

How Do I Compare to a Bat?

Background

EXPLORATION QUESTION

“How does the anatomy, physiology, and behavior of bats compare to humans?”

MATERIALS

- Pencils
- Copies of Student Worksheet
- “How Do I Compare to a Bat” illustration (print at least one color copy)
- Bat skeleton (optional)
- Fabric wingspans or bat models
- Metric scales (less than 30 grams)
- Tape measure
- Stopwatch or clock with second Hand
- Weight scale for humans
- Can Goods (optional)
- Calculator (optional)

OVERVIEW

Children can learn a great deal about bats and themselves by comparing various aspects of their anatomy, physiology, and behavior. In this activity, children take their own measurements and compare them to those of two bat species found in the Eastern United States, the Eastern small-footed bat and big brown bat.

VOCABULARY

Adaptation, gravity, mammal, membrane, wingspan

GROUP SIZE

Any

AGE

7 - 10

Even though bats fly and people walk on the ground, bats and people are similar in many ways. That’s because both people and bats are mammals. With few exceptions, all mammals give birth to live young, nurse babies with milk, and have hair. There are over 4,000 named species of mammals in the world, and bats make up a quarter of all these species. Other mammals include dogs, cats, chipmunks, raccoons, elephants, monkeys, and whales.

Bats are the only mammals that can truly fly. Other mammals such as the “flying” squirrel and “flying” lemurs actually glide or parachute by means of a furred membrane. And, they have to climb a tree or other tall object to be able to glide. Only bats have the structural adaptations that allow for full powered flight. Flight has enabled bats to become one of the most widely distributed groups of mammals. Bats are literally found everywhere – except for the regions surrounding the North and South poles, and a few remote islands.

There are over 1,300 species of bats in the world and 47 species are found in the United States and Canada. The smallest of these bats in the Eastern United States is the Eastern small-footed bat and one of our largest is the big brown bat.

Number of fingers/Bat Wing

A bat’s wing is actually a modified hand. Refer to the bat skeleton and explain how the wing bones are greatly elongated fingers. This elongation of the bones is required to support the wing membrane. Compare the bones of the wing to the fingers on a human hand. Use the “How Do I Compare to a Bat” illustration to compare the finger bones. Also point out the thumb. The thumb, usually with a sharp claw, is not attached in the wing membrane but remains free. This helps the bat crawl around on rough surfaces.

The membrane of a bat’s wing is living tissue similar to the tiny flaps of skin joining the bases of our human fingers. Because the membrane of skin joins their long fingers from the bases to the tips, a bat’s fingers cannot flex independently. The muscles in the arm open up the hand/wing. The structure of the wing membrane, the arrangement of the bones supporting it, and the positioning of the muscles provide the bat with the lightness and maneuverability necessary for catching insects, hovering above flowers, or quickly avoiding obstacles.

Wingspan

Bat wingspans in the Eastern United States vary from about eight inches (the Eastern small-footed bat) to almost 20 inches (Wagner’s mastiff bat– found in southern Florida). The species evaluated in this activity include the Eastern small-footed bat and the big brown bat (wingspan up to 13 inches). The big brown bat was selected because it is much more widely distributed than Wagner’s mastiff bat.

Height/Body Length

Students will work in pairs to measure their height (referred to as body length for bats). They will compare their height to the two bat species.

Weight

Most bats in the Eastern United States are very small. The smallest, the Eastern small-footed bat, weighs only 3.5 to 6 grams. Our largest bat, Wagner's mastiff bat, weighs up to 50 grams. The species evaluated in this activity include the Eastern small-footed bat and the big brown bat (weighs up to 25 grams).

Lifespan

The average lifespan for a human is 74 years. Among young bats, mortality is very high. If they can make it to adulthood, bats can live relatively long lives. Small bats like those found in the United States tend to live about 6-10 years.

Banding records have shown that some insectivorous bats live up to 30 to 40 years; however, this is not very common. For their size, bats are among the longest-lived animal which is important since most bats only have 1 or 2 pups a year. For comparison, most mice have a lifespan of only about two years.

Wing Beats

To support a body in the air and overcome the force of gravity, a flying animal must beat its wings very quickly to maintain altitude. Statistics for the little brown bat indicate that this bat flaps its wings about 12 times a second.

Food Consumption

Some bats can eat about half their body weight in insects each night. Scientists have discovered that many small bats can catch up to 1,000 or more small insects in a single hour.

Get Ready – Set Up Stations

1. Set up stations for each item to be measured or observed.
2. Provide the following items at the appropriate station:

Number of Fingers

- "How Do I Compare to a Bat" illustration
- Bat skeleton (optional)

Wingspan and Body Length/Height

- Tape measure

Weight

- Scale for students
- Gram scale
- Assorted coins
- Small bag

Lifespan

- Picture of human (with average lifespan of 74 years printed on back)
- Picture of big brown bat (with average lifespan of 6-10 years printed on back)
- Picture of a mouse (with average lifespan of 2 years printed on back)

Wing Beats

- Stop watch or clock with second hand

Food Consumption

- Can goods (optional)
- Scale for can goods (optional)

Get Set -Background Activities

1. Explain to students that bats and humans have many similarities. Brainstorm with the students about some of the similarities and differences between bats and humans. Include the fact that bats are mammals that give birth to live young, nurse babies with milk, and have hair.
2. Discuss some of the special adaptations unique to bats such as their ability to fly thanks to elongated finger bones and their quick wing beats.
3. Demonstrate how a bird flies by flapping your arms up and down with your elbows rigid. Ask students, "What am I?" When they respond with the correct "bird" answer, encourage further participation by asking them to form a line and fly around the room for a few minutes.
4. Bring your elbows out to the side and forward (similar to an exaggerated breast stroke). Say, "I also fly. What am I now?" Note how your arms are moving differently than a bird's wing motion. Reinforce the idea that a bat's wing encloses its very long fingers which keeps the wing spread out. Have the students repeat your arm motions and fly around the room as a bat. Encourage their enthusiasm and great leaping swoops! Compliment them on being great bats.

5. Divide students into pairs that will work together to take measurements, record times and measurements, and record other information collected at each station.

Go! - Measurement and Comparison Activity

1. Give the students the following handouts:
 - Student Instruction Sheet
 - Student Worksheet
2. Have the students write down their name, the kingdom that humans belong to, and what humans are usually fed as newborn babies on their Student Worksheet.
3. Have students move to each of the stations.
4. At the stations have the students work through the instructions on the Student Instruction Sheet. Each student will have a chance to measure their partner and be measured in return. Each student should keep track of their own results on their Student Worksheet.

Reflect – Student Assessment

1. Accurately measure information at each station.
2. Record all data completely.
3. Correctly calculate weight in grams.
4. Solve math questions correctly. For problem two, student's weight divided by 2 = half their weight. Multiply this by 2 to get the number of Big Macs that would need to be eaten (this turns out to be the student's weight).
5. Compare and contrast the differences between bats and humans.

Extension – Enjoy the Flight of Bats

Show your classroom the following two short videos about bat flight before or after the activity:

1. Bats in Slow Motion –Organization for Bat Conservation – (37 seconds)
http://www.youtube.com/watch?v=Ni_mS4cKPXY
2. Secrets of the Bat Wing - Science Take, The New York Times (1:30 minutes)
<http://www.youtube.com/watch?v=Vq0rVBD9mDY>

Ask the students to watch the bats wings. Do they see the membrane? The thumb? Encourage your students to create their own piece of art inspired by

the flight of bats. The Get to Know Society hosts an online expressive arts contest for young people (19 years old or younger). Art work including fine art, photography, writing, music, and video can be entered into this free contest. The contest is geared at inspiring connections between children and nature. Get to Know also provides a fantastic tool kit of resources to help you use the expressive arts to inspire children. Be sure to go to their website at www.get-to-know.org for information on how to spark your students' inner artists. Accepted artwork will be showcased in a virtual art gallery.

Just for fun

Have students make their own bat airplanes. This fun activity is included in Project Edubat with the permission of Brian Lies. Bat airplanes can be copied for school (indoor and outdoor), library, or home use.

Suggested Resources:

Animal Diversity Web – *Eumops glaucinus*
http://animaldiversity.ummz.umich.edu/accounts/Eumops_glaucinus

Animal Diversity Web - *Myotis leibii*
http://animaldiversity.ummz.umich.edu/accounts/Myotis_leibii

Bat Conservation International – BCI Handouts
<http://www.batcon.org/index.php/resources/media-education/bci-handouts>

Brian Lies – The Bat Wing
http://www.brianlies.com/bat_wing.htm

BBC – Is it a Bird? Is it a Plane? Is it a flying Squirrel?
https://www.youtube.com/watch?v=UCSf5_894B4

Discovery Education – What's A Mammal?
<http://www.discoveryeducation.com/teachers/free-lesson-plans/whats-a-mammal.cfm>

How Do Bats Fly? – Science Take
<http://www.youtube.com/watch?v=Vq0rVBD9mDY>

National Wildlife Federation - Night Friends
http://batslive.pwnet.org/pdf/Night_Friends.pdf

Why Bats are More Efficient Flyers Than Birds
<http://www.livescience.com/1245-bats-efficient-flyers-birds.html>

Student Instruction Sheet

You will be moving from station to station to answer questions and learn how bats and humans are similar. Record all of your answers on your Student Worksheet.

Start Your Comparison

Before going to the stations, write down the kingdom that you belong to on your Student Worksheet. Also write down what you were fed as a newborn baby. Make your way to one of the available stations.

Station 1 – Write down the number of fingers that you have on one hand. Look at the bat skeleton and “How Do I Compare to a Bat” illustration and compare the bones of your hand to those of a bat.

Station 2 – Using a tape measure, have your partner measure the length of your “wingspan.” You will need to stretch out your arms. Your partner will measure the distance from the fingertips on your right hand to the fingertips on your left hand. Write down the length of your wingspan and then switch places with your partner.

Station 3 – Using a tape measure, have your partner measure your height in inches. Write down your height and then switch places with your partner.

Station 4 – Step on the scale and take your own weight. You will need to convert your weight to grams. Remember that one pound equals 453.6 grams. Once you have written down your weight in pounds and grams, let your partner do the same steps. Using the gram scale, add coins to a small bag and determine how many coins equal the same weight as an Eastern small-footed bat. How many equal the same weight as a big brown bat? Are you surprised how little these bats weigh?

Station 5 – Write down what you think is the average lifespan of a human. Pick up the photo of the person and look at the back to see if you answered correctly. Record the correct answer and compare this to the average lifespan of a bat. Also look on the back of the photo of the mouse. How long do they live on average?

Station 6 -To determine wing beats per minute, you will have to flap your arms like a bat for thirty seconds. Be sure to count the number of times you flap out loud so that you don't lose track. Your partner will tell you when to begin and when to stop using a stopwatch or clock. You will need to multiply the number of wing flaps times two to find the rate per minute. Remember to record your answer. How does your rate compare to the bats'? Why do they need to move their wings so quickly?

Station 7 - Bats eat an incredible amount of insects each night. In fact, they can eat about half of their weight in insects each evening. How many Big Macs would you have to eat each night to eat the same amount of food as a bat? Hint, a Big Mac weighs about 0.5 lbs. Show your work and be sure to write down your final answer. If available, add can goods to the scale until you have added enough food to equal half your body weight. Think about trying to eat that amount of food in a single evening.

How Do I Compare to a Bat? – Student Worksheet

Name: _____

| Characteristic/Measurement | Student | Eastern Small-Footed Bat | Big Brown Bat |
|-------------------------------|---------|--------------------------|-----------------------|
| Kingdom | | Mammal | Mammal |
| Drink as a Baby | | Milk | Milk |
| Number of Fingers | | 4 fingers and 1 thumb | 4 fingers and 1 thumb |
| Wingspan | | 8.2- 10.2 inches | up to 13 inches |
| Height/Body Length | | 2.9 to 3.4 inches | 4 to 5 inches |
| Weight | | 3.5 to 6 grams | up to 25 grams |
| Average Lifespan | | 6-10 years | 6-10 years |
| Wings Beats Per Minute | | About 720* | About 720* |

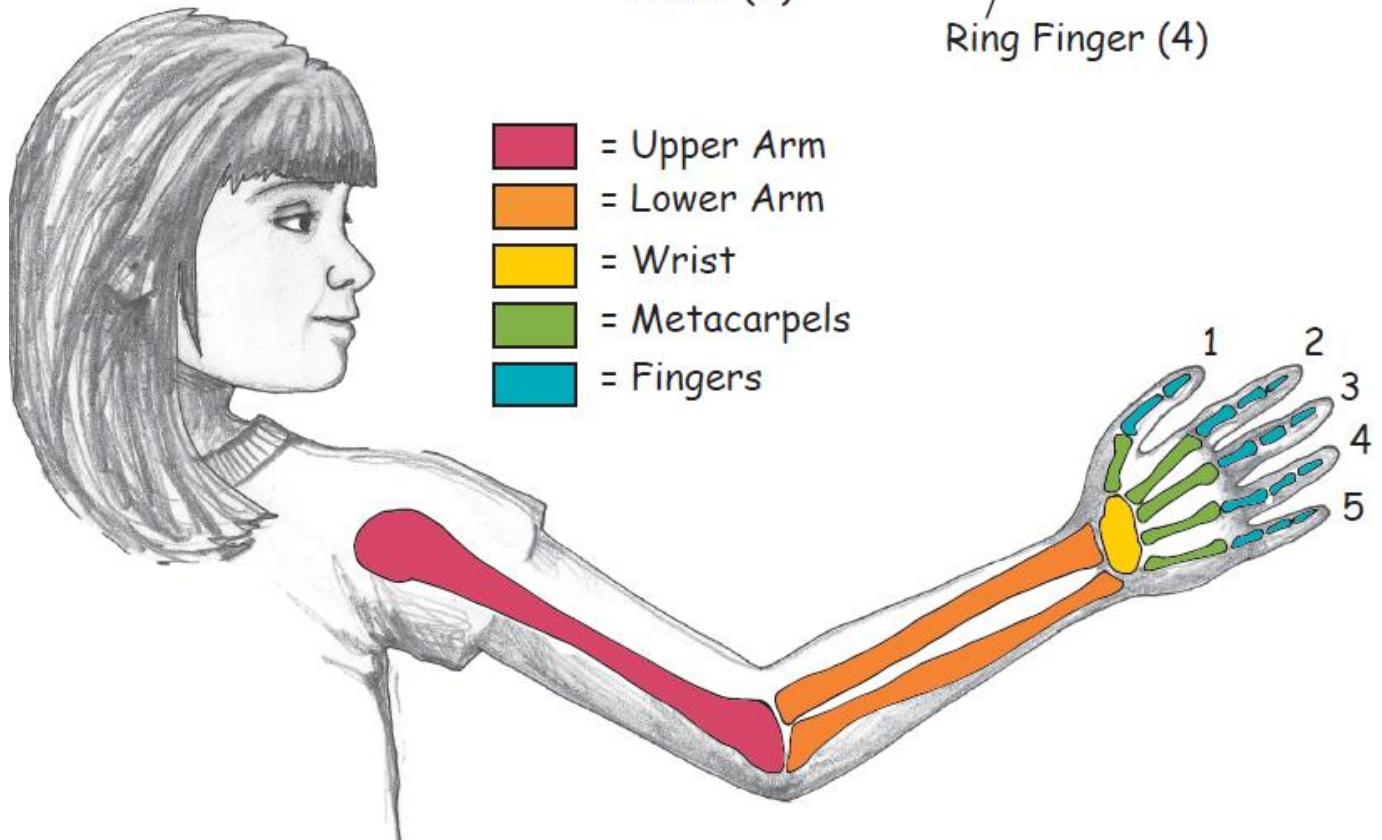
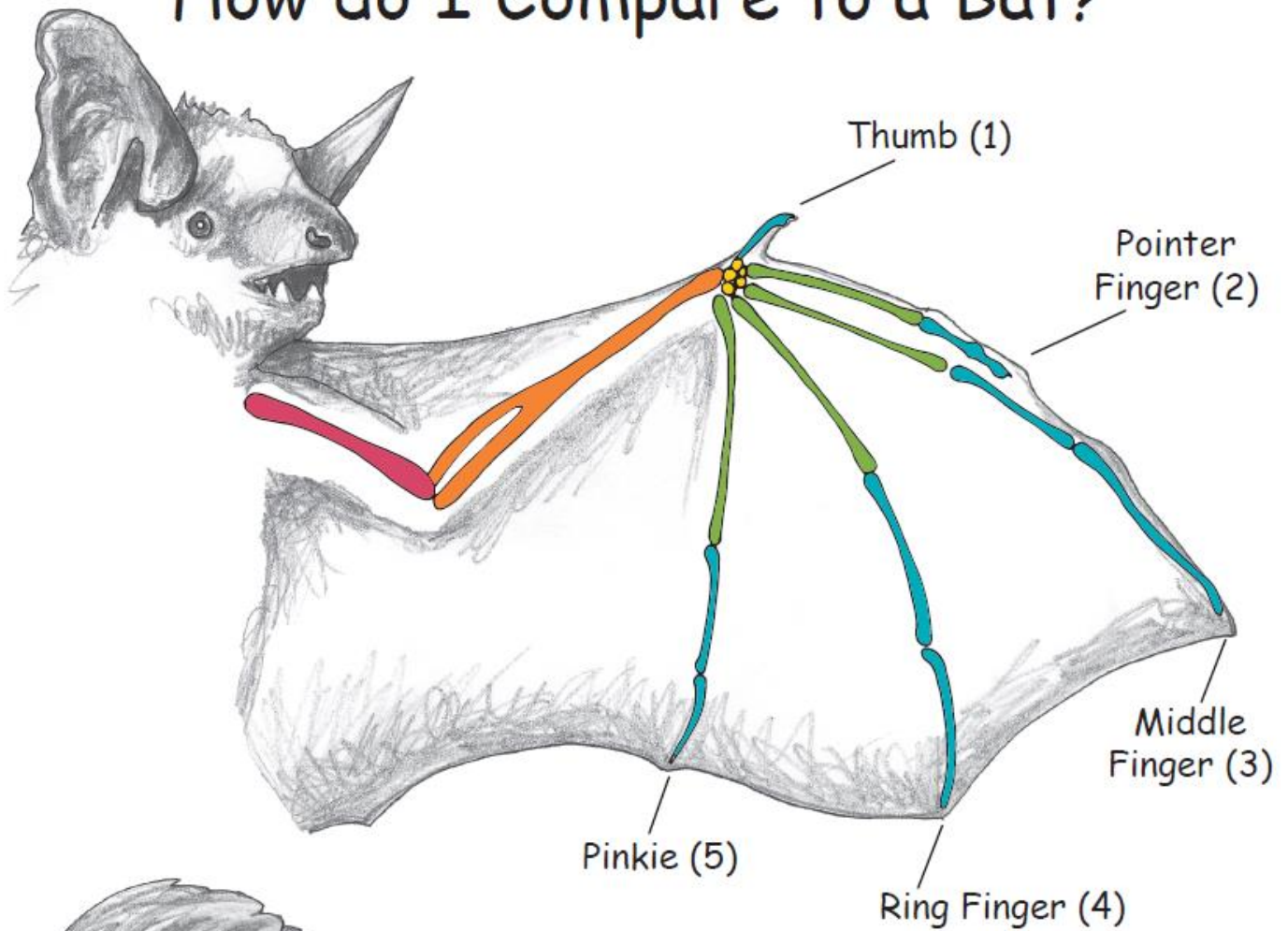
*Statistics for the little brown bat

Math Problems:

1. How much do you weigh in grams? Remember that one pound equals 453.6 grams, so your weight X 453.6 = your weight in grams. Show your work!

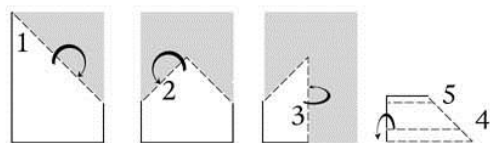
2. Bats can eat about 1/2 their body weight in insects each night! How many Big Macs would you have to eat each night to eat the same amount of food as a bat? Hint, a Big Mac weighs about 0.5 lbs.

How do I Compare to a Bat?

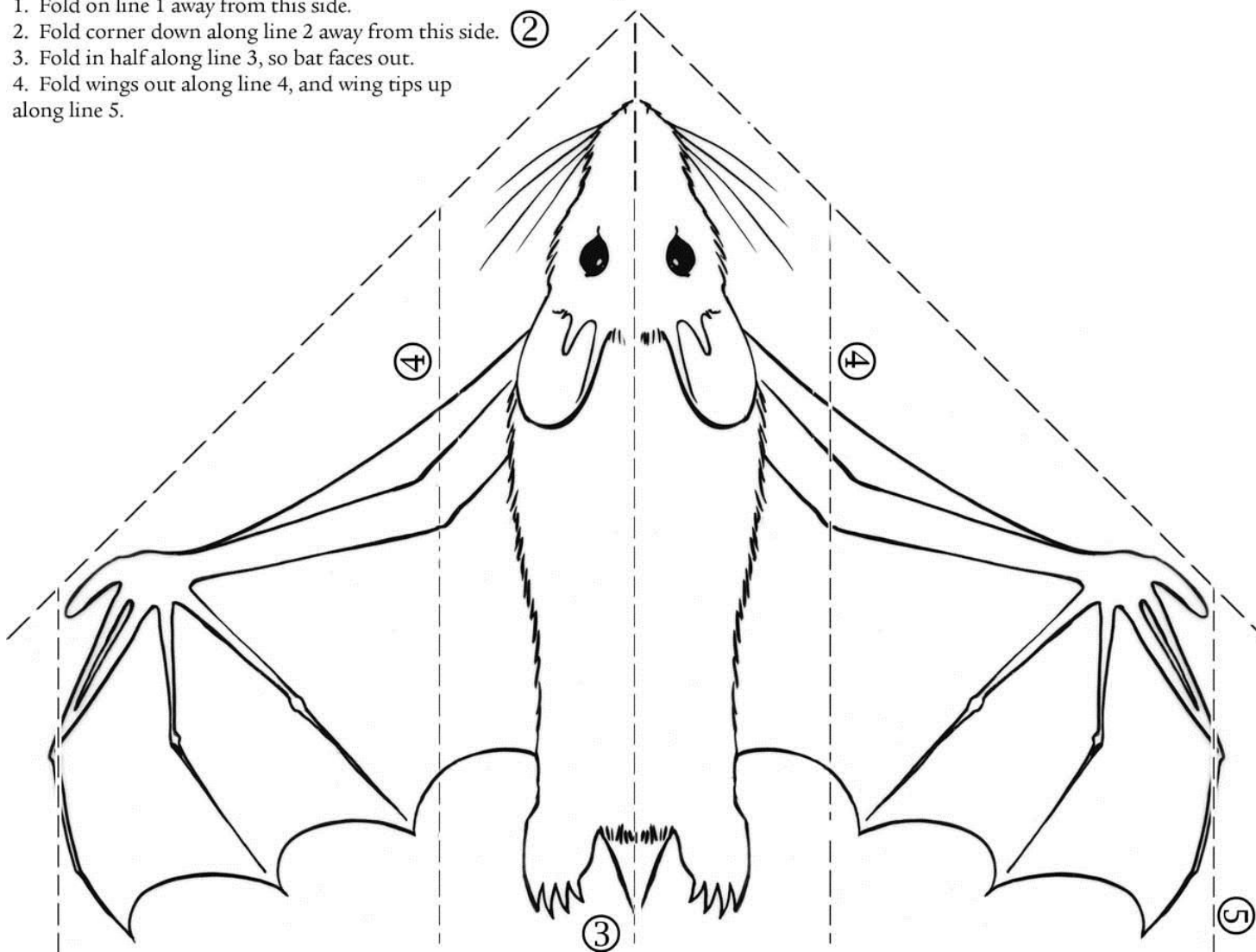


Bat Paper Airplane from *Bats at the Library*

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1. Fold on line 1 away from this side.
2. Fold corner down along line 2 away from this side.
3. Fold in half along line 3, so bat faces out.
4. Fold wings out along line 4, and wing tips up along line 5.



Common Core State Standards - Math

Grade 2

Measure and estimate lengths in standard units.

CCSS.MATH.CONTENT.2.MD.A.1

Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

CCSS.MATH.CONTENT.2.MD.A.4

Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

Grade 3

Solve problems involving measurement and estimation.

CCSS.MATH.CONTENT.3.MD.A.2

Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l).
1 Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.