



**Teacher Guide: 4<sup>th</sup> Grade**



## Lesson 1: Compost

### Materials:

Teacher and student workbooks/handouts  
Pencils, regular  
Buckets  
Worm castings  
Plastic trays  
Gloves  
Cups

### Plan:

Review rules and black widow awareness

Discuss Food webs & Compost

### Garden Group

- Harvest worm castings. If a significant number of worms remain in the castings, have students put these back in the worm bin, in the food area.
- Look for organisms in addition to worms. Discuss if they are 1<sup>o</sup>, 2<sup>o</sup> or 3<sup>o</sup> level consumers.
- Plastic trays and cups (in shed) can be used when sorting through compost.

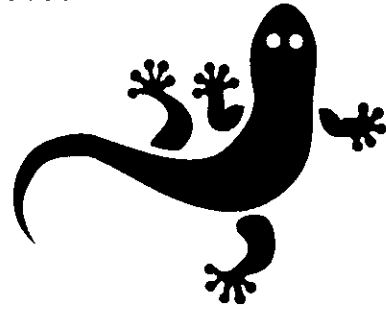
### Table

- Worksheets: Food Web of the Compost Pile
- Wormformation

Divide into groups and switch after approximately 15 minutes.

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)

*Gecko Garden*  
**Outdoor Science Lab**  
Student Agreement

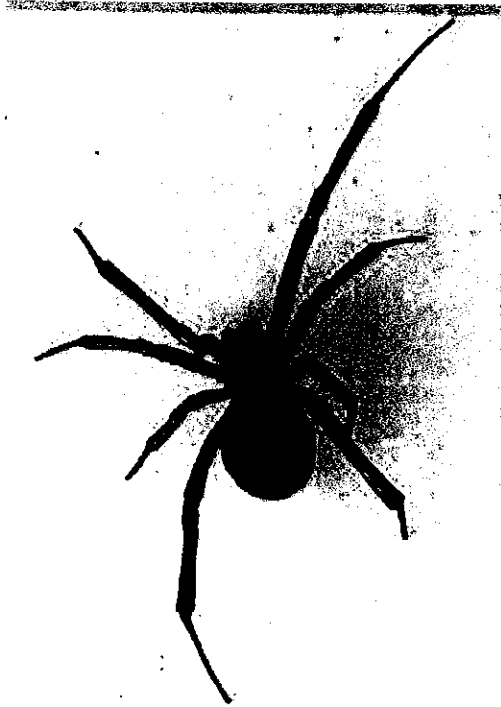


*I agree to...*

- ☐ 1) Use a quiet voice.
- ☐ 2) No running.
- ☐ 3) Always keep working end of tools down.
- ☐ 4) Ask before picking or eating any plants
- ☐ 5) Not put my hands in places I can not see.
- ☐ 6) Wash my hands when I am finished gardening.
- ☐ 7) Respect plants, animals and each other.

# Black Widow Spider

TOP

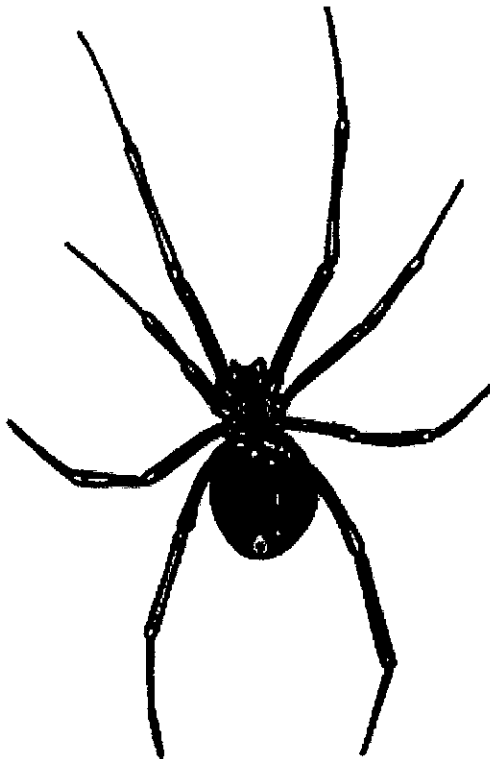


Kingdom: Animalia  
Phylum: Arthropoda  
Class: Arachnida

\_\_\_\_\_ legs

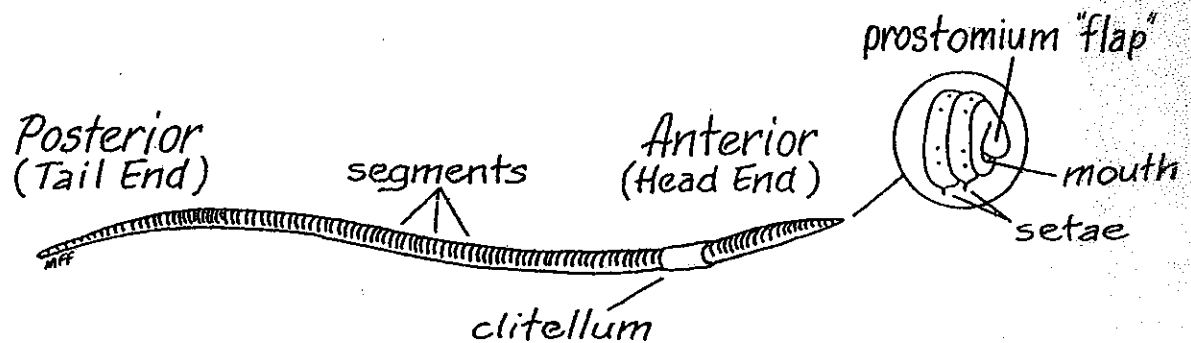
\_\_\_\_\_ body  
sections

BOTTOM



## Wormformation

The shape of a worm is long and thin. It has a soft body and it has no bones beneath its skin. The body of a worm is made of many little rings with grooves between them. Each of these rings is called a segment. Each segment has bristles called setae that help the worm move. A worm has no arms, legs, or eyes.



### Directions

Read the *Wormformation* and look at the earthworm diagram to answer the questions. (Hint: Use the glossary for extra help.)

1. What is the basic shape of a worm? \_\_\_\_\_
2. Does a worm have arms or legs? \_\_\_\_\_
3. Does a worm have a mouth? \_\_\_\_\_
4. The prostomium is a flap above the worm's \_\_\_\_\_
5. Does a worm have eyes? \_\_\_\_\_
6. What is the head end of a worm called? \_\_\_\_\_
7. What is the tail end of a worm called? \_\_\_\_\_
8. What is the name of the swollen band? \_\_\_\_\_
9. What are the rings on a worm's body called? \_\_\_\_\_
10. The bristles that aid in a worm's movement are called \_\_\_\_\_

**Bonus Activity** Look at a real worm. Identify its parts.

## Lesson 2: Soil Preparation

### Materials:

Teacher and student workbooks

Pencils, regular

Tools: Shovel, rakes, trowels

Buckets

Amendments: ½ bucket vermicompost, ½ bucket compost, 1 bucket Black Gold.

### Plan:

Review soil components: Mineral (sand, silt, clay) and Humus

Discuss Journal entries: Date and information pertaining to crop preparation.

### Explain Group Activities.

Garden Group: Turn and amend soil

Harvest any remaining worm castings

Table group: Journal Entry

Complete worksheets from last week

Optional Activity: Have students look around the garden for evidence of and then draw a food chain starting with: Sun - plant - 1<sup>0</sup> consumer - 2 consumer - 3<sup>0</sup> consumer

Divide into groups and switch after approximately 15 minutes.

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)

## **Lesson 3: Three Sisters**

### **Materials:**

- Teacher and student workbooks
- Pencils, regular
- Tools
- Corn seeds

Note: Please read the attached pages on the Native American “Three Sisters” crops for complete information. This is our first year of doing this in the Gecko Garden so please take notes on when and how you plant so it can be repeated and improved upon in following years.

Discuss the significance of the Three Sister crops.

### **Explain Group Activities.**

- Garden Group: Saturate soil with water if not already moist from rain.
  - Make rows or mounds as desired.
  - Plant corn seeds (Use a ruler to show students how deep to plant)

Table group:

Journal Entry:

Divide into groups and switch after approximately 10 minutes.

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)





## growing ideas Classroom Projects

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This month . . .

### Creating a Three Sisters Garden Discovering A Native Trio

*Native peoples from different parts of North America have used a wide range of agricultural techniques. Perhaps the best known is the interplanting of corn, beans, and squash together – a trio often referred to as the "three sisters."*

Cultivating these companions in your school garden, a small patch near the building, a barrel, or even indoors, can inspire studies of Native American customs, nutrition, and folklore. As students dig in, investigations of plant growth and relationships will also flourish.

In a three sisters planting, the three partners benefit one another. Corn provides support for beans. Beans, like other *legumes*, have bacteria living on their roots that help them absorb nitrogen from the air and convert it to a form that plants can use. (Corn, which requires a lot of nitrogen to grow, benefits most.) The large, prickly squash leaves shade the soil, preventing weed growth, and deter animal pests. The three sisters also complement each other nutritionally. (See [Nutritious Lessons](#).)

It's hardly surprising that these crops – considered by many to be special gifts from the creator – played such an important role in the agriculture and nutrition of most of the Native people of the Americas. Because of the sisters' central role as "sustainers of life," a host of stories, customs, celebrations, and ceremonies are associated with them.



### Materials

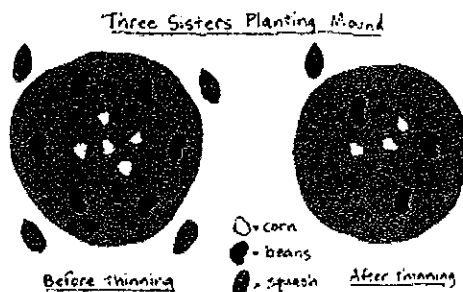
soil preparation tools (e.g., spading forks, rakes)  
measurement tools (rulers, yardsticks, or tape measures)  
sticks (to mark mound locations)  
seeds: corn, pole beans, winter squash or pumpkins

(Find seeds that mature between your area's "frost-free" dates. The [Resources](#) page features links to sources of traditional Native seeds.)

### Creating a Three Sisters Garden

Each Native culture that grew the three sisters had a unique planting system. Here we feature guidelines for one type of setup.

1. **Plan and select a site.** You'll want to plant your three sisters garden in late spring once the danger of frost has passed. Choose a site that has direct sunshine for most of the day and



### Three Sisters

#### Contents

#### Classroom Project

#### Background

#### Materials and Procedures

#### Curriculum Connections

#### [Tuning in to the Sisters' Cycles](#)

#### [Growing Inquiries](#)

#### [Nutritious Lessons](#)

#### [Something Fishy?](#)

#### [An A-Maize-ing Crop](#)

access to water. Once students have determined their site's dimensions, challenge them to plan their three sisters garden on paper. They can use the layout suggested below or research and try others.

2. **Prepare the soil.** First, break up and rake the soil. Next, build a mound about 12 inches high and between 18 inches and 3 feet in diameter. If you're in a dry area, flatten the top of the mound and make a shallow depression to keep water from running off. The number of mounds your students create depends on the size of your growing area. Mounds should be 3 to 4 feet apart in all directions.
3. **Plant corn.** Soak four to seven corn seeds overnight and then plant them about 6 inches apart in the center of each mound. (You'll eventually thin to three or four seedlings.) Many Native people honor the tradition of giving thanks to the "Four Directions" by orienting the corn seeds to the north, south, east, and west. By doing the same, students can learn to use compasses and observe the sun's movements.
4. **Plant beans and squash.** After a week or two, when the corn is at least 4 inches high, soak and then plant six pole bean seeds in a circle about 6 inches away from the corn. (You'll eventually thin to three or four bean seedlings.) At about the same time, plant four squash or pumpkin seeds next to the mound, about a foot away from the beans, eventually thinning to one. If you are planting a large area, you can also sow the squash in separate mounds (1 foot in diameter) between every few corn and bean mounds.
5. **Consider other additions.** Consider planting other traditional crops, such as sunflowers or jerusalem artichokes (a tuberous perennial sunflower), around at the edge of the three sisters garden. Put them on the north side so they won't shade your other plants. Potatoes, sweet potatoes, and other native crops are often planted in nearby plots. (Some of the many other indigenous plants used by native North, South, and Central Americans include melon, tobacco, chili pepper, cotton, blueberry, wild rice, and hazelnuts.) Let your students' creative juices flow as they create a unique scarecrow; a number of Native culture's gardens incorporate these familiar figures.
6. **Maintain your traditional garden.** As corn plants grow, weed gently around them and mound soil around the base of each stem for support. When the corn is knee-high and again when silks appear on the husks, "side-dress" by putting a high nitrogen fertilizer (such as aged manure or fish emulsion) on the soil surface near each plant. If beans aren't winding their way around the corn, youngsters can help by moving tendrils to the stalks. (Keen observers may notice a pattern in the direction in which the bean vines wind.) To allow room for corn and beans to grow, gently direct squash vines into walkways, garden edges, or between mounds. Once students observe young fruits, side-dress the squash plants with aged manure or compost. If you pinch off the tips of squash runners after several fruits have started to form, the plants will devote more energy to producing squash.



#### Raising Three Sisters in Containers

If your outdoor growing space is limited, you can create a mini three sisters garden in an outdoor container, such as a barrel, or even in the classroom. Although students won't likely see the crops grow to maturity, especially indoors, they should be able to observe the pole beans twine around the corn and the large squash leaves form a mat. To simulate this planting system, use a large container with holes or gravel in the bottom and fill it with potting mix (and compost if you're growing outdoors). Follow the above instructions, but plant only 3 corn seeds (and thin to 1), 2 bean seeds, and 1 mini pumpkin seed. Place the container where it will receive at least six hours of sunlight (or 12 hours of grow lights) each day.

#### Coming Full Cycle (Saving Seeds)

By saving and replanting some of the seeds from their three sisters gardens, Native

#### Resources

##### Web Sites

##### Books

##### Native American Seed Sources

#### Related Articles

##### Sowing Seeds of Understanding

##### Stalking A-Maize-ing Lessons

##### Ethnobotany: The People/Plant Connection

#### Did you know . . . ?

Although many Native American groups grow corn, beans, and squash, the tradition of calling them three sisters originated with the Haudenosaunee, the People of the Longhouse (also known as Iroquois).

cultures brought the cycle of life full circle. Your students may want to save some to replant or package and give to other gardeners. Below are some tips for gathering and preserving the seeds.

**Corn**

Leave several ears on the stalk until husks dry and turn brown. Remove and peel back the husks and hang them to dry, out of direct sun, for a month. Once they're dry, remove the individual kernels. Store them in an airtight container. (Note: If you save and replant seed from hybrid corn, the plants will not have their parents' good qualities.)

**Beans**

Leave several pods on a plant until they turn brown and brittle. Break open the pods and remove the seeds. Leave them on a flat surface or screen, out of direct sun, to air dry for a few days. Put them in an airtight, dark container protected from extreme heat and cold.

**Squash**

Scoop out the seeds with a spoon and rinse them with water in a colander. Follow the same instructions as listed for drying and storing beans.



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## **Lesson 4: Beans and Squash**

### **Materials:**

- Teacher and student workbooks
- Pencils, regular
- Rulers
- Bean and Squash Seeds

Optional: Create Three Sister written activity or worksheet.

### **Explain Group Activities.**

#### **Garden Group**

- Observe corn plants and count how many have germinated.
- Plant bean and squash seeds according to directions
- Look for pest such as pill bugs and remove (send to "Canyon Camp")
- Weed
- Cover bed with netting

#### **Table group:**

- Journal entry

Optional Math Activities: Calculate % germination

- Measure and plot the growth of the corn plants.

Divide into groups and switch after approximately 10 minutes.

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)

## **Lesson 5: Maintenance and Measurements**

### **Materials:**

Teacher and student workbooks  
Pencils, regular

### **Plan:**

- Discuss pollination
  - Self-pollination – such is done by the bean plant.
  - Biotic pollination – by insects and animals

### **Explain Group Activities.**

#### **Garden Group:**

- Observe and look for flowers
- Remove any competitors – pill bugs, weeds
- Add supplemental vermicompost around corn. If difficult to spread you can mix with water and pour around corn.
- Optional: Measure plant growth

#### **Table group:**

- Journal entry
- growth measurements

Divide into groups and switch after approximately 10 minutes.

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)

# Corn Pollination - An Overview

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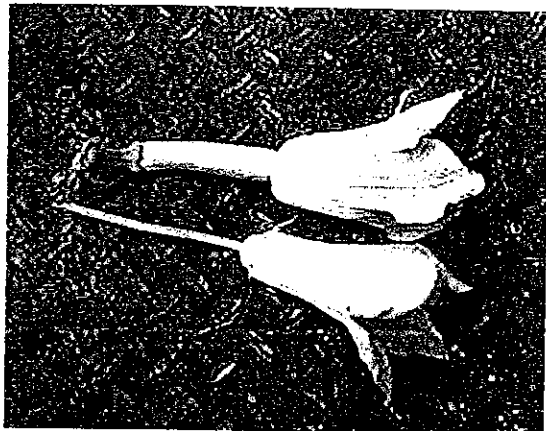
Unlike all other major grain crops, the corn plant has separate male and female flowering parts. The tassel and ear shoot are the male and female flowering structures, respectively, of the plant. The flowering stage in corn, which involves pollen shed and silking, is the most critical period in the development of a corn plant from the standpoint of grain yield determination. Drought, high temperature stress, as well as hail damage and insect feeding have the greatest impact on yield potential during the reproductive stage. The following is an overview of some of the key steps and phases of the corn pollination process.

- Pollen shed usually begins two to three days prior to silk emergence and continues for five to eight days with peak shed on the third day. On a typical midsummer day, the shedding of pollen is in the morning between 9:00 and 11:00 a.m.
- The tassel is usually fully emerged and stretched out before any pollen is shed. Pollen shed begins at the middle of the central spike of the tassel and spreads out later over the whole tassel with the lower branches last to shed pollen.
- Pollen grains are borne in anthers, each of which contains a large number of pollen grains. The anthers open and the pollen grains pour out in early to mid morning after dew has dried off the tassels. Pollen is light and is often carried considerable distances by the wind. However, most of it settles within 20 to 50 feet.
- Pollen shed is not a continuous process. It stops when the tassel is too wet or too dry and begins again when temperature conditions are favorable. Pollen stands little chance of being washed off the silks during a rain storm as little to none is shed when the tassel is wet. Also, silks are covered with fine, sticky hairs which serve to catch and anchor pollen grains.
- Under favorable conditions, pollen grain remains viable for only 18 to 24 hours. However, the pollen grain starts growth of the pollen tube down the silk channel within minutes of coming in contact with a silk and the pollen tube grows the length of the silk and enters the female flower (ovule) in 12 to 28 hours.
- A well developed ear shoot should have 750 to 1,000 ovules (potential kernels) each producing a silk. The silks from near the base of the ear emerge first and those from the tip appear last. Under good conditions, all silks will emerge and be ready for pollination within 3 to 5 days and this usually provides adequate time for all silks to be pollinated before pollen shed ceases.
- Pollen of a given plant rarely fertilizes the silks of the same plant. Under field conditions 97% or more of the kernels produced by each plant are pollinated by other plants in the field.
- The amount of pollen is rarely a cause of poor kernel set. Each tassel contains from 2 to 5 million pollen grains which translates to 2,000 to 5,000 pollen grains produced for each silk of the ear shoot. Shortages of pollen are usually only a problem under conditions of extreme heat and drought. Poor seed set is more often associated with poor timing of pollen shed with silk emergence (silks emerging after pollen shed).

Source: Aldrich, S. R., W. O. Scott, and R. G. Hoeft. 1986. *Modern Corn Production*. 3rd edition. A&L Publications (Chapter 1 - "How the Corn Plant Grows").

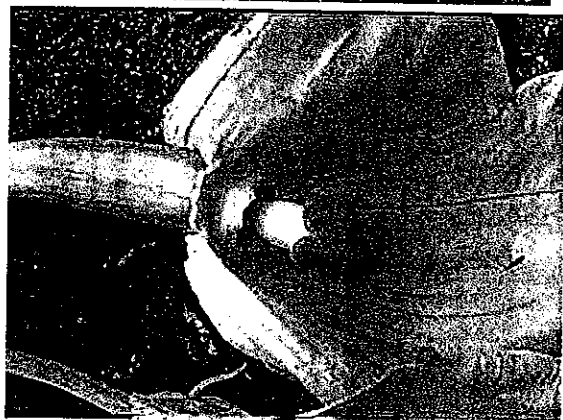
# Squash & Pumpkin Pollination

## Visual Aids



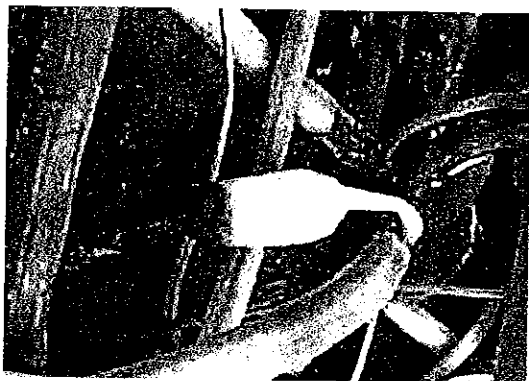
### Male and Female

The female flower has an ovary, which looks like a little squash (which is what it does become) at the base. The lower example is the male, which is just on a stalk. Below are the flowers with petals removed to show the internal structure.

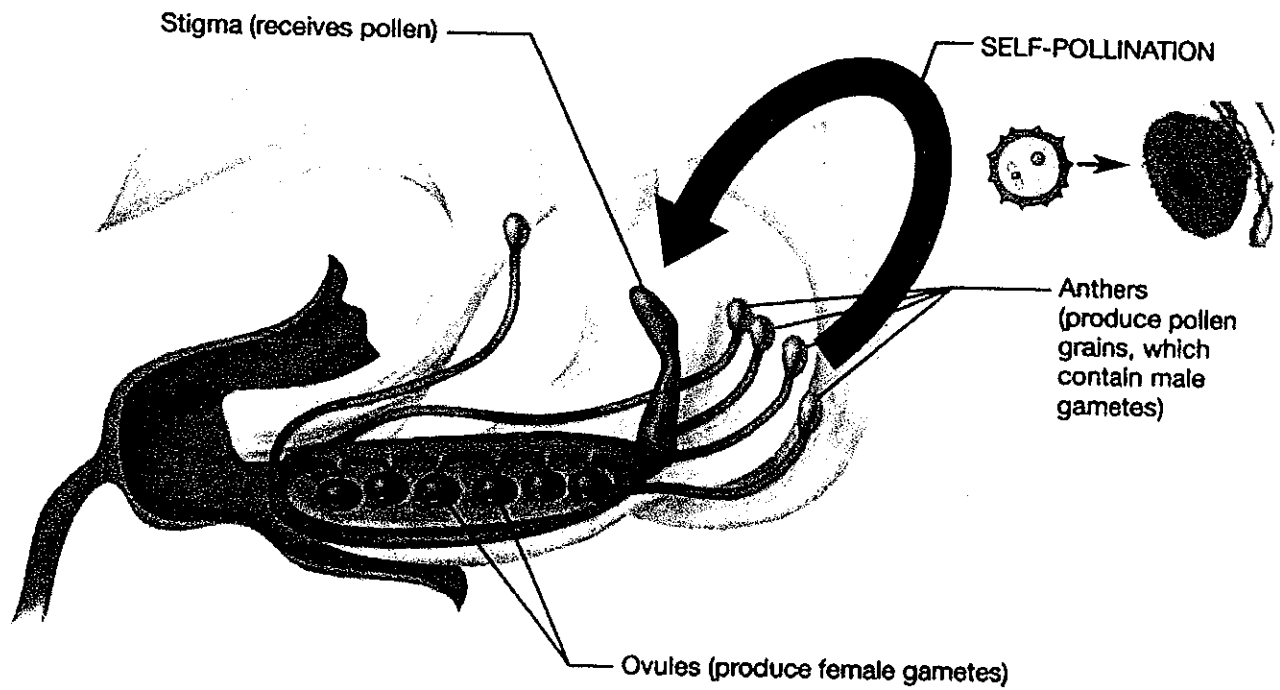


### When Not Enough Bees Visit the Blossoms....

Below are some pictures of inadequately pollinated squash, which begins to develop, then aborts. A fungus is usually present, but it is an opportunist, not the cause of the problem. Note how many of the fruits are wrinkled, as well. With the decline of pollinator populations in recent years, this has become a common gardener complaint. Many gardeners think pollination is not the problem, because fruit started development, so they spray fungicides -- an exercise in futility. One bee visit will not usually make a quality squash, because not enough pollen is delivered. There needs to be enough pollen grains for each incipient seed -- and that takes *many* bee visits.



EXAMPLE OF SELF-POLLINATION IN LEGUMES  
SUCH AS BEAN & PEA.





## Lesson 6: Harvest

### Materials:

- Teacher and student workbooks
- Pencils, regular
- Storage containers
- Gloves
- Scissors

### Plan:

Being the first year of experimenting with the 3 Sisters crops it is likely they will be ready for harvest at different times. Corn and beans need to be eaten within a few days of harvest. Depending on the type of squash, they may store for a period of time. Beans will typically need to be harvested every few days once they start coming in. If they are ready for market – great, if not, decide along with the students what you would like to do with the crops. Prepare in class, dry the corn, sell before or after school, etc.

Discuss how to harvest.

Beans: cut from vine with scissors. Remind students not to pull the vine as this may damage it and reduce yield. Put in baggies and store in fridge.

Corn: Gently feel ear to see if kernels have developed. You can try to carefully peek to see if kernels have developed. Once they have, you will want to pick soon. If corn stays on the stalk too long it will become increasingly tough.

Squash: Use scissors to cut from vine – do not pull. Students may want to wear gloves as the vines can be prickly.

### Garden Group

Harvest half of fruit that is ready.

### Table Group

Journal entry

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)

## Lesson 7: Compost

### Materials:

Teacher and student workbooks  
Pencils, regular  
Gloves  
Tools  
Scissors

### Plan:

- Continue harvest if there is still viable fruit.
- If letting plants dry for seed collection, you can leave as long as necessary.
- If the class is done with the plants, turn off water at the bed and allow to dry. Plants can then be pulled up, cut into small pieces and put in the compost bins. Thus completing the cycle!

Have students make final journal entries and then they can take home their journals.

Wrap-up and summarize the year.

Save the last 5 minutes to clean up. (Tools, pencils and journals put away)