Where are the Birds?
Urban Birds in a Heat Island

Objectives:
Students will be able to:

1. propose a relationship for how urban heat island might affect birds.

2. test whether schoolyard microclimates affect the distribution and abundance of urban bird species.

Author:
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Time:
30 min.

Grade Level:
6-9

Standards

AZ Science Strands
Inquiry, Social Perspectives, Life Sciences

NGSS - Core Ideas
Earth materials and systems; Biogeology; Human impacts on Earth systems; Structure and function; Information Processing; Interdependent relationships in ecosystems; Ecosystem dynamics, functioning, and resilience; Biodiversity and humans

Practices
Planning and carrying out investigations and more

Crosscutting Concepts
All

Specific AZ, Common Core, and NGSS standards on page 3.

Background:
The Sonoran Desert has some of the most diverse native plant and animal species of any desert in the world. Many birds are uniquely adapted to living here and they are part of food webs that include animals and plants that also are adapted to desert living. Bird researchers have found over 50 bird species in the Phoenix metropolitan area. The most numerous of these bird species are the: House Finch, Starling, House Sparrow, Mourning Dove, Inca Dove, Pigeon (Rock Dove) and Great-tailed Grackle. These birds occupy different habitats and microclimates within the urban environment. The distribution and abundance of birds in various microclimates across the city may be affected by the Urban Heat Island.

Some species found in the city are native Sonoran desert birds, adapted over generations to hot, arid conditions (e.g. Inca Dove and Gila Woodpecker). However, urban temperatures have increased recently, making the city a hotter place to live than the desert. The average nighttime low temperature in Phoenix has increased by 8°F over the last 30 years and during the months of May through September, the average number of hours per day with temperatures over 100°F has doubled since 1948.

Other urban bird species are non-natives that have taken up residence in desert cities (Starlings, House sparrows, and Rock doves are native to Europe). Vegetation planted by humans and artificial irrigation not only provide food and shelter for these birds, but may also help decrease the effects of the urban heat island, creating more favorable microclimates.

To discover how different bird species respond to the urban heat island, we must determine how many of which species are utilizing different microclimates. Ecologists use Point Counts as one method for surveying birds. In a Point Count, one person counts all the birds located within a circle with the radius of 20 meters for 10 minutes.

Vocabulary:
Urban Heat Island - A metropolitan area which is significantly warmer than its surrounding rural areas. A night time phenomenon of increased temperatures in the Phoenix Metropolitan area.

Point Count - a method of to census organisms within a standard radius from a random point for a standard amount of time

Bird Distribution - the pattern of different types or species of birds in a landscape

Bird Abundance - the total number of birds surveyed

Advanced Preparation:
Students should practice identifying birds before doing bird counts. Learning to identify silhouettes, size, beak shape and habits are key characteristics for identifying birds. Interactive bird identification games are available at http://ecologyexplorers.asu.edu

Materials:

- meter tape or meter stick and string
- binoculars
- clipboards

Recommended Procedure:

Engagement:

1) Take a walk outside or review from memory the various microclimates in your schoolyard. Ask students to list different locations and their boundaries, keeping in mind the 20m radius you will use for the survey.

   What is different about each of these locations: vegetation, built structures, ground cover, sun/shade, irrigation?

   Have you actually measured temperature differences in these locations before?

   Which sites do you predict will be hottest and coolest? Why?

2) Choose at least two different locations in your schoolyard to conduct the survey, such as the middle of a lawn, near trees and bushes, near asphalt, near the edge of the property, etc. Assign a number and name to each site. Encourage the class to consider other factors that might affect your survey (e.g. maintenance activities, watering schedule, class schedule, high activity or traffic areas). Have students describe their sites on the Student Worksheet - Bird Point Count Survey Design.

3) Decide on a time of day to do the survey and keep it consistent. If possible conduct the survey once early in the morning (before 9:30 am) and once in the afternoon to explore the effects of overnight temperatures due to the Urban Heat Island. You may survey several days or weeks in a row and alternate the survey time on different days. If possible, several classes can survey at different times of day or on different days. (Note: to enter your data into the CAP LTER database, you will need to establish the habitat description first and census at least one site, twice per week, for 4 consecutive weeks).

4) Ask students to carefully state their questions and predictions. Record these on the Student Worksheet - Bird Point Count Survey Design.

   For example: Will there be a difference in the types of and number of birds between site 1 and 2? In the morning? In the afternoon? (e.g. We predict there will be fewer birds at both locations in the afternoon when it is hotter, but overall there will be more birds at the grassy site than at the concrete site.)

Exploration:

5) You may divide students into two groups to survey two sites simultaneously. Establish a random point at each location and mark out a circle with a 20-meter radius from the points. (You can drop a small rock backward over your shoulder and wherever it lands, that is your point). Make sure there are no large obstructions within the circle. For example, if there is a block wall in the area, position the circle so the it is near the perimeter of the circle. If you just don't have enough space for a 20-meter radius circle, then you need to note the size of the study area on the data sheet.

6) Complete a habitat description for each of your point count sites. Record your findings on the Student Worksheet - Bird Point Count Habitat Description.

The following technique can be used to estimate the land cover in your 20m radius (40m diameter) circular study area:

- Take two pieces of string and divide the plot into 4 equal sections, so the strings cross in the middle.
- Mark the string every four meters. Start marking the first string at meter zero, and the second string at meter 1. (This staggers the points along the strings to provide 20 total marked points)
- At each point place a meter stick. In the first column of the data table, record the type of cover beneath your feet and less than 0.15m (ground cover). Also, in the appropriate column, record any vegetation that is between 0.15m to 1.5m tall (shrubs) and any which is taller than 1.5m (tree). Only write down the type of land cover that is at that point and touching your meter stick. The land cover type can be "building" or "cement" as well as plants.

7) For each type of ground cover, add the number of times it was recorded, divide by the total number of points and multiply by 100. For example if you recorded "shrubs" at 5 of the points and there were 20 points, then shrubs would be 25% of the land cover (5/20 x 100).

8) Observe the cloud cover and measure the air temperature at each survey point (center of the circle) and record on the Student Worksheet - Bird Point Count Data Collection.

9) Conduct the point count. Spread students around the circle and allow some time to pass after this disturbance to the area. Select 1 observer and 1 recorder. Count all birds that enter the circle for 10 min. Count each bird only once. Use the Student Worksheet - Bird Point Count Data Collection to record the number of individuals from each species that you have seen. (Although all students can observe and record birds on their own data sheets, the official data should be collected by only one observer to avoid over counting. It may be interesting to compare data afterward and discuss differences among observers)

Explanation:

10) Compare your species lists for each site. Ask students if they can see any obvious differences. How might they explain those differences?

11) Sum the total numbers of each species found at each site at each time of day from all surveys. Use the table on Student Worksheet - Bird Count Data Analysis to summarize the results.

Expansion:

12) Have students make bar graphs of the compiled data to look for patterns between times of day and sites. Which birds were more abundant at which sites? Why might this be?

13) Evaluate the effects of temperature. Create averages for each site and each time of day. Was it warmer at one site than another? If so, did the time of day affect this site difference, i.e. was it the same amount warmer in the afternoon as in the morning? (Sites where the Urban Heat Island effect is observed would show heat radiating at night and higher early morning temperatures).

14) If temperature appears to be related to species abundance or distribution, investigate further by making a line graph with temperature on the x-axis and total birds on the y-axis. Use a different colored line for each site. What trends do you see? Do your data provide information about how temperature affects birds in your schoolyard? Encourage students to think of other tests they could perform to explore this question further.

Evaluation:

Students will participate in all activities and complete the worksheets and graphs.

Extensions:

- Have students read the article "The Good Life of Birds" by James Hathaway in the ASU Chain Reaction magazine volume 4. http://chainreactionkids.org/files/issues/4/chreact4_p16_17.pdf
- Ask students to discuss the article in small groups and summarize the results. What did the researchers discover? Which variables did they control in their study? How? What hypotheses did the researchers propose to explain their results? Ask students to generate their own hypotheses that could explain how people's lifestyles might affect bird distribution in this way. How would they design a new study to test their best hypothesis?
- Students may pick one bird species they observed and research it further to produce a written and/or verbal report on the birds' natural history (habits, range, prey, predators). Include evidence and inferences about how the bird species interacts with humans and how its life might be different in the city vs. the desert.

Standards

Arizona Science Standards

S1-C1-GR5-8-PO1
S1-C1-GR5-6-PO1-2
S1-C2-GR5-8-PO1
S1-C3-GR5-8 PO1-4
S1-C4-GR5-8-PO3, PO5
S3-C1-GR7-PO1
S4-C1-GR6-PO1
S4-C3-GR6-PO1-2
S4-C3-GR7-PO1-6
S4-C4-GR8-PO1, PO4-6
S1-C1-GRHS– PO1-4
S1-C2-GRHS-PO1, PO4-5
S1-C3-GRHS-PO1-2
S1-C4-GRHS-PO1-4
S3-C1-GRHS-PO1-5
S4-C3-GRHS-PO1-3
S4-C4-GRHS-PO4
S4-C5-GRHS-PO3-5

NGSS Core Ideas

ESS2.A: Earth materials and systems
ESS2.E: Biogeology
ESS3.C: Human impacts on Earth systems
LS1.A: Structure and function
LS1.D: Information Processing
LS2.A: Interdependent relationships in ecosystems
LS2.C: Ecosystem dynamics, functioning, and resilience
LS4.D: Biodiversity and humans

NGSS Practices
Asking questions
Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data
Using mathematics and computational thinking
Constructing explanations
Engaging in argument from evidence
Obtaining, evaluating, and communication information

NGSS Crosscutting Concepts
Patterns
Cause and effect
Scale, proportion and quantity
Systems and system models
Energy and matter; Flows, cycles, and conservation
Structure and function
Stability and Change

Common Core/ELA Literacy
RST7: Integration of knowledge and Ideas
WHTS1: Write Arguments
WTS7: Research/investigate to answer a focused question
SL1: Comprehension and Collaboration
SL2: Integrate oral information

Common Core/Mathematics
Domains:
Number and Quantity
Measurement and Data
Statistics and Probability
Math Practices:
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate mathematic tools strategically.

Student Worksheet
Bird Point Count Survey Design

Sites :
Site 1 Name: _____

Location: Write a brief description of where your site is located. (i.e. SW corner of playground):

Description: Write a description of your site so that a visitor to your school would be able to find your point count site

Site 2 Name: _____

Location: Write a brief description of where your site is located:

Description: Write a description of your site so that a visitor to your school would be able to find your point count site:

Scientific Question: _____

_____

Predictions: _____

_____

Factors to consider when collecting data: _____

_____

_____

Time(s) of survey:_____

Student Worksheet
Bird Point Count Habitat Description

Data Table for Describing Land Cover in your Point Count Circle

Point	0-0.15m				0.15-1.5m Shrubs	> 1.5m Tree Canopy
	Lawn	Gravel or Soil	Pavement or Building	Other Vegetation		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Totals:

Lawn _____ x 100 = _____%
20

Other Vegetation _____ x 100= _____%
20

Gravel/Soil _____ x 100 = _____%
20

Pavement/Building _____ x 100 = _____%
20

Shrubs _____ x 100 = _____%
20

Tree Canopy _____ x 100 = _____%
20

Student Worksheet
Bird Point Count Data Collection

Teacher: _____ **Class:**_____

Site ID: _____

Observer's Name: _____

Date of Survey: _____

Comments/Observations: _____

_____

_____

Cloud Cover: none scattered overcast **Temperature:** _____°F

Start Time: ____:_____ AM PM **End Time:** ____:_____ AM PM

Species Name	Tally Number

Student Worksheet
Graphs

Y-axis=_____

X-axis=_____

Student Worksheet
Bird Point Count Data Analysis

Species Name	Site	Time of Day	Total Number

Average Temperatures (°F)

Site 1_____

Time of Day 1_____

Site 2 _____

Time of Day 2 _____

Conclusions (write answer on back)

- Were some birds more abundant at one site than another? Why might this be?

- Was it warmer at one site than another? Was this difference the same at different times of day? Explain.