Smithsonian
National Museum of Natural History

FossiLab Deep Time Training

Specimen Housing Workshop

Goals and benefits of proper specimen housing

The goal of work to house specimens is to provide for specimens a physically and chemically stable environment for long term storage, with consideration for access during research or inventory.

The benefits of ensuring proper specimen housing are many, including:

- Long term physical and chemical stability prevents breakage and degradation.
- Housing structures provide support for specimen while allowing access for safe removal and easy handling.
- Better organization of specimens to make finding them in collections easier.
- Easily visible labeling for quick inventory.
- Savings in time/materials/etc. in the future care of specimens.

Tools and materials used

Ethafoam – Polyethylene closed-cell foam, blown with an inert gas such as nitrogen. Can come in thin sheets or thick slabs of varying densities and colors.

Tyvek – A polyethylene nonwoven fabric made from spunbond olefin fibers. Used for everything from house wrapping to HAZMAT suits. Permeable to water vapor, but not liquid water. Resistant to stretching and tearing, but can be cut like paper.

Polyester batting – Lightweight loose polyester fibers forming a fluffy material, used for stuffing and filling objects.

Cutting tools – Craft knives, box cutters, carving knives, electric hot knives.

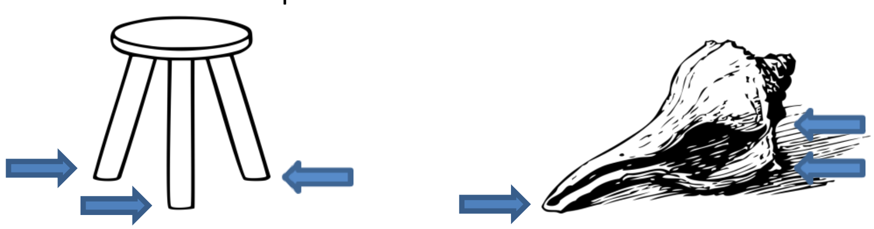
Adhesives – Polyvinyl butyral (Butvar B76), ethyl methacrylate (Acryloid B72)

Other materials – Acid-free cardstock, archival plastic sleeve, documentation recording forms

Step-by-step guide

Step 1: Know your specimen

- Observe your specimen from all angles. Note any structural weak points or areas of previous repair. Document any areas of concern, return to repair stage if the specimen is not adequately stabilized for storage.
- Note the location of writing or labeling on the specimen, and document all occurrences if this has not already been done.
- Determine which side should face “up”. Ideally, this is a position in which the upward-facing surface is structurally the weakest (so that it will not be bearing the specimen’s weight), and where any labels or numbers on the specimens are visible. This is also a position most convenient for researchers to access important data from the specimen, minimizing the need for it to be removed from housing and handled.
    - For example, skulls are usually stored with the skull and jaws separated, the teeth pointing upwards.
- Consider the **“three points rule”**. All objects resting on a flat surface must rest on at least three points. Where are those three points on your specimen? How can you create a structure underneath that will distribute weight equally across a greater surface, to relieve stress on those three points?

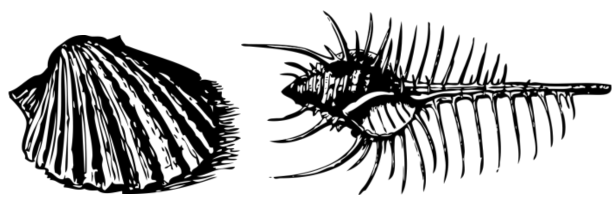


Step 2: Plan housing structure

- Choose the right size of tray. Specimens should fit completely inside, with room allowed for the placement of any associated labels and documentation. Make sure fragile structures do not hang over the sides of trays.
- Specimens should not roll, slide, or impact the sides of the tray. If you’ve ever opened a ‘stuck’ specimen drawer, you’ll understand why specimens are often damaged from simply accessing them in collections. Proper housing can nearly eliminate this type of damage. Make sure your housing is designed so that specimens are centered in the tray, and cannot move beyond that.
    - The best way to both ensure weight distribution across the surface of the specimen (see “three points rule” above) and keep a specimen secured in its tray is to construct a form-fitting cradle, by carving a depression into the ethafoam

liner and/or adding ethafoam wedges under raised structures to prop them up and prevent the specimen from rolling.

- How is your specimen going to be removed from the tray? If your specimen has a complex shape, leave space to carve extra scoop-shaped depressions next to structurally strong areas on the specimen. Fingers inserted into those depressions can grip the specimen by the sides for removal, rather than pulling on one or two points from the top.
- Choose your liner thickness - vertically shallow specimens may only need one or two pieces of sheet ethafoam to form a proper housing. Specimens with greater vertical relief may require a piece of slab ethafoam for a tray liner.
- Does your specimen need an extra pillow? Specimens with very delicate structures or no 'good' surface to rest on will need a layer of extra soft polyester batting at the bottom of the carved cradle.



A robust specimen (left) doesn't need extra batting for support, but the delicate specimen (right) does.

Step 3: Create housing structure

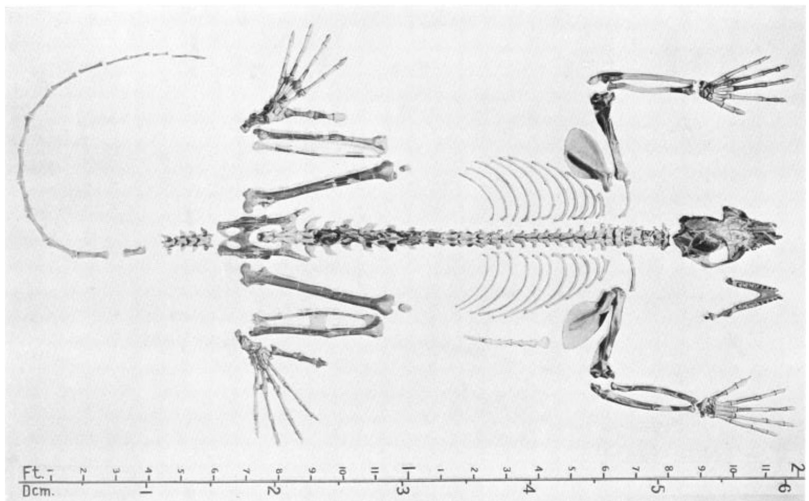
- Insert ethafoam liner into specimen tray, making sure the foam is sized properly so that it fits snugly and does not shift or buckle.
- Place your specimen into the padded tray to work out its positioning and orientation.
- Mark areas for depressions to be carved. This can most easily be done by placing the specimen in its tray with foam layer(s) inserted, and tracing around it to indicate the areas you want to cut. Remove specimen.
- Use a craft knife or box cutter to carve depressions in the ethafoam liner. Carving the liner to achieve various levels of depression and shapes that will form-fit to the underside of the specimen often needs to be done in several steps. Avoid leaving ragged edges along carving lines. If you will insert batting to give the specimen extra cushioning, allow space for it.
- If needed, carve raised ethafoam props to support raised projections of bone. Make a few rough, shallow cuts into both the bottom of the prop and the top of the foam liner in the tray, and use Butvar B76 glue to adhere the prop securely in place.
- Carve finger grips into foam alongside depressions for the specimen.
- Test-fit your specimen, and make any adjustments to the carved areas as needed. Remove specimen.

- Using a craft knife or box cutter, make a straight vertical cut down in a ring around the outside of both the carved depression and finger grips, about ¼” away from the edge.
- Insert polyester batting if needed.
- Cut a sheet of Tyvek to the approximate shape of your carved depression. Leave extra space on the sheet for the depth of the depression, and for tucking in securely. Note: specimens placed on flat surfaces with no carved depression or batting do not need a Tyvek liner.
- Using a tongue depressor, coffee stirrer, or other blunt-edged tool, tuck the edges of the Tyvek sheet into the ring around the carved depressions. Keep the Tyvek loose enough to contour into the depression, but try to avoid wrinkles or baggy areas the specimen could snag on.
- Place your specimen into the tray, and measure from the bottom of the tray to the highest vertical point the specimen reaches as it sits in the tray.
- Use the vertical height measurement to create drawer guards. Measure and cut at least two, as many as four rectangles in cardstock. The rectangles should be longer by ½” than the vertical height of the specimen. For specimens in small trays, rectangles should be at least 2” wide. For larger trays, they should be at least 3-5” wide. Small trays will need only two drawer guards, larger trays will need four.
- Cut out the cardstock rectangles, and fold each in half along the length.
- Draw a curve at the top of each folded rectangle, then cut it out, to give each drawer guard a rounded edge.
- Unfold the rectangles enough to slot them between the tray and ethafoam liner at each tray corner.
- Insert any documentation accompanying the specimen into archival plastic sleeves, cutting each to size. Place documentation into the tray with the specimen.

Organizing a skeleton into trays

- Be aware that most skeletons are composites of numerous individuals and many specimen numbers, or a specimen with a number of fabricated parts, or both.
- Before dismantling a specimen, look it over carefully and determine how many specimens are incorporated into the mount, and which bones are labeled with which numbers.
- **Each specimen (by number) should be housed separately**, even if it was previously combined to make a full mounted skeleton. Organizing in this way makes the specimen more useful to researchers. If the skeleton should ever need to be reassembled, your notes regarding which parts came from which specimen will be the tool to put it all back together.

- This guide will assume that you will be putting a full skeleton into collections.
- In general, it is preferred that specimens be arranged in collections so that each ‘section’ of the body fits into a tray. These sections fall into two categories:
    - Axial sections: Cranium and jaws, vertebrae, left and right ribs, sternum.
    - Appendicular sections: Shoulder girdles, forelimbs, pelvic girdles, hindlimbs.



- You will be dismantling skeletal mounts piece by piece, and so will need to plan specimen housing ahead to make sure that appropriate skeletal elements can fit into a tray together.
    - It may make sense to dismantle and place a section of elements in a tray to work out their arrangements prior to carving the foam, rather than doing it one element at a time.
- Elements that normally articulate together (vertebrae or toe bones, for example) should be housed in sequence, with at least a piece of sheet ethafoam between adjoining elements to prevent them from abrading against each other.
- If elements are too small to carve individual cradles in trays (toe and ankle bones, loose fragments, etc.), place the elements in a clear plastic lidded box. Include a small cardstock label with the specimen number written on it. If the elements are especially delicate, put them in gelcaps or insert a square of ethafoam to pad the bottom of the box. Then, carve a depression for the box into the appropriate tray holding the larger elements, and place the box into that tray to keep everything associated.
- When using multiple trays/jackets to house a specimen, **make sure that a copy of the specimen card goes with every separate tray/jacket**. They may not be able to be stored adjacent to one another in collections, so having labels with each piece is important to ID them.

Resources and further reading

- Accessible through the PaleoPortal Fossil Preparation website at http://preparation.paleo.amnh.org/
  - The PaleoPortal Fossil Preparation specimen housing website: http://preparation.paleo.amnh.org/22/housing
    - Fox, Marylin and Yarborough, Vicky Y. (2004). A Review of Vertebrate Fossil Support (and storage) Systems at the Yale Peabody Museum of Natural History. (Powerpoint presentation file, PDF write-up of which is found below)
    - Rutzky, Ivy. Rehousing Techniques for Fossil Specimens. (Powerpoint presentation file)
    - Davidson, Amy. Cavity Mounts for Safe Storage and Handling. (Powerpoint presentation file)
  - The PaleoPortal Collections Management mounts and materials website: http://collections.paleo.amnh.org/33/mounts-and-materials
    - Specimen Rehousing Tips/Fossil Mammal Type Collection Rehousing Guidelines (.zip folder of images)
    - Rehousing Workshop Presentation/Kaplan, Amy and Arenstein, Rachel P. Specimen/Artifact Re-housing & Support: Materials, Techniques, and Designs for Long-Term Storage (Powerpoint presentation file)
    - Fossil Housing Report/ Graf, John. Type Re-Housing Project – Summer Internship 2007
- Accessible through the SVP Preparators Resources website at http://vertpaleo.org/Education---Resources/Preparators-Resources.aspx
  - Defining the Professional Vertebrate Fossil Preparator: Essential Competencies (PDF file)
  - Fox, Marylin (2004). A Review of Vertebrate Fossil Support (and storage) Systems at the Yale Peabody Museum of Natural History. (PDF file)
  - Smith, Matt (2007). Vertebrate microfossil storage, the basics, and a new technique. (Powerpoint presentation file)

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Inventory labels designed by Amanda Millhouse, Museum Technician, Department of Paleobiology, Smithsonian Institution National Museum of Natural History

Inventory ID # ________ Imaged? ☐
Genus species: ____________________
____
Element(s): ____________________
____________________ Left Right
cm

Inventory ID # ________ Imaged? ☐
Genus species: ____________________
____
Element(s): ____________________
____________________ Left Right
cm

Inventory ID # ________ Imaged? ☐
Genus species: ____________________
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Element(s): ____________________
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cm

Inventory ID # ________ Imaged? ☐
Genus species: ____________________
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Element(s): ____________________
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Genus species: ____________________
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Element(s): ____________________
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Inventory ID # ________ Imaged? ☐
Genus species: ____________________
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Element(s): ____________________
____________________ Left Right
cm

Inventory ID # ________ Imaged? ☐
Genus species: ____________________
____
Element(s): ____________________
____________________ Left Right
cm

Inventory ID #____________ Genus species________________________________

Date Started: ____________ Volunteer Initials:________________________________

Instructions: On the line next to the element, record any numbers written on the bone. Record (or cirle appropriately for the limbs) what is real bone, fabricated/cast/sculpted, or a combination of real and fabricated elements (combo). For any element that you cannot determine this for, circle/record unknown. Record any additional notes or things that CM should know about.

HEAD

Skull Numbers: ________________________

Real Fabricated Combo Unknown

Jaws Numbers: ____________________

Real Fabricated Combo Unknown

Additional Notes: ____

BODY

NECK VERTEBRAE Numbers: ____

Approx # of: Real ______ Fabricated______ Combo ______ Unknown ______

Additional Notes: ____

BODY VERTEBRAE Numbers: ____

Approx # of: Real ______ Fabricated______ Combo ______ Unknown ______

Additional Notes: ____

LEFT RIBS Numbers: ________________________

Approx # of: Real ______ Combo ______

Fabricated______ Unknown ______

RIGHT RIBS Numbers: ____________________

Approx # of: Real ______ Combo ______

Fabricated______ Unknown ______

Additional Notes: ____

TAIL VERTEBRAE Numbers: ____

Approx # of: Real ______ Fabricated______ Combo ______ Unknown ______

Additional Notes: ____

LEFT FORE LIMBS

Scapula Numbers: ______________________

Real Fabricated Combo Unknown

Humerus Numbers: ______________________

Real Fabricated Combo Unknown

Radius/Ulna Numbers: ______________________

Real Fabricated Combo Unknown

Hand Numbers: ______________________

Real Fabricated Combo Unknown

RIGHT FORE LIMBS

Scapula Numbers: ______________________

Real Fabricated Combo Unknown

Humerus Numbers: ______________________

Real Fabricated Combo Unknown

Radius/Ulna Numbers: ______________________

Real Fabricated Combo Unknown

Hand Numbers: ______________________

Real Fabricated Combo Unknown

Additional Notes: ______________________

____

LEFT HIND LIMBS

Pelvis Numbers: ______________________

Real Fabricated Combo Unknown

Femur Numbers: ______________________

Real Fabricated Combo Unknown

Tibia/Fibula Numbers: ______________________

Real Fabricated Combo Unknown

Foot Numbers: ______________________

Real Fabricated Combo Unknown

RIGHT HIND LIMBS

Pelvis Numbers: ______________________

Real Fabricated Combo Unknown

Femur Numbers: ______________________

Real Fabricated Combo Unknown

Tibia/Fibula Numbers: ______________________

Real Fabricated Combo Unknown

Foot Numbers: ______________________

Real Fabricated Combo Unknown

Additional Notes: ______________________

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