On August 22, 1805, near the present town of Tendoy, Idaho, Clark wrote:

*I saw today a Bird of the woodpecker kind which fed on Pine burs its Bill and tale white the wings black every other part of a light brown, and about the size of a robin.*

Although originally mistaken as a woodpecker, Clark’s description refers to what is currently called Clark’s Nutcracker (*Nucifraga columbiana*). It is a jay-sized corvid that is crowlike in build and flight, averaging 27-30 cm in length, with males weighing approximately 141 g and females approximately 129 g. The sexes are similar in appearance, light to medium gray, with varying amounts of white around the eyes, on forehead, and on the chin; white around vent and at base of tail; wings and tail glossy black; secondaries broadly tipped with white (forming a white patch); outer rectrices white. It has a long, pointed, black bill with short nasal bristles (nares covered). It has a distinctive grating call that can be heard at great distance.

One of the distinguishing characteristics of Clark’s Nutcracker is its sublingual pouch, shared only by the Spotted nutcracker (*Nucifraga caryocatactes*) of Eurasia. It is formed by ventral diverticulum on floor of mouth between mandibular rami. The opening to the pouch lies under the tongue. The pouch bulges massively in throat region when filled with seeds, holding as many as 150 [whitebark] at one time.

**Habitat for Clark’s Nutcracker**

Clark’s Nutcracker lives in the mountain regions of the western United States and Canada, preferring a coniferous forest with large-seeded pines. “All
nutcracker-dependent pines have large, wingless seeds that are not effectively dispersed by wind; also, seeds are retained in ripe whitebark and pinon pine cones; trees tend to have upswept branches with cones conspicuous on tips” (Tomback, p. 8). The pictures below show one of the pines on the Lolo Trail that most likely were encountered during the Lewis and Clark expedition.

Pines on the Lolo Trail

Clark’s Nutcracker plays a key role in the survival of several pines. Seed dispersal by Clark’s Nutcracker has resulted in a commonly occurring tree cluster growth form in three of the following pines—whitebark (\textit{Pinus albicaulis}), limber (\textit{P. flexilis}), Colorado pinon (\textit{P. edulis}), single-leaf pinon (\textit{P. monophylla}), and southwestern white (\textit{P. strobiiformis}). As a result, Clark’s Nutcracker has played a role in altering their genetic population structure in comparison to wind-dispersed pines (Tomback, 1998, p. 1).

Clark observed the most frequent pastime of Clark’s Nutcracker—collecting pine seeds. The annual cycle of the nutcracker is closely tied to its dietary needs so collecting, storing, and retrieving stored seeds consume a great amount of the nutcracker’s time. It begins by prying the cones open with its bill and extracting the seeds. If hungry, it may eat some after crushing them in its beak, but most are slipped into the elastic pouch under the tongue. Once the pouch is full, the nutcracker flaps heavily away to an area of open ground where it digs a series of holes with its bill and deposits a few seeds in each one (Cassidy, 1990). Ornithologists (scientists who study birds) observed individual nutcracker caches in late summer and fall, noting the following pattern of collected pine seeds:

<table>
<thead>
<tr>
<th>Pine</th>
<th>Number of Seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textit{Colorado pinon}</td>
<td>22,000 – 33,000</td>
</tr>
<tr>
<td>Whitebark pine (Study 1)</td>
<td>35,000</td>
</tr>
<tr>
<td>Whitebark pine (Study 2)</td>
<td>98,000</td>
</tr>
<tr>
<td>Single-leaf pinon (Study 1)</td>
<td>7,000</td>
</tr>
<tr>
<td>Single-leaf pinon (Study 2)</td>
<td>17,900</td>
</tr>
<tr>
<td>Limber pine</td>
<td>16,300</td>
</tr>
</tbody>
</table>

Photo by Carl Hansen
Smithsonian Institution

Whitebark Pine
The total number of seeds cached by one Clark’s Nutcracker in one year depends on the cone crop size, availability of other cone crops, harvest duration, estimates of number of trips per day, and estimates of sublingual pouch load, which varies with age and body mass of nutcracker (Tomback, 1998). Clark’s Nutcracker has a highly developed spatial memory which means that it has an “uncanny knack for finding the stashes many months later” (Cassidy, 1990, p. 66). It uses the retrieved seeds for food during the winter and spring as well as to feed its young during nesting season. Certainly not all seeds are retrieved and the remaining seeds often grow into the pines that feed future generations of nutcrackers.

CLARK’S NUTCRACKER
Lesson Plan for Middle School Students

Grade Levels  Middle School (6-8)
Time  One Hour Teacher Directed; Several Days for Field Research

Purpose  The purpose of this lesson is to demonstrate the interdependence between Clark’s Nutcracker and selected pine trees. Both contribute to each other’s survival.

Previous Knowledge  Assume that this lesson will be an interdisciplinary extension to lessons describing the Lewis and Clark Expedition. This lesson should follow a viewing of the Smithsonian primary resources featuring Clark’s Nutcracker, pine trees, and pinecones.

Objectives

1. Given Smithsonian website and handout of Clark’s Nutcracker bird calls, students will match the sound on the website to the pictograph.
2. Given access to free roaming birds, students will sketch bird(s), tape-record, and draw pictograph of bird calls.
3. Given field research, students will compare and contrast the bird calls of Clark’s Nutcracker and the birds in their region.
**Procedure**

**Motivation:** Provide students with background information about Clark’s Nutcracker such as the context in which it was identified by William Clark on the Lolo Trail as well as its characteristics. Show picture if available or inform students that they will see a picture on the internet. Direct students to the Smithsonian website where they can read about Clark’s Nutcracker and listen to six of the calls it makes. Distribute the handout of the sounds and ask students to match the sound to the pictograph. Explain that the range of bird calls helps the bird survive by communicating a variety of needs such as hunger, excitement, territoriality, contact, mating, location, threat, and bonding.

Supplement handout with scientific research in Background Information section.

**Content Focus:** Ask students to name some of the birds they are familiar with in their own region. Explain that over a period of several days they will conduct field research similar to that done by the ornithologists (L. R. Mewaldt and D. F. Tomback) who collected data about Clark’s Nutcracker. Provide pairs of students with audio tapes and recorders, timing devices with second hands, sketch paper, pencils, binoculars, and graph paper that is divided into second intervals like the handout of Clark’s Nutcracker. Ask students to sketch the bird they observe, record the sounds it makes, and draw images of the sounds the bird makes on the graph paper. Before students get started, ask them to make predictions about how they think the sounds they record may be similar or different to the sounds made by Clark’s Nutcracker. In cases where birds are not making many sounds, students can record other behaviors such as flight patterns, eating, drinking, and/or nesting.

**Closure:** Identify a large area where students can display their sound graphs. In pairs, ask students to describe their findings and play excerpts from their audio tapes. Or better yet, include bird calling as an option to enhance the originality of their presentation. [Explain that bird calling is practically a sporting event around the world]. After all students have presented their findings, ask students to identify patterns in the research. Ask students to compare their research with the patterns of Clark’s Nutcracker.

**Evaluation**
- Students’ tape recorded sounds of bird calls; sketches of birds; pictographs.
- Students’ comparisons between the calls of birds in their region and the calls of Clark’s Nutcracker.
Background Information

Vocalizations (Tomback, 1998, pp. 9-10):

Group I: Characterized by broad bands of low-frequency sound, occasionally with overtones.
  
  *Regular Call; Fast Locational Call.* Sharp, rapid *kraaks* or *kraas*; grating, noisy Sound. Contact call, often given in flight or when no other birds are in sight.
  
  *Slow Locational Call.* Drawn out *kraaaack* or *kraaaa*, with many variants.
  
  Contact call often exchanged by birds in same stand of trees.

Group II: Have broad bands of low-frequency sounds of short duration. They are uncommon year-round, but most common February through September, probably serving a pair-bonding function.
  
  *Hiccup Call.* Rhythmic, throaty clicks. Soft call given by female in presence of male, accompanied by neck-stretching. Also used by lone juveniles.
  
  *Crackle- and Whistle Call; Crackle Call.* Soft, alternating crackles and wheezing whistles; accompanied by neck stretching and bowing; both sexes, particularly March and April.

Group III: Have low fundamental frequencies with 420 harmonics at 0.20-1.20-kHz intervals.
  
  *Hunger Call.* Urgent, repetitive *aaaa*; juvenile food-begging call, given near parent. Heard may-late August. Speeds up as parent approaches with food.
  
  *Shrill Call; Mew Call.* Decreasing in pitch; *meerk* or *mew*; common year-round; given by both sexes. Often exchanged among nutcrackers perched in same or adjacent trees.

Materials

**Primary Resources**—Images of Clark’s Nutcracker from Smithsonian web site (http://www.mnh.si.edu/lewisandclark); pines and pinecones; sound recordings of bird calls; sketch paper; pencils; timing devices; audio tape recorder; graph paper; binoculars (if available).

Education Standards

**National Science Education Standards:** (http://www.nap.edu/html/nses/html/) Life Science C; Science and Technology E; History and Nature of Science G

**National Council for the Social Studies:** (http://www.ncss.org/) Culture, b., c., d.; Science, Technology, and Society d.
References

Adult


Student
