

**University of Colorado, Colorado Springs**  
**Center for Cognitive Archaeology**  
**ANTH 4200-781: Neuroarchaeology**

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## **Course Description**

This course takes an interdisciplinary approach to evolutionary research by combining archaeology and neuroscience into the field of neuroarchaeology. This class will explore what both disciplines' strengths, weakness, and overlaps are in order to foster a holistic perspective on the evolution of cognition.

## **Course Objectives**

1. Students will be introduced to prehistoric cognition. This class will explore how we interpret cognition and cognitive functions through the medium of the archaeological record. This is then furthered with a close look at how modern neuroscience can contribute to our understanding of archaeological sites.
2. Exploration of how we understand the modern brain through use of neuroimaging can help unlock questions about our evolution. We will compare how data from the brain can be viewed through archaeological materials like tools and weapons. Tools are foundational to how we understand the mind, especially in the context of evolution.
3. Students will explore interdisciplinary methods with a focus on translating archaeology to other fields. An interdisciplinary approach to the archaeological record is important for understanding how the modern mind evolved.
4. While we will be fully exploring the brain, this class is primarily concerned with archaeology. This course is focused on how neuroscience can be applied to the study of the archaeological record; students should not be worried about their preparedness for neuroscience topics.

## **Course Competencies**

1. Students will be able to demonstrate an understanding of:
  - Prehistoric archaeology and how it is applied to our evolution as a species
  - How the brain works in both modern and ancient contexts
  - How our brains have evolved over time
  - How tools and material objects interact with brains and impact evolution
  - How we can apply a wide range of disciplines to questions within archaeology
2. Students have the opportunity to deeply explore how the brain works by looking at modern neuroscience research and techniques.

3. Students will gain an appreciation for interdisciplinary research and how it can be widely applied to archaeological and anthropological research.
4. Students will learn about how material culture like artefacts have impacted our brains, and how these changes have persisted and assisted in modern culture.
5. The interdisciplinary nature of this class will foster critical analysis skills in students and give them the ability to interpret research across different disciplines and its application to their field.
6. Students will gain a robust understanding of the brain's anatomy, structures, regions of specialization, and organization.
7. Students will learn about modern methods of research in both archaeology and neuroscience; including geometric morphometrics, statistical analysis, and the basics of fMRI, fNIRS, and PET technology.
9. Students will learn how to approach evolutionary questions and break them down into testable hypotheses.

## Course Outline & Required Reading

### Week 1

**Introduction & Course Expectations:** How do we understand the ancient mind? History exploring cognitive archaeology. Different methods to approaching cognition: cognitive archaeology, neuroarchaeology, evolutionary psychology, paleoneurology, etc.

- **Reading:** (Gowlett 2024)
- **Assignment:** Online comprehension quiz

### Week 2

**The History of Us:** We will comprehensively examine the lives of our ancestors through the artefacts they left behind. What kind of environment did early *Homo sapiens* and Neandertals live in? What was the social structure, diet, and lifestyles of previous species? What was the genesis for tool making and how did it effect our evolution?

- **Reading:** (Stringer 2016; White et al. 2009)
- **Assignment:** Online comprehension quiz

### Week 3

**Theoretical Basis:** How do we study the mind in the context of what archaeological evidence is left? How do we design experiments to make testable hypotheses? How do we validate such hypotheses? A deeper history of cognitive archaeology and Material Engagement Theory explored.

- **Reading:** (Malafouris 2024; Stout & Hecht 2024)
- **Assignment:** Online comprehension quiz

### Week 4

**A Comprehensive Introduction to the Brain:** Learn about the anatomy, networks, regional specialties, etc. for the whole brain. How does the brain change over time? How can we tell?

- **Reading:** (Coolidge 2020; Newen 2018)
- **Assignment:** Online comprehension quiz

### Week 5

**Comparative Anatomies:** What do we know about brain evolution and our closest living relative, the chimpanzee? How do we interpret data across species? What did the brains of our ancestors look like, and how has it changed over hominid evolution?

- **Reading:** (Pittella 2024; Preuss 2009)
- **Assignment:** Online comprehension quiz

### Week 6

**Center of Attention, The Parietal Lobe (and Cerebellum):** A deep dive into how the parietal lobe functions, where its connections lead, and how they operate in day-to-day life. We explore how and why this region might have specialties derived only in recent evolution. We will also explore the oft forgotten cerebellum and its increasing recognition as a key area to modern cognition.

- **Reading:** (Vandervert 2018; Bruner et al 2023; Coolidge 2021)
- **Assignment:** Online comprehension quiz

### Week 7

**All You Need is Stone:** A deep exploration of stone tools, their importance, proliferation, evolution, and production. Stone tools were the mainstay in technology for 99.7% of human existence. When, where, and why they started can give us clues to our very earliest split from our last common ancestors. How they evolved over time can give us insight into how minds changed with tools.

- **Reading:** (Toth & Schick 2024; Moore 2024)
- **Assignment:** Online comprehension quiz

### Week 8

**All You Need is Brains:** What does neuroarchaeology research look like? How do we mix experimental archaeology with neuroimaging? How does neuroimaging work? We will explore fMRI, PET, EEG, fNIRS, and how they can be used to learn about our evolution. What does this data look like and how do we process it to answer evolutionary questions?

- **Reading:** (Balzeau & Mangin 2021; Hecht & Stout 2024; Hodgson 2019)
- **Assignment:** Online comprehension quiz

### Week 9

**Bigger, Better, Rounder:** Does the shape of the brain impact its function? All about globularization, how its evolved, and how we can establish a relationship between shape and function. Does asymmetry and lateralization show up in our ancestors? How do we analyze an endocast? How are endocasts made? Exploring geometric morphometrics.

- **Reading:** (Neubauer et al. 2018; Gunz et al. 2012; de Sousa et al. 2023)
- **Assignment:** Online comprehension quiz

### Week 10

**Working Memory:** We will go over the well established model of expanded working memory and how this theory has been applied to cognitive evolution. How would a Neandertal's behavior differ from ours? How would expanded working memory impact daily life to our ancestors? When did working memory start in our history?

- **Reading:** (Coolidge 2019)
- **Assignment:** Online comprehension quiz

### Week 11

**Tools, Bodies, Attention, and Spacial Specialties:** Where do tools, bodies, and minds meld? How does spatial and body awareness help with tool-body integration? Attention, visual awareness, tool use,

expertise, and working memory converge on the parietal lobe for a highly integrated multi-modal network.

- **Reading:** (Miller & Martel 2023; Tia et al. 2023; Coolidge 2023)
- **Assignment:** Online comprehension quiz

### Week 12

**Neuroarchaeology in Practice:** We will walk through how to design an experiment to answer tool-body questions, and how we apply them in our greater theory of cognitive evolution. We will integrate the perspectives and limitations of different fields of research to see how to explore cognitive evolutionary questions.

- **Reading:** (Stout 2023; Sollenberger 2023; Wadley 2024)
- **Assignment:** Online comprehension quiz

### Week 13

**Culture, Language, Tools, and the Neandertal Question:** What factors influence cognition? Are tools and language connected? Is culture required to make certain tools? What really happened at the shift to the Upper Paleolithic?

- **Reading:** (Putt 2024; Stout & Chaminade 2012; Osiurak et al. 2024)
- **Assignment:** Online comprehension quiz

### Week 14

**The Big Questions:** Why does any of this matter anyway? What questions can we not answer? What questions have we forgotten to ask? What are the key limitations to cognitive archaeology?

- **Reading:** (Narvaez 2020; Kilin & Pain 2023)
- **Assignment:** Online comprehension quiz

### Week 15

**Looking Forward into the Past:** What does the future of cognitive archaeology and neuroarchaeology look like? What does the future of our cognition look like? What can we take away from interdisciplinary research?

- **Reading:** (Witmore 2024; Wynn 2019)
- **Assignment:** Online comprehension quiz

### Reading List

- Balzeau, A., & Mangin, J.F. (2021). What Are the Synergies Between Paleoanthropology and Brain Imaging? *Symmetry*, 13(10), Article 10. <https://doi.org/10.3390/sym13101974>
- Bruner, E., Battaglia-Mayer, A., & Caminiti, R. (2023). The parietal lobe evolution and the emergence of material culture in the human genus. *Brain Structure and Function*, 228(1), 145–167. <https://doi.org/10.1007/s00429-022-02487-w>
- Coolidge, F. L. (2019). The Enhanced Working Memory Model: Its Origin and Development. In K. A. Overmann & F. L. Coolidge (Eds.), *Squeezing Minds From Stones: Cognitive Archaeology and the Evolution of the Human Mind*. Oxford University Press. <https://doi.org/10.1093/oso/9780190854614.003.0020>

- Coolidge, F. L. (2020). An Introduction to the Brain. In F. L. Coolidge (Ed.), *Evolutionary Neuropsychology: An Introduction to the Evolution of the Structures and Functions of the Human Brain*. Oxford University Press. <https://doi.org/10.1093/oso/9780190940942.003.0003>
- Coolidge, F. L. (2021). The role of the cerebellum in creativity and expert stone knapping. *Adaptive Behavior*, 29(2), 217–229. <https://doi.org/10.1177/1059712320966462>
- Coolidge, F. L. (2023). Chapter 8—Parietal lobe expansion, its consequences for working memory, and the evolution of modern thinking. In E. Bruner (Ed.), *Cognitive Archaeology, Body Cognition, and the Evolution of Visuospatial Perception* (pp. 181–194). Academic Press. <https://doi.org/10.1016/B978-0-323-99193-3.00002-7>
- de Sousa, A. A., Beudet, A., Calvey, T., Bardo, A., Benoit, J., Charvet, C. J., Dehay, C., Gómez-Robles, A., Gunz, P., Heuer, K., van den Heuvel, M. P., Hurst, S., Lauters, P., Reed, D., Salagnon, M., Sherwood, C. C., Ströckens, F., Tawane, M., Todorov, O. S., ... Wei, Y. (2023). From fossils to mind. *Communications Biology*, 6(1), 1–21. <https://doi.org/10.1038/s42003-023-04803-4>
- Gowlett, J. A. J. (2024). Ideas of Cognitive Evolution in the Making. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.58>
- Gunz, P., Neubauer, S., Golovanova, L., Doronichev, V., Maureille, B., & Hublin, J.-J. (2012). A Uniquely Modern Human Pattern of Endocranial Development: Insights from a New Cranial Reconstruction of the Neandertal Newborn from Mezmaiskaya. *Journal of Human Evolution*, 62(2), 300–313. <https://doi.org/10.1016/j.jhevol.2011.11.013>
- Hecht, E., & Stout, D. (2024). Methods in Neuroarchaeology. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology* (p. 0). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.7>
- Hodgson, D. (2019). Stone Tools and Spatial Cognition. In K. A. Overmann & F. L. Coolidge (Eds.), *Squeezing Minds From Stones: Cognitive Archaeology and the Evolution of the Human Mind*. Oxford University Press. <https://doi.org/10.1093/oso/9780190854614.003.0010>
- Killin, A., & Pain, R. (2023). How WEIRD is Cognitive Archaeology? Engaging with the Challenge of Cultural Variation and Sample Diversity. *Review of Philosophy and Psychology*, 14(2), 539–563. <https://doi.org/10.1007/s13164-021-00611-z>
- Malafouris, L. (2024). What Is Cognitive Archaeology? The Material Engagement Approach. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.54>
- Miller, L. E., & Martel, M. (2023). Chapter 6 - Body-tool integration: Past, present, and future. In E. Bruner (Ed.), *Cognitive Archaeology, Body Cognition, and the Evolution of Visuospatial Perception* (pp. 131–150). Academic Press. <https://doi.org/10.1016/B978-0-323-99193-3.00010-6>
- Moore, M. W. (2024). Hominin Stone Tool Manufacture: Design Space Constraints and Implications for Interpreting Cognitive Evolution. In T. Wynn, K. A. Overmann, & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology* (p. 0). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.20>

- Narvaez, D. (2020). Why Psychology Needs Cognitive Archaeology. In *Handbook of Cognitive Archaeology: Psychology in Prehistory*. Routledge.
- Neubauer, S., Hublin, J.-J., & Gunz, P. (2018). The Evolution of Modern Human Brain Shape. *Science Advances*. <https://doi.org/10.1126/sciadv.aao5961>
- Osiurak, F., Bryche, C., Bluet, A., & Reynaud, E. (2024). From Technical Reasoning to Cumulative Technological Culture. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology* (p. 0). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.9>
- Preuss, T. M. (2009). The Cognitive Neuroscience of Human Uniqueness. In *The Cognitive Neurosciences: Ed. 4* MIT Press. <https://direct.mit.edu/books/edited-volume/5453/chapter/3964938/The-Cognitive-Neuroscience-of-Human-Uniqueness>
- Pittella, J. E. H. (n.d.). The uniqueness of the human brain: A review. *Dementia & Neuropsychologia*, 18, e20230078. <https://doi.org/10.1590/1980-5764-DN-2023-0078>
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- Stout, D. (2023). Chapter 9—Experimental Neuroarchaeology of Visuospatial Behavior. In E. Bruner (Ed.), *Cognitive Archaeology, Body Cognition, and the Evolution of Visuospatial Perception* (pp. 195–211). Academic Press. <https://doi.org/10.1016/B978-0-323-99193-3.00008-8>
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- Stout, D., Hecht, E., Pargeter, J., & Khreisheh, N. (2023). Neuroplasticity Enables Bio-cultural Feedback in Paleolithic Stone-tool Making | *Scientific Reports*. <https://www.nature.com/articles/s41598-023-29994-y>
- Stout, D., & Hecht, E. (2024). Evolutionary Neuroarchaeology. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology* (p. 0). Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.14>
- Stringer, C. (2016). The origin and evolution of Homo sapiens. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 371(1698), 20150237. <https://doi.org/10.1098/rstb.2015.0237>
- Tia, B., Bretas, R., Yamazaki, Y., & Iriki, A. (2023). Chapter 4 - The body in the world: Tools and somato-centric maps in the primate brain. In E. Bruner (Ed.), *Cognitive Archaeology, Body Cognition, and the Evolution of Visuospatial Perception* (pp. 85–107). Academic Press. <https://doi.org/10.1016/B978-0-323-99193-3.00011-8>
- Toth, N., & Schick, K. (2024). Insights into the Cognitive Abilities of Oldowan and Acheulean Hominins: Experimental Approaches. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.30>

- Wadley, L. (2024). Experimental Archaeology Enables Inferences about Human Cognition. In T. Wynn, K. A. Overmann, & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.15>
- Witmore, C. (2024). Anthropeoiesis Revisited: Hominization Through the Incorporation of Non-Humans. In K. A. Overmann & F. L. Coolidge (Eds.), *Oxford Handbook of Cognitive Archaeology*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780192895950.013.46>
- White, T. D., Asfaw, B., Beyene, Y., Haile-Selassie, Y., Lovejoy, C. O., Suwa, G., & WoldeGabriel, G. (2009). *Ardipithecus ramidus* and the Paleobiology of Early Hominids. *Science*, 326(5949), 64–86. <https://doi.org/10.1126/science.1175802>
- Wynn, T. (2019). Epilogue: Situating the Cognitive in Cognitive Archaeology. In K. A. Overmann & F. L. Coolidge (Eds.), *Squeezing Minds From Stones: Cognitive Archaeology and the Evolution of the Human Mind*. Oxford University Press. <https://doi.org/10.1093/oso/9780190854614.003.0024>

## Policies

**Attendance and Participation:** Students are expected to complete all lessons, assignments, and exams. Students who choose to withdraw from the course are responsible for completing the necessary withdrawal forms. Students who stop attending without formally withdrawing still appear on the final grade roster and must be assigned a grade. Consult the schedule for additional information and withdrawal dates.

**Preparation:** Students should prepare for the weekly lesson by reading/ watching the lesson first, and then completing the assigned reading by each session. Students should have a general grasp of the relevant ideas introduced in the material. Students should be prepared to apply reading assignments and material presented in previous weeks to assignments and exams.

**Academic Conduct:** Students should read the University Bulletin and make note of the campus policies regarding breaches of the honor system and academic honesty. Misuse of academic materials will not be tolerated. For additional information on academic conduct, see the university website: ---

**Deadlines, Due Dates, Etc.:** Students should notify the instructor immediately of any extenuating circumstances which do not allow them to meet course deadlines, due dates, or exams.

**Reading Assignments:** Reading assignments comprise the text and majority of instructional material. The complete bibliography with option readings is available upon request.

**Exams:** Tests for the course will be based on the material presented in the weekly assignments. Exams will consist of online multiple choice and written questions. Exams will be graded on a 100-point scale: A (90-100), B (80-89), C (70-79), D (60-69), F (59 & below).

**Disabilities:** Students requesting an accommodation should contact Disability Services. Please advise the instructor of any special needs. Please submit any required forms prior to the exams. For additional information on disability services, see the university website: <https://disability.uccs.edu/>

**Military Service:** Students who are active or reserve military with the potential of being called to service and/or training during the course should coordinate with the instructor during the first week to discuss accommodations. For additional information on the military student support, see the university website: ---

### Useful University Phone Numbers: (719) 255-

Academic Advising **3260**; Anthropology Department **3620**; Disability Services **3354**; LGBTQ Resource Center **3447**; Library **3296**; Public Safety **3111**; University Testing Center **3354**; Veteran and Military Student Affairs Office **3253**; Veterans Health and Trauma Clinic **8003**;

Wellness Center Mental Health Services **4444**; Writing Center **4336**.