

NNMD 5270: Introduction to Nanomedicine Science and Technology

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COURSE OVERVIEW

This introductory course provides an overview of the distinctive features of nanotechnology and its applications in medicine. Cutting-edge research in disease screening, diagnosis, treatment, and prevention will be discussed. Students will be exposed to clinical technologies, as well as those still under development. Rotating talks on emerging research will be provided by experts from hospitals and industry.

This is one of five courses offered through the Nanomedicine Academy, a partnership between Northeastern University, Morgan State University, University of Puerto Rico Mayaguez, Tuskegee University, and Florida International University supported by the National Science Foundation (NSF). This course will be taught by lead instructors at Northeastern University with support from faculty at partner universities.

Guiding Questions

- What are the potential benefits and challenges of nanomedicine?
- How is nanomedicine currently being used to treat patients?
- What are the building blocks of nanomedicine? How do they provide unique & distinctive functions in the body?
- How can we customize nanomedicine solutions for specific diseases?
- How do we demonstrate that nanomedicine is both safe and effective?

Outcomes and Objectives

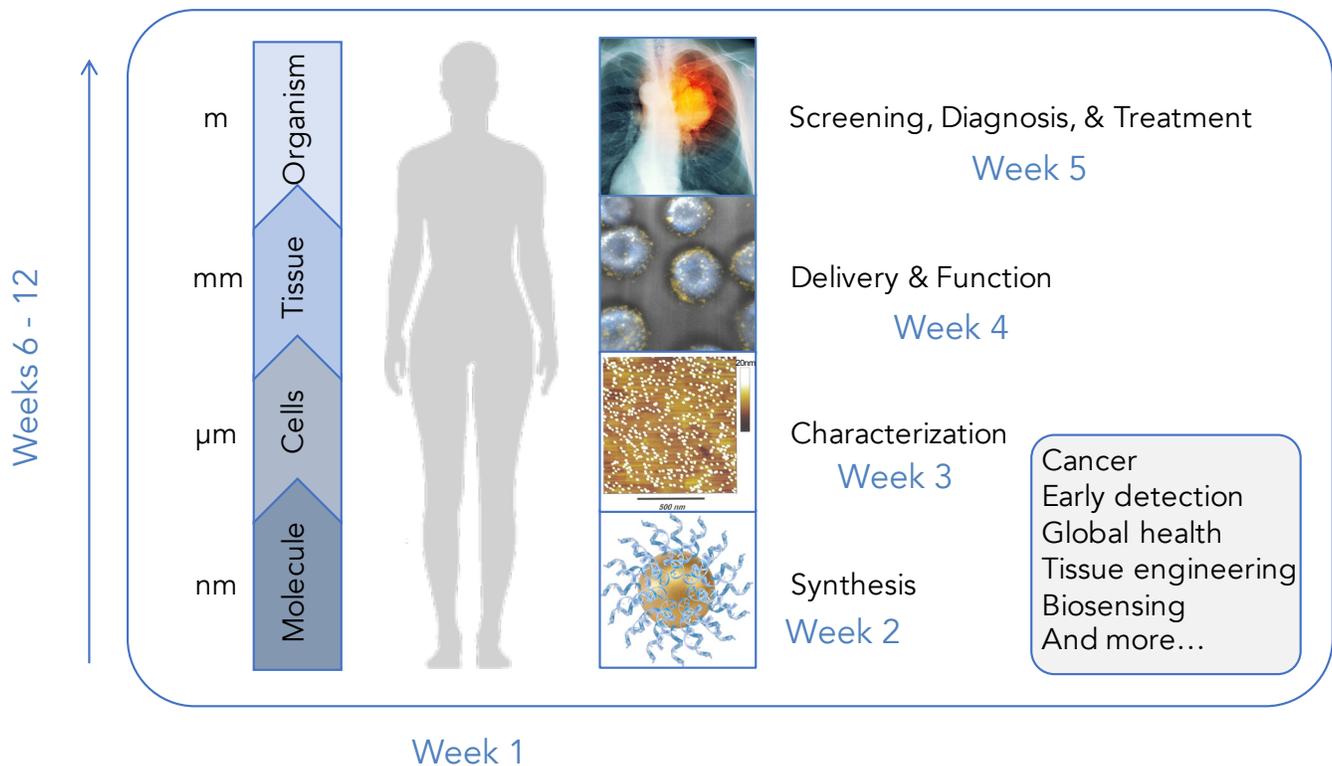
- Identify and articulate examples of medical problems amenable to nanomedicine solutions
- Compare and contrast existing nanomaterial designs and their ability to perform specific functions
- Analyze how cellular and physiological phenomena will impact nanomaterial success
- Recognize that meeting the challenges of nanomedicine requires the coordinated efforts of interdisciplinary teams

WHY NANOMEDICINE?

Ever wondered how to screen for thousands of diseases with just a single drop of blood? Or search out and destroy cancer cells without surgery or chemotherapy? Or texture materials to promote tissue regeneration while preventing implant rejection? These ideas may sound futuristic, but they are being studied in labs right now.

Nanomedicine is the application of nanotechnology to medicine. It is a rapidly expanding interdisciplinary field that seeks to develop new and improved techniques for the screening, diagnosis, treatment, and prevention of disease. Today, nanomedicines are used globally for patients suffering from a range of disorders including ovarian and breast cancer, kidney disease, fungal infections, elevated cholesterol, menopausal symptoms, multiple sclerosis, chronic pain, asthma and emphysema.

Developing new and effective nanomedicines requires an understanding of how basic building blocks assembled at the nanoscale allow materials to have unique and distinctive features that are not possible with bulk materials. These nanomaterials interact with biological structures at the scale of molecules, and thus have found widespread use for biomedical research and applications. A variety of tools exist to characterize, optimize, and predict nanomaterial interactions with cells and molecules. Upon validation *in vitro*, nanomaterials are tested *in vivo* to better understand how their delivery and function impacts behavior at the tissue scale. Ultimately, researchers hope to use these nanomaterials to improve the screening, diagnosis, and treatment of disease, provided that the nanomaterials can be proven to be both safe and effective in clinical trials.



REQUIRED BOOKS AND TECHNOLOGY

There is no textbook because this course draws widely from peer-reviewed literature and investigates cutting-edge work in the field of nanomedicine. Weekly materials will be provided within Blackboard. Additionally, you will search your library resources and the web as part of your assignments.

It is recommended that you have a headset that includes a microphone for this class, because some assignments will require you to record audio. We will also hold optional live review and Q/A sessions during the course.

HOW THE COURSE IS STRUCTURED

This course features a variety of interactive classroom and online activities that will allow you to engage with classmates and faculty at multiple institutions. These include:

Online Video Lectures and Tasks: All lecture content is posted online. Each week you will start with one online lecture module, supplemented with a variety of tasks. These tasks are activities that will help you engage with the course materials in a variety of ways to enhance your learning. These tasks should be considered as part of the lecture materials and are mandatory. While the lectures and tasks are not graded, the instructors can monitor the completion of these activities and will factor this into your participation grade. **It is important that each week's online lectures and tasks be completed before class on Friday!**

Interactive Lectures: You will attend live classes led by Nanomedicine Academy faculty and guest experts hosted in your local classroom on Fridays. The purpose of these Friday classes is to apply the knowledge and concepts you learned in the online lecture, so it is very important to complete the week's online lecture before coming to class on Friday. Please note that attendance of these lectures is **mandatory** for all students enrolled in the ground-based courses at NU, UPRM, TU, FIU, and MSU. **We will be featuring high-profile speakers starting promptly at 3:25pm EST, so please arrive on time!**

Weekly Assignments and Term Paper: Each week you will be assigned one or more tasks that you will post to your personal blog on Blackboard. These blogs are not open to the public but can be viewed by your classmates and instructors. The assignments are structured in such a way to help you build content and ideas centered around a medical problem or disease that you are interested in. At the end of the course, you will integrate your findings and forecasts to write a term paper that demonstrates your acquired knowledge. The assignments and term paper make up 40% of your grade.

Peer-to-peer Commenting & Response: Each week after posting to your blog, you will review and comment on the blogs of your classmates, as well as respond to comments made on your blog. The purpose of this activity is to engage in an active and ongoing exchange of ideas with your classmates. This portion of the course is your participation grade (15%), so you should give it your full and thoughtful attention!

Midterm: The midterm is a timed, online exam that assesses both learning and comprehension, with a focus on the three learning objectives above. You will have one week to complete the exam. The midterm is 25% of your grade.

Burning Questions: Many of you probably have a burning question about some aspect of nanomedicine. As part of your first assignment, we ask that you to post a question on the Burning Questions Discussion Forum. The course instructors and TAs will work to see that all these questions are answered by the end of the semester, either in the course materials or discussion forum.

Group Multimedia Presentation: In the second half of the semester, you will work as part of group to create an 8- to 10-minute narrated multimedia presentation about a peer-reviewed paper in nanomedicine that highlights a key concept covered in class. This presentation will be embedded in your blog and should therefore be created in a format that can be embedded, such as VoiceThread. All instructions may be found on BB. In addition to creating a resource for others that depicts the paper in a vivid and engaging format, this project serves as an opportunity for you to experiment with and improve your use of technology. This group project is 20% of your grade.

MANAGING ASSIGNMENTS IN AN ONLINE ENVIRONMENT

There is a rhythm and pattern to completing online assignments. While one of the advantages of online learning is the flexibility it affords students in completing work, you will need to arrange your schedule according to the regular deadlines outlined in the chart below, setting aside several regular blocks of time each week to participate in online class activities.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Watch, read, & do assignments	Watch, read, & do assignments	Watch, read, & do assignments Blogs due	Peer-to-peer commenting & responding	Peer-to-peer commenting & responding	3:25-5:05 pm Class Peer-to-peer commenting & responding Comments & responses due	Start next week's activities

All blogs and other assignments (midterm, group video presentation, and term paper) are due at midnight on Tuesdays. A new course topic will be introduced each week and the blog on that topic will be due the following week on Tuesday. Following each blog post, you will be asked to comment on your classmates' new posts, as well as respond to comments made about your post(s) in the previous week. Peer-to-peer commenting must be completed by midnight on Fridays after the blog is due.

You should plan to be online two to three times per week, particularly during the Wednesday-Friday window to follow through on responses to your blog. Your participation is asynchronous, allowing you to work at any time convenient to you. However, you must contribute in a regular and timely fashion so that your group of Blogging Buddies can achieve its goals. It's not a "discussion" if you post all your messages at the same time.

Assignment and participation points are earned. This means that you start at zero and earn 30% of your final grade through thoughtful, substantive, collegially constructive, and timely contributions.

Here are 4 ways to ensure getting maximum points for your assignment and participation grades:

- **Add** new knowledge beyond the topics covered in class
- **Reframe** ideas presented in class (and your peer's blogs) in a new, novel way
- **Extend** the idea by asking one or more focused questions
- **Include** direct references or sources (either citations or hyperlinks may be used)

To receive a full grade for peer-to-peer commenting, you are expected to provide at least 3 substantive comments each week.

COMMUNICATION WITH YOUR PEERS

The students who attend this course with you come from universities in 5 different states and territories across the U.S. Each of you brings a unique background, area of expertise, and perspective to the course. We are providing you with the opportunity to interact with each other in a variety of ways so that you can benefit from each other's experiences.

Blogging Buddies: For participation in peer-to-peer commenting, you will be assigned to a group of blogging buddies. As a group, you will review each other's work, make comments, and respond to comments. This ensures that you get continued feedback from peers who are familiar with your entire body of blog posts.

Group Assignments: You will be provided with all the software needed to collaborate and create a group multimedia presentation. For example, you could use Google docs to collaboratively create a PowerPoint presentation and then prepare a voice-over using VoiceThread. The great thing about all this online software means it is no longer necessary to be in same room to do a group project!

"Burning Questions" Discussion Forum: As you are investigating cutting edge research on topics covered in class, you might come across ideas and answers to questions posed by your fellow students. Feel free to share these in the discussion forum. [Tip: The discussion "subscribe" option forwards messages directly to your email, making it easier to monitor.](#)

Technical Questions and Concerns

Please visit Blackboard's Online Support Center at <http://nuonlinebbsupport.neu.edu> to access tutorials and live chat support, or call the Center at (855) 836-3520. **This 24/7 hotline is available to ALL nanomedicine students; no matter what institution you attend.**

COMMUNICATION WITH THE INSTRUCTORS

Instructor Participation in Blog Posts: The weekly blog posts and peer-to-peer commenting are intended to create a conversation among students, not a back-and-forth between the professor and students. We believe in your capacity for taking the discussion in interesting and productive directions. The course instructors will occasionally provide expert advice and personalized help to challenge and motivate you. Even though we may not respond to every blog post, please know we are "listening" intently.

Messages and Announcements: We will regularly post announcements with observations and questions designed to spur, focus, or deepen the whole group's discussion. We'll also send logistical updates as needed. These announcements will typically be posted to a Blackboard announcement that is also forwarded to your email address. This redundancy ensures that everyone in the course sees the communication.

"Ask the Instructor" Discussion Area for General Questions: There is a Forum included in the Discussions area entitled *Ask the Instructor*. Use this forum as a place to post requests for clarification on content or assignments. If you have a question, others are probably wondering about it, too. This discussion allows the whole class to benefit from your query. *Note:* Questions that are specific to your own work should be communicated via email and/or during a scheduled appointment.

Face-time with a Course Instructor: We have designated a local Faculty Facilitator at each institution. The role of this faculty is to host the classroom space, act as a local point of contact for any questions you have, and provide mentoring for group projects. Feel free to contact your local Faculty Facilitator as needed.

Getting Help: The best place to go for help depends on the specifics of your concern or question. As noted above, please post *course-related questions and concerns* to the "Ask the Instructor" discussion. It's also a good idea to check this discussion regularly to stay in the loop on questions and clarifications. [Tip: The discussion "subscribe" option forwards messages directly to your email, making it easier to monitor.](#)

TIMELINE AND GRADING

- 9/7** **Week One (thru 9/15):** Nanomedicine and personalized nanomedicine
- 9/18** **Week Two:** Nanoparticle design, synthesis, and functionalization
- 9/25** **Week Three:** Nanoparticle characterization *in vitro* and *in vivo*
- 10/2** **Week Four:** Nanoparticle delivery to tumors
- 10/9** **Week Five:** Nanotechnology for biosensing applications
- 10/16** **Week Six:** Imaging for early detection
- 10/23** **Week Seven:** Magnetic nanoparticles
- 10/30** **Week Eight:** Nanodiagnostics for global health
- 11/6** **Week Nine:** Nanoparticles for MRI
- 11/13** **Week Ten:** Nanoplatfoms for radiation oncology
- 11/20** **Week Eleven: NO CLASS, THANKSGIVING**
- 11/27** **Week Twelve:** Nanotechnology for tissue engineering
- 12/4** **Week Thirteen (thru 12/6):** Course finale

You will be assessed on the basis of weekly assignments, a midterm examination, a group video presentation, a term paper, and active participation in peer-to-peer commenting.

Assignment	Description	Due Date	Grade
Weekly assignments	Small weekly assignments posted to your weekly blog, centered around your medical topic of choice	Tuesdays weekly	30%
Participation in commenting	Weekly commenting and response within your blogging buddy group	Fridays weekly	
Midterm	A timed, online exam that you have 1 week to complete	Tuesday 10/18	25%
Group presentation	An 8-10 minute multimedia presentation on a peer-reviewed paper that emphasizes a central concept of the course	Tuesday 11/7	20%
Term Paper	A 10-page paper that summarizes and forecasts the application of nanomedicine to your medical topic of choice	Tuesday 12/5	25%

COURSE POLICIES

1. Class attendance on Fridays is mandatory. You are encouraged to also actively participate in this course by engaging local and remote instructors in discussion of course content and asking questions both online and during talks.
2. You are expected to check Blackboard regularly. All required assignments, readings, course communications, and lecture notes/presentations will be posted on Blackboard.
3. You are expected to follow guidelines stated in the NEU Academic Integrity Policy (<http://www.northeastern.edu/osccr/academichonesty.html>)
4. The use of mobile devices and laptops during lectures is restricted to course activities only.

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