



Building a Pollinator Garden

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Minecraft Education Lesson Plan
“Building a Pollinator Garden”

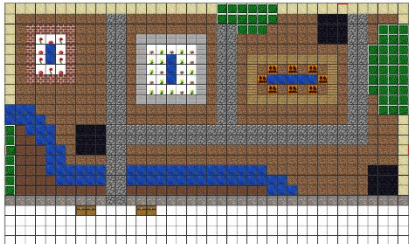
LEARNING OBJECTIVES

- To learn the importance of pollinators
- To learn different ways to attract pollinators to a garden
- To understand the value of creating pollinator gardens to protect threatened and endangered species

GUIDING IDEAS

1. Students should understand the importance of pollinators, reasons that pollinators are at risk, and what the world would be like if we no longer had bees. Prepare the students by sharing one or both of the recommended videos.
 - “A World without bees”
<https://www.youtube.com/watch?v=7X1xIlyZw3M>
 - “What would happen if bees went extinct?” a BBC Production
<http://www.bbc.com/future/story/20140502-what-if-bees-went-extinct>
2. From the videos, students should be able to understand that one in every three bites of food we eat relies on bees for pollination. And without bees, our sources of food and ability to feed the world’s population would become a great challenge.
3. Before students create their Minecraft pollinator garden, discuss the following questions with the students:
 - What is a pollinator?
 - Why are pollinators important?
 - What types of plants are dependent on pollinators?
 - What are ways we can help protect pollinators?
 - How might a pollinator garden help to protect pollinators?
 - What are some items we might consider putting in our garden?
4. You can find more information on region specific plants for attracting pollinators at <http://pollinator.org/guides>

STUDENT ACTIVITIES

1. Provide students with the color-coded information charts.
 - a. **Pink chart** – Common pollinators. Are all pollinators bees? Discuss the many different types of pollinators. What ways are they different? Are there certain pollinators you would like to attract to your garden?
 - b. **Yellow chart** – Minecraft plants. These are various plants available in Minecraft that may be attractive to different pollinators. Note that most bees do not see red, and most flowers that they are attractive to are white, yellow, blue, or purple. However, hummingbirds and butterflies might be more attracted to red flowers.
 - c. **Blue chart** – Items available in Minecraft that will be useful in developing a pollinator garden. Discuss with the students why it is important to have different substrates (wood, dirt, sand) available.
2. Have students plan out their gardens on the provided graph paper. There is also available software (<https://mcdesign.michd.me>) if students would rather design their garden online. There are four plots available in the pollinator garden world, each of which is 40 x 20 blocks. Plots are directly behind the pollinator garden museum, where they can gather materials in order to build. They should have an idea of the flowers and materials available in Minecraft using the color coded informational charts. All of these items will be available either in the museum or in the chests next to the gardens. Have them draw out walking paths, raised beds, edible landscaping, flower gardens, water sources, informational signs, and other materials. Consider having them work in groups, either by working together to design the plots, delegating different tasks, or by having them select the best design in the group.
3. Have students explore the provided pollinator garden world, and construct their very own pollinator gardens within Minecraft Education. Students will find all materials they need (those described in the blue and yellow charts) in the museum, walking path, or chests. Students should take photos of their completed pollinator gardens. They should also have photos of signs throughout the gardens that provide educational information on pollinators.

PERFORMANCE EXPECTATIONS

- Students should be able to discuss the components of their pollinator gardens, why they chose certain flowers or materials, and how the gardens can help protect threatened and endangered pollinators.
- Have student groups present their findings as a group in a report or presentation. Have them follow the standard format below:
 - Introduction: They should include basic information on the importance of pollinators and pollinator gardens
 - Methods: How did they go about planning and constructing their gardens? What plants did they select? What other materials did they use?
 - Results: What did the final pollinator garden look like? Utilize screen shots and photos to show their final garden.
 - Discussion: If this was a real garden, what types of pollinators would they anticipate using this?

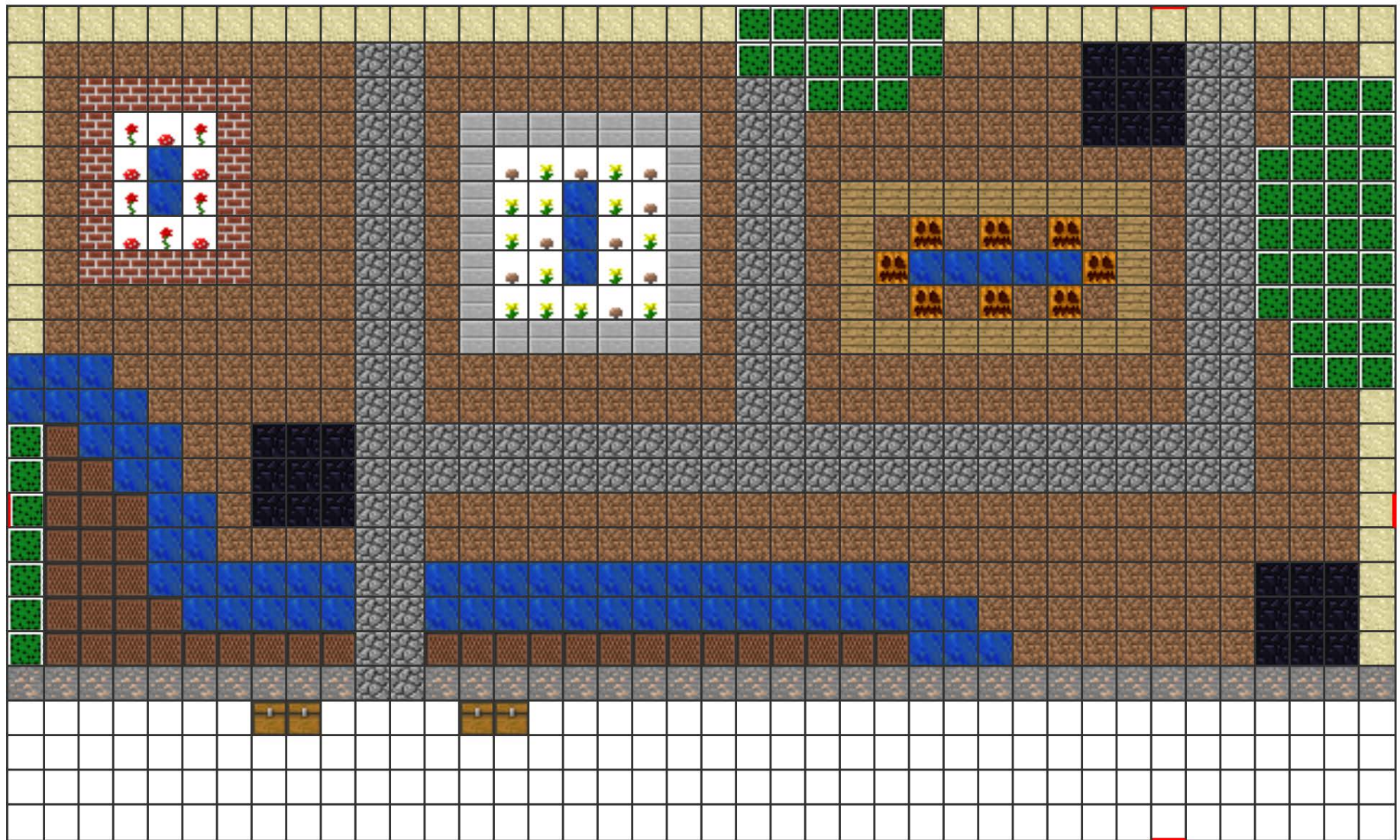
SKILLS

- Creativity
- Communication

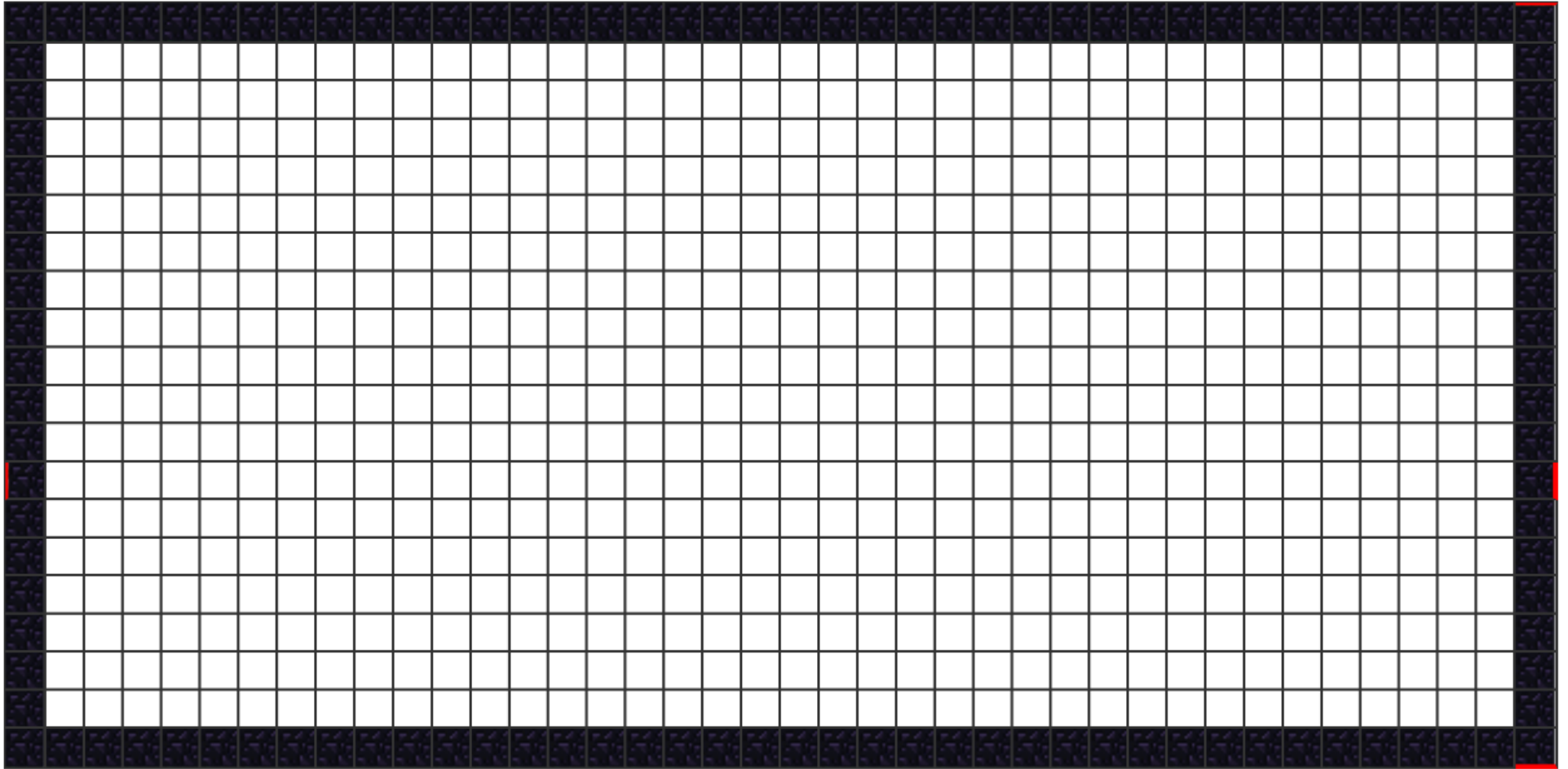
SUPPORTING FILES

- Color coded information charts
 - Pink – pollinators
 - Yellow – plants
 - Blue – other items
- Graph paper template to design gardens (40 x 20 blocks)
- Minecraft education world file
- LSU AgCenter fact sheets on pollinators
 - Pollinator Gardening
 - Constructing Bee Hotels
 - Edible Landscaping

Example Minecraft pollinator garden



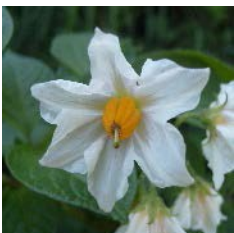
Pollinator Garden Template



You can find this template at <https://mcdesign.michd.me/1ykj3f3a/>
Or you can create your own template at <https://mcdesign.michd.me>

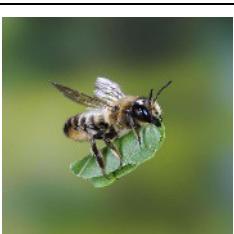
	Minecraft plants	Scientific name	Potential pollinators	Nutritional information
	Dandelion	<i>Taraxacum species</i>	Many bees and other insect pollinators, including honey bees and bumble bees.	Excellent source of both nectar and pollen for long periods of time. However, dandelions do not rely on insects for pollination.
	Poppy (California poppy is a good option for pollinators)	<i>Eschscholzia californica</i>	Bumblebees, and other bees. Not commonly used by butterflies.	Produce very little nectar, but is an excellent source of pollen.
	Blue Orchid	<i>Vanda coerulea</i>	Many orchids evolve along with specific pollinator species. Orchids often mimic insects or release chemicals to lure these species to the flower.	Often a good source of nectar.
	Allium (Onion)	<i>Allium species</i>	Bumble bees, leafcutter bees, sweat bees, small resin bees, and cellophane bees.	Good source of both pollen and nectar.
	Azure Bluet	<i>Houstonia caerulea</i>	Small bees, bee flies, and several small butterflies.	Similar flowers, called mountain bluets or knapweed, are an excellent source of both pollen and nectar.
	Tulips	<i>Tulipa species</i>	Tulips can self-pollinate, but many species of bees and other insects will collect the pollen in the early spring, before other flowers begin to bloom.	Not a great source of nectar.
	Oxeye daisy	<i>Leucanthemum vulgare</i>	Widely used by a variety of insect species, including bees, wasps, flies, beetles, butterflies, and moths.	Great source of pollen and nectar.

	Minecraft plants	Scientific name of plant	Potential pollinators	Nutritional information
	Sunflower	<i>Helianthus species</i>	Attracts a very wide diversity of pollinators, including bees, wasps, flies, butterflies, and pollen feeding beetles (bumble bees, mining bees, and long horned bees).	Abundant pollen and nectar.
	Lilac	<i>Syringa species</i>	Butterflies and many species of bees, including native bees, leaf cutter bees, and bumble bees.	Good source of pollen and nectar.
	Rose Bush	<i>Rosa species</i>	Pollen collecting bees, leaf cutter bees, mining bees, sweat bees.	More commonly used for pollen.
	Peony	<i>Paeonia species</i>	Wasps, flower flies, honey bees, and sweat bees.	Good source of pollen and nectar.
	Watermelon	<i>Citrullus lanatus</i>	Sweat bees, honey bees, bumble bees, long horned bees, and several other insects.	Flowers are a good source of pollen.
	Pumpkin	<i>Cucurbita species</i>	Squash and gourd bees, carpenter bees, long horned bees, honey bees, and bumble bees.	Flowers produce abundant nectar and pollen.

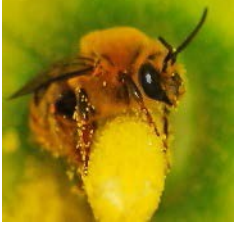
	Minecraft plants	Scientific name of plant	Potential pollinators	Nutritional information
	Cocoa bean	<i>Theobroma cacao</i>	Very tiny flies, called biting midges. Mosquitoes have also been suggested as potential pollinators of cocoa bean flowers.	Small source of pollen and nectar to those small flies capable of feeding on the small flowers.
	Beet root	<i>Beta vulgaris</i>	Both wind and insect pollinated. Some potential pollinators include honey bees, beetles, and flower flies.	Probably more of an important nectar source than pollen source.
	Potato	<i>Solanum tuberosum</i>	Bumble bees, mining bees.	Not a significant nectar producer, so are more important for pollen collecting insects.
	Carrots	<i>Daucus carota</i>	Honey bees, bumble bees, and leafcutter bees.	Less rewarding source of both nectar and pollen, but the number of flowers can be abundant.
	Apple trees	<i>Malus pumila</i>	Mason bees, sweat bees, digger bees, honey bees, and bumble bees.	Good source of both nectar and pollen.
	Cactus	Cactaceae family	Insects (bees, beetles, flies, and moths), hummingbirds, and bats.	Wide variation in nectar and pollen content by species, but will be an important floral source in many environments with limited forage.

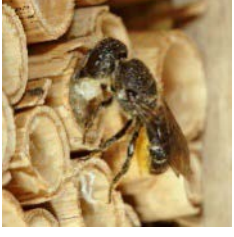
Building a Pollinator Garden

	Minecraft materials	Potential pollinators	How it is used
	Wooden blocks and boards	Honey bees, carpenter bees, bumble bees	Place wooden blocks (hollow or solid) around your pollinator garden to use as a nesting site. Many social insects (such as honey bees or bumble bees) will develop their nests inside. Solid boxes can be a great habitat for those that burrow holes in wood, such as carpenter bees or mason bees.
	Sand	Digger bees, carpenter bees, leafcutter bees, resin bees, sweat bees, cellophane bees, and long horned bees	And is an excellent nesting site for many solitary native pollinators. Rather than using just soil on the ground, have areas of the ground that use sand instead.
	Logs	Mason bees, digger bees, carpenter bees, bumble bees	Many pollinators will build nests in logs and rotting wood. Place logs around the garden for native pollinators to use as a nesting site.
	Bee Hotel Block (uses the gold block)	Mason bees, digger bees, carpenter bees, bumble bees	We provided a special block that you can use to construct your own bee hotels
	Stone	While bees will not be able to dig into stone, stone walkways provide a natural setting to the pollinator garden. Try using natural stone materials to accentuate the garden.	Use different types of natural stone to enhance the garden. Consider creating a stone walkway throughout the garden, so you can enjoy the different plants.
	Dirt	Dirt is an important component that will be necessary to grow flowers and other plants. Also, several bees prefer to build nests underground.	Use the dirt as both a location for nest building pollinators, but more importantly to grow flowers and other edible plants.

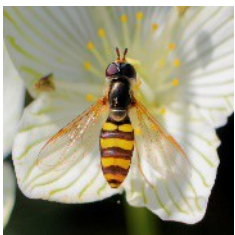
	Minecraft materials	Potential pollinators	How it is used
	Water	All pollinators drink water.	All pollinators require water to drink. While nectar and pollen is an excellent source of food, consider placing some structures similar to bird baths around the garden (such as the cauldron), or create rivers or waterfalls, to allow bees a source of clean water.
	Hoe	Tilled soil is necessary for planting many flowers that will attract different pollinators.	Use the hoe to make sure the soil is tilled prior to planting flowers and crops.
	Bone Meal	Bone meal is type of fertilizer that will allow greater and faster growth of different plants in the garden.	Use the bone meal as a source of fertilizer in your garden to help your plants grow bigger.
	Leaf litter and leaves	Leaf cutter bees, mason bees	Several pollinators use leaves to build nests or build part of their nests. Leaf cutter bees use leaves to create a cap over their developing brood. They also provision their young with food that is contained with the leaves.
	Plants	While flowering plants are important, many pollinators also use plant materials in their nests, or prefer to build their nests in shady environments.	Use plants, such as ferns, as a way to add other dense vegetation around the landscape. These will also provide shade in the habitat, as well as plant material for certain pollinators.
	Trees	Trees, like plants, provide shade and plant material for many pollinators.	While trees are a great way to add shade to your garden, make sure you do not have too much shade over your flower and plant gardens. However, trees around the garden will provide important shade and plant material, and nesting sites.

	Minecraft materials	Potential pollinators	How it is used
	Signs	Placing a sign in your garden will not attract pollinators, but it will help to let people know that you are trying to protect pollinators.	Place a sign at the entrance to your pollinator garden, to tell us more about your garden.
	Fruits and flowers	While flowers provide nectar and pollen, leftover fruit (such as old pieces of watermelon) can be a good sugary source of food for many pollinators.	Composting leftover fruit can also provide nutrients to your garden. Be sure to drop an occasional watermelon or apple into your garden as an extra sugar source for insects.
	Hay bale	Can provide a nest building site for some above ground bees.	While hay bales are not a critical pollinator garden item, you can place a hay bale to provide extra resting areas in the landscape for insects.
	Sugarcane	When sugarcane gets cut, some of the sweet syrup can be found at the edges. Many insects will feed on the sugary syrup from the sugarcane.	While sugarcane is not necessary in your garden, you can plant sugarcane around the garden as an extra source of sugar that you can feed bees if necessary.
	Flower pots	Flower pots are not only great at growing flowers, but they can create a nesting site for many bees, including bumble bees, and honey bees.	Place empty flower pots around the garden to attract native pollinators to build nests
	Mud or clay	Digger bees, carpenter bees, leafcutter bees, resin bees, sweat bees, cellophane bees, and long horned bees.	Use mud or clay in the landscape as a tool to help nest building pollinators in the garden.

	Pollinator	Favorite food sources	Where it lives
	Honey Bee (<i>Apis mellifera</i>)	Feed on a very wide variety of flowering plants. Will travel within several miles for a good source of food. Bees will communicate a good food source to other bees using a waggle dance.	These social bees build large social colonies within man made hives, or cavities of buildings or trees. Man-made hives are made of wooden boxes, with thin frames placed inside to allow the worker bees (all females) to store nectar and pollen. The single queen in the colony also lays all of the tens of thousands of eggs.
	Bumble Bee (<i>Bombus species</i>)	Bumble bees will shake out pollen from flowers by buzz pollination (sonication). They will forage on a wide variety of flowers, flowering shrubs, and flowering trees.	These social bees build nests in rodent holes, in abandoned wooden structures (boxes, sheds, barns, or bird houses), or under plant debris. Over the winter, the females will burrow underground in the soil or in a rodent burrow.
	Carpenter Bee (<i>Xylocopa species</i>)	Feed on a variety of common wild flowers, and tree flowers, such as asters, milkweed, thistle, oxeye, and redbud flowers.	Large carpenter bees (different species are either solitary or communal) are known for burrowing out rotting wood or man-made wooden structures to create their nests.
	Digger Bee (<i>Anthophora species</i>)	Forage on several common species of wild flower, including thistle, dogbane, milkweed, and ironweed.	These solitary bees build their nests in soil or wood, such as in piles of clay soil, bare ground, overturned trees and root masses, or cavities within rotten wood. Several species of digger bee prefer to use clay, which they reshape to make nest structures.
	Squash and Gourd Bees (<i>Peponapis species</i>)	Squash bees are specialists, and feed on flowers of various squashes and pumpkins.	These solitary bees are ground nesters, and will establish their nests close to squash flowers (their preferred food source). Prior to building a nest, the females will sleep in squash flowers, until they mate and are ready to build a nest.
	Leafcutter Bees (<i>Megachile species</i>)	Leafcutter bees will forage on a wide variety of flowers. Asters and daisies are a great source of forage. Roses are also a good option, as leafcutter bees also use the leaves for nesting material.	Leafcutter bees are solitary bees and build their nests above or below ground in dead trees, plant stems, rock cavities, or other abandoned structures. Leaf cutter bees get their name, as they cut pieces of leaves to cap the nest sites containing their young.

	Pollinator	Favorite food sources	Where it lives
	Mason Bees (<i>Osmia</i> species)	Mason bees are important pollinators of flowers, crops, and many tree fruits. They also commonly forage on a wide variety of flowers.	These solitary nest builders will build nests in cavities above or below ground. They will build holes in dead trees or plant stems. Many people try to attract mason bees (which are excellent pollinators) into their garden by providing bee hotels, with hollowed out bamboo.
	Sweat Bees (<i>Halictus</i> species)	These are generalists, and will feed on a wide variety of flowers. They often choose flowers where the pollen is easy to access.	Sweat bees (different species are either solitary or communal) are ground nesting bees. They often build communal nests in exposed, well drained, compacted soil.
	Green Sweat Bee (<i>Agapostemon</i> species)	Is a generalist, and will feed on a wide variety of flowers. Often forage on asters. Oxeye daisies are an excellent choice to attract these bees.	Metallic green sweat bees (different species are either solitary or communal) are ground nesters. Many species are communal, building large nests underground. They typically create nests in flat soils that are relatively bare. This includes sandy and loamy soils. Some species will also build nests in rotting wood.
	Cellophane Bees (<i>Colletes</i> species) AKA: Plasterer or polyester bees	Pollinates a wide variety of flower, tree, and crop species. Onion (<i>Allium</i>) is one common forage plant in the summer.	These solitary bees often construct their nests in bare soil or in areas with very light vegetation. Cellophane bees will build typically build their nests in open areas. These bees get their name, since they use a cellophane structure to cover the nest sites to prevent their young from drying or flooding.
	Resin Bees (<i>Heriades</i> species)	Resin bees forage on various flowers, including sunflowers, oxeye daisies, allium (onion) flowers, and other common wild flowers.	Resin bees are solitary bees and create their nests in cavities of wood or stems. They often create long cavities, in which each brood cell is provisioned with food, and divided and capped with resin.
	Long horned Bees (<i>Melissodes</i> species)	Long horned bees prefer to forage on composite flowers, such as asters, sunflowers, oxeye, and coneflowers.	These solitary bees are ground nesters. Substrates include sandy soils, bare soils, or soil partially covered by grass. Males generally do not return to the nest, rather group together on plants and flowers during the evening.

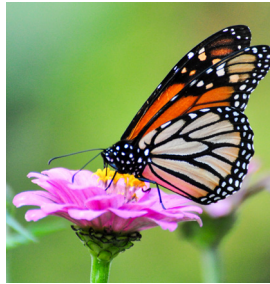
Building a Pollinator Garden

	Pollinator	Favorite food sources	Where it lives
	Butterflies	While caterpillars feed on plant tissues and leaves, the adult butterflies feed on plant nectars. As a result, they can also function as pollinators.	Adult butterflies lay eggs on very specific plants, in which the caterpillar will feed on. Monarch caterpillars will feed on different species of milkweed plants. Before becoming an adult, the caterpillar will transition into a pupae (non-feeding stage).
	Moths	Similar to butterflies, moths feed on various flower nectars as an adult. However, the caterpillar (immature stage) feeds on various plant tissues and leaves.	Adult moths also lay eggs on plants, in which their young (caterpillars) will feed and grow. Different species of moths can be found on very specific species of plants.
	Flower Flies	Flower flies feed on a wide variety of flowers, and are incredibly diverse. They feed on both pollen and nectar, and use the pollen protein for egg production.	While flower flies look similar to bees, they do not build nests. Also, they do not provide care to their young. Immature flower flies are called maggots, and generally live in moist, decaying soil. Adult flies emerge from these habitats and can be found in and around flowers and other types of vegetation.
	Bee Flies	While bee flies look similar to some robust bees, they are actually flies. Their hairy bodies allow them to pick up large amounts of pollen. They feed on a wide variety of flowers.	Even though bee flies resemble large bees, they are not nest builders. They also do not exhibit any care for their young. Rather they lay eggs that turn into maggots.
	Soldier Beetle	Soldier beetles are very common flower feeders, and scrape off pollen using their chewing mouthparts. Can be seen on a variety of flowers. Some species are also predators of aphids.	Soldier beetles are not nest builders and do not exhibit any care to their immatures. They will lay eggs in moist soil or leaf litter, and the developing grubs will feed on smaller organisms in their environment.
	Assassin Bug	Assassin bugs are not plant feeders, rather they hunt for other insects as prey. One of their favorite hunting sites is within flowers, where other insects will visit.	Assassin bugs do not build nests. They do not exhibit any care to their immatures. Since they are bugs, the immatures are similar in appearance to the adults, and do not have wings. Therefore, even the immature stages are hunters.

URBAN POLLINATOR CONSERVATION



Pollinator Gardening in Louisiana

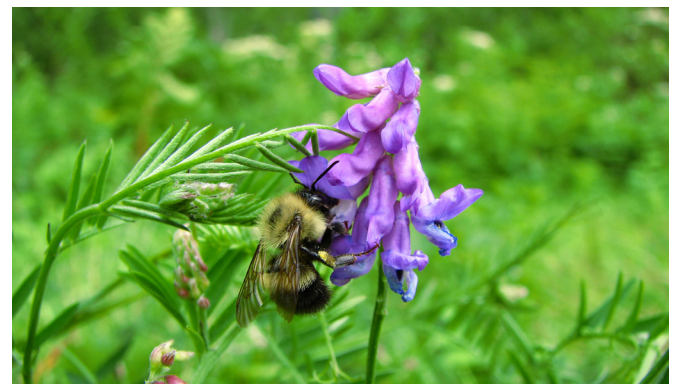


Pollinators are animals that transfer pollen from one plant to another. They are essential for the production of many crops and wildflowers. The honey bee is arguably the most important, but bumblebees, solitary native bees, butterflies, moths, flies and even beetles can also serve as pollinators. Pollinator declines have gained much attention in recent years, and concerned citizens wonder about what they can do to help. Fortunately, establishing pollinator gardens in your community will go a long way towards sustaining these important and beneficial insects!

Common garden visitors. North America alone is home to over 4,000 species of native bees that vary in size from tiny *Perdita* to the easily recognizable carpenter and bumblebees. Louisiana has over 200 bee species! While some are distinguished by yellow, orange or red stripes, others range in color from all black to metallic blues and greens.

Providing habitat around your home to support our six-legged friends will benefit more than just pollinators—healthy gardens support many other insects too. Natural enemies (predators and parasitoids) like green lacewings, ladybugs, spiders and solitary wasps are attracted to flowering plants and are great at controlling common garden pests without the need for insecticides. Hover flies, often mistaken for sweat bees, even have a predaceous larval stage. You might spot cuckoo bees that parasitize the nests of other bees. This may seem like a bad thing, but diverse insect communities are a sign of a healthy ecosystem and a healthy garden!

Considerations when choosing plants. Bees provision their nests with pollen to feed to their young in the spring, while butterflies sip nectar as they search for host plants to lay their eggs. Not all plants are equally good at producing pollen and nectar, so planning your garden to have good sources of both throughout the year is important. Many common ornamental plants are selected for showy flowers at the expense of nectar and pollen production. Choosing native



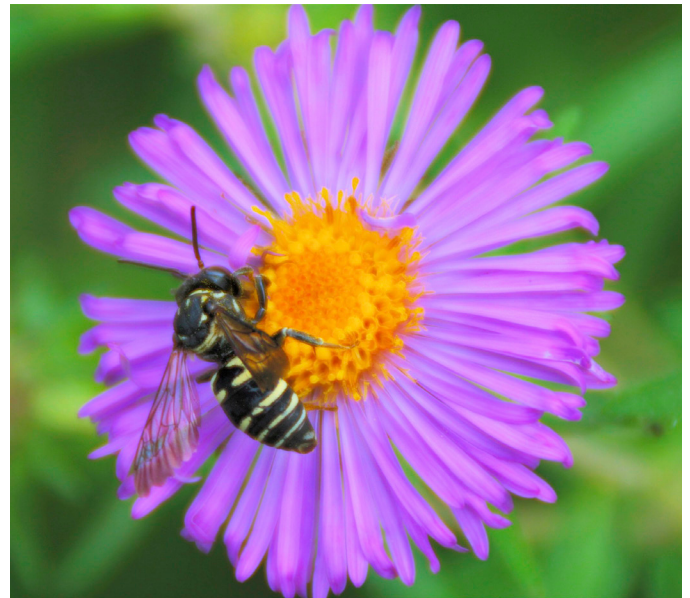
and heirloom varieties will ensure that pollinators benefit from your garden.

Some species of bees specialize on one type of flower, like the Southeastern blueberry bee, while others are generalists and can feed on many types of flowers. Provide a variety of floral shapes, sizes, and colors to attract the greatest diversity to your garden. Group plantings of a species together to create bold color statement, which will also help pollinators locate your garden. Seeds of zinnia, cosmos and Shasta daisy are an inexpensive way to cover a large area in blooms throughout the summer. Be sure to check with experts at your local nursery to identify plants that will work best in your garden.

Edible landscaping. Not all pollinator habitats need to be ornamental. Consider this: one in every three bites of food we eat relies on pollination. But we aren't the only ones to benefit from this interaction—plants produce nectar and pollen specifically to attract pollinators. A 100 sq. ft. vegetable garden can produce hundreds of pounds of produce in a summer! If this seems daunting, consider an herb garden—flowering borage, lavender, rosemary and basil also benefits pollinators. Citrus or pecan trees in southern Louisiana can double as shade trees, and blueberries, which are native to the region, can be trained as hedges.

Nesting habitat. Honey bees travel many miles from their hives in search of food, but the majority of native bees only travel a few hundred feet from their nests. Providing habitat for nesting is therefore essential to ensuring native bees come back to your garden year after year. “Bee hotels” (or bed-and-breakfasts when combined with a garden!) can serve as a focal point and give children a safe and up-close look at nesting behaviors of our native stingless bees. These can be easily constructed using recycled garden materials. Be sure also to leave patches of soil free from mulch or pine straw, since 70% of native bees nest in the ground.

Additional information may be found at the Xerces Society (www.xerces.org/pollinator-conservation), the Pollinator Partnership (pollinator.org/guides) and the LSU AgCenter (www.LSUAgCenter.com).



Examples of plant species to use for Louisiana pollinator gardens and general landscaping and when they bloom.																
Common name	Scientific name	Type ¹	Notes ²	Jan ³	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Lemons/limes	Citrus sp.	T	P, I													
Hairy vetch	Vicia villosa	W	P, I													
Butterweed	Packera glabella	W	A, N													
Buckwheat tree	Cliftonia monophylla	T	P, N													
Rabbiteye blueberry	Vaccinium ashei	Sh	P, N													
Verbena	Verbena canadensis	W	P, N													
Blue vervain	Verbena bonariensis	W	P, I													
Yaupon holly	Ilex vomitoria	T	P, N													
Coreopsis	Coreopsis lanceolata	W	A, N													
Spiderwort	Tradescantia	W	P, N													
Buttonbush	Cephalanthus occidentalis	Sh	P, N													
Wisteria	Wisteria frutescens	V	P, N													
Butterflyweed	Asclepias sp.	W	P, N													
Prairie rose	Rosa carolina	Sh	P, N													
Purple coneflower	Echinacea purpurea	W	P, N													
Black-eyed Susan	Rudbeckia hirta	W	P, N													
Beautyberry	Callicarpa americana	Sh	P, N													
Crepe myrtle	Lagerstroemia	T	P, I													
Maypop/ Passionflower	Passiflora incarnata	V	P, N													
Blazing star	Liatris spicata	W	P, N													
Sunflower	Helianthus	W	A, N													
Blanketflower	Gaillardia pulchella	W	P, N													
Ironweed	Vernonia altissima	W	P, N													
Goldenrod	Solidago altissima	W	P, N													

¹Type: Sh=shrub, T=tree, V=vine, W=wildflower; ²Notes: P=perennial, A=annual, N=native to Louisiana, I=introduced or ornamental/non-weedy in Louisiana; ³Line color refers to flower color. Gray/white=white flowers, blue dots=multiple colors available.

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URBAN POLLINATOR CONSERVATION

Constructing Backyard Bee Hotels

North America is home to approximately 4,000 species of native bees, of which 30% are wood nesters that build their nests inside of hollow tunnels. These tunnels may be pithy stems, beetle holes or burrows excavated by the bees themselves (carpenter bees). Unlike honey bees, which work together to construct their hives of comb made from beeswax, the females of solitary native bees build and provision their nests by themselves. Typically, these solitary bees use materials gathered from the environment, such as pieces of leaves or flower petals, mud, pebbles and tree resins. Because many of our native bees are able to forage only within a couple hundred meters of their nests, providing nesting structures in the vicinity of your pollinator garden will encourage nesting and pollination year after year!

Bee hotels are an easy way to provide artificial nesting sites to observe the behaviors of our gentle native bees. Unlike honey bees, native bees are less defensive of their nests and thus allow you to closely observe their foraging trips, bringing pollen back for their young. **Wooden nest blocks** can be constructed from preservative-free pieces of 4x4 or 4x6 lumber, or with pieces of firewood or fallen logs. These simulate the beetle holes bees encounter in the wild. Holes should be drilled into the block 3-6 inches deep, 3/4 inches apart and between 3/32 inch (2.5 mm) and 3/8 inch (10 mm) in diameter. Alternatively, **stem bundles** of bamboo reeds of various sizes that are cut at the nodes, such that one end is closed, also can be provided for nesting. Hang or mount nests securely in protected locations that face east with afternoon shade. Charring or painting the front has been shown to attract bees more, but otherwise the structures can be painted any color or left natural.



Depth is important when drilling holes, as female bees can control the sex of their offspring, and will lay male eggs closer to the entrance. Deeper holes encourage them to produce more female offspring, which will in turn pollinate your garden.

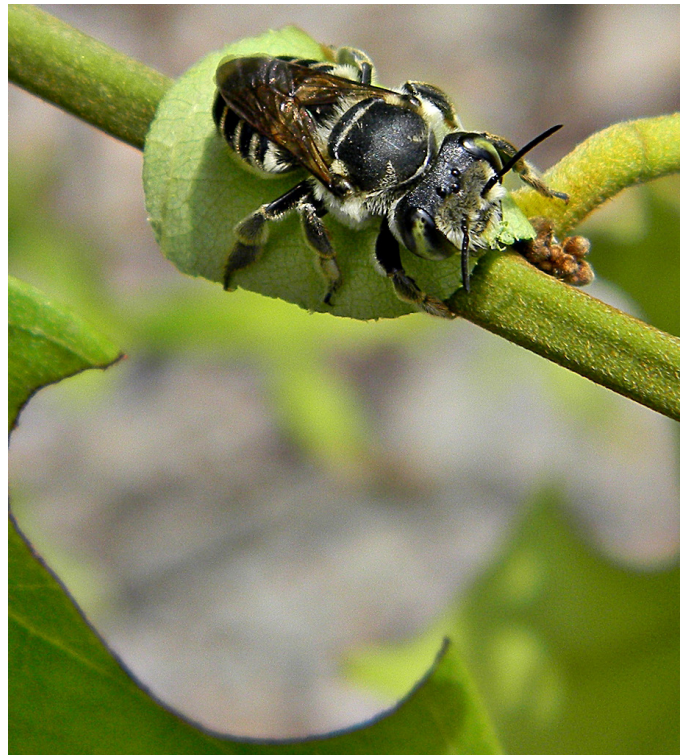
Females of the leaf cutter bees (Megachilidae) can be seen cutting perfect circles of leaves, which they use to line their nests. Unlike honey bees, they carry pollen under their abdomens.

Even if you never observe the females, you will know when mason bees have been using your hotels, as they plug the full tunnels with mud to protect their young. Once mature, the new adults chew their way out.

When setting aside pollinator habitat, keep in mind that 70% of native bees are ground nesting; leaving mulch-free areas of soil in your garden will give these important pollinators a place to live in your yard as well.

Extravagant **5-star bee hotels** also can be used as a focal structure in your garden. Growing turf or other plants as a green roof will help to keep the interior cool. These can incorporate broken and upcycled garden supplies for nesting.

Further information is available at Xerces Society (www.xerces.org/pollinator-conservation) and the LSU AgCenter (www.LSUAgCenter.com).



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URBAN POLLINATOR CONSERVATION



Conserving Pollinators With Edible Landscaping

Not all pollinator habitats need to be ornamental, and readjusting our notions of aesthetics opens the door to a world of gardening possibilities! Edible landscaping has the added benefit of providing nutritious and locally sourced food for the home gardener while providing much-needed resources to local pollinators. This is particularly important in urban areas, which often have fragmentation of native pollinator habitat. Networks of private and public gardens, both ornamental and edible, can provide considerable conservation and biodiversity benefits for pollinators throughout the area.

Pollination is a service provided by native and managed bees that is essential for the production of many crops. In fact, one in every three bites of food we eat relies on pollination. This includes some of the most nutritious components of our diets, such as fruits, vegetables and nuts. Even though pollination may not be directly necessary for a plant to produce the part that we eat, such as carrots, onions and other root vegetables, pollination is needed to produce the seeds that will grow into more plants.

But we are not the only ones to benefit from the interaction of pollinators with flowering crop plants. Edible crop plants produce pollen and nectar specifically to attract their pollinators. Commercial agricultural operations rely heavily on honey bees for crop pollination, but a number of native bees are more efficient crop pollinators. Providing these plants in your home garden enhances urban pollinator habitat while allowing you to enjoy the freshness and flavor of home grown produce, as well as savings on grocery bills!

Design considerations. Most fruits and vegetables require 6-8 hours of sun a day to produce well, so site selection is an important first consideration. When arranging plants, be sure to account for final plant size, since many vining varieties, like cucumbers or melons, will spread over a large area. If space is limited, provide structures so plants can be trained to grow vertically, or consider compact varieties. Growing your own produce also provides the opportunity to experiment with heirloom or unusual varieties that may not otherwise be available in grocery stores. With these you can mix beauty and utility in both vegetable and flower gardens. Leafy greens come in many colors and textures and can be incorporated along borders. When left to bolt, they provide resources to pollinators that in turn facilitates the possibility of saving your own seeds for subsequent plantings. Indeterminate types of tomatoes will grow to 6-12 feet high and can be trained to grow over an arch. These tomatoes

come in a plethora of sizes and colors to provide season-long aesthetics and flowers for the bees.

Rabbiteye blueberries (*Vaccinium virgatum*) are a native shrub originating in the southeastern U.S. and thus well-adapted to our soil and moisture conditions in southern Louisiana. Plants thrive in the same soil conditions suitable for azaleas and rhododendrons and can be trained as hedges in home gardens. They are also the host plant for the southeastern blueberry bee (*Habropoda laboriosa*), which is the most efficient pollinator of this crop. They develop as larvae in underground nests and are active as adults only for a few weeks every year when blueberries are flowering.



Squashes and gourds (*Curcubita* sp.), in addition to being excellent sources of vitamins A and C, are the host plants for a number of native squash bees. Originally specializing on buffalo gourd, as agriculture spread in North America, so did the ranges of these native bees. *Peponapis pruinosa*, among others, are specialists on squash flowers and the most effective pollinators of crops such as zucchini, pumpkins and squash (like butternut, buttercup and spaghetti) because their biology is closely linked to that of their host plants. Females provision their young only with squash pollen, so observe flowers first thing in the morning when flowers are most fertile for these native visitors. Females nest in the ground near host plants, so leave some bare soil nearby to encourage a healthy population, and hearty supply of squash!



Plants belonging to the nightshade (*Solanaceae*) family include tomatoes, tomatillos, peppers, eggplants and potatoes. These plants all require a specific type of pollination, called “buzz pollination,” to release their pollen. This technique can be carried out only by bumble bees and certain other native bee species, in which they rapidly vibrate

their flight muscles when they visit the flower. Although varieties of tomato and pepper do not necessarily need to be pollinated to set fruit, a higher quality harvest is achieved by a healthy pollinator presence.



Substituting fruit trees for other common shade trees is a great option for southern Louisiana residents. Honey bees and numerous other native bees visit blossoming citrus trees for the abundant nectar and pollen. Oranges are particularly good nectar producers in the spring, but lemons and limes will bloom continuously through the year. Grapefruit is also a good nectar producer, but few are grown in Louisiana. Although they can be pests for citrus farmers, the Giant Swallowtail (*Heraclides cresphontes*) uses citrus as a host plant, with the larvae resembling bird droppings to deter predators! Pears adapted to our climate and persimmons are other low-maintenance options.



Figs (*Ficus carica*) have a unique pollination syndrome in that their flowers are not visible, but open inside of a hollow stem called the scion. Instead of attracting bees, they rely on a tiny, seemingly insignificant wasp (*Blastophaga psenes*) for the “fruit” to develop. These wasps do not sting and would likely go unnoticed in your garden if not for all the figs on your tree!

Before purchasing or planting any trees, be sure you locate them in a well-draining part of your yard that is not susceptible to frost, since fruit trees can be damaged by freezing temperatures.

Herb gardens are a great way to incorporate lots of floral diversity in relatively small areas, especially since most will grow well in pots. Herb plants have



a wide diversity of flower types, which, in turn, will attract numerous different types of pollinators to your garden, particularly butterflies. Caterpillars like the Black Swallowtail (*Papilio polyxenes*) can use caraway, dill, fennel and parsley as host plants, though adults feed on nectar from many herbs, including chives, Echinacea, marjoram and mint. Bees benefit from flowering basil, lavender, hyssop, borage, rosemary and thyme, among others.



Although it is a common practice to pinch off flowers of herbs to encourage more leaf growth, allowing some to bolt will greatly increase the diversity of beneficial insects in your yard.

Prickly pear cactus, *Opuntia engelmannii*, has a native range that extends east into Louisiana and is a common landscaping plant. Native Americans across the southern part of the country utilized the younger pads (or nopalitos) and fruits as food. While a less common practice among home gardeners today, the flowers of this cactus are an important resource for bees of *Diadasia* and *Melissodes* present in Louisiana and many other pollen generalists. Please note: the spines of prickly pear cactus can cause severe inflammation of the mouth and throat. If you plan on growing this plant for food, research the best ways to safely remove spines before consuming, or plant a spineless cultivar.



Further information about fruit and vegetable gardening and plant varietal selection may be found at the LSU AgCenter website (www.LSUAgCenter.com).

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