

# Bats & Agave:

## Using Science to Protect the Lesser Long-Nosed Bat

**Overview:** In this one-hour lesson, students learn that Lesser Long-Nosed Bats feed on nectar from agave flowers as they migrate from southwest New Mexico to Mexico in the fall. However, the agave habitats they rely on are often threatened by human activities. Students read handouts to learn about one of three bat study methods and view a map showing where their study detected Lesser Long-Nosed Bats. They use this information to select agave habitats on the map that they would want to protect. Students learn how different study methods reveal different information and why sharing data and looking at the results from multiple studies is so important in science.

**Grade Level:** 3<sup>rd</sup> – 5<sup>th</sup>

**Phenomenon:** The Lesser Long-Nosed Bat is a “Species of Greatest Conservation Need” in New Mexico. How can we protect this species using scientific ideas, but with a limited amount of time and money?

### Next Generation Science Standards

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.

| Science & Engineering Practices                      | Disciplinary Core Ideas                             | Crosscutting Concepts  |
|--|---|--|
| Asking questions and defining problems               | ETS1.A Defining and delimiting engineering problems | Influence of science, engineering, and technology on society and the natural world |
| Constructing explanations & designing solutions      | ETS1.B Developing possible solutions                | System and system models   |
| Obtaining, evaluating, and communicating information | ESS3.C Human impacts on earths systems              | Patterns   |
| Analyzing and interpreting data                      | LS4.D Biodiversity and humans                       |  |
| Engaging in argument from evidence                   |   |  |

### Common Core State Standards

ELA-LITERACY.RI. 3.7, 4.7 and 5.7: Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on

Web pages) and explain how the information contributes to an understanding of the text in which it appears.

ELA- LITERACY.RI. 3.10, 4.10, and 5.10: By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 3-5 text complexity band independently and proficiently.

ELA- LITERACY.W. 3.7, 4.7, and 5.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

ELA- LITERACY.W.5.9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

ELA- LITERACY.SL. 3.1, 4.1, and 5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade level topics and texts*, building on others' ideas and expressing their own clearly.

ELA- LITERACY.SL.3.3: Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.

ELA- LITERACY.SL. 4.2 AND 5.2: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

## **Time**

60 minutes

## **Materials**

- Student worksheets
- Slide presentation (with working audio, internet access)
- 1 balloon
- Necklace signs: New Mexico, Arizona, Mexico (2)
- Study methods handout envelopes with “Your Study” page on the outside and “Your Results” page inside (6 of each):
  - Community Science
  - Sound Recording
  - Radio Tracking
- Example study method envelope with “Bat Study Methods: Infrared Camera Survey” page on the outside, and “Results: Infrared Camera Survey” page on the inside.
- Laminated New Mexico map poster
- Dry-erase markers: 1 red, 1 blue, 1 green

## **Preparation**

1. Prepare the slide presentation to be shown to students.
2. Fix the laminated map to a wall or board low enough for students to write on.
3. Blow up one balloon.

## Procedures

### 1. Introduction (5 minutes)

- A. Slide 1: Introduce students to the lesson. They are going to play the role of biologists in charge of gathering information and making a plan to protect a special species of bat in New Mexico.
- B. Slide 2: Introduce the Lesser Long-Nosed Bat (LLNB).
  - This is a small bat species that is found in the southwest United States and Mexico.
  - All the bat species students have likely seen or heard of are insectivorous; however, the Lesser Long-Nosed bat is one of the few bat species in the U.S. that feeds primarily on nectar. This makes them important pollinators.
  - New Mexico has labeled the LLNB as a Species of Greatest Conservation Need.
  - Find more info here: <https://www.nps.gov/articles/lesser-long-nose-bat.htm>
- C. Slide 3: Explain that many bats migrate to find food, warmer weather, and to raise young. The LLNB migrates north from Mexico in the spring, relying on cactus flowers like cardón and saguaro along the way. Indicate the path that the LLNB follows on the map.
- D. Slide 4: When LLNBs head south in the fall, they follow a slightly different route and rely on flowers from a different plant - Palmer's Agave. Point out the graphic showing an agave plant. Indicate the path that these bats follow south on the map and point out where it passes through New Mexico.

### 2. Migration Activity (5 minutes)

- A. Slide 5: Setup
  - Ask students to stand up and make two parallel lines stretching from one end of the room to the other. The two lines should face each other, with a few feet between each student and several feet between the two lines.
  - Tell students in one line they are **saguaro** cacti. Have them put their arms up, bent at the elbow like a saguaro. Give the first student in this line a **Mexico** sign and the last student in line the **Arizona** sign.
  - Tell the other line that they are **agave** plants. Have them hold their arms straight and at an upward angle like agave leaves. Give the first student in this line a **Mexico** sign and the last student the **New Mexico** sign.
- B. Slide 6: Pass the balloon north
  - Show the students the inflated balloon and tell them it is a bat in Mexico, ready to fly north in the spring. Show them this slide, which shows a blooming saguaro and non-blooming agave and ask which plant has flowers for the bats to feed on (the **saguaro**).



- Tell the saguaro line they must get the balloon-bat to Arizona using a one-handed tap, and not to let it touch the ground. Toss the balloon to the student holding the Mexico sign and let it travel to the other end.
- C. Slide 7: Pass the balloon south
- Tell the students that the balloon-bat will spend the summer in Arizona. Then fall arrives. Show this slide with a non-blooming saguaro and a blooming agave and ask them which plant has flowers for the bat to feed on now (**agave**).
  - Toss the balloon to the student holding the New Mexico sign and let them pass the balloon down the line with one-handed taps.
- D. Slide 8: Once the balloon has returned to Mexico have all students return to their seats. **Pass out worksheets and divide students into groups of 2 or 3.** Point out the graphic showing how they modeled the real migration of the LLNB and learned that bats need agave when they migrate through New Mexico every year.

### 3. Group Work Set Up (15 minutes)

- A. Slide 9: Explain that **if we want to protect these amazing bats, we need to protect the agave they rely on**. Read the information about the [Agave Restoration Project](#) on this slide:
- Agave is threatened by drought, land development, and overgrazing.
  - Agave has many traditional uses including tequila, fibers, soap, and livestock feed.
  - Click the “Watch Video” icon to watch a 1-minute YouTube video about The Agave Restoration Project (<https://youtu.be/mCfmz4Bx2lo?feature=shared>)
- B. Slide 10: Read the slide to introduce the problem of the day. We know we need to protect agave habitats for the bats in New Mexico. However, we must be careful about *which* agave habitats we choose to protect, since we can’t protect all of them. Explain that the map shows a portion of New Mexico, and use the map key to show students that the green areas on the map are agave habitats – there are quite a lot of them!
- C. Slide 11: Before we can choose which agave habitats to protect, what do we need to find out? Have students answer **question 1** on their worksheets.
- D. Slide 12: We need to find out *where* Lesser Long-Nosed Bats can be found in New Mexico in the fall (answer C). This will help us identify which agave habitats are most important to them and help us prioritize which ones to protect.
- E. Slide 13: Explain that each student group will be in charge of a study to find LLNBs. Using the map key, explain that the orange area is the [estimated range](#) where scientists expect to find LLNBs in New Mexico. This is our search area.
- F. Slide 14: Read the slide to explain that students will learn about 3 different bat study methods. They will only be able to choose 1 of these to help them learn about where LLNBs are found in New Mexico, so they should listen carefully.
- Slide 15: Community Science (Note: click the video link to watch the **first minute** of a YouTube video showing a Lesser Long-Nosed Bat visiting a hummingbird feeder in New Mexico, [https://youtu.be/8\\_f\\_UL-6GnU?feature=shared](https://youtu.be/8_f_UL-6GnU?feature=shared). An interesting background note for this video: it was taken by the community scientist who first discovered these bats in Glenwood

in 2022, which the students who choose this study method will later learn extended the known range of this species by ~ 30 miles north).

- Slide 16: Sound Recording (Note: click the video link to watch a 15-second YouTube video of a bat call made audible to human ears, <https://youtu.be/Z8oZWmsF3DQ?feature=shared>)
  - Slide 17: Radio Tracking (Note: click the video link to watch the first 1.5 minutes of a YouTube video showing the steps of a bat radio tracking survey, <https://youtu.be/sMMDJf3RtIQ?feature=shared>. A bat in this video is harmlessly captured and restrained, its fur is trimmed, and then a transmitter is painlessly glued to its fur. We suggest you explain this to students as they watch the video, as they may think the scientists cut the bat's skin.)
- G. Slide 18: Give students a few minutes to complete the “To Do” list on this slide.
- As a group they must choose one research method.
  - Each student should answer **questions 2 and 3** on their worksheet.
- H. Slide 19: Before giving students the information about their chosen research method, you will do an example together. Read these slides to **quickly** guide students through each step of the activity using the Infrared Camera Study as a practice.
- Slide 20: Click the video icon to watch the **first minute** of a YouTube video showing footage of bats taken with an infrared camera (<https://youtu.be/-k7pDrgxlW8?feature=shared>)
  - Slide 21: Students will receive an envelope with their chosen study method. Grab the example envelope with the “Bat Study Methods: Infrared Camera Survey” page on the outside. Do not open the envelope.
  - Slide 22: This is the page from the outside of the envelope. It will give students more information about how the data were collected and the advantages and disadvantages of this method. As you read the page out loud, point out that the map shows where the cameras for the study were set up.
  - Slide 23: Explain that students will answer questions 4 and 5 after reading their study methods page, like the example shows. Then they can remove the Results page from inside the envelope.
  - Slide 24: Read the Results page, which shows on the map where LLNBs were detected and any other information learned from the study.
  - Slide 25: Explain that after reading the Results page, students should answer question 6 on their worksheet. In the example study, the two agave habitats that were chosen were the same two habitats where the infrared cameras detected LLNBs.

#### 4. Group Work (10 minutes)

- A. Slide 26: Let the students know that now it is their turn. Leave this slide with a new “To Do” list on the screen and hand out envelopes to student groups based on the method they chose. Students should answer **questions 4 - 6**.

#### 5. Class Discussion (25 minutes)

- A. Slide 27: After students have answered question 6, explain that you will now review the results of each method as a class. For each of the 3 study method results slides

below: go over the advantages and disadvantages of each method, point out the bat symbols on the map (these show where LLNBs were found during this study), and have the student groups that chose that method go to the large laminated map in turn. Give them a dry erase marker of the appropriate color and have them mark the two (only two) agave habitats they chose to protect with a checkmark and very briefly explain why they chose those habitats. Have the Community Science groups use a **red** marker, the Sound Recording groups use dark **green**, and the Radio Tracking groups use **blue** (substitute other colors if these are not available).

- Slide 28: Results – Community Science
  - Slide 29: Results – Sound Recording
  - Slide 30: Results – Radio Tracking
- B. Slide 31: Point out that now the bat symbols on the map are color coded to show where each study method found Lesser Long-Nosed Bats. The map also shows where the volunteers were located for the Community Science study, where the recorders were placed for Sound Recording, and where the Radio Tracking study was done. Lead a discussion about how and why different student groups found bats in different places and chose different agave habitats to protect (the agave habitats on the laminated map are labeled with letters to make it easier for you and the students to refer to them). A few notes on the suggested discussion questions that are provided on this slide:
- Gap in the map: Students may notice that no LLNB's were found in the middle region of map (around Lordsburg). Point out that we didn't have any study sites in that area, so LLNB's *may* be found there, but we don't know since we didn't do any studies in that region.
  - Next Study: Because of the gap in the map, this middle region might be a good place to do a new study.
  - Unexpected discoveries: There are always surprises in scientific investigations! As the "Unexpected Discovery" section of the Radio Tracking handout describes, this method also revealed an important, previously unknown LLNB roosting site in a cave. The Sound Recording method revealed that a higher number of bat species were identified in the area than was previously known. The Community Science method revealed that LLNBs can be found further north than was previously thought. (This is based on an actual community science program during which a volunteer saw a LLNB in Glenwood, which is outside the orange area indicating the known range of LLNBs on the map. The video on slide 15 was taken by this volunteer.)
- C. Slide 32: Review any take-away lessons that you uncovered as a class, and help students understand that no particular group was "right" or "wrong." They were simply making different decisions because they had different information. This shows why sharing data and looking at the results from multiple studies is so important. Point out that some studies only found bats in one or two places, but they also revealed a lot of detailed information that will help scientists protect these bats in other important ways. Have students answer **question 7** on their worksheet.

## References

*LLNB migration: Arizona-Sonora Desert Museum Migratory Pollinators Program*

[https://www.desertmuseum.org/pollination/bat\\_results.php](https://www.desertmuseum.org/pollination/bat_results.php)

*Estimated range of LLNB: IUCN Red List*

<https://www.iucnredlist.org/fr/species/136659/21988965#conservation-actions>

*LLNB records in NM (see map below):*

- *An overview of the mammals of the Gila region, New Mexico.* Jones, A. K. et al (2021) <https://mastozoologiamexicana.com/therya/index.php/THERYA/article/view/1123>
- *Northernmost record of the long-nosed bat in New Mexico: Conservation Implications.* Laws, J. et al. (2023) [https://wwwjournal.org/wp-content/uploads/sites/9/2023/02/Laws\\_etal\\_WW\\_2023.pdf](https://wwwjournal.org/wp-content/uploads/sites/9/2023/02/Laws_etal_WW_2023.pdf)

*Agave habitats in NM:*

- *iNaturalist* [https://www.inaturalist.org/observations?place\\_id=9&subview=map&taxon\\_id=158098](https://www.inaturalist.org/observations?place_id=9&subview=map&taxon_id=158098)
- *Modeling the Distribution of Palmer's Agave.* Burke, R. A. (2010) [https://geography.nmsu.edu/masters-program/RBurke\\_MastersOfAppliedGeographyThesis.pdf](https://geography.nmsu.edu/masters-program/RBurke_MastersOfAppliedGeographyThesis.pdf)

*Radio tracking LLNBs:*

- *Landscape movements by two species of migratory nectar-feeding bats.* Bogan, M. A. et al. *Western North American Naturalist.* <https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=2358&context=wnan>

*Recording and identifying bat sounds:*

- <https://www.wildlifeacoustics.com/products/song-meter-mini-2-bat-aa>
- <https://www.wildlifeacoustics.com/products/kaleidoscope-pro>

*Community Science with LLNBs:*

- *Citizen Science eDNA Project, Bat Conservation International* <https://www.batcon.org/citizen-science-edna-project-faqs/>



*The locations of agave habitats and LLNB detections in this lesson are based on real data:*

