PHYSICAL & CHEMICAL ANALYSIS OF METAL & CERAMIC OBJECTS: ATHENS, GREECE

Course ID: HIS 489

June 22 - July 05, 2025

Academic Credits: 4 Semester Credit Units (Equivalent to 6 Quarter Units)

School of Record: Culver Stockton College

This program does not provide accommodation or meals. Athens is a major tourist destination with many hotels for all price ranges, Airbnb's, and plenty of excellent, affordable restaurants. Athens' public transportation is excellent, connecting the city with an efficient & affordable metro and bus system.

DIRECTORS:

Dr. Adamandia Panagopoulou, Post-Doc Researcher at the Institute of Nanoscience & Nanotechnology "Demokritos" National Center for Scientific Research, Athens (a.panagopoulou@inn.demokritos.gr)

Dr. Angela Pencheva, Co-Founder of Balkan Heritage Foundation, Adjunct Professor at CPCE, New Bulgarian University (Bulgaria) & ICCM Board Member (balkanheritage@gmail.com)

INTRODUCTION

This is an intensive program designed to teach students how to conduct intensive physical and chemical analysis of ethnographic and archaeological metal and ceramic objects. The program will

introduce students to multiple analytical techniques and instruments, including Optical Microscopy (OM), X-Ray Fluorescence Spectroscopy (pXRF), Scanning Electron Microscopy (SEM-EDS), IR spectroscopy and Statistical analysis, dating techniques, petrography, elemental analysis, SEM, X-Ray Diffraction Spectroscopy (XRD), IR spectroscopy and 3D Scanning.

This program is for students who may seek careers in conservation or archaeology. The large range of methods and technologies presented are important tools for the study, analysis, and interpretation of cultural artifacts. Graduating students may not be experts in all the techniques presented but will get comprehensive understanding of the ways these techniques may be deployed in research and enhance our ability to understand and interpret material culture.

The program is hosted by the Institute of Nanoscience and Nanotechnology (INN) at the National Centre for Scientific Research ΄Demokritos΄ in Greece. During the program, students will work with ethnographic and archaeological artifacts from the collection of Demokritos.

IMPORTANT DISCLAIMER

The Center for Field Sciences was established to support field training in a range of sciences at sites within the U.S. & across the world. Traveling and conducting field work involves risk. Students interested in participating in any CFS program must weigh the potential risk against the value of education provided by the program of their choosing.

Risk is inherent in everything we do and the CFS takes risks seriously. A committee of leading scholars review each field school location prior to approval. Once a program is accepted, the CFS continually monitor conditions at the program's site and so we can provide an experience that is as safe as possible.

The CFS does not provide trip or travel cancellation insurance. Students are encouraged to explore such insurance policies on their own. Post Covid 19, most basic policies do not cover trip cancelation due to pandemics. If you wish to purchase an insurance policy that covers such contingencies, explore Cancel for Any Reason (CFAR) plans. Insuremytrip.com, Squaremouth.com or Travelguard.com are possible websites where students may explore different insurance policies.

Students should be aware that conditions in the field are different than those experienced at home, dorms or college towns. Students will be exposed to the elements, live in rustic accommodation, and expect to engage in daily physical activity.

We do our best to follow schedule and activities as outlined in this syllabus. Yet local permitting agencies, political, environmental, personal, and/or weather conditions may force changes. This syllabus, therefore, is only a general commitment. Students should allow flexibility and adaptability as research work is frequently subject to modification.

All students must consult medical professionals to ensure they are fit to participate in a CFS field program. CFS is not qualified to provide medical advice. For all other concerns, please consult with CFS staff members or program director(s) – as appropriate.

COURSE OBJECTIVES

By the end of the workshop the participants will:

- Get acquainted with the basic methods of documentation and physicochemical analyses of ethnographic and archaeological objects.

- Learn about the benefits and limitations of physical and chemical analysis of cultural artifacts.
- Learn about shapes, types and construction technologies of ceramic and metal artifacts.
- Improve knowledge about the history and archaeology of Greece.

LEARNT SKILLS

We are aware that many students may not seek academic careers but will pursue employment in the private sector. To that end, we are following the example set by Twin Cairns with their Skills Log Matrix™ (https://twincairns.com/skills-log-matrix/). Students will be trained in the following skills:

Skill	Skill Definition
Artifact Documentation	Ability to measure, record, photograph and classify various artifact types in the lab
Artifact Processing	Understand how to assign artifacts to accepted cultural/geological spheres, across space (classification) & time (seriation)
Data Recording	Ability to use printed or digital sheets to document & record field data
Archival Search	Ability to find & search various databases for records related to prior work/research done on cultural or natural heritage in the project area
Public Interpretation	Ability to understand site history and provide clear and coherent interpretation for the public
Report Writing	Ability to write technical reports in coherent language that follow both federal and state regulations and law

SKILLS MATRIX LEVELS

The school instructors will evaluate the level each student achieved on the Twin Cairns Skills Log Matrix™ skills list provided above. Each skill will be graded on one of the following three levels:

Basic: Can perform the skill/task with some supervision.

Competent: Can perform the skill/task without any supervision.

Advanced: Can perform the skill/task and teach others how to do it.

COURSE SCHEDULE

The field school has two parts, each lasting a week: Week 1 – Metal Objects; Week 2 – Ceramics.

Date	Activity
June 22	Arrive to Athens and check in to your accommodation
Week 1	**Lectures** ➢ Lecture 1: History of ethnographic and archaeological metal artefacts. ➢ Lecture 2: Construction technology of ethnographic and archaeological metal artefacts. ➢ Lecture 3: The necessity of physicochemical analysis on metals. ➢ Lecture 4: Optical Microscopy on metal objects. ➢ Lecture 5: Elemental Analysis of metal objects. ➢ Lecture 6: Scanning Electron Microscopy (SEM-EDS) on metal objects. ➢ Lecture 7: Multianalytical approach on metal objects (XRF, ICP, Metallography, IR, UV, SEM). ➢ Lecture 8: 3D scanning techniques in Archaeology. **Workshops**

	➢ Workshop 1: Documentation techniques of metal objects. ➢ Workshop 2: Optical Microscopy on metal objects (Application). ➢ Workshop 3: Optical Microscopy on metal objects (Report). ➢ Workshop 4: X-Ray Fluorescence Spectroscopy (pXRF) on metal objects (Application). ➢ Workshop 5: X-Ray Fluorescence Spectroscopy (pXRF) on metal objects (Report with statistical results). ➢ Workshop 6: Scanning Electron Microscopy (SEM-EDS) on metal objects (Application). ➢ Workshop 7: Scanning Electron Microscopy (SEM-EDS) on metal objects (Report with statistical results). Guided Visits: Acropolis Museum and Byzantine and Christian Museum;
June 29-30	Weekend off – explore Athens on your own
Week 2	**<u>Lectures</u>** ➢ Lecture 1: History of ethnographic and archaeological ceramics. Construction technology of ethnographic and archaeological ceramics. ➢ Lecture 2: The necessity of physicochemical analysis in archaeology and conservation. ➢ Lecture 3: The application of dating techniques in archaeology. ➢ Lecture 4: The luminescence dating in archaeology. ➢ Lecture 5: Optical Microscopy on ceramics. ➢ Lecture 6: Elemental Analysis of Ceramics: Scope and Analytical Methods. ➢ Lecture 7: Scanning Electron Microscopy (SEM-EDS) on ceramics. ➢ Lecture 8: 3D scanning techniques in Archaeology. ➢ Lecture 9: The integrated analytical approach in the study of ceramics: combining petrography, elemental analysis, SEM, XRD, IR spectroscopy. **<u>Workshops</u>** ➢ Workshop 1: Documentation techniques of ceramics. ➢ Workshop 2: Optical Microscopy on ceramics (Application). ➢ Workshop 3: Optical Microscopy on ceramics (Report). ➢ Workshop 4: X-Ray Fluorescence Spectroscopy (pXRF) on ceramics (Application). ➢ Workshop 5: X-Ray Fluorescence Spectroscopy (pXRF) on ceramics (Report with statistical results). ➢ Workshop 6: Scanning Electron Microscopy (SEM-EDS) on ceramics (Application) Excursion to Salamina Island on June 30, 2024.
July 5	Depart Athens

** Course structure may be subject to change upon directors' discretion.*

TYPICAL WORKDAY

Students will follow this daily schedule during the three weeks of lab work.

8:00 am	Arrive at Demokritos Institute
8:15am-12pm	Lectures and Workshops
12:00-1:00pm	Lunch Break
1:00-4:30pm	Lectures and Workshops
4:30pm	Departure to your own accommodation

ACADEMIC GRADING MATRIX

Students are required to participate in all components of the field school. Grades are determined as follows:

- **60% - Lab work**: Students will be assessed on the quality of their lab work (i.e., their ability to effectively use conservation methods and instruments to treat cultural artifacts) Students are expected to be able to link the lectures and readings to their laboratory work.
- **25% - Lab Records, demonstrated diligence and Active participation**: Students are required to record their work in a notebook that must be submitted to the project at the end of the field school. The notebook must include scaled sketches, procedures and other notes taken while working on assigned objects.
- **15% - Attendance**.

ATTENDANCE POLICY

The required minimum attendance for the successful completion of the field school is 95% of the course hours. Any significant delay or early departure from an activity will be calculated as an absence from the activity.

An acceptable number of absences for medical or other personal reasons will not be considered if the student catches up on the field school study plan through additional readings, homework, or tutorials with program staff members.

PREREQUISITES

There are no prerequisites for participation in this field school. Note that conservation work requires good manual dexterity skills and ability to carry out delicate bench work. Students will receive hands-on training in analytical and conservation work and will spend most of the time in the lab.

Students will be taught how to use a variety of laboratory procedures and equipment – from microscopes to analytical instruments. Analytical work is slow and may be tedious. It requires patience and focus. This is an introductory course so we will cover all the very basic elements of analytic and conservation ethnographic work.

PROGRAM ETIQUETTE

Greece, a land steeped in myth and history, is a captivating blend of ancient heritage and modern allure. From the birthplace of democracy in Athens to the legendary temples of Olympia and Delphi, Greece is a living museum showcasing the achievements of past civilizations. Its vibrant culture, with its rich traditions, delicious cuisine, and warm hospitality, captivates visitors from around the globe. Whether exploring its archaeological wonders, soaking in the Mediterranean sun, or indulging in its vibrant nightlife, Greece offers an unforgettable experience. Greek people take pride in their heritage and achievements, and we kindly ask for your respect towards their customs, traditions, and culture.

EQUIPMENT LIST

- A pair of comfortable shoes for walking/hiking.
- Small backpack (for your water bottle, snacks, camera, etc.)
- Lab coat
- Medication - only prescription medicines you may need. It is not necessary to bring non-prescription medicine from your country since you can buy all basic non-prescription drugs in Greece.
- A converter to EU type electricity wall-plug if needed.
- A good attitude for work, fun, study, and discoveries.

TRAVEL & MEETING POINT

We suggest you hold purchasing your airline ticket until six (6) weeks prior to departure date. Natural

disasters, political changes, weather conditions and a range of other factors may require the cancelation of a program. The CFS typically takes a close look at local conditions 6-7 weeks prior to program beginning and makes a Go/No Go decision by then. Such a time frame still allows for the purchase of deeply discounted airline tickets while protecting students from potential loss of airline ticket costs if CFS is forced to cancel a program.

The meeting point is at 8:00 am at the Demokritos Institute on the first day of the program. Students may get to the institute by:

- Taking the metro and getting off the Nomismatokopio station
- Take bus lines B5, 407 or 406 towards Agia Paraskevi. Get off at the 4th stop of Agia Paraskevi/ "Demokritos"

Figure 1: the Institute of Nanoscience & Nanotechnology "Demokritos"

VISA REQUIREMENTS

There are no special visa requirements for U.S. citizen travelling to Greece, as long as they do not stay longer than 3 months. Passport's expiration date should exceed the stay by at least 3 months.

Citizens of other countries are asked to check the embassy website page at their home country for specific visa requirements.

MEALS & ACCOMMODATIONS

This program does not provide room and board. Students should find their own accommodation in Athens and will enjoy the many restaurants, Tavernas, and grocery stores in the city. Athens is a major tourist destination with many hotels offering accommodation at all price ranges. At the time of the writing of this syllabus, short term rentals (Airbnb, Vrbo, etc) are legal and available.

PRACTICAL INFORMATION

International dialing code: The Greek international phone code is +30.

Money/Banks/Credit Cards: Greece's currency is the Euro, and there are many banks at Athens. Most shops/supermarkets accept major credit cards (with the exception of American Express, which is not always accepted). However, credit cards are not commonly used for small purchases (for example coffee at a café).

ATM Availability: There are numerous ATM machines at Athens.

Local Language: The native language is Greek. Given that Zakynthos is a major tourist destination, many locals speak English at least at some level.

Measurement units: degree Celsius (ºC), meter (m.), gram (gr.), liter (l)

ACADEMIC CREDITS & TRANSCRIPT

Attending students will be awarded 4 semester credit units (equivalent to 6 quarter credit units). Students will receive a letter grade for attending this field school based on the assessment matrix (above). This program provides a minimum of 80 direct instructional hours. Students are encouraged to discuss the transferability of credit units with faculty and the registrar at their home institutions prior to attending this program.

Students will be able to access their transcript through our School of Record – Culver-Stockton College. C-SC has authorized the National Student Clearinghouse to provide enrollment and degree verification (at https://tsorder.studentclearinghouse.org/school/select). Upon completion of a program, students will get an email from C-SC with a student ID that may be used to retrieve transcripts. The first set of transcripts will be provided at no cost, additional transcripts may require payment. If you have questions about ordering a transcript, contact the C-SC office of the registrar at registrar@culver.edu.

REQUIRED READINGS

PDF files of all mandatory readings will be provided to enrolled students via a shared Dropbox folder.

Egerton, R. F., 2005. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM. New York: Publications Springer.

Hein, A., Dobosz, A., Day, P. M. and Kilikoglou, V., 2021. 'Portable ED-XRF as a tool for optimizing sampling strategy: The case study of a Hellenistic amphora assemblage from Paphos (Cyprus)'. Journal of Archaeological Science, p. 133.

Stuart, B., 2007. Analytical Techniques in Material Conservation. New York: John Wiley & Sons.

RECOMMENDED READINGS

Buxeda i Garrigos, J., Cau Ontiveros, M.A., Kilikoglou, V., 2003b. Chemical variability in clays and pottery from a traditional cooking pot production village: testing assumptions in Pereruela. Archaeometry, 45, pp. 1–17.

Derrick, M. R., Stulik, D. and Landry, J. M., 1999. Infrared Spectroscopy in Conservation Science, Scientific Tools for Conservation. Los Angeles: The Getty Conservation Institute.

Ferretti, M., 2000. X-ray fluorescence applications for the study and conservation of cultural heritage. In: D. C. Creagh and D. A. Bradley, eds. Radiation in Art and Archaeometry. Amsterdam: Elsevier, pp. 285-296.

Freestone, I. C. and Middlestone, A. P., 1987. 'Mineralogical applications of the analytical SEM in archaeology'. Mineralogical Magazine, 51, pp. 21-31.

Guggenheim, S. and Martin, R. T., 1995. 'Definition of Clay and Clay Mineral: Joint Report of the Aipea and CMS Nomenclature Committees'. Clays and Clay Minerals, 44(5), pp. 710-712.

Hein, A., 2018. Elemental Analysis of Pottery. In: S. L. L. Varela., ed. The Encyclopedia of Archaeological Sciences. John Wiley & Sons, Inc., pp. 1-5.

Hein, A., 2021. Revisiting the groups – Exploring the feasibility of portable EDXRF in provenance studies of transport amphorae in the Eastern Aegean. In: M. Hegewisch, M. Dazkiewicz and G.

Schneider, eds. Using pXRF for the Analysis of Ancient Pottery. Berlin: Topoi-Berlin Studies of the Ancient World, pp. 43-61.

Hein, A. and Kilikoglou, V., 2017. 'Compositional variability of archaeological ceramics in the eastern Mediterranean and implications for the design of provenance studies'. Journal of Archaeological Science: Reports, 16, pp. 564-572.

Hein, A. and Kilikoglou, V., 2020. 'Ceramic raw materials: how to recognize them and locate the supply basins: chemistry'. Archaeological and Anthropological Sciences, 12, p. 180.

Hein, A., Dobosz, A., Day, P. M. and Kilikoglou, V., 2021. 'Portable ED-XRF as a tool for optimizing sampling strategy: The case study of a Hellenistic amphora assemblage from Paphos (Cyprus)'. Journal of Archaeological Science, p. 133.

Henderson, J., 2020. The Science and Archaeology of Materials. An Investigation of Inorganic Materials. Routledge.

Janssens, K., 2004. X-ray based methods of analysis. In: K. Jannsens and R. Van Grieken, eds. Non-Destructive Microanalysis of Cultural Heritage Materials. Amsterdam: Elsevier, pp. 129-226.

Janssens, K., Vittiglio, G., Deraedt, I., Aerts, A., Vekemans, B., Vincze, L., Wei, F., Deryck, I., Schalm, O., Adams, F., Rindby, A., Knochel, A., Simionovici, A. and Snigirev, A., 2000. 'Use of microscopic XRF for non-destructive analysis in art and archaeometry'. X-ray Spectrometry, 29, pp. 73-91.

Jose-Yacaman, M. and Ascencio, J. A., 2000. Electron microscopy and its application to the study of archaeological materials and art preservation. In: E. Ciliberto and G. Spoto, eds. Modern Analytical Methods in Art and Archaeology. New York: John Wiley & Sons Inc., pp. 405-444.

Karydas, A. G., 2007. 'Application of a portable XRF Spectrometer for the non- Invasive ana Kilikoglou, V., Maniatis, Y., Grimanis, A. P., 1988. The effect of purification and firing of clays on trace element provenance studies. Archaeometry, 30, 1, pp. 37-46. lysis of museum metal artifacts'. Annali di Chimica, p. 97.

Kousouni C.K., Ganetsos Th., Panagopoulou A., 2021, Non – Destructive XRF Analysis of Metallic Objects from Benaki Museum of Islamic Art, Scientific Culture, Vol. 7, No. 2, pp. 69-79, Open access, DOI: 10.5281/zenodo.4465536.

Kousouni C.K., Panagopoulou A., 2018, Non-destructive physicochemical analysis and conservation of metallic book covers of ecclesiastical books from Saint Mavra and Timotheos Church in Zakynthos (Greece), International Journal of Scientific Culture, Volume:4, No 2, pp. 85-95, DOI: 10.5281/zenodo.1214571.

Maniatis, Y., 1976. 'Examination of Ancient Pottery Using the Scanning Electron Microscope'. PhD thesis. Department of Physics, University of Essex.

Panagopoulou A., Karanasios K., Xanthopoulou G., 2016, Ancient Egyptian Blue (CaCuSi4O10) Pigment by Modern Solution Combustion Synthesis Method, Eurasian Chemico-Technological Journal, Volume: 18, No 1, pp.31-37, ISSN: 1562-3920.

Panagopoulou, A. P., Vroom, J., Hein, A. and Kilikoglou, V., 2021. Production Technology of Glazed Pottery in Chalcis, Euboea, during the Middle Byzantine Period, MDPI, Heritage 4(4), 4473-4494; https://doi.org/10.3390/heritage4040247.