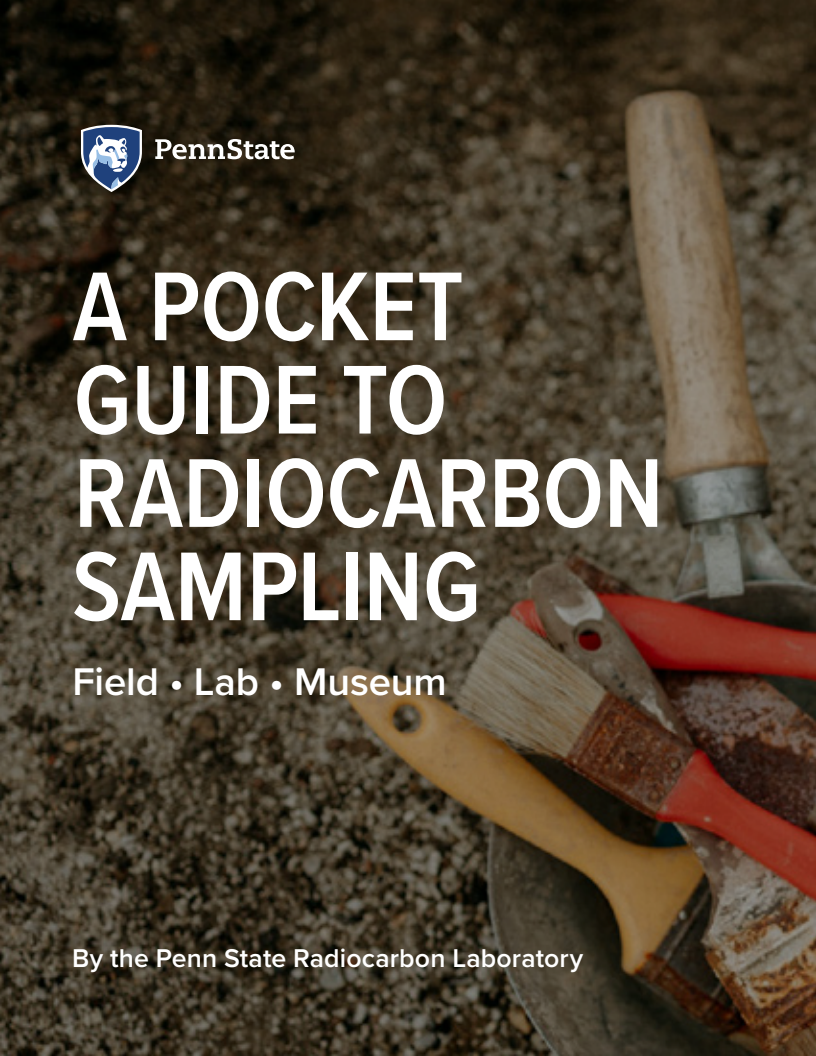

PennState

A POCKET GUIDE TO RADIOCARBON SAMPLING

Field • Lab • Museum

By the Penn State Radiocarbon Laboratory

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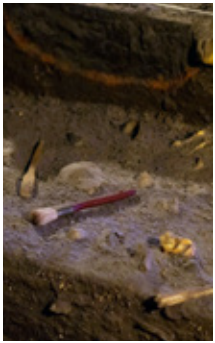


This pocket guide is intended to assist researchers collecting ^{14}C samples in the field, lab, or museum to make the best decisions to achieve their research goals. In the moment of choosing your samples you often face physical, intellectual and logistical challenges: weather extremes; time crunches; complex stratigraphic observations; and the inevitable critical find at 3pm on the last day of the field season. This guide is a resource to help clarify your decision process in those moments, and to help you do good science.

The advice and recommendations that follow are suggested best practices. The more you apply these ideas the greater the confidence you will have in your results. Whenever you have the opportunity to improve the quality of your sample – even incrementally – do it. Do your best given your experience, your budget, the conditions, and the tools at hand. Do not allow the perfect to become the enemy of the good.

Defining the context

Sampling in the excavation context is guided by an understanding of depositional processes and interpretation of natural and cultural stratigraphy. Collecting samples opportunistically during excavation is a good idea, but targeted sampling when the entire context is fully understood is critical. When you collect a sample, **always define the question that will be answered by getting a ^{14}C date**. Write this down explicitly in your notes when you collect the sample. It may seem obvious that charcoal from a fire pit tells you the age of the pit, but it also may indicate the age of the floor it is built on, the age of associated artifacts, and constrain the age of another stratum that overlays it. **Write it all down**.

Target abrupt changes in stratigraphy or lithology, which indicate changes in external conditions. Sample directly above and below such breaks to determine whether the break also represents a hiatus of deposition. Sample all discrete features. Take more samples than you expect or can afford to analyze.

Sample Selection

Typically, the ^{14}C age of a dated sample is indirectly related to an event of interest. When dating charcoal from a hearth, we want to know when the hearth was made and the timing of associated artifacts and behaviors. What we date is the death of the plant from which the charcoal was derived, which can predate the hearth by decades or centuries in some cases. To reduce the effects of old wood and in-built ages, short-lived samples are recommended where possible.

Sampling strategy to constrain timing of wall construction, subsequent burial by debris flow, and later swidden land use at an ancient Maya site.

A Charcoal from buried A horizon

B Charcoal from debris flow

C Charcoal from beneath wall

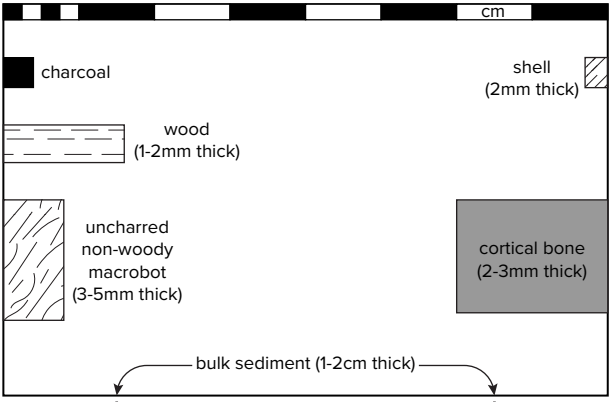
- **Single year growth:** seeds; grains; nutshells; antlers; pinecones; inflorescences; leaves; twigs; grasses; outer wood; outer lip of mollusk shells; insects.
- **<10 years:** most animal bone (incl. brief lifespan and collagen turnover), smaller branches; certain mollusks.
- **10+ years:** inner wood of trees; collagen in dentine and the petrous portion of the temporal; bulk soil organics.
- **Avoid multiple or mixed samples**

Recommended sample sizes

Materials	Sample Weight
Organics (uncharred)	20-100 mg
Charcoal	5-50 mg
Bulk Sediment	10-100 g
Bone	200-1000 mg
Bone collagen	>5 mg
Calcined bone	1-5 g
Hair/fibers/textiles	10-100 mg
Carbonates	25-50 mg

The table gives recommended sample sizes for analysis by the AMS, assuming an optimal 0.7–1.0 mg of final carbon after processing.

Recommended sample sizes (actual size)



Storing your samples

Common containers for ^{14}C samples include aluminum foil packets, Ziploc or WhirlPac-syle bags, film or prescription canisters, and centrifuge tubes. Using paper bags for storage is not a good idea for organic samples as standard pretreatment methods (ABA) will not remove cellulose from a deteriorating/soggy bag. Similarly, a paper sample tag kept with the sample should have its own plastic bag to protect it. Air drying wet samples is a good idea if practical.

Aluminum Foil: Most kitchen foil is coated to help it separate from the roll, and this likely contains some form of carbon. There is a legend that only either the shiny side or the dull side has this coating; in fact, it is on both

sides. Being food grade, though, the coating is water soluble and will be removed by standard pretreatments. Uncoated chemistry grade foil is available as well.

*Fold your foil, don't crush it!

Plastic Bags: Depending on your sample type, bags from 2-4mil thickness are recommended for durability. Typically sandwich bags are often too thin to handle soil, shells, wood fragments, etc., without puncturing. Off-gassing of carbon compounds from polypropylene is typically not an issue that affects ^{14}C samples in the short term.

The air- and water-tight conditions a plastic bag can create may foster growth of bacteria, mold, and fungi that can physically degrade the material and introduce modern carbon contamination. As with cellulose, standard ABA treatments will not necessarily remove this contamination. Allow moist samples to air dry as soon as you can get them into a protected environment. Wet samples (e.g. from a lake core or bog deposit) are best kept submerged in a vial with distilled water until they can be dried in a controlled setting.

Consolidants and Adhesives

If a bone or artifact must be consolidated in the field before removing it, use the minimum required and record where specifically it was applied so it can be avoided or removed when later sampled in the lab. Always note the possible presence of a consolidant when submitting the material to a ^{14}C lab. Likewise, always assume any material held in museum collections has something applied to it.

Sampling in the Lab and in Museums

Whether working with field samples back in the lab or collecting samples in a museum setting, certain tools and materials are always useful to have on hand:

- Notebook
- Pencils – many museums do not allow ink pens to be used
- Aluminum foil: A clean surface, disposable between samples
- Forceps, scalpels, spatulas, X-acto knife
- Methanol or isopropyl alcohol for cleaning tools (do not use ethanol; and do not use scented hand sanitizer)
- Kimwipes
- Dremel tool with disposable cut-off wheels and drill bits/burrs for sampling bone and shell
- Safety glasses
- Nitrile gloves
- Sharpies (note prohibitions against ink)
- Bags, vials, and other containers suitable for the sample material

Cutting bone with a Dremel should be done in a hood with safety glasses and a particle mask if necessary. Bone dust is messy and not good to inhale.

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Accelerator Mass Spectrometry at Penn State

Center for Quantitative Imaging

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Environmental Contaminants Analytical Laboratory

Mass Spectrometry Facility at Penn State

Lab facilities are available to assist both Penn State researchers and clients from industry, government, and other universities.

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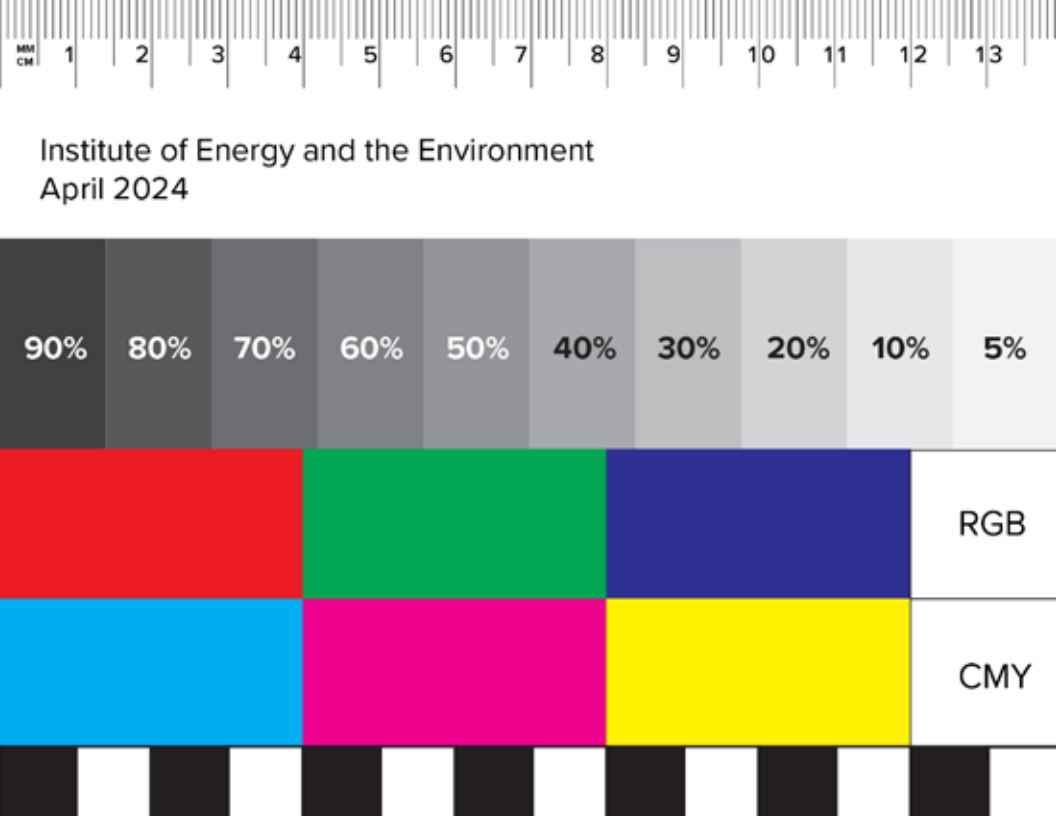
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