THE LIVING DESERT
ZOO | GARDENS

SCHOOL EXPLORERS: THE POWER OF POLLINATORS

GRADES TK-6TH

THE LIVING DESERT ZOO | GARDENS

SCHOOL EXPLORERS CURRICULUM OVERVIEW

NGSS ALIGNMENT

2-LS2-2: Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

OBJECTIVE

Students will discover the variety of pollinators and their interactions with plants that allow our world to grow and thrive.

MATERIALS

For chaperones:

- Map
- Activity: Zoo Search (3 possible versions depending on grade levels)
- Game: Bingo (3 possible versions depending on grade levels)
- Activity: Flower Fascination
- Pollinator Information Guide

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TEACHER GUIDE

HOW TO USE CURRICULUM PACKET

Thank you for joining us for Mission: Pollination!

In this curriculum, you will find a *Chaperone Guide* for a self-led tour and activities. Make copies depending on your chaperone headcount. Students do not need any copies of the materials, however, you may print individual bingo sheets for students if you prefer.

Self-Guided Tour

Assign chaperone groups. Each chaperone will be able to lead their group using their *Map*, *Activities*, and *Information Guide*.

Using the Map (Page 5)

Attached is a map with marked locations of our supersized pollinators. The map includes dashed lines to indicate suggested walking paths, but your route may vary! Feel free to encourage chaperones to venture from the route to visit animal habitats and gardens as desired.

Facilitating the Activities and Games (Pages 6-12)

In this packet you will find three different activities. The "Zoo Search" and "Bingo" activities have 3 different versions, each with a suggested grade level range. You may print any or all of these for your chaperones and their groups to participate in.

The "Zoo Search" and "Bingo" activities are best facilitated with the chaperone having a writing implement. (Groups can work on this individually or compete with other groups.)

The Activity "Flower Fascination" is observation and verbal response based, guided by the chaperone. No other materials are required.

Using the Pollinator Information Guide (Pages 13-21)

In this packet is a guide that includes information about each supersized pollinator species featured in our exhibit. There are also ways to "BE A HERO" for chaperones to share with the students about protecting wildlife. The stars by the upper right corner of each box match the stars on the map, so you can easily locate the information about any of our pollinator heroes.

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TEACHER GUIDE

FIELD TRIP SCHEDULE

Use the space below to plan your itinerary.

TIME	ACTIVITY	LOCATION

CHECKLIST

Item	Count	Item	Count
☐		☐	
☐		☐	
☐		☐	
☐		☐	

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SCHOOL EXPLORERS CHAPERONE PACKET

INSTUCTIONS

Using the Map

Attached is a map with marked locations of our supersized pollinators. The map includes dashed lines to indicate suggested walking paths, but your route may vary! Feel free to venture from the route to visit animal habitats and gardens as desired.

Facilitating the Activities and Games

In this packet you may find three different activities. The "Zoo Search" and "Bingo" activities are best completed with the chaperone using a writing tool like a pend or pencil. The "Flower Fascination" activity is observation and verbal response based, guided by the chaperone. No other materials are required.

Using the Pollinator Information Guide

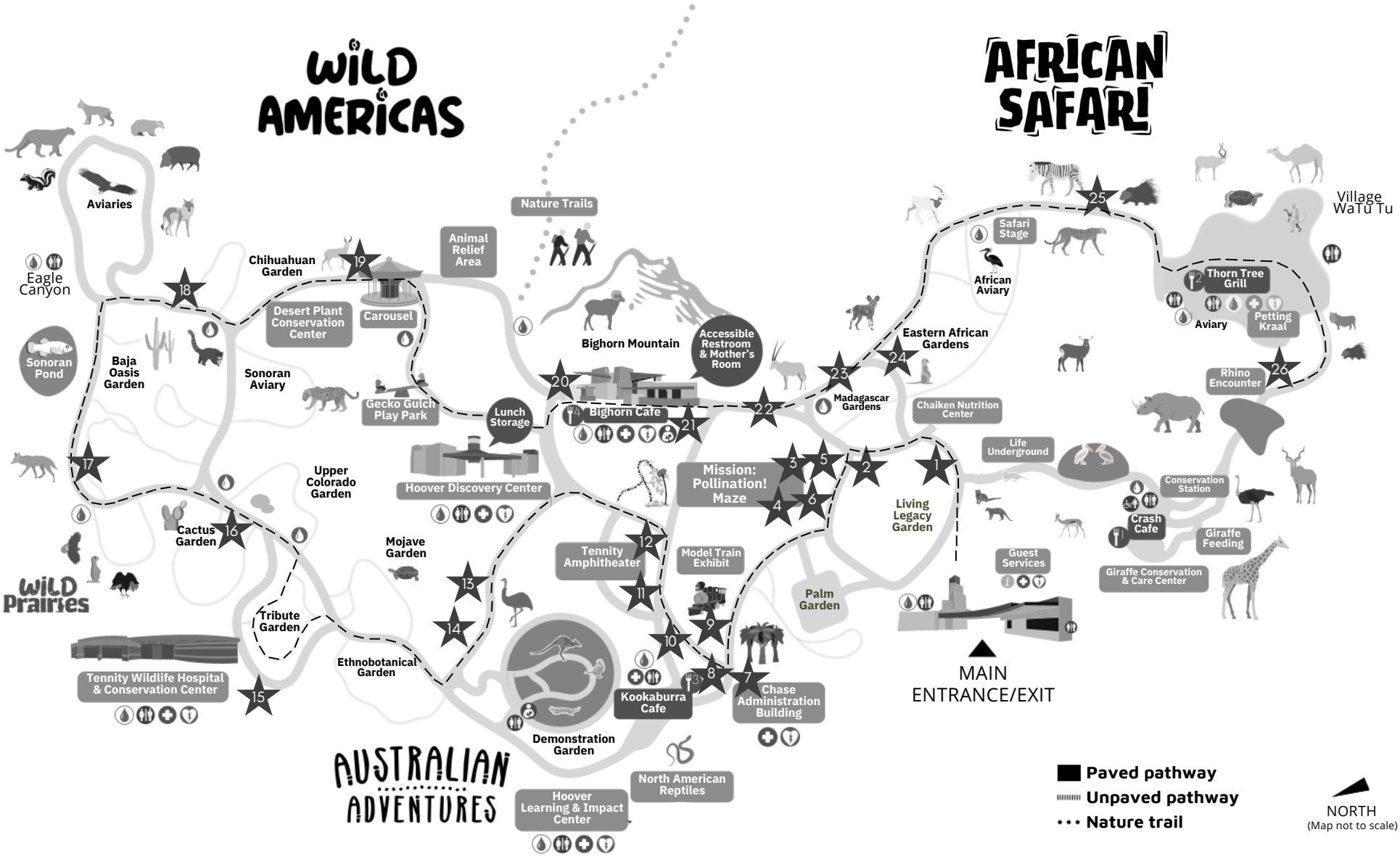
In this packet is a guide that includes information about each supersized pollinator species featured in our exhibit. There are also ways to "BE A HERO" for chaperones to share with the students about protecting wildlife. The stars by the upper right corner of each box match the stars on the map, so you can easily locate the information about any of our pollinator heroes.

Note: Your teacher may have omitted some of these materials for the sake of time or their own learning goals, so don't be surprised if you don't see all the materials mentioned.

MY GROUP

List your student group below.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____



FOOD & DRINK:

1. **Crash Cafe*** - Specialty coffees, snacks, soft-serve, beverages, and draft beer.
2. **Thorn Tree Grill*** - Freshly-made burgers, hot sandwiches, salads, soft drinks, beer, and wine.
3. **Kookaburra Cafe*** - Made to order pizza, pasta, salads, snacks, soft drinks, beer, and wine.
4. **Bighorn Cafe** - Asian and Southwest inspired rice and noodle bowls, sandwiches, pizzas, smoothies, snacks, beer, wine, and more!

*Closed for Summer

GUEST SERVICES:

- Information | Lost and Found
  Stroller/Wheelchair/ECV Rentals
- Restrooms
- Adult Changing Table
- First Aid Station
- Mother's Room
- Drinking Fountain
- Water Bottle Refill Station
- Automated External Defibrillator (AED)

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Suggested Grades: TK - 1st

ACTIVITY: ZOO SEARCH

DIRECTIONS

Search the zoo to find each pollinator that matches the descriptions below. Try to check off every box as you go!

Orange butterfly wings				
Any bees				
Making buzzing sounds				
Red colored				
Fuzzy hairs				
Caterpillars				

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Suggested Grades: 2nd-3rd

ACTIVITY: ZOO SEARCH

DIRECTIONS

Search the zoo to find each pollinator that matches the descriptions below. Try to check off every box as you go!

Spotted shell				
Buzzing wasp				
Spines on legs				
Orange butterfly wings				
More than six legs				
Stripes				

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Suggested Grades: 4th-6th

ACTIVITY: ZOO SEARCH

DIRECTIONS

Search the zoo to find each pollinator that matches the descriptions below. Try to check off every box as you go!

Moving orange wings				
Parasitic wasps				
Eats nectar				
Solitary bees				
Feeds on aphids				
Fuzzy wasps or bees				

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Suggested Grades: TK - 1st

GAME: POLLINATOR BINGO

DIRECTIONS

Try to get a bingo by marking off the boxes below while visiting our exciting pollinator heroes around the zoo!

Fuzzy or hairy	**Red eyes**	**Body moves**	**Clear wings**	**Eight eyes**
Black spots	**Spiky legs**	**Yellow body**	**Makes buzzing noise**	**Blue body**
Green body	**Head moves**	**Six legs (free space)**	**Orange wings**	**Bright flowers to attract pollinators**
Blue wings	**Orange body**	**More than eight legs**	**Stinger**	**Feathers**
Stripes	**Pink body or wings**	**Beak**	**Red Body**	**Eight legs**

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Suggested Grades: 2nd-3rd

GAME: POLLINATOR BINGO

DIRECTIONS

Try to get a bingo by marking off the boxes below while visiting our exciting pollinator heroes around the zoo!

Butterfly with blue wings	**Beetle that moves its head**	**Green bee**	**Colorful leafhopper**	**Pink moth**
Red beetle	**Butterfly with orange wings**	**Wasp with moving antennae**	**Bright flowers to attract pollinators**	**Caterpillar with yellow stripes**
Green beetle	**Fuzzy bee**	**Insect with six legs (free spot)**	**Yellow-orange beetle**	**Blue wasp**
Moth with red wings	**Mammal with brown fur**	**Spider with a friend on its back**	**Moth with moving wings**	**Fly with red eyes**
Caterpillar with colorful spikes	**Orange scorpion**	**Beetle with black spots**	**Fuzzy or hairy wasp**	**Bee that buzzes**

THE LIVING DESERT ZOO | GARDENS

Suggested Grades: 4th-6th

GAME: POLLINATOR BINGO

DIRECTIONS

Try to get a bingo by marking off the boxes below while visiting our exciting pollinator heroes around the zoo!

Nocturnal (active at night)	**Butterfly that migrates**	**Beetle that eats aphids**	**Bee that builds nest by burrowing into wood**	**Moth that doesn't eat as an adult**
Toxic caterpillar	**Spider that ambushes its prey**	**Beetle that is found on milkweed plants**	**Bright flowers to attract pollinators**	**Dig long burrows in the ground**
Bird that has to feed nearly constantly	**Solitary bee species**	**Insect with six legs (free spot)**	**Butterfly that lives in prairies of North America**	**Eats by sucking sap out of plant stems**
Wasp that steals nests	**Fly that eats aphids as a larva**	**Very fuzzy yellow bee**	**Wasp that lays eggs in beetle larvae**	**Bee that can get salt from human sweat**
Wasp with no stinger	**Caterpillar with harmless spikes**	**Endangered butterfly**	**Has partially translucent wings**	**Feeds on decaying plant matter**

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Suggested Grades: ALL

ACTIVITY: FLOWER FACINATION

ACTIVITY OVERVIEW

Goal/Objective: Make observations to explain what traits flowers use to attract pollinators in order to successfully reproduce.

Location: Tribute Garden

Topic Overview: Pollination, insects, flowers, traits, adaptations

Activity Time: 15-20 minutes

INSTRUCTIONS

In this activity students will observe a garden to determine what traits flowers have to attract pollinators, and what traits pollinators have to collect pollen and nectar from those plants.

Key Information:

Pollinators assist with plant reproduction by moving pollen between flowers. When they visit a flower they pick up some pollen on their body, and bring it along with them to the next flower they visit. This allows the flower to reproduce. Flowers attract these important pollinators with nectar, color, scent, large flowers, and more.

Chaperone Instructions:

Lead students through the Tribute Garden pointing out each of the flowering plants and pollinators as you pass by and asking the questions below to the group. Allow students to point out their own observations and show the group pollinators they find while traveling through the garden.

Ask:

- What living things act as pollinators to flowering plants?
  - Insects: bees, butterflies, flies, wasps, beetles
  - Birds: hummingbirds, doves, orioles
  - Mammals: mostly bats
- How are the plants here attracting the pollinators to visit them?
  - Students might observe color, scent, size, texture, or other attributes.
- Why is attracting pollinators so important for these plants?
  - They require pollination to reproduce.

LESSER LONG-NOSED BAT

1

- These bats have tongues as long as their entire bodies, specially adapted for drinking nectar from desert flowers-especially cacti that bloom at night.
- They disperse (help move) seeds for some cacti by eating the fruit and moving around. The seeds pass through their bodies and are "planted" elsewhere.
- They migrate along "nectar corridors" of cacti and agave plants where food can be found. Like a habitat highway!
- They roost (sleep and have their babies) in the same places every year, and are very picky! Across their entire range, only 40 roosting locations are known.
    - Any disturbance to their roosts from humans, such as hiking off the trails, rock climbing, or caving in protected areas, can be a serious threat to their survival.

BLUE MUD WASP

2

- These wasps are solitary and they don't live in groups to build nests.
- Instead of building their own nests, they often use the mud nests of other solitary wasps to lay their own larvae.
- They are known for feeding their larvae spiders, particularly black widow spiders. But despite the fearsome reputation, these wasps are not aggressive toward humans. In fact, the males cannot sting at all!
- As adults, these wasps feed on nectar from flowers. Flying from flower to flower means they help pollinate several species of wildflower.
- One species they pollinate is Golden Zizia, which has been used in traditional medicine and tea, and can also be eaten!
- The mud nests of these wasps are often disturbed or destroyed, despite the beneficial and non-aggressive nature of the wasps.

BE A HERO:

You can be a DESERT DEFENDER by coexisting with wildlife, staying on the trails, and not disturbing wildlife.

BIG IDEA: Animals that seem "spooky" are often more sensitive than you might think.

MONARCH BUTTERFLY (WINGS)

3

Take a picture with the butterfly wings, and ask your students where they see butterflies the most.

- *The park? Home garden? Out on a hike?*

Why do they think butterflies are most common in those places?

MALACHITE BUTTERFLY (WINGS)

4

NINE-SPOTTED LADY BEETLE

5

- Like the milkweed leaf beetle, this beetle has bright red colors with black spots to warn predators to stay away. It has a strong bitter taste that most predators would want to avoid.
- They are natural pest controllers who feed on aphids and other insects that often eat crops, both as larva and as adult beetles. Due to this, it is an insect that farmers are fond of, and was made New York's state insect.
- However, this insect has undergone a huge drop in population for reasons that scientists are still trying to study.

You can participate in science by documenting any sightings you might have of this beetle to programs like The Lost Ladybug Project or Inaturalist.

MONARCH CATERPILLAR

6

- Monarch caterpillars feed exclusively on milkweed plants.
- This means that if there are no native milkweed plants available to them, they will be unable to survive, and will lack the nutrients to molt, form a chrysalis, and transform into the famous monarch butterfly.
- As butterflies this species is a very important pollinator that migrates thousands of miles between North America and Central Mexico.

You can help this species by planting native plants, such as milkweed, in your own gardens at home and at school.

VIOLET CARPENTER BEE

7

Did you know bees can also be solitary?

- These bees burrow individual tunnel nests into rotting wood and create a mixture of pollen and nectar for their young to feed on.
- Though large, these bees are not aggressive, and only the females have stingers.
- They are important pollinators, known to pollinate two of the largest plant groups-one of which includes legumes, peas, and beans!
- However, these bees are still harmed by pesticides, especially neonicotinoids, which can kill any insect that come into contact with them, even helpful ones.
    - Avoiding neonicotinoid pesticides in your home, plants, and gardens can help protect many kinds of wildlife and helpful pollinators!

BLUE-WINGED SCOLIID WASP

8

These wasps are free "pest control" for your garden!

- These wasps are not aggressive towards people and rarely sting.
- They dig in the soil to find the beetle larvae that they will lay their eggs in. Once the wasp eggs hatch the young will eat the beetle.
- Adults feed on the nectar from North American flowers.
    - Digging up the grubs of beetle larvae takes a lot of energy, so they need the fuel of nectar to lay their eggs.
- They also pollinate several species of flowers while feeding from nectar, making them another pollinator species.

BE A HERO:

You can be a DESERT DEFENDER by avoiding the use of harmful pesticides, like neonicotinoids.

BIG IDEA: Pollinators can be harmed by the chemicals we put on our plants to kill insects

PURE GREEN SWEAT BEE

9

Ask: Where do you think bees live?

- These bees are solitary, and make their nests under the bark of old trees.
- Each female bee will make cells for her own eggs. Then she will gather pollen and nectar to mix together and prepare food for the larva before she ever lays an egg there.
- Not living in hives doesn't make them any less important as pollinators, in fact, forest bees like these are especially important for certain flowers that other bees don't like to pollinate.
- Around 30 percent of U.S. crops need native bees for pollination, including the pure green sweat bee.
- These bees pollinate wildflowers, fruits, vegetables, and other crops that you might eat!

AMERICAN PELICINID WASP

10

- Though these wasps look intimidating with their long segmented bodies, they are harmless to humans. None of them, females or males, have a stinger!
- These wasps lay eggs in a specific type of beetle larvae, but not by digging! Instead the females will detect the larva under the surface and poke their long abdomen up to two inches into the ground to lay their eggs.
- In some areas where males are rare this species is parthenogenic, which means they reproduce without mating. The offspring of pathogenesis will be near clones of their mother.
- The adults feed on nectar and pick up pollen from flowers, making them pollinators wherever they live.

BE A HERO:

You can be a DESERT DEFENDER by creating or protecting a Certified Wildlife Habitat!

BIG IDEA: No matter what you look like, every living thing needs a safe place to live and food to survive!

GIANT HAIRY SCORPION

11

- This is the largest species of scorpion in the US.
- Like many scorpions, the giant hairy scorpion is nocturnal.
- They are burrowing species but can sometimes be found hiding underneath rocks.
- The hairs on their legs help them detect vibrations in the soil. This helps them hunt and avoid their own predators.
- This species eats mostly large insects and spiders, but occasionally eats small reptiles, rodents, and other scorpions.

GLORIOUS SCARAB BEETLE

12

BIG IDEA: Some insects are <u>accidental</u> pollinators, who don't eat pollen or nectar, but visit multiple flowers and pollinate by chance.

Glorious Scarab Beetles are decomposers, which means they feed on decaying plant matter!

- This is really important, imagine all the leaves, branches, bark, and pieces of cactus that would be piled around without decomposers to break it down into soil and dirt for plants to use again.

They don't intentionally pick up pollen at all, but...

- Glorious Scarab Beetles use flowers as locations to hide or mate, and may visit multiple flowers, which means they accidentally spread pollen.
- This type of pollination is called "mess and soil" pollination, and is an effective and important way many plants are pollinated.

ASK: What is something we can do that breaks things back into soil like a decomposer?

Answer: Composting!

HUMMINGBIRD CLEARWING MOTH

13

This species of moth resembles a hummingbird flying quickly around flowers!

- They can fly 25-35 miles per hour!
- They are a diurnal (daytime) moth.
- They are often seen in gardens, since they pollinate several cultivated flowers (flowers raised by humans) and are the main pollinator for some species of orchid.

RUBY-THROATED HUMMINGBIRD

14

BIG IDEA: Wildlife needs high-quality places to rest and eat in order to survive.

- This species is the most common hummingbird in North America.
- Hummingbirds have the highest metabolism of any bird, which means they need to be feeding nearly constantly.
- They feed primarily on nectar from flowers, but also occasionally eat small insects for protein.

The constant need to eat means that a lack of food can quickly become deadly, and loss of food sources due to human destruction of habitat is especially impactful.

MONARCH BUTTERFLY

15

BIG IDEA: Some species rely on a specific plant to survive.

- Monarch butterflies migrate thousands of miles between North America and Central Mexico.
- As adults they eat nectar from flowers and are important pollinators.
- They are able to taste with their feet due to special sensory organs called chemoreceptors.
- This species is toxic to most predators because of the milkweed they eat as caterpillars.

BE A HERO:

Help build or protect a path of Certified Wildlife Habitats

POWESHIEK SKIPPERLING

16

BIG IDEA: Some species are endangered due to loss of important habitat.

- This species of butterfly is considered critically endangered due to habitat loss. There are less than 1,000 individuals in only 2 locations.
- They can only live in 2 unique ecosystems: tall grass prairies and prairie fens. These ecosystems are made up of over 600 different plant species, including the wildflowers that poweshiek butterflies need for food.
- The loss of bison, introduction of invasive species, and changes in water use by humans have made the prairies so different that tall grass prairies are now one of the most endangered ecosystems in the world.
- Poweshiek skipperlings are an indicator species used to show scientists how the ecosystem is doing overall, such as if it is declining or recovering.

AMERICAN HOVERFLY

17

- Despite the bee-like stripes, this is a species that is completely harmless to humans. They play a very important role in gardens, both as a larvae and as an adult fly.
- As a larvae they eat aphids and other small insects. Aphids are often considered pests that hurt many crops and garden plants, so these flies are helpful to have around.
- They only spend 7 days of their 3-4 week lifespan as a larva, but during that time they will eat about 35 aphids per day.
- As adults hoverflies feed on nectar and pollen. They will quickly dart from flower to flower and are considered by experts to be the second-most important pollinators in in the continent (after bees).

ROSY MAPLE MOTH

18

- This brightly colored moth is nocturnal, which means they are awake and active during the night.
- They are in the family of silk moths and are known for their woolly body and unique coloration.
- The caterpillars eat maple tree leaves, primarily staying on the underside of leaves to stay safe from predators.
- Adult moths completely lack a digestive system and do not eat.

MILKWEED LEAF BEETLE

19

BIG IDEA: Some animals have bright colors or patterns to warn predators that they aren't worth eating.

- Despite their resemblance to lady beetles (that you might call lady bugs) this is a different beetle commonly found on milkweed plants.
- They are brightly colored for the same reason, just like lady beetles, milkweed leaf beetles are not a good snack for most predators and the bright red and black pattern acts as a warning.
- Milkweed plants contain a toxin that is harmless to the beetle, but very unpleasant to most birds or other animals that might then eat the beetle.

CECROPIA MOTH CATERPILLAR

20

- This is the caterpillar life stage for one of the largest moths found in North America. The adult moths can have up to a 7-inch wingspan!
- As a caterpillar this species eats the leaves from maple, birch, and cherry trees.
- Though brightly colored with spiky tubercles, this caterpillar is harmless.
- As an adult the moth will only live 1-2 weeks, and will not eat as it completely lacks a digestive tract.

The females will produce a pheromone (chemical for communication) that the males an detect from over a mile away to attract them. **The females have to stay close to where they released the pheromones to make sure the males can find them, so being disturbed by humans can hurt their one chance of successfully laying eggs.**

GOLDENROD SOLDIER BEETLE

21

- These beetles are considered beneficial for gardens, both because they are important pollinators but also because they eat aphids, caterpillars, and eggs of pest species.
- The adults feed on nectar and pollen while visiting a variety of flowers, including the goldenrod flower they are named after.
- They also visit flowers while mating, causing no damage to the plants in the process but spreading pollen from flower to flower.
- They also hunt and eat insects such as aphids, which are known for harming human crop plants.
- Though they are sometimes confused for blister beetles (a species that secretes defensive chemicals that can cause injury when touched) these beetles are harmless to humans.

RED-BANDED LEAFHOPPER

22

- These insects are quick fliers and excellent jumpers. They can quickly jump forward or sideways to avoid danger.
- They feed by piercing plant leaves and sucking sap with their tube-like mouthpart called a proboscis.
- Some scientists are researching leafhoppers due to special nanoparticles they excrete called brochosomes. The insects spread the particles over their legs, body, and wings, where it scatters light and reduces their reflection. This makes them less visible to some predators, especially birds and reptiles.
- These particles also protect them by keeping water and sticky sap waste from sticking to their bodies.
- Learning about these particles could help scientists develop things like better sunscreen and new coatings for pills!

COMMON LONG-HORNED BEE

23

- These fuzzy bees are fast-flying pollinators for many types of flowers and crops!
- These bees are solitary, rather than forming hives each female will make their own nest in the ground to lay her eggs in.
- They pollinate many wildflowers along with crops that you might enjoy! They are known to visit sunflowers and squash.
- These bees are particularly important because they are pollinate plants later in the season than many other bee species, including late blooming crops and wildflowers.

GOLDENROD CRAB SPIDER

24

- The crab spider gets its name because it is known to walk sideways, much like a crab.
- These spiders can change their color depending on the color of the flower they are on, allowing them to camouflage (blend in).
- They hide in these flowers to hunt, ambushing the insects that land in the flowers to eat them. This hunting strategy means the spiders do not spin webs.
- The male goldenrod crab spiders are much, much smaller than the females.
- The females will typically find a suitable flower and stay there, but the males spend much of their life traveling in search of the females.

KARNER BLUE BUTTERFLY

25

BIG IDEA: Some species are very sensitive to climate change

- The Karner blue butterfly is an endangered species found in the United States.
- Though it used to be found across 12 states and part of Canada, now it only lives in small areas of 5 states.
- Part of the reason for their decrease in numbers is due to habitat loss. This species has lost most of the habitat they require to live due to human development.
- These butterflies require a very specific habitat to survive, and much like monarchs, their caterpillars feed on only one species of plant: wild lupine.
- Another part of their decrease is because they are highly sensitive to the changes in temperature that have occurred due to climate change.

GREEN LACEWING

26

- Green lacewings are a large group of insects that contain between 1,300-2,000 individual species.
- The larvae of green lacewings are fierce predators that eat aphids, caterpillars, and other insects. Gardeners will often intentionally attract lacewings to their gardens to help control pests.
- As adults, green lacewings eat nectar and pollen, taking part in pollination for many species of plants and flowers.
- They have organs at the base of their forewings that give then a particularly good sense of hearing.
- They will use vibrations as a form of communication between themselves, especially when selecting a mate.
- Adult lacewings are nocturnal (active at night) or crepuscular (active in dawn/dusk).

BE A HERO:

You can be a DESERT DEFENDER by choosing to Eat Like A Giraffe once a week by eating a plant-based meal.

BIG IDEA: Climate change has negative impacts on animals and we can help by eating more plants.