

# Student Activity Guide

Duplicate and  
distribute to  
students.

## Overview

Scientists classify many features in our environment, such as species of life, forest types or rock types. These classifications, or categories, help us to organize and understand the natural world. In order for these classifications to be useful to scientists, we need to know how accurate they are. A difference/error matrix is the basic tool used to measure the accuracy of a classification procedure. This difference/error matrix also shows us where there was confusion or difficulty classifying certain classes.

In this activity you will:

- Classify pictures of birds into three categories
- Compare answers with the reference data provided
- Generate a difference/error matrix using the results of the comparison

When you have completed this activity, you will be able to:

- Classify birds as carnivores, herbivores or omnivores using given criteria
- Compare answers to a set of validation data and produce a difference/error matrix
- Identify categories with the most errors
- Evaluate the overall accuracy of the bird classification
- Understand the importance of the Difference/Error Matrix and how to use the information it provides

## Materials

1. A set of 10 bird pictures
2. Sample beak type sketches
3. Classification and Difference/Error Matrix Work Sheets for Bird Classification

## What To Do and How To Do It

In the following activity you will be classifying types of birds as:

- C...carnivores (meat eaters)
- H...herbivores (plant eaters)
- O...omnivores (plant and meat eaters)

Examples of preferred foods:

- Carnivores.....fish, meat, insects, worms, small mammals
- Herbivores.....vegetation, seeds, nuts, and berries
- Omnivores.....all of the above

The size and shape of the bird's beak will usually indicate its preferred food type. Many birds are opportunistic, however, and will supplement their preferred diet with a variety of foods when a scarcity of food requires it.

## Student Reference Sheet for Activity

### Herbivore Beak Types



*Finch Type:* Heavy wedge shaped beaks are good for cracking nuts and seed



*Parrot Type:* Thick curved upper and lower beak are also for cracking nuts or tearing fruit apart. The upper beak has a sharp point and usually curves over the lower beak.

### Carnivore Beak Types



*Insect Eater Type:* Long slender, slightly curved beaks are used to probe for insects and spiders in tree bark and soils



*Meat Eater Type:* Shorter than the insect eater, upper beak has a sharp curved overhanging tip and straight lower beak specialized for tearing meat.

### Omnivore Beak Types



*Jay Type:* Wide, medium length beak is used for eating insects, fruit, seeds, and even carrion.



*Thrush Type:* Shorter and more slender than the Jay type, also for eating meat, plants, and insects.

# Bird Classification Work Sheet

## Procedure

1. Look at each of the birds on the cards (numbered 1-10) and classify it as a carnivore, herbivore, or omnivore. Record each answer in the student classification column on the bird classification work sheet below.
2. Your teacher will provide the information to be recorded in the column labeled “validation data”. Be sure to fill in this column accurately, this data will be needed to complete the difference/error matrix.
3. Look at all ten pairs and mark each matching pair with a check mark and each different (incorrect) pair with an “X” in the third column.

Table LAND-L-3: Bird Classification Work Sheet

Bird Id#	Student Classification	Validation Data	✓ or x
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

## Difference/Error Work Sheet for Bird Classification

4. Fill in the first row of the difference/error matrix by using the following directions:
- A. Count how many times your group matched a student classification of carnivore with a validation answer of carnivore. Place that number here \_\_\_\_\_. Now place the same number in the box labeled A1 of the difference/error matrix.
  - B. Count how many times your group matched a student classification of carnivore with a validation answer of herbivore. Place that number here \_\_\_\_\_. Now place the same number in the box labeled B1 of the difference/error matrix.
  - C. Count how many times your group matched a student classification of carnivore with a validation answer of omnivore. Place that number here \_\_\_\_\_. Now place the same number in the box labeled C1 of the difference/error matrix.

Be sure to check with your teacher before continuing...

Repeat this process for each of the other categories filling in the remaining two rows.

Table LAND-L-4: Difference/Error Matrix for Bird Classification

		Validation Data			
		Carnivore	Herbivore	Omnivore	Row Total
Student Data	Carnivore	A1.	B1.	C1.	D1.
	Herbivore	A2.	B2.	C2.	D2.
	Omnivore	A3.	B3.	C3.	D3.
	Column Total	A4.	B4.	C4.	D4.

5. Sum the row totals, column totals and box D4.

$$\text{Box D4} = \text{A4} + \text{B4} + \text{C4} = \text{D1} + \text{D2} + \text{D3}$$

(column total)      (row total)

The numbers in the outlined boxes (the major diagonal), are classified correctly. Go through the other boxes in the matrix to find any incorrect classifications. The difference/error matrix shows which categories are most difficult to identify. The numbers off the major diagonal represent “incorrect” classifications. Each error or difference is an omission from the correct category and a commission (i.e., an erroneous addition) to the incorrect category.

Which difference/error box has the largest number?

Figure LAND-L-4: Calculating the Difference/Error Matrix

$$\text{Overall Accuracy} = \frac{(A1+B2+C3)}{D4} \times 100$$

$$\text{Overall Accuracy} = \frac{\boxed{A1} + \boxed{B2} + \boxed{C3}}{\boxed{D4}} \times 100 =$$

6. Calculate the overall accuracy as outlined on the sample work sheet.

If your answer is between:	Your level is:
0%-50%	Novice
51%-85%	Intermediate
86%-100%	Advanced

### Follow up Discussion and Activities

1. Did you have difficulty correctly classifying a particular category. Why?
2. How could you reduce the number of errors next time?
3. What are some other ways to classify birds?
4. Do you have any suggestions for improving the classification criteria?
5. How did different students' results vary? Compare your difference/error matrix to other students' difference/error matrices to see who had the largest number of accurate answers and to see if other groups made mistakes classifying the same categories. What caused the mistakes?
6. What other measures can be used to evaluate data quality?

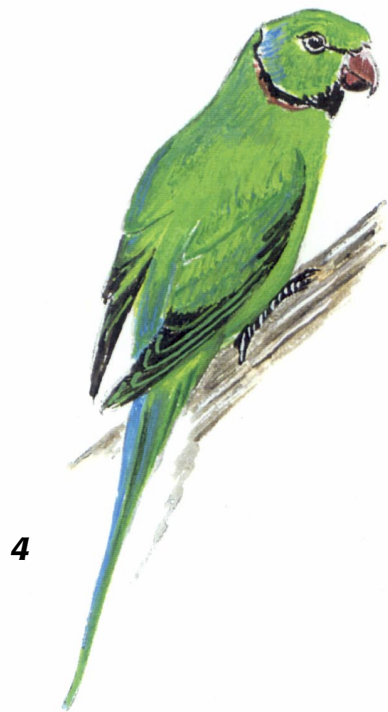
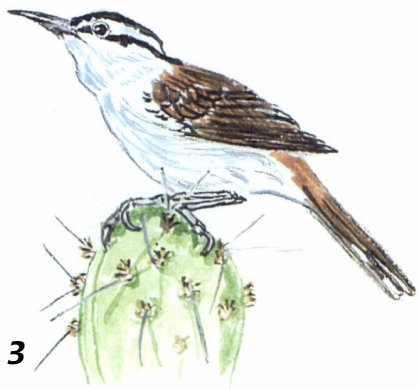
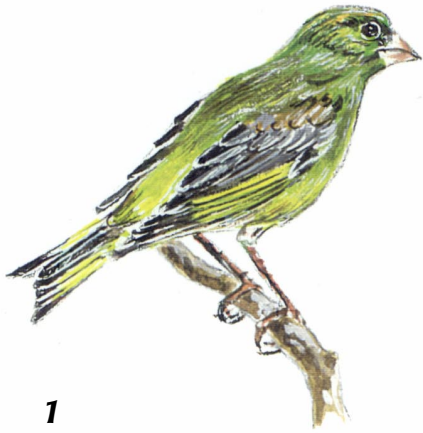
### Further Investigations

1. Combine all the class data to create a class difference/error matrix. Calculate the overall accuracy of the class.  
Which do you think is more accurate, your matrix or the combined class results? Why?
2. Try to develop your own criteria for classifying a group of objects (for example, insects).

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*Table LAND-L-5: Bird Classification Validation Data Sheet*

	Bird Name	Classification
1	Western Greenfinch	Herbivore
2	European Starling	Omnivore
3	Bicolored Wren	Carnivore
4	Rose-ringed Parakeet	Herbivore
5	Bru Bru Shrike	Carnivore
6	Clay Colored Robin	Omnivore
7	Pine Grosbeak	Herbivore
8	Eurasian Jay	Omnivore
9	Common Tree Creeper	Carnivore
10	Hermit Thrush	Omnivore



Art by Linda Isaacson

2. European Starling

(*Sturnus vulgaris*)

This bird (21 cm in size) lives in open woods, parks, and gardens in Europe and Western Asia, and has been introduced to North America, South America, Southern Australia and New Zealand. It eats both plants and animals.

Classification:

OMNIVORE

1. Western Greenfinch

(*Carduelis chloris*)

This bird (14.5 cm in size) lives in open woodland, bushes, and gardens in Europe, Northern Africa, Asia Minor, Middle East, and Central Asia. Its diet consists of nuts and seeds, especially sunflower seeds and peanuts.

Classification:

HERBIVORE

4. Rose-ringed Parakeet (*Psittacula krameri*)

This bird (41 cm in size) lives in woodlands and farmlands in Central Africa east to Uganda, India, Sri Lanka, and has been introduced to Middle and Far East, North America, England, Netherlands, Belgium, and West Germany. It eats grain or ripening fruit.

Classification:

HERBIVORE

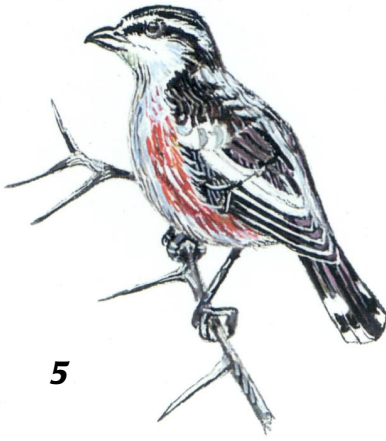
3. Bicolored Wren (*Campylorhynchus griseus*)

This bird (22 cm in size) lives in dry savanna, cactus scrub, and open woods in Colombia, Venezuela, Northern Brazil and Guyana. Its finds insects and insect eggs by peering and poking into crevices on the ground.

Classification:

CARNIVORE





Art by Linda Isaacson

6. Clay Colored Robin (*Turdus grayi*)

This bird (23-24 cm in size) lives in open woodland, woodland edge and clearings, usually near streams in Southeast Mexico, Central America, coastal Colombia. It eats insects, earthworms, slugs and lizards as well as fruit.

Classification:

OMNIVORE

5. Bru Bru Shrike

(*Nilaus afer*)

This bird (15 cm in size) lives in savanna woodland and sometimes the forest edge in tropical Africa. It eats insects and catches food on the wing.

Classification:

CARNIVORE

8. Eurasian Jay

(*Garrulus glandarius*)

This bird lives in oak woods, and open country in Western Europe, across Asia to Japan and Southeast Asia. It eats insects, beech nuts and acorns.

Classification:

OMNIVORE

7. Pine Grosbeak

(*Pinicola enucleator*)

This bird (20 cm in size) lives in the coniferous and scrub forests of North and West North America, North Scandinavia and Siberia. It eats berries and buds on the ground or in treetops.

Classification:

HERBIVORE

9



10



*Art by Linda Isaacson*

10. Hermit Thrush  
(*Catharus guttatus*)

This bird (15-20 cm in size) lives in woodlands, forest edges and thickets in North and Central America. It eats insects, spiders, snails, earthworms and salamanders as well as fruits and seeds.

Classification:  
OMNIVORE

9. Common Treecreeper  
(*Certhia familiaris*)

This bird (12.5 cm in size) lives in woodlands particularly coniferous woodlands in Western Europe and Japan. It eats insects and insect eggs gleaned from tree bark.

Classification:  
CARNIVORE

Reference: *The Illustrated Encyclopedia of Birds: The Definitive Reference to Birds of the World.*  
Consultant-in Chief Dr. C. Perrins. New York: Prentice Hall Press, 1990.