Virtual Creature Festival: Bat Math

In this series of bat articles, you will have the opportunity to explore the 9 native bats of New Jersey and why they are essential to the ecosystem, why they are beneficial to humans, and why we must work harder to protect them.

Activity 1: How Much Does a Bat Weigh Compared to Common Household Items?

Below is a chart, labeled Table A, with bat species and their approximate weights in grams. Notice that adult bats we have included can weigh as little as 4 grams and as much as 35 grams. But how much is a gram and how can we demonstrate how that feels?

Table B – To complete this table, use a kitchen scale to weigh common objects around your house. Notice that some objects are filled in for you. Complete the rest of the "object" column with things you can find. If you do not have a kitchen scale, you can just use the common objects we have selected or use the internet to discover the weights of additional items. Bats are really small, so it is best to use items that are fairly light.

When you have completed the "object" and "object's weight", find a bat or any combination of bats that equal the weight of the common object.

For example:
A pencil (7 grams) is the same approximate weight as an Indiana bat (6-9 grams).
One double A battery (23 grams) could be *about* the same weight as 1 hoary bat (20-35 grams) or 6 eastern small-footed myotis (6 eastern small-footed myotis x 4 grams each = 24 grams).

As an extension, you can complete Table B or additionally, see how many combinations you can make for each item.

Table A	
Bat Species	*Weight*
Eastern small-footed myotis	4 to 6 grams
Northern long-eared bat	6 to 9 grams
Indiana bat	6 to 9 grams
Tri-colored bat	8 grams
Eastern red bat	7 to 13 grams
Silver-haired bat	8 to 11 grams
Little brown bat	10 grams
Big brown bat	23 grams
Hoary bat	20 to 35 grams

Table B		
Object	*Object's weight*	*= which bat species?*
Penny	2.5 grams	= 2 pennies weigh about the same as 1 eastern small-footed myotis
Dime	2.2 grams	
Nickel	5.0 grams	
Quarter	5.7 grams	
No. 2 Pencil	7.0 grams	
Metal teaspoon	25 grams	
AAA battery	11.5 grams	
AA battery	23 grams	
A stick of butter	113 grams	
A large egg	57 grams	

Activity 2: How Much Does a Bat Eat?

Bats can eat more than half their weight in insects each night. Wow! Think about how much you weigh. Can you imagine eating half of your body weight in food *every night*?! For example, if a person weighs 100 pounds, they would need to eat 50 pounds of food in one night. (If an average pizza weighs 2 pounds, to be like a bat, that person would need to eat 25 whole pizzas in one night to get to half their body weight in food.) Ugh!

Use Table A, bat species and their estimated weights, for this next activity. To complete Table B, fill in how many insects each bat can eat based on their weight. You can determine how many insects can be eaten in one night. Fill in the bat species based on what they eat by using the information in this article about NJ native bats. Fill in the "% of bats' weight eaten in insects" anywhere between 50% and 100%, because that is the estimated range.

Use this equation: *b x 1000 x p ÷ i = t*

b = weight of the bat

p = % of body weight eaten in insects (decimal) *(to convert grams to milligrams you must multiple the number in grams by 1000)*

i = weight of insect

Example 1: If a big brown bat can eat (insert percentage between 50% to 100 %) of its body weight in Asian tiger mosquitoes in one night, then how many individual insects can it eat?

Let's select 70%. If a big brown bat can eat 70% of its body weight in Asian tiger mosquitos in one night, then how manyindividual insects can it eat?

23 grams (big brown bat weight) x 1000 (grams to milligrams) x 0.7 (percentage of body weight eaten in insects in decimal form) ÷ 2.5 milligrams (weight of insect) = 6440 Asian tiger mosquitos

Table A

Bat Species	*Weight*
Eastern small-footed myotis	4 to 6 grams
Northern long-eared bat	6 to 9 grams
Indiana bat	6 to 9 grams
Tri-colored bat	8 grams
Eastern red bat	7 to 13 grams
Silver-haired bat	8 to 11 grams
Little brown bat	10 grams
Big brown bat	23 grams
Hoary bat	20 to 35 grams

Table B

#	Insect	Insect weight *(i)*	% of bats weight eaten in insects *(p)*	Bat species	Bat species weight *(b)*	Amount of insects eaten in one night *(t)*
1	**Asian tiger mosquito**	2.5 milligrams				
2	**Asian tiger mosquito**	2.5 milligrams				
3	**Asian tiger mosquito**	2.5 milligrams				
4	**Eastern subterranean termite**	1.5 milligrams				
5	**House fly**	12 milligrams				
6	**House fly**	12 milligrams				
7	**Lady bug (beetle)**	20 milligrams				
8	**Lady bug (beetle)**	20 milligrams				
9	**Lady bug (beetle)**	20 milligrams				

Answer Key

In the chart below, the percentage of each bats weight eaten in insects is 50% for each species. Let walk through an example. Look at row 1.

The question we're trying to answer: If a big brown bat weighs 23 grams and can eat 50% of its body weight in Asian tiger mosquitoes in one night, and 1 moquitoes weighs 2.5 milligrams, then how many individual insects can it eat?

The equation: *b x 1000 x p ÷ i = t*

b = 23,000 — Because the insects are so small, their weight is in milligrams so we need to convert the weight of the bat from grams (23 grams) to milligrams by multiplying their weight by 1,000 (23,000 milligrams).

p = .50 — The percentage must be converted into a decimal for it to be properly used in the equation. To do this you move the decimal point 2 places to the left. 50.0% = 0.50

i = 2.5 — The weight of the insects are already in milligrams so this number can get pulled directly from the chart.

The math: 23 x 1000 x 0.5 ÷ 2.5 = 4,600 Asian tiger mosquitos

When those numbers are plugged into the equation you learn that if a big brown bat eats 50% of its body weight in insects in one night, then it can consume 4,600 Asian tiger mosquitoes.

#	Insect	Insect weight *(i)*	% of bats weight eaten in insects *(p)*	Bat species	Bat species weight *(b)*	Amount of insects eaten in one night *(t)*
1	**Asian tiger mosquito**	2.5 milligrams	50%	Big brown bat	23 grams	**4,600**
2	**Asian tiger mosquito**	2.5 milligrams	50%	Little brown bat	10 grams	**2,000**
3	**Asian tiger mosquito**	2.5 milligrams	50%	Eastern small-footed myotis	5 grams	**1,000**
4	**Eastern subterranean termite**	1.5 milligrams	50%	Indiana bat	8 grams	**2,667**
5	**House fly**	12 milligrams	50%	Silver-haired bat	10 grams	**417**
6	**House fly**	12 milligrams	50%	Hoary bat	18 grams	**750**
7	**Lady bug (beetle)**	20 milligrams	50%	Northern long-eared bat	9 grams	**225**
8	**Lady bug (beetle)**	20 milligrams	50%	Tri-colored bat	8 grams	**200**
9	**Lady bug (beetle)**	20 milligrams	50%	Eastern red bat	12 grams	**300**

In the chart below, the percentage of each bats weight eaten in insects is 100% for each species. Let walk through an exmaple. Look at row 5.

The question we're trying to answer: If a silver-haired bat weighs 10 grams and can eat 100% of its body weight in house flies in one night, and 1 house fly weighs 12 milligrams, then how many individual insects can it eat?

The equation: *b x 1000 x p ÷ i = t*

b = 10,000 — Because the insects are so small, their weight is in milligrams so we need to convert the weight of the bat from grams (10 grams) to milligrams by multiplying their weight by 1,000 (10,000 milligrams).

p = 1.0 — The percentage must be converted into a decimal for it to be properly used in the equation. To do this you move the decimal point 2 places to the left. 100.0% = 1.0

i = 12 — The weight of the insects are already in milligrams so this number can get pulled directly from the chart.

The math: 10 x 1000 x 1.0 ÷ 12 milligrams = 833 house flies

When those numbers are plugged into the equation you learn that if a silver-haired bat eats 100% of its body weight in insects in one night, then it can consume 833 house flies.

#	Insect	Insect weight *(i)*	% of bats weight eaten in insects *(p)*	Bat species	Bat species weight *(b)*	Amount of insects eaten in one night *(t)*
1	**Asian tiger mosquito**	2.5 milligrams	100%	Big brown bat	23 grams	**9,200**
2	**Asian tiger mosquito**	2.5 milligrams	100%	Little brown bat	10 grams	**4,000**
3	**Asian tiger mosquito**	2.5 milligrams	100%	Eastern small-footed myotis	5 grams	**2,000**
4	**Eastern subterranean termite**	1.5 milligrams	100%	Indiana bat	8 grams	**5,333**
5	**House fly**	12 milligrams	100%	Silver-haired bat	10 grams	**833**
6	**House fly**	12 milligrams	100%	Hoary bat	18 grams	**1,500**
7	**Lady bug (beetle)**	20 milligrams	100%	Northern long-eared bat	9 grams	**450**
8	**Lady bug (beetle)**	20 milligrams	100%	Tri-colored bat	8 grams	**400**
9	**Lady bug (beetle)**	20 milligrams	100%	Eastern red bat	12 grams	**600**

In the chart below, the percentage of each bats weight eaten in insects is anywhere between 50% and 100% for each species. Let walk through an exmaple. Look at row 7.

The question we're trying to answer: If a Northern long-eared bat weighs 9 grams and can eat 74% of its body weight in lady bugs in one night, and 1 lady bug weighs 20 milligrams, then how many individual insects can it eat?

The equation: *b x 1000 x p ÷ i = t*

b = 9,000 — Because the insects are so small, their weight is in milligrams so we need to convert the weight of the bat from grams (9 grams) to milligrams by multiplying their weight by 1,000 (9,000 milligrams).

p = .74 — The percentage must be converted into a decimal for it to be properly used in the equation. To do this you move the decimal point 2 places to the left. 74.0% = 0.74

i = 20 — The weight of the insects are already in milligrams so this number can get pulled directly from the chart.

The math: 9 x 1000 x 0.74 ÷ 20 milligrams = 333 lady bugs

When those numbers are plugged into the equation you learn that if a Northern long-eared bat eats 74% of its body weight in insects in one night, then it can consume 333 lady bugs

#	Insect	Insect weight *(i)*	% of bats weight eaten in insects *(p)*	Bat species	Bat species weight *(b)*	Amount of insects eaten in one night *(t)*
1	**Asian tiger mosquito**	2.5 milligrams	70%	Big brown bat	23 grams	**6,440**
2	**Asian tiger mosquito**	2.5 milligrams	91%	Little brown bat	10 grams	**3,640**
3	**Asian tiger mosquito**	2.5 milligrams	85%	Eastern small-footed myotis	5 grams	**1,700**
4	**Eastern subterranean termite**	1.5 milligrams	57%	Indiana bat	8 grams	**3,040**
5	**House fly**	12 milligrams	62%	Silver-haired bat	10 grams	**517**
6	**House fly**	12 milligrams	55%	Hoary bat	18 grams	**825**
7	**Lady bug (beetle)**	20 milligrams	74%	Northern long-eared bat	9 grams	**333**
8	**Lady bug (beetle)**	20 milligrams	65%	Tri-colored bat	8 grams	**260**
9	**Lady bug (beetle)**	20 milligrams	97%	Eastern red bat	12 grams	**582**

Climate Change and Standards Integration

This is an ideal lesson to demonstrate the interconnectivity between the teaching of mathematics and the teaching of environmental science.

- As our natural resources continue to be impacted by climate change, food webs are altered. Here are some discussion questions to consider:
- Many towns still implement expansive spraying operations to “control” mosquitoes. How might these operations impact bat populations?
- How are bat populations beneficial to neighborhoods or to areas where people live?
- Explain what happens when one element of a food web changes. Provide examples.

For more information on the many interdisciplinary ways this lesson can be used in your classroom, contact Kate Reilly, Manager of Education, Duke Farms at kreilly@dukefarms.org