COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Introduction to Sonoran Desert Pollinators

Teacher: Zane Rossi and Erin Randall
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*5.L3U1.9* • *Obtain, evaluate, and communicate information about patterns between the offspring of plants, and the offspring of animals (including humans); construct an explanation of how genetic information is passed from one generation to the next.*
Content Objective: Math, Reading, Science, Writing, Other:	• *Students will be able to define and explain pollination* • *Students will be able to describe the main types of pollinators in the Sonoran Desert* • *Students will be able to explain how pollination impacts the Sonoran Desert*
Language Objective: (Optional)	*N/A*
Scientist of the Week:	• *Katherine Esau* • *German-American Botanist* • *Born in the Russian Empire, eventually lived and worked in California* • *Made important discoveries about plant anatomy, specifically in the realm of phloem*

Vocabulary	**Materials**
Provide a bulleted, alphabetized list of words that students will hear, speak, write, and/or read about in the lesson. These words are integral to developing content understanding: • Pollination • Sonoran Desert • Proboscis • Pollen	Provide a bulleted list of relevant materials for the lesson. • Printouts of flower • Construction paper • Crayons • Markers • Colored Pencils • Different colored stickers • Scissors • Glue

Seasonality: N/A

Monsoons	*Autumn*	*Winter*	*Spring*	*Dry Summer*
July-Sept.	Oct.-Nov.	Dec.- Feb.	Mar.-Apr.	May-June

Guiding Questions:

- What makes Sonoran Desert Pollinators unique compared to other pollinators in the world?
- What does pollinator biodiversity look like in the Sonoran Desert? What pollinators live and flourish here?
- What kind of impact do pollinators have on ecosystem function and productivity

Engagement/Introductory Activity: ~10 to 15 minutes

- Begin with introductory slide talking about the teacher (e.g. name, background, major, etc). Segway this slide into talking about the scientist of the week- show slide and say a few words.
- Ask students to fold a piece of paper into thirds to make a nametag. Have them write their names and draw a picture of their favorite Sonoran Desert animal (or just favorite animal for younger kids).
- Segway discussion of favorite animals into a discussion of pollinators
    - "Do any of you have an animal that is a pollinator?"
    - "What is a pollinator?"

Exploratory Activity: 25 minutes

- Each student gets one flower to cut out and decorate. They choose 2 of the 4 provided materials (colored pencils, crayons, markers, construction paper)
    - For the construction paper, they will need glue to glue it onto their flowers.
- Assign different colored stickers, representing a different pollinator (e.g. bats, hummingbirds, flies, bees) to each different decorating material.
- Each student is given two stickers of the same color and instructed to place a sticker on two different flowers. They can only place a sticker on a flower that is decorated correspondingly. (Ex: Johnny is given a two green stickers, which represents bees. Green stickers correlate with the colored pencil decorating material. Johnny can only place his stickers on two flowers that have been decorated with colored pencils).
- Wrap up by introducing the concept of pollination adaptations. Flowers have different structures, smells, and colors to attract different pollinators. Introduce the concept of competition. If everyone decorated their flower with colored pencils, it will be harder to gain a sticker. If all flowers looked the same, they would have a harder time attracting the attention of a pollinator.

Explain: 10 minutes

- Show Bee Movie Clip (s) (shows the act of pollination) https://www.youtube.com/watch?v=oNWAiWBup2Q
- Introduce the vocab terms and ask them how they relate to the activity
    - The activity shows how different adaptations on the part of flowers can attract different pollinators
    - Pollination: The process by which pollen is transferred from one flower to another in order for plants to reproduce
    - Sonoran Desert: a North American desert that spans from the southwestern United States to parts of Northwestern Mexico. Tucson is in the Sonoran Desert
    - Proboscis: A long sucking organ that is typically tabular and flexible
    - Pollen: A fine, typically yellow, substance containing reproductive information for plants.
- Ask:
    - What pollinators have you seen in Tucson?
    - What purpose do these pollinators serve?
    - Do different plants have different pollinators?

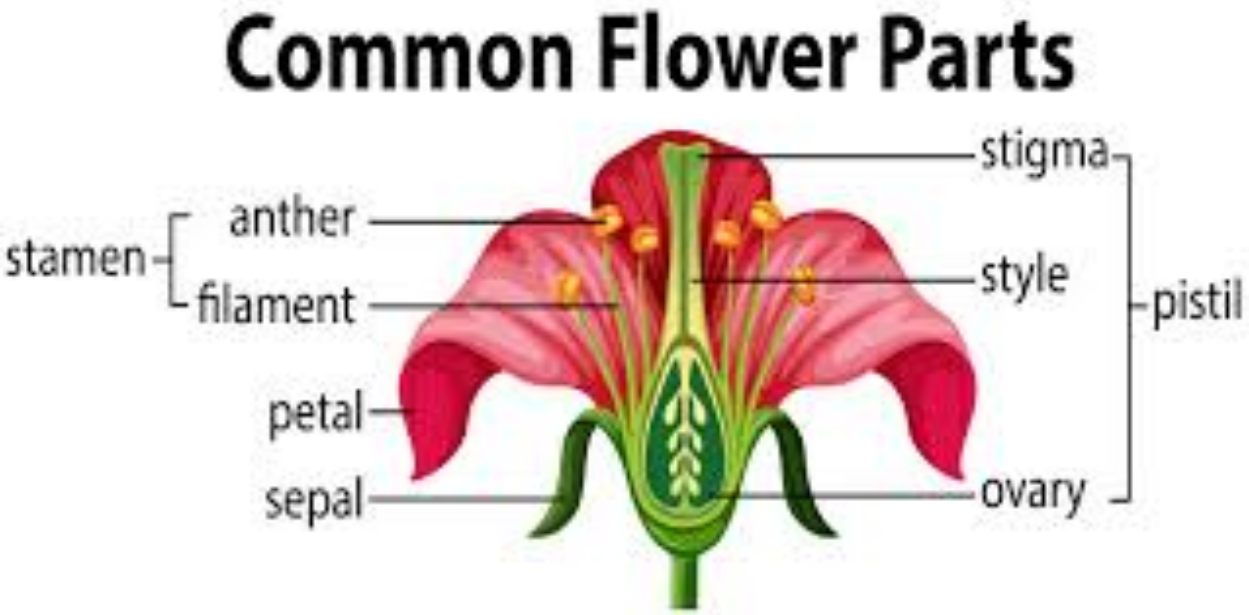
Extension Activity/Questions: 10 minutes

- Hand out flower diagram and have students write down:

- Where in the flower the pollinators get the pollen from
- Where in the flower the pollinators get the nectar from
- How the pollen stays with the pollinators
- What parts of the flowers attract pollinators

Evaluation Activity: 5 to 10 minutes

- Show pictures of different pollinators on slideshow and ask students to identify how those specific animals might interact with flowers
- Have each student identify a favorite Sonoran Desert pollinator and ask them to explain to their neighbors why that's their favorite



Where in the flower the pollinators get the pollen from?

_____

Where in the flower the pollinators get the nectar from?

_____

How does the pollen stay with the pollinators?

_____

What parts of the flowers attract pollinators?

_____

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Specific Pollinators; Bees

Teacher: Erin Randall, Zane Rossi
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*3.L1U1.5* • *Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction.*
Content Objective: :	• Students will be able to describe how bees perform their role as flower pollinators. • Students will be able to explain and give 2 examples of the importance of bees in the Sonoran Desert. • Students will be able to identify the anatomy of bees that relates to pollination.
Language Objective: (Optional)	N/A
Scientist of the Week:	• *Christina Grozinger* • *Professor of Entomology and Director of Center for Pollinator Research* • *Penn State, Pennsylvania* • *Conducted a study on bee viruses* • *Demonstrated how landscape affects bee health*

Vocabulary	**Materials**
Provide a bulleted, alphabetized list of words that students will hear, speak, write, and/or read about in the lesson. These words are integral to developing content understanding: • Ecosystem • Abdomen • Thorax • Antennae	Provide a bulleted list of relevant materials for the lesson. • Fruit-flavored Lifesavers • Bee Diagram https://www.enchantedlearning.com/subjects/insects/label/bee.shtml
Seasonality: (If more specificity is required, please note date/time range under the season) Highlight which season(s) your lesson would be most suited to. When working with the natural world, it is important to keep this in mind for your planning! Some activities are possible for a brief window of time while	

others may be appropriate during any time of year.

Monsoons July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec.- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June

Guiding Questions:

- Why is it important to understand how bees pollinate flowers?
- Why do bees seem so scary?
- Why does the Sonoran Desert have so many species of bees?

Engagement/Introductory Activity: 10 min

- Introduce Scientist of the Week, explain that bees are the topic of the lesson
- Instruct the students to draw a picture of a bee
- Ask everyone to trade their picture with a desk partner/student nearby
- Relate diversity of pictures to diversity of bees in Sonoran Desert using slideshow information and facts from Arizona Bee Identification Guide https://www.pollinator.org/pollinator.org/assets/generalFiles/AZ_bee_guide_FINAL.pdf
    - There are 1,300 native species of bees in Arizona
    - Leafcutter bees live by themselves and live in nests
    - Honeybees have hair on their eyes
    - Sweat bees smell the salt in your sweat
    - Carpenter bees are all black
    - Cuckoo bees don't collect pollen

Exploratory Activity: 25 min

- Show the Honey Bee "Waggle Dance" video https://video.nationalgeographic.com/video/00000144-0a32-d3cb-a96c-7b3f437c0000
- Divide everyone into groups of 4-5 students and go outside
- Instruct each group to choose an object outside as the "food source" and spend 5 minutes choreographing a 'waggle dance' that will indicate to the rest of the class the object they have chosen as a food source. The students may not use their fingers to point to the object, and they may not stand in the vicinity of the object.
- Gather the class and have all of the groups perform their 'waggle dance.' If the students are able to correctly guess the "food source", they receive a Lifesavers.

Explain: 10 min

- Ask the students:
    - Was it hard to convey instructions? How has their perspective of honey-gathering changed? Was this process different from what they thought?
    - Once the bees find the flower, what happens? How is pollen collected?
- Give each student a Bee Diagram and identify the key body parts:
    - Abdomen: Last segment of insect body, carries important organs
    - Thorax: Middle of the body, where the legs and wings are located
    - Antennae: Structures on the bee's head that relay smells and measure wind speed

Extension Activity/Questions: 5 min

- Ask the students if anyone thinks bees are scary.
    - What are some experiences they've had with bees? What stories have they heard about people being stung?
- Summarize information from "Honey, Don't Forget the Pollinators."

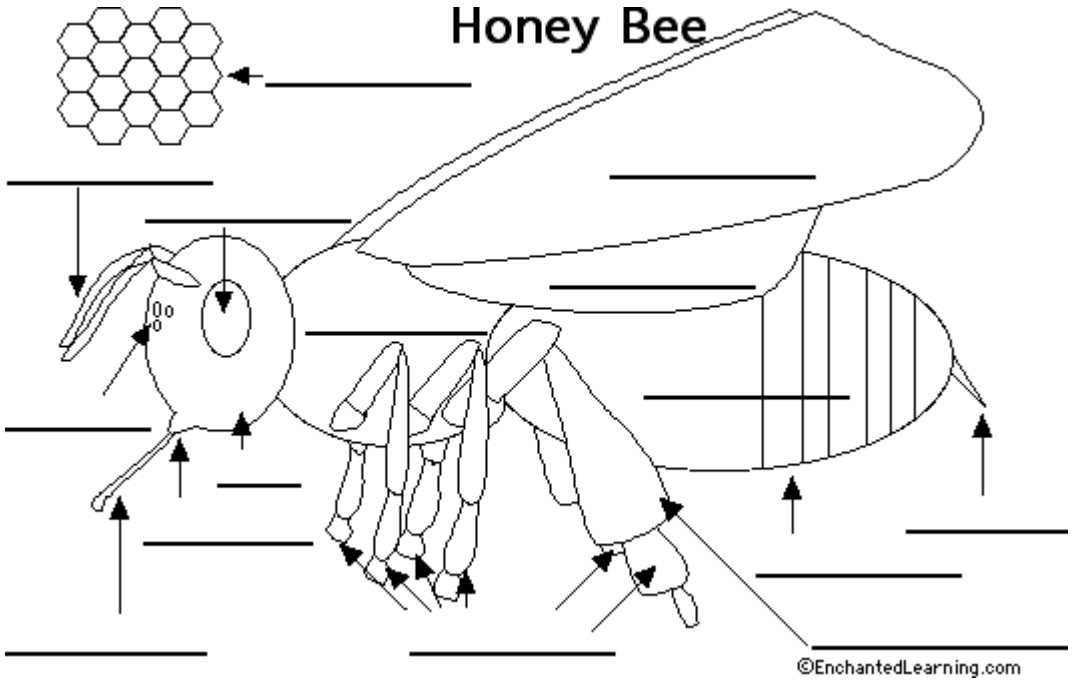
- Bee and butterfly population is decreasing
  - Due to drought, parasites, and Africanized bee competition
  - Africanized bees are very aggressive towards humans and other bees
  - Drought and warmer temps affects bloom times, which affects pollinating schedule. Heat causes bees to abandon their homes
- Arizona has been making efforts to help them rebound
  - Protecting bees from dangerous pesticides
  - Locating colonies in areas with lots of plants
  - Selective breeding with successful colonies
  - Restoring plant diversity in pollinator areas

- Have the students brainstorm: What can we do to help the bees? How can we react when we see one?
  - Have them draw their answers on their bee drawing from the beginning of class
  - Define ecosystem: community of interacting plants and animals and their environment

Evaluation Activity: 5 min

- Go around the room and briefly discuss one-on-one the students' drawings and what their ideas were.

Bee Diagram



COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Pollinators and The Food Supply

Teacher: Erin Randall, Zane Rossi
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*3.L1U1.5* • *Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction.*
Content Objective: Math, Reading, Science, Writing, Other:	• Students will be able to identify 2 to 3 foods that require pollination • Students will be able to explain why pollination is vital for certain foods to exist • Students will be able to describe a basic food web for the Sonoran Desert
Language Objective: (Optional)	*N/A*
Scientist of the Week:	• *Ashley Low* • *Student at University of Arizona* • *Lives here in Tucson, Arizona* • *Studies Plant Sciences, Math, and Plant Systems* • *Has worked with local farmers in our hometown through a university program* • *Built gardens at local schools* • *Enjoys photography and graphic design* • *Wants to work in next-generation food production* • ***Use a student at UA who is a friend****

Vocabulary	Materials
• Crop • Self Pollination • Cross Pollination • Fruit	• Eegee's menu worksheet • Print out of Eegee's menu ○ https://eegees.com/wp-content/uploads/2014/12/EEG001072.02-Menu-brochure_WEB.pdf • Eegee's Slushies (?) • Colored pencils • Blank Paper • Rulers
Seasonality: N/A	

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Women in Science & Engineering

Monsoons July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec.- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June
Guiding Questions: What is the importance of the presence of pollinators in our food supply? How do urban areas contribute to pollinator diversity/degradation? Could we eat healthy, balanced diets without pollinated plants?				

Engagement/Introductory Activity:

- Introduce Scientist of the Week on slideshow. Explain that the lesson will talk about food and how it relates to pollination
- Start with slideshow of five common foods, ask the class whether they need pollinators or not
    - Apple flower and apple (needs pollinators, Honey Bees, Orchard Bees)
    - Sugarcane (needs pollinators, Bees, Thrips)
    - Bread and wheat plant (pollinated by wind)
    - Cocoa Beans and Chocolate (needs pollinators, Midges [flies], stingless bees)
    - Potatoes (needs pollinators for seed, not for the tuber, Bumblebees)
- Move discussion to what foods the students like to eat: ask "what are your favorite foods"
    - Explain what parts of the food may or may not require pollination via pollinator
        - Fruits need pollination
        - Meat doesn't need direct pollination- but may rely upon food that requires pollination
        - Tubers and roots don't require pollination, but the plants they come from might
        - Most leaf vegetables don't require direct pollination, but their plants need it to reproduce
        - Many beans require pollination
        - Tomatoes *can* self-pollinate, but often like pollinators
        - Short list for further clarification: https://www.pollinator.org/list-of-pollinated-food

Exploratory Activity:

- Pair up/ group up students and pass out the Eegee's Menu Worksheet
- Explain the worksheet to students
    - Students will check off the boxes of Eegee's menu items that could exist without pollinator-driven pollination
    - Students will then list what they would eat after the pollinators are gone
- Instruct pairs/groups to share with nearby groups/pairs what they found and to compare answers

Explain:

- Project picture of a sonoran desert food web and verbally explain how it works
- Assign each table an organism at a different trophic level (one table is a cactus, one is a bird, one is a mountain lion, etc)
- Instruct each table to identify what table eats what table, keeping the diagram on the board
- Explain how an organism that eats food that requires pollinator pollination can't survive without pollinators
    - A mammal that eats fruits from prickly-pear cactus cannot survive if the prickly pear cactus aren't being pollinated

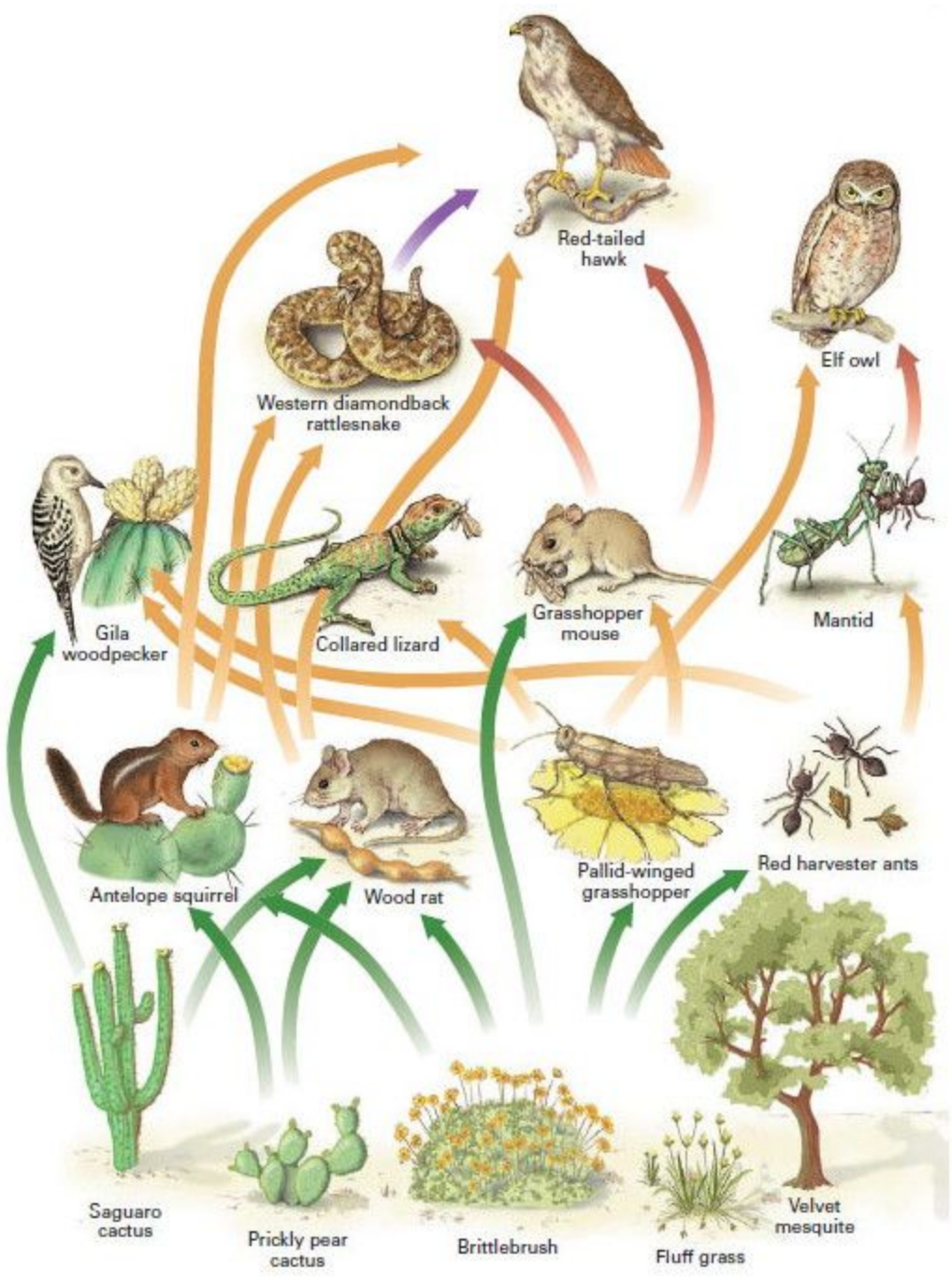
Extension Activity/Questions:

- Hand out colored pencils and blank pieces of paper
- Instruct each student to create a short comic that they could use to explain to their families/ friends/ etc the importance of pollinator driven pollination

- Encourage them to come up with some ideas for what could possibly be done to help pollinators thrive in our community, and then put those in their comic

Evaluation Activity:

- Have students turn in their comic drawings and look them over for demonstration of the concepts presented in class
- Hang up comics around classroom/around school grounds
    - If that isn't possible, have students take them home


Red-tailed hawk
Elf owl
Western diamondback rattlesnake
Gila woodpecker
Collared lizard
Grasshopper mouse
Mantid
Antelope squirrel
Wood rat
Pallid-winged grasshopper
Red harvester ants
Saguaro cactus
Prickly pear cactus
Brittlebrush
Fluff grass
Velvet mesquite
Nutrient transfer from producers to primary consumers
Nutrient transfer from primary to secondary consumers
Nutrient transfer from secondary to tertiary consumers
Nutrient transfer from tertiary to quaternary consumers

Red-Tailed Hawk

Saguaro Cactus

Brittlebrush

Woodrat

Western Rattlesnake

Pallid-Winged Grasshopper

Pollinator-Free Eegee's

Put a checkmark next to foods we could still have without pollinators

- Pizza Pretzel ☐
- Ham and Cheese ☐
- Antipasto Salad ☐
- Veggie Grinder ☐
- Ranch Fries ☐
- BLT ☐
- Tuna Salad ☐
- Cheese Pretzel ☐
- Eeegee's Slush ☐
- Sugar Cookies ☐
- Salami and Cheese ☐

Some of the more common products from animal-pollinated plants include tomatoes, onions, cucumbers, lettuce, potatoes, oranges, lemons, limes, mustard seed, cacao bean (used in making chocolate), vanilla, sugar, almonds, watermelon, and apples

What would you eat out of what's left?

_____

_____

_____

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
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Bio/Diversity Project
Lesson Title: Bats

Teacher: Erin Randall, Zane Rossi
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*3.L2U1.8* • *Construct an argument from evidence that organisms are interdependent.*
Content Objective: Math, Reading, Science, Writing, Other:	• *Students will be able to demonstrate how bats use echolocation to navigate.* • *Students will be able to identify the types of flowers that are pollinated by bats.*
Language Objective: (Optional)	N/A
Scientist of the Week:	• *Bhargavi Srinivasulu* • *Chiropterologist (studies bats)* • *Kolar, India* • *Made sure Kolar leaf-nosed bat was recognized as critically endangered* • *Part of a team that was the first to photograph this species*

Vocabulary	**Materials**
• Echolocation • Nocturnal	Provide a bulleted list of relevant materials for the lesson. • 6 paper bowls • ~30 cotton balls (dyed 6 different colors in groups of 5 prior to the lesson) • 30 partyblowers prepared with double-sided tape on the end

Monsoons July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec.- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June

Guiding Questions:

- How do bats navigate?
- How are bats different from other pollinators?

- How does a flower attract a bat?
- How are bats affected by human actions?

Engagement/Introductory Activity: 5 min

- Scientist of the week
- Determine students' knowledge of bats (lesser long-nosed species) in the wild:
    - Where do they live? (Sonoran Desert, migratory. Southwest US during summer, Western Mexico during winter. Cave dwelling).
    - What do they eat? (Nectar from saguaro, organ pipe, and agave flowers)
    - Who are their predators? (Bobcats, snakes, owls)
    - How long do they live? (20 years)
    - Bats are the only flying mammals!
- Capture students' attention with video about bats feeding from cactus https://www.youtube.com/watch?v=5pyVY5tbQO8
- Describe that bats are extremely important for pollinating saguaro, organ pipe, and agave flowers.
    - They bloom at night, most other pollinators are active during the day.
    - White in color with strong smell---birds, bees, and butterflies are attracted to colorful flowers.
    - Define nocturnal: active at night
- Ask the students if they can describe the process of echolocation.
    - If not: echolocation is the process through which some animal species navigate by calling out to their surroundings and determining the location of nearby objects based off of their echoes.

Exploratory Activity: 30 min

- Take the class outside, establish boundaries for a playing yard. Designate one end of the yard as Arizona, designate the other end as Mexico.
- Distribute 3 bowls in each location, and fill each bowl with 5 cotton balls (each bowl will be one color of cotton ball).
- Name five students as predators: snake, bobcat, owl. Have them stand in the middle of the playing yard.
- Give the remaining students a party blower and divide them in half. Have one group begin in Arizona, the other in Mexico.
- Direct the students to collect as many cotton balls as they can from the bowl using only their party blower. At the same time, they must avoid being tagged by a predator (WALKING ONLY). At various intervals, yell "Migrate!" at which point the students must cross the play yard to the alternate location. There, they will put all cotton balls they have collected up to that point in one of the paper bowls and begin collecting from a different one. Continue as time permits.

Explain/Extension Activity/Questions: 20 min

- Explain that bats migrate according to the seasons, in order to find food from flowers that bloom in those temperatures in those locations. In Arizona, saguaros and organ pipe bloom April to June. In the winter they migrate to Mexico to feed on trees and shrubs.
- Explain that this January had the warmest temperatures ever recorded (https://www.ncei.noaa.gov/news/global-climate-202001). Flowers bloom in the spring, when temperatures begin to rise. If temperatures are warmer earlier in the year, the flowers will bloom sooner. This becomes a problem for the bats, who migrate depending on food availability.
- Ask the students to write a short story (5 sentences max) about Christian the bat. Christian is a young bat that still lives with his mom and his younger sister Rachel. Christian and his family have been in Mexico all winter and are ready to fly back to Arizona. This winter was very warm. Write about their journey.

Evaluation Activity: 5 min

- Put some pictures of various flowers on a slide show presentation. Display each flower and ask the students if they think it's pollinated by bats.

- Rose (no)
- Saguaro (yes)
- Agave (yes)
- Forget me not (no)
- Organ Pipe (yes)
- Blue Palo Verde (no)

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Birds and Hummingbirds

Teacher: Zane Rossi and Erin Randall
Grade Level: *3rd through 5th*
Time: *60 minutes*

AZ State Science Standard:	*3.L2U1.8* • *Construct an argument from evidence that organisms are interdependent.*
Content Objective: Math, Reading, Science, Writing, Other:	• *Students will be able to list 2 to 3 bird species that pollinate in the Sonoran Desert* • *Students will be able to describe the types of flowers that attract different bird species* • *Students will be able to describe the way birds acquire nectar from flowers* • *Students will be able to identify how white winged dove and hummingbird pollination differs*
Language Objective: (Optional)	*N/A*
Scientist of the Week:	• Gillian Bowser • Champion of gender and racial diversity in the sciences • Ecologist who grew up in the city in New York, New York • Works at Colorado State University in the Natural Resource Lab • Pioneer in citizen science projects using modern technology (iNaturalist, etc)

Vocabulary	**Materials**
• Adaptation • Migration • Breeding Season	• Bird Diagram • Markers • Migration activity worksheet

Seasonality: N/A

Monsoons	*Autumn*	*Winter*	*Spring*	*Dry Summer*
July-Sept.	Oct.-Nov.	Dec.- Feb.	Mar.-Apr.	May-June

Guiding Questions:

- What are some characteristics that birds have to survive here in the Sonoran Desert?
- What types of birds do you think pollinate?
- Why do certain birds migrate?

Engagement/Introductory Activity: 10 mins

- Introduce scientist of the week on whiteboard. Explain that the lesson will be about Roufus Hummingbirds and White Winged Doves.
    - Start lesson by telling students that these are the two main pollinating and migrating birds in the Sonoran Desert
- Project facts about each bird on the first slide
    - White Winged Dove:
        - Around 5 oz
        - Dull colors: brown and white
        - Sip nectar through beaks
        - Found mostly in the Southwest and Mexico
    - Rufous Hummingbird:
        - Around 0.15 oz
        - Bright orange, red, and black colors
        - Use specialized tongues to slurp nectar, slender beaks
        - Migrate from the North Eastern United States to Mexico and back
- Project an example of a flower that the Dove would pollinate (Saguaro), and one that the hummingbird would pollinate (Tree morning glories, tree ocotillos, chuparrosa, etc)
- Have students reason why each bird might be attracted to each flower given their structures and raise hands.

Exploratory Activity: 20 mins

- Hand out play-dough to every student, along with pictures of bird beaks.
- Instruct students to model their play-dough to look like one of the beaks
    - Have a pre-made example
    - Explain that each beak type has a different function
        - I.E. duck bills are meant for filtering food from water, eagle beaks are meant for eating prey
- Next, present three or four different scenarios that birds might face in the Sonoran Desert
    - Scenario 1: Your bird has just killed a small rodent.
    - Scenario 2: Your bird has found a collection of tubular flowers.
    - Scenario 3: Your bird has found a few loose seeds.
    - Scenario 4: Your bird has hunted down some grasshoppers.
- For each scenario, ask the class to modify their beaks to suit the different scenarios. The object of the scenarios is for the birds to be able to eat.
    - They may use the example beaks to help them, though they are perfectly welcome to create their own, unique beaks
- For each scenario, ask students to raise their hands and share what they changed about their beaks
    - Call on about 3 students every time, and then if no one made the kind of changes that were expected, explain why certain beak types might be more conducive to the scenario at hand
- End by asking the class whether they could identify another part of a bird that is different among different birds
    - color, size, wing shape, etc.

Explain: 10 mins

- Explain that the different beak types are examples of Adaptations
    - Adaptation: A change in the behavior, structure, or internal function of an organism to make it more suited to a certain environment.
- Present slide describing possible issues that birds face living in the desert
    - Water shortage

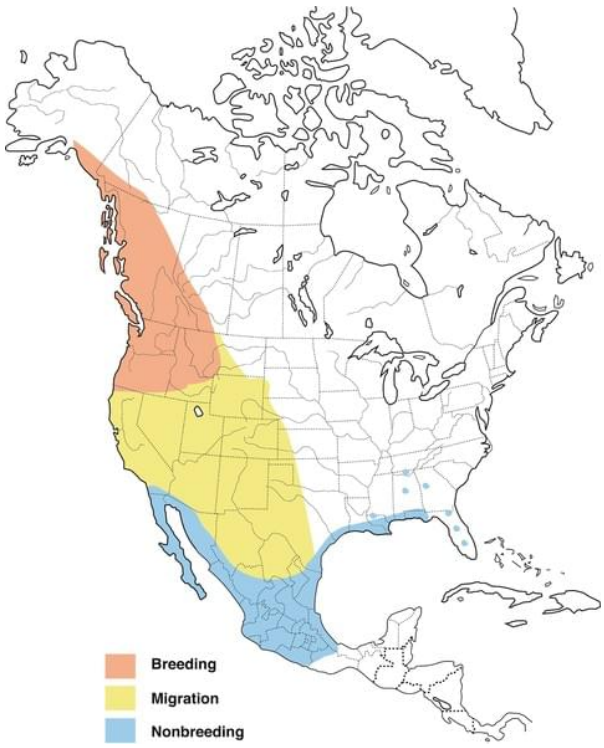
    - Food shortage
    - Heat
    - Hostile plant-life
    - Predators
- Present slide explaining how White Winged Doves and Rufous Hummingbirds deal with each of these issues respectively
    - Rufous Hummingbird
        - Brain: excellent memory retention to keep track of food sources (flowers)
        - Powerful Heart and Lungs: Keep oxygen delivered to muscles which have to power wings, lungs pump oxygen everywhere, helping cool the bird.
            - About 4 breaths per second, 250-1250 beats per minute. Humans do about 50 to 200 beats per minute
        - Tongue: covered in hairs to aid in capturing nectar and small insects
        - Beak: specialized and slender to get into slender flowers
        - Advanced eyes: can see in front and to the sides, can see full range of color and ultraviolet light.
    - White Winged Dove:
        - Coloration: dull colors to help campflogue when foraging for water or food
        - Flight Duration: can fly up to 25 miles at a time to search for water
            - a lot of their size
        - Group travel: when migrating, travel in large groups of up to 4000 for safety
        - Saguaro Pollinator: use saguaro cactus and their flowers for moisture in the Sonoran Desert
        - Can nest in desert trees and shrubs: mesquite, saguaro, cholla

Extension Activity/Questions: 10 mins

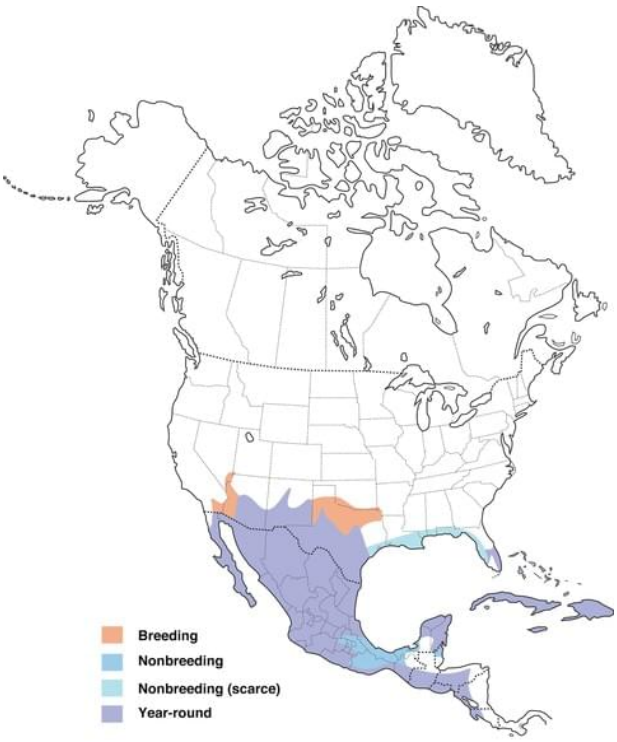
- Introduce topic by explaining that both of these pollinating birds also migrate
    - Migration: Seasonal movement of animals from one region to another
- Hand out migration activity worksheets
- Explain instructions and instruct students to work on the worksheet with one or two partners near them
- Go over answers to the worksheet with the class, allowing students to raise hands and explain their answers
    - Allow students to present any questions they might have about the geography or reasons for migration

Evaluation Activity: 10 mins

- Instruct students to draw the beak of their favorite bird in their lab notebooks, and then explain why that beak is their favorite in a sentence or two.
- If time permits, allow some students to share their choices, and read out their explanation



Rufous Hummingbird



White-Winged Dove

1. What is the northernmost point that each bird migrates to?

_____

2. According to the map, why do Rufous Hummingbirds migrate north?

_____

3. Which bird lives primarily in Mexico and Central America?

_____

4. What does “Year-round” mean on the White-Winged Dove Map?

_____

5. Describe the main differences in migratory patterns between White-Winged Doves and Rufous Hummingbirds based upon the maps above. What might this tell you about each bird?

_____

_____

_____

_____

GENERALIST

INSECT CATCHING

GRAIN EATING

CONIFEROUS-SEED EATING

SCYTHING

FRUIT EATING

CHISELING

DIP NETTING

SURFACE SKIMMING

NECTAR FEEDING

RAPTORIAL

FILTER FEEDING

AERIAL FISHING

PURSUIT FISHING

SCAVENGING

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Butterflies and Moths

Teacher: Erin Randall, Zane Rossi
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*3.L1U1.5* • *Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction.*
Content Objective: Math, Reading, Science, Writing, Other:	. • *Students will be able to describe 3 main differences between butterflies and moths.* • *Students will be able to explain the importance of ultraviolet in pollination.* • *Students will be able to recall information about other pollinators from previous lessons.*
Language Objective: (Optional)	N/A
Scientist of the Week:	• *Margaret Fountaine* • *Lepidopterist from Norwich, England late 1880's to early 1930's* • *Travelled the world collecting butterflies---one of the first recognized female lepidopterists* • *Started a journal when she was 16, kept it up until her death at 78.*

Vocabulary	Materials
Provide a bulleted, alphabetized list of words that students will hear, speak, write, and/or read about in the lesson. These words are integral to developing content understanding: • Symbiosis • Metamorphosis • Chrysalis • Proboscis	Provide a bulleted list of relevant materials for the lesson. • Neon paint set (https://www.michaels.com/ensemble-de-peintures-acryliques-fluorescentes-d%27artist%E2%80%99s-loft/10317552.html?cm_mmc=PLASearch-_-google-_-MICH_Shopping_US_N_ArtSupplies_Paint%26PaintingSupplies_N_N_N-_-&Kenshoo_ida=&kpid=go_cmp-6723840689_adg-78851613509_ad-388052366841_pla-612641485637_dev-c_ext-_prd-10317552&gclid=EAIaIQobChMI8fSL_6335wIVFP5kCh3ckgCvEAQYASABEgIRfvD_BwE)

	• 10 paper plates • 10 plastic cups • 30 paintbrushes • UV flashlight (https://www.amazon.com/Blacklight-Flashlight-Bright-Detector-Scorpions/dp/B07N5C3NXQ/ref=asc_df_B07N5C3NXQ/?tag=hyprod-20&linkCode=df0&hvadid=312123596780&hvpos=&hvnetw=g&hvrand=12388901400425429471&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=1013509&hvtargid=pla-645919333393&psc=1&tag=&ref=&adgrpid=61495041029&hvpone=&hvptwo=&hvadid=312123596780&hvpos=&hvnetw=g&hvrand=12388901400425429471&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=1013509&hvtargid=pla-645919333393) • 30 printouts of flower (included at bottom) • 90 popsicle sticks • 30 prinouts of the word 'mutualism' • 30 printouts of the word 'commensalism' • 30 printouts of the word 'parasitism' • (glue each printout to a popsicle stick)

Seasonality: (If more specificity is required, please note date/time range under the season)

Highlight which season(s) your lesson would be most suited to. When working with the natural world, it is important to keep this in mind for your planning! Some activities are possible for a brief window of time while others may be appropriate during any time of year.

Monsoons	*Autumn*	*Winter*	*Spring*	*Dry Summer*
July-Sept.	Oct.-Nov.	Dec.- Feb.	Mar.-Apr.	May-June

Guiding Questions:

- What traits make an animal good at pollinating?
- Why do organisms (butterflies vs moths) have similar shapes and functions, but so many differences?

Engagement/Introductory Activity: 5 min

- Scientist of the Week
- Ask students to brainstorm differences between butterflies and moths. Project images of local Tucson butterflies (Western Swallowtail, American Snout, Painted Lady, Queen Butterfly) illustrating these differences:
    - Butterflies rest with closed wings, moths rest with open wings
    - Butterflies have long thin antennae, moths' are shorter and feathery
    - Butterflies are diurnal, moths are nocturnal
    - Butterfly caterpillars make a shiny chrysalis (definition: hard outer case where butterfly metamorphosis takes place), moth caterpillars make silk cocoons
        - Define metamorphosis: transformation from immature form to adult stage
        - Caterpillars undergo this process in the chrysalis

    - Moths have a fringe called a frenulum that connects their wings
    - Butterflies have thinner bodies, moth bodies are plump
    - Butterflies have to land on a flower to feed, while moths flutter
- Recall information from bee lesson; compare bees to butterflies and moths---which is more effective?
    - Bees are plumper and have pollen sacs on their longs
    - Butterflies/moths are thinner with skinny legs, no specific pollen adaptations. Have proboscis (defintion: long mouthpart that functions through sucking), so they end up incidentally avoiding the pollen

Exploratory Activity: 20 min

- Define symbiosis: close interaction between two living things
    - Mutualism: a form of symbiosis where both organisms benefit
    - Commensalism: a form of symbiosis where one organism benefits and the other is not impacted
    - Parasitism: a form of symbiosis where one organism benefits and the other is harmed
- Give each student a 'mutualism', 'commensalism', and 'parasitism' popsicle stick. Instruct them to raise the correct stick for each verbal example:
    - Sharks and remoras (commensalism)
    - Clownfish and anemone (mutualism)
    - Ticks and deer (parasitism)
    - Fish and coral reefs (mutualism)
    - Barnacles and whales (commensalism)
    - Humans and dogs (mutualism)
    - Butterflies and flowers (mutualism)
- Explain that butterflies are attracted to brightly colored (purple, orange, red) flowers, moths are attracted to white flowers. Project image of a nectar guide in a flower.
    - Nectar guides are areas near the middle of the flower that reflect ultraviolet light, which butterflies/moths are able to see.
- Provide students (seated in normal groups) with a plate with samples of each color of paint, a cup filled with water, a brush, and printout of flower.
- Instruct them to paint a flower that would attract a butterfly.
- Turn off the lights in the classroom and use the UV flashlight to illuminate the flowers.
- Explain that the glowing paint replicates how butterflies/moths view flowers.

Explain: 5 min

- Tell the students that flowers have evolved to have nectar guides, because the flowers that attracted pollinators most consistently were able to produce a next generation. Bees also see in UV light, so this a doubly effective method.
- Describe that flowers evolved another method to ensure pollination: shape.
    - Many moth-pollinated flowers are deep and tubular, so the moth must enter more into the flower. This ensures better pollen coverage.
- Instruct the students to draw a butterfly life cycle.
    - 4 stages: egg, larva, pupa, butterfly
- Remind the students that butterflies are in the adult stages of their life. Their larvae (baby) stage is a caterpillar.
    - Caterpillars are not equipped to drink nectar, so instead they eat plants. Monarch caterpillars only eat milkweed, which blooms at different times in different places. Monarch butterflies spend the winter in Mexico, where they can stay warm. As it turns into spring, they begin to fly north, following the bloom of milkweed plants so their babies have something to eat. They reach Canada for the summer, then fly back to Mexico when it starts to get cold again.

Extension Activity: 15 min

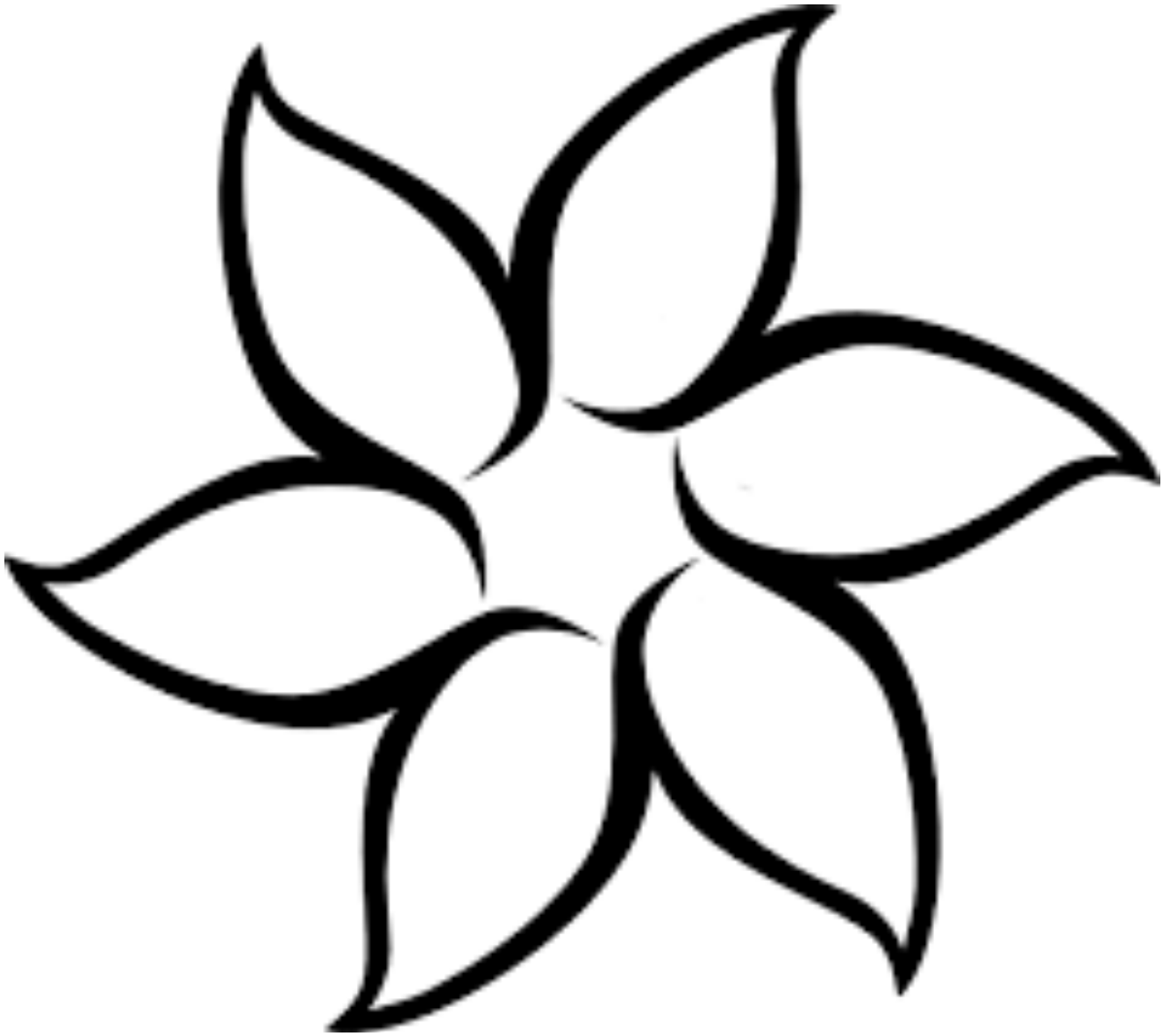
- Teach that the Tohono O'odham Native American tribe lives here in Tucson. Native Americans have a lot of different myths and legends to explain the creation of the Earth and things in it.
- Read myth "How Butterflies Came to Be" https://www.firstpeople.us/FP-Html-

Legends/HowTheButterfliesCameToBe-Papago.html

- Divide the students into partners and have them share and discuss other examples of common beliefs about butterflies within their communities and families.
    - Examples:
    - Aztecs believed butterflies took the souls of warriors to their resting places
    - Toltecs carved butterflies on their warrior statues and temples
    - Many believed that seeing a certain dark brown butterfly in a home meant that person would soon die
- Explain that people have been scientists for a long time. Early Mexicans gave names to different butterfly species depending on color/appearance, similar to the way that we do today (obsidian butterfly, white butterfly, blue butterfly, butterfly that stands on its head, etc).

Evaluation: 5 min

- Project an image of a moth and a butterfly
- Name 5 identifying characteristics listed in the Engage section. Ask the students to point to the image of the pollinator that possesses that characteristic



COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Protecting Urban Pollinators

Teacher: Erin Randall, Zane Rossi
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*3.L1U1.5* • *Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction.*
Content Objective: Math, Reading, Science, Writing, Other:	• Students will be able to describe 1 negative and 1 positive impact urbanization has on biodiversity • Students will be able to define conservation
Language Objective: (Optional)	N/A
Scientist of the Week:	• *Gillian Bowser* • *Research scientist---natural resources and minorities in STEM programs* • *Graduated from Colorado State University* • *On the board for Rocky Mountain Sustainability and Science Network* • *Worked as wildlife biologist for the National Park Service*

Vocabulary	**Materials**
• Urban • Conservation • Botanical Garden	Provide a bulleted list of relevant materials for the lesson. • Blank paper • Colored pencils, markers • 30 copies of Conservation map • 30 copies of Conservation wkst/instructions, Animal profiles

Seasonality: N/A

Monsoons July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec.- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June

Guiding Questions:

- How has urbanization impacted pollinators?

- How can we continue to help pollinator species?

Engagement/Introductory Activity:

- Introduce Scientist of the Week
- Define **urban:** relating to a town or city
- Project an image of Tucson in the 1920's versus now. State that in the 1920's the population was 20,300 and now it is over 520,000.


- Ask the students to pair off to brainstorm answers to the following questions:
  - What was wildlife like around Tucson in the 1920's?
  - What effect would the population increase have on surrounding wildlife ecosystems?
  - What will happen as the human population continues to grow?
- Call on a few pairs to share their answers.
- Define **conservation:** prevention of wasting a resource

Exploratory Activity:

Joya Area Conservation

- Give each student a map and worksheet.
  - Students will choose 8 tiles on the map to 'conserve.' The goal is to help conserve all 3 animal species, but students will find this may prove difficult to do without impacting nearby human populations.

Explain:

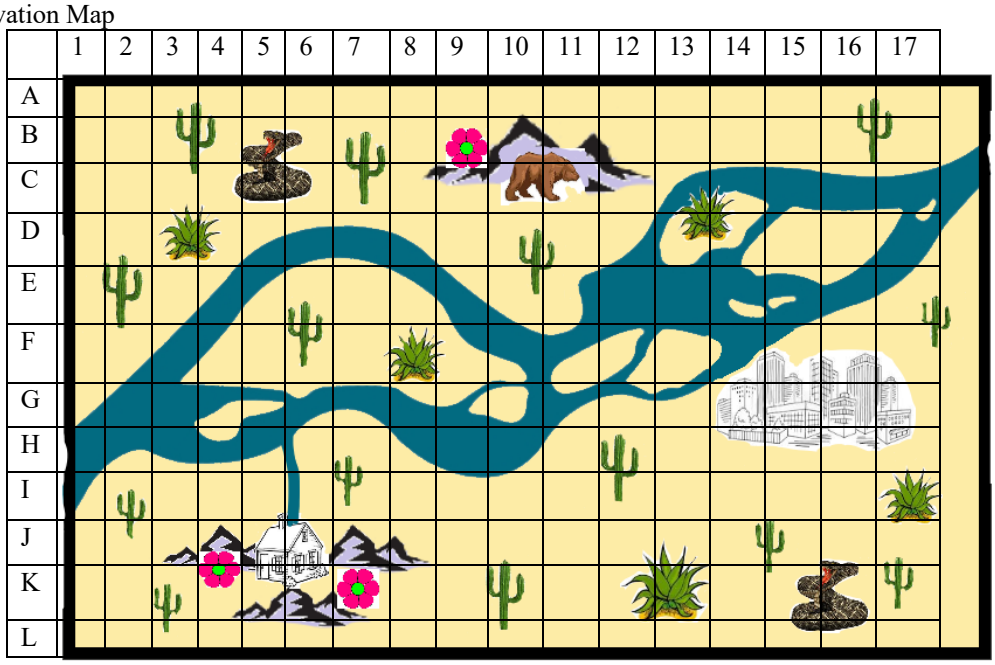
- Explain that conservation means we have to take action to save resources. If we don't do anything, they'll continue to be used up. However, lots of people want to use resources for different reasons.
- Project an image of the Colorado River. Ask the students what kind of plants and animals would use it.
  - Beavers, fish, turtles, frogs, deer, birds, seaweed, shrubs, flowers
  - These in turn support other wildlife (including pollinators) as demonstrated by the food web in earlier lesson.
- Ask the students how humans would use the river.
  - Drinking water, crop irrigation, showering, recreation
- Describe that all of these things are important, so when talking about conservation it is key to balance human and wildlife needs.
- Detail the following struggle: in the 1920's there was concern about who would have access to the Colorado River, especially because the population in California was growing very fast. An agreement called the Colorado River Compact was signed which gave each state dependent on the river a certain amount of water. However, the total amount of water promised to the states was more than the river produced, which has led to a water scarcity issue.
  - Ask the students to think about the Colorado River and who else it serves. Was there anyone else that needed to be included in the compact?
- Negotiaters at that time failed to consider the needs of Native American tribes, Mexico, or the environment, acting purely on selfish motivations. These are all issues that are needing to be addressed now as we face

drastically lowered water levels, loss of natural habitat, and endangered species.

Extension/Evaluation Activity:

- Teach that urbanization and conservation aren't always mutually exclusive. There are a lot of species that actually do better with the help of humans, including a whole study on who there is more bee diversity in an urban setting than in the surrounding ecosystem (source: https://conbio.onlinelibrary.wiley.com/doi/pdf/10.1111/cobi.12840)
- Give each student a blank piece of paper and coloring supplies and instruct them to draw a city plan that would help pollinators discussed in class---bees, butterflies, birds, bats. Cities should include:
    - Neighborhoods
    - Business buildings
    - Schools
- Cities can include:
    - Parks
    - **Botanical garden** (area meant for growing plants for study)
    - Home gardens
    - Flowerbeds
- Remind the students to include not only the dietary needs of the pollinators, but also places for them to live (like under a bridge for a bat).
- Instruct the students to write a sentence about how their city plan will help conserve pollinator species.
- An example of a simple student plan to show the students without them being intimidated about artistic requirements:

Conservation Map




passion flower


rattlesnake


saguaro


agave

Joya Area Conservation Instructions

The populations of important pollinators in the Joya area---the carpenter bee, white-winged dove, and lesser-long nosed bat---have been decreasing. The state

government has asked for your help in conserving these species.

Choose a total of 8 tiles to conserve and mark them with colored pencils. This means humans will not be able to develop, build, or impact in any way your chosen land.
As you conserve, think about how you the human populations in the city and the native tribe will be impacted.

1. How did you decide what areas to conserve?

2. How will your decisions impact local human populations?

Joya Area Animal Profiles

Carpenter Bee:
- Lives in mountainous areas
- Only pollinator for the passion flower
- Important food source for bears, skunks, badgers

White-winged Dove:
- Lives in southeast region of Joya area
- Pollinates saguaro cactus

Lesser Long-nosed Bat:
- Lives in northern region of Joya area, including mountains
- Pollinates saguaro cactus, agave flower
- Food source for snakes and bobcats

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Action Project Week 1

Teacher: Zane Rossi
Grade Level: *3rd-5th*
Time: *60 minutes*

AZ State Science Standard:	*5.L4U3.11* • *Obtain, evaluate, and communicate evidence about how natural and human-caused changes to habitats or climate can impact populations.* *5.L3U1.9* • *Obtain, evaluate, and communicate information about patterns between the offspring of plants, and the offspring of animals (including humans); construct an explanation of how genetic information is passed from one generation to the next.*
Content Objective: Math, Reading, Science, Writing, Other:	• *Students will be able to explain what plants need in order to grow* • *Students will be able to identify which plants are meant to attract hummingbirds and butterflies, respectively* • *Students will be able to articulate why certain plants attract certain pollinators*
Language Objective: (Optional)	*N/A*
Scientist of the Week:	*Michelle McMahon* *Research Professor at the University of Arizona* *Tucson, AZ* *Published papers on the diversity of plant species* *Also contributed to the field of molecular data analysis*

Vocabulary	**Materials**
• Mutualism • Irrigation • Sketch • Soil	• Mini White Boards • White Board Markers • Worksheets • Clipboards • Index cards

Seasonality: Planting should probably happen in the warmer months. Flowers bloom in spring, and blooming flowers would be nice for the lesson.

Monsoons	*Autumn*	*Winter*	*Spring*	*Dry Summer*
July-Sept.	Oct.-Nov.	Dec.- Feb.	Mar.-Apr.	May-June

Guiding Questions:

- What materials do we need to plant flowers?
- What is the ideal spot to plant flowers?
- Why do flowers attract pollinators?
- Why do some flowers attract different pollinators than others?

Engagement/Introductory Activity: 10 mins

- Introduce scientist of the week, emphasize her contributions to plant science
    - Explain to students that we will be working with plants for the next couple weeks
- Break the class into teams of 2-3 students
- Hand out white boards and white board markers
- Instruct each team to come up with "4 things that plants need to grow"
- After a few minutes of brainstorming, allow groups to share what they found, raising hands and telling the class.
- Finish this section by explaining that in the coming weeks, you will be planting 4 plants: 2 to attract hummingbirds and 2 to attract monarch butterflies.
    - Allow time for questions

Exploratory Activity: 20-25 minutes

- Take the class outside to where you will start laying the groundwork for your garden
    - Make sure to hand out the worksheets and clipboards for each student
- Instruct students to work on the worksheets for about 5-10 minutes.
    - Make sure to make your own sketch of the garden to help students who may be struggling

Explain: 10-15 minutes

- Draw an outline of the garden space on the board, allowing students to raise their hands to add features from their sketches.
    - Make sure that these features are accurately placed and pertinent to the planting of the flowers
        - e.g. Where is the water source, where is the walkway, what areas have things that provide shade and what don't, etc.
- Denote on the board where the four flowers will be going, marking them in a different color on the board.
- Instruct students to use the information from their worksheets and the brainstorm to explain in 2 to 3 sentences in their science notebooks why the spot where the flowers are going is a good one
    - Proximity to water source, sunlight access, walkway access, etc.

Extension Activity/Questions: 10 minutes

- Explain mutualism to the class, ask them what mutualistic relationships will exist in the garden.
    - **Mutualism**: a biological or ecological relationship that is beneficial to both parties participating in it
    - The mutualistic relationship is between the flowers and pollinators
- Instruct students to write a 4 sentence (or more) story about a mutualistic relationship they have in their life
    - This relationship should be a real relationship they have with someone in their life, and should follow the definition of mutualism in some way

Evaluation Activity: 5 minutes

- Hand out index cards to each student
- Write three questions on board, numbering them 1 through 3
    - What do plants need in order to grow?
    - Which of the plants we are growing will attract which pollinator?
    - Why do certain plants attract specific types of pollinators?

- Allow students to raise hands to answer questions, collect note cards at the end to evaluate student understanding

Pollinator Garden Planning Sheet

Name_____

This space will be used to create a small pollinator garden. What is its shape? Is it big or small? Is it easy to access or difficult to get to? Describe the space and how it relates to the rest of the school.

_____
_____
_____
_____

Take note of how the sun is shining in the space right now. What areas are getting sunlight? What areas are covered or shady? Why might we care about that?

_____
_____
_____

Just like us, plants need water to survive. Where are the water sources in this space? What water sources do you think will work best for flowerpots? Is the area dry or wet?

_____
_____
_____

Observe the soil. Is it rough or soft? Is it dark or light? Is the soil more like sand or more like mud? Describe it here.

_____
_____
_____

Use the space below to make a simple sketch of the area, considering all the objects in the space. Make sure to include everything you think will be helpful to remember for planting.

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Action Project Week 2

Teacher: Zane Rossi
Grade Level: *5th*
Time: *80 minutes*

AZ State Science Standard:	*5.L4U3.11* ● *Obtain, evaluate, and communicate evidence about how natural and human-caused changes to habitats or climate can impact populations.* *5.L3U1.9* ● *Obtain, evaluate, and communicate information about patterns between the offspring of plants, and the offspring of animals (including humans); construct an explanation of how genetic information is passed from one generation to the next.*
Content Objective: Math, Reading, Science, Writing, Other:	Students will be able to explain the difference between native soil and potting soil Students will be able to articulate the difference between a native and non-native plant Students will be able to describe the importance of microorganisms in the growth and development of plants
Language Objective: (Optional)	*N/A*
Scientist of the Week:	● Eijiro Miyako ● Senior Researcher at the Japanese National Institute, and researcher at the Japan Advanced Institute of Science and Technology ● Based in Nomi, Japan ● Focused on nanotechnology and artificial pollination ● Designed a drone that can pollinate flowers just like a bee

Vocabulary	Materials
● Soil ● Microorganism ● Fertilizer ● Nutrients	● 4 flower pots ● potting soil ● local soil ● hand shovels ● Acrylic Paint ● Paint brushes ● Paper plates or cardboard ● Cups with water ● Note Cards ● Four different soils in containers: clay, compost, garden soil, sand ● Scrap paper ● Four large pieces of construction paper ● Colored markers

Seasonality: Springtime is generally when we should be planting flowers. The sun is out, and the flowers will be blooming for the students.

Monsoons July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec.- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June

Guiding Questions:
How can soil affect a plant's development?
Is it important to plant plants that are adapted to your environment?
Can poor plant development have an effect upon the pollinators that pollinate for it?

Engagement/Introductory Activity: 5 minutes

- Introduce scientist of the week on the whiteboard, make sure that students can pronounce the name
  - Eh-ee-jee-ro Mee-yah-koh
- Review and write some safety guidelines for going outside and working with plants, pots, and dirt
  - Be careful with the shovels, they aren't toys. Don't use them without the assistance or guidance of a teacher or adult
  - Be kind to your classmates
  - Look out for insects and be mindful of your surroundings
  - Stay hydrated and be aware of the sun
  - Be mindful of your mess, and be sure to be clean
- Break the class up into 4 groups, one for each pot
- Head outside to where the pots and supplies will be prepared

Exploratory Activity: 30 minutes

- Make sure to pre-prepare the pots, shovels, and soil by putting them outside before class starts.
- Each group should be assigned the following: 1 cup with water, paint brushes, a palette of paint, cardboard/paper plate, 1 pot
- Each group should use the paint to decorate the pot as a group
  - Ideally, each group is assigned one adult. However, this can be substituted with two adults rotating
  - This is meant to be fun, so the students don't really have any limits as to what they can paint, as long as it's appropriate
- Once everyone is done painting, move over to the soils and allow each student to touch (if they want to) and observe both the native soil and bagged potting soil
- Instruct students to write a short compare/contrast in their science notebooks between the two soils
  - Guiding questions:
    - Which soil is wetter?
    - Which is more coarse?
    - Does one have more twigs and organic matter?
    - How do the colors compare?
    - What are some similarities between the two.
- Return inside and stop at the bathroom on the way back to let students clean up

Explain: 10 minutes

- Ask students to explain what they noticed about the differences and similarities between the native soil and potting soil
  - Draw a Venn Diagram to visually represent it on the board
- Continue this discussion by instructing students to talk to a neighbor about why we are using local soils in planting native plants

    - After about a minute or two of this, allow students to share out if they wish
- Explain to students that potting soils have lots of nutrients
    - nutrients: any substance that provides the nourishment essential for the growth and maintenance of life
- Explain to students that local soils have a specific microbiome, with many microorganisms that are essential for plants adapted for our area
    - microorganism: microscopic organisms, specifically viruses, bacterium, and fungi
- Wrap up activity by asking the students where the information about nutrients and microorganisms would go on the venn diagram.

Extension Activity/Questions: 25 minutes

- Set up 4 stations around the room, each with: a container of soil, markers and scrap paper
- Divide the class into four equal-sized groups of students.
- Tell the students you will be exploring four different types of mystery soil and using scientific/descriptive words to describe them.
    - Explain that they are meant to use a variety of senses, bar taste
- Assign each group a station and instruct them to conglomerate around the station.
- Ask your students to keep a lid on their containers and have them shake the containers and listen.
- Now have them open the containers slowly and allow them to touch the soil with their fingers, exploring the soil texture.
- Invite the students to hold the containers up to their noses to smell the soil.
    - They do not have to smell if they don't want to
- Ask them to take a close look at the soil. They can also rub a bit on some paper and look at the color it leaves.
- Now have each student share one word about their soil, based on one of their senses. Have them record their word on a piece of scrap paper and place their word face-down into a pile at the end of the station.
- Once all students are finished writing a word about their soil, have them leave all the materials at the station and rotate to the next container of soil. Repeat until all students have rotated through the four stations.
- After the students have experienced all four soils, explain that the groups will now use all of the words in the pile to create a poem about their type of soil.
- Have each group spread these words over the table and move them around until their poem has a pleasing sound. They must use every word, no matter how often it appears. Ask them to give the poem a title.
- Hand out construction paper to each group and instruct them to write their final poem on the construction paper with the markers
- Once each group has prepared a poem, have them practice reading it. When they are ready, have each group present their poem to the class.
    - If the groups don't want to present it, the instructor can read the poems out instead

Evaluation Activity: 5 minutes

- Hand out notecards to the class
- Instruct the class to write down 3 to 5 things that they learned about local plants and soils
- Once they are done with the notecards, ask:
    - What is the difference between a native and non-native plant?
    - Are soils mostly the same or are they diverse?
    - What is the significance of the microbiome in a soil?
- Allow students to raise hands to answer these questions

COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

Bio/Diversity Project
Lesson Title: Action Project Week 3

Teacher: Zane Rossi
Grade Level: *5th*
Time: *70 minutes*

AZ State Science Standard:	*5.L4U3.11* ● *Obtain, evaluate, and communicate evidence about how natural and human-caused changes to habitats or climate can impact populations.* *5.L3U1.9* ● *Obtain, evaluate, and communicate information about patterns between the offspring of plants, and the offspring of animals (including humans); construct an explanation of how genetic information is passed from one generation to the next.*
Content Objective: Math, Reading, Science, Writing, Other:	Students will be able to explain the re-potting process Students will be able to summarize what was learned over the course of the semester Students will be able to describe the necessary steps to take care of the garden in the long term
Language Objective: (Optional)	*N/A*
Scientist of the Week:	● George Washington Carver ● African American scientists who worked at the head of the Tuskegee institute in Alabama ● Survived through slavery, the civil war, and continued racial inequality ● Responsible for inventions related to agriculture, mostly in usages for crops ○ Often credited with inventing peanut butter, not true but he did do research into alternative peanut uses ● Also a large advocate for racial equality during the great depression

Vocabulary	**Materials**
● Repotting ● Wilting ● Irrigation ● Seed-planting ● Trans-planting	● Pots ● Soil ● Flowers (2 monarch-specific, 2 hummingbird-specific) ● Hand shovels ● Pollinator-themed snacks ● Coffee filters/napkins ● Bingo sheets ● Tokens for bingo ● Jolly Ranchers
Seasonality: Springtime is generally when we should be planting flowers. The sun is out, and the flowers will be blooming for the students.	

Monsoons July-Sept.	*Autumn* Oct.-Nov.	*Winter* Dec.- Feb.	*Spring* Mar.-Apr.	*Dry Summer* May-June

Guiding Questions:

What is it called when a plant is moved from one pot to another?
Why are we even planting these plants in the first place?
What is some information we learned this semester that could help inform us in planting a pollinator garden?

Engagement/Introductory Activity: 5 mins

- Introduce scientist of the week, explain that this will be the last meeting week of the semester
  - Be sure to also mention that today you will be planting the flowers in the pollinator garden
- Review and write some safety guidelines for going outside and working with plants, pots, and dirt
  - Be careful with the shovels, they aren't toys. Don't use them without the assistance or guidance of a teacher or adult
  - Be kind to your classmates
  - Look out for insects and be mindful of your surroundings
  - Stay hydrated and be aware of the sun
  - Be mindful of your mess, and be sure to be clean
- Instruct the class to congregate into the groups they were in last week for painting the pots
- Take the class outside, ideally with one adult instructor per group

Exploratory Activity: 15 mins

- Before starting class, make sure that all of the required materials are outside
  - Pots, soil, plants, shovels
- Each pot should be something like a potting station, having enough soil, a plant, a shovel, etc.
- Once the students are outside, instruct each group to go to their potting station
- Each group should start by taking turns using the hand shovel to shovel some soil into the pot
  - Remember: each pot should be about 50/50 local and potting soil, the pots shouldn't be completely full, just full enough for the flowers to root in
- Next, the adult instructor should use the shovel to demonstrate to the students the process of re-potting the flower
  - Dig a small hole in the soil in the pot, about 1.5 to 2x as deep as the roots of the flower appear to be
  - Carefully take the flower from its transportation pot and place it into the hole that was just made
  - Re-cover the hole with the flower in it
- End the planting process by having the groups take turns with the hose, watering the flowers.
- If the pots weren't in their designated places to account for planting, instruct students to transport the pots to where they will permanently reside, as was decided in the week before last.

Explain: 10 mins

- While still outside, instruct the students to take out their science notebooks
- Instruct them to write down two to three reasons why we planted the flowers
  - Encourage them to think about the ecological impacts, and the symbolic reasons for planting flowers for specific pollinators
- Once the students are done writing those reasons down, start a discussion about taking care of the garden
  - What does the garden need?
    - Regular watering, care for the plants, attention to how the plants are faring
  - What would you need to do to do this at home?
    - Soil, plants/seeds, water, and some adult supervision
  - What happens if pollinators start coming and visiting the plants?
    - Watch from a distance, don't disturb them. They are doing an important job.

- Wrap up and take the class back inside.

Extension Activity/Questions: 30 mins

- Set out the pollinator themed snack options on the table
    - Last page of this lesson has some ideas: also check out http://copy-kids.com/bat-snacks/ and http://copy-kids.com/butterfly-snacks/
    - No real limit on what can go in the bags, obviously, so be sure to take into account any dietary restrictions that any kids have
- Students can take one each, and then go for seconds if there are any left
    - Ideally, it should be 1 per student and then a couple extras to make sure everyone gets the pollinator they want
- Allow students to take some time to eat their snacks and talk amongst themselves, while writing a few things on the board
    - For each pollinator represented with the snacks, section off part of the board
- Start the review activity by having volunteers write facts about each pollinator
    - These facts can be related to morphology (how do they acquire nectar and pollen), habitat, the types of flowers pollinated, or anything else that was learned throughout the semester
- Once the class has exhausted what they know, fill in what's left and move on.
- Pass out tokens and bingo sheets to every student (https://myfreebingocards.com/bingo-card-generator/30-free-cards/e75jnz)
- Play bingo with the class, using one of the sheets to call out vocab words from throughout the year
- For every vocab word, have students raise hands to define or explain it
- For every first bingo, students will receive a jolly rancher
- Play until time runs out or until all vocab words have been announced

Evaluation Activity: 5 mins

- Hand out notecards to the class
- Instruct the class to write down 3 to 5 things that they enjoyed most about the semester
- Once they are done with the notecards, ask:
    - What is your favorite pollinator?
    - How will you help pollinators in the future?
    - What will you do to help your teacher take care of the plants?
- Allow students to raise hands to answer these questions


HORIZON