are the characteristics of a “true” sunflower?

Compare and contrast a “true” sunflower and one that is not. Can that distinction be made by looking at the flower?

The primary role of flowers is their function in reproduction, although we admire them because they are colorful, fragrant and showy. What is the primary purpose of these appealing characteristics?

The inflorescence of a plant is one characteristic that helps to identify a plant. What are two other botanical characteristics that can be used to identify a plant?

**ACTIVITY 1:** Have students bring in sunflowers from a variety of sites and practice keying them in the classroom. (Use the “Key to Nebraska Sunflowers” in APPENDIX B).

**ACTIVITY 2:** Draw a sunflower and identify as many parts as you are able. If sunflowers are in season or if you have access to a dried one, slice it in half and separate the different parts.

#### RESOURCES:

#### APPENDIX B—Botany of Sunflowers

The CD “Sunflowers of Nebraska: A Practical Guide to Identifying Sunflowers” created by Kay Kottas, UNL Research Specialist in Agronomy & Horticulture, can be found at [schoolgardens.unl.edu](http://schoolgardens.unl.edu)

#### GRAPHICS APPENDIXES A-C

CD “Sunflowers of Nebraska: A Practical Guide to Identifying Sunflowers”

#### **4. Plants in the Physical Environment**

(Life Science, Writing, Environmental Studies)

Where would you be most likely to find sunflowers in the landscape?

Would you find them most readily where they had been planted by humans or where they were part of the natural vegetation?

What kind of natural environment are they likely to be found in?

What does its natural environment reveal about the plant, i.e. what does the environment in which it occurs tell us about what it tolerates or what it requires?

What other plants or what “plant communities” might it be likely to be found with?

What insects or wildlife might it attract? Why? What characteristics does it have that would cause the attraction?

The sunflowers in this curriculum are abundantly found, yet exist in communities with many other diverse plants and animals that interact. Nebraska has 1,470 native plant species. Why is plant diversity important?

Select one of the “true sunflowers” found in upland grassland habitat. Explore resources to find and list two other native forbs and two native grasses that are part of the same plant community.

Think about the “community” (plants, humans, physical structures, insects and wildlife) sunflowers exist in and write an essay about them as parts of that community.

NOTE: Your essay need not be literal. You may want to think about the characteristics of a sunflower or other plant or plants, and write about those same characteristics as they might occur in a very different community—a group of individuals, a series of buildings, animals in a group setting like a farmyard or a zoo, a system of planets or machines, etc.

RESOURCES:

APPENDIX B—Botany of Sunflowers

GRAPHICS APPENDIXES A-C

ARTS PROJECT 1—Observing the Subject (Variation b)

ARTS PROJECT 8—Playing with Different Perspectives

STATE STANDARDS: LIFE SCIENCE “Interdependence of Organisms” 12.4.4

WRITING “Different audiences and purposes” 12.2.4 and “Self-generated questions and note-taking” 12.2.5

SPEAKING “Oral presentations” 12.3.2

## **5. Plants in the Cultural Environment**

(Writing/Speaking, Social Studies)

Do plants influence the culture in which they're found?

What are some examples of the ways they influence the culture of the region where they're found (in the United States or in other countries)?

Give some examples of how plants influence architecture.

Influence diet.

Influence the health of a population.

Are there particular countries or cultures that are more likely to be influenced by vegetation and the physical environment? What countries or cultures and why?

Do you think the impact of regional plants has diminished or increased in recent history?

Do some research to substantiate your assumptions. (See "6. Plants in the Economy" and APPENDIX C—Economic Impact of Sunflower")

What are the disadvantages and advantages to that influence?

What other plant or plants native to your region are most important to your local or regional community? Why?

Write an essay about how plants influence a culture. Write it in a form that best suits your goals as a writer. Is your goal to narrate, persuade, describe, inform or entertain? Select a form that best suits your purposes, using anything from a factual scientific report to an imaginative work of science fiction.

Present it to the classroom in an oral presentation.

STATE STANDARDS: WRITING "Different audiences and purposes" 12.2.4

SPEAKING "Oral presentations" 12.3.2

SOCIAL STUDIES "How regional landscapes reflect the cultural characteristics of their inhabitants" 12.4.2

## **6. Plants in the Economy—Local and Global** (Social Studies)

Do much do plants influence the economy of a country?

What are the most significant ways in which they impact a nation's wealth? (in the United States or in other countries)?

Are there particular environments, cultures or countries that might be more likely be influenced by vegetation and the physical environment?

Has that influence diminished or increased over time?

What are the disadvantages and advantages to that influence?

What are reasons that demand for particular plants fluctuates? (trends, scientific research)

What are reasons that supply of a particular plant fluctuates?

What is a global market?

Define the following words: Supply and demand, Production, Export, Import

What changes, related to sunflowers, occurred in the 1500s? What other things were brought back to Europe?

What plant-related inventions were created and used in the 1700s in Europe?

What events in Russia in the 1920s had an impact on the use of sunflowers?

Select a crop and do research to determine how much of that crop your county produces, using the internet resource: [http://www.nass.usda.gov/Charts\\_and\\_Maps/Crops\\_County/index.asp](http://www.nass.usda.gov/Charts_and_Maps/Crops_County/index.asp)

What is the primary crop produced in your county?

### RESOURCES:

APPENDIX C—Economic Impact of Sunflower

STATE STANDARDS: SOCIAL STUDIES “U.S. free market economy” 12.3.11

## 7. Phototropism in Plants

(Life Science)

Does a plant move?

What is a tropism? Geotropism? Phototropism?

Have you ever noticed plants “orient” themselves (“to arrange with reference to the east”) according to the location of light?

What would happen if a light source was placed in an unlikely location, such as below the plant?

What other environmental factors can you think of that might cause a plant to move or face a different direction? (e.g. touch, water, gravity)

Do you think phototropism is a more common response in sun-loving or shade-loving plants? Why? (Note: Any plant, even a shade-loving plant, has the capacity for phototropic responses if the stimulus is present. Describe or observe how some houseplants will “reach for the light.”)

How does phototropism help a plant to survive in both the forest and the prairie?

Discuss succession, fire and competition and how responding to light may be advantageous.

### **Possible activities:**

**Grow sunflowers** in the classroom (or outside) and record their growth rate and reaction to light movement.

**Develop a hypothesis** about how a plant might respond to an environmental cue. Create an experiment to test the hypothesis.

### **Phototropism in Sunflowers**

**Morning.** As the sun comes up, IAA begins to accumulate on the opposite or western side of the plant. IAA is a growth hormone, so cells begin to grow where it accumulates. This is why sunflowers will often face east in the morning as the sun rises.

**Afternoon.** The best shade from the sun is directly under the sunflower head so this is where the IAA accumulates. Stem elongation occurs as a result of IAA.

**Early Evening.** Now the sun has moved to the west so IAA is building up on the east side. The same thing occurs and tissues elongate on that side, causing the head to “bend” toward the sun.

**Night.** At night, IAA is spread throughout the entire plant, but it will always “hide” from direct sunlight by building up on the side of the plant opposite the location of the sun.

**Vocabulary and Concepts:** Phototropism, Tropism, Indole Acetic Acid or IAA, Plant growth regulators, Auxin, Hormone, Cell Elongation, Adventitious

## APPENDIX D—Phototropism: A Case Study on Sunflowers

STATE STANDARDS: LIFE SCIENCE “Matter, energy and organization in living systems” 12.4.5 and “Behavior of Organisms” 12.4.6

## **8. Native to This Place**

(Life Science, Science, Environmental Studies)

What is a “native plant”?

How do we know which plants are native?

Why is it important to know what plants are native to a region?

What purposes does a plant serve within its physical environment?

What advantages might native plants have over introduced/non-native plants?

Define ecosystem. What are the dangers of introducing “non-native” plants into an ecosystem?

Find and describe an example of a “non-native” problem plant.

Can an ecosystem be “restored”? How?

Define “biodiversity.” Why is it important?

Select a fairly wild or natural area near your home and identify as many plant species as possible. What percentage of them are native?

### **RESOURCES:**

APPENDIX B. Botany of Sunflowers

*Becoming Native to this Place*, Wendell Berry

### **WEB RESOURCES:**

<http://www.wildflower2.org/>

<http://www.wildflower2.org/NPIN/Bibliography/Bibliography.html>

STATE STANDARDS: LIFE SCIENCE “Interdependence of Organisms” 12.4.4

SCIENCE “Diversity and adaptations of organisms” 8.4.5, “Systems, order and organization” 12.1.1, “Change over a period of time” 12.1.5

## **9. Plants and Landscapes as Inspiration for Visual Art** (Reading)

Do a web search for sunflowers or plants in the arts.

Who are some artists who have used plants as a subject for their work?

Why do you think they chose plants as subject matter?

Spend some time looking at a variety of botanical illustrations.

Botanically-inspired art varies from very traditional botanical illustrations with detailed, scientific drawings of the plants as a whole and/or with close-up drawings of separate elements of the plant to botanically-inspired artwork that is very abstract in nature. (See GRAPHICS APPENDIX D)

What form or forms do you prefer? Why?

Select one particular artistic style that appeals to you and create your own illustration or painting, using a sunflower or other plant as the inspiration for the piece.

### **RESOURCES:**

Artists: Gauguin, Monet, Renoir, Rivera, Van Gogh

STATE STANDARDS: READING “Using primary and secondary resources for research” 12.1.2

## 10. Plants and Landscapes as Inspiration for Writers

(Reading/Writing/Speaking)

Who are some authors whose work deals with plants or the environment?

How many Nebraska authors are you familiar with? (Write them down before checking the web resources below.)

How important is “sense of place” in their writing?

Name some books, not necessarily regional, in which plants or the natural environment have a primary role.

Look for references to sunflowers (or select a different plant or plants) in the Journals of Lewis and Clark. Think about the importance of describing and classifying plant and animal life to early explorers. Why was it so important? Does their work continue to have influence and/or importance? Why?

Are you familiar with any poets who have written about sunflowers?

What kinds of writers, what countries or regions, and/or what form of writing (narrative, persuasive, descriptive, informative, humorous) might be most likely to focus on plants?

Choose one of the forms of writing listed above and write about a landscape that is important to you.

### RESOURCES:

Poets: Sir Philip Sidney, Abraham Cowley, James Thomson, Erasmus Darwin, William Blake, Percy Bysshe Shelley, James Montgomery, Thomas Moore, Charles Swinburne, Clinton Scollard, Robert Tristram Coffin, Nora Unwin

Famous Nebraska authors: <http://info.neded.org/stathand/parttwo/author.html>

Nebraska Library Commission: <http://www.nlc.state.ne.us/nsf/nebraskaauthors.html>

Literary tour of Nebraska authors: <http://mockingbird.creighton.edu/NCW/tour.htm>

STATE STANDARDS: READING “Using primary and secondary resources for research” 12.1.2 and 12.1.8

WRITING “Compositions with focus, related ideas, and supporting details” 12.2.2

SPEAKING “Oral presentations” 12.3.2

# Appendix A

## Ethnobotany: The Uses of Sunflowers

Compiled by Bob Henrickson, Nebraska Statewide Arboretum

**Ethnobotany:** “The study of how plants are used in a particular culture.” *Webster’s New World College Dictionary*

### Sunflowers for Food

- There is no record of sunflowers being cultivated in Nebraska, although eastern and North Dakota tribes reportedly grew sunflowers.
- During the last 3000 years Indians increased the seed size approximately 1000 percent. They gradually changed the seed size by repeatedly selecting and growing only the largest seeds.
- Seeds collected from caves in Mitchell, South Dakota and from eastern Kansas show that sunflowers were being grown for food since 1000 A.D.
- The Jerusalem artichoke, *Helianthus tuberosus*, was never cultivated in Nebraska, but many tribes used it for food. The Pawnee ate them only raw, others boiled or roasted them also.
- The flower buds were eaten raw or boiled and oil from the seeds of wild sunflowers was used to produce a superior cooking oil.
- Jerusalem artichokes were being cultivated in the east when the first settlers arrived, and it is believed that they shared them with the hungry settlers. They are also called “earth apples” and “Native American potato.”
- Lewis and Clark made the following entry on July 17, 1805 along the Missouri river in Montana: “*Along the bottoms, which have a covering of high grass, we observe the sunflower blooming in great abundance. The Indians of the Missouri, more especially those who do not cultivate maize, make great use of the seed of this plant for bread, or in thickening their soup. They first parch and then pound it between two stones, until it is reduced to a fine meal. Sometimes they add a portion of water, and drink it diluted; at other times they add a sufficient proportion of marrow-grease to reduce it to the consistency of common dough and eat it in this manner. This last composition we preferred to all the rest, and thought it at that time a very palatable dish.*”
- In 1871 Edward Palmer reported that the seeds of sunflowers, being very sweet and oily, were eaten raw or pounded up with other things, made into flat cakes and dried in the sun. These cakes were eaten throughout the winter.
- The Chiricahua Apache harvested both the common, *Helianthus annuus* and plains sunflower, *Helianthus petiolaris*. The seeds were sometimes ground and the flour used for thick gravy or made into dough and baked on hot stones as a kind of thin bread. “Having eaten of the bread made from sunflowers I must say that it is as good as much of the corn bread eaten by Whites.”
- Parched sunflower seeds were pounded into a meal and used in a dish called four-vegetables-mixed; it included beans, dried squash and parched corn.
- Sunflower seed balls, made of sunflower seed meal, were carried by warriors in a bag made of buffalo-heart skin. When weary, the warrior nibbled on the ball to refresh himself.
- The flower heads were gathered after being frosted in fall, making them oilier. The Hidatsa grew sunflowers but preferred the wild ones for their superior cooking oil.

### Sunflowers for Agriculture and Industry

- American colonists did not cultivate sunflowers. It probably went from Mexico to Spain, and from there to other parts of Europe. Russians developed the Mammoth Russian variety that was first introduced to the U.S. in 1893.
- Today the sunflower is an important crop in the Midwest mainly for production of oil type seeds. The oil is used in cooking and baking. In some varieties the seed contains up to 49 percent oil. The remaining seed material (meal) is fed to livestock.

- Sunflower oil is generally considered premium oil because of its light color, high level of unsaturated fatty acids, bland flavor and high smoke points. The primary use is as a salad and cooking oil or in margarine.
- Sunflower oil has been used for industrial purposes such as dust retardants and lubrication for irrigation wells. Eventually, the plant may produce motor oil for vehicles using sunflower oil.
- Sunflower oil burns 75 percent cleaner than petroleum based diesel. It is highly lubricating, reducing wear and tear on engine parts. It requires no engine modifications to be used. The by-product of biodiesel is glycerin, which can be used in the manufacture of soap or hundreds of other products.
- Ornamental varieties have been developed for the home flower garden including short 1' plants to selections towering at 15'. They come in a variety of colors, from burgundy and magenta, to orange and white.
- Roasted sunflower seeds are used for snacks and other varieties for bird food.
- Sunflower stalks have been used for fuel, fodder for livestock and food for poultry. The remaining ashes are returned to the soil. The ash is high in potash and can be sprinkled around plants as an organic fertilizer.
- The seed hulls have been used as "litter" for poultry, for compost or as a fuel source.
- Today the hulls are used in the Soviet Union to manufacture ethyl alcohol, in lining plywood, and in growing yeast.
- The stems have been used as a source of commercial fiber and the Chinese have used this fiber to manufacture fabrics. Other countries are experimenting with this fiber for paper production.
- The pith (center of the stem) is so light—one of the lightest substances known—that it is used in scientific laboratories. The stems were also once used to fill life preservers.
- Sunflowers have long been used as "food plots" in wildlife plantings. They are of outstanding value to wildlife in the prairies. At least 23 species of song birds and 13 different mammals eat the seeds, stems, leaves or roots.
- One of the most beneficial uses of sunflowers is in the removal of toxic waste from the environment. Utilizing an emerging technology called rhizofiltration, hydroponically grown plants are grown floating over water. Possessing extensive root systems, they are able to reach deep into sources of polluted water and extract large amounts of toxic metals, including uranium. Such a process has been utilized in the former Soviet Union to decontaminate water polluted as a result of the 1986 accident at the Chernobyl nuclear power plant. The roots of floating rafts of sunflowers were able to extract 95 percent of the radioactivity in the water caused by that accident.

### **Sunflowers as Medicine**

- The seeds are also used medicinally, to calm the nerves, and for their antioxidant properties. A quarter cup of sunflower seeds has 120 percent of the RDA for Vitamin E. Vitamin E has significant anti-inflammatory effects that result in the reduction of symptoms in asthma, osteoarthritis, and rheumatoid arthritis, conditions where free radicals and inflammation play a big role. Vitamin E has also been shown to reduce the risk of colon cancer, help decrease the severity and frequency of hot flashes in women going through menopause, and help reduce the development of diabetic complications. Sunflower seeds are also high in magnesium, which helps reduce the severity of asthma, lower high blood pressure, and prevent migraine headaches, as well as reducing the risk of heart attack and stroke. Insufficient magnesium can thus contribute to high blood pressure, muscle spasms (including spasms of the heart muscle or the spasms of the airways symptomatic of asthma), and migraine headaches, as well as muscle cramps, tension, soreness and fatigue.
- The Teton Dakota boiled the sunflower heads in water to make a strong tea as a remedy for breathing ailments.
- The Pawnee pounded the seeds up with certain roots for women who became pregnant while still nursing a child. This was done in order that the nursing child should not become sick.
- Among the Chochiti, a reliable "home remedy" for cuts and other wounds was the juice of freshly crushed sunflower stems. The juice was smeared liberally over the wounds and bandaged, resulting in a speedy recovery without infection.
- The Thompson Indians used powdered sunflower leaves alone or in an ointment on sores and swellings.

- The Pima applied a paste of warm ashes to the stomach for worms and used a strong tea made from the leaves for high fevers and as a wash for horses' sores caused by screwworms.
- Zuni medicine men chewed the root and applied a paste to treat snakebite.
- Sunflower seeds are a good source of selenium, which inhibits the proliferation of cancer cells. They are also high in B-1, B-5, phosphorous, tryptophan, copper, B-6, manganese, folate, fiber, iron and zinc. Sunflower seeds have no cholesterol. Sprouted sunflower seeds are an excellent source of amino acids and Omega-3 Fatty Acids.

### **Sunflowers for Ceremony**

- The Pawnee name for the annual sunflower is Kirik-tara-kata or "yellow-eyes."
- The famous Hidatsa grower, Buffalobird Woman, reported in 1917 that sunflower seed was planted as soon as the ice broke on the Missouri, usually early April. The native name for April is translated to mean "sunflower-planting-moon."
- The Teton had a saying that "when the sunflowers were tall and in full bloom the buffalo were fat and the meat good."
- The Mandan and Rees used sunflower seeds as a stimulant, taking them along on a war party or hunt to revive them; and oil from the seeds was used to lubricate or paint the face and body. The bloom petals, mixed with pollen, were used for face paint.
- The Navaho used the plant for the sun sand painting ceremony and made a salve of pulverized seed and root to prevent injury from a horse falling on a person.
- In the Southwest the Hopi used the sunflower plant as a "spider medicine." They believed when sunflowers were abundant, it was a sign of an abundant harvest.
- The Hopi wore the wild sunflowers in their hair during ceremonies. Carved wooden sunflower disks have been recovered from prehistoric sites in Arizona.
- The sunflower is part of the Onondaga (Iroquois) tribe creation myth.
- Famous Nebraska explorer John C. Fremont reported in 1842 on the north fork of the Platte River: "The valley is without timber, but the grasses are fine and the herbaceous plants abundant. The whole country resembled a vast garden, but the most common plants were the sunflowers."
- The legislature of Kansas in 1903 proclaimed the wild sunflower as the state flower due to their abundance in the prairies, along with their beauty and symbolism.
- Other beliefs about the plant included:
  - if you cut a sunflower at sunset while making a wish the wish will come true the next day (provided it is not too extravagant!)
  - sleeping with a sunflower under the bed allows you to know the truth in any matter
  - seeds worn around the neck will protect the wearer from smallpox
  - sunflowers grown in the garden bring good luck to the gardener.
- Late in the nineteenth century, sunflowers were adopted by writer Oscar Wilde as a symbol of good taste. They are featured in the paintings of Claude Monet, and Vincent van Gogh painted thirteen famous studies of the flowers.

After 8,000 years of cultivation, it seems safe to say that the sunflower will still be around for many future generations. And who knows what marvelous products and numerous benefits are yet to be discovered.

# Appendix B

## Botany of Sunflowers

Compiled by Sue Kohles, Nebraska Statewide Arboretum and Kay Kottas, UNL Agronomy & Horticulture

All of the ten sunflowers most common to Nebraska are in the aster or *Asteraceae* family. Eight are in the genus *Helianthus* and are true sunflowers. Three are in the genera *Heliopsis* and *Silphium* and are not true sunflowers, but might be thought of as sunflowers because their appearance is similar.

Plants of the *Asteraceae* Family are characterized by their flowers, referred to as composite or aster flowers. All three of the genera share this flower type, but true sunflowers produce seed from the disc portion of the flower only. “False sunflowers” produce seed from only the ray portion of the flower, or from both the disc and ray flowers. Although this may seem insignificant, it is necessary to group plants according to characteristics such as these in order to classify, name, identify and study them.

All of these plant species are abundantly found and native to Nebraska. They account for 34 percent of the leading forbs found in Great Plains prairies. Most are dominant, competitive species within their plant community and adapt to environmental disturbances of their habitat. All have deep and branching root systems that allow them to compete with other forbs and survive amidst the massive fibrous root systems of native grasses. They reproduce through seed and vegetative structures called rhizomes and tubers.

### Plant Naming

Plants are known by common names and botanical names. Common names are usually easier to pronounce and remember because they use common terms. Unfortunately common names are not governed by formal naming, thus many different plants may have the same or similar common names or the same plant may have a different common name in a different geographical region. And, although certain plants may resemble each other, they may not be botanically related. With such variability it is difficult for botanists and horticulturists to accurately communicate about plants by using common names.

Botanical names, also referred to as scientific names, are written in the Latin language and use a system to organize and categorize plants so that each has a unique name. They are more accurate and universally understood because different plants cannot be confused, as with common names. Botanical names are governed by internationally accepted rules. The work of Carolus Linnaeus in the 1700s led to the universally understood, written and communicated method of describing, naming and classifying plants that is used today. The system is called taxonomy or nomenclature of plants. In this system plants are divided into ranked groups called taxa. Taxa group plants with similar genetic and structural characteristics in a hierarchical series of ranks beginning with the broadest group called the Kingdom. The ranks narrow as they descend. The genus and the specific epithet (binomial nomenclature) form the scientific species name. The complete written species name also contains the abbreviated name of the person who named the plant, called the authority. The authority is often present in written communication, but is not usually used when speaking about the plant. Knowing who gave the plant its name provides scientists with information about the history of a plant. The species can be further subdivided into subspecies (implies geographic distribution) and variety (may imply origin, importance or form), or can be followed by a cultivar name (horticultural name for plants cultivated to maintain a specific characteristic). The species name is underlined or italicized when written.

The taxonomic hierarchy is listed in the left column as follows with an example of *Helianthus maximiliani* Schrad. (Maximilian sunflower) in the right column:

Kingdom	Plantae - plants
Phylum/Division	Magnoliophyta – angiosperms, flowering plants
Class	Magnoliopsida - dicots
Order	Asterales
Family	<i>Asteraceae</i> – aster family
Genus	<i>Helianthus</i>
Specific Epithet	<i>maximiliani</i>
Authority	Schrad. Heinrich Adolph Schrader (1767-1836)



# Glossary of Botanical Terms

- achene** – a small, dry fruit with a single locule and a single seed (ovule), and with the seed attached to the ovary wall at a single point (e.g. sunflower seed).
- alternate leaf** – refers to leaves spaced singly along two sides of a stem with a single leaf at each node.
- angiosperm** – plants that form flowers and whose seeds develop fruit; the seeds of flowering plants contain either one cotyledon (monocot) or two cotyledons (dicot).
- annual** – a plant that lives its entire life-cycle in one year; it germinates, flowers, produces seed and dies.
- anther** – pollen-producing portion of the stamen.
- apex** – the tip; the point farthest from the point of attachment.
- authority** – the person who gave the plant its name. It is part of the scientific name and should be used in written communication about a plant; knowing who named the plant helps scientists track the history of a plant name.
- binomial nomenclature** – scientific system of using a double name for each plant and animal—the name of the genus followed by the specific epithet. Combined, these form the species name.
- botany** – science involving the study of plants.
- calyx** – all sepals collectively.
- capitate** – headlike or in a headlike cluster, as in the flowers of the aster family.
- cauline** – on or pertaining to the stem.
- clasping** – partly or entirely surrounding the stem.
- composite flower** – also termed aster, a type of inflorescence composed of clusters of many small disc and ray flowers.
- corolla** – all the petals of a flower collectively. In the aster family, these are fused together into a tube in the disk flower or fused into a ligule in the ray flower.
- cotyledon** – a seed leaf; the first leaf at germination; stores or absorbs food.
- decurrent** – extending downward from place of attachment, as in a leaf base along a stem.
- dicot** – an angiosperm characterized by having two cotyledons in their seeds.
- disc flower** – tubular florets in the center part of a composite flower head.
- embryo** – an immature plant within a seed.
- epigynous** – descriptive of the arrangement of floral parts with respect to the ovary. Stamens, petals and sepals attached above ovary. Ovary is inferior to the floral parts.
- filament** – stalk that supports the anther.
- floret** – a small flower that is part of a cluster of flowers; in the aster family they are arranged in a head with disc florets and ray florets.
- flower head** – a dense cluster of flowers as in the aster family; often with both disc and ray flowers, but sometimes with only one or the other.
- flower head** – type of inflorescence with a dense cluster of flowers, as in the aster family; often with both disc and ray flowers, but sometimes with only one or the other.
- forb** – herbaceous plants other than grasses or grass-like plants.
- habitat** – the community where a plant naturally grows.
- herbaceous plants** – non-woody plants that die after one season of growth (annuals); or die back to the ground after growing season (perennials or biennials). Includes grasses, grass-like plants and forbs; excludes trees and shrubs.
- hypogynous** – stamens, petals and sepals attached below the ovary, ovary superior.
- imbricate** – arranged so they overlap one another (like shingles on a house).
- inferior ovary** – (see epigynous).
- inflorescence** – flowering part of a plant; it can consist of one flower (solitary flower) or many flowers (a head, as in sunflowers).
- introduced plant** – plant brought to a region with the help of human intervention.
- involucral bracts** – a whorl of leaf-like structures found at the base of a flower or flower structure.
- lanceolate** – lance-shaped; wider at the base and tapering to a point.
- ligulate** – having a ligule (a strap-shaped organ, such as the corolla of a ray flower in the aster family).
- ligule** – a strap-shaped organ such as the corolla of a ray flower in the aster family.
- linear** – long and narrow with sides more or less parallel.
- lobed** – lobes cut less than halfway to the midrib.
- lowlands** – areas of higher water content, such as ravines and depressions.
- midrib** – the central nerve or vein.
- monocot** – an angiosperm characterized by having one cotyledon in their seeds.
- native** – used to describe plants originating and growing in a place. (In this curriculum, native refers to a time before European settlement when other plants were introduced to the region from other continents.)
- opposite leaf** – leaves arranged in pairs opposite each other on a stem and sharing the same node.

**ovary** – immature fruit, enlarged base of the pistil, that contains the ovules.  
**ovule** – immature seed.  
**panicle** – branched inflorescence with flowers maturing from the bottom up.  
**pappus** – modified calyx of the aster family. (In sunflowers, the pappus is a set of scales or hair-like bristles.)  
**peduncle** – the stalk of an inflorescence.  
**perennial** – a plant that remains alive more than 2 years even if the upper vegetative portion dies for a season or more.  
**perfoliate** – a leaf that totally surrounds a stem so that the stem appears to pass through.  
**petiolate** – a leaf which has a petiole.  
**petiole** – the stalk of a leaf.  
**phyllaries** – small leaf-like structures at the base of a flower or flowers.  
**pinnatifid** – pinnately lobed; cutting in at least half the distance to the midrib.  
**pistil** – female plant reproductive organs; includes the stigma, style, and ovary.  
**plant community** – an association of plants inhabiting a common environment and interacting with one another.  
**pollen** – the tiny grains produced in the anthers that contain the male reproductive cells.  
**racemose** – flowers arranged in a raceme.  
**ray flower** – any of the strap-shaped marginal florets around a composite flower head.  
**receptacle** – expanded tip of the peduncle on which the parts of a flower are borne.  
**rhizome** – horizontal underground stem giving rise to new plants.  
**sepals** – leaf-like structures that enclose the petals and usually form the outer covering of the flower bud.  
**serrate** – having “teeth” along the border or margin.  
**sessile** – attached without a petiole.  
**simple leaf** – a leaf which has an individual leaf blade, not separated into several leaflets; unbranched.  
**stamen** – the collective term for the male reproductive parts of a flower, the filament and anther.  
**stigma** – portion of the pistil that receives the pollen.  
**style** – connects the stigma to the ovary.  
**sunflower, false** – genus *Heliopsis*, both disc and ray florets usually fertile.  
**sunflower, true** – genus *Helianthus*, disc florets are fertile and produce seed.  
**superior ovary** – (see hypogynous).  
**taxonomy** – science of classifying; laws and principles that govern the classifying of plants and animals into related groups.  
**terrate** – round in form.  
**tomentose** – covered with short, soft, matted hairs.  
**tuber** – an enlarged, fleshy underground stem for food storage and reproduction.  
**uplands** – areas of land above the water table with soils of lower water content, such as slopes or hilltops.  
**wetlands** – land areas with saturated soils most of the year (such as stream beds, ponds, and swamps).  
**whorl** – three or more leaves or branches growing from a common point.  
**winged petiole** – a thin margin on either side of the stem or leaf.  
**winter annual** – plant that germinates in the summer or fall of one year, then produces flowers and seed in the spring or summer of the following year before dying.

## References

- Great Plains Flora Association. 1986. *Flora of the Great Plains*. University Press of Kansas, Lawrence, KS.
- Ladd, Doug. 1995. *Tallgrass Prairie Wildflowers*. The Nature Conservancy and Falcon Press Publishing, Helena, MT.
- Neal, Bill. 1992. *Gardener's Latin*. Algonquin Books, Chapel Hill, NC.
- Rolfsmeier, Steve and Steinauer, Gerry. *Nebraska Vascular Plant List*. Nebraska Game and Parks, Lincoln, NE.
- Stearn, William T., 1995. *Botanical Latin*, 4<sup>th</sup> Ed. Timber Press, Portland, OR
- Stern, Kinsley. 1992. *Introductory Plant Biology*. Wm. C. Brown Publishers, Dubuque, IA.
- Weaver, J.E. and Fitzpatrick, T.J., 1934. *The Prairie*. Duke University, Durham, NC.

# Appendix C

## Economic Impact of Sunflowers

Compiled by Christina Hoyt, Nebraska Statewide Arboretum

Sunflowers are native to the United States. The first users of sunflowers were Native American tribes, who used them as early as 3000 BC. They domesticated the plant into a more usable form with a single flower head. European settlers exported them to Europe in the 1500s, but it was not until the 1700s that sunflowers began to be an important cash crop.

In 1716, the English developed a way to derive oil from the sunflowers. Russian farmers grew more than two million acres of them and expanded their development and usage. Sunflower varieties were developed for specific usage, such as oil production, human consumption, etc.

Today, sunflowers are still grown for their oil and seed. The oil is often used as a vegetable oil substitute. In the 1920s, growers in the United States began growing and processing sunflower seeds for reasons other than silage and aesthetics.

Global economics change continually. When demand in Europe or elsewhere outweighs supply, the United States exports sunflowers, when demand drops, exports likewise decrease.

### Fast Facts:

In 2003     \$316, 214 x \$1,000 were earned

In 2004     1,873,000 acres were planted  
              2,049,613 x 1,000lbs of seed was produced

Kansas, South Dakota, Colorado, Nebraska, Minnesota and Texas are all major producers of sunflowers in the United States.

### Web Resources:

To see how many sunflowers your county produces:

[http://www.nass.usda.gov/Charts\\_and\\_Maps/Crops\\_County/index.asp](http://www.nass.usda.gov/Charts_and_Maps/Crops_County/index.asp)

To find out how many acres of sunflowers it would take to make a \$50,000 profit each year, go to

<http://www.jeffersoninstitute.org/pubs/sunflower.shtml> or <http://www.usda.gov>

For facts, uses, economics, history and science behind sunflowers. <http://www.sunflowermsa.com>

United States Department of Agriculture, <http://www.usda.gov/wps/portal/usdahome>

Thomas Jefferson Agriculture Institute, <http://www.jeffersoninstitute.org/pubs/sunflower.shtml>

For economic issues, <http://www.oznet.ksu.edu/library/agec2/mf2514.pdf>

For general information on history, economics and growth,

<http://muextension.missouri.edu/xplor/agguides/crops/g04290.htm>

International Sunflower Association, <http://www.isa.cetiom.fr/>

# Appendix D

## Phototropism: A Case Study on Sunflowers

Compiled by Christina Hoyt, Nebraska Statewide Arboretum

**Phototropism:** “Any positive, or negative, movement of a part of a plant toward, or away from, light sources.” *Webster’s New World College Dictionary*

Many of our plants, such as sunflowers, are known for their phototropic response to light. Their “faces” are said to follow the sun’s movements. To understand phototropism it is helpful to look at the meanings of the Greek words involving the phenomena. The word “photo” is derived from the Greek word meaning “light.” The scientific definition of tropism is the direction of a plant’s growth determined by the direction of an environmental factor such as light, gravity or touch. Phototropism can be thought of as a plant turning towards (or away) from the light.

Scientists realized that this movement was probably a hormonal response similar to those found in animals and humans. “The first plant hormone to be discovered was the substance causing stems to grow towards light—a physiological response called phototropism” (Capon).

Auxins are a group of hormones called “plant growth regulators.” They differ from hormones in animals because they are synthesized directly within the cells of general organs (Capon). Phototropic movement is caused by a natural hormone called indole acetic acid or IAA. IAA is a light-sensitive chemical that causes cell elongation in both the roots and the shoots. Growth towards the stimulus is called “positive-phototropism” and growth away from the stimulus is “negative-phototropism.” Normally shoots grow toward the sun and roots grow away from sun.

Phototropism is most easily observed on young shoots in plants. However, phototropism can be visually observed in mature sunflowers as they move in response to the sun’s location. Examining IAA’s location in a 24 day can help demonstrate how the hormone affects the plant’s movement.

**Related topics: Gravitropism, Thigmotropism, Hydrotropism, photoperiodism**

### RESOURCES:

Capon Brain, *Botany for Gardeners: An introduction and Guide*, published by Timber Press, ISBN 0-88192-163-7.

University of York online flash video displaying time-lapse video sequences of plant tropisms.

<http://www-users.york.ac.uk/~drf1/tropism/tropisms.htm>

Plants in Motion, Indiana University Department of Biology online video.

<http://sunflower.bio.indiana.edu/%7Erhangart/plantmotion/movements/tropism/tropisms.html>