IMPACT
of Materials on Society

Introduction

Semiconductors have forever changed human-human and human-material interactions because they are the foundation of the computing revolution and form the basis of increasingly ubiquitous digital devices. This module looks at how our use of semiconductor-based devices impacts individual human relationships, and draws lessons learned for designing needs-based applications for new 2D materials. As semiconducting materials become more invisibly embedded in our everyday lives, and even in our own persons, only intentional design will ensure that they serve us, versus us serving them.

Module Objectives
Students will:
- identify the properties of semiconductors
- identify the properties of graphene and 2D materials
- discover the uses and applications of semiconductors
- examine how materials mediate human relationships
- relate the relationship of industrial to information revolutions

Readings, Lecture, and Practice

Watch: Silicon (16:40)

Read: *Semiconductors and Cyborgs* by Sophia Krzys Acord (TBA)

Kuang, Cliff (2013) "Why a New Golden Age for UI Design Is Around the Corner". Wired Magazine, September: 142-147. http://www.wired.com/design/2013/08/design-and-the-digital-world/

To prepare for your quizzes and exams, take notes and think about how the lecture content relates to your readings as you watch the lecture.

Practice: Take the Semiconductors Quiz

The practice quiz has 10 questions. You will have 90 seconds to complete each question. You may only take the practice quiz one time and you must finish it once you open it so be sure you have adequately prepared by taking notes while you watched the lecture and by reading the chapter and studying before you begin.

Assignment: Application Video Analysis and Interview

Key Concept: As microelectronic devices continue to shrink there is a strong driving force to consider switching to 2-D materials like MoS2. These materials offer the potential of high performance even when only a few atom layers thick. In addition, 2-D materials are potentially flexible and as such there

is growing interest in exploring applications for devices beyond computing. Just as earlier computing technologies have revolutionized our lives and raised concerns about device addiction, these new embedded technologies based on 2-D materials may have profound impacts on how we interact with the people and objects in our world.

Assignment Instructions:

Part 1: Interview
Spend a few moments learning about the needs and interests people have for the use of digital technologies in their world. Schedule and conduct a 15-minute interview with someone you know (a friend, roommate, relative, co-worker, etc.). The exact interview questions are up to you, but we suggest that you discuss how people feel about the digital technologies that they use in their everyday lives. What are their personal relationships to these materials and artifacts? How do these artifacts mediate their relationships with other people, and how do they use them to develop their own self-identities? What do people wish they could do with smaller, more embedded devices, and what concerns do they have? Take notes during the interview (about 1 page, hand-written or typed).

Part 2: Watch the Video
Before the video reflect on the lessons of this unit by considering the questions below. As you watch the video, think about how each question is answered.
- Is the current use of semiconductors being driven by any social needs?
- Why is MoS_2 being considered for transistors more than graphene?
- What are nanomaterials and what are some of the requirements for studying these materials?

Watch: [2D Materials(13:29)]

Write a 1-page essay synthesizing the answers to the questions above with what you've learned in the lectures, your interview, and readings. (full sentences in paragraphs, double-space, 11-12 pt. font). This assignment will be graded out of 10 points on effort, use of the lecture, video, reading materials, and thoughtful reflection. See the rubric attached to this assignment for grading criteria. Be sure your name is on the paper. A cover page is not necessary.

Submit BOTH your interview notes and essay for full credit.

Refer to the due dates document for submission dates and the assignment rubric for grading criteria.

Application Video Analysis Rubric

Criterion	9-10 points	6-8 points	3-5 points	0-2 points
Response Content (10 Points)	Responses are appropriate,	Responses have minor	Responses have major	Responses are inaccurate,

	thoughtful, and indicate engagement with the video. Interview notes and questions are thoughtful and reflect engagement.	inconsistencies with the video or are not supported by content. Interview notes are complete.	inconsistencies with the video or are not supported by content. Interview notes reflect little effort.	careless, and/or opinions are not supported by content. Interview notes are missing
Mechanics (10 Points)	Grammar, sentence structure and punctuation are correct and paper is properly cited.	Minor issues with grammar, punctuation and/or sentence structure and citations.	Significant issues with grammar, punctuation and/or sentence structure and citations.	Major issues with grammar, punctuation and/or sentences and citations
Total				

Assignment: Material Entanglement and Impact Paradigm Reflection

Think about your own and society's relationship with this module's material both in the past and present.

Part 1 Instructions:

- **Open** to your Material Entanglement Reflection Document created in Module 2.
- **Label** this new entry with this module's material and the date at the top of the page. *(Example: 1/23/16 Module 15: Diamonds)*
- **Create** a tanglegram that illustrates your relationship with the material from this module. (*If this module covered more than one material, then choose just one of these materials to explore your entanglement.)
  - o Refer to the example tanglegram in the Module 2 reading, *Entanglement of Earth.* Make sure that this tanglegram demonstrates the new information about the relationship of materials to society that you learned in this lesson (e.g., our dependence on trade to acquire materials)
  - o *Note that you may hand draw your tanglegram and take a picture to add to your document or use any other type of application that suits you. There are many free concept mapping applications found online. Just search mind-mapping applications.*
- **Add your tanglegram** under your new entry.
- **Source an image** that illustrates an aspect of your entanglement (or supports your lack of entanglement) with the material from this module. The image can be found, created, or photographed. If the image isn't yours, be sure to include a reference.
- **Add your sourced image** under your tanglegram.
- **Caption** the image telling what it is and its context.

- **Discuss** your thoughts related to your personal relationship with this material and how that relates to society.
    - Consider:
        - How do the social and cultural properties of this material affect you and society?
        - Based on what you've learned about this material what might be the consequences of the corrosion, degradation, or scarcity of this material?

Note: Your entry should be no more than two paragraphs. Entries are evaluated for content, thoughtfully supported writing, and mechanics. Refer to the Physical and Social Properties of Matter document introduced in Module 1 to guide your discussions.

Part 2 Instructions:

- **Open** your Impact Paradigm Document
- Add at least one question to any one of the categories. If you're having trouble coming up with a new question, think about the particular case studies of the material in this module, and the new information that you've learned about the relationships between materials and society. What is one new way to think about the social life of materials that you learned in this module?
- Submit BOTH your Material Entanglement Reflection Document AND your Impact Paradigm Document

Refer to the due dates document for submission dates and the rubric for grading criteria.

Material Entanglement and Impact Paradigm Reflection Grading Rubric

Criterion	9-10 points	6-8 points	3-5 points	0-2 points
Response Content (10 Points)	Responses are appropriate, comprehensive, and indicate thoughtful engagement with the information and concepts from the lecture, readings, and videos. Novel ideas, creativity, and attention to complexity are a plus. Tanglegram is fully supported by responses and image.	Good effort. Responses and arguments are not as clearly presented, or as comprehensive and thoughtful as in a full credit answer. Tanglegram is fully supported by responses and images.	Responses are less appropriate to the assignment, less thoughtful and engaged, with less complete information. Tanglegram is partially incomplete or unrelated to images and responses.	Responses are inaccurate, careless, and/or opinions not supported by content. Tanglegram is incomplete.

Mechanics (10 Points)	Grammar, sentence structure and punctuation are correct. Works are cited properly when appropriate.	Occasional grammar or mechanics issue or works are cited incorrectly.	Some issues with grammar, punctuation and or sentence structure or chosen image or other works are not cited when appropriate.	Major issues with grammar, punctuation and or sentences. Chosen image or other works are not cited when appropriate.

Additional Resources

- **Turkle, Sherry.** (2011) *Alone Together: Why We Expect More from Technology and Less from Each Other.* "Always On" (pgs 151-170) and "The Nostalgia of the Young" (pgs 265-277)

- Kuang, Cliff (2013) "Why a New Golden Age for UI Design Is Around the Corner". *Wired Magazine*, September: 142-147. http://www.wired.com/design/2013/08/design-and-the-digital-world/