

Bag of Bones



Richard A. Menger

Frequently I'm asked for the technique that I've used to mount the demonstration skeletons used in my classroom. My technique was modified from Dr. Hans Gruneberg's *The Genetics of the Mouse*, and is the most time conservative and effective method I've seen anywhere. This method utilizes a proteolytic enzyme, papain, which is derived from the tropical papaya fruit. (Papain may be purchased from Difco Laboratories, Box 1058, Detroit, MI 48232.) It costs approximately \$80 for 500 grams. This quantity lasts a long time. The procedure is recommended for any size animal that is medium-dog size or smaller. This size is restricted only because of the size of Ziploc® bags available and display requirements.

First, completely skin and eviscerate the specimen. Then section the body into head, limbs, trunk and tail. While sectioning, also remove the larger muscles from the legs, and remove the tongue, eyes and brain from the skull. No scraping is necessary, since the proteolytic enzyme will take care of the rest. After rinsing in tap water, place each section in an appropriate-sized Ziploc® bag, which can be either quart, one-gallon or two-gallon size. Make sure to label each bag.

A section might be similar to Figure 1 and be labeled left shoulder girdle and arm. Sectioning and bagging will save you an enormous amount of time later because you won't have to sort one big pile of bones.

Cover each section within the bag with tap water and double boil it for 10 minutes in a large kettle. You should now have five to six bags boiling at the same time. Carefully pour off the boiled water and cover again in the

same bag with a 5% aqueous solution of sodium chloride. To this solution add a good pinch of papain (amount depends on size of skeleton). Zip the bag closed, shake it, and place it in an incubator at 38–40°C for 24 hours.

The next day, shake each bag again vigorously to loosen any tissue still remaining on bones. Rinse the bones once or twice in tap water while still in the bag to, again, free bones of any tissue still remaining. Great care should be taken not to lose any of the little bones as the solutions are poured off. Do not allow the bones to dry with tissue still adhered to them. Keep all bones submerged while any solution is used in the bags.

The bones are then bleached by placing them in hydrogen peroxide in the same bag for about five hours. Placing the bags during this time in direct sunlight will hasten this portion of the procedure.

Then, after pouring off the hydrogen peroxide solution, replace with acetone in the same bag for 12–24 hours. This will remove any grease and fat and prepare the bones better for gluing. Following this, empty each bag onto paper toweling and allow the contents to dry.

Students may either assemble the skeleton in a standing position with wire and Duco® contact cement (Dev-

con® or Dupont® works best, because these are clear), or lay them out in order on black art paper, gluing them in place with the contact cement. Labeling can be neatly done in a variety of ways. Stainless steel rods of a quarter-inch or better in diameter can be used for support, as well as wire of different gauges to mount on a wood base. Any bones connected in the wrong place can be loosened with acetone.

Besides the satisfaction a student gets by using this technique, it may

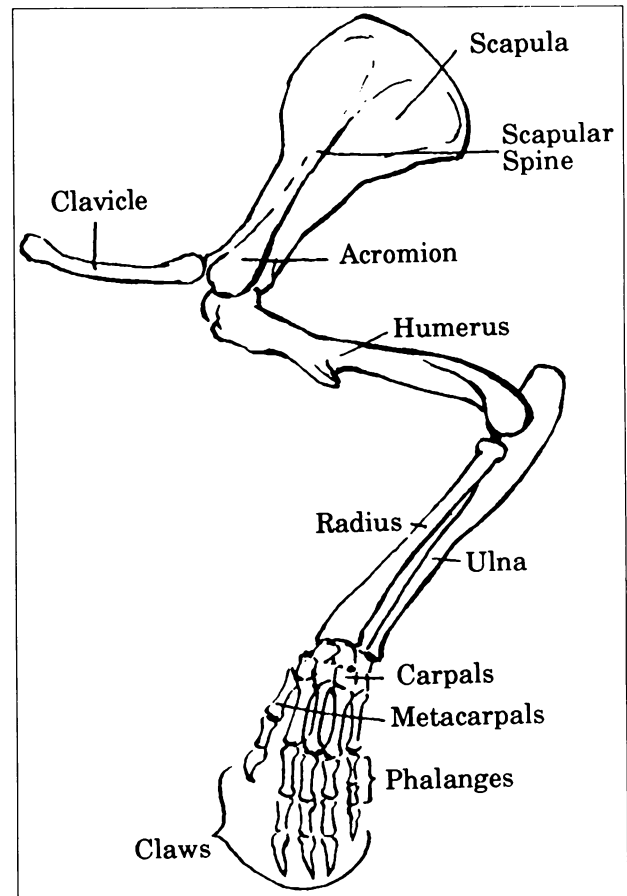


Figure 1. Typical "bagged" section might be labeled *left arm section*.

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be applied to research problems such as:

1. Effects of vitamins, hormones and respiratory gases on bone development
2. Rates of bone growth
3. Strain skeletal differences
4. Genetic variations.

This *Bag of Bones* technique may be used for the preparation of any skeleton, but larger animals require more papain and larger Ziploc® bags, and have to stay in the various solutions for longer periods of time. The use of Ziploc® bags, papain and the related procedure is quick, convenient and less odoriferous than relying on beetle

larvae. My students have mounted animals ranging from shrews to coyotes, and everything between. A raccoon eating a frog and a coyote chasing a rabbit are two of the more interesting specimens. You'd be surprised how fast a collection grows and the time saved by using *Bag of Bones*.

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The authors, Robert D. Allen, Ph.D., vice president of instructional services at Victor Valley College, Victorville, CA, and David J. Stroup, Ph.D., department of biology, Francis Marion University, Florence, SC, have worked together for more than 15 years focusing their instructional research on development of students' critical thinking skills. They have presented more than 40 national workshops on the topic.

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