Fall 2018 (Updated October 3, 2018)

**ARCH 0730 The Secrets of Ancient Bones: Discovering Ancient DNA**

Class Meetings: MWF 10:00-10:50am

Instructor: Dr. Katherine Brunson

Office Hours: Wednesdays, 11:00-1:00pm, Rhode Island Hall 102

Email: katherine\_brunson@brown.edu

Canvas Website: https://canvas.brown.edu/courses/1072243

Teaching Assistant: Rachel Kalisher

Office Hours: Mondays, 11:00-12:00pm, Rhode Island Hall 016

Email: rachel\_kalisher@brown.edu

**Course Description:**

New analyses of ancient DNA preserved for millennia in bones and soils have revolutionized the field of archaeology. Suddenly, archaeologists have gained new insight into human origins and migrations, diseases, agriculture, and even the slave trade. Recent genetic case studies will provide a lens for learning about the archaeology of diverse world regions and time periods, from Oceania to Mesoamerica and from the Paleolithic through recent history. Topics will include: genetic relationships between humans, Neanderthals, and Denisovans; the peopling of the globe; diasporas; extinction and de-extinction; and plant and animal domestication.

**Course Learning Goals:**

* Learn basic genetic principles, including the differences between mtDNA studies, Y-chromosome studies, genome-wide studies, next generation techniques, and the special methods needed to extract, amplify, and analyze poorly preserved fragments of ancient DNA (aDNA).
* Compare the genetic, fossil, and archaeological evidence for human origins.
* Examine genetic evidence for admixture between humans and other hominin populations and its implications for interpreting the Paleolithic archaeological record.
* Learn how aDNA provides clues about ancient human migrations across the globe.
* Consider case studies of how aDNA is helping to address key archaeological and anthropological research questions in different parts of the world (e.g., the relationship between high-altitude adaptation and the peopling of the Tibetan Plateau, evidence for the spread of plague in Eurasia, etc.).
* Discover the ways that genetics can help clarify aspects of ancient plant and animal exploitation, including domestication processes and the role of aDNA in conservation and de-extinction debates.
* Discuss how aDNA contributes to our understanding of diasporas, especially those associated with the transatlantic slave trade, and the important role that genetics plays in modern discussions of race and ancestry.

**Course Requirements and Grading:**

 Participation 5%

Weekly response posts 20%

 Midterm exam #1 20%

Midterm exam #2 25%

 Final exam 30%

**Lectures and Discussion:** Classes held on Mondays and Wednesdays will be lecture-based. Fridays will be reserved for discussion of assigned readings and other activities.

**Participation and Response Posts:** Students should attend all classes and participate in discussions. Required readings should be completed before Friday discussions. Students are responsible for posting a short, approximately two paragraph response to the readings on the course website each week. Responses are due by 5pm the day before discussion. Each assignment will be graded out of 3 points (3 points for a complete and thoughtful response to the prompt questions, 2 points for a satisfactory response, 1 point for a less than satisfactory response, and 0 points for an incomplete or late assignment). Out of eleven total response post assignments, only ten will count toward the final grade.

**Midterm and Final Exams:** There will be two in-class midterm exams and one final exam that will test students on materials from lectures and readings. **The midterm exams will take place in class on October 1 and November 5. The final exam will take place during the scheduled final exam period on December 18 at 9am.**

**Estimated Time Allocation:** Class meetings (37 hours); readings (5 hours per week, 70 hours total); response posts (3 hour per week, 30 hours total); studying for midterm exams (30 hours); studying for final exam (20 hours); final exam (3 hours).

**Accommodation for Students with Disabilities:** Any student with a documented disability is welcome to contact me as early in the semester as possible to arrange accommodations. As part of this process, please be in touch with Student and Employee Accessibility Services (SEAS).

**Readings:** All readings will be available as PDFs on the course website. Additionally, the following books will be on reserve in the library for reference:

1. Robert Boyd & Joan Silk (2014). *How Humans Evolved* (7th Edition). W.W. Norton Incorporated.
2. Elizabeth Matisoo-Smith & Kay Ann Horsburgh (2012). *DNA for Archaeologists*. Walnut Creek: Left Coast Press.
3. Alondra Nelson (2016). *The Social Life of DNA: Race, Reparations, and Reconciliation after the Genome*. Boston: Beacon Press.
4. Svante Pääbo (2014). *Neanderthal Man: In Search of Lost Genomes*. Hachette UK.
5. David Reich (2018). *Who we are and how we got here: Ancient DNA and the new science of the human past*. New York: Pantheon Books.
6. Beth Shapiro (2015). *How to Clone a Mammoth: The Science of De-Extinction*. Princeton University Press.
7. Kim TallBear (2013). Native American DNA: Tribal Belonging and the False Promise of Genetic Science. Minneapolis: University of Minnesota Press.

**Course Schedule:**

**WEEK 1:**

Wednesday, Sept. 5: Introduction to the course: Ancient DNA in archaeology.

Friday, Sept. 7: Basic genetic principles.

Required Readings:

1. <https://www.archaeological.org/pdfs/education/Arch101.2.pdf>
2. Renfrew, C. & Bahn, P. (2004). *Archaeology: Theories, Methods, and Practice* (4th Edition). London: Thames and Hudson. Sections on dating methods.
3. Matisoo-Smith, E., & Horsburgh, K.A. (2012). *DNA for Archaeologists*. Walnut Creek: Left Coast Press. Chapter 2.

Optional:

1. Watch videos on the search for the tomb of Genghis Khan: <http://natgeotv.com/asia/forbidden-tomb-of-genghis-khan/videos>

**WEEK 2:**

Monday, Sept. 10: The ancient DNA revolution.

Wednesday, Sept. 12: Anthropological and genetic perspectives on human origins and migrations.

Friday, Sept. 14: Discussion of basic genetics and archaeological methods.

Required Readings:

1. Pääbo, S. (2014). *Neanderthal Man: In Search of Lost Genomes*. Hachette UK. Chapter 1-4.
2. Shapiro, B. (2015). *How to Clone a Mammoth: The Science of De-Extinction*. Princeton University Press. Chapter 3.

Optional Readings:

1. Matisoo-Smith, E., & Horsburgh, K.A. (2012). *DNA for Archaeologists*. Walnut Creek: Left Coast Press. Chapter 3.

**WEEK 3:**

Monday, Sept. 17: Hominin origins in Africa.

Wednesday, Sept. 19: Out of Africa.

Friday, Sept. 21: Discussion of the fossil, archaeological, and genetic evidence for hominin evolution in Africa. Examine fossil skull casts.

Required Readings:

1. Boyd, R. & Silk, J.B. (2014). *How Humans Evolved* (7th Edition). W.W. Norton Incorporated. Chapter 12 (page 291-314).
2. Reich, D. (2018). *Who we are and how we got here: Ancient DNA and the new science of the human past*. New York: Pantheon Books. Chapter 1.
3. Qiu, J. (2016). How China is Rewriting the Book on Human Origins. *Nature* 535: 218-220.

Optional Readings:

1. Boyd, R. & Silk, J.B. (2014). *How Humans Evolved* (7th Edition). W.W. Norton Incorporated. Chapter 10-11.

**WEEK 4:**

Monday, Sept. 24: The fate of the Neanderthals.

Wednesday, Sept. 26: The mystery of Denisovans and other hominins in Asia.

Friday, Sept. 28: Discuss Paleolithic Eurasia. Examine Paleolithic stone tools.

Required Readings:

1. Boyd, R. & Silk, J.B. (2014). *How Humans Evolved* (7th Edition). W.W. Norton Incorporated. Chapter 12 (page 314-326) and 13.
2. Reich, D. (2018). *Who we are and how we got here: Ancient DNA and the new science of the human past*. New York: Pantheon Books. Chapter 2 and 3.

Optional Readings:

1. Pääbo, S. (2014). *Neanderthal Man: In Search of Lost Genomes*. Hachette UK. Chapter 16-19.
2. Greshko, M. “700,000-year-old stone tools point to mysterious human relative. *National Geographic*, May 2, 2018.

**WEEK 5:**

Monday, Oct. 1: **MIDTERM EXAM #1**

Wednesday, Oct. 3: Reaching the edges of the Old World: Migrations into Oceania, high altitude adaptations, and the peopling of the Tibetan Plateau.

Friday, Oct. 5: Discussion of the peopling of the Old World.

Required Readings:

1. Matisoo-Smith, E. (2014). Ancient DNA and the human settlement of the Pacific: A review. *Journal of Human Evolution* *79*: 93-104.
2. <http://www.archaeology.org/issues/268-1709/features/5816-tibet-high-altitude-adaptation> (and watch the associated video)

Optional Readings:

1. Nielsen, R., et al. (2017). Tracing the peopling of the world through genomics. *Nature* 541(7637): 302-310.
2. St. Fleur, N. “Humans First Arrived in Australia 65,000 Years Ago, Study Suggests.” *New York Times*, July 19, 2017.
3. Bellwood, P.S. (2013). *First migrants: Ancient migration in global perspective*. Chichester, West Sussex, UK; Malden, MA: Wiley Blackwell. Chapters on Oceania.

**WEEK 6:**

Monday, Oct. 8: HOLIDAY, NO CLASS MEETING

Wednesday, Oct. 10: Case studies: Near East and Europe.

Friday, Oct. 12: Discussion of Old World migrations and population structure. Discuss evidence for the origins of dairying.

Required Readings:

1. Diamond, J. “The Worst Mistake in Human History.” *Discover Magazine*, May 1987, 64-66.
2. Curry, A. (2013). The Milk Revolution. *Nature* 500: 20-22.
3. Gerbault, P. et al. (2013). Inferring Processes of Neolithic Gene-Culture Co-Evolution using Genetic and Archaeological Data: The Case of Lactase Persistence and Dairying. In S. Colledge, J. Conolly, K. Dobney, K. Manning, & S. Shennan (Eds.), *Origins and Spread of Domestic Animals in Southwest Asia and Europe* (pp. 37-48). Walnut Creek: Left Coast Press.

Optional Readings:

1. Bellwood, P.S. (2013). *First migrants: Ancient migration in global perspective*. Chichester, West Sussex, UK; Malden, MA: Wiley Blackwell. Chapters on the Near East, and Europe.
2. [Haak, W., et al. (2015). Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature* 522: 207-11.](https://canvas.harvard.edu/courses/7085/files/1151659/download?wrap=1)

**WEEK 7:**

Monday, Oct. 15: Case studies: Africa and South Asia.

Wednesday, Oct 17: Case studies: East Asia

Friday, Oct. 19: Discuss Old World migrations and population structure.

Required Readings:

1. Yin, S. “In South Asian Social Castes, a Living Lab for Genetic Disease.” *New York Times*, July 17, 2017.
2. Prendergast, M. & Sawchuk, E. (2018). Boots on the ground in Africa’s ancient DNA ‘revolution’: archaeological perspectives on ethics and best practices. *Antiquity* 92 (363): 803-815.

Optional Readings:

1. Reich, D. (2018). *Who we are and how we got here: Ancient DNA and the new science of the human past*. New York: Pantheon Books. Chapter 6.
2. https://www.edge.org/conversation/david\_reich-the-genomic-ancient-dna-revolution
3. Zimmer, C. “Clues to Africa’s Mysterious Past Found in Ancient Skeletons.” *New York Times*, September 21, 2017.
4. Bellwood, P.S. (2013). *First migrants: Ancient migration in global perspective*. Chichester, West Sussex, UK; Malden, MA: Wiley Blackwell. Sections on Africa.

**WEEK 8:**

Monday, Oct. 22: Peopling of the New World.

Wednesday, Oct. 24: Case studies: North America.

Friday, Oct. 26: Discussion of debates and controversies surrounding genetic studies of Native Americans.

Required Readings:

1. Meltzer, D.J. (2015) Kennewick Man: Coming to closure. *Antiquity* 89(348): 1485–1493.
2. Tallbear, K. (2013). Native American DNA: Tribal Belonging and the False Promise of Genetic Science. Minneapolis: University of Minnesota Press. Chapter 4.
3. Select at least one of the following:
	1. Yong, E. “The Increasingly Intricate Story of How the Americas were Peopled.” *The Atlantic*, May 31, 2018.
	2. Balter, M. “The ethical battle over ancient DNA.” *Sapiens*, March 30, 2017.

Optional Readings:

1. Reardon, J. and Tallbear, K. (2012). “Your DNA is our history”: Genomics, anthropology, and the construction of whiteness as property. *Current Anthropology* 53(S5): S233-S245.
2. Gilbert, M.T.P., et al. (2008). DNA from pre-Clovis human coprolites in Oregon, North America. *Science* 320(5877): 786-789.
3. Heintzman, P.D., et al. (2016). Bison phylogeography constrains dispersal and viability of the Ice Free Corridor in western Canada. *Proceedings of the National Academy of Sciences* 113(29): 8057-8063.

**WEEK 9:**

Monday, Oct. 29: Case studies: Mesoamerica and South America.

Wednesday, Oct. 31: Ancient DNA from animal remains: Extinctions and conservation archaeogenomics.

Friday, Nov. 2: Discussion of debates over the de-extinction of mammoths and other animals.

Required Readings:

1. Hofman, C.A., et al. (2015). Conservation archaeogenomics: Ancient DNA and biodiversity in the Anthropocene. *Trends in Ecology & Evolution* 30(9): 540-549.
2. Shapiro, B. (2015). *How to Clone a Mammoth: The Science of De-Extinction*. Princeton University Press. Chapter 1 and 2.
3. Andersen, R. “Welcome to Pleistocene Park.” *The Atlantic*, April 2017.
4. Explore the Revive and Restore website (reviverestore.org)

Optional Readings:

1. González-Martín, A., et al. (2015). Demographic history of indigenous populations in Mesoamerica based on mtDNA sequence data. *PLoS One* 10(8): e0131791.
2. Álvarez-Sandoval, B.A., et al. (2015). Genetic evidence supports the multiethnic character of Teopancazco, a neighborhood center of Teotihuacan, Mexico (AD 200-600). *PloS One* 10(7): e0132371.
3. Reich, D. (2018). *Who we are and how we got here: Ancient DNA and the new science of the human past*. New York: Pantheon Books. Chapter 7.
4. Shultz, D. “Bringing extinct species back from the dead could hurt—not help—conservation efforts.” *Science*, Feb 27, 2017.

**WEEK 10:**

Monday, Nov. 5: **MIDTERM EXAM #2**

Wednesday, Nov. 7: Ancient DNA from plants and soils: Environmental reconstruction

Friday, Nov. 9:Discuss environmental archaeology and the potential for studying materials in museum collections. Visit Haffenreffer Museum.

Required Readings:

1. Thomsen, P.F., & Willerslev, E. (2015). Environmental DNA – An emerging tool in conservation for monitoring past and present biodiversity. *Biological Conservation* 183: 4-18.
2. Choose at least one of the following:
	1. <https://www.theatlantic.com/science/archive/2017/04/ancient-dna-sediment-neanderthal-denisovan/524433/>
	2. <https://www.theatlantic.com/science/archive/2017/08/the-secret-life-of-illuminated-manuscripts-as-told-in-dna/536172/>
	3. <http://www.smithsonianmag.com/smart-news/dna-analysis-reveals-what-otzi-iceman-wore-his-grave-180960170/>
	4. <https://phys.org/news/2017-10-indigenous-australian-ochre-sources-microbial.html>
	5. <https://arstechnica.com/science/2018/02/what-did-new-zealand-look-like-before-humans-came-along/>
	6. <https://www.sciencedaily.com/releases/2018/01/180116222507.htm>

Optional Readings:

1. Green, E.J., and Speller, C.F. (2017). Novel Substrates as Sources of Ancient DNA: Prospects and Hurdles. *Genes* 8(7): 180.
2. González-Martín, A., et al. (2007). Quids and aprons: Ancient DNA from artifacts from the American Southwest. *Journal of Field Archaeology* 32(2): 161-175.
3. Giguet-Covex, C., et al. (2014). Long livestock farming history and human landscape shaping revealed by lake sediment DNA. *Nature Communications* 5: 3211.

**WEEK 11:**

Monday, Nov. 12: Plant and animal domestication part I.

Wednesday, Nov. 14: Plant and animal domestication part II.

Friday, Nov. 16: Discussion of genetic, paleobotanical, and zooarchaeological evidence for plant and animal domestication.

Required Readings:

1. Larson, G., & Fuller, D.Q. (2014). The evolution of animal domestication. *Annu. Rev. Ecol. Evol. Syst.* 45: 115-36.
2. Read at least one of the following:
	1. Lallensack, R. “Ancient genomes heat up dog domestication debate.” *Nature News*, July 18, 2017.
	2. Yong, E. “The original American dogs are gone.” *The Atlantic*, July 5, 2018.

Optional Readings:

1. MacHugh, D.E., Larson, G., & Orlando, L. (2016). Taming the past: Ancient DNA and the study of animal domestication. *Annual Review of Animal Biosciences* 5: 329-351.
2. Irving-Pease, E.K., et al. (2018). Rabbits and the specious origins of domestication. *Trends in Ecology and Evolution* 33(3): 149-152.
3. Jaenicke-Després, V.R., & Smith, B.D. (2016). Ancient DNA and the integration of archaeological and genetic approaches to the study of maize domestication. In J.E. Staller, R.H. Tykot, & B.F. Benz (Eds.), *Histories of Maize in Mesoamerica: Multidisciplinary Approaches* (pp. 32-44). London and New York: Routledge.

**WEEK 12:**

Monday, Nov. 19: Paleodisease and microbiomes.

Wednesday, Nov. 21: NO CLASS MEETING

Friday, Nov. 23: HOLIDAY, NO CLASS MEETING

Required Readings:

1. Watch Christina Warinner’s 20 minute talk on the oral microbiome: <https://www.youtube.com/watch?v=h3FawTt1sXg>
2. Yong, E. “Neanderthal Dental Plaque Shows What a Paleo Diet Really Looks Like.” *The Atlantic*, March 8, 2017.
3. <http://www.cam.ac.uk/research/news/plague-in-humans-twice-as-old-but-didnt-begin-as-flea-borne-ancient-dna-reveals>
4. Zhang, S. “A new clue to the mystery disease that once killed most of Mexico.” *The Atlantic*, Jan 15, 2018.

Optional Readings:

1. Warinner, C. et al. (2014). Direct evidence of milk consumption from ancient human dental calculus. *Scientific Reports* 4: 7104.
2. Schnorr, S. L., Sankaranarayanan, K., Lewis, C. M., & Warinner, C. (2016). Insights into human evolution from ancient and contemporary microbiome studies. *Current Opinion in Genetics & Development* 41: 14-26.

**WEEK 13:**

Monday, Nov. 26: Diasporas associated with the Trans-Atlantic slave trade.

Wednesday, Nov. 28: Guest lecture by Dr. Lauren Sugden, Postdoctoral Fellow (Ramachandran Lab).

Friday, Nov. 30: Discuss ancient DNA in contemporary discussions of race and genetic ancestry.

Required Readings:

1. Nelson, A. (2016). *The Social Life of DNA: Race, Reparations, and Reconciliation after the Genome*. Boston: Beacon Press. Introduction and Chapters 2-3.
2. Tallbear, K. (2013). *Native American DNA: Tribal Belonging and the False Promise of Genetic Science*. Minneapolis: University of Minnesota Press. Chapter 2.
3. Explore the 23andMe website and the African Ancestry website.

Optional Readings:

1. [Bryc, K., et al. (2015). The genetic ancestry of African Americans, Latinos, and European Americans across the United States. *Am J Hum Genet* 96: 37-53.](https://canvas.harvard.edu/courses/7085/files/1199199/download?wrap=1)
2. Campbell M.C., et al. (2014). The peopling of the African continent and the diaspora into the new world. *Current Opinion in Genetics & Development* 29:120-132.
3. Boyd, R. & Silk, J.B. (2014). *How Humans Evolved* (7th Edition). W.W. Norton Incorporated. Chapter 14 (page 388-393).
4. Schroeder, H., et al. (2015). Genome-wide ancestry of 17th-century enslaved Africans from the Caribbean. *Proceedings of the National Academy of Sciences* 112(12): 3669-3673.
5. Lee, E.J., et al. (2009). MtDNA origins of an enslaved labor force from the 18th century Schuyler Flatts Burial Ground in colonial Albany, NY: Africans, Native Americans, and Malagasy? *Journal of Archaeological Science* 36(12): 2805-2810.

**WEEK 14:**

Monday, Dec. 3: Continue discussion of race and ancestry or current debates in ancient DNA research. Guest lecture?

Wednesday, Dec. 5: The future of ancient DNA research and remaining controversies. Course evaluations.

Friday, Dec. 7: Course summary and final exam review.

Required Readings:

1. Callaway, E. (2018). Divided by DNA: The uneasy relationship between archaeology and genetics. *Nature* News Feature, March 28, 2018.
2. <https://www.nytimes.com/2018/03/23/opinion/sunday/genetics-race.html>
3. <https://www.buzzfeed.com/bfopinion/race-genetics-david-reich?utm_term=.ivRQja0R8#.cwz5lPx1E>
4. <https://www.theatlantic.com/science/archive/2018/04/reich-genetics-racism/558818/>

Optional Readings:

1. Hofreiter, M., et al. (2015). The future of ancient DNA: Technical advances and conceptual shifts. *BioEssays* 37(3): 284-293.
2. Pickrell, J.K., and D. Reich. (2014). Toward a new history and geography of human genes informed by ancient DNA. *Trends in Genetics* 30 (9): 377-389.
3. Linderholm, A. (2016). Ancient DNA: The next generation–chapter and verse. *Biological Journal of the Linnean Society* 117(1): 150-160.

**NO CLASS MEETINGS DURING READING PERIOD. FINAL EXAM DECEMBER 18 AT 9AM.**