LIFE CYCLES, REPRODUCTION & HEREDITY

all that buzz
sexual and asexual reproduction in plants

△ FRAMEWORKS

SCIENCE
NS 1.6.5 Communicate results and conclusions from scientific inquiry.
NS 3.7.10 Explain the role of cell division.
LS 3.7.7 Differentiate between sexual and asexual reproduction in:
△ Vertebrates
△ Plants
LS 4.7.1 Explain the role of reproduction in the continuation of a species.

LANGUAGE ARTS
W 5.6.10 Write across the curriculum.
W 5.7.10 Write across the curriculum.
W 5.8.10 Write across the curriculum.

△ OBJECTIVES

The students will learn:

OBJECTIVE #1 To define angiosperms.
OBJECTIVE #2 To explain pollination.
OBJECTIVE #3 To define sexual reproduction in plants.
OBJECTIVE #4 To define asexual reproduction in plants.
OBJECTIVE #5 To describe budding, regeneration and fission.
OBJECTIVE #6 To appropriately use verbal speaking skills in class discussion with the teacher and Garden Program Specialist.
Many food crops reproduce sexually with the aid of pollinators. Some, such as potatoes, produce offspring asexually through simple cell division. Many plants can reproduce either way, e.g., strawberries.

**OVERVIEW**

Sexual reproduction of plants, including most of our food crops, depends on pollinators, especially bees. Some plants can reproduce asexually through simple cell division. While asexual reproduction is very rare among vertebrates, some invertebrates can reproduce through budding, regeneration or fission.

**GARDEN ACTIVITIES**

▲ Examining flowers for pollinating activity
▲ Plant, harvest and work in the garden following the Garden Guide
▲ Recipes and Taste tests as time permits (refer to Delta Garden Study Recipe Book)
tips for the classroom

pre-lesson preparation:

1. Check with the Garden Program Specialist to determine which plants in the garden are good examples of asexual and sexual reproducers.

lesson outline

<table>
<thead>
<tr>
<th>activities</th>
<th>estimated duration</th>
<th>actual duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>in the classroom</td>
<td>▲ Offer the icebreaker</td>
<td>5 minutes</td>
</tr>
<tr>
<td>in the garden/chicken coop</td>
<td>▲ Examine flowers. Look for bees and pollination activity.</td>
<td>20 minutes</td>
</tr>
<tr>
<td></td>
<td>▲ Point out plants that require natural pollinators</td>
<td>5 minutes</td>
</tr>
<tr>
<td></td>
<td>▲ Perform any gardening activities as necessary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▲ Implement recipes and taste tests as time permits (refer to Delta Garden Recipe book)</td>
<td>10 minutes</td>
</tr>
<tr>
<td>back in the classroom</td>
<td>▲ Hand out Student Workbooks, review and assign “Take it Home Activity” as homework</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>

tips for the garden

pre-lesson preparation:

1. Prepare to discuss sexual reproduction through pollination and asexual reproduction, particularly through budding.

2. Prepare a brief garden work activity for students in the garden. Consider working with a plant that reproduces asexually, such as strawberries or potatoes in order to illustrate both sexual and asexual reproduction during the garden task.
# LESSON PLAN

## I. Start in the classroom

### A. Icebreaker

Offer the icebreaker. Ask the students: “Can anyone describe why a bee might be important to the garden?” Instruct the students that you will explore that topic in today’s lesson.

## II. Take class to the garden

- Point out any flowering plants and review the definition of angiosperm.
- Examine any flowers for bees. Review how pollination works. If possible, take a close look at bees to check for the tiny hairs on body and legs. Observe bees. Explain how pollination leads to fertilization, which is sexual reproduction of plants.
- Examine strawberry plants (if available). Explain how the runners are the product of asexual reproduction. Describe simple cell division as one example of asexual reproduction.
- Explain that asexual reproduction is very rare among vertebrates. Explain how some invertebrates reproduce through fission, budding or regeneration.
- Perform any gardening tasks as necessary.
- Taste available produce. Ask students for feedback.

## III. Take class back to classroom

- Hand out the Student Learning Workbook as reference material and class assignment. Review take it home activities and encourage students to do them.

<table>
<thead>
<tr>
<th>MEETS OBJECTIVE #1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEETS OBJECTIVES #2–3</td>
</tr>
<tr>
<td>MEETS OBJECTIVE #4</td>
</tr>
<tr>
<td>MEETS OBJECTIVE #5</td>
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</tbody>
</table>
**SUPPORTING INFORMATION FOR TEACHERS**

It is estimated that bees are responsible for pollinating more than 80 percent of our cultivated crops, not to mention countless ornamental plants in gardens, parks and in the wild.

Without enough natural pollinators, food costs would soar to pay for the transfer of hives from their winter homes to areas of agricultural production. Unfortunately, the number of bees in the United States has decreased dramatically due to lost habitat, pesticides and disease.

Home and school gardens should be designed to attract bees and help boost their populations. Native bees are solitary and live in small holes in dead wood or on the ground. Since they have no hive to defend, they are less aggressive and less likely to sting than honey bees.

To create a great bee garden, follow these guidelines:

▲ Avoid pesticides, which will kill the bees.

▲ Use native plants. Not only are they adapted to your local climate, but the bees will be familiar with them.

▲ Plant flowers of several different colors, especially white, blue, purple and yellow. The flowers of many food crops have these colors, e.g., tomatoes, sweet potato, peppers and squash. Bees have good color vision so they are able to pick out flowers that offer pollen and nectar. Gardens with at least 10 different types of flowering plants attract the most bees.

▲ Plant large patches or clumps of flowers. Bees prefer groupings of the same flower planted in a 2 to 3 feet wide area, rather than individual specimen spread out.

▲ Have something in bloom all season long. Plant a variety of flowering plants so bees can feed uninterrupted from spring through fall. Different bee species fly at different times of the year.

▲ Plant in sunny, wind-protected areas. Bees like a place in the sun, sheltered from the wind. The sunny side of a wall or fence is ideal.

▲ Plant flowers of different shapes and sizes to ensure a varied food source to various bee species. There are about 4,000 bee species in North America, all of different sizes and with different tongue lengths.

Here are some important Arkansas food crops that depend on pollinators, mostly honey bees:

- Apple
- Apricot
- Asparagus
- Blackberry
- Blueberry
- Broccoli
- Brussels sprouts
- Cabbage
- Cantaloupe
- Carrots
- Cauliflower
- Cherry
- Chinese cabbage
- Collards
- Cranberry
- Cucumber
- Eggplant
- Garlic
- Huckleberry
- Kale
- Kohlrabi
- Leek
- Lima beans
- Mustard
- Nectarine
- Onion
- Parsley
- Peach
- Pear
- Peppers
- Persimmon
- Plum
- Pumpkin
- Radish
- Raspberry
- Squash
- Strawberry
- Turnip
- Watermelon

Here is a list of plants across Arkansas that attract bees:

- Agastache
- Aster
- Basil
- Butterfly bush
- Black-eyed Susan
- Caltrop
- Coreopsis
- Cosmos
- Creosote bush
- Daisy
- Elder
- Fennel
- Goldenrod
- Joe pye weed
- Lavender
- Lilac
- Lupine
- Marjoram
- Mexican Sunflower
- Mint
- Oregano
- Pincushion Flower
- Purple Coneflower
- Rosemary
- Rhododendron
- Sage
- Sunflower
- Willow
- Zinnia
SOURCES

Master Gardener Manual Reference
Arizona Cooperative Extension, College of Agriculture, University of Arizona, Plant Parts and Functions, http://ag.arizona.edu/pubs/garden/mg/botany/plantparts.html

U.S. Department of Education
http://www2.ed.gov/pubs/parents/Science/celery.html

The Complete Book of Science, Grades 5-6
American Education Publishing, 2005

Master Gardener Arkansas Handbook
University of Arkansas, Division of Agriculture, Cooperative Extension Service, 2001-2002
http://www.ekcskl2.org/faculty/jbuckley/regbio/mitosisnts.html

Science, See learning in a whole new light
by Scott Foresman, 2007 Pearson Education Inc.

Urban Bee Gardens
http://nature.berkeley.edu/urbanbeegardens/general_guidelines.html

Veggie Gardener
http://www.veggiegardener.com/attracting-bees-vegetable-garden/

About.com: Gardening
http://gardening.about.com/od/attractingwildlife/a/Bee_Plants_2.htm

University of Arkansas, Division of Agriculture
http://bees.uark.edu/pages/AR_pollinators.html
study guide for students

Last time you learned about the reproductive organs of plants. Any time male and female organs are involved, sexual reproduction occurs. Angiosperms, or flowering plants, depend on pollinators like insects and birds, to transfer the pollen from the male stamen to the female counterpart, the pistil. What, exactly, goes on during this process?

Some of nature's best pollinators are honey bees and native bees. They literally make a beeline for bright, fragrant flowers because they provide two important nutrients: pollen and nectar. Pollen provides important proteins and fats for the bee. Nectar is high in sugar and is a bee's main source of energy. So the bee lands on a flower for a feast. As it bustles about, some pollen sticks to the bee's very tiny hairs on body and legs and eventually settles on the pistil. Pollination occurs. When the bee leaves, it transfers some pollen to another flower. Again, pollination occurs. The pollen grows a long tube down the inside of the style to the ovules inside the ovary. Then, the male sperm nucleus from the pollen grain and the female egg found in the ovary join. That's called fertilization.

The ovule develops into a seed and the ovary into a fruit. Many fruits and vegetables are the result of such pollination and fertilization: okra, peppers, squash, cucumbers, beans and many others. In fact, without bees being busy pollinating, these crops wouldn't grow.

But many other plants can reproduce asexually. Some plants can reproduce both ways. For example, a potato can grow a new, viable plant from each sprout. Or strawberry plants develop from runners, which are horizontal stems that grow from the mother plant. Strawberries also have flowers and reproduce sexually through pollination.

Asexual reproduction can occur in some of the following ways:

▲ **Fission.** A single-cell organism without a nucleus, such as bacteria, splits into two new identical organisms.

▲ **Budding.** Through cell division, a “bud” develops on the body of the parent organism. This bud grows large and viable enough to break off and live on its own as an independent organism. Some examples of budding organisms include strawberries, bermuda grass, corrals and jellyfish.
**Regeneration:** Through cell division, an organism can regrow entire body parts or even produce offspring. Some invertebrates (animals that lack backbones) like sponges and sea stars can grow entire colonies from a single organism that has been cut into pieces. Asexual reproduction of vertebrates (animals with backbones) is very rare.

- **fission** when a single-cell organism without a nucleus, such as bacteria, splits into two new identical organisms.
- **angiosperm** a flowering plant with seeds enclosed in a fruit such as an apple
- **asexual reproduction** a type of reproduction in which a new organism is produced from one parent, like a strawberry or potato
- **cell division** the process by which two cells are formed from one
- **budding** through cell division a “bud” develops on the body of the parent organism. This bud grows large and viable enough to break off and live on its own as an independent organism.
- **regeneration** through cell division, an organism can regrow entire body parts or even produce offspring
- **reproduction** the production of offspring by an organism
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LS 3.7.7 Differentiate between sexual and asexual reproduction in:
△ Vertebrates
△ Plants.

1. Compare and contrast sexual and asexual reproduction, by checking which characteristics go with each type of reproduction. Some may have checkmarks in both boxes.

<table>
<thead>
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<th>sexual reproduction</th>
<th>asexual reproduction</th>
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<tbody>
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<td>Uses pollinators</td>
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<tr>
<td>Fission occurs</td>
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</tr>
<tr>
<td>Male and female organs are involved</td>
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<tr>
<td>Can create a new plant</td>
<td></td>
</tr>
<tr>
<td>Budding occurs</td>
<td></td>
</tr>
<tr>
<td>Regeneration occurs</td>
<td></td>
</tr>
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</table>

2. Define angiosperms:

3. Asexual reproduction requires male and female parts.
   a. True
   b. False

Take it Home

Bees are busy little insects. Pretend you are a bee and stay active for at least 60 minutes today.
1. Compare and contrast sexual and asexual reproduction, by checking which characteristics go with each type of reproduction. Some may have checkmarks in both boxes.

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<thead>
<tr>
<th></th>
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<th>asexual reproduction</th>
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<tbody>
<tr>
<td>Uses pollinators</td>
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2. Define angiosperms:

   Flowering plants

3. Asexual reproduction requires male and female parts.

   b. False