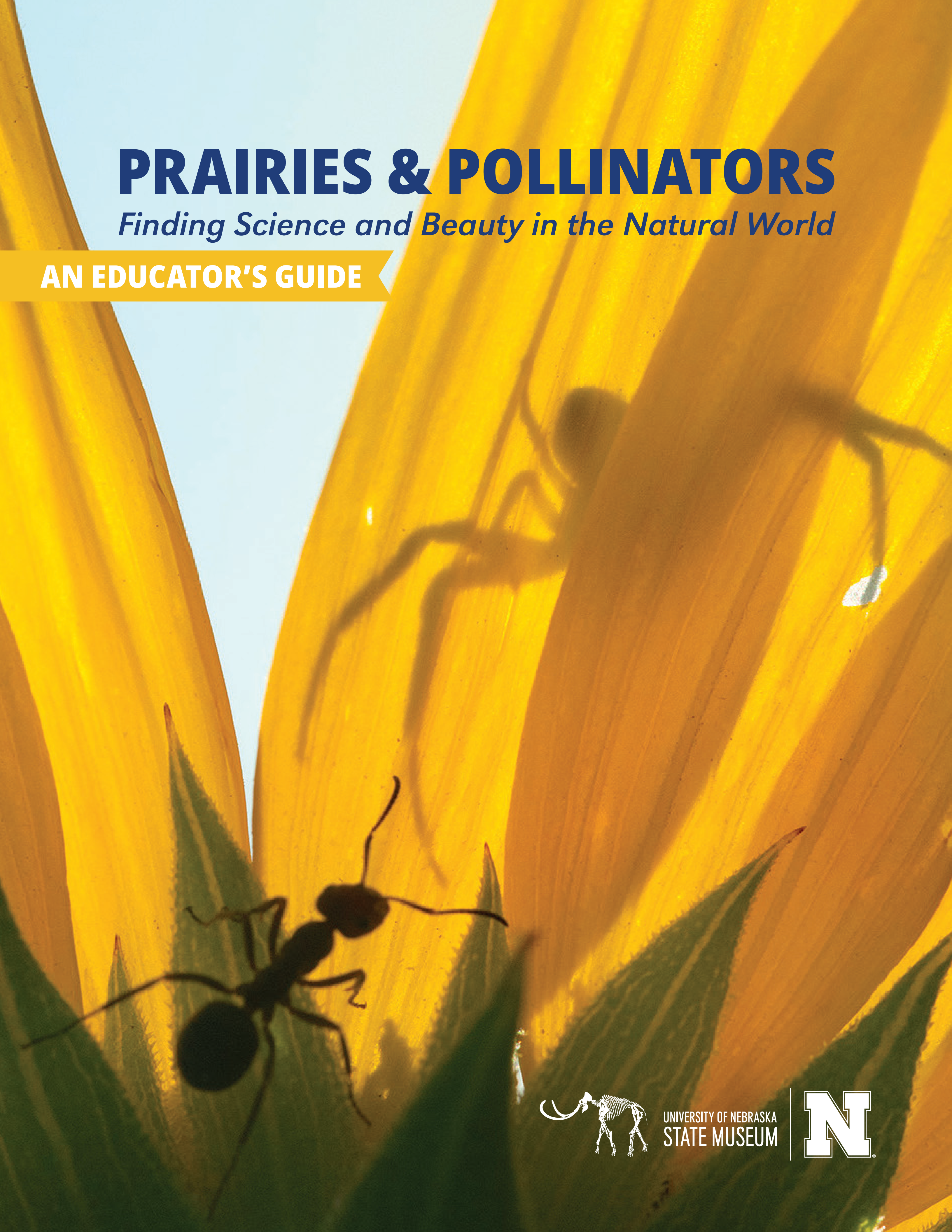
PRAIRIES & POLLINATORS

Finding Science and Beauty in the Natural World

AN EDUCATOR'S GUIDE



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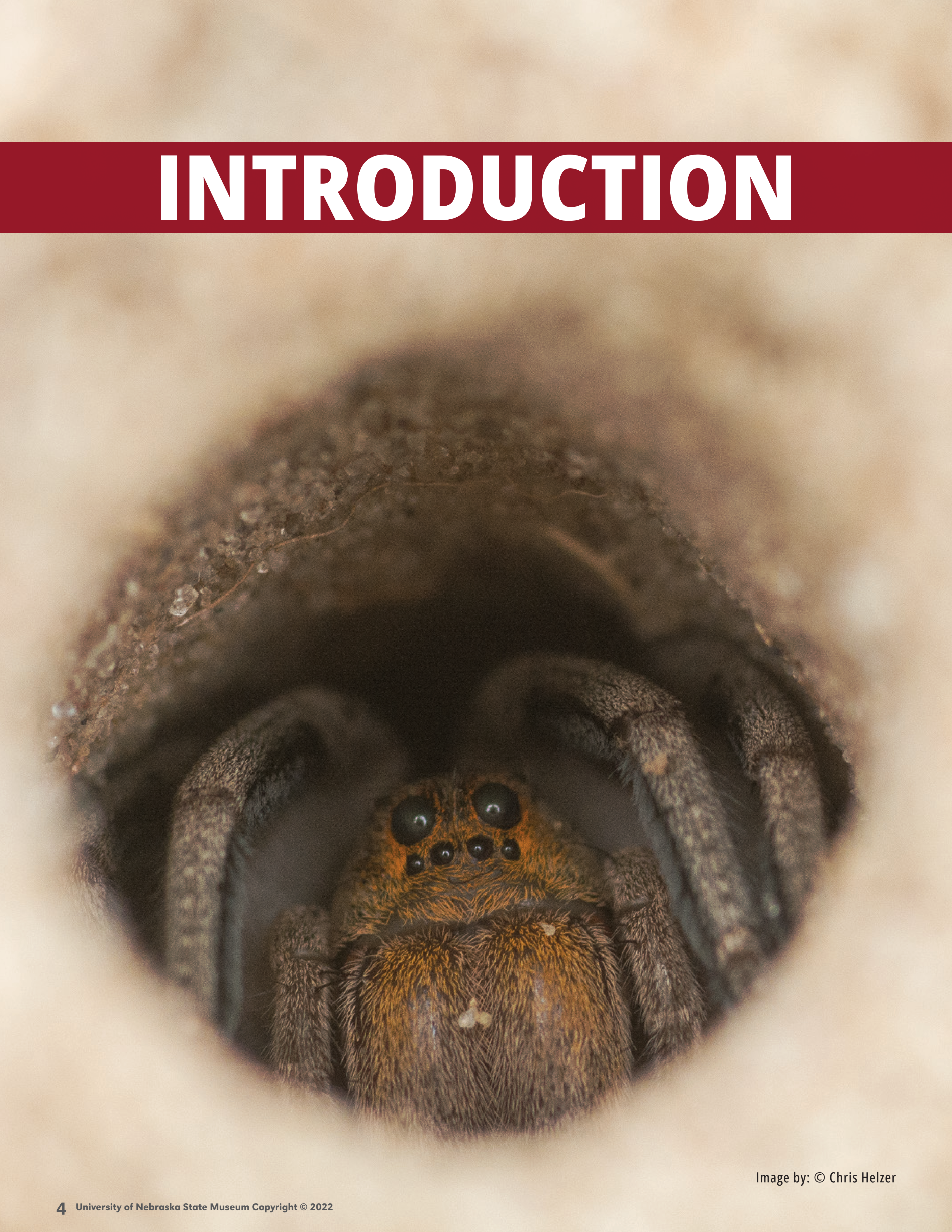


Image by: © Chris Helzer

INTRODUCTION

On January 18, 2018, a prairie ecologist named Chris Helzer used flags to mark off one square meter of prairie in eastern Nebraska. It was the first step on a year-long project that would meld science and art together in order to educate people about the beauty and complexity of North America's native prairies. Throughout the year, Chris returned to that single meter of prairie repeatedly, using his camera to document the plants and animals that lived there. By the time his project was finished, Chris had photographed 113 species within his square meter: 15 species of plants, 22 species of flies, 18 species of beetles, 14 species of bees, and 44 other types of animals.

Chris's project became the book *Hidden Prairie*, and that book became an exhibit of the same name at the University of Nebraska State Museum. The exhibit *Hidden Prairie* and another UNSM exhibit, *Operation Pollination*, are the inspirations for the activities contained within this book.

The idea behind this educators' guide was an ambitious one. We wanted to create a set of lessons that would be valuable both for traditional classroom teachers as well as for informal educators such as librarians, scout leaders, and homeschooling parents. We wanted a guide that would help adults to connect young people with the museum exhibits that inspired it, while at the same time being useful for educators with no access to the exhibits in question. Finally, we wanted a guide that would be useful for educators working with a variety of different age groups. Though the activities that follow are generally aimed towards older elementary students, they've been designed so that, with a small number of changes, they should work well with children younger or older than that target age.

Following Chris's example of using the beauty of nature as a pedagogical tool, many of the activities in this guide use photography in order to help teach and inspire. The resources section at the end of this book has many high-definition images formatted to print out on 8.5 x 11 sheets of paper. For best results, use glossy photographic paper or cardstock. These same images can also be reformatted to be used in PowerPoint presentations if digital imagery works better for your needs.

As Chris Helzer explored his square meter of prairie, he was amazed by the beauty and complexity he noticed when he simply slowed down and observed the plants and animals that surrounded him. We hope that the following activities will help you and the young people you work with to explore some of the science and the beauty in our natural world.

HIDDEN PRAIRIE

Image by: © Chris Helzer

THE STORY OF CHRIS HELZER

Time: 20 minutes

Description: Tell the story of Chris Helzer, a prairie ecologist who embarked on a project to photograph all the living things he could see in one square meter of prairie over the course of one year.

Purpose:

- Inspire students with the diversity and beauty of life in a prairie ecosystem.
- Introduce students to the exhibit *Hidden Prairie*.

Connections: This presentation can be done all on its own, or it can be connected to other activities and lessons. If you have access to the *Hidden Prairie* exhibit, you can use this presentation as an introduction to that exhibit. Time allowing, you can go directly from *The Story of Chris Helzer* into the next activity, *The Closer You Look*. This presentation also acts as a good introduction to *Stories from the Prairie* and *Your Own Square Meter*.

Materials:

- Photograph A1 (Page 47 of this booklet)
- A one-meter square piece of cloth
- Access to the Hidden Prairie exhibit, or photographs A2 through A13 (Pages 48 to 59 of this booklet)

ACTIVITY

Gather students together, preferably in a circle where they can see you and each other easily. Have the materials listed above in easy reach.

- *Say:* Today we are going to talk about prairies, so perhaps we should start by asking what is a prairie. Do any of you know what a prairie is?

Take answers. After some discussion, show photograph A1.

- *Say:* This is a picture of a prairie in the Nebraska sandhills. What kinds of living things do you see? Do you think there is a wide variety of living things on this prairie?

Discuss.

- *Say:* Sometimes when people think of prairies, all they think about is grass. It may seem kind of boring, like there isn't a lot there, and certainly when you look at this picture, you see a lot of grass, and this yucca plant, but not much else.

  Well, today I want to tell you about a scientist named Chris Helzer. He is a prairie ecologist, which means that he studies how the living and non-living things in a prairie interact with and affect each other. Chris really loves prairies, and he knows that there is a beauty and complexity to prairies that can sometimes be hidden from view. So, he came up with the following project.

Unfold the one-square meter piece of cloth in such a way that the students can easily see one square meter. If you are sitting in a circle, place the cloth in the middle.

- *Say:* This is one square meter. Chris wondered what he would see if he spent one year observing and photographing just one square meter of prairie. He wondered how many species he might find, what small details he would notice, and how the meter would change over the span of a year. What do you think? How many species of plants and animals do you think Chris was able to photograph over the span of one year, all just in one square meter of prairie?

Take guesses and discuss students' reasons for their guesses.

- *Say:* Those are all great guesses. Over the span of one year, Chris was able to photograph 113 different species just in his one square meter, including 15 species of plants, 22 species of flies, 18 species of beetles, 14 species of bees, and 44 other types of animals. He saw many other species that he couldn't get a picture of; sometimes a grasshopper would jump out of his meter right before he could snap a picture. Let's look at some of the photographs he took.

At this point, if you have access to the Hidden Prairie exhibit, you may choose to allow the students to explore the exhibit. If you don't have access to the exhibit, or if you just want the students to handle some of the pictures up close, proceed by showing them pictures and then passing the photographs around for them to see up close. For now, show and pass pictures A2 through A10. Encourage the students to share their thoughts and ask questions about the photographs. Does anything surprise them? What do they find beautiful or interesting? After they've enjoyed the pictures, asked questions and made comments, move on.

- *Say:* That's just nine of the 113 species that Chris was able to observe and photograph. But it wasn't just the number of species that Chris noticed that amazed him. Chris was also impressed by the small changes that he observed over time.

Show picture A11.

- *Say:* For instance, one day Chris noticed this single blade of grass with a little oval mark that he'd never noticed before. When he first saw it, the leaf was green, then it slowly changed red with autumn, and then it turned brown and the oval became a hole. Chris thinks it was likely some sort of fungus that started growing on the leaf.

Show picture A12.

- *Say:* Here we have a small burrow that some creature decided to make one day in the stem of a Maximilian sunflower.

Show picture A13.

- *Say:* And here we have a leadplant seedpod, covered in snow. Chris was able to see the buds of this plant in the spring when they were fuzzy, gray, and preparing to bloom; then in the summer when it transformed into brilliant purple flowers with radiant yellow stamens; and then here, in the wintertime, after the flowers have withered and spread their seeds.

  It was the tiny details that Chris could see when he stopped to look closely at the prairie, and the changes that he could watch happen slowly over time, that moved Chris the most. His Hidden Prairie project is a wonderful reminder that science can be amazingly complicated and interconnected, and those many small details, when you stop to look at them, can be incredibly beautiful and inspiring.

The presentation can end here, or go directly into the next activity, *The Closer You Look*.

Image by: © Chris Helzer

THE CLOSER YOU LOOK

Time: 20 minutes

Description: Investigate some of Chris Helzer's photographs to find details that aren't obvious at first glance.

Purpose:
- Practice observation skills.
- Think about the diversity of natural phenomenon that are only seen with careful observation.

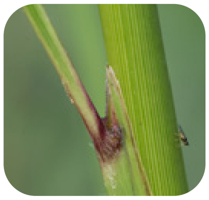
Connections: This activity can be directly connected to *The Story of Chris Helzer*, or it can be done at a later time. It can also work as a standalone activity with a small introduction at the beginning.

Materials:
- Photographs B1 through B6 (Pages 60 to 65 of this booklet)

ACTIVITY

Divide the students into five groups. If the students have not heard *The Story of Chris Helzer*, give them a brief overview of his work.

- *Say:* One of the things that Chris finds most interesting about photographing prairie ecosystems, and about being a scientist in general, is that he often finds small details and levels of complexity that he didn't notice at first.



Show the students photograph B1.

- *Say:* For instance, in this photograph Chris didn't even notice this tiny fly when he was taking the picture. He was trying to get a photograph of this red part of the Indiangrass, since one of the ways to identify Indiangrass is by the red coloration it can have where the leaf meets the stem. It wasn't until later when Chris viewed this photograph on his computer that he noticed the little fly.

  One of the beautiful things about both science and art is that our world is filled with tiny complexities that only become obvious when we take the time to look at the world with greater detail.

  I'm going to pass out some photographs that Chris took, one to each group. Each of the pictures has an interesting detail that may not be evident until you look closely. I want you to use your skills of observation to see what you might notice.

Pass out photographs B2 through B6, one to each group. Encourage the students to look closely at the photographs and discuss what they see. Some of the surprising details may be easier to notice than others, so you may want to provide assistance as needed. The details that Chris noticed on close observation are discussed below, but be open to students making different observations; the point is to stop and take time to observe, question, and discuss.

Photograph B2: This photograph shows two plains lubber grasshoppers mating. When you look closely, you can notice small red dots on the sides of both grasshoppers. These are tiny mites, arachnids that live on the grasshoppers and feed on their blood.

Photograph B3: A young monarch caterpillar crawls along a blade of grass, and the remnants of a monarch egg sits nearby. If you look closely at the back of the caterpillar you can see another smaller egg. This is the egg of a parasitoid, likely a wasp or a fly. When the egg hatches the parasite will burrow into the caterpillar in order to feed off it.

Photograph B4: At first it is obvious that there is a bee, upside down below a yellow flower petal. With further examination, one sees that the bee is being held by an ambush bug that looks like part of the flower. (Notice one leg overlapping with the flower petal, and the yellow eyeball off to the side of the bee.)

Photograph B5: The brown and yellow patch is the head of a caterpillar that is curled up inside of a plains sunflower.

Photograph B6: The hover fly at the center of this photograph is surrounded by three other insects: One above it and to the right, one below it and to the right, and one directly below it and out of focus.

After giving the students time to discuss, have them present any things they noticed to their peers. You can do this by having a spokesperson from each group, or by having the group present collectively; whichever makes the most sense for your students. If students missed the details that Chris noticed, and you haven't yet pointed them out to them, this would be a good time. After students have finished presenting, get their attention again.

- *Say:* As you can see, sometimes nature has small but important details that we only notice if we stop and take the time to observe in closer detail. Those mites living on the grasshoppers, they seem like a small detail to us, but they'll certainly affect the lives of those two grasshoppers.

POSSIBLE EXTENSION: Take the students outside with some basic art materials. Have them look closely at the world around them, searching for interesting details that are only noticeable when one observes with great detail. Have them draw or paint the things they see. When finished, interested students can share their artwork and explain what they observed.

Image by: © Chris Helzer

STORIES FROM THE PRAIRIE

Time: 60 minutes

Description: Students write short stories inspired by the interconnections in a prairie ecosystem.

Purpose:
- Practice creative writing.
- Think about interconnections in a prairie ecosystem and imagine how these connections affect individual organisms.

Connections: This activity connects thematically to all the other activities in this section, but it can also work well on its own. Because many of the organisms described in this activity are involved with pollination, this activity can connect well to the activities in the second part of this booklet, *The World of Pollinators*.

Materials:
- Printed copies of *Stories from the Prairie* Sheets 1, 2, and 3 (Pages 66, 67, and 68 of this booklet)
- Writing Paper
- Pencils

ACTIVITY

This activity can work as a writing exercise where students work in small groups to collaboratively write a single story, or it can be done as a silent writing exercise where each child creates their own narrative. If your students are working in small groups, they will need one *Stories from the Prairie Sheet*—number one, two, or three—per group. If your students are writing individually, each student will need their own *Stories from the Prairie Sheet*. Only one sheet is needed per group or student.

- *Say:* We've been learning and thinking quite a bit about prairies and how the huge variety of different creatures all live together and affect each other. Today we're going to use those ideas to write a short story inspired by some of the creatures who live on the prairie.

  You all have a sheet in front of you with three pictures, each featuring a different organism that lives on the prairie. Next to each picture is a brief description of the plant or animal pictured, including some of the ways that organisms can interact with and affect the other living things in its environment.

  We're going to use those pictures and descriptions to write a story. You'll want to ask yourself, who is my protagonist, the character that my story follows? Since your protagonist won't be human, think about how the prairie looks and feels and smells differently to them. How does your character interact with the other plants and animals that live on the prairie? What is your protagonist looking to do with their day, and what types of things happen to them as the story goes on?

After introducing the activity, give the students time to write. If time allows at the end, have interested students read their writing out loud.

For students who cannot yet write, you can share the images from one or more of the *Stories from the Prairie Sheets*, tell them about the organism, and then "write" a story together out loud. Or, for younger children, use the sheets to write a story of your own, read your story out loud to the students, and let the students create drawings to illustrate the story.

YOUR OWN SQUARE METER

Time: This is a long-term project that can be done in short segments over an extended period of time.

Description: Create your own square meter project for students to observe over time.

Purpose:
- Practice close observation for scientific and artistic purposes.
- Practice skills such as photography, drawing, writing, or data collection.

Connections: *The Story of Chris Helzer* works well as an introduction to this project. *The Closer You Look* and *Stories from the Prairie* reinforce many of the ideas and practices that you can explore with your square meter. All the presentations in *The World of Pollinators* section of this book can tie back to observations and ideas that students can explore through their own square meter.

Materials: The materials you need will vary depending on how you develop your square meter. Some potential materials include:

- Meter stick or tape measure
- Flags, stakes, or stones for marking your square meter(s)
- Pencils and paper for making sketches, writing descriptions, keeping data, etc.
- Digital camera
- Plant and animal identification guides
- The book *Hidden Prairie: Photographing Life in One Square Meter* by Chris Helzer

ACTIVITY

You can help young people explore the intricacies of the natural world and practice their skills of observation by helping them to develop their own square meter project. Even if you have limited access to natural environments, you can still use Chris Helzer's work to inspire young people to observe small details and changes over time.

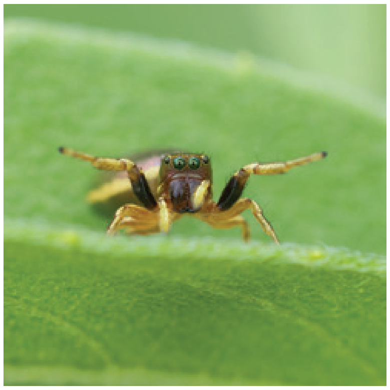
A project like this can take many forms, so instead of providing you with a single template that may or may not work for you, below you will find questions you should ask yourself in order to develop a square meter project that will work well for your students.

What type of environment will you observe?

Though Chris Helzer set his square meter project in a prairie, there are many different environments that can teach you about the world if you decide to observe them closely. Your students could observe:

- A meter of well mown grass.
- A meter of a school garden.
- Plants growing on a windowsill.
- A meter of gravel on the playground.
- A square meter of tree bark wrapped around a tree.

If you have access to more traditional "natural" environments, you may notice a larger variety of living things, but any square meter can be interesting when observed in detail over time.



Images by: © Chris Helzer

How many square meters will your group observe?

As one person, Chris limited himself to one square meter. For your group, you have a wide variety of options:

- Choose one square meter that everyone in your group will observe at different times.
- Separate your students into small groups; have each group select their own square meter.
- Have each person select their own square meter.

You'll also need to ask yourself...

How will you mark your square meter(s)?

Again, there are many options for how you will keep track of your square meter:

- Mark it clearly with flags.
- Attach a hula hoop to the ground with gardening stakes.
- Outline the meter with paving stones.
- Build your meter off an unchanging landmark. For instance, use the corner and wall of a building to mark one side of your meter, or use a tree to mark one corner of the meter.
- Have students draw maps or write in-depth descriptions describing exactly how to locate the square meter being observed.

How will the children record their observations?

Chris documented his observations with photography, but there are many other ways that children could document their observations. You can have them:

- Take photographs, like Chris did.
- Make drawings of the things they observe.
- Write detailed descriptions of what they see.
- Write poetry, such as Haiku, inspired by their observations.
- Do a detailed count of the different species witnessed in the square meter.
- Paint a picture of the square meter or something observed inside the square meter.

Depending on your classroom objectives, you can have each student document their observations in the same way, or you could work with the students to help them each choose a documentation style that interests them.

How will you carry out your observations?

Depending on your group and how many square meters you have, you may conduct your observations in a variety of ways. You may choose to:

- Select a time once a week or once a month where the entire group will observe their square meters.
- Each week select a different child who will perform the job of making observations, then have them share their observations with the class.

How long will you carry out your observations?

Since one of the amazing things about observing a square meter is seeing change over time, it is best if the activity can be continued over an extended period. You'll want to decide if your class will observe their square meter for just a single day or over the span of a month, a semester, or an entire year.

How will the children share their observations?

The end product that your students create will depend a lot on how they make their observations. Students may:

- Create an art exhibit featuring their photographs, drawings, or paintings.
- Create a poetry collection.
- Use their notes to write a narrative describing the square meter's change over time.
- Write a report discussing the different species that were observed at different times of the year.
- Make a video featuring the class's photography or artwork.
- Record a podcast discussing the different creatures and phenomena they've observed.

THE WORLD OF POLLINATORS

Image by: © Chris Helzer

THE IMPORTANCE OF FLOWERS

Time: 20 Minutes

Description: Explore and discuss how our lives are dependent on flowering plants.

Purpose:

- Help students explore how the human food supply depends on flowering plants.
- Provide context for why pollination is important to human life.

Connections: *The Importance of Flowers* works as an introduction to *What is Pollination*, since it helps children understand the importance of flowering plants.

Materials:

- A flower (optional)
- Paper and pencils for each student (optional)
- A whiteboard, chalk board, piece of tagboard, or video projector
- An apple (Additional fruit such as pears, zucchini, or tomatoes can also be helpful.)

ACTIVITY

Gather the students however works best for your space. If you have a living flower available, hold it out in front of you so that all the students can see it.

- *Say:* You are alive because of flowers.

  This may sound strange. Afterall, flowers are beautiful to look at, and they smell nice, but we would be alive without their colors or their scents, right? But the truth is, it is likely none of us would be here today, certainly we couldn't survive in the ways we do, without flowers.

Begin collecting examples of the students' favorite foods. You can do this by giving them time to quietly write a short list that they can then share out loud, or you can just have them raise their hands and share examples. Either way, develop a list that everybody can see on a white board, chalk board, video screen, or large piece of tagboard. The list will ideally have a wide variety of foods on it, so if you see types of foods that are not being included, you can share some of your favorites and add them to the list as well. When all students have had a chance to share, look at the list and *say:*

- (Almost) none of these foods that you've listed, the foods that you love to eat, the foods that power your body and provide you with vitamins and minerals, (almost) none of them would exist without flowers.

Lead a discussion about why this is true. Begin by allowing the students to discuss it together, to see if they can determine reasons why their favorite foods require flowers. Give them assistance as needed. Below is a description of different types of foods and why they depend on flowers. Fruits are the easiest to demonstrate for the students, so unless their discussion or ideas lead you elsewhere, fruits are a good place to start.

- **Fruits:** All fruits come from Angiosperms, the scientific name for flowering plants. Angiosperms need flowers to reproduce; without flowers, all species of angiosperms would die out in a single generation. Fruits themselves are the ripened ovary of a flower that was pollinated. The remains of the flower can often be seen on the bottom of the fruit (opposite where the fruit was attached to the stem). Demonstrate this to the students by showing them the withered remains of the flower at the bottom of the apple, or simply give them an apple and ask if they can find the remains of the flower. Having other fruits available— pears, zucchini, tomatoes, etc.— can be nice since the remains of the flower will appear different on different fruits.

- **Vegetables:** Almost all the vegetables we eat also come from Angiosperms. When we are eating vegetables we are not eating the ripened ovaries, as we do when we eat fruits, but we are still eating a part of a plant that requires flowers to reproduce.

- **Grains:** The different grains that we eat—including wheat, rice, barley, quinoa, etc.— are all angiosperms and rely upon flowers for reproduction.

- **Nuts:** Most of the foods that we consider to be nuts are composed of the seeds and dried fruit of angiosperms. Two exceptions are discussed below.

- **Legumes:** Beans are seeds that have been removed from the inside of a fruit.

- **Meats, Eggs, and Dairy:** Though meats, eggs, and dairy products are not directly produced by angiosperms, they are all coming from animals that rely on angiosperms for survival.

- **Sweets:** Sugarcane is an angiosperm, as are maple trees, stevia plants, and other natural sources of sweeteners. Honey is produced by bees who gather nectar from flowers. Cocoa plants, used to make chocolate, are also angiosperms.

- **Compound Foods:** Many of the food that children list will be made of multiple ingredients. Help children to break them down and think about how the different parts are all dependent on flowering plants. For instance, pizza has a crust made primarily from wheat, a sauce made from tomatoes, cheese made from animals' milk, and a variety of vegetables, fruits, or meats as toppings. All these foods either come directly from a flowering plant or from an animal that depends on flowering plants to survive.

EXCEPTIONS: Humans have some foods that are not directly dependent on angiosperms. Pine nuts and gingko nuts are seeds from gymnosperms, plants that don't produce flowers. Mushrooms are fungus, not plants at all.

Fish and other marine animals are far less dependent on flowering plants than terrestrial animals; there are only around 60 species of angiosperms that exist in the ocean. Although these sea grasses provide important habitat for many species, they are not as central to the marine food chain as land-based angiosperms.

Kelp, and other edible seaweeds, are species of algae and not flowering plants.

If humans wanted to feed themselves without angiosperms, their diet would need to be limited to marine animals, seaweed, mushrooms, pine nuts, and gingko nuts.

When you are finished with the discussion, *say:*

- As you can see, almost all the foods we enjoy and depend on for our survival are dependent in some way on plants that use flowers to reproduce. We'll be learning more about this process—a process called pollination.

WHAT IS POLLINATION

Time: 30 Minutes

Description: Do an activity with flour and marbles that helps illustrate that pollination happens accidentally while animals are gathering food.

Purpose:

- Introduce children to the basic processes underlying pollination.
- Emphasize that when animals pollinate flowers, they do so accidentally.

Connections: *What is Pollination* can follow *The Importance of Flowers*, or it can be done on its own. It acts as a good introduction for *Animal Structures*, *Flowery Adaptations*, and *Darwin's Mystery*.

Materials:

- Marbles (four or five per child)
- Bowls (enough to scatter in various parts of the room)
- Flour
- Washcloths, paper towels, or wet wipes
- Photographs C1 and C2 (pages 69 and 70 of this booklet)

ACTIVITY

Before gathering the students, take several bowls and place marbles at the bottom of them. The number of bowls needed, and the number of marbles per bowl, will depend on the number of children you are working with. There should be four or five marbles per child, and enough bowls so that they can be distributed around your room in a variety of places. (The more marbles you use, and the more bowls you have, the longer the beginning part of this activity will last.) Next, pour flour into each of the bowls, using enough to make sure that the marbles are completely covered. Distribute the bowls around the room in a wide variety of areas.

Gather the students.

- *Say:* Today we're going to start out with a little bit of an odd activity. You'll notice that I've scattered bowls all around the room. At the bottom of the bowls are marbles, though you'll have to dig around a little to find them. In a moment, I'm going to have you go around the room gathering marbles. I'd like you to gather as many marbles as you can, but you can only gather one marble from each bowl; once you've gotten one marble from a bowl, move on to another bowl and gather one from there.

If necessary for your group, talk about appropriate ways to gather the marbles— no pushing each other, running, knocking over the bowls, etc. Allow the children time to gather marbles. After enough time has passed, gather the children together again.

- *Say:* What was that experience like? What did you notice while you were gathering the marbles?

Allow the students to discuss their experience. If nobody mentions flour sticking to their fingers, ask further questions to elicit this response. After the students have shared their experiences, and mentioned the flour sticking to their hands, gather the marbles from them and allow them to wipe off their fingers with washcloths, paper towels, or wet wipes.

- *Say:* You just had an experience that in some ways is similar to what this little creature is experiencing right now.

Hold up C1.

- *Say:* Does anybody know why bees and other animals visit flowers like this one?

Take answers. If somebody says, “to pollinate the flower”, let them know that animals who visit flowers often do in fact pollinate them, but that isn’t why they visit them. They visit flowers to gather food.

- *Say:* That’s right. Animals like this bee visit flowers to gather food. Most animals who visit flowers come there to gather a sugary liquid called nectar that they eat. Just like you went from bowl to bowl gathering something you wanted—marbles—many animals travel from flower to flower gathering something they want— food, usually in the form of nectar.

  But when you were gathering your marbles, something unintentional happened. What happened to you while you were gathering marbles that you didn’t mean to happen?

The students will likely answer that flour accidentally got stuck to their fingers. If they don’t, ask them further questions leading to this conclusion.

- *Say:* Right. While you were gathering marbles, you accidentally got flour all over your hands. Something similar is happening to this bee. What do you see that is accidentally getting all over this bee?

The children will likely see that a yellow powder is sticking to the bee and may know that it is called pollen.

- *Say:* Yes, when an animal comes to a flower to feed on nectar, this yellow powder—a substance called pollen— sticks to the animal.

Some students may know that certain insects, including bees and beetles, also eat pollen. If they mention this, confirm it, and stress that even when an animal is gathering pollen to eat, pollen still sticks to the outside of the animal without that animal intending it to.

Show C2

- *Say:* This is a really neat photograph of pollen taken using an instrument called a scanning electron microscope, which allows you to see very small things in amazing detail. There is pollen here from several different types of flowers. What do you notice about the pollen?

Listen to the students' observations. If the students notice that many of the pollen grains are spiky, ask them why they think some pollen might evolve to be spiky. If they don't notice this, point it out to them, and ask them the same question.

- *Say:* That's right, the spikes on the pollen can help them stick to animals that come to the flower to gather nectar. Some pollen is also very sticky, like glue, which helps them stick to animals as well. But does anybody know why it is important for the flower to have its pollen stick onto animals that come there to feed?

Take answers. If nobody knows why this is important, you can explain it to them. If you receive correct answers, you can fill in any details that might be missed.

- *Say:* Pollen is important because it protects a gamete. Gametes are cells that help living things reproduce. For a plant to create seeds, and eventually new plants, pollen needs to travel from one flower to another, where the gamete inside the pollen will meet up with and combine with a different form of gamete, the egg. After the pollen and egg have come together, they begin to form a seed. So, for many plants to reproduce, it is necessary for pollen to travel from one flower to another.

  Think about when you were traveling from one bowl to another, gathering marbles. We know that flour stuck to your fingers when you got to your first bowl. What do you figure happened to that flour when you went to other bowls afterwards?

Take answers. Ideally, they will realize that, as they traveled from bowl to bowl, some of the flour that had stuck to their fingers from earlier bowls was falling off into later bowls. Help them to this conclusion if they need assistance.

- *Say:* The same thing happens as an animal goes from one flower to another gathering nectar. As the animal gathers its food, it accidentally passes pollen from one flower to another. The animal doesn't mean to spread the pollen; they just want a meal. But it is this accidental spreading of pollen that allows the flowers to reproduce. We call this whole process pollination.

  In this way, flowers and pollinating animals support each other. Flowers provide food for animals like bees, moths, bats, and birds, and these animals accidentally help the flowers to create seeds by spreading pollen from flower to flower.

ANIMAL STRUCTURES

Time: 40 Minutes

Description: Children examine photographs of common pollinators, looking for structures and adaptations that help the animal gather food while accidentally spreading pollen from one flower to the next.

Purpose:
- Introduce the idea that pollinators have adaptations that help them to gather their food from flowers, and structures that allow them to be efficient pollinators.
- Reinforce the idea that animals go to flowers to gather food and pollinate the flowers by accident.

Connections: *Animal Structures* should be proceeded by *What is Pollination*. The ideas explored in this activity are further developed in *Flowery Adaptations* and *Darwin's Mystery*.

Materials:
- Photographs D1 and D2 (pages 71 and 72 of this booklet)
- One copy of each *Pollinator Sheet* (pages 73 through 78 of this booklet)
- Six copies of *Pollinator Structures* (page 79 of this booklet)
- Pencils

ACTIVITY

Gather the students.

- *Say:* I want to show you a picture and see if you can guess what it might be.

Show the students photograph D1. Allow them to guess what it might be.

- *Say:* This photograph was taken using a scanning electron microscope, which allows us to get detailed images of very tiny things. What you are seeing here is a close-up image of the hairs of a honeybee. They look very different than your hair would look. Why might a bee's hairs be all branched and barbed like this?

Take answers. After a while, show the students photograph D2.

- *Say:* This second photograph shows very well why bees have branched hairs. What is this you see trapped in the branching hairs? Right, it is pollen. The branches in the hair make it easier for pollen to stick to them. This helps the bee gather pollen which they feed to their larvae, and it helps the plant because it makes it more likely that a bee will accidentally spread pollen from one flower to the next.

  These branched hairs are an example of an adaptation, something about the structure of a living thing that helps it interact with its environment. We are going to look at several different types of pollinators and think about what structures and adaptations they have that make them good at gathering nectar or good at spreading pollen.

Separate the students into six groups and have them sit together. Each group should receive a different *Pollinator Sheet*, and each child should receive a *Pollinator Structures Sheet*. Each student will also need a pencil.

- *Say:* Each group has a different type of pollinator they'll be focusing on. I want you to look at the pictures of your pollinator, and then talk amongst your group. You'll want to look for two things. First, what are any adaptations you see that will allow your pollinators to gather or eat food? These could be any part of their bodies that allow them to access pollen or nectar. Second, what structures on their body might help them accidentally transport pollen from one flower to the next? As you discuss these structures, write them down on your paper. When you are finished, the different groups will all present the adaptations they saw on their pollinator.

Give the students time to look at the photographs, discuss what they see, and write. If they need help finding adaptations, ask them questions like "How do you think they can get from flower to flower when feeding?" When they are finished, help them to present their findings to each other. Adaptations they might notice include:

- **Bats** use their wings to fly from flower to flower. Some bats have special wings that let them hover in place when they gather nectar, while others may use the claws on their thumbs to hang onto the plant while they feed. Bats that feed on nectar have long narrow tongues that act like mops, slurping up large amounts of nectar. Their fur can collect large amounts of pollen that easily spreads to the next flower when they feed.

- **Beetles** may use their wings or legs to travel from flower to flower to gather food. They use their mandibles to eat pollen and the physical structures of the flower, such as the petals. Many species of beetle have small hairs on their bodies, which pollen can stick to quite easily.

- **Butterflies** drink nectar with their long proboscis which curls up when not in use. Pollen can also stick to this proboscis, pollinating future flowers. Their wings carry them easily from flower to flower, and their long legs help them grip and support themselves when they land. The hairs on their heads and bodies are perfect surfaces for pollen to stick to.

- **Flies,** like butterflies, feed by slurping nectar through a proboscis, though their proboscis is not as long as a butterfly's, meaning they'll likely feed from different flowers whose nectaries are shallower. Wings will carry them from flower to flower, and the hairs on their bodies and legs can quickly get covered in pollen.

- **Hummingbirds** have long beaks that can go deep into flowers to find nectar, and very long tongues that are specially adapted for grabbing up liquids. Their special wings allow them to hover in front of flowers while they feed. Pollen can easily get stuck to the outside of their beaks or the feathers of their heads.

- **Moths**, like butterflies, have long proboscises that uncurl and allow them to get nectar from deep in a flower. Moths use their wings to fly from flower to flower, and some can even hover while feeding. Pollen sticks easily to the hair on their heads and bodies, as well as to the sides of their proboscises.

After each of the groups have had a chance to present, ask the students if they noticed any similarities or differences between the different pollinators. You may want to use a chalk board, white board, or piece of tagboard to keep track of their thoughts. Help them to recognize that, though the pollinators are all different, they have many similarities that make them effective pollinators. Some examples they may notice include:

- All the pollinators that eat nectar have long slender body parts— beaks, tongues, or proboscises— specially designed for gathering nectar.
- All the pollinators have ways to get to the flowers easily, whether that be by using wings, claws, or feet that help them climb.
- Hummingbirds and some moths can hover, an unusual adaptation among flying animals, but one that can help the pollinator gain access to the nectar of some flowers.
- Many pollinators have adaptations meant for other purposes— hairs, feathers, etc.— that make it easier for pollen to stick to them and be moved from flower to flower.

After you are finished discussing, *say:*

- As you can see, there are many different types of pollinators, all of whom go to flowers to find their food and then accidentally help the flowers reproduce by moving pollen from one flower to another. Even though these pollinators are different in a wide variety of ways, they have all evolved similar adaptations that help them to gather the food that they need, and many of them have structures that accidentally move pollen from flower to flower.

The activity can end here, or you can continue directly into *Flowery Adaptations*.

Image by : © Chris Helzer

FLOWERY ADAPTATIONS

Time: 40 Minutes

Description: Students analyze data to find connections between flower characteristics and the types of pollinators they attract.

Purpose:

- Help students understand that flowers have evolved certain traits for attracting different pollinators.
- Allow students to practice using data to make an informed conclusion.

Connections: This activity is a direct continuation of the ideas explored in *Animal Structures*, and these ideas are reinforced in the following lesson, *Darwin's Mystery*.

Materials:

- 6 copies each of the *Pollinator Visitation Rates* and *Flower Traits* sheets (pages 80 and 81 of this booklet)
- One copy of the *Flower Adaptations Log* sheet for each child (pages 82 to 83 of this booklet)
- One pencil per child

ACTIVITY

Gather the students. Separate them into six groups.

- *Say:* If you are an animal that needs nectar or pollen to survive, how do you go about getting that nectar or pollen?

Take answers from the students. If they need help, point them towards some of the ideas in the previous activity—pollinators may travel to the flowers they feed from using wings or legs; they may use tongues, beaks, or proboscises to help them get nectar; they may use specialized hairs to help them gather pollen.

- *Say:* Wonderful. So, we know that animals who need flowers to survive use structures on their bodies to travel from flower to flower and get the food they need.

  But what if you are the flower, and you need a pollinator to help you reproduce? If you are a rose or a daffodil, and you can't move, how do you go about getting a pollinator to come to you?

Take answers from the students. They may know that flowers attract pollinators, or they may not.

- *Say:* Just as pollinators have evolved over millions of years to be able to get their food from flowers, flowers have evolved over millions of years to draw in pollinators. They've developed adaptations that attract pollinators and make them want to come visit. Today we are going to see if we can discover some of the traits that flowers have evolved to attract different pollinators.

  To do so, we are going to think like scientists. Scientists make discoveries about our world through careful observation and experimentation. I'm going to pass out two sheets of paper to each of our groups. These sheets have observations that have already been made about different flowers and pollinators. These are all flowers that exist in the Great Plains of America, either because they grow here naturally or because people plant them in their gardens. We can pretend that these are observations you have made by carefully watching flowers and pollinators. I'll also pass out a sheet for each of you for writing down any conclusions you might be able to make from these observations.

Pass out one copy of the *Pollinator Visitation Rates* and *Flower Traits* sheets to each group. Pass one copy of the *Flower Adaptations Log* to each student. As you pass out the sheets, assign each group to one of the six types of pollinators represented in the data: butterflies, birds, bees, moths, flies and beetles.

- *Say*: On this first sheet that says *Pollinator Visitation Rates* at the top, you'll see a chart that lists different flowers going down the side, and a list of six different types of pollinators going across the top. The numbers in the chart show how many times each type of pollinator visited each type of flower during the time that the flowers were being observed. For instance, we can see here that petunias were visited by bees 21 times during the time that the flowers were being observed.

  On the second sheet that says *Flower Traits* at the top, you'll see the names of the different flowers being observed, followed by a list of some of the characteristics that the flowers possess. For instance, it may tell you the flower's color, or information about how the flower smells.

  You'll use these two sheets of observations to see if you can draw any conclusions about the flower traits that may or may not attract the pollinator you are studying. On your third sheet, the one that says *Flower Adaptations Log* at the top, you'll find a series of activities and questions that will help your group analyze the observations that were made. Talk with your group and begin filling in your *Flower Adaptations Log* using the observations from your other two sheets.

Allow the students a chance to work, discussing amongst their group what they can learn from the observations provided on the sheets. Provide assistance as needed. Once the students have finished discussing and have had a chance to fill in their logs, have each group stand one by one and provide their findings to the rest of the students. As the students present, encourage a larger discussion about how solid the evidence is for different conclusions, and what further observation or experimentation can be done to increase our certainty. Discuss why certain pollinators might be attracted to certain traits, and what could be done to test any hypothesis the students come up with.

Below are some of the traits the students might notice are attracting their pollinators:

- **Butterflies:** Because butterflies feed using a long probiscis, they tend to prefer tube shaped flowers. They also prefer bright colors, particularly red and purple.

- **Birds**: Since hummingbirds have long slender beaks and long tongues adapted for gathering pollen, they tend to feed from deep tube-shaped flowers.

- **Bees**: Bees can see ultraviolet light, a type of light our eyes can't see. Because of this, many flowers have evolved patterns that can only be seen in ultraviolet, including UV bullseye patterns, which tend to attract bees. Bees also like bright colors including bright yellow. They tend to prefer flowers that provide a strong platform that they can land on.

- **Moths**: Because moths tend to be nocturnal, they prefer flowers that bloom or emit their scents at night. Though moths can be attracted to a variety of colors, one color they prefer is white. Moths tend to prefer flowers with a strong sweet scent.

- **Flies**: Since some flies are attracted to feces or dead animals, some flowers have evolved a putrid scent to draw in pollinators. Flies prefer dull or pale colored flowers with an open, bowl-shaped bloom.

- **Beetles**: Beetles often like large bowl-shaped flowers with a dull coloration. Beetles can be attracted to a variety of scents, including sweet scents and putrid scents.

After the students have presented and discussed their conclusions, you can end the activity, or move on to *Darwin's Mystery*.

Image by: © Ziva and Amir / Flickr

DARWIN'S MYSTERY

Time: 30 Minutes

Description: Use knowledge about flowers and pollinators to help solve a mystery first solved by Charles Darwin.

Purpose:

- Introduce the idea that flowers and pollinators have coevolved.
- Reinforce the idea that flowers and pollinators have adaptations that help them gather food or attract pollinators.
- Reinforce the idea that animals pollinate flowers by accident.

Connections: This activity reinforces the ideas introduced in *Animal Structures* and *Flowery Adaptations*.

Materials:

- One copy of *Darwin's Mystery* for each group of children (page 85 of this booklet)
- One copy of *Darwin's Mystery Answered* for each child (page 86 of this booklet)
- One copy of E1 (page 84 of this booklet)
- One manilla envelope for each group
- One pencil per child

ACTIVITY

Gather the students. Divide them into small groups. Provide each group with an envelope containing a copy of *Darwin's Mystery* and enough copies of *Darwin's Mystery Answered* so that each student has their own sheet. Instruct them to keep the envelope sealed until they are asked to open it.

- *Say:* Have any of you heard of a man named Charles Darwin?

If any children raise their hands, ask them what they know about him. Otherwise, *say*:

- Darwin became very famous as a scientist for discovering that living things change over time; as the generations pass by, living things evolve in response to their environment. When it came to flowers and pollinators, Darwin noticed many of the things that we've been noticing— pollinators have evolved special structures to gather food from the flowers they visit, and many flowers have evolved adaptations that they use to attract pollinators to them. When two living things evolve in this way, where they both change in response to each other, we call that coevolution.

  Well, one day in 1862 somebody sent Charles Darwin a package in the mail. This package contained a beautiful white flower, a type of orchid from Madagascar. This flower was a bit of a mystery, one that the sender hoped the famous scientist could help solve.

Instruct the students to open their envelope and look at the copy of *Darwin's Mystery* that is inside. Use a copy of *Darwin's Mystery* as a visual aid while you explain the activity.

Image by: © Matfald / Wikimedia

- *Say:* Here is why this flower is a mystery. As you can see, it has this very long structure called a nectar spur. It is 11 inches long. All the flower's nectar is stored way down at the bottom of the nectar spur, but there is no opening at the bottom, so any creature that comes here looking for food must be able to somehow get part of their body into the nectar spur in order to get nectar from way down here. Darwin was amazed. He wondered to himself, "What kind of animal has coevolved with this flower and pollinates it? How does it get the nectar out?" He knew there must be some creature that had evolved specifically to feed from this nectar spur, but such a creature had never been seen by modern scientists.

  You'll be working together in your groups to come up with a hypothesis that answers this question, "What type of animal must feed from and pollinate this orchid?" Your sheet has three clues on it that Darwin used to try to discover the answer to this question. Read the clues and then discuss what they might mean. When you have an answer, fill out the questions on the other sheet titled Darwin's Mystery Answered. When you are finished, we'll discuss your ideas.

Allow the groups to discuss the mystery and discuss their possible solutions. Clue #1 should let them know that the animal involved interacts with the flower near the top of the nectar spur; otherwise, it couldn't get pollen on its body and help with pollination. Clue #2 reinforces this idea, since the animal needs to be up top to have access to the entry to the nectar spur. Clue #3 should let them know that the animal involved is nocturnal, which is why the orchid emits its smell at night. If the children took part in the *Flowery Adaptations* activity, they may remember that many moths are attracted to white flowers, and that the Western Prairie Fringed Orchid that they examined attracted moths.

If the children want clues, you can provide them, though it isn't necessary that they come to a correct answer, only that they use problem solving to develop a possible answer. If you want, you can tell them that Darwin knew that other orchids with much smaller nectar spurs were pollinated by moths, or you can remind them that moths have proboscises that they use to gather nectar from tubelike flowers.

After they have had sufficient time to work, you can allow groups to present any conclusions they've made. Invite a larger conversation about the strengths or weaknesses of the different hypothesis.

When the discussion is finished, *say*:

- Do you want to know what Darwin's hypothesis was? He concluded that because the orchid is white and emits its scent at night that it must be pollinated by a moth. But no moth had ever been seen by scientists that could possibly get nectar out of that nectar spur. So, Darwin hypothesized that a moth must exist somewhere in Madagascar that has a proboscis that is long enough to fit all the way down that nectar spur, a proboscis that is at least 11 inches long.

  Many people thought his hypothesis was absurd. What do you think?

Allow for discussion.

- Well, a little more than a decade after Darwin made his hypothesis, scientists discovered this Hawk Moth living in Madagascar.

Show E1.

- *Say*: There is in fact a moth that matches Darwin's prediction. It coevolved with this Orchid to fit it perfectly; its proboscis can grow to be more than 11 inches long, just long enough to get nectar out of this nectar spur.

  Though this is a dramatic example of coevolution, we see this a lot with pollinators and flowers; since pollinators need flowers for their food, they evolve structures to gather that food very efficiently, and since flowers need pollinators to reproduce, flowers evolve many ways to attract pollinators to them and to ensure that the pollinators accidentally get covered in pollen.

Possible Extension: Have children imagine and draw a fictional flower and a creature that pollinates it. Before they begin drawing, have them answer three questions:

1. What traits does your flower have that allow it to attract your pollinator?
2. What structures does your pollinator have that helps it to gather nectar or pollen for food?
3. Are there any structures on your pollinator that help it to accidentally move pollen from one flower to the next?

TEACHER RESOURCES

Image by: © Chris Helzer

STANDARDS

The chart below displays possible connections for the activities in this lesson guide to NGSS and the Nebraska College and Career Ready Standards. There are also many connections to the Nebraska Social Studies Standards for Geography: Regions.

	NGSS		
Activity	**Disciplinary Core Idea**	**Science and Engineering Practices**	**Crosscutting Concepts**
The Story of Chris Helzer	LS2: Ecosystems: Interactions, Energy, and Dynamics LS4.D: Biodiversity and Humans	Asking Questions	Scale, Proportion, Quantity
The Closer You Look	LS2: Ecosystems: Interactions, Energy, and Dynamics LS4.D: Biodiversity and Humans	Asking Questions Obtaining, Evaluating, and Communicating Information	Patterns Structure and Function
Stories from the Prairie	LS2: Ecosystems: Interactions, Energy, and Dynamics LS4.D: Biodiversity and Humans	Obtaining, Evaluating, and Communicating Information	Patterns Structure and Function
Your Own Square Meter	LS2: Ecosystems: Interactions, Energy, and Dynamics LS4: Biological Evolution: Unity and Diversity	Planning and Carrying Out Investigations Obtaining, Evaluating, and Communicating Information	Patterns Scale, Proportion, Quantity
The Importance of Flowers	LS1.A: Structure and Function LS2: Ecosystems: Interactions, Energy, and Dynamics	Asking Questions Constructing Explanations	Systems and System Models Structure and Function

Animal Structures	LS1.A: Structure adn Function	Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	Scale, Proportion, Quantity Structure and Function
Flowery Adaptations	LS1.A: Structure and Function LS4: Biological Evolution: Unity and Diversity	Analyzing and Interpreting Data Using Mathematics and Computational Thinking Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	Patterns Scale, Proportion, Quantity Structure and Function
Darwin's Mystery	LS1.A: Structure and Function LS4: Biological Evolution: Unity and Diversity	Engaging in Argument from Evidence Obtaining, Evaluating, and Communicating Information	Stucture and Function Stability and Change Cause and Effect

A1

Image by: © Chris Helzer

A2

Ant on Leadplant

Image by: © Chris Helzer

A3

Image by: © Chris Helzer

Longhorn Milkweed Beetle

Cope's Gray Tree Frog

Image by: © Chris Helzer

A5

Miner Bee on Leadplant

Image by: © Chris Helzer

A6

Planthopper on Leadplant

Image by: © Chris Helzer

A7

Butterfly Milkweed

Image by: © Chris Helzer

A8

Chinese Praying Mantis

Image by: © Chris Helzer

A9

Fly on Indiangrass

Image by: © Chris Helzer

A10

Jumping Spider

Image by: © Chris Helzer

A11

Fungal Spot

Image by: © Chris Helzer

A12

Insect Burrow in Maximilian Sunflower

Image by: © Chris Helzer

A13

Leadplant Under Snow

Image by: © Chris Helzer

B1

This Side Up

Image by: © Chris Helzer

B2

This Side Up

Image by: © Chris Helzer

B3

This Side Up

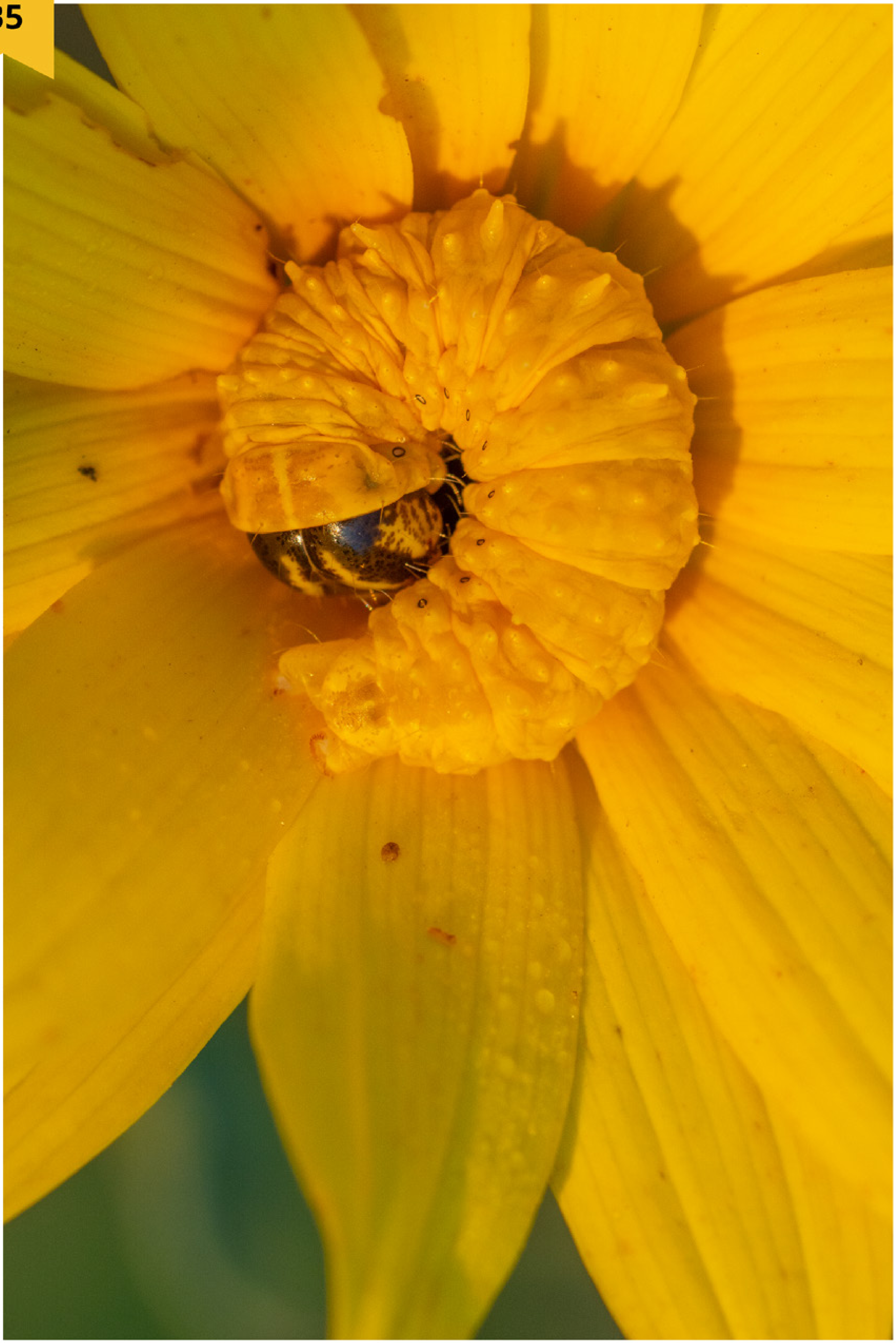
Image by: © Chris Helzer

B4

This Side Up

Image by: © Chris Helzer

B5



This Side Up

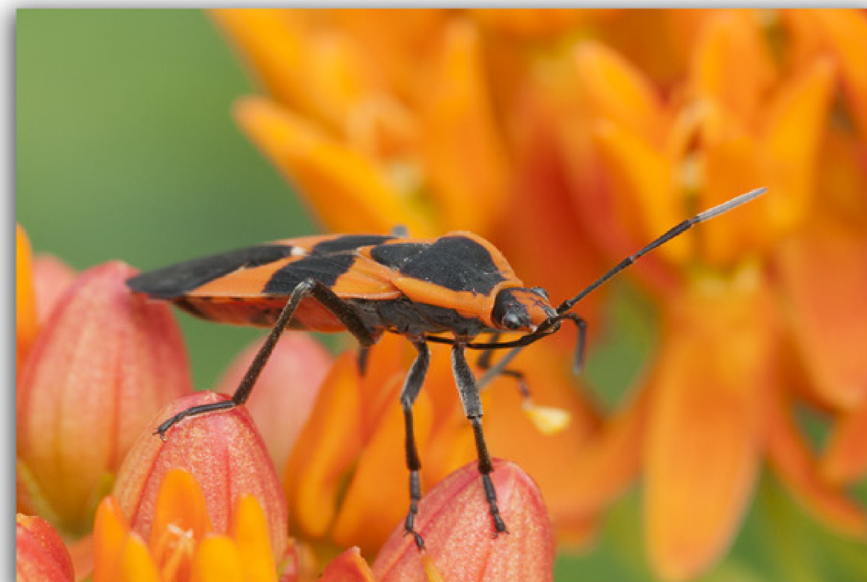
Image by: © Chris Helzer

B6

This Side Up

Image by: © Chris Helzer

Stories from the Prairie- Sheet 1



Large Milkweed Bugs help pollinate milkweed plants. While walking across the flowers, large milkweed bugs can accidently step into little bags of pollen called "pollinia" which then get stuck on their feet. When the large milkweed bug moves to another flower, the pollen in the pollinia can help pollinate the new flower.

Later, when the milkweed plant forms seeds, it is time for the large milkweed bug to eat. The large milkweed bug inserts its long mouthpart into a seed then injects it with its own saliva. The saliva digests the inside of the seed, turning it into a liquid, which the large milkweed bug then slurps out. Large milkweed bugs rarely eat enough seeds to hurt the plant.

Adult **Monarch Butterflies** love to eat nectar from milkweed flowers. While slurping up nectar, they often accidently pollinate the milkweed by stepping in the pollina and moving them from flower to flower.

Monarchs always lay their eggs on milkweed plants. They'll usually glue a single egg to the underside of a milkweed leaf. After 3 to 5 days, the egg hatches, and a tiny caterpillar emerges.

Monarch caterpillars only eat milkweed leaves. They eat as much as they can for about two weeks until they begin to form a chrysalis, preparing themselves to turn into butterflies.

After they've been pollinated, **Milkweed** flowers form seed pods that start out soft and green, then harden and turn brown as they age. In the fall, the seed pods crack open and release small brown seeds with long cottony tails called "pappi" that get caught in the breeze, transporting them off to a different part of the prairie where they can grow into a new milkweed plant.

Images by: © Chris Helzer

Stories from the Prairie- Sheet 2

Several species of **Long-Horned Bees** get almost all of their food from sunflowers— the adults drink up the nectar and eat pollen, and females gather pollen to leave with their eggs so the larva have something to eat when they hatch. While gathering their food, long-horned bees unintentionally carry pollen from flower to flower, helping the sunflowers to reproduce.

Long-horned bees are solitary, meaning they don't live together in a hive or make honey. Females tend to nest in burrows underground, and males frequently curl up and sleep inside flowers.

Unlike many insects that only eat nectar or pollen while leaving the rest of the flower alone, these **Leaf Beetles** also eat the flower itself. When gathered in large groups, they can completely destroy the flower, leaving it unable to make seeds and reproduce.

Ambush Bugs wait patiently on the sides of plants, using their color and texture as camoflage. When an insect like this leaf beetle comes too close, the ambush bug grabs it with its strong front arms and then uses its mouthparts to inject the prey with venom. This venom paralyzes the victim while turning their insides into a liquid that the ambush bug can slurp up and eat.

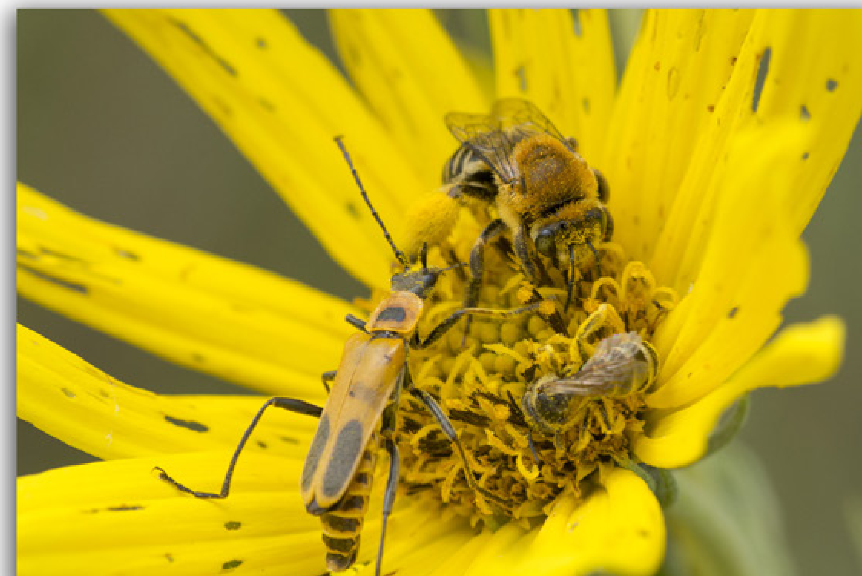
Predators like ambush bugs can help to keep leaf beetle populations low, making it easier for flowers to reproduce.

Images by: © Chris Helzer

Stories from the Prairie- Sheet 3

Maximilian Sunflowers can grow to be up to ten feet tall, forming thick forests on the prairie covered with small yellow flowers. They have hairy stems and long thin leaves. Birds love to eat their seeds, and they grow thick tubers underground that can be dug up and eaten by humans.

Many different insects come to Maximilian sunflowers to feed, including this **Soldier Beetle** and many species of **Bees**. As insects move from flower to flower searching for food, they unintentionally spread pollen, helping the flowers to reproduce.



Head-Clipping Weevils chew around the stems of sunflower plants, causing the flowers to sag over and begin to wilt. This likely makes the flowers unattractive to other insects that might otherwise come to eat pollen or nectar. The head-clipping weevils then lay their eggs in the sunflower heads. After the flowers finally dry and fall to the ground, the weevil eggs hatch and the larvae feed on the decomposing flowers. After they've eaten all they need the larvae burrow down into the ground where they live over the cold winter months.

Images by: © Chris Helzer

C1

Image by: © Chris Helzer

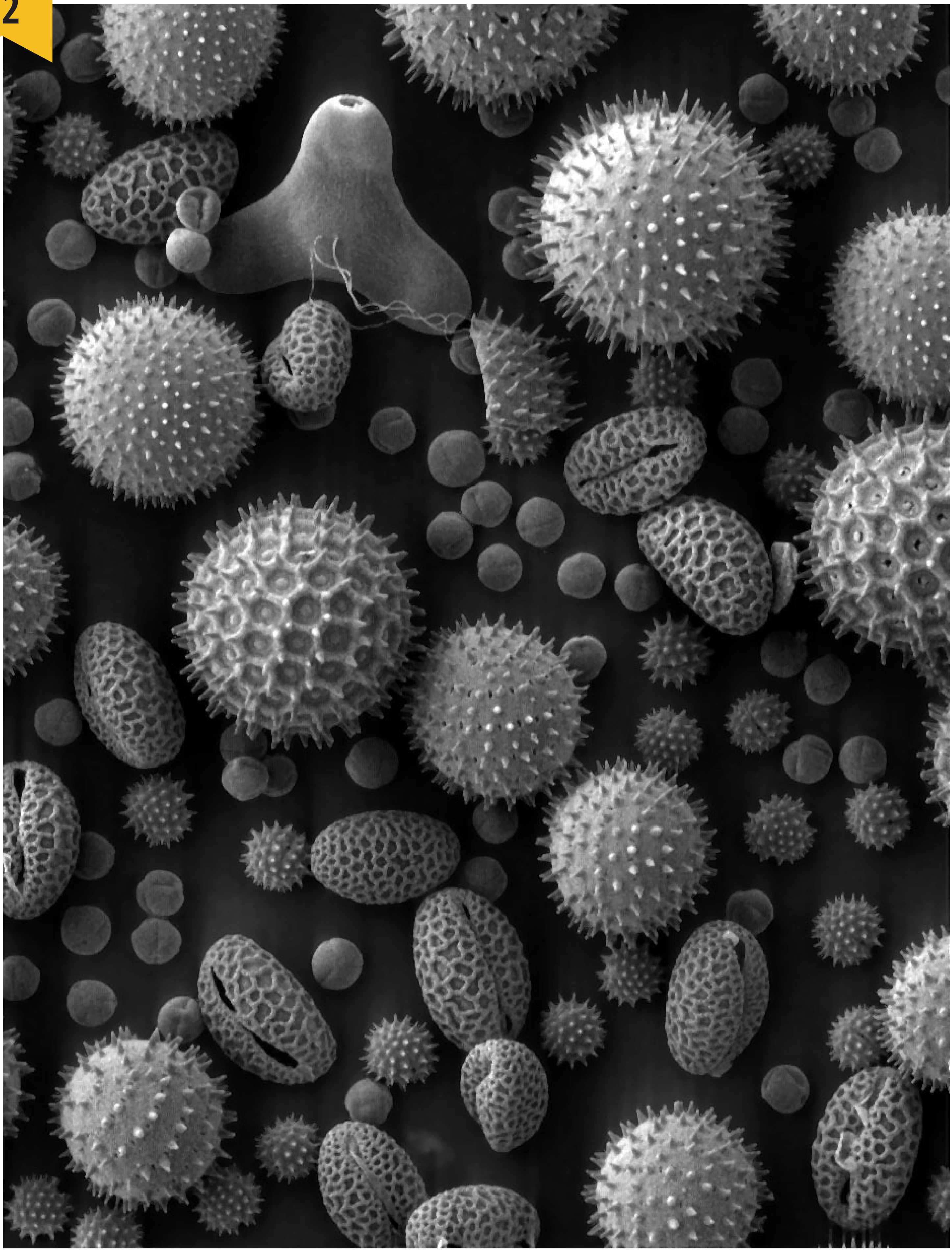


Image by: © NASA/Goddard Space Flight Center / nasa.gov

D1

Image by: © Megan Asche

D2

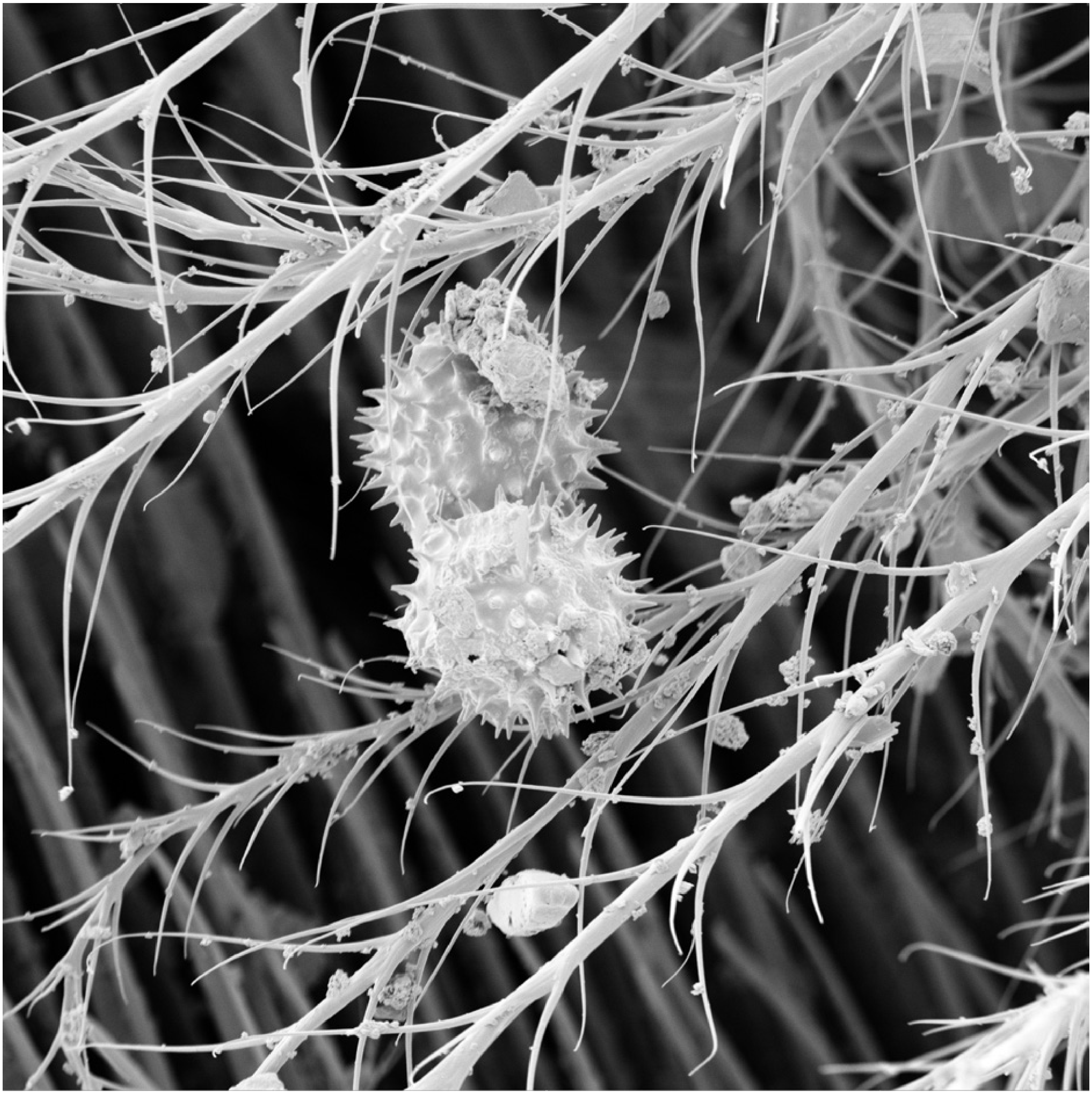


Image by: © Megan Asche

POLLINATOR SHEETS: BATS

Image by: © Jacques de Speville

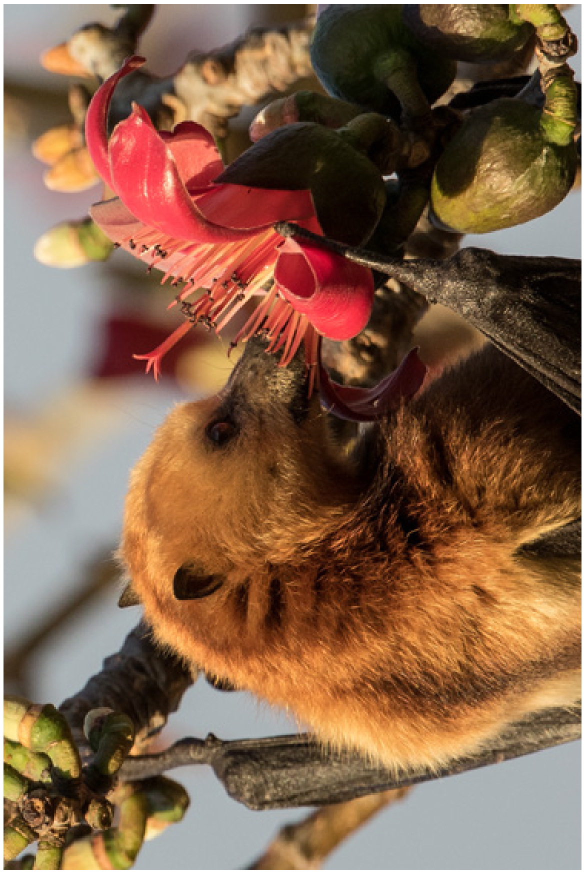


Image by: © MerlinTuttle.org

Image by: © MerlinTuttle.org

POLLINATOR SHEETS: BEETLES


Image by: © Dave Price / Flickr


Image by: © Chris Helzer


Image by: © Brett Whaley / Flickr

POLLINATOR SHEETS: BUTTERFLIES

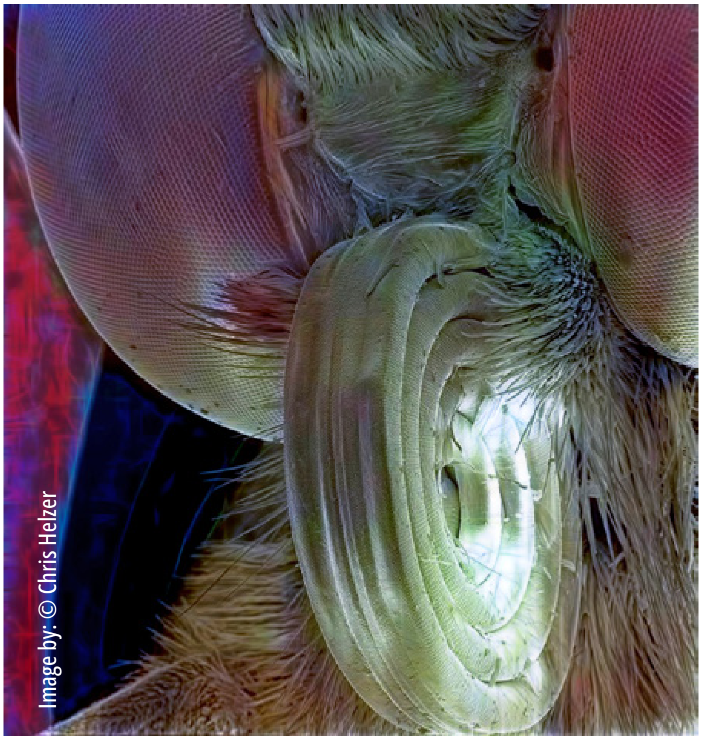


Image by: © Chris Helzer


Image by: © TexasEagle / Flickr


Image by: © Richard Bartz / Wikimedia

POLLINATOR SHEETS: FLIES


Image by: © Jean and Fred Hort / Flickr


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Image by: © Ziva and Amir / Flickr

POLLINATOR SHEETS: HUMMINGBIRDS

POLLINATOR SHEETS: MOTHS

POLLINATOR STRUCTURES

1. What adaptations does your pollinator have that help it to gather nectar or pollen for food?

2. What structures on your pollinators might help them accidentally transport pollen from one flower to the next?

POLLINATOR VISITATION RATES

	Butterfly	Bird	Bee	Moth	Fly	Beetle
Columbine	4	32	0	0	1	0
Dandilion	2	0	46	0	6	0
Magnolia	0	0	0	0	13	37
Maximilian Sunflower	8	0	51	0	0	7
Pawpaw	0	0	0	0	57	29
Petunia	47	21	2	0	0	0
Summer Lilac	56	0	15	3	0	0
Western Prairie Fringed Orchid	0	0	0	39	0	0
Yucca	0	0	0	43	0	0

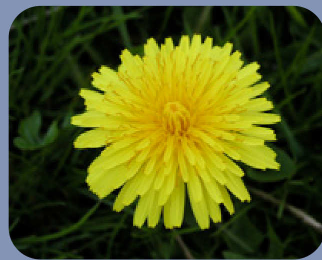
The numbers above show how many times each pollinator visited each flower during the period of observation.

FLOWER TRAITS

Columbine

Red, deep tube shaped flower, no fragrance, little room to land

Image by: © Diane Cordell / Flickr



Dandelion

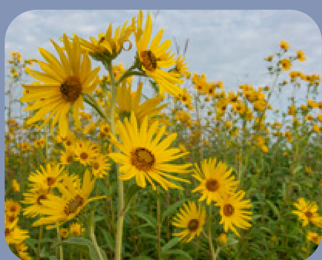
Bright yellow, ultraviolet bullseye pattern, blooms in the daytime, strong platform of petals

Image by: © Benjamin Esham / Flickr

Magnolia

Dull white, sweet scent, bowl shaped

Image by: © Susanne Nilsson / Flickr



Maximilian Sunflower

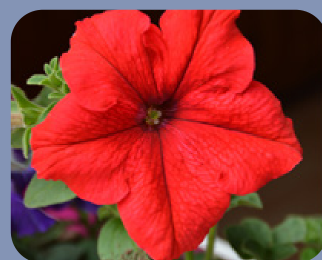
Bright yellow, ultraviolet bullseye pattern, strong landing platform, flower heads follow the sun

Image by: © Chris Helzer

Pawpaw

Dull red, faint scent of rotting flesh, bowl shaped flower

Image by: © Ted / Flickr



Petunia

Bright red, deep tube shaped flower, wide landing pad, sweet scent

Image by: © Gillyan9 / Flickr

Summer Lilac

Bright purple, small tube shaped flowers, sweet scent

Image by: © Jakub T. Jankiewicz / Flickr

Western Prairie Fringed Orchid

Pale white, strong vanilla scent emitted at night

Image by: © ND Parks and Recreation / Flickr

Yucca

Dull white, blooms only at night, strong sweet scent

Image by: © Lisa Jacobs / Flickr

Name: ______________________________

FLOWER ADAPTATIONS LOG

1. What Pollinator are you studying? ______________________________

2. Create a bar graph showing how many times your pollinator visited each of the flowers being studied.

POLLINATOR VISITS

3. Which flowers were visited most frequently by your pollinator? ______________________________

4. Using the flower traits sheet, identify any flower adaptations that might be attracting your pollinator. Then describe how certain you are that the listed adaptation is attracting your pollinator. Why are you certain or uncertain?

Flower Trait: ______________________________

How certain are you that this trait is attracting your pollinators? Why?

Flower Trait: ______________________________

How certain are you that this trait is attracting your pollinators? Why?

5. If you wanted to confirm that one of your flower traits is in fact attracting your pollinator, what could you do to increase certainty?

E1

Image by: © Nesnad / Wikimedia

DARWIN'S MYSTERY

Clue #1

The pollen is stored right here

Clue #2

The entrance to the nectar spur is found here, but the nectar is stored down here.

Clue #3

The orchid is white in color and realeases its scent at night.

Image by: © Sunoochi / Wikimedia

DARWIN'S MYSTERY ANSWERED

1. What type of animal do you think is pollinating this orchid? Why?

2. How do you think this animal gets nectar from the bottom of the nectar spur?

3. What special structures must your animal have in order to gather nectar or be an efficient pollinator?

