Mexican Free-Tailed Bats: Structures & Functions Prekinder – Grade 2

Learning Objectives

1. Students will identify external structures of Mexican free-tailed bats.
2. Students will identify how the external structures of Mexican free-tailed bats allow them to interact with their environment and meet their basic needs.
3. Students will compare and contrast Mexican free-tailed bats and humans.

Essential Questions

1. What are the external physical structures of Mexican free-tailed bats?
2. How do the external structures of Mexican free-tailed bats allow them to interact with their environment and meet their basic needs?
3. How are the external structures of Mexican free-tailed bats similar to humans? How are they different?

Time Needed

• Engage: Meet the Mexican Free-Tailed (MFT) Bat	20-30 minutes
• Explore 1: Bat Structures	20-30 minutes
• Explore 2: How do MFT bats interact with their environment?	30-40 minutes
• Explain: How are MFT bats and humans similar and different?	15-20 minutes
• Elaborate: Bat Kid	20-30 minutes
• Evaluate: What did you learn?	15 minutes

Texas Essential Knowledge & Skills (TEKS)

Texas Prekindergarten Guidelines
• PK4.VI.B.1 Child observes, investigates, describes, and discusses the characteristics of organisms. o describe the color, size, and shape of organisms o describe an organism's need for food, water, air, light, and shelter o compare differences and similarities of animals and plants (e.g., fish live in water, all birds have feathers, we can eat some plants)

2017 Science TEKS	Science TEKS, Approved by SBOE 2021 *implementation begins fall 2024*
• K(10)(B) identify basic parts of plants and animals • 1(10)(A) investigate how the external characteristics of an animal are related to where it lives, how it moves, and what it eats • 2(10)(A) observe, record, and compare how the physical characteristics and behaviors of animals help them meet their basic needs	• K(13)(B) identify the different structures that animals have that allow them to interact with their environment such as seeing, hearing, moving, and grasping objects • 1(13)(A) identify the external structures of different animals and compare how those structures help different animals live, move, and meet basic needs for survival • 2(13)(B) record and compare how the structures and behaviors of animals help them find and take in food, water, and air
Scientific and Engineering Practices Approved by SBOE 2021	
• Kinder-Grade 2(1)(F) record and organize data using pictures, numbers, words, symbols, and simple graphs	
Recurring Themes and Concepts Approved by SBOE 2021	
• Kinder-Grade 2(5)(F) describe the relationship between the structure and function of objects, organisms, and systems	

2018 Social Studies TEKS	Social Studies TEKS Adopted by SBOE 2022 *implementation begins fall 2024*
• K(4)(A) identify the physical characteristics of place such as landforms, bodies of water, Earth's resources, and weather • 1(4)(B) locate and explore the community, Texas, and the United States on maps and globes	• K(4)(A) identify the physical characteristics of place such as landforms, bodies of water, Earth's resources, and weather • 1(4)(B) locate and explore the community, Texas, and the United States on maps and globes

• 1(5)(A) identify and describe the physical characteristics of place such as landforms, bodies of water, Earth's resources, and weather • 2(3)(A) identify and use information on maps and globes using basic map elements such as title, cardinal directions, and legend • 2(4)(B) locate places, including the local community, Texas, the United States, the state capital, the U.S. capital, and the bordering countries of Canada & Mexico on maps & globes	• 1(5)(B) identify and describe the physical characteristics of place such as landforms, bodies of water, Earth's resources, and weather • 2(3)(A) identify and use information on maps and globes using basic map elements such as title, cardinal directions, and legend • 2(4)(B) locate places, including the local community, Texas, the United States, the state capital, the U.S. capital, and the bordering countries of Canada and Mexico on maps & globes

Next Generation Science Standards (NGSS)

- **1-LS1-1** Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

The performance expectation listed above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science & Engineering Practices Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. • Use materials to design a device that solves a specific problem or a solution to a specific problem.
Disciplinary Core Ideas LS1.A: Structure and Function • All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. LS1.D: Information Processing • Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.
Crosscutting Concepts Structure and Function • The shape and stability of structures of natural and designed objects are related to their function(s).

Academic Vocabulary

From: lead4ward Kinder-Grade 12 Academic Vocab https://lead4ward.com/resources/

Kinder	Grade 1	Grade 2
• animal • basic needs of animals • basic parts of animals (limb, eye, head, tail, fin, wing, mouth, etc.) • body covering (fur, feathers, scales, hair, etc.) • characteristic • organism • resemble • structure • survive	• appendage • body shape • external characteristic • habitat • moves (legs, wings, fins) *Previously introduced* • animal • body covering • organism • resemble • survival	• behavior • communication • environment • migration • movement *Previously introduced* • basic needs of animals (water, food shelter, air) • organism • physical characteristics of animals (color, body covering, size)

Background Information

Bats are unique and fascinating animals. They are the only mammals capable of true flight. They belong to the order Chiroptera which includes more than 1,400 bat species. They live on every continent, apart from Antarctica, and have survived on Earth for over 50 million years (BCI, 2023).

Mexican Free-Tailed Bats

This lesson focuses on one species of bat that is native to North, Central, and South America, the Mexican free-tailed bat, *Tadarida brasiliensis*. These bats are also called Brazilian free-tailed bats.

- Habitats
  Mexican free-tailed bats live in a variety of habitats, including caves, abandoned mines, culverts, bat houses, and under bridges. The colonies of this species tend to be large, reaching hundreds of thousands, even millions of bats.

- Distribution
  In North America, most Mexican free-tailed bats are migratory. They spend the summer months in the central and southern United States where males and females roost separately. The females form maternity colonies where they each give birth to and raise a new pup. Males form smaller bachelor colonies.

In the summer, Mexican free-tailed bats are found throughout Texas. Although some appear to stay in Texas year-round, most of the western sub-species of Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) that spend the summer in Texas migrate to Mexico in the autumn. The subspecies, *Tadarida brasiliensis cynocephala* lives in the eastern quarter of Texas year-round. Due to their wide distribution throughout the state, Mexican free-tailed bats are designated as the state's official flying mammal (Texas Tech University, 2023).

- Diet
  Mexican free-tailed bats are insectivores that primarily feed on moths. They also eat other flying insects such as beetles, flies, true bugs, and ants, to name a few. Insectivore bats play an important role in controlling the insect population. It is estimated that one nursing Mexican free-tailed bat eats at least her body mass in insects every night. An adult female Mexican free-tailed bat has a mass of about 12 grams. This means each night a nursing Mexican free-tailed bat eats roughly 12 grams of insects, which is about the same mass as 2 quarters or 1 AAA battery. This may not seem like a lot, but 20 million bats each consuming 12 grams of insects every night adds up to 220 tons of insects. That's the approximate mass of 55 elephants – consumed each night!

- Role in the Ecosystem
  Mexican free-tailed bats play an important role in the ecosystem. Large populations help control insect populations. When they live near farmland, Mexican free-tailed bats protect agricultural crops from pests. Bats also are a food source for many animals including hawks, owls, raccoons, and snakes.

- Echolocation
  One of the *Deep in the Heart* videos included in this lesson, *Bats of Bracken Cave* mentions echolocation. In addition to sight, a Mexican free-tailed bat relies on echolocation to navigate its environment and hunt prey. A bat emits high-frequency sounds through its mouth or nose that are too high for a human to hear. These sounds bounce off objects and return to the bat as echoes which provide information about the distance and size of objects around it. The echolocation calls of Mexican free-tailed bats range between 20 and 75 KHz, depending on habitat and weather conditions (BCI, 2023).

- Communication
  Mexican free-tailed bats also make a variety of social vocalizations including isolation calls, begging calls, and multi-syllabic songs (BCI, 2023). Each night a mother bat leaves the cave to hunt. She leaves her new pup in the cave, huddled with the other pups in the colony. Upon her return, she uses calls and smells to find and nurse her own pup. An amazing feat in a colony of millions!

- Structures & Functions
  - Mexican free-tailed bats' fur varies in color and may include shades of dark brown, rusty brown, and gray.
  - A bat's body is adapted for flight. Its chest and shoulders are larger with muscles that provide power to the wings. Its hips and legs are slender (Wilson, n.d.).
  - An adult Mexican free-tailed bat has a mass of about 12 grams, about the same as 2 quarters or 1 AAA battery.
  - An adult Mexican free-tailed bat's wingspan ranges from 11-14 inches, and its body length ranges from 3.5-4 inches.
  - A bat's wing has a similar bone structure to a human's hand. The bones of a bat's wing are connected by a thin membrane of skin. The thumb, however, is free from the wing membrane, has a claw at the end, and is used for crawling and climbing. (Bonus fact: As mentioned above, bats are mammals that belong to the order Chiroptera. This name comes from the Greek words, "cheir" which means hand, and "pteron" which means wing.)
  - The uropatagium is a skin membrane that extends between the legs and tail of a bat. In many bat species, the uropatagium extends from the legs to the entire length of the tail. However, in Mexican free-tailed bats, some of the tail extends beyond the uropatagium. This is why this species has "free-tailed" in its name. Other species of bats also have this feature. All free-tailed bats are classified in the Molossidae family which is the 4th largest family of bats. The Molossidae family includes over 100 bat species that live in North America, South America, Europe, and Africa. Insectivores, like the Mexican free-tailed bat, use the uropatagium to catch insects mid-flight.
  - Mexican free-tailed bats have small dark eyes. They see about as well as humans see in the dark. To hunt and navigate their environment at night, Mexican free-tailed bats rely on echolocation.

- Conservation Status
  Mexican free-tailed bats are classified as "Least Concern" on the International Union for Conservation of Nature's (IUCN) Red List. They currently have a broad geographic range and large population sizes. They have adapted to living in urban areas and roost in human-made structures such as houses, tunnels, and under bridges. Potential conservation threats to this species include habitat loss, the impacts of climate change, wind energy development, accumulation of pesticides in their diet, and persecution.

Bracken Cave
Texas is home to the world's largest bat colony and one of the largest concentrations of mammals on Earth. Bracken Cave, located along the southeastern edge of the Hill Country near San Antonio, Texas, is home to approximately 20 million Mexican free-tailed bats. This population is a maternity colony, consisting of females and their pups. The emergence of these millions of bats as they leave the cave at dusk during the spring, summer, and fall for their nightly insect hunt, is an unforgettable sight. They fly out of the cave in a spiral that looks like a tornado, a tornado of bats, a batnado!

Congress Avenue Bridge in Austin, Texas
The largest urban colony of bats in the world is made up of an estimated 1.5 million Mexican free-tailed bats that live under the Congress Avenue Bridge in Austin during the summer. The emergence of this colony each night has become one of the city's most popular summer tourist attractions.

Threats to Bats Worldwide
Bat populations are declining worldwide. Some of the main reasons for their population declines include:

- Human activity that destroys bat habitats such as cutting down forests, mining guano (bat poop), and thoughtless tourism into caves and abandoned mines.
- The impacts of climate change harm bat populations. Some examples include:
  - Increased extreme weather events increase bat mortality.
  - Increased aridity and drought make it difficult for some bat populations to survive and reproduce.
  - Changes in seasonal timing negatively impact bats that migrate.
- A disease called white-nose syndrome is currently spreading throughout bat populations in the United States and Canada. This disease is caused by a fungus that infects hibernating bats.

- Bats are hunted for sport and meat.
- Dead bats are found under wind turbines worldwide. While wind turbines are a step toward reducing our reliance on fossil fuels, they are negatively affecting bats.
  (BCI, Bats 101, 2024).

Common Misconceptions about Bats

Myth	Facts
Bats are blind.	No. All bats are able to see. There is variation in eyesight from species to species. Some bat species have night vision which allows them to see in dimmer light, similar to the adaptation of a cat's eyes. Some species of bats can see ultraviolet light. Other bat species, like the Mexican free-tailed bat, rely on echolocation to navigate and hunt in the dark. While these species do not see well in the dark, they are still able to see. Their night vision is similar to that of a human's (BCI, FAQ, 2023).
All bats drink blood.	No! Of the 1,400+ species of bats on Earth, only three are vampire bats that feed on blood. These three species all live in the New World tropics (i.e., South America, Central America, and Mexico) (BCI, FAQ, 2023). Vampire bats do not actually suck blood. Instead, they use sharp, pointed front teeth to make small cuts in the skin of another animal and then lap up the blood. The saliva of these bats has proteins that prevent wounds from clotting. This anticoagulant has been developed into a medication that helps prevent strokes in humans (BCI, Common Vampire Bat, 2023).
Bats will fly into your hair.	No! Bats are not attracted to human hair. This is an old misconception. This idea could have evolved from humans seeing bats foraging for insects low, just above people's heads. Bats are able to catch small flying insects mid-flight and can definitely avoid a human head! (Virginia Department of Wildlife Resources, 2023). This myth may

	have been told as a way to deter young women from going out at night (Neighborhood Bat Watch, n.d.).
All bats have rabies.	Most bats do NOT have rabies. It is estimated that less than 0.005% of bats in wild populations contract the rabies virus (Idaho Fish and Game, 2005). Even among bats submitted for rabies testing in the U.S., only about 6 percent had rabies (Florida Fish and Wildlife Conservation Commission, 2024). All mammals can contract rabies. In 2021, 8,686 mammals (multiple species) in Texas were tested for rabies. Of those 8,686 animals, 455 (5%) were positive for rabies. In 2021, skunks were the primary source of positive rabies cases in Texas and bats had the second-highest number of confirmed rabies cases (Texas Department of State Health Services, 2021). It is very important to NEVER touch a wild animal, including a bat. If you find a bat on the ground or out during the daytime, there is a high chance that it is sick or injured. If you encounter a bat in a building or on the ground, contact a local rescue organization to help (BCI, FAQ, 2023).
Bats are not that important. Bats are "vermin" and should be exterminated.	Not true! All around the world, bats provide vital ecosystem services such as insect pest consumption, plant pollination, and seed dispersal. They are essential to the health of global ecosystems (BCI, Bats 101, 2023).
Bats are flying mice.	No! The most recent studies using gene comparisons suggest that bats are in the superorder Laurasiatheria. Bats' exact placement within the Laurasiatheria superorder is still uncertain, but they are thought to share a most recent common ancestor with hooved animals like horses and antelope as well as carnivores (Tsagkogeorga et al., 2013).

All bats are the same.	There are over 1,400 different bat species worldwide that vary in size, appearance, and characteristics. 32 of those species live in Texas.

Tips for Addressing Concerns/Fears About Bats

Many people are afraid of bats. For some people, this may stem from a personal experience. However, most people have never been close to a bat. They may have seen the silhouette of a bat flying at night but have never encountered a bat in close range. This means that a fear of bats often comes from social cues.

Some of the common myths listed above may teach people to fear bats. The way bats are depicted for Halloween could also make people leery of bats. These portrayals may come from the fact that bats are different than us. They are active at night and live in dark spaces like caves. A fear of bats may develop due to unfamiliarity.

Watch carefully for your students' reactions as you introduce bats in the Engage section of this lesson. If you notice any fears or discomfort, gently address these concerns directly. Ask students to share what they know about bats and any previous experiences they've had with bats. Use the information in this background reading to speak to any misconceptions students have about bats. Encourage students to become curious about bats, to learn more about bats through this lesson, and see if any of their ideas about bats change by the end of the lessons.

As students observe Mexican free-tailed bats in pictures, diagrams, and videos throughout this lesson, they may develop the opinion that Mexican free-tailed bats are cute! They are small, furry, and curious about what is going on around them.

There are legitimate reasons to steer clear of bats. Like all wild animals, bats should never be touched. If a bat is found on the ground and/or outside during the day, it may be sick. Give the bat plenty of room and contact a local rescue organization to help. Like all mammals, bats can have rabies. This is one reason why one should never touch a bat or any other wild animal.

The organization Bat Conservation International (BCI) is leading the charge to ensure the worldwide survival of bats. Part of their conservation work includes teaching people

about specific bat species and the ecological and economic value of this extraordinary mammal.

Learn more about BCI's conservation work and bats in general here: https://www.batcon.org/our-work/inspire-through-experience/

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Optional Literacy Connections

- *Frankie the Free-Tailed Bat* by Nyta Hensley & Patricia Morton, Illustrated by Steve Stratakos
- *The Bat Book* by Charlotte Milner
- *Bats Biggest! Littlest!* by Sandra Markle
- *Fly Guy Presents Bats* by Tedd Arnold

Materials

Per Class

- *Deep in the Heart: A Texas Wildlife Story* Mexican Free-Tailed Bats: Structures & Functions Prekinder – Grade 2 PowerPoint
  - English: https://docs.google.com/presentation/d/1zFHVJBwM4zxJ2zeO9rj6_Sv9pWY1znUp/edit?usp=sharing&ouid=103309533954542071568&rtpof=true&sd=true
  - Spanish: https://docs.google.com/presentation/d/1lw_SpEgm7lGBCgLcyYq8tjDHP_WkuSNF/edit?usp=sharing&ouid=103309533954542071568&rtpof=true&sd=true
- Large piece of chart paper (or whiteboard or smartboard)
- Markers to write on the chart paper - 3 different colors
  - Color 1 = To record student observations of images of MFT bats
  - Color 2 = To record student observations of a bat diagram
  - Color 3 = To record student observations of bat videos & slides
- Videos:
  - *Deep in the Heart: A Texas Wildlife Story Bats of Bracken Cave* video https://youtu.be/H-q58Jd50Lk?si=gm5xZp_WkthqGXd0
  - How do bats catch bugs? by BatBnB https://youtu.be/zd-X3Pi8Oz0?si=KSCYDACTPu-Y1HTp
- 2 quarters or 1 AAA battery
  to represent the mass of a Mexican free-tailed bat ~12 grams

Per Student

- Ruler or measuring tape
- 'Mexican Free-Tailed Bats & Humans Venn Diagram' (page 21 for English & page 24 for Spanish)
- 'Bat Kid' handout (page 22 below for English & page 25 for Spanish)
- 'What did you learn?' handout (page 23 for English & page 26 for Spanish)

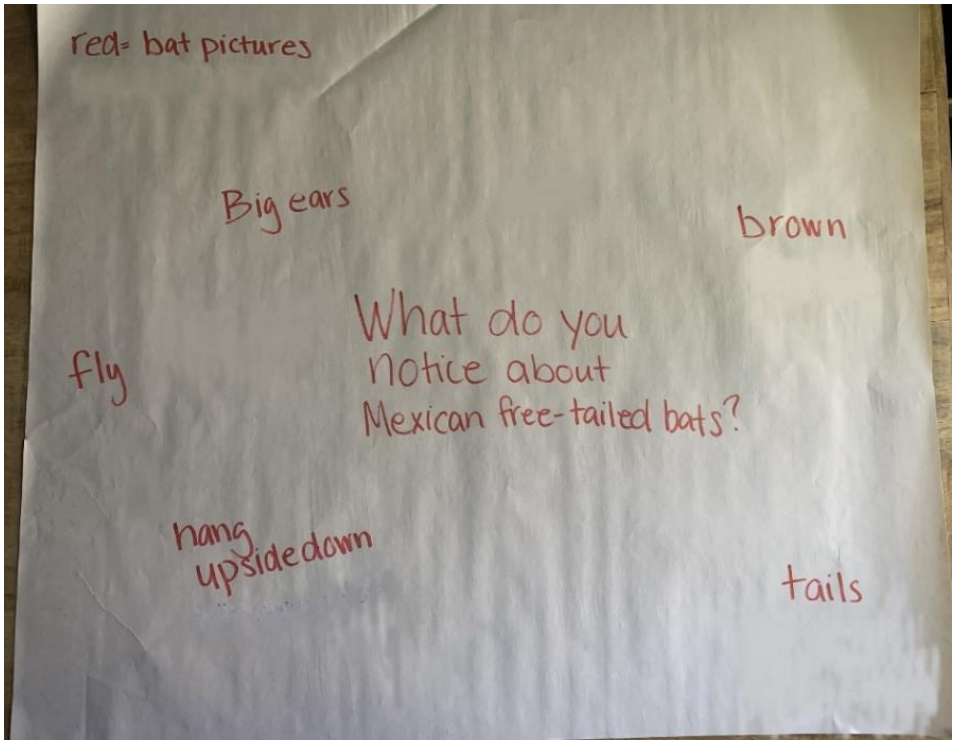
Prep

1. Consider downloading the PowerPoint files instead of viewing them in Google Drive so you have access to the embedded videos and animations.
2. Preview the videos ahead of time to make they work with your technology. See the links in the Materials List above.

Engage – Meet the Mexican Free-Tailed Bat

1. Activate students' prior knowledge by asking,
    a. "When you hear someone talk about a bat, what image forms in your mind?"
    b. "What do you know about bats?"

    Tell students to think about their responses to these questions quietly to themselves. Then have a few students share out.
2. Show students the images of Mexican free-tailed bats on PowerPoint slides 2-6.
3. Ask students to turn to their "elbow partner" (a person sitting next to them) and share one thing they noticed about the Mexican free-tailed bats in the images. Tell students to take turns speaking and listening.
4. As a class, create a "layered brainstorm chart." To do this:
    a. In the center of a piece of chart paper (or whiteboard or smartboard) write, "What do you notice about Mexican free-tailed bats?"
    b. Use the same color marker to record all observations students make of the bats in the PowerPoint pictures.
    c. On the chart write the color of the marker = bat pictures, for example, "red = bat pictures."
5. Below is what the layered brainstorming chart could look like at this point in the lesson. Note: For younger students, consider adding sketches to this chart to depict student observations. Add a sketch to represent the words in the question and the chart key for younger students as well.



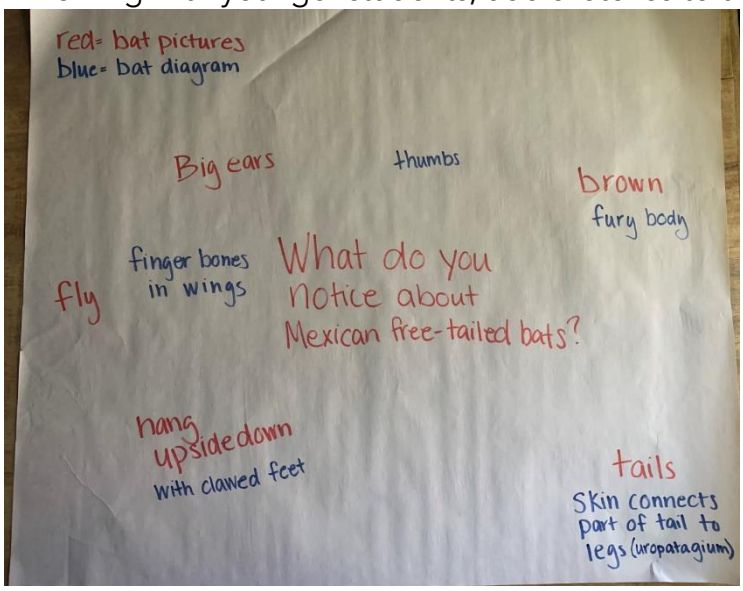
Explore 1 – Bat Structures

6. Show students the bat diagram on PowerPoint slide 7. Note: If you prefer to use a simpler diagram, see the bat diagram on PowerPoint slide 8. Complete this section of the lesson using the bat diagram (on slide 7 or slide 8) that works best for your students.
7. Ask students to turn to a different "elbow partner" and take turns sharing what they each notice about the bat diagram. Again, emphasize that students should take turns speaking and listening.
8. As a whole class, direct students' attention back to the layered brainstorm chart. Ask students to share observations to add to the chart based on what they learned through the diagram. Use a different color marker to record all observations students make of the bat diagram. On the chart write the color of the marker = bat diagram, for example, "blue = bat diagram." A reminder to use sketches if needed for younger students.
9. Additional information to guide the discussion:
    a. Mexican free-tailed bats' fur varies in color and may include shades of dark brown, rusty brown, and gray.
    b. A bat's wing has a similar bone structure to a human's hand. The bones of a bat's wing are connected by a thin membrane of skin.

c. The uropatagium is a skin membrane that extends between the legs and tail of a bat. In many bat species, the uropatagium extends from the legs to the entire tail. However, some of the tail of Mexican free-tailed bats extends beyond the uropatagium. This is why this species has "free-tailed" in its name. Other species of bats also have this feature. All free-tailed bats are classified in the Molossidae family which is the 4th largest family of bats. The Molossidae family includes over 100 bat species that live in North America, South America, Europe, and Africa.
d. Mexican free-tailed bats have small dark eyes. A common misconception is that bats are blind. However, Mexican free-tailed bats do rely on sight to navigate. In the dark, they can see about as well as a human can see in the dark. So to hunt at night, they use echolocation. If echolocation comes up in this discussion, discuss what students already know about echolocation and tell them they will learn more about echolocation in the next part of the lesson. (The video *Bats of Bracken Cave* mentions echolocation.)
e. Help students understand the size of a Mexican free-tailed bat:
    - Pass around 2 quarters. Tell students that an adult Mexican free-tailed bat has a mass of about 12 grams, about the same as 2 quarters. (Could also use 1 AAA battery or anything else with a mass of ~12 grams.)
    - Guide students to use rulers or measuring tapes to measure 11-14 inches across their desks. Tell students that an adult Mexican free-tailed bat's wingspan ranges from 11-14 inches.
        - Ask, "How many of your hands are equal to 11 inches?"
        - Have one student in the class hold up a ruler or measuring tape for you in a place where everyone can see. Then model how to stack your hands on top of each other to show how many of your hands fit inside 11 inches.
        - Tell students, "11 inches is about the same length as # of my hands. That means the wingspan of an adult Mexican free-tailed bat is about the same as # of my hands."
        - Ask, "How many of your hands fit inside 11 inches?"
        - Support students to determine how many of their hands are roughly equal to 11 inches. Guide students to make the connection between a Mexican free-tailed bat's wingspan and the size of their own hands.

- Guide students to use rulers or measuring tapes to measure 3.5-4 inches on their desks. This is the typical length of an adult Mexican free-tailed bat's body. Again, help students make a connection between this length and the size of their hands:
    - Ask, "How many of your hands are equal to 3.5 inches?"
    - Have one student in the class hold up a ruler or measuring tape for you in a place where everyone can see. Then model how to stack your hands on top of each other to show how many of your hands fit inside 3.5 inches.
    - Tell students, "3.5 inches is about the same length as # of my hands. That means the length of an adult Mexican free-tailed bat's body is about the same as # of my hands." (You may need to say, "3.5 inches is about the same length as 1/2 of one of my hands.")
    - Ask, "How many of your hands fit inside 3.5 inches?"
    - Support students to determine how many of their hands are roughly equal to 3.5 inches. Guide them to make the connection between a Mexican free-tailed bat's body length and the size of their hands.

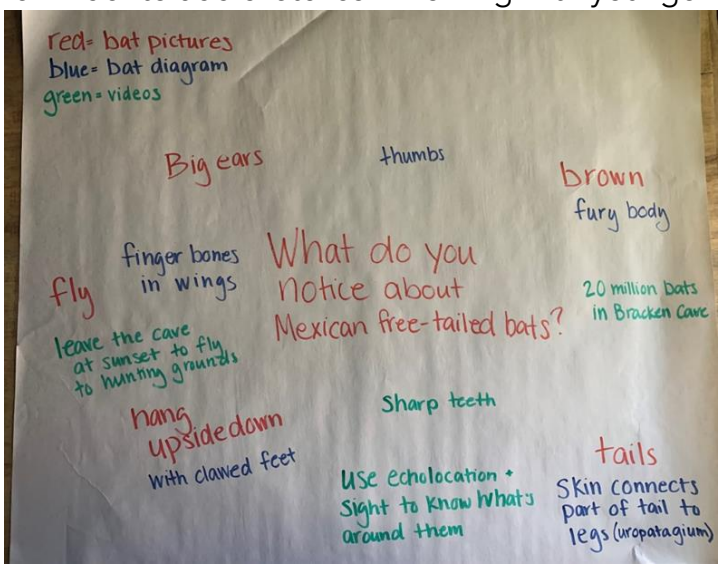
10. Here's what the layered brainstorming chart could look like at this point in the lesson. Again, if working with younger students, add sketches to the chart.



Explore 2 – How do Mexican free-tailed bats interact with their environment?

11. Show students the map of North America on PowerPoint slide 9. Ask them to locate Texas on the map. When showing the slides in presentation mode, an animation is set so a star will appear to identify the location of Texas.
12. Show students the map of Texas on PowerPoint slide 10. Ask them to locate Bracken Cave on the map. (Hint: Bracken Cave is located just outside of San Antonio, TX, to the northeast.) When showing the slides in presentation mode, an animation is set so a star will appear to identify where Bracken Cave is located.
13. Discuss where students live in relation to Bracken Cave. Questions to guide the discussion may include:
    a. Do you live north, east, south, or west of Bracken Cave?
    b. Have you ever been to Bracken Cave? What was it like?
    c. Have you ever been to any cave? What was it like?
14. Tell students they will now learn more about Bracken Cave and the bats that live there.
15. Show the *Bats of Bracken Cave* video. The clip is available here: https://youtu.be/H-q58Jd50Lk?si=gm5xZp_WkthqGXd0. It's also embedded on PowerPoint slide 11. This video is 4 minutes long.
16. After the video, add to the layered brainstorm chart using a third color marker. Use that color marker to write color = videos, for example, "green = videos." Again, use sketches if working with younger students.
    a. Note: This *Deep in the Heart* video, *Bats of Bracken Cave* touches on echolocation. It says, "In addition to sight, a bat relies on echolocation to navigate its environment. The bat emits high-frequency sounds through its mouth or nose that are too high for a human to hear. These sounds bounce off objects and return to the bat as echoes which provide information about the distance and size of objects around it."
    b. The echolocation calls of Mexican free-tailed bats can be highly variable, depending on habitat and weather conditions. They produce calls that range between 20 and 75 KHz. In addition to echolocation calls, Mexican free-tailed bats make a variety of social vocalizations, including isolation calls, begging calls, and multi-syllabic songs.
17. Next show students the following video of a bat catching a moth: *How do bats catch bugs?* by BatBnB https://www.youtube.com/watch?v=zd-X3Pi8Oz0. This link is also embedded on PowerPoint slide 12. This video is 23 seconds.

18. Record student observations from this video, using the same color of marker you selected for video observations.
19. Show students the questions and images on PowerPoint slides 13-18. Each odd-number slide includes a question followed by images on the next slide. Lead a class discussion around each question. Use the images to guide the discussion. The questions and discussion points are:
    a. How do Mexican free-tailed bats move?
        i. Mexican free-tailed bats use their wings to fly.
        ii. They use their wings, thumbs, legs, and feet to crawl on the ground and along the sides of caves and other structures.
    b. How do Mexican free-tailed bats hang upside down?
        i. Mexican free-tailed bats use the claws on their feet to hold on and hang upside down.
    a. How do Mexican free-tailed bats catch insects?
        i. Mexican free-tailed bats catch insects while flying.
        ii. A Mexican free-tailed bat uses its uropatagium, the skin membrane between its legs and tail, to scoop an insect into its mouth.
        iii. While Mexican free-tailed bats do rely on eyesight to some extent, they also use echolocation to determine the location of insects.
20. Return to the layered brainstorming chart. Ask students if there are any observations they made about Mexican free-tailed bats that are not on the chart. Use the marker color that you used for the video observations for these additional observations. The chart could look something like this at this point in the lesson. A reminder to add sketches if working with younger students.



Explain – How are Mexican free-tailed bats & humans similar & different?

21. Challenge students to use what they know about Mexican free-tailed bats to identify how Mexican free-tailed bats are similar to humans and how they are different.
22. Give each student a Venn diagram handout to complete. See page 21 below for the English handout and page 24 below for the Spanish handout.

Elaborate – Bat Kid

23. Challenge students by asking the question, "If you could add one bat structure to your body, what would it be?"
24. Tell students to turn to an "elbow partner" and talk about their initial ideas.
25. Then, either:
    a. Discuss students' ideas as a class. Questions to guide the discussion:
        - What bat structure would you add to your body?
        - How would you use this structure?
        - What would you do with it?
        - Would it make your life better: If so, how?

    OR

    b. Give each student a 'Bat Kid' handout to complete. See page 22 below for the English handout and page 25 below for the Spanish handout. Review the directions as a class and provide students time to complete the handout.

Evaluate – What did you learn?

26. Direct older students to complete the 'What did you learn?' handout. See page 23 below for the English handout and page 26 below for the Spanish handout.
    a. For younger students, return to PowerPoint slide 7 or 8 and discuss the following questions as a class:
        - What structures does a Mexican free-tailed bat use to catch insects?
        - What structures does a Mexican free-tailed bat use to move?

Name _____

Humans

Mexican Free-Tailed Bats

Name _____

Bat Kid

1. Think: If you could add 1 bat structure to your body, what would it be?
2. Draw a picture of yourself with that structure added.

3. How would you use this structure? What would you do with it? Would it make your life better? If so, how?

_____

_____

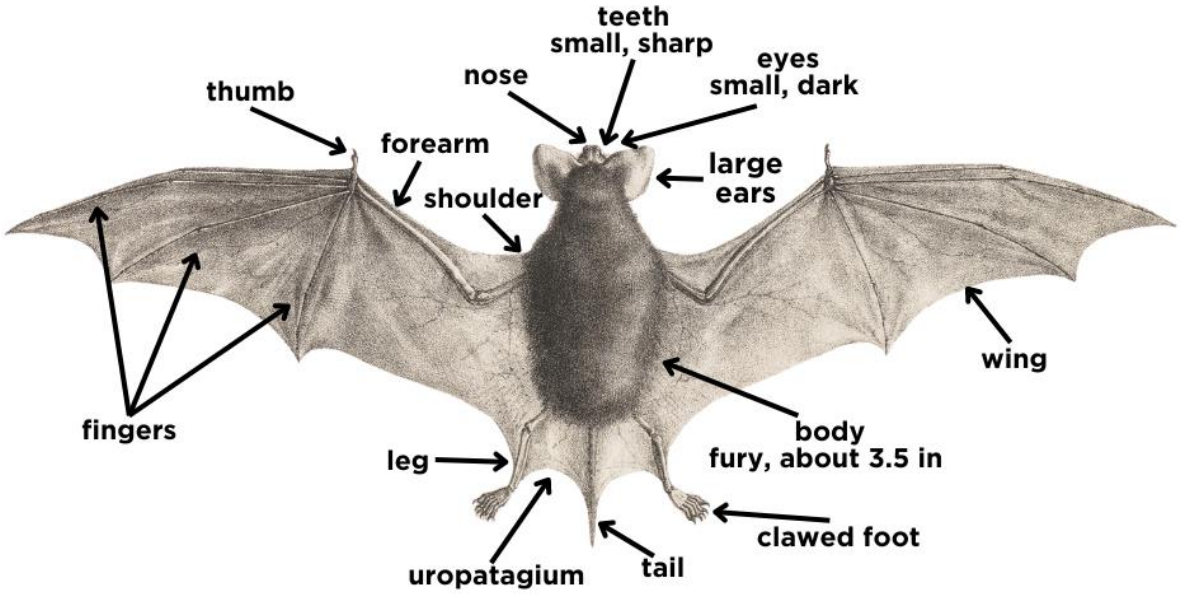
_____

_____

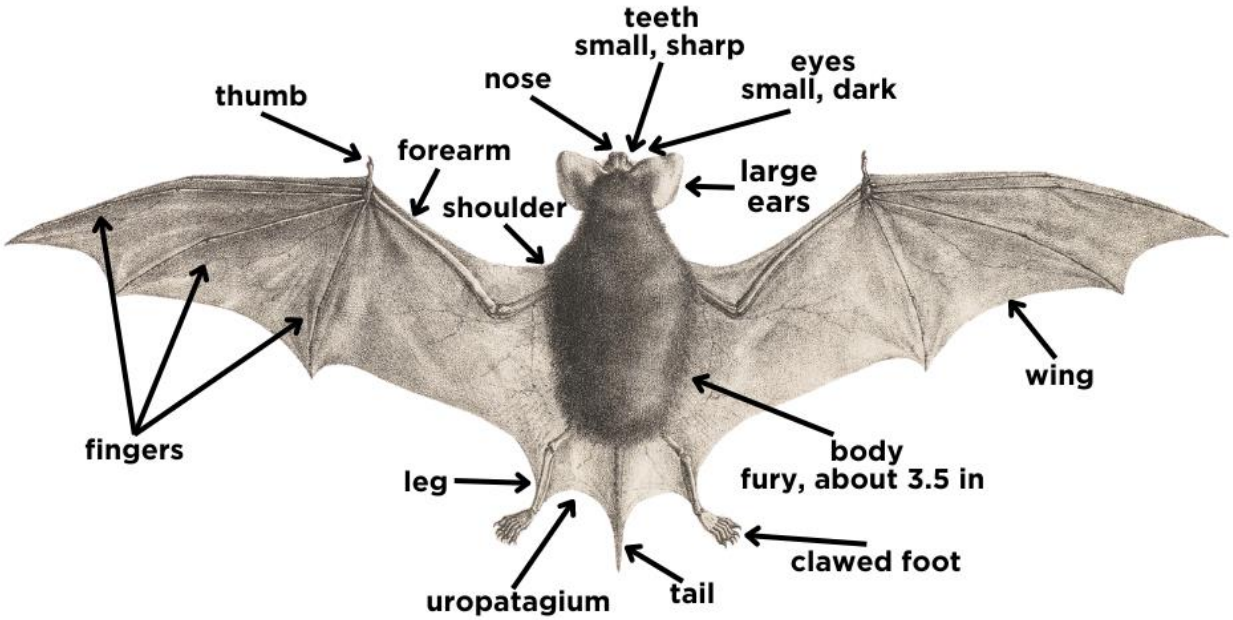
Name _____

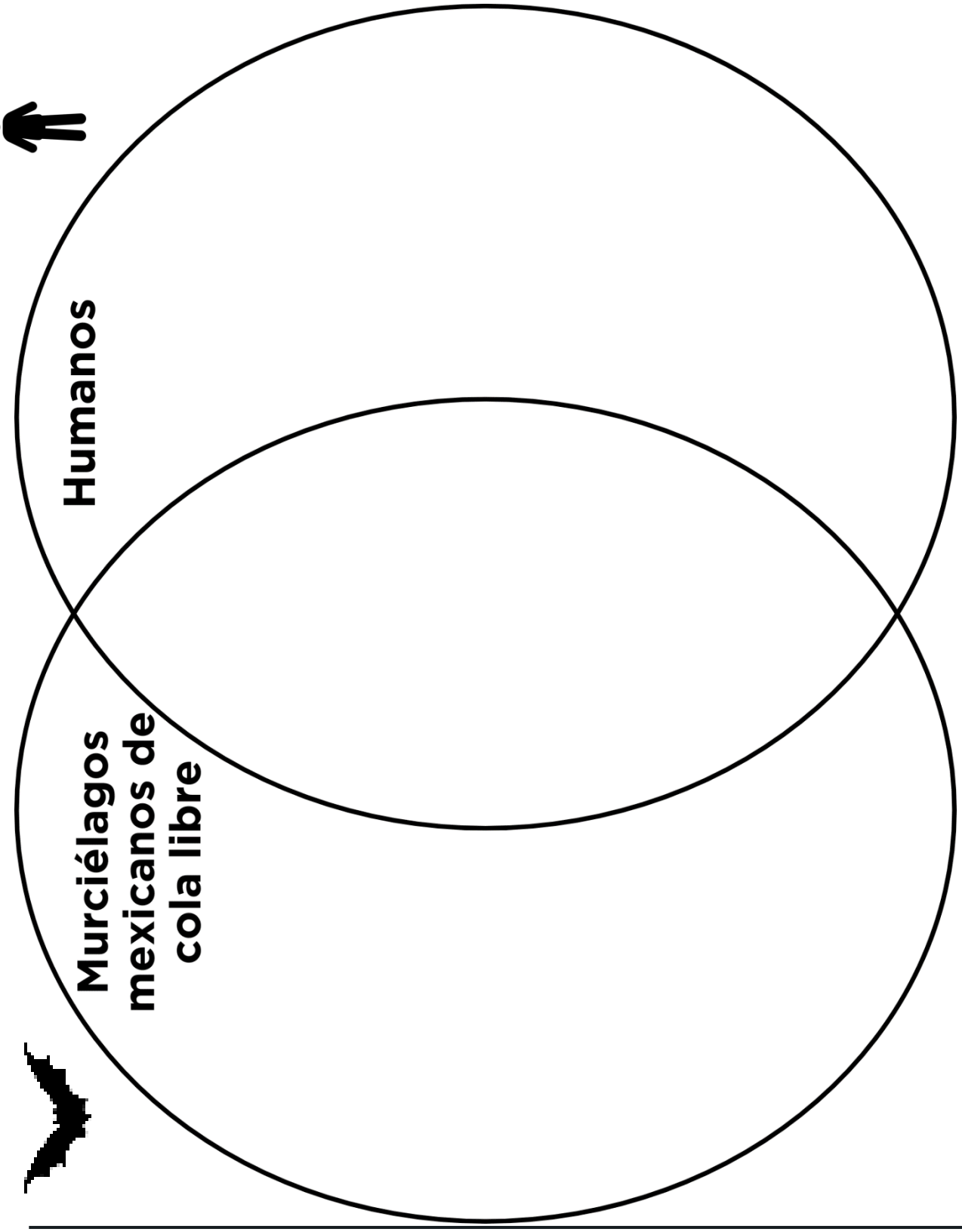
What did you learn?

1. Circle the structures a Mexican free-tailed bat uses to **catch insects**.



2. Circle the structures a Mexican free-tailed bat uses to **move**.





Nombre _____

Nombre _____

Niño murciélago

1. Piensa: Si se pudiera añadir 1 estructura de murciélago a tu propio cuerpo, ¿cuál sería?
2. Haz un dibujo de ti mismo con esta estructura agregada.

3. ¿Cómo usarías esta estructura? ¿Qué harías con ésta? ¿Te mejoraría la vida? Si es así, ¿cómo?

_____

_____

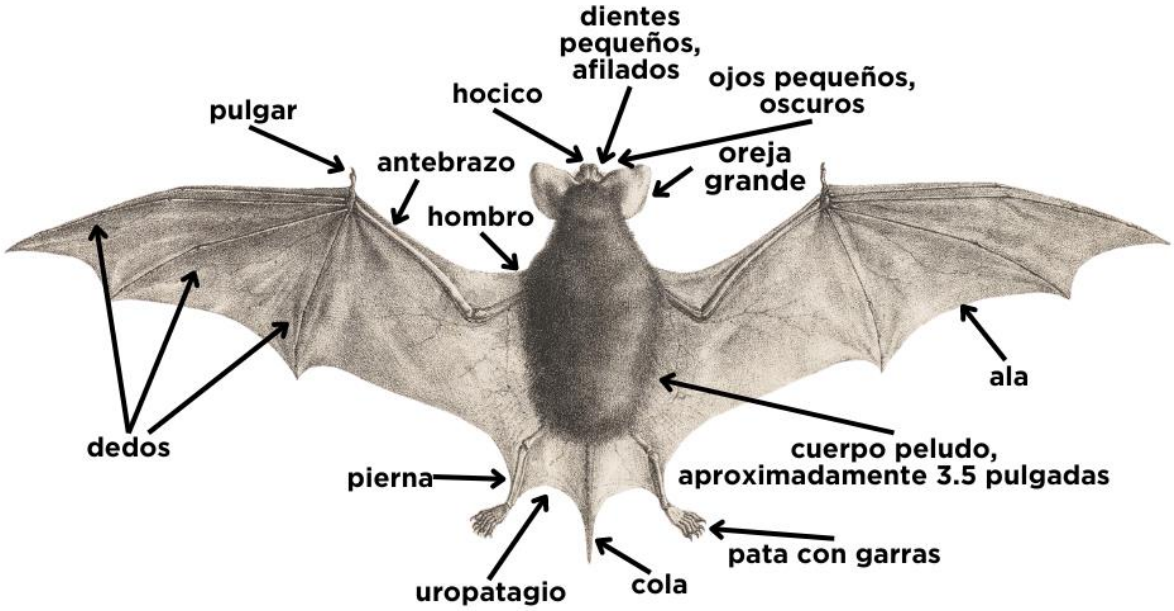
_____

_____

Nombre _____

¿Qué aprendiste?

1. Encierra en un círculo las estructuras que usa el murciélago mexicano de cola libre para **capturar insectos**.



2. Encierra en un círculo las estructuras que usa el murciélago mexicano de cola libre para **moverse**.

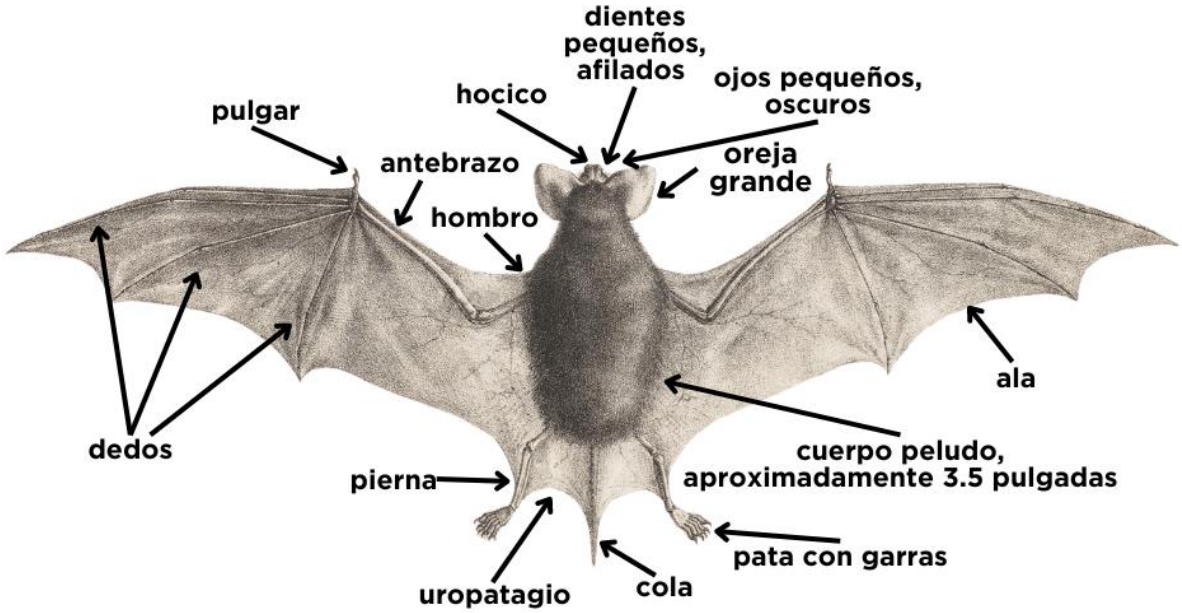


Image Sources

Sample Layered Brainstorming Chart Images by Deep in the Heart

Human icon created by Alice Design from Noun Project

Bats icon on the Venn diagrams created by Vallone Design from Noun Project

Mexican Free-tailed Bat Diagram – Bat Image by Iconographia Zoologica, Public Domain, https://commons.wikimedia.org/w/index.php?curid=55099120, labels added by Deep in the Heart October 2023