

## Module 3: Ceramics and Glass

### The Impact of Materials on Society

#### Module 3 –Ceramics and Glass – Outline of Instruction for Faculty

The manipulation of glass-like rocks and ceramics represent humans' earliest materials innovations. Matter/materials come bundled with many properties, but we only seek to use some of these at particular instances in history. This module examines the process and social impacts of shaping rock and clay, and uses these lessons to explore the possibilities for manipulating tomorrow's functional ceramics. The creation of new processing approaches suggests which properties of materials we can take advantage of in a certain time and place.

#### Module Objectives

Students will:

- identify the properties of ceramics
- describe the work of materials processing
- discover the uses and applications of ceramics both historically and in modern times
- examine how the physical processing of a material involves social acts
- discover the hidden costs of increasing materials manufacturing

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#### Student Reading Assignment before Day 1

Read excerpt (pp. 98-123) from

**Sass, Stephen L.** (1998/2011) *The Substance of Civilization*. New York: Arcade Publishing.

#### Day 1 Class – Material Science & Engineering Lecture on Ceramics and Glass

Materials Science Professor gives an overview of ceramics and glass: Properties, abundance, and structure of ceramics and glass; history of the use of ceramics and glass and how these materials have evolved.

#### Materials Science Lessons

Ceramics and Glasses have unique properties and have played a critical role in the development of civilizations from aspects as diverse as windows to food storage and future applications may even include transducing energy.

#### Day 1 Lecture Development Resources:

1. **Lecture:** [Ceramics and Glass](#) (PPT) slides
2. **Sample lecture Video:** [Ceramics and Glasses](#) (21:59) ([Transcript](#))  
*Excerpts from Kevin Jones' lecture*

Classroom Demo: Break Corningware/ Make Rupert Drop and show video of [Rupert drop experiment](#)  
<https://www.youtube.com/watch?v=xe-f4gokRBs>

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### Student Reading Assignment before Day 2

**Read:** [Firing Clay, Breaking Glass, and the Past Futures of Ceramics](#) by Kenneth E. Sassaman (PDF)

*Abstract: This chapter follows from the previous chapter on earthy materials to consider the entanglements of transforming clay into glass and other substances. Introduced is the concept of operational sequence, or the process by which affordances of both materials and societies are assembled and disassembled as things are made, used, and discarded. Contrasted with the firing of clay to produce true ceramics is the breakage of glass-like rock, such as obsidian and flint. The operational sequence for making an Ice Age spear point illustrates the contingent relationships of physical and social acts in making things, while also showcasing the evolutionary conditions under which ancestral humans developed the cognitive, motor, and social skills to achieve particular outcomes from an array of possibilities. The application of thermal energy to first stone and then clay introduced additional affordances, as well as constraints, that inform our understanding of the potential for ceramic materials of the future to enhance the means by which energy can be generated and stored at lower costs and with lesser negative impacts than conventional technologies.*

### Day 2 Class – Lecture on Flaking stone, early engineering

Guest Humanities/Archaeology Professor presents Obsidian to Porcelain and the concept of an Operational Chain.

**Watch Video:** [flintknapping video with Dr. Bruce Bradley](#) (45:00). *Recommend viewing prior to class*

### Social Lesson:

- 1) People have the ability to modify materials to increase functionality but this requires a sequence of steps.

### Day 2 Lecture Development Resources:

**Lecture:** [Ancestral Glass](#) (PPT) by Prof. Kenneth Sassaman (UF)

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### Student Video and Homework Assignment before Day 3

**Watch Video:** [Ceramics](#) (9:44) ([Transcript](#))

As you watch the ceramics video, think about the following themes:

- a. What do we mean by functional ceramics what are the properties of ceramics that enable them to be "functional".
- b. What are the parallels between creating a process to make modern functional ceramics and early ceramics?
- c. What are the challenges of manipulating these materials?
- d. What are some of the social impacts of early ceramic processing in its cultural context. Think about cognitive impacts such as futures planning; the potential utility of waste by-products; and the relationship among supply, skill, and social value.

### Day 2 Individual Assignment:

1. **Read:** *Firing Clay, Breaking Glass, and the Past Futures of Ceramics* and answer the following questions.
  - a. Define the concept of *operational sequence* and explain how it encompasses social actions, as well as technical steps, in the making of things.
  - b. How is the manufacture and use of a stone tool like a Clovis point a social act? Even though Clovis points may have been made and used by men, what impact did the technology have on women?
  - c. What were the limitations of traditional subceramic cooking vessels in the application of sustained boiling and what did potters do to overcome those limitations?
  - d. What is *intensification* and how does it impact operational sequences? What does it mean to say there are *hidden costs* to intensification?
  - e. Do you see a promising future in ceramic fuel cells, and if so, what do you imagine to be its potential impacts to society?
2. **Read:** [Module 3—Individual Homework Assignment](#) (Word)  
Ceramics Homework Assignment at end of Day 3 class
  - a. Choose an example of a functional ceramic. Make a bulleted list of the steps in the operational sequence used to produce the ceramic. Make sure that you consider the steps to acquire the source material, transform it into a usable product, and transport it. Make sure that you also consider the waste produced in this process, and how it is dealt with.
  - b. Each step in the sequence, of course, has its own entanglements (i.e., it is *contingent* upon other materials, processes, and skills being available). Pick one step in your sequence and make some notes about what contingencies it depends upon. Use arrows or more bullet points to indicate these contingencies in your existing list.
  - c. Bring your bulleted list to class on Day 3, but do not turn it in at the beginning of class. We'll have an in-class activity that draws on this homework.

Please write in bullet points. Illustrations, arrows, etc. are also acceptable. This assignment will

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probably cover  $\frac{1}{2}$  to 1 full page. Assignment will be graded 0-2 points. Be sure your name is on the paper.

### **Your grade will be determined from the following criteria**

Grading Rubric.

2= Responses are appropriate, thoughtful, and indicate engagement with the video and any other required viewing/reading materials. Grammar, sentence structure and punctuation are correct.

1= Responses and arguments are incomplete and/or inconsistent with the required viewing/reading material. Some issues with grammar, punctuation and or sentence structure.

0= Responses are not appropriate to the assignment or missing entirely. Major issues with grammar, punctuation and or sentence structure.

Points = 2

### **Day 3 Class – Flipped Classroom Activity on Operational Sequence/Energy Transducing**

**Key Concepts:** Application of operational sequence to functional ceramics

#### **Day 3 Classroom Activity: Operational Sequences**

Class today should begin with a short lecture to recap the main points about functional ceramics and how they are used for transducing energy and connect them to the homework assignments, before the students break out into their flipped classroom groups. During group work, the instructors should circulate amongst the groups to check understandings. After group work, a few minutes should be left for sharing out findings with the class to verify and correct misunderstandings.

**Day 3 Lecture:** [Ceramics](#) (PPT)

**Watch:** [Fuel from the Air: Sossina Haile at TEDx Bermuda](#) (14:52)

As an extension of entanglement, we now look at the series of processes involved in the processing of a material specifically functional ceramics.

- a. Compare all of the operational sequences that were made by members of your group. Pick the one that you like the best, or create a new sequence together. Make sure you've mapped out the key contingencies. (Use the back of this sheet, or an extra piece of paper to do this.)
- b. As a class, we will then think about what happens when the sequence is disrupted. (Wait for further instructions before taking this step.)
- c. Look at your operational sequence, and write your answer to this question below: What does

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the operational sequence of this ceramic reveal about the sustainability of making and using functional ceramics in our society?

- Refer to **Day 3 In-Class Activity: [Operational Sequences and Functional Ceramics](#)** worksheet for specific instructions.
- Refer to the rubric for grading criteria.

**Your grade will be determined from the following criteria.**

Grading Rubric.

5= Responses are appropriate and indicate engagement with the preparatory material. Grammar, sentence structure and punctuation are correct.

4= Responses and arguments are not as clearly presented. Some minor issues with grammar, punctuation and or sentence structure.

3= Responses are not appropriate to the assignment and do not reinforce the physical and cultural properties of materials. Mistakes in grammar, punctuation and or sentence structure.

2= Responses are incomplete. Major problems with grammar, punctuation and or sentence structure.

1= Responses are inconsistent with material covered in class, videos, and readings. Missing elements of assignment. Poor grammar, punctuation and or sentence structure.

### Day 3 Lecture Development Resources:

1. **Lecture:** [Ceramics](#) PPT slides
2. In-Class Activity: [Operational Sequences and Functional Ceramics](#) (Word) handout

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### Complete Impact Paradigm Assignment:

Thinking about the material that we covered in this week's unit, add another question to the impact paradigm.

- [Module 3—Impact Paradigm Individual Homework Assignment](#) (Word)

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### Additional Resources

#### Online Course Module

- View the online Module 3 in [Word](#) or [PDF](#) format
- Available soon: The full online course to upload to your Learning Management System. Contact Kevin Jones at [kjones@eng.ufl.edu](mailto:kjones@eng.ufl.edu) or Pamela Hupp at [hupp@mrs.org](mailto:hupp@mrs.org) for more information.

#### Videos:

- a. [Flintknapping video with Dr. Bruce Bradley](#)

- b. Tedx Video: [Fuel from the Air: Sossina Haile at TEDxBermuda](#) (14:52)

**Articles and Books:**

- d. Whitaker, John C. (1994) *Flintknapping: Making and Understanding Stone Tools*. Austin: University of Texas Press.

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