Above top row: UC66076 (PMEA) and FTIR spectra from sampled adhesives
Above bottom row: X-ray of Egyptian painted wooden boat; SEM image of layered paint sample from Chinese dance mask, UV image of Ecuadoran painting with sample sites identified
UCL INSTITUTE OF ARCHAEOLOGY

ARCLG123: Conservation Materials Science

2017-18

30 credits

Turnitin Class ID: 3543621

Turnitin Password: IoA1718

Deadlines for coursework for this course: Term 1 – 27 November 2017 / 18 December 2017

Term 2 – 6 April 2018 / 13 April 2018

Co-ordinator: Dr. Caitlin R. O’Grady

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IoA Rm. 203 / 02076797487 / internal 257487

Office hours: Thursdays 11:00 – 13:00 or via appointment

Post-graduate teaching assistant: Ole F. Nordland

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IoA Rm. B11

Please see the last page of this document for important information about submission and marking procedures, or links to the relevant webpages.
1 OVERVIEW
ARCLG123 SHORT DESCRIPTION
This course provides students with an understanding of material chemistry, properties, and structure through the lens of culture. Preindustrial material technologies, their deterioration processes, and relationship to observed condition of objects are the focus. Students gain first-hand experience critically reviewing literature, as well as using and interpreting examination methods and analytical techniques in the analysis of cultural materials. This is facilitated by access to the equipment and facilities in the Institute’s Wolfson laboratories (optical microscopy, X-radiography, scanning electron microscopy, electron microprobe, Fourier-transform infrared spectroscopy and X-ray diffraction).

G123 WEEK-BY-WEEK SUMMARY
Term 1

Week 1 – 2 October 2017
Introduction to the course
Introduction to materials and their structure; analytical methodologies and data

Week 2 – 9 October 2017 [start time 10:00]
Discussion of research projects
Instrumental overview: spot testing and optical microscopy
Discussion articles (CRO to lead discussion)
Visit to PMEA to view research objects TBC (PMEA: 14:00 – 16:00)

Week 2 – 11 October 2017 CONT. [start time 10:30]
Ceramic technology: chemistry and degradation
Discussion articles (CRO to lead discussion)

Week 3 – 16 October 2017
Artefact sampling / Adhesion
Practical session: Sampling – removal and preparation / adhesive reference tile
Discussion articles (student-led)
Work with assigned artefacts TBC (PMEA: 14:00 – 15:00 group 1)
Work with assigned artefacts TBC (PMEA: 15:00 – 16:00 group 2)

Week 4 – 23 October 2017
Instrumental Overview: SEM and pXRF
Discussion articles (student-led)
SEM/SEM-EDS orientation (rm. B4: 14:00 – 15:00 group 1)
SEM/SEM-EDS orientation (rm. B4: 15:00 – 16:00 group 2)

Week 4 – 26 October 2017 CONT.
Visible and UV Photography (rm. 405: 13.00 – 17.00 group 1)

Key to initials: BS= Bill Sillar, CRO= Caitlin O’Grady, IEF= Ignacio Faccin, OFN= Ole F. Nordland, SL= Stuart Laidlaw, SP= Susi Pancaldo, TG= Tom Gregory
**Week 5 – 30 October 2017**
Stone
Developing PhD research
Discussion articles (student-led)
Work with assigned artefacts (PMEA: 14:00 – 15:00 group 1) CRO, SP, IEF
Work with assigned artefacts (PMEA: 15:00 – 16:00 group 2) CRO, SP, IEF

**Week 5 – 2 November 2017 CONT.**
Visible and UV Photography (rm. 405: 13.00 – 17.00 group 2) SL

**READING WEEK: 6 – 10 November 2017 (No Teaching)**

**Week 6 – 13 November 2017 (start time 10:00)**
Pigment ID
Discussion articles (student-led)
Work with assigned artefacts (PMEA: 14:00 – 15:00 group 1) CRO, SP, IEF
Work with assigned artefacts (PMEA: 15:00 – 16:00 group 2) CRO, SP, IEF

**Week 6 – 13 – 17 November 2017 CONT.**
COMPULSARY SEM training and analysis sessions (rm. B4)
13 November – 13:00-17.00 (2 students) CRO, TG, OFN
16 November – 13:00-17.00 (2 students) CRO, TG, OFN
17 November – 9:00-13.00 (2 students) CRO, TG, OFN
17 November – 13:00-17.00 (2 students) CRO, TG, OFN

**Week 7 – 20 November 2017**
Glass, glazes and faience: chemistry and deterioration
Discussion articles (student-led)
Work with assigned artefacts (PMEA: 14:00 – 15:00 group 1) CRO, SP, IEF
Work with assigned artefacts (PMEA: 15:00 – 16:00 group 2) CRO, SP, IEF

**Week 8 – 27 November 2017**
Overview: XRD, FTIR and Raman
Discussion articles (student-led)
Work with assigned artefacts (PMEA: 14:00 – 15:00 group 1) CRO, SP, IEF
Work with assigned artefacts (PMEA: 15:00 – 16:00 group 2) CRO, SP, IEF

***27 November 2017 – summary of SEM/SEM-EDS analysis submitted to CRO by 23:59***

**Week 8 – 27 November 2017 CONT.**
COMPULSARY FTIR training and analysis sessions (rm. B4)
27 November 2017 – 13:00 – 17:00 pm (2-3 students) CRO, OFN
30 November 2017 – 14:00 – 17:00 (2 students) CRO, OFN
1 December 2017 – 10.00 – 13.00 (2 students) CRO, OFN

Key to initials: CRO= Caitlin O’Grady, IEF= Ignacio Faccin, IF= Ian Freestone, OFN= Ole F. Nordland, RS= Ruth Siddall, SL= Stuart Laidlaw, SP= Susi Pancaldo, TG= Tom Gregory
Week 9 – 4 December 2017 (start time 10:00)
Gypsum, lime mortar and hydraulic cements
Discussion articles (student-led)
Work with assigned artefacts (PMEA: 14:00 – 15:00 group 1)
Work with assigned artefacts (PMEA: 15:00 – 16:00 group 2)

Week 10 – 11 December 2017
Copper and copper alloys
Work with assigned artefacts (PMEA: 14:00 – 15:00 group 1)
Work with assigned artefacts (PMEA: 15:00 – 16:00 group 2)

***11 December 2017 – summary of FTIR analysis of reference adhesive submitted to CRO by 17:00***

***18 December 2017 – analytical proposal due***

***18 December 2017 – submission of discussion article for week 12 due***

TERM 2 2018 **Please note that many of the sessions in term 2 are still be confirmed.**

Week 11 – 8 January 2018 – TBC
Iron working: technology and corrosion
Discussion articles

Week 12 – 15 January 2018
Analytical projects and presentation of data
Discussion articles (CRO to lead discussion)

Week 13 – 22 January 2018 – TBC
Plant and animal fibres
Demo/practical: fibre identification

Week 14 – 30 January 2018 (Tuesday) (start time 10:30)
Plastics chemistry, properties and technology
Discussion articles

Week 15 – 5 February 2018
Wood structure and ID
Practical session

READING WEEK: 12 – 16 February 2018 (No Teaching)

Key to initials: CRO= Caitlin O’Grady, ER=Emma Richardson, IEF= Ignacio Faccin, MMT=Marcos Martinón-Torres, OFN= Ole F. Nordland, PA= Phillip Austin, RA= Rahil Alipour, RP= Renata Peters, RS= Ruth Siddall, SB= Sandra Bond, SP= Susi Pancaldo
**Week 16 – 19 February 2018 – TBC**
Wood technology
Wood deterioration
Discussion articles

**Week 17 – 26 February 2018 (long session) – TBC**
Paper

**Week 18 – 5 March 2018 (start time 10:00)**
Textile technology, examination
Discussion articles

**Week 19 – 12 March 2018 – TBC**
Leather, skin and parchment: technology and processing and deterioration
Leather practical class: leather ID
Discussion articles

**Week 20 – 19 March 2018 (start time 10:00) – TBC**
Animal hard tissues 1: bone, teeth, ivory, horn, antler, shell
Demo/practical: identifying hard tissue materials in objects

### 6 April 2018 – analytical report due***

### 13 April 2018 – analytical data, documents, and samples due***

**Key to initials:** DA=Daniel Antoine, DS=Dean Sully, GM= Gustav Milne, MG= Margarita Gleba, MS=Matija Strlic

**Basic texts**
The following books and websites will give you a good introduction and knowledge of materials chemistry, properties and degradation.

e-Book available online through UCL library / ISSUE DESK IOA ART 1

INST ARCH JDA HEN

e-Book available online through UCL library / INST ARCH JD Qto JON

e-book available online through UCL library / INST ARCH AJ MAR


e-Book available online through UCL library / INST ARCH JDD POL


e-Book available online through UCL library / INST ARCH AJ PRI


The following journals and conference proceedings publish relevant case studies:

- Studies in conservation http://www.maneyonline.com/loi/sic
- Journal of the American institute for conservation http://cool.conservation-us.org/jaic/
- Journal of archaeological science http://www.journals.elsevier.com/journal-of-archaeological-science/
- Archaeological and anthropological sciences http://link.springer.com/journal/12520
- Conservation and management of archaeological sites http://www.maneyonline.com/loi/cma

ICOM-CC triennial meetings
ICOM-CC metal conferences, e.g. Metal 04, Metal 07, Metal 10, Metal 13, Metal 16
International symposium on archaeometry
Materials issues in art and archaeology (Materials Research Society)

Other useful resources and case studies available online or through the UCL Library system:

- AATA Online: Abstracts of International Conservation Literature http://aata.getty.edu/Home
- BCIN: Bibliographic Database of the Conservation Information Network http://www.bcin.ca/English/home_english.html
- CAMEO – Boston Museum of Fine Arts http://cameo.mfa.org/wiki/Main_Page
- Internet Archive https://archive.org/
- Science Direct http://www.sciencedirect.com/
- Web of Science/Web of Knowledge http://apps.webofknowledge.com/WOS_GeneralSearch_input.do?product=WOS&search_mode=GeneralSearch&SID=V1SbkM9WV8I77n4UZok&preferencesSaved=
Methods of Assessment
This course is assessed by two pieces of written coursework totaling 7000 words. These include:

a. (i) SEM/SEM-EDS sample report and (ii) research proposal – 3000 words (40% of course mark)

b. report summarizing analytical results/interpretation addressed in research proposal – 4000 words (60% of course mark)

The topics and deadlines for each assessment are discussed in the following sections. If students are unclear about the nature of an assignment, they should contact the Course Co-ordinator is willing to discuss any questions, provided this is planned suitably in advance of submission date.

Teaching Methods
The course is taught over Term 1 and Term 2 of the 2017 – 2018 academic year and includes weekly lectures, demonstrations and practical classes (all are compulsory).

Discussion Articles
Each student will be responsible for leading discussion of selected readings during one lecture in term 1. Discussion SHOULD CRITICALLY ASSESS the success or failure of the selected reading based on writing, format, data presentation, figures/tables, etc. Discussion SHOULD NOT SUMMARIZE reading content. Readings will be assigned during the first class meeting on 2 October 2017. During term 2, discussion of assigned articles will continue without assigned leaders.

Week 12 discussion articles
Each student must submit an article for discussion during week 12 lecture on Analytical projects and presentation of data that is relevant for their research report on or before 18 December 2017. All submitted articles will form the foundation of discussion during lecture. Each student is expected to read all articles submitted for lecture 12.

Where required, additional small group sessions are arranged to give students greater familiarity with some of the techniques covered in the course. Teaching will take place on Mondays in the conservation laboratory (IoA room 615), while practical sessions are held in the conservation laboratories or in the appropriate area of the basement labs.

Owing to the wide variety of techniques taught during the course, practical sessions may be scheduled at different times each week and in various locations depending on the subject taught, therefore it is important that you check your timetable at the beginning of each week. However, UNLESS otherwise indicated, all course events are scheduled to occur in IoA room 615.

Research Artefacts
As part of their assessed coursework, students will analyze ceramic artefacts located in the collections of the Petrie Museum of Egyptian Archaeology (PMEA) and/or the Material Culture Room (MCR). Access to these objects will be by appointment only and must be requested by the student in consultation with staff availability at either institution. This is standard practice for all researchers at museums, archives and educational institutions. Please note that research appointments at the PMEA are generally scheduled on Mondays or Tuesday- Friday mornings – as the museum is closed to the public during these times, while research appointments at the MCR are dependent on availability of the MCR curator.

During collection visits to examine and work with their assigned artefacts, students will have access to digital Dino-Lite cameras (microscope, UV, IR) and a computer in order to document their object and to collect data about it.
PMEA sessions
Students will be introduced to assigned PMEA artefacts on **9 October 2017 between 14:00 – 16:00**. Please note that this date still needs to be confirmed. The PMEA and its staff (Susi Pancaldo, senior conservator, UCL Museums; Anna Garnett, curator, PMEA; Ignacio Eccheveria Faccin, collections assistant, PMEA) have kindly arranged for student research visits on **Monday afternoons** in Term 1.

Students may schedule subsequent visits for additional artefact observation on **Monday afternoons** in one-hour sessions through the Moodle course website, but must do so the Thursday prior – so that PMEA staff can prepare accordingly. In order to accommodate all students, PMEA Monday research sessions are limited to 3 – 4 students per one-hour slot based on group assignments (to be made prior to start of week 3). Please be considerate of fellow colleagues in the MSc cohort to ensure that each equal has equal access throughout the term.

For visits outside of Monday afternoons, students must schedule directly with PMEA. **Availability is at the discretion and schedule of PMEA staff.**

MCR sessions
Students will be introduced to assigned MCR artefacts on a date to be confirmed. Delphine Mercier (Curator - Collections Management and Care, UCL Anthropology) has kindly arranged for student research visits on a time to still be confirmed. For visits outside of Monday afternoons, students must schedule directly with MCR. **Availability is at the discretion and schedule of MCR staff.**

Sampling
While students are expected to sample assigned artefacts as part of course assessments, all sampling of conservation materials from PMEA and MCR artefacts must be approved by the course instructor and Susi Pancaldo (senior conservator, UCL Museums) and/or Delphine Mercier (Curator - Collections Management and Care, UCL Anthropology). Students may only remove samples in the presence of the course instructor, the course PGTA, Susi Pancaldo and/or Delphine Mercier.

It students propose to remove original material from an artefact (e.g. ceramic paste, pigment, or, other original component) for analysis, they must complete a destructive analysis request form as provided by the PMEA or MCR. Please note that all requests for destructive sampling – whether they come from UCL postgraduate students, UCL faculty or external researchers – may take up to 4-6 weeks to process and are approved based on research merit on a case-by-case basis. Destructive sampling forms are available on the Moodle course website.

Analytical Sessions
Analytical sessions will be available to students two days a week. These sessions allow students to work one-on-one with the course instructor or PGTA. Students will be able to sign up for these sessions via the Moodle course website. Students may only sign up for sessions **2 weeks in advance**. This ensures that there is equitable distribution of sessions amongst students. Please take note of session availability on the Moodle course website.

Students should use analytical sessions to do any of the following:
1. discuss analytical proposals/research projects
2. collect and prepare samples for proposals/projects
3. gain experience operating various instruments (subject to instrument availability)
4. collect analytical data (subject to instrument availability)

It is extremely important that students collect data for their analytical projects throughout Terms 1 and 2.
With the course coordinator or PGTA, students can collect empirical data or analytical data using instrumentation – including any of the following methods:

(1) inspection of assigned object/materials under magnification
(2) inspection of assigned object/materials under raking, ultraviolet and infrared light sources
(3) solvent solubility of assigned object/materials
(4) micro-chemical spot-testing
(5) pXRF analysis of assigned object/materials
(6) polarized/reflected light microscopy
(7) SEM/SEM-EDS/FTIR/XRD analysis

Students must be prepared before any analytical session they have scheduled. This means:

(1) object/samples/materials and microscope must be set up and available
(2) tools, solvents and chemicals should be selected and available
(3) pXRF/SEM/SEM-EDS/FTIR/XRD instrumentation needs to be available
(4) reference images, spectra or diffractogram must be identified and printed to use for comparison during data collection

**SEM/SEM-EDS**

Term 1 - SEM access for the MSc Year 1 students will be restricted to a training and data collection sessions scheduled for the week of 13 – 17 November 2017. Students will be trained on the SEM-EDS by the course co-ordinator, Ole F. Nordland (course PGTA), or Dr. Tom Gregory (SEM Lab Manager). Students will use samples prepared during week 3 practical during their training session on the SEM. Please ensure that these samples are prepared and coated prior to selected training session. Training sessions will last two-hours and each student.

Term 2 – If additional time (as determined by the course instructor) is needed to collect data using the SEM/SEM-EDS instrumentation, this will be scheduled during the beginning of term 2.

**FTIR**

Term 1 - FTIR access for the MSc Year 1 students will be restricted to a training and data collection sessions scheduled for the week of 27 November – 1 December 2017. Students will be trained on the FTIR by the course co-ordinator, or, Ole F. Nordland (course PGTA). Students will use adhesive reference samples prepared prior to their training session. Students are expected to bring the following during their training session:

(a) sample of reference adhesive film
(b) solvent (select solvent in which the reference adhesive is soluble), tweezers and scalpel
(c) printed copy of published (web, digital, or paper publication) FTIR spectrum of selected reference adhesive

Students must submit an annotated FTIR spectrum of their selected reference adhesive that they collected for review by 11 December 2017. Annotations to include: peak values and their corresponding bond vibrations.

Term 2 – Students will continue to use the FTIR throughout term 2 and should schedule analytical session time to operate the instrument with the course co-ordinator and/or PGTA.
Please note that the last day of access to instrumentation (in particular FTIR, PLM, SEM, XRD and XRF) will be 26 February 2018. This is to ensure that students plan their analysis appropriately, while having adequate time to analyze/interpret data and write their research report.

**Workload**
The workload for this course will be 300 hours and is divided in the following way:

- Lectures: 40 hours
- Demonstration/practical: 20 hours
- Reading + acting as article discussion leader: 120 hours
- Preparation and production of assessed work: 120 hours

**Prerequisites**
The course is introductory and assumes no previous knowledge of the subject. Lectures will contain technical and scientific content. As such, a basic knowledge of physics and chemistry would be an advantage. However, the course should be comprehensible to students of any background.

2 **AIMS, OBJECTIVES AND ASSESSMENT**

**Aims**
This course is designed to familiarize the student with the properties, technology and decay mechanisms of pre-industrial materials and to provide them with an understanding of the analytical techniques used in identifying, characterizing and assessing their condition. As well, course lectures, labs, practical sessions and assessments will give the student an increased awareness of the important information an object can yield with analysis and technological study.

**Objectives**
On successful completion of this course, a student should:

- be familiar with the technologies involved in producing traditional artefacts and be able to interpret decayed material with a view to understanding an object’s original state
- have an overview of a wide range of analytical techniques for the study of artefacts and be able to choose the most appropriate method of analysis for a particular situation
- be able to carry out the following analytical procedures: SEM/SEM-EDS, XRF, FTIR, optical microscopy
- be aware of information scientists and specialist scholars collect through analysis of cultural heritage materials

**Learning Outcomes**
On successful completion of the course, students should be able to demonstrate/have developed:

- ability to read and critically evaluate scientific reports and papers with reference to the appropriateness of the techniques employed and the presented data
the application of the knowledge acquired to the broader field of conservation practice to ensure that interventive procedures protect and reveal the information an artefact carries, so that information is not destroyed or obscured

ability to communicate and collaborate with scientists and other specialists on analytical projects related to cultural heritage artefacts

ability to propose relevant research and produce a report containing scientific data appropriately presented and interpreted

Coursework
Item 1 [3000 words total] - The first item of coursework is divided into two components including: (a) SEM/SEM-EDS analytical summary (250 words), and, (b) research proposal (2750 words). This piece of coursework is 40% of your final mark for ARCLG123. Students should allocate a nominal 48 hours of work to complete it in entirety — in addition to the time spent during class lectures, demonstrations/practicals/ reading, etc. Students will propose research associated with an assigned object(s) in the Petrie Museum of Egyptian Archaeology (PMEA) and Material Culture Room (MCR) collections using available instrumental equipment in the IoA. When developing your research proposal, ensure that your research question or problem may be answered by undertaking limited analytical investigation and instrumentation available at the UCL-IoA.

(a) SEM/SEM-EDS analytical summary (submitted 27 November 2017):
  • description of sample including image of sample and its original location on artefact
  • description of instrumental parameters including settings used to collect data
  • SEM/SEM-EDS data collected (secondary electron/backscatter electron image, and/or energy dispersive spectrum) with brief discussion of observed features in images or elemental data

The use of images, tables, diagrams are encouraged for this assignment. Additional guidelines regarding the report format will be made available in future class sessions.

***Please see Appendix B of this handbook for analytical report assessment criteria.***

The completed SEM/SEM-EDS analytical summary is due no later than 23:59 on Monday 27 November 2017. Please submit an electronic version to caitlin.r.ogrady@ucl.ac.uk with high resolution images in addition to that submitted to Turnitin and the paper copy.

Please note that students will receive their marked research proposal no later than Monday 6 December 2018.

(b) Research proposal format (submitted 18 December 2017):
  • lays foundation for research report submitted in term 2
  • description of question and/or object that will be investigated; discuss why this research is important
  • literature review of relevant publications that relate to your question
  • proposed analytical work needed to answer research question
  • any preliminary work you may have conducted (visual examination under visible/infrared/ ultraviolet illumination, solvent and micro-chemical spot-tests, etc.) that informs your proposed research

The use of images, tables, diagrams are encouraged for this assignment. Additional guidelines regarding the report format will be made available in future class sessions.
Students are **HIGHLY ENCOURAGED** to submit a draft of the research proposal via email to caitlin.r.ogrady@ucl.ac.uk by 5pm on **Friday 24 November 2017** for review by the course coordinator.

The completed SEM/SEM-EDS analytical summary is due no later **23:59 on Monday 18 December 2017**. Please submit an electronic version to caitlin.r.ogrady@ucl.ac.uk with high resolution images in addition to that submitted to Turnitin and the paper copy.

Please note that students will receive their marked research proposal no later than **Wednesday 17 January 2018**.

**Item 2 [4000 words]** - The second item of coursework is a short analytical report that comprises the remaining 60% of marks for this course. Students should take a nominal 72 hours to complete the research/analysis/practical work/writing required for this report.

The analytical report will build on the previously submitted research proposal. This assessment is designed to help you develop (or further develop) an area of analytical expertise by investigating a specific type of material or problem utilizing a method of analysis available at the IoA. The use of images, tables, diagrams are encouraged for this assignment. Additional guidelines regarding the report format will be discussed in future class sessions.

Students are **HIGHLY ENCOURAGED** to submit a draft of the research report via email to caitlin.r.ogrady@ucl.ac.uk by 5pm on **Friday 9 March 2018** for review.

The completed project should be handed in no later than **Friday 6 April 2018**. Please submit an electronic version to caitlin.r.ogrady@ucl.ac.uk with high resolution images in addition to that submitted to Turnitin and the paper copy.

Please note that students will receive their marked research report no later than **Friday 5 May 2018**.

Students will be required to submit both paper and electronic versions of their research project report to the Petrie Museum of Egyptian Archaeology – along with digital copies of relevant images and analytical data. This is standard practice when conducting research on museum collections. Additional guidelines regarding the format and naming of digital files and samples will be made available in future class sessions.

Samples, research reports and analytical data must be submitted to the course coordinator no later than **Friday 13 April 2018**.

If students are unclear about the nature of an assignment, they should discuss this with the Course Coordinator. Students are not permitted to re-write and re-submit essays in order to try to improve their marks. However, the course co-ordinator is willing to discuss an outline of the student's approach to the assignment, provided this is planned suitably in advance of the submission date.

**Word Counts**
The following should not be included in the word-count: title page, contents pages, lists of figure and tables, abstract, preface, acknowledgements, bibliography, lists of references, captions and contents of tables and figures, appendices.
Penalties will only be imposed if you exceed the upper figure in the range. There is no penalty for using fewer words than the lower figure in the range: the lower figure is simply for your guidance to indicate the sort of length that is expected.

In the 2017-18 session penalties for overlength work will be as follows:

- For work that exceeds the specified maximum length by less than 10% the mark will be reduced by five percentage marks, but the penalised mark will not be reduced below the pass mark, assuming the work merited a Pass.
- For work that exceeds the specified maximum length by 10% or more the mark will be reduced by ten percentage marks, but the penalised mark will not be reduced below the pass mark, assuming the work merited a Pass.

Coursework submission procedures

- All coursework must normally be submitted both as hard copy and electronically. (The only exceptions are bulky portfolios and lab books which are normally submitted as hard copy only.)
- You should staple the appropriate colour-coded IoA coversheet (available in the IoA library and outside room 411a) to the front of each piece of work and submit it to the red box at the Reception Desk (or room 411a in the case of Year 1 undergraduate work)
- All coursework should be uploaded to Turnitin by midnight on the day of the deadline. This will date-stamp your work. It is essential to upload all parts of your work as this is sometimes the version that will be marked.
- Instructions are given below.

Note that Turnitin uses the term ‘class’ for what we normally call a ‘course’.

1. Ensure that your essay or other item of coursework has been saved as a Word doc., docx. or PDF document, and that you have the Class ID for the course (available from the course handbook) and enrolment password (this is IoA1718 for all courses this session - note that this is capital letter I, lower case letter o, upper case A, followed by the current academic year)
2. Click on http://www.turnitinuk.com/en_gb/login
3. Click on ‘Create account’
4. Select your category as ‘Student’
5. Create an account using your UCL email address. Note that you will be asked to specify a new password for your account - do not use your UCL password or the enrolment password, but invent one of your own (Turnitin will permanently associate this with your account, so you will not have to change it every 6 months, unlike your UCL password). In addition, you will be asked for a “Class ID” and a “Class enrolment password” (see point 1 above).
6. Once you have created an account you can just log in at http://www.turnitinuk.com/en_gb/login and enrol for your other classes without
going through the new user process again. Simply click on ‘Enrol in a class’. Make sure you have all the relevant “class IDs” at hand.

7. Click on the course to which you wish to submit your work.
8. Click on the correct assignment (e.g. Essay 1).
9. Double-check that you are in the correct course and assignment and then click ‘Submit’
10. Attach document as a “Single file upload”
11. Enter your name (the examiner will not be able to see this)
12. Fill in the “Submission title” field with the right details: It is essential that the first word in the title is your examination candidate number (e.g. YGBR8 In what sense can culture be said to evolve?),
13. Click “Upload”. When the upload is finished, you will be able to see a text-only version of your submission.
14. Click on “Submit”.

If you have problems, please email the IoA Turnitin Advisors on ioa-turnitin@ucl.ac.uk, explaining the nature of the problem and the exact course and assignment involved.

One of the Turnitin Advisors will normally respond within 24 hours, Monday-Friday during term. Please be sure to email the Turnitin Advisers if technical problems prevent you from uploading work in time to meet a submission deadline - even if you do not obtain an immediate response from one of the Advisors they will be able to notify the relevant Course Coordinator that you had attempted to submit the work before the deadline
3. **SCHEDULE AND SYLLABUS**

**Teaching schedule**

Lectures and demonstrations/practical sessions will be held from 9 am – 1 pm on Mondays in room 615. Lectures will be followed by a practical session or discussion, where one student will be responsible for leading discussion of assigned reading. Please note that some lectures will occur on days other than Monday – when necessary to accommodate guest lecturer schedules. When this occurs, please know that there will be no overlap with other required MSc coursework.

Please note that some lectures are subject to finalisation of arrangements and discussion with the class. Further details will be announced closer to preliminarily scheduled dates.

Owing to the wide variety of techniques taught during the course practical sessions may be scheduled at slightly different times each week and in various locations depending on the subject taught. Therefore, it is important that you check your timetable at the beginning of each week.

**Except in the case of illness, the 70% minimum attendance requirement applies to all aspects of the course (lectures, practicals and demonstrations).**

**Syllabus (detailed lecture summaries and weekly readings)**

The following is an outline for the course as a whole, and identifies essential and supplementary readings relevant to each session. Information is provided as to where in the UCL library system individual readings are available; their location and Teaching Collection (TC) number, and status (whether out on loan) can also be accessed on the eUCLid computer catalogue system. Readings marked with an * are considered essential to keep up with the topics covered in the course. Copies of individual articles and chapters identified as essential reading are in the Teaching Collection in the Institute Library (where permitted by copyright) or are available online.

Students should check the ARCLG123 Moodle course website and their e-mail frequently as any changes to arrangements and other messages will be communicated by this means.

**Term 1 2017**

**Week 1: 2 October 2017**

*Caitlin R. O’Grady: (a) Introduction to course, and, (b) Introduction to materials, their structure and analytical methodologies applied to cultural heritage*

During the first week of class, the course structure, syllabus, aims, objectives, methods of assessment, etc., will be discussed and the course timetable (including practical sessions, teaching times and locations) highlighted. Lectures will also introduce the assessment of materials through investigations of the inter-relationships between their structure, properties and manufacturing method – all seen through the lens of culture.


e-Book available online through UCL library / ISSUE DESK IOA ART 1

-focus on Introduction, Chapter 2: Overview of the analytical techniques.


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Week 2 – 9 October 2017 [start time 10:00]

Caitlin R. O’Grady: (a) Discussion of research projects, and, (b) Instrumental overview: spot testing and optical microscopy

The lecture will focus on the research project that students will be contributing to as part of the assessment for ARCLG123 – analysis and identification of past treatment materials, and, elements of degradation. This
will be followed by a lecture that provides an overview of optical microscopy, a technique available at the Institute, and, micro-chemical spot-testing for chemical characterization.

Please also see reading for week 1!

e-Book available online through UCL library / ISSUE DESK IOA ART 1  
-focus on Introduction, Chapter 2: Overview of the analytical techniques


IN INST ARCH JD EST (reference only) / e-Book available online through UCL library

GEOLOGY D32 GRI

INST ARCH JKA Qto. MAC.

https://serc.carleton.edu/NAGTWorkshops/mineralogy/optical_mineralogy_petrography.html  
-See A guide to thin section microscopy and polarized light microscope fundamentals.

INST ARCH LA ODE  
-Focus on Introduction; Chapter 3: Scientific method and techniques of spot testing; spot tests for carbonates, chlorides, nitrates, sulfates, protein (nitrogen) and nitrate (cellulose).

INST ARCH AJ ROB

INST ARCH BA 10 Qto REE


**Articles for class discussion:** ODEGAARD, N., and C.R. O’GRADY. 2016. “The conservation practices for archaeological ceramics of Sir Flinders Petrie and others between 1880-1930.” In *Recent advances in glass*
Available through Moodle course website.


Week 2 – 9 October 2017 (TBC)
Visit to PMEA to view research objects – 14:00 – 16:00
Students will visit the Petrie Museum of Egyptian Archaeology to view assigned ceramics for their research projects and begin assessment for analysis.

Week 2: 11 October 2017 (start time 10:30)
Bill Sillar: Ceramic technology and degradation
Owing to its wide spread use and durability, large quantities of ceramics are found in the archaeological record. Ceramics and the information archaeologists and conservators may retrieve from recovered ceramics will be addressed, as well as how this enables study of larger cultural and technological questions.

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INST ARCH KD 3 BAR

INST ARCH KL BRA

INST ARCH KD FRE

INST ARCH KD 1 Qtto HAM

INST ARCH KD KIN

INST ARCH KD 3 ORT

INST ARCH KA POT

INST ARCH KD3 RIC


INST ARCH 1754


INST ARCH KD 1 RYE


**Week 3: 16 October 2017**

The lecture on adhesion will have a special focus on adhesives, adherands, their chemical/physical relationships, solubility and failure. The session will be followed by a practical focused on sampling with special attention to removal and preparation for analysis, as well the preparation of an adhesive reference tile sample.

Please also see reading for week 1!


INST ARCH JDE HOR


INST ARCH LA Qto AMB


INST ARCH JDB MIL


INST ARCH JDE CRA


e-Chapter available online through UCL library

**Week 3 – 16 October 2017**

*Group 1 – 14:00 – 15:00 / Group 2 – 15:00 – 16:00 (TBC)*

**Visit to PMEA to view research objects**

Students will continue inspection and documentation of assigned research artefacts.

**Week 4: 23 October 2017**

*Caitlin R. O’Grady: Instrumental overview – SEM and pXRF*

The lecture will give an overview of instrumental analysis concentrating on techniques available at the Institute - in particular scanning electron microscopy (SEM) and portable x-ray fluorescence (pXRF). There will be a brief introduction to terms and concepts used in analytical chemistry including a brief review of atomic structure, emission spectroscopy, energy sources and detectors. SEM and pXRF will be discussed in relationship to sample requirements and preparation, as well as produced data and methods of interpretation.

Please also see reading for week 1!

e-Book available online through UCL library / ISSUE DESK IOA ART 1

*focus on Introduction, Chapter 2: Overview of the analytical techniques.*

GLINSMAN, L. 2004. *The application of X-ray fluorescence spectrometry to the study of museum objects.* INST ARCH JKB GLI


INST ARCH JKA GOL
HITACHI HIGH-TECH. No date. Let’s familiarize ourselves with the SEM. Company promotional materials. Available through Moodle course website.


INST ARCH JDD JAN

e-Book available online through UCL library

e-Book available online through UCL library / INST ARCH JKB SHU

e-Book available online through UCL library / CUP. PHYSICS L30 WAT / INST ARCH JKA WAT (first edition)


Week 4: 23 October 2017 / Group 1 – 14:00 – 15:00 / Group 2 – 15:00 – 16:00
Tom Gregory: SEM/SEM-EDS orientation (B4)
This session will focus on introducing students to the Hitachi S-3400N SEM and EDS systems at the Institute of Archaeology. Students will be introduced to the proper use of the instrument including collection of secondary electron-, and backscatter electron images, as well as energy dispersive data.

Week 4: 26 October 2017 / Group 1 – 13:00 – 17:00
Stuart Laidlaw: Visible/UV light photography of assigned objects (rm. 404)
Group 1 students in allotted time slots will collect visible and UV light images of their assigned objects.

**Week 5: 30 October 2017**
Ian Freestone: Stone
The way in which various types of stone are formed in the earth gives rise to particular characteristics in the resulting material (for example some stone is easily carved and relatively soft while some is hard and cannot easily be worked to produce fine detail). In this lecture, students are introduced to the geological processes that form the three main types of stone (igneous, sedimentary and metamorphic). These will be discussed particularly in relation to the resulting working properties of various types of stone and their subsequent uses. As well, there will be a brief introduction to how stone is quarried and shaped; followed by how the chemical and physical structure of stone effects its deterioration.


INST ARCH KP 1 ASH
This is quite old now but still extremely useful. See the first volume for details of different stone types.


Websites

Igneous, metamorphic and sedimentary rocks
http://csmres.jmu.edu/geollab/Fichter/IgnRx/Ighome.html
http://csmres.jmu.edu/geollab/Fichter/SedRx/
http://csmres.jmu.edu/geollab/Fichter/MetaRx/index.html

-There are university Earth Science department websites covering this topic.


**Week 5: 2 November 2017 / Group 2 – 13:00 – 17:00**

*Stuart Laidlaw: Visible/UV light photography of assigned objects (rm. 404)*

Group 2 students in allotted time slots will collect visible and UV light images of their assigned objects.

**READING WEEK: 6 – 10 November 2017 (NO TEACHING)**

**Week 6: 13 November 2017 (start time 10:00)**

*Ruth Siddall: Pigments and pigment identification*

Whether naturally occurring or synthetically produced, pigments are materials exploited solely or primarily for their colouring properties. This lecture will introduce the three categories of pigments (inorganic, organic and synthetic) and examine the use in the historical record up to 1600 AD. Pigment nomenclature will be discussed, as will their physical properties.


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INST ARCH JDJ DEL


e-Book available online through UCL library / INST ARCH JDJ EST (reference only)


INST ARCH JDJ FEL


INST ARCH JDJ ART


INST ARCH JDJ HAR
Week 7: 20 November 2017

Ian Freestone: Glass, glazes and faience – chemistry and deterioration

The chemistry and structure of glasses resulting from different compositions and manufacturing techniques will be discussed. Mechanisms of glass deterioration will be discussed, as will factors affecting the rate of deterioration.


HECK, M., and P. Hoffmann. 2002. *Analysis of early medieval glass beads - the raw materials to produce green, orange and brown colours*. INST ARCH 3139 (Teaching Collection)


-See A guide to thin section microscopy and polarized light microscope fundamentals.


**Articles for student-led class discussion:**


INST ARCH KL DAI


INST ARCH JD PO


Available on line and IN ENGLISH:


INST ARCH LA TEN


Week 8: 27 November 2017
Caitlin R. O’Grady: Instrumental overview: XRD, FTIR and Raman
The lecture will introduce the principles of XRD, FTIR, and Raman. Sample requirements and preparation will be discussed, as well as data produced by each technique and methods of interpretation.


CHEMISTRY D 273 CUL

Week 9: 4 December 2017 (start time 10:00)

Ruth Siddall: Gypsum, lime mortar and hydraulic cements
This session will cover the raw materials and the chemistry involved in the production of historically used plasters, mortars and cements. The properties and uses of the different materials are explained and relevant methods of scientific analysis employed in the study of such materials will be discussed.

EGYPTOLOGY QUARTOS S 5 ABD

Bartlett TP877 .E2 2005

INST ARCH KN 1 Qto GOW

INST ARCH LC ASH
   -focus on Materials & History of Use – pp. 1-120; and Deterioration & Damage – pp. 121-162.


**Week 10: 11 December 2017**

Marcos Martínón-Torres: Copper and copper alloys
This session will focus specifically on copper and copper alloys and will discuss manufacture, technology and metallurgy as well as different alloy compositions and their effects on the metal produced. Appropriate methods of analysis for the study of copper and copper alloy artefacts will also be discussed.


Term 2 2018  **Please note that many of the sessions in term 2 are still be confirmed.**

**Week 11: 8 January 2018 (TBC)**

Rahil Alipour (TBC): Iron working: technology and corrosion
Continuing with the metals theme, in week 11 we move on to discuss iron working and technology; and corrosion. As in previous sessions, we will discuss manufacture, technology and metallurgy as well as different alloy compositions and their effects on the metal produced. Time will also be given to discussion of appropriate methods of analysis for the study of iron and steel artefacts.


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Inst Arch KE 2 CRA


Inst Arch KE 2 HAY


Inst Arch LA JAN


Inst Arch KEB JON


Inst Arch KEB 2 Qto SCO


Inst Arch KEB SEL

**Articles for student-led class discussion:** Jacot-Guillarmod, M., O. Rozenbaum, V. L’Hostis, P. Dillmann, D. Neff, and C. Gervais. 2015. “Degradation mechanisms of reinforcing iron rebars in


**Week 12: 15 January 2018**

*Caitlin R. O'Grady: Analytical data, interpretation and presentation*

This session will look at the types of analytical data collected to answer research questions and discuss various methods of interpretation and presentation to various audiences.


HISTORY OF SCIENCE A 9 VA


**Articles for student-led class discussion:** Each student will suggest an article that incorporates analytical data for assessment in class on or before 18 December 2017. The selected article should be applicable to their identified research questions.

**Week 13: 22 January 2018 (TBC)**

Renata Peters: Plant and animal fibres

*Sandra Bond: Practical session – fibre sample preparation and identification*

This session will focus on sources of plant and animal fibres, their structure, appearance, and the processes involved in their production. The session will be followed by a practical session on the identification of fibres using a range of diagnostic features.


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INST ARCH BB 51 Qto GAL


INST ARCH KJ GRE


INST ARCH JDB MIL

**Week 14: 30 January 2018 (start time 10:30)**

*Emma Richardson: Plastic chemistry, properties and technology*

The chemistry, properties and technology of plastics will be discussed as they relate to the production of art objects, and, conservation materials. Deterioration mechanisms will also be discussed as they relate to both materials and art objects.


**Week 15: 5 February 2018**

*Phillip Austin: Wood structure and practical identification session*

This session will focus on the structure and anatomy of wood and how these effect species selection in the past. The session will aim to familiarize the student with the structure of wood in order to aid them in species identification and is followed by a practical class in wood identification.


**READING WEEK: 12 – 16 February 2018 (No teaching)**

*Students encouraged to collect analytical data for research projects during this week.*

**Week 16: 19 February 2018 (TBC)**

*Gustave Milne and Dean Sully: Wood technology and deterioration*

Building on the previous session, these lectures will focus on wood technology and deterioration in order to answer the following questions: How is wood used, shaped and formed? How does wood macro-structure lend itself to certain tasks?


**Week 17: 26 February 2018 (long session)**
**Matija Strlič: Paper chemistry, technology, degradation and conservation**
This session will focus on the chemistry of paper, as well as manufacturing technologies. Degradation and methods of conservation will also be discussed.


**Week 18: 5 March 2018 (start time 10:00)**
**Margarita Gleba: Textile technology, examination**
This session will focus on the production of textiles and woven structures. Methods of examination will be discussed as they relate to the analysis of woven materials in order to discover the methods employed in their manufacture.


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INST ARCH KJ BOE

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INST ARCH KJ SCH


INST ARCH KJ SEI


INST ARCH KJ WAT


**Week 19: 12 March 2018 (TBC)**

Dean Sully: Skin and Leather: technology and processing

This session will focus on skin/leather as, its acquisition, processing techniques and degradation. The structure of skin will be addressed on a microscopic level in order to enable the student to identify and locate diagnostic features. The class will include a practical session on microscopic identification of leather species, condition assessment methodologies and tests for deteriorated leather.


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INST ARCH KI Qto LAR


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**Week 20: 19 March 2018 – 10:00 start time (TBC)**

_Daniel Antoine: Animal hard tissues – bone, teeth, ivory, horn, antler, shell_

In this session the micro structure of different hard tissues will be examined and we will discuss what they consist of and how they are produced. This will lead us onto an understanding of the features present in each type of material that can aid us in their identification. This session will be followed by a demonstration/practical in identifying hard tissue materials in objects.


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4  ONLINE RESOURCES
The full UCL Institute of Archaeology coursework guidelines are given here:
http://www.ucl.ac.uk/archaeology/administration/students/handbook

The full text of this handbook is available here (includes clickable links to Moodle and online reading lists):
http://www.ucl.ac.uk/archaeology/administration/staff/handbook

Moodle
There is a Moodle course associated with this core unit, please make sure you sign up so that you can benefit from the extra resources available in this location. The course title is as follows: ARCLG123 Conservation Materials Science and you can log in to the Moodle system here:
http://moodle.ucl.ac.uk/login/

A full online reading list is available from the UCL library website (search for ARCLG123) and the Moodle course website:
http://readinglists.ucl.ac.uk/index.html
http://moodle.ucl.ac.uk/login/

5  ADDITIONAL INFORMATION

LIBRARIES AND OTHER RESOURCES
In addition to the Library of the Institute of Archaeology, other libraries in UCL with holdings of particular relevance to this course are:
Main Library, Wilkins Building, Gower Street, WC1E 6BT
Bartlett Library, Ground Floor, Central House, 14 Upper Woburn Place, WC1H 0NN
Science library, DMS Watson Building, Malet Place, London, WC1E 6BT

Libraries outside of UCL, which have holdings which may also be relevant to this degree are:
The British Museum Conservation Department Library to which you are admitted as a conservation student of this institute (see separate leaflet on access to, and rules for the use of, this library).

INFORMATION FOR INTERCOLLEGIATE AND INTERDEPARTMENTAL STUDENTS
Students enrolled in Departments outside the Institute should obtain the Institute’s coursework guidelines from Judy Medrington (email j.medrington@ucl.ac.uk), which will also be available on the IoA website.
HEALTH AND SAFETY
The Institute has a Health and Safety policy and code of practice which provides guidance on laboratory work, etc. This is revised annually and the new edition will be issued in due course. All work undertaken in the Institute is governed by these guidelines and students have a duty to be aware of them and to adhere to them at all times. This is particularly important in the context of the laboratory work, which will be undertaken as part of this course.
This appendix provides a short précis of policies and procedures relating to courses. It is not a substitute for the full documentation, with which all students should become familiar. For full information on Institute policies and procedures, see the IoA Student Administration section of Moodle: https://moodle.ucl.ac.uk/course/view.php?id=40867

For UCL policies and procedures, see the Academic Regulations and the UCL Academic Manual: http://www.ucl.ac.uk/srs/academic-regulations; http://www.ucl.ac.uk/academic-manual/

GENERAL MATTERS

ATTENDANCE: A minimum attendance of 70% is required. A register will be taken at each class. If you are unable to attend a class, please notify the lecturer by email.

DYSLEXIA: If you have dyslexia or any other disability, please discuss with your lecturers whether there is any way in which they can help you. Students with dyslexia should indicate it on each coursework cover sheet.

COURSEWORK

LATE SUBMISSION: Late submission will be penalized in accordance with current UCL regulations, unless formal permission for late submission has been granted.

The UCL penalties are as follows:
- The marks for coursework received up to two working days after the published date and time will incur a 10 percentage point deduction in marks (but no lower than the pass mark).
- The marks for coursework received more than two working days and up to five working days after the published date and time will receive no more than the pass mark (40% for UG modules, 50% for PGT modules).
- Work submitted more than five working days after the published date and time, but before the second week of the third term will receive a mark of zero but will be considered complete.

GRANTING OF EXTENSIONS: Please note that there are strict UCL-wide regulations with regard to the granting of extensions for coursework. You are reminded that Course Coordinators are not permitted to grant extensions. All requests for extensions must be submitted on a the appropriate UCL form, together with supporting documentation, via Judy Medrington’s office and will then be referred on for consideration. Please be aware that the grounds that are acceptable are limited. Those with long-term difficulties should contact UCL Student Disability Services to make special arrangements. Please see the IoA website for further information. Additional information is given here http://www.ucl.ac.uk/srs/academic-manual/c4/extenuating-circumstances/

RETURN OF COURSEWORK AND RESUBMISSION: You should receive your marked coursework within one month of the submission deadline. If you do not receive your work within this period, or a written explanation, notify the Academic Administrator. When your marked essay is returned to you, return it to the Course Co-ordinator within two weeks. You must retain a copy of all coursework submitted.

CITING OF SOURCES and AVOIDING PLAGIARISM: Coursework must be expressed in your own words, citing the exact source (author, date and page number; website address if applicable) of any ideas, information, diagrams, etc., that are taken from the work of others. This applies to all media (books, articles, websites, images, figures, etc.). Any direct quotations from the work of others must be indicated as such by being placed between quotation marks. Plagiarism is a very serious irregularity, which can carry heavy penalties. It
is your responsibility to abide by requirements for presentation, referencing and avoidance of plagiarism. Make sure you understand definitions of plagiarism and the procedures and penalties as detailed in UCL regulations: http://www.ucl.ac.uk/current-students/guidelines/plagiarism

**RESOURCES**

**MOODLE:** Please ensure you are signed up to the course on Moodle. For help with Moodle, please contact Charlotte Frearson (c.frearson@ucl.ac.uk)
# SEM/SEM-EDS sample analytical summary (part a) – Assessment Form

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Suggestions for improvement</th>
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<tr>
<td>1. Description of sample (15): make sure to describe the sample in terms of material class (adhesive, consolidant, fill, overpaint, residue, etc.); description of sample in visible light including colour, stratigraphy/structure, homogeneity/heterogeneity, material properties, etc.</td>
<td></td>
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<tr>
<td>2. Discussion of sampling methodology and sample preparation (15): clear justification for removing sample for SEM/SEM-EDS analysis; location of sample on artefact identified and described; any sampling limitations described; method of sample preparation (dispersed, embedded, coated, etc.) with details regarding materials and instrumentation used</td>
<td></td>
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<tr>
<td>3. Description of analytical parameters used to collect image and/or spectral data (15): instrument make and model of SEM/SEM-EDS, as well as analysis conditions for data collection (accelerating voltage, data collection time/decay time, working distance, magnification, image type, calibration method used, etc.)</td>
<td></td>
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<tr>
<td>4. Discussion of sample data (15): referring to collected data (secondary electron/backscatter electron image, and/or energy dispersive spectrum), discuss observed features in images or elemental data (structure/stratigraphy, particle size/shape, z-contrast, elemental composition, etc.); interpret data with reference to artefact/research questions; where possible annotate data images</td>
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<tr>
<td>5. Originality and independent thinking (10): critical reflection, evaluation of evidence, original insight, interpretation</td>
<td></td>
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<tr>
<td>6. Sources (10): bibliography – range; relevance and formatting</td>
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<tr>
<td>7. Images/tables (20): image of sample, its original location on the artefact; as well as images and elemental data collected using SEM instrumentation; images must include a scale or magnification and annotations as necessary to define areas for interpretation</td>
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## Best features

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**Appendix B: Assessment Criteria**

**ARCL123 2017-18 Conservation Materials Science**

**Analytical Research Proposal (part b) – Assessment Form**

<table>
<thead>
<tr>
<th>Criteria</th>
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<tbody>
<tr>
<td>1. Abstract and 3-6 subject keywords (5):</td>
<td>100 word abstract clearly describing analytical problem, data required to answer problem, analytical techniques used and summary of preliminary observations/results; abstract must be a stand-alone document that completely summarizes proposal; keywords must relate to proposed research</td>
</tr>
<tr>
<td>2. Problem statement (5):</td>
<td>clear statement of reason for analysis – including data needed to answer your question (microstructure, particle size/shape, elemental/crystalline, quantitative/semi-quantitative, spectral/numerical, solubility, chemical alteration, etc.), as well as analytical techniques you propose to use</td>
</tr>
<tr>
<td>3. Literature Review (20):</td>
<td>selection of evidence bearing on the objectives of research, selection of appropriate case-studies or examples to contextualize discussed research</td>
</tr>
<tr>
<td>4. Description and discussion of samples/object (15):</td>
<td>clear description of object or samples associated with proposed research including material, method of manufacture, stratigraphy and structure; description of object/sample condition and discussion of potential impact on proposed research</td>
</tr>
<tr>
<td>5. Proposed experimental procedure (15):</td>
<td>clear discussion of proposed methods to be used during preparation and analysis of selected samples; what is measured and how; proposed number/ type of samples analyzed, their method of preparation and any sampling limitations; justification of samples; proposed instruments (make and model) used to collect data, suggested analytical conditions, etc.</td>
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<tr>
<td>6. Originality and independent thinking (10):</td>
<td>critical reflection, evaluation of evidence, original insight, interpretation</td>
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<tr>
<td>7. Writing quality (10):</td>
<td>spelling, grammar, punctuation, paragraphing, use of vocabulary, accuracy, formatting</td>
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<tr>
<td>8. Sources (10):</td>
<td>bibliography – range; relevance and formatting</td>
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<tr>
<td>9. Data/images/tables (5):</td>
<td>clear documentation and presentation of object and data; annotate where necessary</td>
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<tr>
<td>10. Supplementary information (5):</td>
<td>summary of proposed time schedule for research including experimental design and sample preparation methods</td>
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<th>PAPER CONTENT</th>
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<td>100 word abstract clearly describing analytical problem, data required to answer problem, analytical techniques used and summary of preliminary observations/results; abstract must be a stand-alone document that completely summarizes research; keywords must relate to analytical research</td>
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</tr>
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<td>2. Problem statement (5):</td>
<td>clear statement of reason for analysis – including data and analytical techniques used to answer your research question</td>
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<td>3. Literature Review (10):</td>
<td>selection of evidence bearing on the objectives of research, selection of appropriate case-studies or examples to contextualize discussed research</td>
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<td>4. Experimental procedure (10):</td>
<td>clear discussion of methods used during preparation and analysis of selected samples; what is measured and how; number/type of samples analyzed, their method of preparation and any sampling limitations; instruments (make and model) used, analysis conditions, etc.</td>
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<tr>
<td>5. Data results (15):</td>
<td>clear reporting and description of collected data and summary using charts, spectra, images, figures, and appendices (if present); annotated where necessary</td>
<td></td>
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<tr>
<td>6. Discussion of data interpretation (15):</td>
<td>what do results mean and how do they answer questions proposed in research; how do they compare to published literature; suggestions for future work</td>
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<td>7. Originality and independent thinking (10):</td>
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<td>9. Sources (10):</td>
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<tr>
<td>10. Acknowledgements (5):</td>
<td>identification of those scientists/specialists who helped with analytical techniques and data interpretation; source of research project</td>
<td></td>
</tr>
<tr>
<td>11. Submission of report and collected data/documentation to object owner (5):</td>
<td>preparation and submission of completed analytical report (electronic &amp; paper) to object owner; submission of electronic copy of all data and documentation to object owner</td>
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