Instructor Information
Mena Youssef
College Core Curriculum
Office: TBD
Email: mena.youssef@nyu.edu
Office hours: TBD, 2 hours/week

Course Information
Time: TBD
Room: TBD

Course Description
What makes your phone work? What types of fabrics are in the clothes you wear? Why was the manipulation of metals so important throughout the course of human history? The answers to all of these questions can be found in the field of materials science. This field of study involves the design and production of new materials with desirable functions. Advances in materials science readily become implemented in new technologies, which influence how humans interact with each other and the world around them – such as the invention of the silicon chip that revolutionized computing and communication. In this seminar, we explore different types of materials that were developed during the span of human history, including ancient tools of the stone, bronze, and iron ages, the rapid technological advances of the industrial revolution, the development of plastic and polymers, and the silicon age of transistors and computers. These historical examples illustrate how materials science combines principles from chemistry, engineering, physics, and even biology and applies them to new devices with practical applications. Finally, we examine the latest generation of 21st century materials that are being used in smartphones, solar cells, batteries, biosensors, and much more.

Course Learning Objectives
By the end of the course, students will be able to:
• Classify different types of materials such as metals, polymers, and semi-conductors.
• Identify materials used to make tools in the ancient world and technology in the modern world.
• Understand how chemical composition gives a material its physical properties.
• Recognize limitations in innovative technologies and the current trends researchers are following to overcome them.
• Analyze scientific peer-reviewed journal articles.
Course Materials

We will use the following books throughout the class:

Stephen L. Sass, *The Substance of Civilization Materials and Human History from the Stone Age to the Age of Silicon*
ISBN: 9781611454017

Mark Miodownik, *Stuff Matters: Exploring the Marvelous Materials that Shape Our Man-Made World*
Boston, MA: Houghton Mifflin Harcourt, 2014
ISBN: 0544236041
The digital copy can be accessed through NYU Libraries for free here: https://ebookcentral.proquest.com/lib/nyulibrary-ebooks/reader.action?docID=3305616

All other course materials will be made available through NYU Classes (which can be accessed at https://globalhome.nyu.edu).

Expectations/Course Requirements

The following are my expectations for you this semester:

- Attend and be on time for all class sessions
- Come to class prepared having read the assigned material
- Actively participate in class discussions
- Be respectful of your peers, even if their opinions and ideas conflict with your own
- Complete all writing assignments and in-class presentations

Assignments

One of the most important objectives of this first-year seminar course is to develop your skills in the areas of reading, writing, research, and public speaking. Regardless of which career you may end up pursuing, you will likely need to read specialized and technical materials, communicate your ideas effectively, and engage in meaningful dialogue with your colleagues. As such, there will be a total of 4 writing assignments and one in-class presentation.

1) Literature Review Papers
You will have the opportunity to conduct literature reviews focused on recent cutting-edge contributions to the field of materials science. You will be assigned a pair of related publications (dealing with material development, assembly, or methods of analysis) from a list of topics pre-determined by the instructor. For each publication, you will write a paper (2 pages) explaining the techniques used, the major contributions made to the field, and the next steps for researchers. Prior to the assignment, the instructor will
systematically explain the process of analyzing scientific journal articles in class. Papers are to be double-spaced, using 12-point Times New Roman font, with one-inch margins.

2) Reflection Paper
You are asked to visit the Metropolitan Museum of Art and focus on any two sections of the museum that demonstrate the different uses of materials. For example, you could choose among Egyptian art, European sculptures, Greek and Roman art, Medieval art, armor and weapons, etc. During your visit, take notes and/or pictures of the works of art that are most appealing to you. Find out what the works of art are comprised of, when they were made, and any other details you think may be important when comparing two works of art. You are asked to write two papers. In the first paper (2 pages) describe the two works of art you chose, the materials that comprise them, how they were made, and when they were made. Do some research and find out if other places or time periods used similar methods and materials to make similar things. In the second paper (2 pages) write a personal reflection ONE of the two works of art you chose. What made you choose that particular work of art? Why was it appealing to you? Did you think the work was ahead of its time? Papers are to be double-spaced, using 12-point Times New Roman font, with one-inch margins.

3) Final Paper
For the final paper (5 pages), identify a technological problem that people face in their everyday lives. In the paper, you are to describe the problem, conduct a literature search, explain how materials science is related to the issue, and describe how innovators are approaching the problem. As an example, current technological issues may include phone and laptop battery life, solar cell efficiency, and smartphone screen durability. You will have the opportunity to revise their final papers prior to the final submission. In the first round, the outline for the paper (2 pages) will be peer-reviewed in class by other students (the instructor will provide a detailed rubric) and the peer-revision will be collected by the instructor. In the second round, students will submit their introductory paragraph and breakdown of every paragraph thereafter (2 pages), as well as a list of references they will cite. Students will receive feedback directly from the instructor. Papers are to be double-spaced, using 12-point Times New Roman font, with one-inch margins.

4) In-Class Presentation
Each student will prepare a 10-minute PowerPoint presentation related to the topic they chose to write about for their final paper. Presentations should include a summary of the problem, a discussion of the implications of that problem that affect people’s lives, and directions for future research. At the end of each presentation, students in the audience will have the opportunity to ask questions (this is part of the class participation grade).

**Quizzes**

At the end of each class, we will have a short quiz that relates to the topics discussed during lecture. The two lowest quiz grades will be dropped. The purpose of these quizzes is not to burden you, but to solidify the main points that were addressed during the lecture.
Course Policies

1) Communication
I will do my best to reply to all emails in a timely manner and will be available in my office during office hours to address any questions or concerns you may have about the course. In the event of an emergency (class cancellation, I cannot make my office hours, etc.) I will notify the entire class via email.

2) Laptops & Cell Phones
I do not allow the use of laptops or cell phones in the classroom. In the event of an emergency, please leave the classroom to make or answer a phone call. As a seminar course, it is important for discussions to be had among us by making eye contact and being engaged with the dialogue.

3) Late Submissions
Assignments are due by 11:59pm on their due date (this means that the file must be in my inbox by 11:59pm!) Late papers will receive a 10% deduction for each day they are late. This does not apply to in-class presentations; you must be present in class the day of your presentation!

4) Religious Observations
If you have a religious obligation that prevents you from attending a class, notify me (at least 1 week in advance) in person or via email. Please notify me of the date(s) you are required to miss class and the reason.

5) Academic Dishonesty
Plagiarism and cheating will not be tolerated in this course. All submitted papers may be reviewed using plagiarism detection software. If you get an idea from anyone else or from a published source, make sure you cite it (we will go over this in detail during class). You are free to work with others and seek help for your assignments, but the final product you submit must be your own. Refer to the following link for more information: https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/academic-integrity-for-students-at-nyu.html

6) Disability Disclosure Statement
Academic accommodations are available for students with disabilities. The Moses Center website is www.nyu.edu/csd. Please contact the Moses Center for Students with Disabilities (212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance.
Grade Breakdown

- Literature Review Assignment #1.................................10%
- Literature Review Assignment #2.................................10%
- Museum Visit Reflection Paper.................................20%
- In-class presentation................................................20%
- Final paper..............................................................20%
- Weekly Quizzes.........................................................10%
- Class participation, discussion, and asking questions........10%

Tentative Course Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Assignment(s) Due</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Atoms, Bonding, &amp; The Periodic Table</td>
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<td>Week 2</td>
<td>Classification of Materials</td>
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<td>Week 3</td>
<td>Navigating Scientific Journal Articles</td>
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<tr>
<td>Week 4</td>
<td>Materials Science in Antiquity</td>
<td>Writing Assignment #1</td>
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<tr>
<td>Week 5</td>
<td>The Development of Iron and Steel</td>
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<td>Week 6</td>
<td>Gold, Silver, and Diamond: What and Why?</td>
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<td>Week 7</td>
<td>Colloids: Microscopic Materials</td>
<td>Writing Assignment #2</td>
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<td>Week 8</td>
<td>Spring Break: NO CLASS SCHEDULED</td>
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<tr>
<td>Week 9</td>
<td>Polymers and Large Molecules</td>
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<td>Week 10</td>
<td>Solar Cells: Past, Present, and Future</td>
<td>Reflection Assignment</td>
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<td>Week 11</td>
<td>Silicon: The Semiconductor of the Century</td>
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<td>Week 12</td>
<td>Special Topic: Materials in Pop Culture</td>
<td>Final Paper (Draft #1)</td>
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<td>Week 13</td>
<td>In-Class Presentations (Group #1)</td>
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<td>Week 14</td>
<td>In-Class Presentations (Group #2)</td>
<td>Final Paper (Draft #2)</td>
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<td>Week 15</td>
<td>In-Class Presentations (Group #3)</td>
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<tr>
<td>Week 16</td>
<td>Where do we go from here?</td>
<td>Final Paper</td>
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**Weekly Course Breakdown**

Due to the technical nature of many reading assignments, some weeks may include reading a fewer number of pages. Do not be fooled! Understanding the language in these readings is challenging and will often require students to reread the material.

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Key Topic(s) &amp; Learning Objectives</th>
<th>Topics:</th>
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|        |                                   | 1) Course Introduction  
|        |                                   | 2) Syllabus Overview  
|        |                                   | 3) What is materials science and why do people study it?  
|        |                                   | 4) The periodic table, atoms, and bonding  
|        |                                   | **Learning Objectives:** |
|        |                                   | 1) Acquire a general understanding for atoms and bonding  
|        |                                   | 2) Be able to extract information from the periodic table  
|        |                                   | 3) Understand trends in the periodic table  
|        | **Assignments**                   | • Print out, read, and bring the course syllabus to class  
|        |                                   | • Print out a copy of the periodic table (posted on NYU classes)  
|        |                                   | • Reading: *Chemistry in Context* (p. 1-35)  

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<th>Week 2</th>
<th>Key Topic(s) &amp; Learning Objectives</th>
<th>Topics:</th>
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|        |                                   | 1) How are materials classified?  
|        |                                   | 2) How does atomic structure affect a material’s properties?  
|        |                                   | **Learning Objectives:** |
|        |                                   | 1) Be able to distinguish between different types of materials based on their chemical composition  
|        |                                   | 2) Learn about the atomic/molecular structures that comprise different materials  
|        | **Assignments**                   | • Reading #1: *The Substance of Civilization* (p. 1-12)  
|        |                                   | • Reading #2: *Stuff Matters*, (p. i-xx; 1-20)  

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<th>Week 3</th>
<th>Key Topic(s) &amp; Learning Objectives</th>
<th>Topics:</th>
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|        |                                   | 1) How to read scientific journal articles  
|        |                                   | **Learning Objectives:** |
|        |                                   | 1) Be equipped to read and extract important formation from scientific journal articles  
|        |                                   | 2) Understand the different components of a scientific journal article  
|        | **Assignments**                   | • Reading #1: “How to read a scientific article” (p. 1-6)  
|        |                                   | • Reading #2: “How to (seriously) read a scientific paper” (p. 1-12)  
|        |                                   | • Reading #3: “Incorporation of rubidium cations into perovskite solar cells improves photovoltaic performance” (p. 206-209)  
|        |                                   | Bring this paper to class!  

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<th><strong>Week 4</strong></th>
<th><strong>Key Topic(s) &amp; Learning Objectives</strong></th>
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<tr>
<td>Topics:</td>
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</table>
1) Materials used in the Stone Age, Bronze Age, and other time periods in antiquity  
2) The evolution of materials  
Learning Objectives: |
|  
1) Identify the types of materials used in different time periods  
2) Recognize how a material’s physical properties allows it to accomplish a specific goal  
Assignments | • Writing Assignment #1 due  
• Reading #1: Your assigned journal article  
• Reading #2: *The Substance of Civilization* (p. 13-67) |

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<th><strong>Week 5</strong></th>
<th><strong>Key Topic(s) &amp; Learning Objectives</strong></th>
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<tr>
<td>Topics:</td>
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1) Materials used in the Iron Age  
2) Development of tools and technology in the Industrial Revolution  
Learning Objectives: |
|  
1) Identify tools and materials made with iron and steel  
2) Distinguish properties of different metals  
3) Recognize how the atomic properties of metals allow them to carry out specific functions  
Assignments | • Reading: *The Substance of Civilization* (p. 82-97; 147-175; 203-215) |

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<th><strong>Week 6</strong></th>
<th><strong>Key Topic(s) &amp; Learning Objectives</strong></th>
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<tr>
<td>Topics:</td>
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</table>
1) Why are silver and gold so special?  
2) How do crystal structures affect a material properties?  
3) The crystal structure of diamond and why it is valued  
Learning Objectives: |
|  
1) Understand why precious metals are considered valuable  
2) Identify the chemical properties of precious metals  
3) Recognize different crystal structures and how they differ  
Assignments | • Reading #1: *The Substance of Civilization* (p. 68-81; 238-249)  
• Reading #2: *Stuff Matters*, (p. 159-178) |
| Week 7 | Key Topic(s) & Learning Objectives | Topics:  
1) Colloids and nanoparticles  
2) How colloids bridge the atomic and macroscopic worlds  
3) Methods of synthesis, assembly, and characterization  
4) Current research efforts in colloid research  
Learning Objectives:  
1) Become exposed to matter on the colloidal scale  
2) Recognize how colloids can be implemented in macroscopic materials  
Assignments  
- Reading: Your assigned journal article  
- Reading: “Colloids and their uses” (p. 1-12)  
- Writing Assignment #2 due |
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<tr>
<td>Week 8</td>
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<td><strong>Spring Break: NO CLASS SCHEDULED</strong></td>
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</table>
| Week 9 | Key Topic(s) & Learning Objectives | Topics:  
1) Polymers: chemical composition and physical properties  
2) Different types of polymers and how they are used  
Learning Objectives:  
1) Understand how polymers are made  
2) Identify how polymers are used in modern day materials  
Assignments  
- Reading #1: *The Substance of Civilization* (p. 215-238)  
- Reading #2: *Stuff Matters*, (p. 111-139) |
| Week 10 | Key Topic(s) & Learning Objectives | Topics:  
1) Materials that make up solar cells  
2) Limits in solar cell efficiency  
3) Current trends and research efforts  
Learning Objectives:  
1) Understand the chemical composition of materials that make up solar cells  
2) Recognize the limits that hinder researchers from developing solar cells with better efficiency  
Assignments  
- Reflection Assignment due  
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<th>Week 11</th>
<th>Key Topic(s) &amp; Learning Objectives</th>
<th>Topics:</th>
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</thead>
</table>
|        |                                  | 1) Silicon-based materials  
2) Applications in communications and technology  
3) The future of silicon chips |
|        |                                  | **Learning Objectives:** |
|        |                                  | 1) Recognize the various applications of silicon in modern technology  
2) Learn where improvements can be made in the field of semiconducting materials |
|        |                                  | **Assignments** |
|        |                                  | • Reading: *The Substance of Civilization* (p. 265-276)  
• Reading #2: “The chip that changed the world” (p. 1-3)  
• Reading #3: “Silicon chips are reaching their limit. Here’s the future” (p. 1-8) |

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<th>Week 12</th>
<th>Key Topic(s) &amp; Learning Objectives</th>
<th>Topics:</th>
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|        |                                  | 1) Examine types of materials in pop culture  
2) Compare/contrast materials in science fiction books and movies to the materials that exist in our world today |
|        |                                  | **Learning Objectives:** |
|        |                                  | 1) Relate materials in pop culture to the topics we learned in class |
|        |                                  | **Assignments** |
|        |                                  | • Bring a paper copy of the 1st draft of your final paper to class  
• Reading #1: “The Materials Science of the Marvel’s The Avengers – Some Assembly Required” (p.215-227)  
• Reading #2: “Black Panther, Vibranium, and the Periodic Table” (p.1243-1244)  
• Reading #3: “Elements of science and fiction” (p.13-16) |

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<tr>
<th>Weeks 13-15</th>
<th>Key Topic(s) &amp; Learning Objectives</th>
<th>Topics:</th>
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|             |                                   | 1) In-class presentations  
2) Question & answer sessions |
|             |                                   | **Learning Objectives:** |
|             |                                   | 1) Synthesize research on a contemporary issue in the field of materials science into a coherent oral presentation  
2) Be able to verbally articulate ideas to your peers  
3) Be able to ask questions to your peers |
|             |                                   | **Assignments** |
|             |                                   | • 2nd draft of your final paper due (by email) |
| Week 16 | **Key Topic(s) & Learning Objectives** | **Topics:**  
1) Problems society faces as they relate to materials science  
2) The development of modern materials  
3) Summary & wrap-up  
**Learning Objectives:**  
1) Identify types of materials that are important in modern-day technologies  
2) Relate current efforts in materials science research to issues people face on a daily basis  
**Assignments**  
• Final paper due (by email)  
• Reading #1: *Stuff Matters*, (p. 215-228)  
• Reading #2: *The Substance of Civilization* (p. 277-282) |