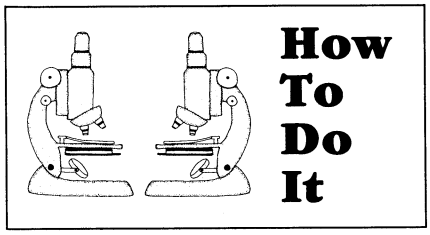

Pellet Puzzlers

R. A. Hoots

At different times, different animals appeal to public sentiment. Cuddly pandas, terrifying tigers, mesozoic dinosaurs and mystic owls have had their turns. Such emotional attachments can be exploited to further investigate the characteristics and behavior of these appealing creatures.

Owls evoke images of worldly knowledge, based on the historical belief that these birds could foretell the future. Magic, mystery and wisdom have been associated with this sagacious appearing raptor. Because of their nocturnal habits, noiseless flight and ominous hooting, owls have been thought to possess supernatural powers. The city of Athens is named after its mythological protector, the Greek goddess Athena, whose name graces *Athene noctua*, the Little owl of Europe. *Tyto alba*, the Barn owl of Europe, has been regarded as a bird of ill omen, and its appearance bespoke disgrace. On the contemporary scene, owls provide wildlife management with a visual and rhymed educational image, as in the slogan so popularly mimicked by children: "Give a hoot, don't pollute." Currently, the Northern spotted owl is making environmental headlines. If the forest is damaged through man's lumbering, this owl's habitat will be destroyed. Without its niche in the essential food web, this bird may not survive.

Within the educational setting, this cultural awareness of owls can be used as the springboard to extend the concept of birds and as a trigger to introduce other biological associations. Depending on the grade level of the learner, the idea of birds and their characteristics can be introduced. Elementary classification can be elucidated for the novice, while taxonomic language describing more precise distinctions can be derived by older groups. The categorical development of birds as flying creatures with beaks, wings and feathers can be expanded to clarify the assignation to the taxonomic schema outlined in Table 1.

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Table 1. The taxonomic schema of owls.

Kingdom: Animalia		
Phylum: Chordates		
Class: Aves		
Order: Strigiformes (owls)		
Family: Tytonidae (Barn owls)	*vs*	Family: Strigidae (Typical owls)
Genus species: *Tyto alba* (Barn owl)		*Strix occidentalis* (Spotted owl)

After elaborating on those features that characterize owls and define the Strigiformes order, further markers can be refined and resolved to sequester these birds into the dichotomous families. Native North American owls are separated into the barn owls and the typical owls. Members of the Tytonidae family are easily recognized by their white, heart-shaped facial discs and absence of ear tufts. They are known as "monkey-faced" owls and only 11 species of this family exist in the world. In contrast, members of the Strigidae possess round or squarish faces which may be marked by conspicuous ear tufts. Not all members of the typical owls, of which 123 species have been identified, show these feathered "horns"; it is a marker found on about 40 percent of this family's members (Heinrich 1987). These tufts or "horns" have nothing to do with hearing and may serve as camouflage or for threat display. In addition to the face shape and ear tufts, other classification clues can include differences noted in leg length during flight. The long legs of the Barn owl extend beyond the tail, while the Typical owls have short legs that do not extend beyond the tail while flying.

Working with pictures, novices can sort the owls into either the "Barn owl" or "Typical owl" family and can gain greater familiarity with the nomenclature by calling out the family title along with the common name. The ear tuft versus the non-ear tuft can serve as the initial discriminator. If no ear tuft is visible, then students can differentiate on the basis of white heart-shaped face vs. round or square face. For the more advanced or older students, classification can be further elaborated to distinguish the typical owl species and identification keys can be constructed to highlight features specific to the owl members. Information about species size, body markings, eye color (yellow vs. dark), voice or hoot, flight style, diurnal or nocturnal, habitat, etc. are available in bird field study guides.

Too often, science activities rely heavily on the visual and tactile senses, but with birds the audio receptors should be activated. Many birds are not readily seen, and their songs serve as evidence of their presence. Owls are closely associated with a hoot, but many of my students were surprised to hear owl calls that sounded more like hisses, yips, barks, whistles and other unexpected noises. Bird calls identify species, and the hoot variations have their own distinct

Figure 1. Great-horned owl, family Strigidae.

Figure 2. Short-eared owl, family Strigidae, photographed on the Galapagos Islands.

characteristics. These sounds have been captured on recordings that can add an acoustic dimension to the visual learning experience.

After generalizing the characteristics that label the birds as a class, students can elaborate on these categorical features to show how specific survival adaptations fit the owl's life style: the beak designed to rip and tear flesh, the soft plumage to aid in silent flight, the feet and talons fashioned for grasping, the ears fine tuned to pick up sound to aid these nocturnal hunters and the coloring to carefully camouflage the raptor within its natural background.

Owls also can be used to model the concept of energy transfer along the food chain. Evidence of the predator-prey relationship is found in their digestive discards. Just as zoologists investigate the scats of other animals to learn about diet and feeding relationships, the expelled bird pellets reveal much information about the owl's food habits.

Owl pellets and laboratory activities that involve their dissection are popular (Bastian 1991; Bealer 1980). These exercises can be used as a science activity at different grade levels. The material is readily available through field collection or purchase from biological supply firms. The study of these regurgitated puzzles should provide a field outing opportunity for learners to locate, identify and collect their own owl pellets. ***Note:** Make sure students wash their hands after handling pellets or have them wear gloves. If you are concerned about eggs, worms or mold, put the pellets

Figure 3. Barn owl, family Tytonidae. Photographed at 1989 NABT national convention in San Diego.

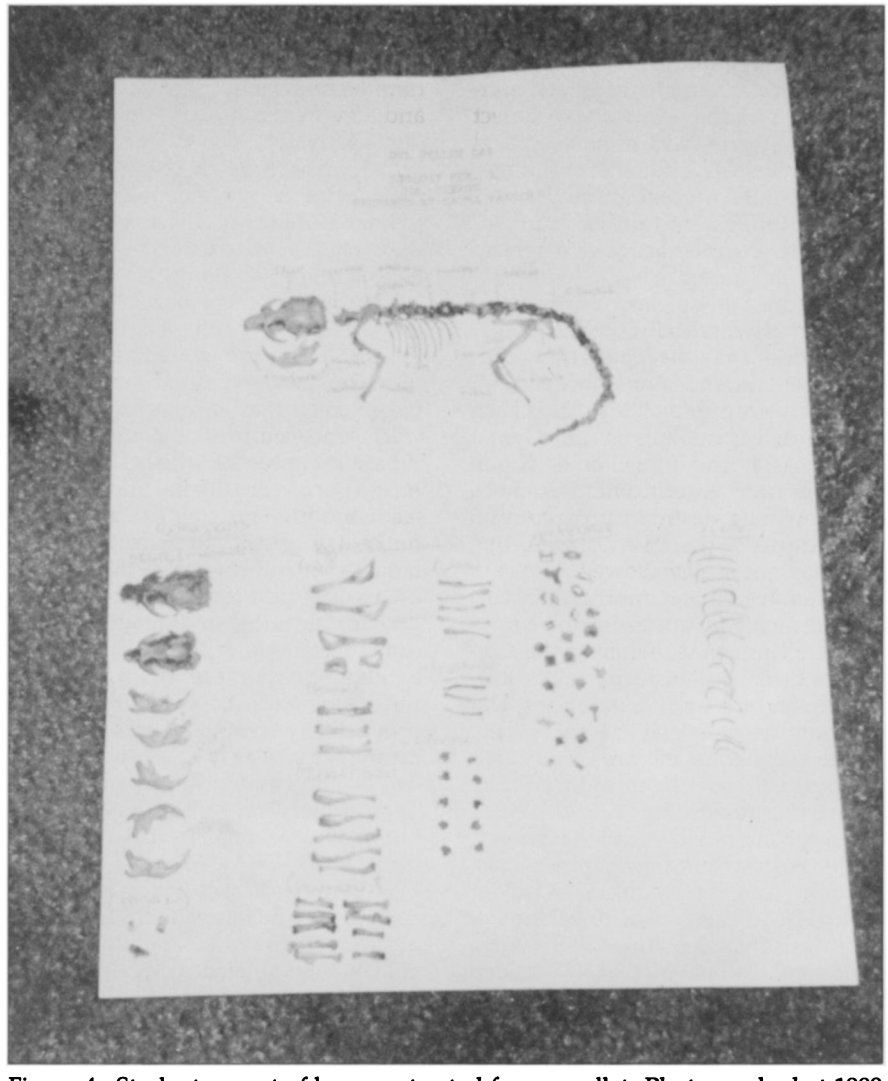

Figure 4. Student mount of bones extracted from a pellet. Photographed at 1989 NABT national convention in San Diego.

Figure 5. Owl pellets in center. At right are dissected bones; at left are bones from one pellet. Discarded fur is at extreme left.

in the freezer for a couple of days or heat them in a microwave at medium temperature for about a minute.

My college is situated in an agricultural community and students respectfully use a nearby cemetery to collect owl pellets (found under tall trees) and other interesting specimens to study in class. Once the amateur collectors have identified a bird pellet, they rapidly become professional pellet pickers.

Owls and other carnivorous birds (raptors) enzymatically digest the soft organs of the ingested prey fairly rapidly, over the course of several hours. Prey may include small mammals such as rodents, birds, insects and crustaceans. Small prey is swallowed whole with the head entering first, whereas larger animals are first torn apart and then gulped down. The Great horned owl can liquefy a swallowed mouse in five minutes. After another 10 minutes, the pressed juices are passed to the small intestine, while the undissolved content, which may consist of bones, fur, feathers, teeth, nails and chitinous exoskeletal remains, becomes trapped in the muscular stomach and is gradually compacted into the pellet package. This residue is usually coughed up (regurgitated) within about 12 hours. Several pellets, the number varying with the abundance and dietary needs, may be cast up several times during the day, thereby reducing the carrying load for the bird (Craighead & Craighead 1956; Heinrich 1987). These oral scats are intriguing puzzles. The dietary evidence is packed in the pellet, and the biological detective needs to identify, analyze and interpret the contents of these digestive discards to elucidate and explain the mystery of this predator-prey intrigue.

Students can easily follow the Pellet Puzzle exercise and pursue the investigation according to their ability level. All bones from the single pellet should be kept together. After isolating the bones within the pellet, they may be sorted by type, size and species. Anatomy is introduced here, and it is helpful to have vertebrate skeletons available so the bone pickers can match and relate the bones. Younger learners will observe that sizes and shapes vary as compared to the human skeleton, but they may note pattern similarities among species' leg bones, vertebrae, jawbones, skulls, etc. More advanced students can specify similarities and differences between bones. They will not only try to identify bones from different parts of the skeleton, but also from different animals. Similarities and differences between homologous structures become apparent through such an activity.

By comparing skulls, teeth and bones isolated from the pellets with the same items in an identified collection or by matching them to illustrated keys provided in Burnie (1988), identifying most parts will be easy and rewarding. Students may glean insights into the research aspects of paleontology and gain an appreciation for the researchers' expertise in identifying and distinguishing the bones of different animal species, dug up from different times. Recent analyses of fossilized owl pellets, several thousands of years old, reveal clues to animals prevalent then, but extinct now (Heinrich 1987). There are more stories that can be told as the evidence unfolds, and we learn how to read and interpret the data and attempt to make the right connections.

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Pellet Puzzle Science Detective Activity (can be modified to fit grades 4–12)

Themes

1. Classification of birds and their characteristics
2. Adaptations, specializations for feeding, flying, grasping, hunting, camouflage
3. Energy transfer, food chain (carnivore), predator-prey relationships

Purpose

To investigate the eating habits of the barn owl by examining an owl pellet and its contents

Materials

owl pellets
construction paper
toothpicks (probes)
5″ × 7″ colored index cards
glue or double-sided tape
forceps
plastic containers to rinse bones
household bleach
plastic bags
mouse bone diagram
rulers
magnifiers
tea strainers

Directions for Getting Bones

1. Observe the pellet. Note its color, texture, shape and size.
2. Sketch the pellet and measure its length, width and depth.
3. Tease the fur apart carefully, using toothpicks.
4. Pick out the bones with the forceps and separate from the fur.
5. Put the bones in a jar of water containing a few drops of bleach. The fur should separate from the bones. The bones will sink and the fur will float on the top of the water. The bleach will clean the bones. [Caution: Too much bleach will dissolve the fragile bones.] Carefully decant off the floating hairs and debris.
6. Add water to the bones in the jar. Pour this mixture of bones and water through the strainer.
7. Put the bones on paper toweling to dry.

Organizing Bony Data

(If exact identification of prey species is desired, it is important not to mix bones from different pellets.)

1. Look at the bones and try to identify head (cranial) bones, teeth, leg bones, rib bones, foot bones and anything else you see.
2. Separate the bones according to size and type.
3. Paste them onto the colored index cards trying to match up similar types of bones.
4. Count the total number of bones found.
5. Measure the shortest and the longest bones.
6. Make a chart of bone types from the cranium, mandible, upper limb, lower limb, phalanges, clavicle, scapula, pelvis, teeth, vertebrae, unidentifiable fragments, etc. Fill in the numbers of bones fitting each category.
7. Try to reconstruct skeleton(s) of prey.

Discussion Questions

1. About how many rodent remains would you estimate to be in this pellet? (number of skulls, jaw bones, femurs, etc.)
2. How do owls hunt their prey?
3. Do owls see, hear or smell the same as man does?
4. Can an owl move its eyes to the side?
5. How many degrees can an owl swivel its head?
6. Do all owls hunt at night? (Are all owls nocturnal?)
7. What different types of rodents can make up an owl's diet?
8. Besides rodents, what else might owls eat?
9. If owls eat mice, what eats owls?
10. What do the rodent prey of owls feed on?
11. Suppose there were a severe drought, what would happen to owls?
12. Why do we use the metaphors "Wise as an ___ " and "Give a hoot, don't pollute?"