To: ENGR 13200 Design Teams

From: Victoria Farnsworth, Managing Director of NCN (nanoHUB.org)

RE: nanoHUB.org Design Project Description

Let me start by telling you a little about nanoHUB.org:

“nanoHUB.org is arguably the largest online user facility for nanoscale engineering and science modeling and simulations in the world. It is a project that is funded by the US National Science Foundation and serves over 240,000 annually. Our users are researchers from the industry, researchers, faculty members at universities worldwide, and most importantly students – at the undergraduate and graduate levels.

nanoHUB.org is the place for computational nanotechnology research, education, and collaboration. nanoHUB hosts a rapidly growing collection of simulation programs for nanoscale phenomena that are accessed through your web browser. In addition there are online presentations, courses, learning modules, podcasts, animations, teaching materials, and more to help you learn about the simulation programs and about nanotechnology. nanoHUB supports collaboration via workspaces and user groups.

Our mission is to support the National Nanotechnology Initiative (NNI) by creating and operating an ever-evolving cyber-platform for sharing simulation and education resources. Our mission is embodied in nanoHUB.org and driven by pioneering research, education, outreach, and support for nanotechnology community formation and growth.”

Nanotechnology is increasingly an important aspect of numerous engineering and science disciplines. Profs. Mark Lundstrom and Ashraf Alam – two of the top scientists working in nanotechnology today and who have contributed numerous materials to nanoHUB.org – point out that “Nanotechnology is not a field of engineering - it is a set of concepts, tools, and techniques that has become important in all engineering disciplines.” And – “Students should realize that whether they become electrical, computer, materials, mechanical, etc. engineers, nanotechnology will be important to them and that the key concepts cut across all disciplines in engineering and science.”

The project you are going to work on is derived from the above perspective. Students think that the study of nanotechnology begins at the advanced levels of undergraduate study. However, the foundations of what is needed to be successful in understanding concepts related to nanotechnology can and should be laid earlier in ones undergraduate program. A solid foundation can prepare undergraduates to be active participants in the development of nanotechnologies through programs like SURF – Summer Undergraduate Research Fellowships (https://engineering.purdue.edu/Engr/Research/SURF). The nanoHUB team believes that your team can help us introduce your peers to the big ideas in nanoscience by developing educational tools that enable visualization and exploration.

The nanoHUB team is therefore requesting that your team produce an interactive and educational MATLAB-based program that engages peers (first-year and sophomore engineering students) in learning how **Size & Scale** and a least one other big idea of nanoscience apply to one or more engineering disciplines via model(s) or simulation(s).



The other big ideas in nanoscience (http://www.mcrel.org/nanoteach/pdfs/big\_ideas.pdf) from which your team can select are:

1. **Structure of Matter:** Atoms make up matter. Atoms are in constant motion and they interact with each other to make molecules. Atoms, molecules and/or nanoscale structures interact with each other to form nanoscale assemblies.
2. **Size-Dependent Properties:** Properties of matter can change with scale. Unexpected properties at the atomic scale can lead to new and desirable functionality.
3. **Forces & Interactions:** The relative impact of forces changes with scale. Electrical forces tends to dominate the interactions between objects at the nanoscale.
4. **Self-Assembly:** Organized structures can spontaneously assemble under specific conditions.

To help your team understand nanotechnology a bit better, create an account on nanoHUB.org and look for resources that introduce you and your team to nanotechnology.

A successful solution to the nanoHUB problem must meet ***ALL*** of the following ***criteria***:

1. Clearly helps peers understand the **Size & Scale** of nanotechnology (big idea #1),
2. Clearly assists peers in connecting **Size & Scale** to at least one other nanoscience big idea, and
3. Clearly engages peers in how 1. & 2. apply to one or more engineering disciplines via model(s) or  simulation(s)
4. Is highly stimulating and interactive for the targeted grade level
5. Is easy to use and operate

To maximize the impact of your team’s effort, various nanoHUB partners, in addition to your instructors, will provide feedback on your work at appropriate times. The following tentative deadlines have been negotiated with your instructors:

1. Project scoping will prepare you and your team to ask nanoHUB representatives questions about the project (February 14/15th)
2. A user-profile will help you understand peers preparation for understanding the big ideas of nanoscience and nanotechnology applications, and evaluation of existing interactive, educational tools will help you understand the possibilities and expectations for your team’s solution (February 21st/22nd)
3. A memo to nanoHUB will summarize results from concept generation and reduction (February 28th/March 1st)
4. A preliminary proposal for your team’s solution will be submitted to the ENGR 132 instructional team for feedback (March 7/8th)
5. A final proposal will be sent to nanoHUB for feedback (March 28/29th)
6. A draft of the graphical-user-interface (GUI) and complete flowcharts for all functions needed to  achieve the criteria will be submitted to the ENGR 132 instructional team for feedback (April  11/12th)
7. A working (beta 1.0 version) program will be demonstrated (April 18/19th)
8. Your team’s “near” final program (beta 2.0 version) will be demonstrated to nanoHUB partners  (April 23/24rd)
9. A demonstration of your team’s final program will be given to the ENGR 132 instructional team.  In addition, an executive summary that describes your team’s solution will be submitted (along with a copy of your final MATLAB program) to nanoHUB (April 25/26th)

I understand that your instructional team will handle posting of your program if your program is properly uploaded to your Blackboard course management software.

Your ENGR 13200 instructors have allowed us to work with you and your team because they believe this project will allow you to demonstrate that you have understood the material included in ENGR 13200.

They also believe that this project will allow you to bring together these course objectives:

* Develop a logical problem solving process which includes sequential structures, conditional  structures, and repetition structures for fundamental engineering problems,
* Solve fundamental engineering problems using computer tools,
* Employ design and problem processes in modeling, problem solving and design work,
* Work effectively and ethically as a member of a technical team,
* Develop a work ethic appropriate for the engineering profession,
* Reflect on personal and team performance to achieve continuous improvement, and
* Demonstrate an ability to engage in continuing professional development.  The time your instructors have designated for this project is short, so your team will need to be focused. I wish you the best of luck and look forward to seeing your creative designs.