PIMA COUNTY
NATURAL RESOURCES
PARKS & RECREATION

This program was developed with an Arizona Game and Fish Department Heritage Fund grant.

Pollinator Survey Field Study
Grades 4-6

Program Description: In this field study, after an introduction to the process and importance of pollination, students survey pollinator populations using both direct and indirect survey protocols. Students use digital cameras to document pollination in action to create a catalog of local pollinators. The class collects and records data on the location and size of a barrel cactus specimen, harvest a ripe fruit, and count the number of seeds contained within. This seed data set is submitted to the Arizona-Sonora Desert Museum for use by scientists to help identify and understand local pollinator hotspots. Data collected are compiled with existing data sets which are made available for student use.

Duration: 2.5 hours

Objectives:

- Identify the parts of a flower and their function.
- Understand that pollination is the process by which flowering plants reproduce.
- Understand that most pollination is animal mediated.
- Understand that pollination represents an animal-plant partnership; an example of interrelationships referred to as mutualism.
- Identify various ways in which plants attract pollinators (including flower color, size, shape, bloom timing, scent, nectar and pollen).
- Understand that pollinators generally receive a reward from the plant (usually in the form of energy-rich nectar and/or protein-rich pollen).
- Understand that pollination is critical to a healthy ecosystem.
- Recognize that pollinators represent species upon which others in the ecosystem rely.
- Identify how pollination is important to humans.
- Document pollination in action to generate a photographic pollinator survey database.
- Participate in citizen science project to help identify pollinator hotspots.
- Collect, compare and analyze pollinator-related data.
- Understand that pollinators are exhibiting population declines due to a myriad of causes including habitat loss/fragmentation/modification, pesticide use, competition, predation and disease spread by introduced species.

Vocabulary:

Pollination	Adaptations	Stigma	Pollen Tube
Pollinator	Interrelationships	Style	Nectar
Cross-pollination	Interdependence	Ovary	Nectary
Self-pollination	Co-evolution	Ovule	Petals
Flowering Plant	Mutualism	Stamen	Sepals
Angiosperm	Flower Anatomy	Filament	Fruit
Reproduction	Pistil	Anther	Seed
Fertilization	Carpel	Pollen	Pollination Syndrome

Equipment and Materials:

Introductory Session:
3D Flower Model & Flower Anatomy Poster
Pollinator Syndrome Matching - Flower Photos & Corresponding Pollinator Figure/Photo

Fieldwork Sessions:
(5) Color-coded Team Backpacks each containing:
(6) Pollinator Observation Data Sheets, (6) Clipboards & Pencils, Team 'Clapboard' w/Dry Erase Marker, GPS Unit, Digital Camera
Other Supplies: Thermometer, Seed Count Data Sheet, Meter Stick, Cutting Board & Knife, Counting Plates, Tweezers & Skewers, Laptop with Internet connectivity

Description of Activity:

Preparation:

The teacher groups students into (5) teams (ideally this would be done before arriving at the park). Each team is assigned a color that corresponds to a color-labeled field equipment pack.

Introduction:

Welcome
Overview of the day
Expectations: rules and safety considerations

Rationale:

Pollinators, such as bees and wasps, moths and butterflies, beetles, and flies as well as some birds and bats, play a crucial role in flowering plant reproduction and in the production of most fruits and vegetables. These industrious animals help pollinate more than 75% of flowering plants, and nearly 75% of our cultivated crops. Without these pollinators, wildlife would have fewer nutritious berries and seeds, and humans would miss out on many fruits, vegetables, and nuts, not to mention chocolate and coffee, which depend on pollinators.

Pollinator populations are on the decline due to a myriad of causes including habitat loss, fragmentation and modification, agricultural and grazing practices, pesticides, spread of disease and parasites by and competition by introduced species. In the United States alone, there are 15 species of vertebrate pollinators listed as endangered, but insect status is less well known. Despite recent advances in monitoring, insect population declines often go unnoticed until they approach local extinction.

The data collected by the students will serve to help establish baseline data for regional pollinators.

Activity Description:

Introductory Session: Students participate in an on-site introductory session on pollination and pollinators. During this introductory portion of the program, students are introduced to pollination as the method by which flowering plants reproduce. They explore flower anatomy to identify the flower structures important to pollination and plant reproduction. Students are introduced to the variety of pollinators and explore the interrelationships between pollinators and the plants they pollinate. Students also consider the importance of pollination to the health of an ecosystem and to human populations.

Pollinator walk: Students take a guided pollinator walk to become more familiar with the variety of local pollinators, their habitat requirements and their behavior.

Fieldwork Protocol: Student teams collect data on pollinators in two fashions:
Photographic Survey – Students, in small groups, document pollination in action. Photographs are used to catalog existing pollinators and pollinator/plant relationships, creating a database to help track populations through time.

- Each student team is assigned a landscape plot to observe.
- Each team takes GPS location of assigned landscape plot.
- Each team fills out and photographs 'Site Location and Conditions' clapboard.
- Team members take turns photographing pollinators, corresponding flower and entire plant.
- All team members also observe and document a variety of pollinator behaviors to identify suitability of habitat for entire lifecycle of pollinators.
- (NRPR staff will later upload photographs and corresponding data to database).

Fishhook Barrel Cactus Fruit Seed Count – Students participate in a barrel cactus seed count and submit resulting data to the Arizona-Sonora Desert Museum's Pollinator Hotspots database. This seed count may act as a proxy for the health of local cactus bee populations.

- Take and record GPS location of barrel cactus.
- Measure (in cm) height of barrel cactus.
- Harvest one ripe fruit from the top of the barrel cactus.
- NRPR staff cuts open, sections and distributes sections to student pairs to count seeds.
- Seed counts from each student pair are compiled to arrive at total seed count.
- Seed count and associated cactus data are submitted to the Arizona-Sonora Desert Museum Pollinator Hotspot Citizen Scientist Project database.

Wrap-up: Add seed count data to database. Introduce photographic survey and seed-count databases and discus how each can be used to further inquiry. Following the field study trip, the NRPR instructor will email a link to the site where the data are compiled.

Extensions:

- Analyze the seed count data for patterns. Attempt to correlate observed patterns with one or more variables (i.e. water availability, geologic features, etc.).
- Use same protocol to survey pollinators at schoolyard and/or at home.
- Collect and submit seed-count data from barrel cactus at school or home.
- Participate in the Great Sunflower Project (https://www.greatsunflower.org/).
- Flower Dissection Lab

Late Arrivals: This field study program is designed for 2.5 hours of instruction (depending on grade level). If the group arrives late or needs to leave early there will be less time allocated to the wrap up activities.

Linked to Arizona State Standards:

Science S1: C1 - G4PO1, G6PO1; C2 - G4PO1, 3, 4, 5, G5PO1, 3, 4, 5, G6PO1, 3, 4, 5; C3 - G4PO1-5, G5PO1-5, G6PO1-6; C4 - G4PO1-3, G5PO1-3, G6PO1-3,5; S2: C2 - G4PO2, G5PO1,4; S3: C1 - G4PO1, G5PO1, G6PO2; S4: C1 - G4PO1, G6PO1; C3 - G6PO2; C4 - G4PO2. **Math:** 4.MP.1; 4.MP.2; 4.MP.3; 4.MP.4; 4.MP.5; 4.MP.6; 4.MP.7; 5.MP.1; 5.MP.2; 5.MP.3; 5.MP.4; 5.MP.5; 5.MP.6; 5.MP.7; 6.NS.C.8; 6.EE.C.9; 6.SP.A.1; 6.SP.A.2; 6.SP.A.3; 6.SP.B.4; 6.SP.B.5; 6.MP.1; 6.MP.2; 6.MP.3; 6.MP.4; 6.MP.5; 6.MP.6; 6.MP.7.

Next Generation Science Standards:

Practices:

This Field Study naturally supports the following Science and Engineering Practices:
Asking questions (for science) and defining problems (for engineering), Planning and carrying out investigations, Analyzing and interpreting data, Using mathematics and computational thinking, Constructing explanations (for science) and designing solutions (for engineering), Engaging in argument from evidence.
Follow-up opportunities support the following Science and Engineering Practices:
Obtaining, evaluating, and communicating information and developing and using models.

Crosscutting Concepts:

This Field Study naturally supports the following Crosscutting Concepts:
Structure and Function, Systems and System Models, Cause and Effect
Follow-up opportunities/Further investigation support(s) the following Crosscutting Concepts:
Stability and Change, Energy and Matter, Scale, Proportion and Quantity, and Patterns.

Disciplinary Core Ideas:

This Field Study addresses the following Disciplinary Core Ideas:
LS1.A Structure and function, LS1.B Growth and development of organisms, LS1.C Organization for matter and energy flow in organisms, LS2.A Interdependent relationships in ecosystems, LS2.C Ecosystem dynamics, functioning, and resilience, LS4.C Adaptation

Follow-up opportunities support the following Disciplinary Core Ideas:
LS1.D Information Processing, LS2.B Cycles of matter and energy transfer in ecosystems, LS2.D Social interactions and group behavior, LS4.B Natural selection

DCI CODES: MS-LS1-4; MS-LS2-1; MS-LS2-2; MS-LS2-4; HS-LS2-2; HS-LS2-6; HS-LS2-7; HS-LS4-5

Foss Kit Alignment/Connections:

4^{th} – 6^{th} Grade:

- This program acts as a good introduction to and/or extension of the ***Living Systems Module, Investigation 1: Systems, Investigation 2: Nutrient Systems; Environments Module, Investigation 2: Ecosystems***
- This program acts as a good introduction to and/or extension of the ***Populations and Ecosystems, Investigation 8: Adaptations***