



Hubbard Brook Research Foundation

Migratory Bird Math and Science Lessons






Blackburnian Warbler/Robert Royse

Lesson: Finding Food in the Forest

Approximately 82 species of birds breed in the forests of the Hubbard Brook Experimental Forest in Woodstock, New Hampshire. Breeding involves the building of nests, mating, laying of eggs, and caring for young; it requires a lot of energy. Where do these breeding birds most efficiently find the food needed to survive and raise their young? Why do some of these birds migrate to the Neotropics while others stay put? This lesson allows students to answer these questions by providing them with data from the Hubbard Brook Experimental Forest and asking them to perform calculations with decimals and percentages based on these data.

Summary	Using basic foraging data from Hubbard Brook, students will convert percents into decimal numbers and vice-versa, and then analyze calculations to investigate where birds find food and better understand reasons for migration.
Subject areas	Math
Skill level	Basic–Average
Objectives	<ul style="list-style-type: none"> • Accurately read and use data from pie charts. • Convert percents into whole numbers. • Convert whole numbers into percents. • Solve word problems involving percents. • Analyze calculations to propose reasons for bird migration.
NH Mathematics and Science Framework Standards	M:N&O:6:2, M(N&O):6:3, M(N&O):6:4, M(N&O)7:1, M(PRP)–8–1, M(CCR)–8–3, S:SPS1:8:4.3
Time	One 45 minute class period, plus homework
Materials	<ul style="list-style-type: none"> • Student Handout: Finding Food in the Forest Optional: <ul style="list-style-type: none"> • Birds with Different Foraging Strategies • Foraging Strategies of NH Forest Songbirds.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 two main questions asked on the Handout:

1. Where do breeding birds most efficiently find the food that they need to survive and raise their young?
2. Why do some birds migrate to the Neotropics in the winter, while others stay put?

This can be done by describing the information that follows to your students.

Additionally, you may wish to show the short slide show [Foraging Strategies of New Hampshire Forest Songbirds](#), included in Support Materials. These slides contain beautiful photographs of species of birds that find food in different locations of the forest, and the information presented will be referred to in the lesson. However, the lesson can be taught without viewing the slide show. Additionally, teachers may wish to show some methods used to study foraging strategies of birds at Hubbard Brook by having students view the slide show [Methods of Bird Research](#).

Introduce lesson to students:

1. Discuss with students: All animals need food to survive, not just for growth but also to maintain bodily functions. For every moment that an animal spends searching for (and for some, trying to capture) food, precious calories are burned to keep its body running properly. Thus, animals need to figure out the most efficient method to acquire food. This is especially true for birds, which spend much of their time foraging for food.

About 82 species of birds breed in the forests of the Hubbard Brook Experimental Forest in Woodstock, New Hampshire. Breeding involves the building of nests, mating, laying of eggs, and caring for young; it requires a lot of energy. Where do these breeding birds most efficiently find the food needed to survive and raise their young? Why do some of these birds migrate to the Neotropics while others stay put?

2. Ask students: How would they go about answering these two questions? Brainstorm ideas, and remind students that their ideas must be observable or testable—something that would allow them to collect data in the field.

3. Describe research by avian scientists: Like many scientific questions, the questions above are not so easily answered. In fact, it took a group of researchers led by Dr. Richard Holmes of Dartmouth College five summer field seasons at Hubbard Brook (1974–1978) to devise a method to answer the question of how different species of birds find food¹. The researchers went out into the forest, day after day, walking slowly and quietly until they spotted a bird. They recorded the species of the bird and followed it for as long as they could. Each time a bird was seen attacking a prey item, the way in which the bird attacked the prey was recorded (i.e., Did it catch it in mid-air? Glean it off a leaf?). The researchers also recorded the *plant species that the prey was on* (for example, sugar maple tree), and the *part of the plant that the prey was on* (leaf, bark, trunk, branch). After many observations, the researchers realized that there were two main factors that described **foraging strategies**, or ways that birds found food.² This lesson deals only with first factor, where the birds found prey:

- on the ground
- on bark of tree trunks
- on tree branches
- on the leaves of trees

For a more complete understanding of how birds acquire their food (which is beyond the scope of this lesson), the second factor, how the birds caught their prey, is also important.

To acquire food, birds can:

- glean (when standing or hopping, a bird up picks stationary prey)
- hover (when flying or hovering, a bird picks up stationary prey)
- hawk (when a bird flies or sallies into the air to pursue flying prey)
- drill/probe (when a bird pecks through the bark or ground to find prey that is below the surface)

When combined together, these two factors provide many possible **foraging strategies**. See the table [Birds with Different Foraging Strategies](#) for examples of foraging strategies of some of the migratory songbirds that breed in New Hampshire.

4. Students will practice calculations

with data from the Hubbard Brook Experimental Forest to answer the two questions.

¹ R.T. Holmes, Black, C.P., and Sherry, T.W. 1979. Comparative Population Bioenergetics of Three Insectivorous Passerines in a Deciduous Forest. *Condor* 81: 9-20.

² R.T. Holmes, Bonney, R.E., and Pacala, S.W. 1979. Guild Structure of the Hubbard Brook Bird Community: A Multivariate Approach. *Ecology* 60: 512-520.

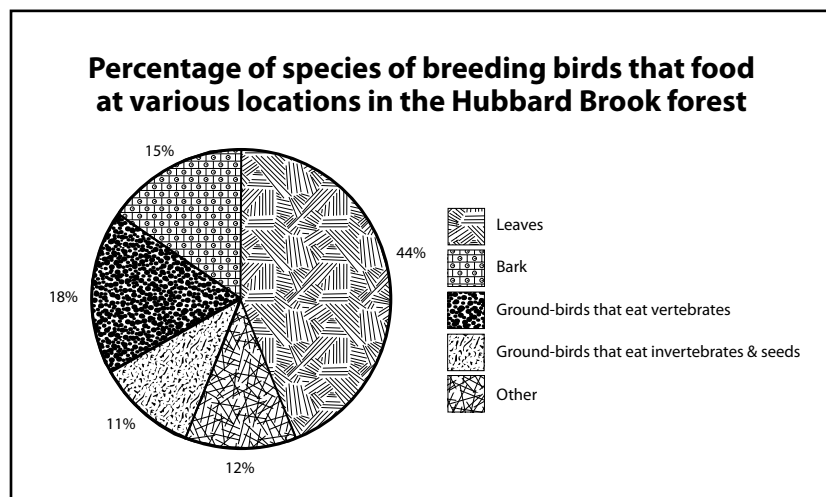


Student Handout: Finding Food in the Forest

Name _____

Where do breeding birds most efficiently find the food that they need to survive and raise their young?

About 82 species of birds breed in the Hubbard Brook Experimental Forest in Woodstock, New Hampshire. Breeding involves the building of nests, mating, laying of eggs, and caring for young—it requires a lot of energy! Where do these birds find the food they need to supply this energy?



1. In what location does the highest percentage of birds find food?

2. What kinds of food do you think they find here? Be as specific as possible.

3. What is the total percentage of birds that find food on the ground?

4. Fifteen percent of birds are included in the “other” category. What might be some of these “other” food locations? (Hint: Think about hummingbirds.)

5. Using the information given in the paragraph and pie chart above, calculate the number of Hubbard Brook bird species that find food in each location and write your answers in Table 1.

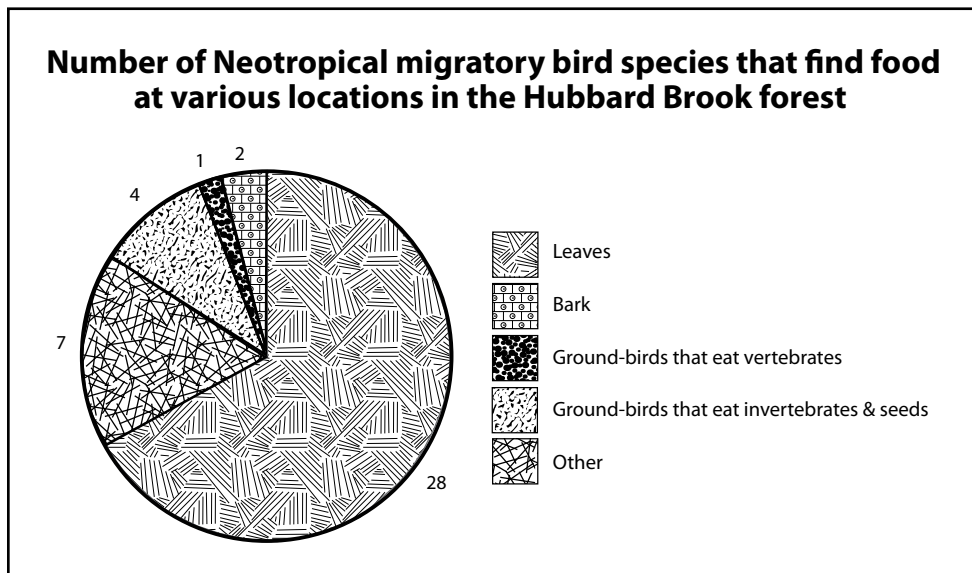
Table 1. Number of bird species at Hubbard Brook that find food in various locations

Location of food	Number of species of birds that find food in this location
Leaves	
Bark	
Ground: predators of invertebrates, seed eaters	
Ground: predators of vertebrates	
Other	

Why do some birds migrate to the Neotropics in the winter, while others stay put?

Some of the birds that breed at Hubbard Brook live there year-round, but others stay only for the summer, while they are breeding. Of these birds, some migrate long distances and are called *Neotropical migrants*. Neotropical migratory birds breed north of the Tropic of Cancer, in the temperate region, and then migrate to the tropics during the non-breeding season (our winter). Over half of the species of birds that breed at Hubbard Brook are Neotropical migratory birds.

The pie chart below shows the actual *number* of Neotropical migratory bird species that find food in various locations. These numbers are different from those you calculated in Table 1, because they represent the number of Neotropical species only.



6. What percentage of Neotropical migratory bird species find food on the leaves of trees at Hubbard Brook?

7. How does this compare to the percentage of all bird species at Hubbard Brook that find food at this location?

8. What percentage of Neotropical migratory bird species eat invertebrates and seeds from the ground at Hubbard Brook?

9. How does this compare to the percentage of all bird species at Hubbard Brook that find food at this location?

10. Why do you think that Neotropical migratory birds migrate? (Hint: think about where many of these birds find food while they are living in New England. Use your answers to Questions 6–9 to support your answer.)

Answer Key: Finding Food in the Forest

Where do breeding birds most efficiently find the food that they need to survive and raise their young?

1. In what location does the highest percentage of birds find food?

Leaves

2. What kinds of food do you think they find here? Be as specific as possible.

Answers will vary, but teachers should encourage students to think about the types of insects, especially immature forms, that eat leaves. (In summer months, most of the arthropods found on leaves that are eaten by birds are caterpillars.)

3. What is the total percentage of birds that find food on the ground?

29% (need to add both Ground categories together)

4. Fifteen percent of birds are included in the “other” category. What might be some of these “other” food locations? (Hint: Think about hummingbirds.)

Answers will vary; hummingbirds sip nectar from flowers.

5. Using the information given in the paragraph and pie chart above, calculate the number of Hubbard Brook bird species that find food in each location and write your answers in Table 1.

Table 1. Number of bird species at Hubbard Brook that find food in various locations

Location of food	Number of species of birds that find food in this location
Leaves	36
Bark	15
Ground: predators of invertebrates, seed eaters	9
Ground: predators of vertebrates	10
Other	12

Why do some birds migrate to the Neotropics in the winter, while others stay put?

6. What percentage of Neotropical migratory bird species find food on the leaves of trees at Hubbard Brook?

67%

7. How does this compare to the percentage of all bird species at Hubbard Brook that find food at this location?

The total percentage of all birds finding food on leaves of trees = 44%, while the percentage of Neotropical migratory birds finding food on leaves = 67%. Proportionately more migratory birds find food on leaves.

8. What percentage of Neotropical migratory bird species eat invertebrates and seeds from the ground at Hubbard Brook?

2%

9. How does this compare to the percentage of all bird species at Hubbard Brook that find food at this location?

The total percentage of all birds eating invertebrates and seeds off of ground = 11%, while the percentage of Neotropical migratory birds eating invertebrates and seeds off of ground = 2%. Proportionately less migratory birds find invertebrates and seeds on ground.





10. Why do you think that Neotropical migratory birds migrate? (Hint: think about where many of these birds find food while they are living in New England. Use your answers to questions 6-9 to support your answer.)




Answers will vary, but answers should indicate that students understand that the food source that many Neotropical migratory birds rely on (caterpillars) is not available in the winter months.

Where do birds in New England forests find their food, and how do they get it?

The table below shows examples of some birds with different foraging strategies.

Unless noted otherwise, photos courtesy of Robert Royse, used with permission (<http://www.roysephotos.com>).

Bird species	Foraging Strategy	Location of food source
Blackburnian Warbler 	Gleans	Leaves
Ovenbird 	Gleans	Ground
American Redstart 	Hawks	Air
Least Flycatcher 	Hawks	Air

Bird species	Foraging Strategy	Location of food source
<p data-bbox="99 163 293 201">Wood Thrush</p> 	<p data-bbox="561 163 662 201">Probes</p>	<p data-bbox="992 163 1097 201">Ground</p>
<p data-bbox="99 573 386 611">Broad-winged Hawk</p> 	<p data-bbox="561 573 943 695">Hawks, though usually not from mid-air (swoops down from a stationary position)</p>	<p data-bbox="992 573 1247 611">Ground (predator)</p>
<p data-bbox="99 1272 363 1310">Hairy Woodpecker</p> 	<p data-bbox="561 1272 662 1310">Probes</p>	<p data-bbox="992 1272 1073 1310">Trunk</p>