

**COURSE SYLLABUS: Human Behavior through Bone Chemistry (ASM 494/591)**  
**Arizona State University, Spring 2007**  
**Day and Time: T 3:40-6:30pm**  
**Room Number: LL 47**

**Professor:** Kelly J. Knudson, Ph.D.  
**Email:** Kelly.Knudson@asu.edu  
**Office Phone:** 480-727-0767  
**Office Location:** Anthropology 312  
**Office Hours:** W 3:00-4:00 pm

**Course Description**

This course will focus on the many ways that biogeochemical analyses of archaeological bone and teeth can inform our understanding of past human behavior. Some of the topics covered include migration and residential mobility, paleodiet, post-depositional contamination and dating methods. Students will learn through lectures, discussions, student presentations, and hands-on laboratory projects.

**Required Texts**

1. Bowman S (1990) Radiocarbon Dating. Berkeley: University of California Press.
2. Additional required readings, including journal articles and book chapters, are listed in the class outline. These readings will be available online via Blackboard and at the Hayden Library Reserve Desk.

**Recommended Texts**

1. Lambert JB (1998) Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry. Reading, MA: Perseus Books.
2. Wright LE (2006) Diet, Health, and Status among the Pasi3n Maya: A Reappraisal of the Collapse. Nashville, TN: Vanderbilt University Press.

**Course Requirements**

The required readings will serve as the main material for the course, which will be supplemented by the lectures and discussions. The required readings should be completed before attending class so that you can participate in class discussions and laboratory work. In addition, students are required to complete five assignments, participate in class discussions and laboratory work, and complete a final project. Participation points will be determined by class attendance and completion of a series of short, mostly in-class, assignments.

**Student Evaluation**

Final project	100 points
Assignment 1: Presentation	50 points
Assignment 2: Diagenesis	50 points
Assignment 3: Paleodiet	50 points
Assignment 4: Trace Elements	50 points
Assignment 5: Essay	50 points
Participation	50 points
Total	400 points

**Grade Scale**

A+	98-100%	B+	88-89%	C+	78-79%	D	61-69%
A	92-97%	B	82-87%	C	72-77%	E	60% or below
A-	90-91%	B-	80-81%	C-	70-71%		

## **Course Policies and General Information**

### ***Research Project in Bone Chemistry***

In order to develop skills in archaeological chemistry, students will work in pairs to complete a semester-long research project. Students will design a research project and then develop the analytical skills necessary to generate, analyze, and interpret their data. This research project will culminate in a final paper that demonstrates independent, critical thought.

The final paper for this course will be due at 3:40pm on Tuesday May 1, 2007. Late papers will be subject to a loss of 10 points (10%) per day, including weekends, and will not be accepted after Monday, May 7, 2007. Electronic copies of the papers will NOT be accepted and hard copies can be placed in the professor's mailbox in the Anthropology Building. Students should use the editorial style used by the *American Journal of Physical Anthropology*, which can be found at <http://www3.interscience.wiley.com/cgi-bin/jabout/28130/ForAuthors.html>. The paper should be formatted as an article submission for the *American Journal of Physical Anthropology* research article following their guide to authors, which can also be found at <http://www3.interscience.wiley.com/cgi-bin/jabout/28130/ForAuthors.html>.

The Writing Center at Arizona State University is an excellent resource for students who want to improve and refine their writing skills; information is available at <http://www.asu.edu/duas/wcenter/>. In addition, the professor will read a maximum of one draft of the final paper for each pair of students. The rough draft should be in final form and should be correctly formatted with no spelling or grammar errors; drafts with incomplete sections or outlines instead of text will not be accepted. Hard copies of paper drafts must be handed in by 3:40pm on Tuesday, April 17, 2007.

### ***Academic Integrity***

Each student is responsible for preparing her or his own work. Cheating on exams or quizzes, plagiarizing other sources, or engaging in any form of academic deceit will not be tolerated. Students who do so will be subject to full disciplinary action by Arizona State University. The following websites are useful resources if you have questions about the Arizona State University policies on academic integrity or if you have questions about how to avoid plagiarism:

[http://www.asu.edu/studentaffairs/studentlife/judicial/academic\\_integrity.htm](http://www.asu.edu/studentaffairs/studentlife/judicial/academic_integrity.htm)

[http://owl.english.purdue.edu/handouts/research/r\\_plagiar.html](http://owl.english.purdue.edu/handouts/research/r_plagiar.html)

<http://www.rbs2.com/plag.htm>

### ***In-Class Behavior***

Students are expected to treat others in the classroom with respect and common courtesy. Cellular phones are not permitted to be used in any way. Laptop computers are to be used only to take notes. Late arrival will not be tolerated and repeated lateness will result in a lower participation grade for the course.

### ***Late Assignments and Late or Missed Exams***

Late assignments will be docked 10% of the total point value for each day they are late, and will not be accepted more than five days late, including weekends. Students will be allowed to turn in late assignments without losing points only in the case of medical or family emergencies. In either case, the professor must be notified *before* the due date and a written excuse from an appropriate source must be provided, such as a doctor.

### ***Special Accommodations***

If you need special accommodations because of a disability, please notify the instructor within the first two weeks of class. Grades for course assignments will normally be available after one week has elapsed. Extra credit is not available for this course.

**HUMAN BEHAVIOR THROUGH BONE CHEMISTRY:  
CLASS OUTLINE AND ASSIGNED READINGS**

The assigned readings that are listed for each week should be completed  
before class each week.

**WEEK 1, January 15-20: Human Behavior through Bone Chemistry**

ACTIVITIES:

- Course introduction in LL 47
- Tour of Archaeological Chemistry Laboratory and the W.M. Keck Foundation Laboratory for Environmental Biogeochemistry

REQUIRED READINGS (ASM 494/591):

Lambert, JB (1998) Chapter 8 in *Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry*. Reading, MA: Perseus Books.

**WEEK 2: January 22-26: Laboratory Safety in the Archaeological Chemistry Laboratory**

ACTIVITIES:

- Laboratory safety orientation, including fire safety and hazardous waste management
  - Class will meet in the Anthropology Conference Room
- Research project meetings in Anthropology 312

REQUIRED READINGS (ASM 494):

Chamberlin TC (1890) The Method of Multiple Working Hypotheses. Reprinted in *Science* 148:754-759.

Killick D, and Young SMM (1997) Archaeology and Archaeometry: From Casual Dating to a Meaningful Relationship? *Antiquity* 71:518-524.

Pollard AM (1995) Why Teach Heisenberg to Archaeologists? *Antiquity* 69:242-247.

REQUIRED READINGS (ASM 591):

Chamberlin TC (1890) The Method of Multiple Working Hypotheses. Reprinted in *Science* 148: 754-759.

Killick D, and Young SMM (1997) Archaeology and Archaeometry: From Casual Dating to a Meaningful Relationship? *Antiquity* 71:518-524.

Pollard AM (1995) Why Teach Heisenberg to Archaeologists? *Antiquity* 69:242-247.

Trigger BG (1989) Archaeology's Relations with the Physical and Biological Sciences: A Historical Review: *Archaeometry Proceedings*. Toronto, pp. 1-9.

Wylie A (2000) Questions of Evidence, Legitimacy, and the (Dis)unity of Science. *American Antiquity* 65:227-237.

**WEEK 3, January 29-February 2: The Use of Chemical Techniques in Anthropology and Current Theoretical Debates in Archaeological Science**

ACTIVITIES:

- Class discussion in LL 47
- Research project meetings in Anthropology 312

REQUIRED READINGS (ASM 494):

Chamberlin TC (1890) The Method of Multiple Working Hypotheses. Reprinted in *Science* 148:754-759.

Gosden, C. 2005. COMMENTS III: Is Science a Foreign Country? *Archaeometry* 47: 182-185.

Killick, D. 2005. COMMENTS IV: Is There Really a Chasm between Archaeological Theory and Archaeological Science? *Archaeometry* 47: 185-189.

Killick D, and Young SMM (1997) Archaeology and Archaeometry: From Casual Dating to a Meaningful Relationship? *Antiquity* 71:518-524.

Pollard AM (1995) Why Teach Heisenberg to Archaeologists? *Antiquity* 69:242-247.

REQUIRED READINGS (ASM 591):

Boivin, N. 2005. COMMENTS I: Post-Textual Archaeology and Archaeological Science. *Archaeometry* 47: 175-179.

- Bray, P.J. & A.M. Pollard. 2005. COMMENTS II: The Underpinnings and Consequences of the Materiality Approach *Archaeometry* 47: 179-182.
- Chamberlin TC (1890) The Method of Multiple Working Hypotheses. Reprinted in *Science* 148: 754-759.
- Gosden, C. 2005. COMMENTS III: Is Science a Foreign Country? *Archaeometry* 47: 182-185.
- Jones, A. 2004. *Archaeometry and Materiality: Materials-Based Analysis in Theory and Practice*. *Archaeometry* 46: 327-338.
- Jones, A. 2005. REPLY. *Archaeometry* 47: 201-207.
- Killick, D. 2005. COMMENTS IV: Is There Really a Chasm between Archaeological Theory and Archaeological Science? *Archaeometry* 47: 185-189.
- Killick D, and Young SMM (1997) *Archaeology and Archaeometry: From Casual Dating to a Meaningful Relationship?* *Antiquity* 71:518-524.
- Mithen, S. 2005. COMMENTS V: The Need for an Evolutionary Perspective on the Human Mind. *Archaeometry* 47: 189-192.
- Needham, S. 2005. COMMENTS VI: Rationalizing Materiality. *Archaeometry* 47: 192-195.
- Pollard AM (1995) Why Teach Heisenberg to Archaeologists? *Antiquity* 69:242-247.
- Taylor, T. 2005. COMMENTS VII: A Cunning Duplicate in Mind: Materiality and the Interpretive Dilemma. *Archaeometry* 47: 196-198.
- Thomas, J. 2005. COMMENTS VIII: Between "Material Qualities" and "Materiality". *Archaeometry* 47: 198-201.
- Trigger BG (1989) *Archaeology's Relations with the Physical and Biological Sciences: A Historical Review: Archaeometry Proceedings*. Toronto, pp. 1-9.
- Wylie A (2000) Questions of Evidence, Legitimacy, and the (Dis)unity of Science. *American Antiquity* 65:227-237.

#### **WEEK 4, February 5-9: Dating**

##### ACTIVITIES:

- Student presentations in LL 47
  - Assignment 1: Presentation DUE at 3:40 pm on Tuesday, February 6, 2007
- Class discussion in LL 47
- Laboratory training in sample collection in Anthropology 303

##### REQUIRED READINGS (ASM 494/591):

- Libby, W. F. (1960). *Radiocarbon Dating*, Nobel Lecture, December 12, 1960.
- Bowman S (1990) *Radiocarbon Dating*. Berkeley: University of California Press.

#### **WEEK 5, February 12-16: Identifying Diagenesis and Pathological Samples**

##### ACTIVITIES:

- Lecture in LL 47
- Laboratory training in chemical cleaning in Anthropology 303

##### REQUIRED READINGS (ASM 494/591):

- Budd, P., J. Montgomery, et al. (2000). Differential Diagenesis of Strontium in Archaeological Human Dental Tissues. *Applied Geochemistry* 15: 687-694.
- Hedges RE (2002) Bone Diagenesis: An Overview of Progress. *Archaeometry* 44:319-328.
- Kohn, M. J., M. J. Schoeninger, et al. (1999). Altered States: Effects of Diagenesis on Fossil Tooth Chemistry. *Geochimica et Cosmochimica Acta* 63(18): 2737-2747.
- Lee-Thorp J (2002) Two Decades of Progress towards Understanding Fossilization Processes and Isotopic Signals in Calcified Tissue Minerals. *Archaeometry* 44:435-446.
- Lee-Thorp J, and Sponheimer M (2003) Three Case Studies Used to Reassess the Reliability of Fossil Bone and Enamel Isotope Signals for Paleodietary Studies. *Journal of Anthropological Archaeology* 22:208-216.

## **WEEK 6, February 19-23: Human Behavior through Non-Human Samples**

### ACTIVITIES:

- Assignment 2: Diagenesis DUE at 3:40 pm on Tuesday, February 20, 2007
- Student presentations in LL 47
  - Assignment 1: Presentation DUE at 3:40 pm on Tuesday, February 20, 2007
- Class discussion in LL 47
- Laboratory training in sample collection in Anthropology 303

### REQUIRED READINGS (ASM 494/591):

- Balasse M (2002) Reconstructing Dietary and Environmental History from Enamel Isotopic Analysis: Time Resolution of Intra-Tooth Sequential Sampling. *International Journal of Osteoarchaeology* 12:155-165.
- Balasse M, Ambrose SH, Smith AB, and Price TD (2002) The Seasonal Mobility Model for Prehistoric Herders in the South-western Cape of South Africa Assessed by Isotopic Analysis of Sheep Tooth Enamel. *Journal of Archaeological Science* 29:917-932.
- Bryant JD, Luz B, and Froelich PN (1994) Oxygen Isotopic Composition of Fossil Horse Tooth Phosphate as a Record of Continental Paleoclimate. *Paleogeography, Paleoclimatology, Paleoecology* 107:303-316.
- Kohn MJ, and Law JM (2006) Stable Isotope Chemistry of Fossil Bone as a New Paleoclimate Indicator. *Geochimica et Cosmochimica Acta* 70:931-946.

## **WEEK 7, February 26-March 2: Migration and Residential Mobility**

### ACTIVITIES:

- Class discussion in LL 47
- Laboratory training in sample preparation in Anthropology 303

### REQUIRED READINGS (ASM 494):

- Bentley RA (2006). Strontium Isotopes from the Earth to the Archaeological Skeleton: A Review. *Journal of Archaeological Method and Theory*. In press.
- Price, T. D., Johnson, C. M., Ezzo, J. A., Ericson, J. and Burton, J. H. (1994). Residential Mobility in the Prehistoric Southwest United States: A Preliminary Study Using Strontium Isotope Analysis. *Journal of Archaeological Science* 21: 315-330.
- Montgomery, J., Evans, J. A., Powlesland, D. and Roberts, C. A. (2005). Continuity or Colonization in Anglo-Saxon England? Isotope Evidence for Mobility, Subsistence Practice, and Status at West Heslerton. *American Journal of Physical Anthropology* **126**: 123-138.
- REQUIRED READINGS (ASM 591):
- Bentley RA (2006). Strontium Isotopes from the Earth to the Archaeological Skeleton: A Review. *Journal of Archaeological Method and Theory*. In press.
- Montgomery, J., Evans, J. A., Powlesland, D. and Roberts, C. A. (2005). Continuity or Colonization in Anglo-Saxon England? Isotope Evidence for Mobility, Subsistence Practice, and Status at West Heslerton. *American Journal of Physical Anthropology* **126**: 123-138.
- Price, T. D., Middleton, W. D. and Manzanilla, L. (2000). Immigration and the Ancient City of Teotihuacan in Mexico: A Study Using Strontium Isotope Ratios in Human Bone and Teeth. *Journal of Archaeological Science* **27**: 903-913.
- Price, T. D., Johnson, C. M., Ezzo, J. A., Ericson, J. and Burton, J. H. (1994). Residential Mobility in the Prehistoric Southwest United States: A Preliminary Study Using Strontium Isotope Analysis. *Journal of Archaeological Science* 21: 315-330.
- White, C. D., Spence, M. W., Longstaffe, F. J. and Law, K. R. (2004). Demography and Ethnic Continuity in the Tlailotlacan Enclave of Teotihuacan: The Evidence from Stable Oxygen Isotopes. *Journal of Anthropological Archaeology* 123: 385-403.

Wright, L. E. (2005). Identifying Immigrants to Tikal, Guatemala: Defining Local Variability in Strontium Isotope Ratios of Human Tooth Enamel. *Journal of Archaeological Science* 32: 555-566.

### **WEEK 8, March 5-9: Paleodiet and Stable Isotope Analysis**

#### ACTIVITIES:

- Student presentations in LL 47
  - Assignment 1: Presentation DUE at 3:40 pm on Tuesday, March 6, 2007
- Class discussion in LL 47

#### REQUIRED READINGS (ASM 494):

Ambrose SH (2006) *ANTHROPOLOGY: Enhanced: A Tool for All Seasons*. Science 314: 930-931.

Lambert, JB (1998) Chapter 8 in *Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry*. Reading, MA: Perseus Books.

Richards MP, Fuller BT, and Hedges REM (2001) Sulphur Isotopic Variation in Ancient Bone Collagen from Europe: Implications for Human Paleodiet, Residence Mobility, and Modern Pollutant Studies. *Earth and Planetary Science Letters* 191:185-190.

White CD (2005) Gendered Food Behaviour among the Maya: Time, Place, Status and Ritual. *Journal of Social Archaeology* 5:356-382.

#### REQUIRED READINGS (ASM 591):

Ambrose SH (2006) *ANTHROPOLOGY: Enhanced: A Tool for All Seasons*. Science 314: 930-931.

Barrett JH, and Richards MP (2004) Identity, Gender, Religion and Economy: New Isotope and Radiocarbon Evidence for Marine Resource Intensification in Early Historic Orkney, Scotland, UK. *European Journal of Archaeology* 7:249-271.

Lambert, JB (1998) Chapter 8 in *Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry*. Reading, MA: Perseus Books.

Lee-Thorp J and Sponheimer M (2006) Contributions of Biogeochemistry to Understanding Hominin Dietary Ecology. *American Journal of Physical Anthropology* 131: 131-148.

Richards MP, Fuller BT, and Hedges REM (2001) Sulphur Isotopic Variation in Ancient Bone Collagen from Europe: Implications for Human Paleodiet, Residence Mobility, and Modern Pollutant Studies. *Earth and Planetary Science Letters* 191:185-190.

Sponheimer M, Passey BH, de Ruiter DJ, Guatelli-Steinberg D, Cerling TE and Lee-Thorp, JA. (2006) Isotopic Evidence for Dietary Variability in the Early Hominin *Paranthropus robustus*. *Science* 314: 980-982.

White CD (2005) Gendered Food Behaviour among the Maya: Time, Place, Status and Ritual. *Journal of Social Archaeology* 5:356-382.

#### RECOMMENDED READINGS (ASM 591):

Wright LE (2006) *Diet, Health, and Status among the Pasión Maya: A Reappraisal of the Collapse*. Nashville, TN: Vanderbilt University Press.

### **WEEK 9, March 12-16: Spring Break (no class)**

### **WEEK 10, March 19-23: Paleodiet and Stable Isotope Analysis (continued)**

#### ACTIVITIES:

- Assignment 3: Paleodiet DUE at 3:40 pm on Tuesday, March 20, 2007
- Class discussion in LL 47
- Laboratory training in sample preparation in Anthropology 303

#### REQUIRED READINGS (ASM 494/591):

Richards MP, Mays S, and Fuller BT (2002) Stable Carbon and Nitrogen Isotope Values of Bone and Teeth Reflect Weaning Age at the Medieval Wharram Percy Site, Yorkshire, UK. *American Journal of Physical Anthropology* 119:205-210.

- Schurr MR (1998) Using Stable Nitrogen-Isotopes to Study Weaning Behavior in Past Populations. *World Archaeology* 30:327-342.
- Williams JS, White CD, and Longstaffe FJ (2005) Trophic Level and Macronutrient Shift Effects Associated With the Weaning Process in the Postclassic Maya. *American Journal of Physical Anthropology* 128:781-790.
- Wright LE, and Schwarcz HP (1998) Stable Carbon and Oxygen Isotopes in Human Tooth Enamel: Identifying Breastfeeding and Weaning in Prehistory. *American Journal of Physical Anthropology* 106:1-18.

### **WEEK 11, March 26-30: AAPAs in Philadelphia**

#### ACTIVITIES:

- Work on Assignment 5
- Laboratory work on final projects

### **WEEK 12, April 2-6: Trace Element Concentrations: Paleodiet and Residential Mobility**

#### ACTIVITIES:

- Class discussion in LL 47
- Laboratory training in trace element analysis in Anthropology 303

#### REQUIRED READINGS (ASM 494/591):

- Burton JH, and Price TD (2000) The Use and Abuse of Trace Elements for Paleodietary Research. In SA Ambrose and MA Katzenberg (eds.): *Biogeochemical Approaches to Paleodietary Analysis*. New York: Kluwer Academic/ Plenum Publishers, pp. 159-171.
- Burton, J. H., Price, T. D., Cahue, L. and Wright, L. (2003). The Use of Barium and Strontium Abundances in Human Skeletal Tissues to Determine their Geographic Origins. *International Journal of Osteoarchaeology* 13: 88-195.
- Ezzo JA (1994) Putting the 'Chemistry' Back Into Bone Chemistry Analysis: Modeling Potential Dietary Indicators. *Journal of Anthropological Archaeology* 13:1-34.
- Sillen A, Sealy JC, and van der Merwe NJ (1989) Chemistry and Paleodietary Research: No More Easy Answers. *American Antiquity* 54:504-512.

### **WEEK 13, April 9-13: Final Projects**

#### ACTIVITIES:

- Laboratory work on final projects

### **WEEK 14, April 16-20: Final Projects**

#### ACTIVITIES:

- Assignment 4: Trace Elements DUE at 3:40 pm on Tuesday, April 17, 2007
- Optional rough draft of final paper DUE at 3:40pm on Tuesday, April 17, 2007
- Laboratory work on final projects

### **WEEK 15, April 25-29: SAAs in Austin**

#### ACTIVITIES:

- Work on Assignment 5
- Laboratory work on final projects

### **WEEK 16, April 30-May 1: Last day of classes**

#### ACTIVITIES:

- Class discussion and student evaluations in LL 47
- Assignment 5: Essay DUE at 3:40 pm on Tuesday, May 1, 2007
- Final paper DUE at 3:40pm on Tuesday, May 1, 2007