




The Bio/Diversity Project Introduction to Sonoran Desert Pollinators

Teacher: Emma Turpin & Zabrina Duran

Grade Level: 6th

Time Teaching: 9:00am-1:05pm

This lesson has been adapted from: [Flowers Seeking Pollinators](#) and [Pollination Investigation Field Journal](#)

AZ Science Standard:	<p>6.L2U1.13</p> <ul style="list-style-type: none"> ● <i>Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.</i>
Learning Objectives:	<ul style="list-style-type: none"> ● Students will be able to explain that flowers attract specific pollinators. ● Students will be able to explain that many plants depend on pollinators to reproduce.
Scientist of the Week:	<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> ● <i>Full Name : Dr. Rebecca Tonietto</i> ● <i>Picture</i> ● <i>Occupation : Bee Specialist</i> ● <i>Location : Urban Midwest</i> ● <i>1-2 important contributions to science: Discovering which garden types to best support native pollinators and reintroduce native plant species as well plants that do well in the midwest.</i> </div>

Vocabulary	Materials
<ul style="list-style-type: none"> ● Pollinator ● Biodiversity 	<ul style="list-style-type: none"> ● Presentation ● Class set of pencils ● Class set of pipecleaners ● Class set of tissue paper ● Class set of blank paper



					<ul style="list-style-type: none"> ● Printed text - select from Texts in English - 4 copies of this file ● Sonoran desert adapted imaginary garden images - 17 copies of this file ● Printed pollinator profile cards - 4 copies of this file ● Field Journals in English - 4 copies of this file <p><i>Do you need any additional materials for the icebreaker activity? If so, add them below.</i></p> <p>6 roles of toilet paper</p>
Seasonality: Any seasonality					
<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June	
Guiding Questions:					
<ul style="list-style-type: none"> ● <i>What does pollinator diversity look like in the Sonoran Desert?</i> ● <i>What kind of impact do pollinators have on ecosystem function and productivity?</i> 					

Engagement/Introductory Activity:

- Introduce yourself to the class. Come up with your own icebreaker/get-to-know you activity and detail the instructions here (5 minutes or less)
- ICEBREAKER: toilet paper pass (<https://www.weareteachers.com/middle-school-icebreakers/>)
 - We will start by passing around a couple rolls of toilet paper and telling the students to take what they need. We won't explain the activity until everyone has "taken what they need" from the roll of toilet paper. Then once everyone has their toilet paper, we will ask each student to share a fun fact about themselves for each square of toilet paper they grabbed.
- Pass out a blank piece of paper to students. Ask students to draw their favorite flower.
- While they draw, ask students: "Why do plants have flowers?" "Are plants trying to win a beauty contest?" *Flowers are the reproductive parts of the plant - flowers have specific traits to attract pollinators, such as bees and butterflies.*
- Ask students, "Why are there so many different types of flowers?" *Different flowers attract different pollinators. The types of flowers that are attractive to bees, for example, won't always be attractive to butterflies.* (5 mins)
- Display a [diagram of flower anatomy](#). Without going into detail on the scientific vocabulary, ask students what they believe happens when a bee visits a flower.
 - Ask follow-up questions to help students reach the basic concept of pollinators accidentally taking pollen (the reproductive "seeds" of flowers) and dispersing pollen from flower to flower when they visit to drink nectar, which helps the flower reproduce.



- If time allows, show this video:
 - ▶ [Pollination For Kids | What Is Pollination ? | Are Wasps Pollinators ? | Pollination ...](#)
- Ask students to draw a pollinator visiting their flower. If students don't know what a pollinator is, ask them to make their best guess as to what kinds of animals visit flowers. Potential pollinators could be bees, bats, butterflies, beetles, moths, flies, birds, etc.

Exploratory Activity:

- **Science Literacy Option**
- Split students into pairs and instruct them to sit together (if they are not already. It helps to use students who are sitting next to each other at a table already so that students don't have to move seats.)
 - Ask groups to decide who will be the reader and who will be the recorder.
- Tell students that we are going to take a virtual field trip to explore pollinators that live in our community.
- Hand out [copies of the different texts](#), one pollinator text per group, and instruct students to read the text out loud
 - The reader will read aloud while other group member follows along silently
 - Each text should discuss a different native pollinator, its relationships with plants, and its overall importance to the Sonoran Desert
 - Options include; bats, flies, beetles, wasps, native bees, hummingbirds. (link to all of the texts: [Texts in English](#) or [Texts in Spanish](#))
- Hand out one [pollinator profile card](#) to each team and a set of the [sonoran desert adapted imaginary garden images](#). Based on what they read in their assigned text and on the pollinator profile card, instruct students to answer the questions listed on their pollinator investigation field journal. (link to the field journals: [UPDATED Journals in English](#) or [Journals in Spanish](#))
 - If teaching in Spanish: here are the [pollinator profile cards](#)
 - If students have a hard time answering questions about the flower's fragrance, ask them to make their best guess, base it on their lived experiences, and/or use their imagination.

Explain:

- Bring the whole class back together and debrief.
- Present discussion questions.
 - *Why are pollinators important to ecosystems?*
 - *Why are pollinators important to humans?*
 - *Pollinators are important because they provide plants with the proper pollination, which is needed for plants to reproduce and produce flowers and any agricultural foods. When we overlook certain pollinators, we overlook the important work they do.*

Extension Activity/Questions:

- Have each student create a flower with craft materials that would be attractive to their pollinator.
- Create flowers with craft material like tissue paper and pipe cleaners. You will need to create the



following flowers:

- Blue or purple flower (butterfly)
 - Red or orange flower (bird)
 - A bunch of small, white, tube-shaped flowers (moth)
 - A large white flower (fly)
 - A flower of any color (bee)
 - Large, white, cone-shaped flower (bat)
 - For each flower, attach the appropriate Flower Tag with its unobservable traits.
- If there is extra time, have each student write a few sentences about why this flower attracts their pollinator.

Evaluation Activity:

- Ask for volunteer students to present their flower to the class and explain why it would be attractive to a specific pollinator.
- Ask the class what they think would happen to their flower if their pollinator disappeared. Would the flower survive? If it did, how might it change?



The Bio/Diversity Project

Lesson Title: Plant Adaptations and Pollinators

Teacher: Emma Turpin & Zabrina Duran

Grade Level: 6th grade

Lesson Length: 55 minutes

This lesson has been adapted from: <https://agclassroom.org/matrix/lesson/542/>

AZ Science Standard:	<p>6.L2U1.13</p> <ul style="list-style-type: none"> Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.
Learning Objective:	<ul style="list-style-type: none"> Students will be able to describe two abiotic and biotic factors in the Sonoran Desert ecosystem. Students will be able to describe one Sonoran Desert abiotic/biotic relationship.
Scientist of the Week:	<div data-bbox="516 1062 924 1604" data-label="Image"></div> <p>Helia Bravo Hollis</p> <ul style="list-style-type: none"> Botanist Mexican Born and raised in Mixcoac (present-day Mexico City) She made contributions to the area of floriculture, although in the arid regions of eastern Mexico, she focused on the taxonomy of cactaceae. She organized a collection of live cactaceae and other succulent plants in order to observe their development and evaluate morphological characteristics.

Vocabulary	Materials
<ul style="list-style-type: none"> Abiotic biotic population adaptation 	<ul style="list-style-type: none"> Powerpoint Apple Time Lapse Video Flower Power: Anatomy and Function- 10 copies



<ul style="list-style-type: none">• <i>characteristics</i>• <i>reproduction</i>	<ul style="list-style-type: none">• aab_flower_anatomy_activity.pdf -90 copies• Abiotic/Biotic cards - 10 copies• 30 colored pencils			
Seasonality:				
<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
Guiding Questions: <ul style="list-style-type: none">• How does variation among individuals in a population affect overall survival?• How do the physical structures and functions of plants and pollinators allow them to meet their needs?				

Engagement/Introductory Activity: (5-7 mins)

- Ask students to brainstorm the ways we use and rely on flowers each day. Make a list on the board. Allow students to offer their ideas using their background knowledge. (They will likely think of ornamental flowers used in flower arrangements or landscaping first.)
- After a few ideas come up, show the [Apple Time Lapse](#) video, and ask again if they can think of any other ways we rely on flowers. This video is supposed to encourage students to think about how we rely on flowers for food, something essential for survival.

Exploratory Activity: (15 mins)

- We will break students up into groups of three based on their elbow partners (the classroom is set up in a way where they are already grouped into 3's). Together they will read through the [Flower Power: Anatomy and Function](#) worksheet together.
- Students will receive a copy of [this worksheet](#) and be asked to color and fill out the parts of the flower based on what they read and talked about in class with us.

Explain: (7-10 mins)

- What parts of the flower are important for the process of pollination?
 - Explain to the students that the parts of a flower that are directly involved in pollination are the anthers, which are the male part of the plant, and the stigma, which is the female part of the plant.
- Why is pollination important for both the pollinator and the plant?
 - Pollination is important for **reproduction** of plants since many plants cannot reproduce without being pollinated. And pollinators need plants for food which means they depend on each other for survival. A relationship between a plant and a pollinator is a relationship between two **biotic** factors.
- What environmental factors may encourage/inhibit pollination?
- What are some abiotic and biotic factors that are involved in the pollination process?
 - biotic factors: plants, pollinators, bacteria
 - abiotic factors: soil, wind, water, sunlight, temperature,



Extension Activity/Questions: (20 mins)

- Give groups of 3 students a set of [Abiotic/Biotic cards](#). Have students sort the cards into two piles — (1) abiotic factors and (2) biotic factors. Allow students to research as needed in the sorting process.
- Have the students sort the "biotic factors" pile into two piles— (1) plants/pollinated factors and (2) animals/pollinators.
- After the sorting, in their groups of 3, students will draw a pie chart in their notebooks based on their 3 piles of cards (abiotic/biotic(plants)/biotic(animals)) to visualize abiotic and biotic factors (26.9% abiotic, 42.3% pollinated biotic factors, 30.8% unpollinated biotic factors)

Evaluation Activity: (5 mins)

We will have our students play this 7-question kahoot quiz on their chromebooks at the end of class.

Kahoot: <https://create.kahoot.it/share/plant-adaptations-and-pollinators/671451e9-34fd-46d0-8448-69dee793ec28>

1. What is an example of an abiotic factor?
 - a. Soil or Sunlight
2. What part(s) of a flower are important for pollination?
 - a. Anthers or Stigma
3. About what percent of grown foods need pollinators?
 - a. 35%
4. What environmental factor(s) might encourage and/or inhibit the process of pollination?
 - a. All of the above (Sunlight, air quality, mineral, natural disasters)
5. T/F: Plants are an abiotic factor.
 - a. FALSE
6. Plants need pollinators for _____.
 - a. Reproduction
7. T/F: Bacteria is a biotic factor.
 - a. TRUE

For extension activity:

Abiotic (7)	Biotic (Plants) (11)	Biotic (Animals) (8)
<ul style="list-style-type: none">- Sunlight- Minerals- Monsoons- Humidity- Sandy/Rocky soils- Bedrock- Temperature	<ul style="list-style-type: none">- Saguaro cactus- Prickly pear cactus- Agave plants- Beans- Squash- Corn- Sunflower seeds- Oranges- Pomegranate- Mesquite tree- Desert milkweed	<ul style="list-style-type: none">- Javelina- Cactus wren- Leafcutter Bee- Rufous hummingbird- Monarch butterflies- Lesser long-nosed bats- Flower fly- Yucca moth



The Bio/Diversity Project
Lesson Title: Migratory Pollinators

Teacher: Zabrina & Emma
Grade Level: 6th
Lesson Length: 55 minutes

This lesson has been adapted from: https://journeynorth.org/tm/monarch/CycleAnnualTG.html

Table with 2 columns and 3 rows. Row 1: AZ Science Standard: 6.L2U1.13, Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors. Row 2: Learning Objective: Students will be able to describe 3 important reasons why pollinators migrate, Students will be able to explain what factors help/inhibit migration. Row 3: Scientist of the Week: Edwin Juarez (with photo), Wildlife Biologist, Located Phoenix, AZ. From El Salvador. He was passionate about wildlife and nature from a very young age in El Salvador. This influenced the work he is doing today. He planned and implemented various bird conservation projects throughout Arizona.

Table with 2 columns: Vocabulary, Materials



<ul style="list-style-type: none">• Direction• Survival• Pattern• Reproduction• Migration• Abundance	<ul style="list-style-type: none">• Powerpoint• Migration puzzle - 15 copies (class set)• Monarch Butterfly Population decline video• Monarch Butterfly Risks Cards - 15 copies (class set)			
Seasonality:				
<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
Guiding Questions:				
<ul style="list-style-type: none">• What kinds of animals migrate?• What are the advantages/disadvantages of pollinator migrations?• How has habitat fragmentation and destruction affected migration patterns of Sonoran Desert pollinators?				

Engagement/Introductory Activity:

- Students will come in and we will display a series of migration trend graphs/maps that show the rates and movements of Monarch butterflies. This will act as their “bell work” for the day.
- Show the students 3 different graphs/maps and ask students to write down what they infer the graph/map is showing. Ask them to be as specific as possible.
 - What do the different colors represent? What might be a possible key? What might be the labels of the x/y axis? What concept might the graph/map be trying to explain to us?
- Introduce the overall goals of the lesson as a segway from the graphs/maps to explain the key points of pollinator migration.

Exploratory Activity:

- Start by exploring the annual migration of Monarch butterflies through [this website](#) (this website is also linked on slide 8 of the ppt. when you click on the two butterflies).
 - Before you press play on the map, ask students where they think the pattern of butterfly migration will be?
 - Ask students why they think that monarch butterflies migrate in this way? This could be due to the weather conditions, availability of food sources, etc. **Monarch butterflies migrate north in search of a plant called milkweed where they like to lay their eggs for the next generation.**
- Give students [this puzzle](#) that shows the steps of monarch migration, and with their elbow partners, have them put the puzzle pieces in the correct order.

Explain:

- Bring the class back together for a small discussion after students have finished putting their puzzle together.
- Ask these questions for further discussion:



- What migratory **patterns** do we notice?
- For what **reason(s)** do monarchs migrate?
- Why is migration important for **pollinators**?
- Talk about the answers to these questions with them and further explain that monarchs “overwinter” in mountain areas of Mexico during the winter months, roughly from October to November. Define overwintering - where an animal/organism spends or waits out the winter, usually warm areas.
- Explain that March-Oct. monarchs migrate and reproduce up to 4 new generations. Discuss how monarchs are able to know what direction to migrate (north).

Extension Activity/Questions:

- Explain that while monarchs go on their migratory journey, they also are a threatened species.
- Show [this video](#) which covers a few reasons why monarch populations have declined in recent years.
- Pass out [cards](#) to groups of 3 that display three different terms of why monarchs are in danger (habitat loss, pesticides/herbicides, climate change), the corresponding definitions to these terms, and their corresponding consequences.
- Have students match the terms to their definitions and their corresponding consequences.
- Ask students to share:
 - What threat are they most concerned about towards monarch butterflies?
 - Ask if they have any ideas on ways that these problems can be solved.

Evaluation Activity:

- We will have our students play a Kahoot quiz on their chromebooks at the end of class.
 1. Monarch butterflies migrate north in search of a plant called _____.
 - a. Milkweed.
 2. What has monarch butterfly’s population decline been impacted by?
 - a. All of the above. (Habitat loss, Climate change, Pesticides & Herbicide.
 3. (T/F)Climate change can impact the migration patterns of monarch butterflies, leading to mismatches in the timing of their life cycle events.
 - a. TRUE
 4. Up to how many generations of monarchs are created in one annual cycle of breeding?
 - a. 4
 5. Why is migration important for pollinators?
 - a. Food and reproduction

Link: <https://create.kahoot.it/details/ad198c52-5d54-43a1-ae24-67a61e1ab816>



The Bio/Diversity Project
Lesson Title: Calculating Biodiversity

Teacher: Emma Turpin & Zabrina Duran
Grade Level: 6th Grade
Lesson Length: 55 minutes

This lesson has been adapted from: https://www.mdsci.org/wp-content/uploads/2020/06/CalculatingBiodiversity.pdf

Table with 2 columns and 3 rows. Row 1: AZ Science Standard: 6.L2U1.13, Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors. Row 2: Learning Objective: Students will be able to calculate the biodiversity index of their surrounding neighborhood/environment. Students will be able to explain what it means to them to be a citizen scientist. Row 3: Scientist of the Week: Juan Pablo Jordán, He is from Quito, Ecuador. He is currently a PhD student at Cornell University in Ithaca, NY. PhD student. He is helping document Ecuador's wide variety of spiders before they all disappear. Includes a portrait photo of Juan Pablo Jordán.

Table with 2 columns: Vocabulary and Materials. Vocabulary includes Biodiversity Index, Citizen Science, and Data. Materials include Powerpoint, 5 boxes with open top, and 20 6-sided dice.



<ul style="list-style-type: none"> Observations 		<ul style="list-style-type: none"> 50 beans 10 fake bugs 35 jumbo cotton balls 40 mini pompom balls 25 googly eyes 		
Seasonality:				
<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
Guiding Questions: <ul style="list-style-type: none"> How do you calculate biodiversity? What is citizen science and why is it important? How do you go about conducting a bioblitz? 				

Engagement/Introductory Activity:

- Students will come in and we will display [this map](#) that will show a general idea of biodiversity across the state of AZ.
 - Ask students what they can infer from the map. Ask them to be as specific as possible.
 - What do they think the map is representing? Why are some areas of the map more densely colored than others? Why is the map limited to Arizona?
- Transition to explaining how this data was collected by people being citizen scientists and sharing 1.7 million observations of how the frequency they observed these birds in Arizona.

Exploratory Activity:

- Introduce this activity by discussing what citizen science is and what it means to be a citizen scientist. Make sure students have a good understanding of this concept.
- Show students 2-3 examples of citizen science projects from [this website](#).
- Students will then visit: <https://scistarter.org/finder?active=true> and do some research to find a project that they are interested in (they may pick a project individually or in partners)
- Ask students to take notes on the following information and be ready to share it out loud.
 - Their notes should include:
 - Project title/name
 - Goal of the project
 - Project task
 - Why they are interested in this project

Explain:

- Have students pull out their chromebooks for a kahoot! We decided to do it earlier in the class because it is a review Kahoot that includes questions from the past three weeks of lessons.
- Review kahoot: <https://create.kahoot.it/share/pollination-review/bcd6fd12-94c8-4841-a8b0-867ea20b044f>
 1. Monarch butterflies migrate north in search of a plant called _____.



- Milkweed.
- 2. What has monarch butterfly's population decline been impacted by?
 - a. All of the above. (Habitat loss, Climate change, Pesticides & Herbicide.
- 3. What environmental factor(s) might encourage and/or inhibit the process of pollination?
 - a. All of the above (Sunlight, air quality, mineral, natural disasters)
- 4. Why is migration important for pollinators?
 - a. Food and reproduction
- 5. What part(s) of a flower are important for pollination?
 - a. Anthers or Stigma
- 6. Plants need pollinators for _____.
 - a. Reproduction

Extension Activity/Questions:

- Introduce the activity by explaining how when ecologists want to find out how diverse an area of land is with organisms, they calculate biodiversity by sectioning off a small area and surveying the number of organisms in that specific area.
- We will pass out 5 boxes with various items in them (Each box will have: 4 dice, 10 beans, 2 fake bugs, 7 jumbo cotton balls, 8 mini pompom balls, and 5 googly eyes) to the different areas in the room and have students work in groups.
- Explain how the students will practice those same practices by observing and calculating the 'biodiversity' in class.
 - We will then ask students to count and write down how many different items they see in the box. They are documenting the 'species richness' of the box by doing this. **The species richness for this activity should be 6.** Next, students count and write down the number of each object to represent the abundance of each object. Ecologists call this data species evenness. **The species evenness should be 36 .**
 - With the species richness and species evenness, we will have students can now calculate the biodiversity index.
 - $\text{number of different objects (richness)} \div \text{total number of objects (evenness)} = \text{Biodiversity index.}$
 - Students should get **0.16** ($6/36=0.16$) as the biodiversity index.
- Ask students whether or not they think these boxes are biodiverse or not? Why or why not?
- 0 indicate a low biodiversity while numbers closer to 1 indicate a high biodiversity.

Evaluation Activity:

- Ask discussion questions about calculating biodiversity, a bioblitz, and what it means to be a citizen scientist.
 - What does it mean to be a **citizen scientist**? How did the project you chose to participate in qualify as citizen science?
 - What is a **bioblitz**? How can we conduct a bioblitz here in Tucson?
 - How do you calculate **biodiversity**? What information do you need to know and what **formula** should you use?
 - Biodiversity Index formula: Number of different species (richness)/ total number of species in that area (evenness)
- Introduce what the next 4 lessons will look like with the inclusion of the action project.



The Bio/Diversity Project


Lesson Title: Specific Pollinators-Birds & Hummingbirds

Teacher: Zabrina and Emma

Grade Level: 6

Lesson Length: 55 minutes

This lesson has been adapted from: Feathered Friends - Complete-2.pdf

AZ Science Standard:	<ul style="list-style-type: none"> Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors
Learning Objective:	<ul style="list-style-type: none"> Students will be able to describe three true features about birds in general. Students will be able to identify which types of bird beaks can pick up what food source.
Scientist of the Week:	<ul style="list-style-type: none"> Sergio Díaz Infante Maldonado  <ul style="list-style-type: none"> Biologist Patagonia, Arizona & Mexico City, Mexico He has studied about forest birds & hummingbird-plant interactions. He has collaborated on several hummingbird ecology studies in different parts of Mexico and has also worked in environmental education programs.

Vocabulary	Materials
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<ul style="list-style-type: none"> • Adaptation • Migration • Interdependence • Symbiosis • Characteristics • Species Diversity • Hibernation 	<ul style="list-style-type: none"> • Powerpoint • 30 Colored Single Sided Copies of true/false print out • 5 boxes/containers • 15 marbles • 15 mini pom poms • 25 pinto beans • 20 rubber bands • 5 Clothespins • 10 Plastic Straws • 5 Pairs of Chopsticks • 5 Plastic Spoons • 5 Plastic Tweezers • 80 flashcards
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Seasonality:

<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
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Guiding Questions:

- Hummingbirds:*
- How does the species diversity of hummingbirds in the Sonoran Desert contribute to the overall biodiversity of the region?
- Birds:*
- How does the pollination method of the white-winged dove compare to pollination done by hummingbirds?
 - What are the advantages of bird adaptations, and how do these adaptations contribute to the species diversity?

Engagement/Introductory Activity:

- Pass out a [“TRUE” and a “FALSE” piece of paper](#) to each individual student for this activity.
- Then, display each True/False statement on the screen, reading each out loud for the students. Ask students to take at least 10 seconds to think before you have them put up their answer so that everyone can have the chance to think independently.
- Here are the statements:
 - 1. Birds are the only living animals that have feathers. (TRUE)
 - 2. Birds lose and replace their worn or damaged feathers. (TRUE)
 - 3. All birds have thick, heavy bones that provide the structure needed to fly. (FALSE)
 - 4. Birds have poor eyesight. (FALSE)
 - 5. Bird hearts beat more slowly than human hearts. (FALSE)
 - 6. All birds lay eggs. (TRUE)
 - 7. All birds migrate. (FALSE)
 - 8. Birds are vertebrate animals. (TRUE)
 - 9. All birds are warm-blooded. (TRUE)
 - 10. All baby birds hatch covered in downy feathers. (FALSE)
 - 11. Male and female birds of some species look different. (TRUE)

Exploratory Activity:

Gather as many of the following items as you can to represent foods birds eat.

- **Food Resources:** Pinto beans (small animals), rubber bands (earthworms), mini pompoms (grubs/caterpillars), marbles (insects), We will place 3 marbles, 3 mini pompoms, 5 pinto beans, and 4 rubber bands into containers.
- **Beaks (utensils):** Clothespins, chopsticks, straw, spoon, tweezers.
- In groups of 5, Students will then hold one type of “beak” in one hand and keep the other hand behind their back. With one type of food in front of them, they will try to gather as much food as possible in 15 seconds (A timer will be displayed on the projector). Keeping in mind, their survival depends on their ability to gather food! After 15 seconds, they will try another beak and gather food for another 15 seconds (A timer will again be displayed on the projector). Repeat these steps for each type of beak.
- **Questions:**
- After students have finished the activity, they will help clean up the supplies and then return to their seats where interns will discuss the following questions with the class to gauge learning from the activity:
 - Which beak was most successful in gathering each type of food?
 - Bird beaks are like the tools you used in this activity. Can you match the shape/function of any of the tools with any real beaks?
 - The shape of a bird’s beak is a critical adaptation for their survival because it helps them gather the food within their habitat. Different beaks are better suited for different foods. Next time you see a bird, take a look at its beak and see if you can tell what it eats!

Explain:

- Show students [this video](#) to introduce the idea of bird conservation before talking about our action project. (It’s about 4 minutes long).

Extension Activity/Questions:

- Model the creation of a few different bird feeders to have students start thinking about what they want their own to look like (*For the purpose of our action project, our interns will be making three different bird feeders at home prior to this lesson that we can bring in and show as examples*)
- Explain that over the next month we will be creating and decorating our very own bird feeders so that we can play a part in helping/conserving local bird species.
- Explain to students which material they will have access to: **popsicle sticks, string, glue, paint**
- Have each student draw out a model on paper of what they might want their bird feeder to look like.

Evaluation Activity:


- Pass out a final notecard to each student and ask them to write down a 3-2-1 reflection as their exit ticket.
- Ideally, it should consist of 3 things they learned in the lesson, 2 things they want to learn more about, and 1 question they might have about either the lesson or the upcoming action project.
- This will help us address any confusion before we start building.



The Bio/Diversity Project
Lesson Title: Pollinators in Urban Areas

Teacher: Zabrina & Emma
Grade Level: 6
Lesson Length: 55 minutes

This lesson has been adapted from:

AZ Science Standard:	<ul style="list-style-type: none">• <i>6.L2U3.11</i>• <i>Use evidence to construct an argument regarding the impact of human activities on the environment and how they positively and negatively affect the competition for energy and resources in ecosystems</i>
Learning Objective:	<ul style="list-style-type: none">• <i>Students will be able to describe what an urban area is and how pollinators live amongst us within them.</i>• <i>Students will be able to explain the connection between the bird feeder action project and how we can help birds in our own neighborhoods.</i>
Scientist of the Week:	<ul style="list-style-type: none">• <i>Julia Carabias Lillo</i>  <ul style="list-style-type: none">• <i>Professor at National Autonomous University of Mexico</i>• <i>Professor at the National Autonomous University of Mexico</i>• <i>Served as the Secretariat of Environment and Natural Resources under President Ernesto Zedillo from 1994 to 2000 doing restoration and conservation projects around Mexico</i>



Vocabulary		Materials		
<ul style="list-style-type: none">• Abundance• Conservation• Habitat Loss• Landscape• Fragmentation• Ecosystem Diversity		<ul style="list-style-type: none">• <i>Powerpoint</i>• <i>15 poster papers (anything bigger than standard printer paper)</i>• <i>90 blank pieces of paper</i>		
Seasonality:				
<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
Guiding Questions:				
<ul style="list-style-type: none">• How has urbanization impacted pollinators?• How can urban areas act as places of refuge for pollinators?• How do pollinators contribute to the overall ecosystem diversity in urban areas?				

Engagement/Introductory Activity:

- Students will come in and we will display [this chart](#) that will show the biodiversity of different bird species in varying environments.
 - The following discussion will be a **THINK-PAIR-SHARE**.
 - Ask students what they can infer from the chart. Ask them to be as specific as possible.
 - What do they think the chart is representing? What could the different colors on the chart represent?
- Transition to explain how there are different types of species of birds living in various habitats. Urban environments are home to many types of bird species.

Exploratory Activity:

- Set up the gallery walk by placing 5 large pieces of BLANK poster papers around the room. On each piece of paper, write the following questions (1 per poster). The questions being written will be made prior to class:
 - **• How do pollinators and humans live together in urban areas?**
 - Through the construction of parks, gardens, houses/sanctuaries, etc. The point is that we can foster a healthy artificial environment for our pollinators by knowing what plants/food they need to survive and thrive and doing our best to build spaces with those plants.
 - **• What aspects of urban living harm pollinators?**
 - *Chemicals:* Pesticides are chemicals that people apply to their gardens or crops to kill particular



pest insects that are causing problems. Unfortunately, pesticides can kill pollinators too, even if people spraying them don't mean to! Herbicides kill weeds, but can also kill native plants if sprayed on them, which shrinks the local food source for pollinators.

- *Disease*: Did you know that honeybees are not native to North America? They are actually from Europe! Beekeepers take care of hives of these non-native honeybees, but if they aren't careful, the honeybees can get sick and then spread the illness to native wild bees. Wooden "bug hotels" are often marketed for bees and other insects to find shelter during the winter, but if not properly cleaned out, they can harbor harmful diseases and make the next bug tenants sick.
- *Destruction of natural habitats*: As urban areas grow and grow, more and more natural habitats are being destroyed, many of which are home to organisms and pollinators
- **• Why should humans protect pollinators?**
- Without pollinators, humans would be very hungry! Pollinators are also food for other wild animals, and help a wide variety of plants to grow. A diverse and healthy ecosystem is important for everyone on the planet! Pollinators are also beautiful and fascinating, and deserve to be protected!
- **• How can you help pollinators?**
- Plant a pollinator garden with native plants, Create shelter for pollinators by making small brush piles with sticks, leaving the leaves on the ground in the fall, and leaving dead plant stalks up all winter. If you decide to put up a bug hotel, make sure to clean it out and refresh the materials so pollinators don't get sick, Don't use chemicals in your yard. Instead, opt for natural pest and weed control options, Learn how to identify invasive plants and remove them from your yard, city park, or community garden, If you're going to be a beekeeper, make sure your bees are healthy.
- **• What are some cool facts you know about pollinators?** Answers will vary!
- Explain to students that there are 5 pieces of paper around the room with questions for them to answer about pollinators. Pass out markers and disperse groups of 5 or 6 around the room. Give students about 2 minutes per question with the timer displayed on the board.
- Give students about 10-15 minutes total to walk around the room independently and write their thoughts on each piece of paper. Encourage students to come up with their own ideas, and that answers can be anonymous.
- When the time is up, collect the markers and give students a couple of minutes to walk back through and read the answers from other classmates, ask them to think about what stands out to them.
- Gather students back together and begin a big group discussion which begins below in the **explain** section.

Explain:

- As a fun way to check for understanding, students will have 5 minutes (which will be displayed as a timer on the board) to draw out their own vision of a healthy pollinator/human relationship. Questions to get them thinking as they draw might be:
 - What do humans need to do to help pollinators thrive?
 - Why do humans need pollinators?
 - What might the world look like without pollinators in our urban areas?
- Have students share these with their elbow partners and then you can ask for 2-3 volunteers to share with the whole class.

Extension Activity/Questions:

- Students will now have 25-30 minutes to work on the building phase of their action project. The expectation for this activity is that students will have:
 - picked out all their materials they need for their project they brainstormed the previous week
 - started construction on their bird feeders with the hope that they will be at least half way done by the end of this activity



- have a space in the classroom where they can store their materials and project neatly until the following week (for our current project, this will be discussed the week before materials are passed out)

Evaluation Activity:


- Due to the nature of today's class, we will take the last five minutes to have a discussion about how their project went today and what goals they have for finishing their project in the next two weeks.
 - Ask students what went well during their building and how this action project connects/relates to the lesson topic today (pollinators in urban areas)
 - Ensure that students have made the connection between the need to protect pollinators and how our projects can make a difference!

The Bio/Diversity Project
 Lesson Title: Self-Pollination vs. Cross-Pollination

Teacher: Emma & Zabrina
 Grade Level: 6th
 Time Teaching: 55 Minutes

This lesson has been adapted from:

https://www.teachervision.com/seeds-pollination/activity-investigating-self-cross-pollination?check_logged_in=1

AZ Science Standard:	<p>6.L2U1.13</p> <ul style="list-style-type: none"> • <i>Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.</i>
Learning Objectives:	<ul style="list-style-type: none"> • Students will be able to explain the difference between cross-pollination and self-pollination. • Students will be able to describe one way in which we can help conserve pollinators.
Scientist of the Week:	<ul style="list-style-type: none"> • <i>Eijiro Miyako</i>  <ul style="list-style-type: none"> •



	<ul style="list-style-type: none"> • <i>Technological Pollination Researcher</i> • <i>Japan</i> • Helped create tiny drones that can facilitate pollination in a similar way as bees would. • This could be extremely important and positively impactful if the bee population continues to decline.
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Vocabulary	Materials
<ul style="list-style-type: none"> • Self-Pollination • Individuals • Flower • Cross-Pollination • Genetic Variation 	<ul style="list-style-type: none"> - Powerpoint - 30 "Cross-Pollination" and "Self-Pollination" signs - <i>Bird feed</i> - <i>Jumbo popsicle sticks</i> - <i>String</i> - <i>Acrylic paint</i> - <i>Paint brushes</i> - <i>Elmer's glue</i> - <i>Hot glue guns</i>

Seasonality: Any seasonality

<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
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<p>Guiding Questions:</p> <ul style="list-style-type: none"> • What morphological plant adaptations can be seen as a result of pollination? • How does self-pollination differ from cross-pollination?

Engagement/Introductory Activity:

- Students will come in and we will display [this chart](#) that will show the changing amount of beehive populations on a worldwide scale..
 - The following discussion will be a **THINK-PAIR-SHARE**.
 - Ask students what they can infer from the chart. Ask them to be as specific as possible.
 - What do they think the chart is representing? What could the different colors on the chart represent?
- Transition to explain how bees are very important pollinators. They play a very big role in aiding plants who cross-pollinate.

Exploratory Activity:

- Before we begin the activity, students will watch [this video](#) on the projected screen. (Play only from 2:43-4:28)
- We will now be playing a game of “This or That” but with “Self-Pollination or Cross-Pollination”.
- Display the following questions one-by-one on the board through the presentation and ask students whether each one is an example of “Self-Pollination” or “Cross-Pollination” which they will indicate by holding up either their “Cross-Pollination” sign or “Self-Pollination” sign (see materials list).
- Here are the questions:
 1. Pollen grains fall off a stamen and land on a pistil of the same plant. SELF-POLLINATION
 2. Pollen from male flowers of a plant land on the female flowers of a different plant.
CROSS-POLLINATION
 3. Pollen from the stamen of one flower gets stuck on the legs of a bee. The bee then lands on the pistil of a different flower on the same plant. SELF-POLLINATION
 4. Pollen from the male flower of one plant is carried by wind to the female flowers of another plant.
CROSS-POLLINATION
 5. Water carriers pollen from the stamens of one plant to the pistils of a neighboring plant.
CROSS-POLLINATION

Explain:

- Ask students the following questions to ensure they understand the difference between self-pollination and cross-pollination from the information they learned in the previous video and activity.
 - Which form of pollination requires pollinators? Cross-pollination
 - What is animal-based cross pollination called? Zoophily
 - What is **anemophily**? (Cross-pollination by wind) What is **anthropophily**? (Cross-pollination by artificial means)
 - Remind students that the easiest way to tell the difference between the two pollination processes is that **self-pollination** is pollination that occurs within the SAME plant and **cross-pollination** is pollination that takes place between two DIFFERENT plants.

Extension Activity/Questions:

- Students will now have 25-30 minutes to work on the building phase of their action project. The expectation for this activity is that students will have:
 - Finished the construction of their individual bird feeders.
 - Start and hopefully finish the decoration (with paint) of their feeders. The idea with the decoration is that students will incorporate what they have learned about pollinators and colors to best attract birds.

Evaluation Activity:

- Students will have the chance to play [this kahoot](#)
- Here are the questions:
 - How many different types of cross-pollination were mentioned in the video?
 - 3
 - Which type of pollination occurs between flowers of the same plant?
 - Self-pollination
 - What is wind-based cross pollination called? (Think back to the video)
 - Anemophily
 - Self-Pollination is pollination between different flowers of different plants.
 - False
 - Which form of pollination requires the work of pollinators?
 - Cross-pollination
 - Do you all remember our 6 pollinators? Which of the following animals was NOT one of those pollinators?
 - Squirrels




- What is the female part of the flower?
 - Stigma
- Which part of the flower holds the most pollen? (Think of the part that pollinators usually land on)
 - Anther
- If you see a plant with both male and female parts, what kind of pollination(s) can occur?
 - Cross-pollination or self-pollination
- I am done building my bird feeder!
 - TRUE

The Bio/Diversity Project
 Lesson Title: Protecting Pollinators

Teacher: Emma & Zabrina
 Grade Level: 6th
 Time Teaching: 55 minutes

This lesson has been adapted from:

AZ Science Standard:	<p><i>6.L2U1.11</i></p> <ul style="list-style-type: none"> • <i>Use evidence to construct an argument regarding the impact of human activities on the environment and how they positively and negatively affect the competition for energy and resources in ecosystems .</i>
Learning Objectives:	<ul style="list-style-type: none"> • Students will be able to explain one important reason why we should protect pollinators. • Students will be able to describe how their bird feeder helps protect pollinators.
Scientist of the Week:	<div style="display: flex; align-items: center;">  <ul style="list-style-type: none"> • <i>Earyn McGee</i> • <i>Conservation Biologist</i> • <i>PhD from University of Arizona</i> • <i>Tucson, Arizona</i> • Dr. McGee is a science communicator who advocates for the rights of all people to be able to love and care for the natural world. <ul style="list-style-type: none"> • With her efforts, people can enjoy and care for our world, nature, and the environment with fewer restrictions. </div>

Vocabulary	Materials
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<ul style="list-style-type: none"> ● Conservation ● Population ● Biotic ● Restoration ● Abundance 	<ul style="list-style-type: none"> ● Powerpoint ● 80 bird feeder collection sheets 			
Seasonality: Any seasonality				
<i>Monsoons</i> July-Sept.	<i>Autumn</i> Oct.-Nov.	<i>Winter</i> Dec.- Feb.	<i>Spring</i> Mar.-Apr.	<i>Dry Summer</i> May-June
Guiding Questions:				
<ul style="list-style-type: none"> ● What is the importance of protecting pollinators? ● How can conservation and restoration be used to help protect pollinators? 				

Engagement/Introductory Activity:

- Students will be shown a series of 5 common birds in the Tucson area. This will help them be able to identify birds that might visit their bird feeders.
- As birds are displayed, as a class, students will be asked if they notice anything about the birds. Answers can be anything like the bird's colors, beak size, or eyes. We will go over their specific traits before moving on to the next slides.
- **Anna's hummingbird:** "flame" throated, iridescent green and grey body, males have the characteristically rose-colored throat whereas females are duller
- **Rufous hummingbird:** They are cinnamon-rufous colored on the upper parts, tail, and lower breast and belly. In good light, the male's throat iridescens a metallic orange to scarlet. The female is more iridescent bronze-green above and dull white below.
- **Northern Cardinal:** The Northern Cardinal is likely one of our most recognizable birds, particularly the bright red males. Young Northern Cardinals do not have orange beaks. Sunflower seeds attract them.
- **Cactus Wren:** This is Arizona's state bird! The bird's spotted and speckled black, white, and cinnamon-colored feathers, large white eyebrows, and red iris are hard to miss.
- **Mourning Dove:** Mourning Dove has a brown body, blue-gray wings, and a long pointed tail. Doves are strong, fast fliers and noisy too, as they clap their wings together when they start into flight.

Exploratory Activity:

- Students will now have 15-20 minutes to work on the decorating and wrapping up phase of their action project. The expectation for this activity is that students will have:
 - Complete any finishing touches for the decoration (with paint) of their feeders. The idea with the decoration is that students will incorporate what they have learned about pollinators and colors to best attract birds.

Explain:

- Each student should receive a copy of a [bird feeder data collection sheet](#).
- Show students [this video of live wildlife camera footage](#) (similar to what they would see on their school



wildlife cameras) and ask them to note down any observations they see while watching the video.

- The idea is to get the students comfortable with collecting observational data of their very own bird feeders.
- Students will take home their data collection sheets so that they can make similar observations at home!

Extension Activity/Questions:

- For this activity, us interns and our teacher will lead the students outside around campus where each class will pick a location (based on accessibility, wildlife camera placement, and level of attraction for birds) for their class bird feeder to be hung up.
 - This one feeder per classroom will be built by the interns to represent the class since we do not want 70+ bird feeders hanging around campus.
 - The remainder of the bird feeders that the students made individually will be sent home with each student so that they can protect pollinators at home as well.

Evaluation Activity:

- Students will have 7 minutes at the end of class to write a minimum of 5 sentences of a reflection on their action project.
 - Some guiding questions for these reflections include:
 - What is citizen science? How does your bird feeder project reflect this idea?
 - What things that you learned about birds this semester did you keep in mind when making your bird feeders (colors, style, decor, feed)?
 - What is your favorite thing you learned this semester overall?
- These reflections will be turned in to us intern teachers but not shared out loud with the class.