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Classroom materials for student use are very expensive to purchase from biological supply houses. In many cases, teachers are left with two choices when it comes to laboratory materials, either find some way to produce their own or do without. Preserved and live specimens fall into this category particularly with respect to the higher vertebrates. While it may be impossible, or at least impractical, to keep a suitable number of birds or mammals, it is possible and may even be preferred to study skins, skeletal and other preserved material. Mammal skulls are easy to collect, prepare and preserve for use in the classroom. Such skulls may be used in a wide variety of lessons and activities and may be handled by the students without the threat of high replacement cost.

Don Sievers from the Iowa Conservation Education Center at Guthrie Center, Iowa, and I have worked out a simple method of preparing mammal skulls for classroom use. While many such methods exist and may be found in the literature, we believe this method to be simple, fast and suitable for most teachers' needs. It has been used successfully for mammal skulls ranging in size from shrews to white tail deer. It produces clean articulated skulls at very low cost. The method could be used to clean and prepare any portion of the skeleton of a mammal, but we have used it only for skull preparation. We also have not worked with birds.

Skulls may be obtained from many sources such as road kills (if the skull isn't crushed), hunters and trappers. Our best sources of small and medium-sized mammal heads are our own mouse trapping activities and heads saved for us by commercial trappers and fur buyers. Furbearers are skinned out leaving the head intact and several local fur buyers have readily consented to save a box of heads in their freezers for us. Mice, voles, other rodents, raccoons, opossums, weasels, coyotes, foxes, bats, moles and even shrews make excellent specimens. Some heads received from commercial trappers may be damaged by small caliber bullet holes. These holes may or may not make the skull useless. Often, the preparation of the skull must be nearly completed before the extent of this damage may be judged.

The preparation and preservation of the skull is carried out by the following procedure:

1. Skin the skull; use scissors or scalpel to remove as much muscle as possible.
2. Gently boil the whole skull in clean water until the meat is tender and begins to pull away from the bone. Take care not to overcook

the skull for this will reduce the strength of the bone and will cause it to disarticulate. (A bit underdone is better than the opposite.) A pan on the stove may be used for this gentle boiling. However, large skulls, a large number at one time or the odor may drive this step outdoors to a camp stove or other equipment. Boiling time varies from 15 minutes to two hours depending on the size and amount of material.

3. Under gently running water over a strainer, screen or in a basin, wash the remaining muscle and soft tissue from the skull.
   a. Take care to save the teeth which may come loose.
   b. Use a toothbrush, dissecting needle, large hypodermic or other convenient tools.
   c. Clean the brain case thoroughly. A large hypodermic may be used to flush the brain case. Skulls which are not thoroughly cleaned may assume a stained appearance. Remove any vertebrae.
   d. If any bones disarticulate, reserve them to be glued later.
   e. Take pains to clean the mouth and around the teeth thoroughly; use a stiffer brush or scrape with a knife blade if needed. Tiny flecks of soft tissue may dry or be bleached away in later steps.
   f. Be careful not to damage the turbinal bones of the nasal cavity.
4. Dry the skull on paper towels in the open air overnight.
5. Bleach the skull in full strength laundry bleach for four to eight minutes depending on its size.
6. Dry the skull overnight without rinsing.
7. Use high quality clear, all purpose household cement (ex. Duco brand Household Cement) to attach any loose teeth or disarticulated bones. It is a good idea to run a bead of glue along all of the teeth. Do not glue the lower jaw to the skull, leave it separate.
8. Allow the skull to dry for two days.
9. Label or number both pieces with India ink.
10. Spray with clear plastic spray (ex. Flecto brand Varathane liquid plastic clear stain spray); apply two coats on successive days.

Some skulls will assume a stained or darkened appearance, some may be over cooked or over bleached, some may be broken or have a bullet hole. You will almost certainly lose a tooth here or there but most of the skulls you prepare by this method will turn out very well. They will have a good natural bone color and will feel smooth and clean. The sutures will show clearly as will the openings for blood vessels. The plastic spray protects the bone from dirt and stains. If a skull is lost or broken during use, it can be easily replaced at very low cost. Students are quite capable of preparing skulls using this method, and they enjoy keeping their own work.

Many activities are possible for using these skulls. Those listed are ones which I have used successfully.

1. Keying activities. For practice in using identification keys, prepare a key for a set of mammal skulls. The skulls are unfamiliar enough to the students that they must use the key for identification. The skulls make the activity more interesting and fun.

2. Specialization or teeth. Comparison of teeth in the skulls can spark an excellent discussion of food specializations and habits. After students recognize that certain teeth are used for eating certain types of foods, they soon discover how paleontologists can tell so much about fossil animals by examining just their teeth. Observations made of teeth may also lead to discussion of ecological niches and other topics dealing with ecology.

3. Anatomy. The clean dry skulls are excellent for lessons in anatomy. Minute details easily seen in the skulls and the fact that they are the real thing make these lessons exciting for the students.

4. Evolution. Differences from group to group in skull anatomy make evolution topics come alive in the students' hands. Animals such as the opossum and the shrews reveal their primitive form. Comparisons of brain case volume are easy.

5. Taxonomy. Group relationships and naming are much easier for students to understand when they can see the features involved. The skulls are excellent props to use in classification activities.

6. Display. Having the prepared skulls on display in the classroom stimulates all sorts of discussion and interest. The skulls are exciting conversation pieces by themselves even when they are not the center of a planned activity.

However they are used, mammal skulls are a real asset to any science classroom.

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