Chapter 6: Archaeological Methods

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Learning Objectives

- Define archaeology and other important terms in archaeology
- Examine how archaeologists find, assess, and excavate archaeological sites
- Explore the differences between excavation and looting of archaeological sites
- Examine the two ways that chronologies are established in archaeology: Relative and Absolute Dating
- Explore how archaeologists protect archaeological sites and the ethical issues surrounding repatriation

What is Archaeology?

Archaeology generates a lot of interest from the general public. People are fascinated by the subjects studied by archaeologists such as Stonehenge, the pyramids, cave paintings, and the Maya and are enthusiastic about the prospect of finding lost ancient civilizations or buried treasure. Archaeology, as a field, both benefits and suffers from this interest. The reality of archaeology is less glamorous: it involves rigorous scientific methods that are used to generate conclusions about past cultures from tiny, broken bits of trash. And most of what professional archaeologists learn about the past is only communicated to other archaeologists. People take advantage of this communication barrier to exploit public interest in archaeology, so the general public often learns about archaeology from people looking to exploit their interest by making unsubstantiated claims about the past. As a result, there are many misconceptions about archaeology and what it studies (Figure 1). So, before delving into what archaeologists actually study, we must first address what archaeology is not: Archaeology is not about seeking adventure or looking for buried treasure. Archaeologists do not study dinosaurs (that's paleontology), and the wonders of the ancient world were not built by aliens (for a good discussion on why this myth persists, see the Sapiens.org article in "Resource Links").

Archaeology is the study of humans and human cultures through the recovery and analysis of material remains. Archaeologists use the things that people made, used, and eventually discarded to piece together what life was like for the humans that were responsible for those things. Typically, archaeologists study the human past. However, that does not mean that archaeology can only be used to study the ancient past. In fact, archaeologists can, and do, study modern society. But archaeologists tend to study the past because for most of the past, the only way to learn about humans – what they ate, what clothes they wore, what tools they used, what kinds of houses they lived in – is through archaeology.

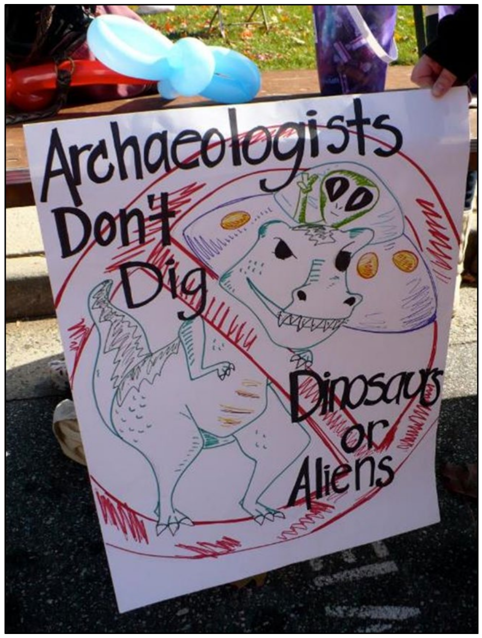

Figure 1: Image highlighting some common misconceptions about archaeology. Source: drawing courtesy of Julia Rogers; Image courtesy of Kathryn Deeley

Archaeologists reconstruct the behavior and cultural patterns of people in the past using a combination of artifacts and archaeological features. **Artifacts** are moveable objects that were made, used, or modified by humans. They include things like tools, pottery, bottles, buttons, and animal bones (Figure 2). **Archaeological features** are both evidence of the past and a place, and they often provide evidence about human technologies. They include immovable evidence of human behaviors like architectural elements (such as walls, post holes, and post molds, as well as hearths, wells, and cemeteries). Together, artifacts and archaeological features make up the **archaeological record**. The archaeological record also includes **ecofacts**, the remains of plants and animals that weren't made, used, or modified by humans but ended up in the archaeological record anyway. The places where we find these elements are known as **archaeological sites**. Technically, an archaeological site is any place where there is evidence about human behaviors, but usually, the term is used to refer to places where there is a concentration of that evidence. There are many different kinds of archaeological sites. Some sites are easy to identify and have clear boundaries, like a village site or a cemetery. Other sites are smaller, with fewer artifacts, and less easily identifiable boundaries, such as temporary campsites or kill sites.

How do Archaeologists Know Where to Dig? Finding Archaeological Sites

Finding an archaeological site is the first step in the archaeological research process. There are many different ways that archaeologists find sites. Sometimes we find archaeological sites by accident, usually because there is something on the ground surface that suggests there is more evidence beneath the ground. This evidence could be a large feature (like a pyramid or mound) that sticks up above the ground surface; the ruins of a house foundation or a chimney that someone stumbles upon on a walk in the woods; or a stone projectile point that a farmer accidentally pulls up when plowing their field. Sometimes archaeologists find archaeological sites because there is historical evidence or oral history that indicates that something happened at a particular place in the past. This could include historic maps, documents, photographs, or family stories passed down from one generation to the next. But, in the United States,

Figure 2: Artifacts recovered from Annapolis, MD. Source: Archaeology in Annapolis

the most frequent way that archaeological sites are discovered is through development and construction projects. In this case, archaeological sites are found because someone picks a place to build something – a road, a hospital, a dam, or a shopping mall – and before that thing can be built, archaeological testing is done to make sure that no historic, cultural, or archaeological resources will be damaged in the building process. For example, when the subway system was built in Mexico City, workers discovered the ruins of two Aztec temples in the tunnels they were digging. Most of this work is done by **Cultural Resource Management (CRM)** archaeologists (see the Case Study below for more information).

Once archaeologists have found an archaeological site, they have to try to assess that site before any excavations begin. As we begin inspecting a site, we must remember that even if it is where humans did things in the past, not all evidence of those behaviors will survive into the present, and not all objects are preserved in the ground. **Decomposition** occurs in two ways: Chemical and physical processes, and microorganisms. Some things resist decomposition by microorganisms, mostly inorganic materials like rocks and man-made materials like glass and ceramics. While ceramics and glass survive reasonably well in the ground, the problem is that ceramics and glass are relatively new inventions for humans. Fortunately for archaeologists, for most of human history, we made most of our tools from stone. Unfortunately, we also made a lot of tools out of organic materials, such as leather, wood, paper, fur, feathers, plants, and shell. These materials decay very quickly, sometimes surviving only a few days or a few decades. Typically, it takes less than twenty years for most organic materials to decompose; however, for these microorganisms to break down organic material, they need warmth, oxygen, and water. So occasionally, we find archaeological sites where there isn't warmth (sites that are frozen, for example), sites where there isn't oxygen (sites that are underwater), and sites where there isn't water (sites in the desert). At those archaeological sites, we do sometimes find organic material.

When we find an archaeological site, before we begin our excavations, we want to have an idea of what we might find when we start digging. We want to have an idea of how big the site is and where most of the artifacts are located. There are many different techniques for assessing archaeological sites: Some create maps of the changes to the surface, and some create maps of the disturbances beneath the surface. Some of the more common techniques that archaeologists use to assess archaeological sites include Side-Looking Airborne Radar (SLAR), Light Detection and Ranging (LiDAR), Electrical Resistivity testing, Ground-Penetrating Radar (GPR), and Magnetic Surveys.

SLAR and LiDAR are the two above-ground techniques most commonly used by archaeologists to conduct **non-invasive assessments** of archaeological sites. **Side-Looking Airborne Radar (SLAR)** uses an electromagnetic pulse sent perpendicularly from a plane to create topographic maps of the terrain on either side of the airplane's flight path. This creates detailed maps of changes in elevation on the ground surface. **Light Detection and Ranging (LiDAR)** also creates topographic maps of the ground surface, but it uses a light pulse sent from the plane to the ground directly beneath the plane and measures the amount of time it takes the light to return to the plane. LiDAR is more commonly used by archaeologists because it creates highly accurate maps, even in areas with dense tree cover. This has been particularly useful for archaeologists who work in areas covered by rainforests, such as the archaeologists studying the Maya in Guatemala. Thanks to new maps made using LiDAR, archaeologists have discovered over 60,000 previously unidentified Maya structures, demonstrating that at its peak, the Maya civilization was much more complex, more densely populated, and covered a much greater territory than scholars previously believed.

Archaeologists also use non-invasive assessment techniques that are conducted on the ground surface and generate maps of the soil beneath the ground surface. These **subsurface detection techniques** allow archaeologists to identify potential archaeological elements by finding places underground where there is something that is different from the background soil. **Electrical Resistivity**, also known as Soil Resistivity, uses an electrical current transmitted through electrodes planted in the soil to detect places underground where there is something that has a higher or lower electrical resistance than the rest of the soil. Typically, something will be more or less resistant to an electrical current based on the relative amount of moisture it contains. This is useful for detecting archaeological features such as building foundations, which typically have less moisture, and therefore higher electrical resistivity than the surrounding soil, or burial pits or wells, which typically have more moisture and lower electrical resistivity because the soil is less densely compacted than the surrounding soil. **Ground-Penetrating Radar** (GPR) is a very common technique in archaeology for subsurface detection (Figure 3). GPR sends radar pulses into the ground and measures those radio waves as they reflect back to the ground surface. When the radio waves sent out from the machine hit something in the ground that is different from the surrounding soil, such as buried objects, voids, or rocks, it reflects back to the surface as an anomaly. How deep the GPR reaches into the ground depends on the frequency of the antennae the machine uses: higher frequencies can reach greater depth and achieve higher resolution, but they are more likely to pick up background noises, such as cell phone waves. The quality of the GPR results is also affected by the soil conditions and weather, with the best results coming from soil that is well-drained and compacted.

Figure 3: Ground-Penetrating Radar at the William Harris Homestead. Source: Kathryn Deeley

Finally, archaeologists use **Magnetic or Magnetometer surveys** to find places beneath the ground where there are slight variations from the earth's background magnetic field. Metal objects are able to deflect the Earth's magnetic field very slightly. A magnetometer measures the strength of the magnetism between the earth's magnetic core and the sensor held by the archaeologist. This survey creates a contour map showing the shape and intensity of objects buried beneath the surface that interfere with or are anomalous to the earth's magnetic core. While this will work with metal objects, it also works for fired clays that contain iron because when iron minerals are heated, they will all point in the same direction (deflecting the magnetic field). Magnetometer surveys, therefore, are also useful for identifying archaeological features such as brick walls and stoves.

Metal detecting and archaeology have a contentious relationship. While metal detectors can be very useful for identifying buried metal objects, archaeologists are not typically the people who are trained in using this equipment. More often, metal detectors are used by advocational or enthusiast metal detectorists who are not trained in archaeological methods. For many, but not all, of these hobbyists, the goal of metal detecting is simply to find objects, not to learn from those objects. This usually results in the destruction of archaeological sites. However, when archaeologists and metal detectorists work together, marking the metal finds beneath the ground rather than digging them all up, metal detecting can be a very effective archaeological technique.

All of these maps are designed to help archaeologists estimate where the most information about the human past will come from on an archaeological site so that we can minimize the amount of digging we have to do. But all the maps can do is identify places where there are anomalies. We assume that these are the places where there is the most potential information. Eventually, archaeologists will have to dig to find out what those anomalies are in order to learn about the past. But digging is destructive. When an archaeologist excavates an archaeological site, they destroy it. They can never put it back the way they found it. So, when we do excavate a site, we want to only dig as much of the site as is necessary to answer our research question. There are some exceptions to this rule. For example, if an archaeological site is threatened (by erosion, flooding, or development for example) then archaeologists may excavate a larger portion of the site since it would be destroyed anyway. Regardless of how much of the site we excavate, archaeologists always take very detailed notes about every step of the process. Typically, archaeologists use standardized forms to help ensure that no details are forgotten when we excavate an archaeological site.

Digging Square Holes: Archaeological Excavations

The most important information that comes from any archaeological site is where things are found and what things are found together, known as **context** or **provenience**. Knowing where on an archaeological site something came from – which excavation unit, how far down in the unit, where in the unit – for every artifact, ecofact, and archaeological feature is what allows archaeologists to draw conclusions about human behaviors. An artifact or feature, by itself, doesn’t tell archaeologists much about humans. Understanding which artifacts were used at the same time, which artifacts were used in order, or which artifacts were used on one part of a site but not on another part of the site is meaningful. It can tell us about how people lived in the past. Context and provenience allow archaeologists to study relationships between artifacts, ecofacts, and features; study change over time; and develop patterns that explain human behaviors.

To help make it easier to record where things are found and what things are found together, archaeologists use a site grid. This is an X-Y coordinate system laid out over the archaeological site, anchored to a zero-point known as a **datum**. Typically, the datum is placed just outside of the archaeological site, ideally someplace that will not change over time. The datum serves as a fixed reference point from which all of the measurements on the archaeological site can be taken. The X-Y coordinate system laid over the archaeological site creates a series of squares on the site. Each square is known as an **excavation unit** (Figure 4). It is assigned its own site-specific number and all material from each excavation unit is kept separate from all others. The archaeologist determines the size of the excavation units based on their research questions, what they are expecting to find, and other conditions of that specific excavation. The most common size, though, is a one-meter by one-meter square.

Figure 4: Archaeological excavation in Annapolis, MD. Source: Archaeology in Annapolis

There is no one "right" way to excavate an archaeological site, although there are many wrong ways. Most of the wrong ways start with excavations that are not done by a professional archaeologist trying to answer a research question but are instead done by amateur enthusiasts or treasurer hunters who (best case) want something cool to show to their friends or (worst case) are trying to earn money to fund illegal activities such as money laundering and terrorism. This is known as **looting**. In most cases, looting is illegal. In all cases, it destroys archaeological sites and prevents us from learning about the past. Unfortunately, there is still a high demand for owning pieces of ancient antiquity, so archaeological sites continue to be looted. The sale of illegally obtained antiquities is the second largest illegal international trade, second only to drugs.

To excavate an archaeological site correctly, the excavations must be conducted by a team led by a professional archaeologist who has obtained proper permission from the landowner to conduct archaeological investigations on the property. The archaeologist must be excavating the site to answer a research question and learn about humans in the past. How those excavations are conducted varies depending on the kind of question the archaeologist is trying to answer, the amount of time the archaeologist has to excavate the site, and the technology that is available to excavate the site, all of which are often tied to the amount of money available for that archaeological excavation. Sometimes the right tool for excavation is a shovel, sometimes it is a backhoe, sometimes it is a toothbrush, but given infinite time and money, an archaeologist would choose to excavate a site using a trowel. A **trowel** allows archaeologists to carefully peel back one layer of dirt after another, removing the dirt in the reverse order in which it was deposited into the ground. This is called excavating in **natural levels** (Figure 5). Excavating in natural levels is always preferred by archaeologists because it means that the artifacts that went into the ground at the same time will come out of the ground at the same time, and therefore be studied together, preserving the context of the artifacts and helping archaeologists be able to draw conclusions about human behaviors. However, sometimes archaeologists must use **arbitrary levels** instead, excavating to a set, measured depth such as 10 centimeters or 1 foot.

Figure 5: Profile of an archaeological unit in Annapolis showing the natural, stratigraphic levels. Source: Archaeology in Annapolis

Regardless of how archaeologists remove dirt from the ground, excavation is not just digging. It is scientific digging. All dirt that is removed from an archaeological site is screened for artifacts. Most people think that archaeologists find artifacts when they are still in the ground, but the truth is that most artifacts are found during the screening process. There are several different options for what kind of screen to use, most of which are mechanical screens that the archaeologists shake to force the dirt through a set size hole, typically ¼ inch. Choosing the size of the hole is an important part of the scientific process because it means that anything smaller than the hole size will not be recovered or kept. The size of the hole also affects how quickly the dirt will be screened (Figure 6). In addition to **mechanical screening**, archaeologists also use water-based techniques to screen dirt such as water-screening and flotation. For **water-screening**, archaeologists place the dirt removed from an excavation unit on a screen with very small holes and wash away all of the dirt with hoses. This technique is used when archaeologists expect to find tiny artifacts, like beads, or when they would be difficult to find without washing away the dirt. For **flotation**, archaeologists pour the dirt (and artifacts) removed from an excavation unit into a tank of water and let the heavy materials sink to the bottom and light materials float to the top where they can be recovered by the archaeologist. This technique is primarily used for recovering plant materials and tiny bones. Once the artifacts are found in the screen, all of the artifacts found in the same natural level are kept together and brought to the lab.

Figure 6: Mechanical Screening. Source: Archaeology in Annapolis

When people think of archaeology, they typically think of the excavation process – the digging part of archaeology. But excavating objects is only a small portion of the archaeological process. Most archaeologists joke that for every day they spend in the field digging, they will spend a week or a month in the lab processing what they found. Every artifact recovered from an archaeological site must be cleaned, identified, cataloged, and prepared for permanent storage. All artifacts must be kept safe from decomposition and damage for all time. Finding space to keep all of these artifacts is rapidly becoming one of the biggest problems that archaeologists face. This problem emphasizes why it is so important to excavate as little of a site as possible (see the "Curation Crisis" document in the "Resource Links" for more information).

Establishing Chronology

One of the reasons why it is so important for archaeologists to know the precise context and provenience for each element on an archaeological site is that it helps establish the site's chronology. Knowing when things happened and establishing the order in which things happened is an important part of understanding human behaviors and how those behaviors changed over time. In archaeology, there are two main types of dating that we can use to establish a site's chronology: Relative Dating and Absolute Dating.

Relative Dating

Relative Dating is a series of techniques that allows archaeologists to establish a sequence of events without a fixed time-scale. Relative Dating can tell you which thing happened first, second and third, but it cannot tell you whether the first event was a hundred years ago or a million years ago. Relative Dating is useful because it can be used on every archaeological site, as long as that site has not been disturbed and has been excavated correctly. It is not useful for a single artifact or feature because relative dating expresses dates for artifacts and features relative to one another. Instead, relative dating works best on groups of elements from an archaeological site.

Relative Dating works by relying on two interrelated geological principles: **The Law of Superposition** and **the Law of Association**. The Law of Association states that objects found in the same natural layer in the ground went into the ground at approximately the same time and are, therefore, approximately the same age. The Law of Superposition states that a geological (or archaeological) layer will be younger than the one below it and older than the one above it, if undisturbed since the time of deposition. This means that if nothing other than natural, geological processes have taken place on a site since the time that a sediment layer will be older than the layer above it and younger than the layer below it. We are able to use the Law of Superposition on archaeological sites because sediment is deposited and accumulates in strata: Layers that are more or less homogenous and visually distinct. Because we can see the distinction between different layers, we can understand how, and when, those layers appeared on an archaeological site relative to the other layers. This is known as **stratigraphy** (Figure 7).

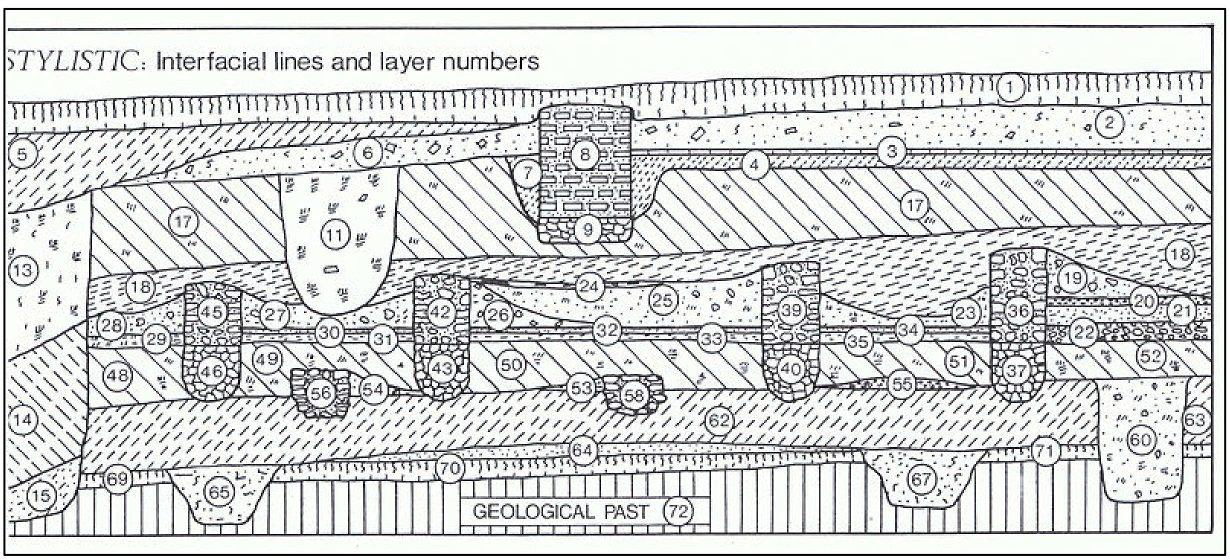

Figure 7: An example of a stratigraphy diagram with numbered layers. Source: E. C. Harris, Principles of Archaeological Stratigraphy (London – San Diego 1979)

Absolute Dating

Absolute Dating, on the other hand, is a series of techniques that tell you how old something is not relative to something else but expressed in a scientific measure of time, such as years, or centuries. They yield a specific date or range of dates, anchored to a zero point. The zero point that most people are familiar with is the one associated with the AD/BC (or CE/BCE) calendar, the one that is 2,023 years in the past. This calendar expresses dates as “from 1900” or “from 4004 BCE”. However, this is not the calendar that archaeologists typically use. Instead, we prefer the zero point of today and count backward, expressing the dates from above “123 years ago” or “6,004 years ago”. For publications, archaeologists use a standardized zero point of “before present” or **BP** for their dates, with “present” being 1950.

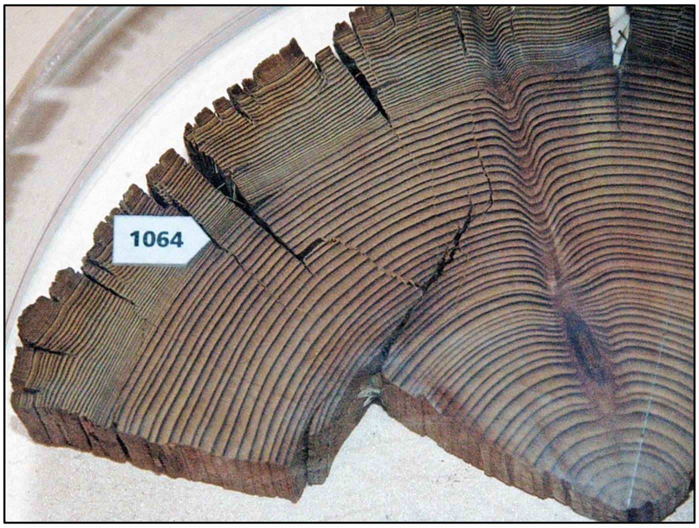

Figure 8: Tree slab (“cookie”) showing light and dark-colored rings with the year 1064 CE marked.
Source: Wikimedia Commons

There are many different absolute dating techniques used in archaeology. The most accurate, but not the most common, technique is dendrochronology. **Dendrochronology** is the scientific study of tree rings. Each year that a tree is alive, it grows two rings: A light-colored one in the spring and a dark-colored one in the summer/fall (Figure 8). If you cut down a tree today, you could count the rings, starting on the outside, and the first two rings you saw would be this year’s growth. The next two would be last year, and so on. Each year, how thick or how thin those rings are varies depending on the growing environment that season. This means that each year, the ring widths will be different, and it means that you can create a master sequence that shows how wide the rings should be for any given year in the past. Once you have a master sequence, you can take archaeological samples of wood and compare them to the master sequence to find the part of the master sequence that matches your sample, and this will tell you what year your archaeological wood was cut down. The problem with dendrochronology is that wood does not preserve particularly well in the archaeological record, so we don’t recover a lot of it. Additionally, for dendrochronology to work, you need at least 10 years of growth shown in your archaeological sample to reliably match it to the master sequence. Dendrochronology is also difficult because you have to have a master sequence for the same tree species from the same region as your archaeological wood sample. This means that this technique is really accurate but works best on archaeological sites that are less than 3000 years old and/or on archaeological sites with excellent preservation. It has worked well for dating the structures built by the Ancestral Puebloan peoples in New Mexico and Colorado, such as Mesa Verde.

The most commonly used Absolute Dating technique in archaeology is **Radiocarbon Dating**, also known as Carbon Dating, or Carbon-14 Dating. Carbon Dating, invented by Willard Libby in 1949, is just one of the many radiometric dating techniques archaeologists use. It relies on the presence of different natural isotopes of carbon in the atmosphere: The stable isotopes ^{12}C and ^{13}C, and radioactive ^{14}C. Radiocarbon is produced in the upper levels of the earth's atmosphere when ^{12}C is bombarded by solar and cosmic radiation. ^{14}C is then absorbed into the carbon system, along with ^{12}C and ^{13}C as plants take up carbon dioxide and animals eat plants. As long as something is alive, the amount of ^{12}C, ^{13}C, and ^{14}C in the organisms will stay constant and match the surrounding environment because (even though ^{14}C is radioactive and decaying) it is constantly being replenished as new ^{14}C is ingested by the organisms. However, once an organism dies, the amount of ^{14}C declines until there is no measurable ^{14}C left in the organism, while the amount of ^{13}C and ^{12}C in that organism remains constant. ^{14}C declines at a known rate. So, if we measure the amount of ^{14}C left in a sample and compare it to the amount of ^{13}C and ^{12}C in that sample, then we can determine how long ago something died. The known rate of decay for radioactive materials is known as the half-life, or the amount of time it takes half of the radioactive sample to lose their electrons and become stable isotopes. The half-life for radiocarbon is 5,730 years, plus/minus 40 years. Radiometric dating techniques can reliably date materials up to approximately ten half-lives. This means that radiocarbon dating can be used to reliably date materials that are up to approximately 60,000 years old. Anything older than that can't be dated using radiocarbon dating because the amount of ^{14}C left in the sample will read as zero and we can't know if that sample reached zero yesterday or a thousand years ago. Radiocarbon dating can, therefore, be used to date older materials than dendrochronology, but it has some of the same drawbacks. In particular, radiocarbon dating can only be used on archaeological samples that contain ^{14}C, which means it can only be used on organic material (or things that used to be alive). As mentioned previously, organic material is typically not common on archaeological sites because it does not preserve well. The second drawback of radiocarbon dating is that to measure the amount of ^{14}C left in an archaeological sample, that sample must be destroyed. Finally, archaeologists must consider the fact that the amount of radiocarbon in the atmosphere can change due to external factors, such as solar flares, changes in the earth's orbit, sunspots, or humans producing a bunch of radioactive material when they detonate nuclear bombs. These fluctuations mean that if you rely strictly on the half-life of radiocarbon to generate a date for an archaeological sample, you will get a year that is too young. Therefore, you must calibrate your carbon date into calendar years, giving you a date expressed as "cal. BP" or calibrated before present.

Radiocarbon Dating is just one of the many radiometric dating techniques that archaeologists use. Another common technique, although arguably more common for paleoanthropologists than archaeologists, is **Potassium/Argon Dating**, also known as Radio-potassium Dating. This technique relies on radio-potassium, ^{40}K, which decays into Argon, ^{40}Ar. Radio-potassium has a much longer half-life than radiocarbon, taking 1.31 billion years to decay into Argon, which means that this technique can be used to date much older materials. In fact, it cannot be used on materials less than 200,000 years old, and it can only be used on materials that contain ^{40}K – which is only volcanic rock. Not that much archaeological material is made of volcanic rock and knowing when a rock formed doesn't tell you when that rock was used by a human. Therefore, Potassium-Argon dating is used with relative dating, to date a volcanic layer above and/or below a sediment layer that contains archaeological (or paleoanthropological) materials.

Another radiometric dating technique archaeologists use is **Uranium-Series dating**, which relies on various isotopes of radioactive Uranium that decay into thorium and are found in calcium carbonate. Each isotope has a slightly different half-life, but Uranium-series dating is particularly useful because it can be used to date materials between the ranges of Radiocarbon dating and Potassium-Argon dating, dating material up to approximately 500,000 years old. This has been particularly helpful in dating previously un-dated materials associated with Neanderthals in Europe.

In addition to radiometric dating techniques, archaeologists can also use trapped-charge dating techniques, such as **Thermoluminescence**, and magnetic dating techniques, known as **Archaeomagnetic Dating**, to date archaeological material. Thermoluminescence works on inorganic materials, such as stone or ceramic, that have been heated to a high temperature in the past. Many materials in organic substances trap electrons at a known rate. When one of these substances is heated rapidly, they release the trapped electrons in the form of light, essentially re-setting the electrons in that substance. So, an archaeologist can intentionally heat that same object up in the present and measure the amount of light released to determine when the last time that object was "reset". This is typically used for fire-cracked rocks and ceramics and can date materials between 40,000 years and 200,000 years ago.

Archaeomagnetic Dating relies on Paleomagnetic dating, which studies the record of the earth's changing magnetic field in rocks. Magnetic north is constantly moving and periodically even reverses itself. Geologists can identify the boundaries that form when the magnetic field collapses and reverses itself in sediments. This information is not particularly useful by itself for dating archaeological material; however, there are some archaeological features that contain magnetic minerals that can record the direction and strength of the Earth's magnetic field, specifically objects that contain iron oxide and objects that have been heated to a high temperature. By comparing the magnetic direction recorded in the archaeological feature to known, calibrated reconstructions of the changes in the magnetic field over time, archaeologists can determine when that archaeological feature was made. This technique is primarily used on historic archaeological sites, as it is most useful for dating kilns, fireplaces, and other fired materials that are less than 2,500 years old.

Case Study: Protecting Archaeological Sites & Repatriation

Most archaeological sites in the United States are not found because of an academic research question or by someone accidentally stumbling over the ruins of a forgotten city. Instead, most archaeological sites are found as part of Cultural Resource Management (CRM) projects, and most people who identify themselves as archaeologists work for CRM firms. It is a multi-million-dollar industry and employs thousands of archaeologists across the country. Cultural Resource Management is an industry that strives to balance two important things in our society: Progress and development in modern society and protecting historical, cultural, and archaeological resources. In the United States, we have several pieces of legislation in place designed to protect these resources from potential damage when new construction or development is proposed. A summary of the most important pieces of legislation related to protecting archaeological, cultural, and historic resources is in Table 1. Most CRM archaeology is conducted to comply with one (or more) of these pieces of legislation, particularly Section 106 of the National Historic Preservation Act and the Environmental Policy Act, and it is largely done by archaeologists who work for private companies. Sometimes these are companies that specialize in compliance archaeology, but other times these are larger companies that do a wide range of environmental, geological, and engineering assessments that have archaeologists on their teams. There are also CRM archaeologists employed by state and federal agencies, particularly state Departments of Transportation. The company or agency proposing the "undertaking" (whoever is building the highway, hospital, or pipeline), pays for the archaeological work to be completed. This often makes construction companies view archaeologists negatively because we are expensive and slow down their projects.

Table 1: Summary of important pieces of federal legislation that are used to protect archaeological resources

Legislation	Date	Importance
Antiquities Act	1906	This piece of legislation established the protection of archaeological and cultural resources on federal lands. It requires that excavations be conducted by a professional archaeologist, with permission from the landowner and criminalized the sale of illegally obtained objects. It also prohibits the removal of antiquities from federal lands
Historic Sites Act	1935	Established the Historic American Building Survey (HABS) for recording historic houses and established the National Historic Landmark program
National Historic Preservation Act (NHPA) – Section 106	1966	This section of the National Historic Preservation Act mandates that the government must "take into account any potential adverse effects on cultural or historic resources in a proposed undertaking". This means that when the federal government spends money or issues a permit, they have to take into account the cultural, archaeological, and/or historic resources that would be affected by that project. Section 106 also established the National Register of Historic Places and created State Historic Preservation Officers (SHPOs)

National Historic Preservation Act (NHPA) - Section 110	1966	This section of the NHPA requires federal agencies to responsibly preserve and use historic resources that it controls, including inventorying and caring for said resources
Department of Transportation Act – Section 4f	1966	Section 4f of the Department of Transportation Act requires federal agencies to look for alternatives when projects use historic, park, recreation, or wildlife land and only use these lands if there is no alternative or if there will be no damage to these lands. This legislation applies to historic sites (both publicly and privately owned) but only for transportation projects
Environmental Policy Act	1969	The Environmental Policy Act mandates that an Environmental Impact Statement (EIS) be made when the federal government proposes an undertaking that discloses the impacts of the project on any environmental, cultural, and historic resources
Archaeological Resources Protection Act (ARPA)	1979	This piece of legislation defines archaeological resources as having to be at least 100 years old, defines who can get a permit for excavations, and adds bigger penalties for excavating without a permit than we listed in the Antiquities Act. It also made excavating without a permit a felony.
Native American Graves Protection and Repatriation Act (NAGPRA)	1990	This piece of legislation is intended to guarantee protection for human remains, funerary objects, sacred objects, and objects of cultural patrimony. It applies to federal museums, museums obtaining federal funds, and to objects found on federal and tribal lands.

The issue of **repatriation**, which was codified in the 1990 NAGPRA legislation, is one of the ethical dilemmas that all archaeologists (not just CRM archaeologists) are trying to address as we establish the best practices for doing our work ethically and respecting the interests of the stake-holder communities we work with. The edited excerpt below highlights why this is potentially controversial and how many archaeologists today would like to see this go in the future:

> *In 1996, the discovery of a skull on the banks of the Columbia River in Kennewick, Washington, sparked an intense controversy and a yearslong court case.*
>
> *The remains belonged to an individual—dubbed "Kennewick Man" or "the Ancient One"—who lived between 8,340 and 9,200 years ago. Within months, the Army Corps of Engineers, which had jurisdiction over the remains, announced that they planned to*

return the bones to five Native American tribes who claimed the Ancient One as their Ancestor. In response, a team of eight scientists launched a lawsuit claiming their right to study the remains.

The ensuing conflict climaxed in 2015, when a DNA study performed in collaboration with the Confederated Tribes of the Colville Reservation confirmed the tribes' position by providing a strong link to Native American groups. The U.S. Congress acknowledged years of political advocacy by the tribes and soon passed a law for the Ancient One's transfer to the Washington State Department of Archaeology and Historic Preservation. The Ancient One was reburied in 2017, more than 20 years after his initial discovery.

The trial and the Ancient One became famous. It's easy to see why. For the media, it was a good story: a lengthy and high-profile legal battle with many actors. At the time, few individuals dating to that period had been found, so the Ancient One was potentially very important for understanding the peopling of the Americas. The debates emphasized the conflicting interests of science, politics, and religion.

But the extensive notoriety afforded to this case, and others like it, negatively impacted both academic and public impressions of ***repatriation****—the return of ancestral remains and other cultural patrimony to descendant groups from institutions like museums and universities. Such controversial cases often overshadow more collaborative repatriation work and promote the idea that repatriation is always incompatible with scientific research.*

This myth persists today. It is often why institutions continue to resist repatriation. For example, the 2020 book Repatriation and Erasing the Past argues that repatriation has harmed science and threatens to end certain types of archaeological research. It garnered significant backlash online, including a petition for the book's retraction.

It is true that not all descendant communities are interested in pursuing archaeological and anthropological research. For many, their Ancestors' very presence in institutional collections is evidence of traumatic histories and colonial violence. Repatriation, even when mandated by legislation or policy, also faces continued resistance and, for some, remains out of reach.

Our aim is not to convince descendants that research is important. Instead, as settler anthropologists, we are pushing back against the institutional narratives that see repatriation as incompatible with research. We are countering the notions that *collaborative work is "non-scientific," "biased," or even an imposition on academic freedom.*

Frankly, these arguments too often dismiss the important transformations that repatriation has brought to research practices and the many successful collaborative projects that have developed. Indigenous scientists and community-based researchers are leading the way. Our recent edited volume, Working With and For Ancestors*, shows how research of all kinds—from oral history work to DNA analysis—has featured prominently in many repatriation cases where researchers sought to work with and for descendant communities.*

Research involving Ancestors can certainly take place alongside repatriation. But for that to work, respectful relationships between institutions and descendant communities must be developed and maintained, the wishes of community partners need to be prioritized, and community control over the disposition of their Ancestors must be respected. This may not always be easy, but it is always worthwhile.

The same year the Ancient One was found in Washington, an Ancestor known as Shuká Káa ("The Man Ahead of Us") was found on Prince of Wales Island in Alaska. Shuká Káa was another important individual for our understanding of the past; however, his story would follow a very different path.

Within 24 hours, archaeologists had contacted local tribal governments to inform them of the discovery and to request permission to study their Ancestor. After consultation and negotiation, the tribal governments agreed to the scientific investigation of Shuká Káa, including DNA analysis (which involves removing a portion of a tooth or bone), so long as the community continued to be closely involved in the research.

Initial studies did not reveal a clear link between Shuká Káa and DNA samples taken from 200 Tlingit community members. Shuká Káa was repatriated and reburied close to where he was found in 2008. However, with the community's consent, a small sample of dental tissue was retained for later re-analysis. In 2017, a new study found that Shuká Káa was likely a distant Ancestor of contemporary Indigenous groups in the Pacific Northwest, including the Tlingit.

What was different in the case of Shuká Káa compared to the lengthy controversy surrounding the Ancient One?

Comparing them shows that two essential components of mutually beneficial research partnerships were present in the case of Shuká Káa: respect for the wishes of the descendant community and a collaborative approach to research. Archaeologists also had a preexisting working relationship with the local tribal governments, and repatriation was always the end goal.

Collaborative relationships such as these can and do result in compelling research, while also respecting community wishes for repatriation and reburial. But truly collaborative research is complicated and hard to do. Luckily, there are many other examples of researchers and community partners working together in a good way to help show us the way forward…

Working collaboratively requires researchers to seriously rethink their understandings of research ownership and control. Communities must be equal partners in the creation, implementation, and dissemination of research projects. This can be difficult—partner communities often have very different goals and ways of thinking from Western-trained scientists—but drawing on multiple lines of evidence actually leads to stronger science.

Collaboration is not new to scientific research—partnerships and team-based projects have a long history in the academy. The only new things are who scientists are collaborating with, and that these new collaborations require us to deliberately shift power to ensure that voices so long excluded are now heard and respected.

This is not to say that everyone will choose to pursue research. In many places, repatriation work continues to be controversial and slow. Too many Ancestors are still housed in colonial institutions, with no plans for their return. Given this, some—perhaps many—descendant communities will not be interested in pursuing scientific research prior to reburial. This is a particularly hard choice for outside researchers to accept, but they must do so to begin redressing the power imbalances in anthropology and archaeology. These disciplines have a difficult history that is rooted in colonialism. Respecting the wishes of descendant communities is the only way to do ethical, responsible, and meaningful research going forward.

Repatriation has indeed transformed the research landscape. It has required a major shift in how Western-trained scientists think about and approach this kind of work. Indigenous scientists and community-based researchers have been doing this work and doing it well for many years already. They've shown that community-led repatriation projects can challenge assumptions, build respectful relationships, increase community research *capacity, and still meaningfully contribute to scientific discussions. Continuing to focus on repatriation as "the end" of research ignores the alternate collaborative path forward.*

Working with and for descendant communities puts research skills and outcomes to work in service of something bigger. Much work remains, but from here we can start to do better together. (Nichols et al. 2021)

Chapter Summary

Many people are fascinated by archaeology, but there are a lot of misconceptions about archaeology and what it studies. Archaeology is the study of humans and human cultures through the recovery and analysis of material remains. Archaeologists rely on the archaeological features, artifacts, and ecofacts that make up the archaeological record to study human cultures. It is important to note that all evidence survives, and the archaeological record is biased toward inorganic materials. There are many ways that archaeologists find archaeological sites, but one of the most frequent ways in the United States is through development projects. Ensuring development does not interfere with cultural history is the work of Cultural Resource Management (CRM) archaeologists. When a site is found, archaeologists use noninvasive techniques to understand what they might find during an excavation. Above-ground techniques create maps of changes in the surface of an area (SLAR and LiDAR), while subsurface detection techniques (Electrical Resistivity, GPR, and Magnetic Surveys) create maps of disturbances beneath the surface. Archaeological excavations rely on detailed records to maintain the context (provenience) of objects. This context allows archaeologists to study relationships between objects and changes over time, as well as develop patterns that explain human behaviors. Looting is not archaeology – it is the illegal removal of artifacts and destroys context. Once the dirt has been removed from the ground, archaeologists screen the dirt to find the objects (using mechanical screens, water screening, or flotation). Archaeologists then bring the objects to a lab for further study. One of the things archaeologists do in the lab is determining a site's chronology. They can do this using relative dating techniques (e.g.: stratigraphy) or absolute dating techniques (e.g.: dendrochronology, radiometric dating, thermoluminescence, and archaeomagnetic dating). All dating techniques in archaeology have benefits and limitations and are often used together to determine when things happened on an archaeological site.

Key Terms

Archaeology
Artifacts
Archaeological features
Archaeological record
Ecofacts
Archaeological sites
Cultural Resource Management
Decomposition

Non-invasive assessment
Side-Looking Airborne Radar (SLAR)
Light Detection and Ranging (LiDAR)
Subsurface Detection techniques
Electrical Resistivity
Ground-Penetrating Radar
Magnetic surveys
Context
Provenience
Datum
Excavation Unit
Looting
Trowel
Natural Levels
Arbitrary Levels
Mechanical Screening
Water-Screening
Flotation
Relative Dating
Law of Superposition
Law of Association
Stratigraphy
Absolute Dating
Dendrochronology
Radiocarbon Dating
Potassium/Argon Dating
Uranium-Series Dating
Thermoluminescence
Archaeomagnetic Dating
Repatriation

Comprehension Questions

1. What is archaeology? Why does it get so much attention in popular media and how does this both help and hurt the discipline?
2. How do archaeologists find and assess archaeological sites?
3. Why is it important to dig as little as possible during an archaeological excavation? How do archaeologists accomplish this?
4. What is the difference between relative dating and absolute dating? Why do archaeologists need both kinds of dating?
5. What are the major absolute dating techniques used by archaeologists? What materials and time periods do they work for?

Critical Thinking and Engagement Questions

1. Given that many archaeological sites are located along waterways, how will the changing climate, especially rising sea-levels, impact how archaeology is done over the next decades?
2. With space for storing archaeological collections rapidly running out in museums and universities, how can archaeologists ethically balance learning about the past and preserving the collections we obtain through excavation?

3. How can we balance the needs of contemporary society with the need to understand and protect the past? Do the current protections offer enough protection? Too much? Not enough? How can we address the contentious relationship between CRM archaeologists and developers?
4. Why is repatriation significant? How can archaeologists build better working relationships with descendant and stakeholder communities?

Resource Links

Because of its mass media appeal, there is a lot of information about archaeology on the internet. But not all of that information is accurate. Here are so good resources for learning more about archaeology and archaeological methods:

- https://www.saa.org/about-archaeology/what-is-archaeology The Society for American Archaeology has great resources for learning about archaeology
- https://www.crowcanyon.org/education/learn-about-archaeology/archaeological-dating/ Crow Canyon Archaeological Center has lots of good resources on their website, but their discussion of archaeological dating techniques is particularly good
- https://www.southeasternarchaeology.org/ The Southeastern Archaeological Conference is the professional archaeological organization for researchers who study the American southeast region
- https://sha.org/ The Society for Historical Archaeology has great resources for studying historic sites. They also house the Advisory Council on Underwater Archaeology
- https://www.nsf.gov/news/special_reports/archaeology/index.jsp This National Science Foundation website does a nice analysis of what movies get right and what movies get wrong about archaeology
- https://sha.org/assets/documents/research/collections_management/SAA2003TheArchaeologicalCurationCrisis.pdf This article discusses the "curation crisis" in archaeology
- https://www.sapiens.org/archaeology/pseudoarchaeology-racism/ This is an article about the dangers of pseudo-archaeological myths

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