



Hubbard Brook Research Foundation

Migratory Bird Math and Science Lessons



Black and White Warbler/Robert Royse

Lesson: Calorie Counting is for the Birds

One of the greatest feats in avian biology is the process by which many migratory songbirds, weighing barely a third of an ounce, can manage to find and consume enough calories to sustain their thousand-mile journey from their breeding grounds to wintering grounds and back again.

Similar to *Migration Math*, this lesson explores the energy requirements of migrating birds. However, while the skills required to perform the calculations are similar, the context of this lesson is conceptually more advanced: Students will hypothesize and then calculate which animal—a migrating songbird or human—requires more calories relative to its body weight.

Summary	Students will hypothesize and then calculate which animal—a migrating songbird or human—requires more calories relative to its body weight.
Subject areas	Math
Skill level	Average
Objectives	<ul style="list-style-type: none"> • Demonstrate conceptual understanding of mathematical operations. • Accurately solve word problems involving single or multiple operations.
NH Mathematics and Science Framework Standards	M(N&O)–6–3, M(N&O)–6–4, M(PRP)–8–1, M(CCR)–8–3
Time	One 45-minute class period
Materials	<ul style="list-style-type: none"> • Student Handout: Calorie Counting is for Birds Optional: <ul style="list-style-type: none"> • Calculators • Introductory Slides.pdf
Assessment	Student Handout with answer key included

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Note to Teachers

Before students begin work on the Student Handout, it is recommended that the teacher provide background information as context for the main question asked on the Handout: *which animal—a migrating songbird or human—requires more calories relative to its body weight?* This can be done by describing the information that follows to your students.

Two [Introductory Slides](#), which contain images of warblers, are included in Support Materials and may be displayed overhead as props for discussion.

Introduce lesson to students: Calories

A *calorie* is a unit of energy, particularly heat energy. Technically speaking, one calorie is the amount of energy needed to raise the temperature of one gram of water by 1°Celsius. One thousand calories equal one *kilocalorie* (kcal). When we talk about the number of *Calories* in the food we eat, we are actually talking about *kilocalories*. One *kilocalorie* (or one *Calorie*) actually equals *one thousand calories*. We write *Calories* with a capital “C” to abbreviate kilocalories when describing the amount of energy in the food we eat or work we do. This is done to make the numbers smaller since the amount of calories humans process is relatively large. So... the 110 *Calories* in that chocolate milk you just drank is actually 110,000 calories!

Discuss: Why do you think we talk about nutritional energy in terms of kilocalories instead of calories? *Answers may vary, but students should recognize that using real calories on the side of cereal boxes, etc. would mean very large numbers and would likely be more confusing for consumers.*

How many calories must a small songbird eat?

Migratory songbirds have caloric needs just like humans do. Many of these species breed in New England where they build

nests, defend territories, and prepare for long flights to their winter grounds in the tropics. The amount of calories a songbird must take in daily to survive depends upon its activity level. Think about humans: you use a greater number of calories playing basketball than you do sitting in front of a computer, right? Similarly, preparation for late summer migration requires songbirds to take in more calories than in mid-summer, when they are spending time near their nests. This is also true of their northward migration from the tropics in the spring. When migratory songbirds arrive in the Northeastern US from their southern wintering grounds, they need to find enough food to sustain them after such a long flight. Furthermore, once they arrive, they are busy preparing for the breeding season, which is also a relatively calorie-intensive activity.

Researchers Jean and Richard Graber¹ calculated that migrating warblers moving through forests, like those in New England, ate about 1.5 times their own weight in caterpillars per day in order to reach a gross caloric intake of 17 kcal per day. This is the amount of calories birds of this type would need to sustain themselves and restore their body reserves during their migration. Because migration requires so much energy, this amount far exceeds the usual calorie intake for warblers when they are in their summer or winter grounds.

Go to Student Handout: Students will use the Grabers’ calculations to perform calculations of their own to further investigate the energy requirements of warblers and humans.

¹ J.W. Graber, and Graber, R.R. 1983. Feeding Rates of Warblers in Spring. *Condor* 85: 139-150.



Student Handout: Calorie Counting is for the Birds

Name _____

1. Researchers calculated that migrating warblers moving through forests, like those in New England, need to consume 17 kcal per day. An average caterpillar contains 8.7 calories.

Approximately how many caterpillars must a migrating warbler eat to satisfy its energy requirements? (*Hint: first convert 17.0 kcal into calories*)

2. The recommended daily intake of nutritional calories for a typical human adult is 2000, which we know is actually 2000 kcal.

What if humans could eat only caterpillars? How many would we need to eat per day?

3. Which animal—a migrating songbird or human—requires more calories relative to its body weight?

A. Hypothesize an answer: state what you think, and why you think it.

B. To determine if your hypothesis is correct, calculate the number of calories that each organism uses per gram of body weight.

Given: Mass of migrating warbler = 10 g
Mass of human = 150 lbs
Calories required by migrating warbler daily = 17,000 cal
Calories required by human daily = 2,000,000 cal
1 lb = 0.45 kg
1 kg = 1000g

i. First convert the human weight into grams.

ii. Complete the table below to find the ratio of the number of calories needed per gram of body weight.

	Migrating warbler	Human
Calories required		
Mass		
Ratio of cal/g		

iii. Now you can determine if your hypothesis is correct: which animal requires more calories relative to its body weight?

4. Why do you think that this is so?

Answer Key: Calorie Counting is for the Birds

1. Approximately how many caterpillars must a migrating warbler eat to satisfy its energy requirements?

17.0 kcal = 17,000 calories

17,000 calories divided by 8.7 calories = 1,954 caterpillars

2. What if humans could eat only caterpillars? How many would we need to eat per day?

2,000,000 calories divided by 8.7 calories = 229,885 caterpillars

3. Which animal—a migrating songbird or human—requires more calories relative to its body weight?

A. Hypothesize an answer: state what you think, and why you think it.

Answers will vary.

4. To determine if your hypothesis is correct, calculate the number of calories that each organism uses per gram of body weight.

i. First convert the human weight into grams.

150 lb x 0.45 kg/lb = 68.2 kg

68.2 kg x 1000 g/kg = 68,200 g

ii. Complete the table below to find the ratio of the number of calories needed per gram of body weight.

	Migrating warbler	Human
Calories required	17,000 calories	2,000,000 calories
Mass	10 g	68,200 g
Ratio of cal/g	1700 cal/g	29.3 cal/g

iii. Now you can determine if your hypothesis is correct: which animal requires more calories relative to its body weight?

Migrating warbler

C. Why do you think that this is so?

Answers will vary, but students might consider surface-to-volume ratios, the energetic cost of migration, the energetic cost of finding/capturing food, higher metabolic rate of birds, and/or lack of shelter for birds vs. humans.