IPRO 348

Project Plan

I. Team Charter

A. Team Information

1. Details

a. See Appendix for names, majors, strengths, expectations, and tasks

2. Team Identity

a. Name: Ag Nano

b. Logo:

c. Motto: Ag Nano – Less Doing More

B. Team Purpose and Objectives

1. Team Purpose

a. IPRO 348 is a group of students brought together through a common interest in nanotechnology; we look to gain practical and professional experience in experiments and scale-up design, academic research, and project management. The team is striving to improve the process and production of silver nanorods along with discovering, comparing and evaluating new applications for their use.

2. Objectives

a. Create a viable experimental procedure for the production of silver nanorods

b. Consistently synthesize quality batches of silver nanorods in a laboratory environment

c. Modify the 'half-lives' of silver nanorods according to the intended application

d. Employ absorption spectroscopy to determine the quality of produced nanorods

e. Determine optimal conditions for silver nanorods formation

f. Research, design and test processes to improve the effective production of silver nanorods

g. Provide information regarding different processes used to facilitate silver nanorod formation

h. Discover new technologies and applications relating to nanorods, specifically those of medical applications, through academic research

i. Compare existing technology with discovered nanorod applications based on function, cost, economic demand, practicality, and environmental impact

j. Facilitate ChE 296 students' learning of the fundamentals in operating Aspen HYSYS software and conducting laboratory research

k. Cooperative teamwork in working towards common goals while maintaining academic and behavioral integrity

l. Gain a greater knowledge base in nanotechnology while participating in a positive, team-building experience

C. Background

1. History

a. There is no sponsor involved with this Interprofessional Project. This project is, however, based on Professor Perez-Luna's research and will receive guidance from him in accomplishing the laboratory syntheses of viable silver nanorods and the production of a continuous flow reactor to prototype efforts to mass-produce these nanorods. Our team is focusing on continuing the efforts put forth by the former IPRO 348 team from the previous academic year: their main objective was to accomplish the synthesis of a viable batch of silver nanorods, and despite prolonged experimental difficulties encountered in attempting to do so, the former team eventually succeeded in producing several batches of nanorods and designed a continuous flow reactor prototype. The previous IPRO looked at the silver nanorods to be used as thermal indicators in food.

2. Technical Issues

a. Although silver nanorods have proven to be a viable source for the development of new technologies, there remains a large need to develop nanorods of uniform size and shape—the market and concurrent demand behind the utilization of silver nanorods is directly dependent on the ability to homogeneously mass-produce these nanoparticles while maintaining specific aspect ratios. In lieu of these challenges, the laboratory team may encounter difficulties in precisely controlling the growth and development of these silver nanostructures.

b. The IPRO 348 laboratory team is employing a method referred to as seed-mediated growth in order to successfully synthesize silver nanorods. These seeds facilitate the growth of short silver nanorods, and over time, these short nanorods elongate into longer silver nanorods. Following the completion of several trials, the laboratory group will experiment with altered concentrations of the numerous starting components in order to create silver nanorods of various length-to-diameter ratios. These modifications to the original experimental protocol will be executed to pursue the optimization of the ability to create silver nanorods of variant sizes and to create each nanorod type in abundance.

c. The synthesis of silver nanorods has been accomplished in a number of ways, including ultraviolet irradiation and photo-reduction, templating via DNA, carbon nanotubes, polymer films, porous membranes, and even electrochemical deposition. It has also been shown that silver nanorods can form in solution when their growth is promoted by the presence of a pre-existing seed: this seed, which exists as a rod-like micelle in solution, facilitates the formation of nanorods. This method is known as the "wet" aqueous synthesis of silver nanorods, and because it does not require the presence of a molecular membrane, it is believed to be more conducive towards achieving large-scale production of silver nanorods. The former IPRO 348 team encountered difficulties in wet synthesis of silver nanorods, but once this had been achieved, a continuous flow reactor prototype was designed. Our laboratory objectives will be to successfully achieve consistent production of well-formed silver nanorods and to design viable methodologies by which they may be mass-produced.

3. Ethical concerns

a. Two major ethical issues that concern IPRO 348 are laboratory safety protocols, which present issues in both ethics and health, and academic misconduct. Experiments, namely those of

silver nanorods synthesis, will be executed such that the immediate health of laboratory personnel will not be endangered. Also, individuals present in the laboratory are required to wear safety gear to minimize hazardous health risks during experiments. Academic and scientific misconduct is widely understood to be the presence of falsification, fabrication, or plagiarism in work that is presented and assumed to possess originality in conception. Therefore, the IPRO 348 team will strive to strictly follow scientific citation format where required and will neither falsify nor fabricate experimentally obtained results.

b. It is possible that silver nanorods could have adverse effects upon humans or animals exposed to them. This effect needs to be monitored and any adverse effects need to be properly documented.

4. Potential Applications

a. The synthesis and application of silver nanorods as potential thermal indicators has been projected to represent a solid business strategy: previous estimations approximated that silver nanorods may be up to nearly ten times more cost-effective to produce than commercially available thermal indicators. This estimation, however, does not carry over to the potential utility presented by silver nanorods: because these nano particles irreversibly decay from rods to spherical arrangements in the process of being used as thermal indicators, their overall cost-effectiveness may differ. Recent research has revealed that silver nanorods may benefit from even greater use when used as potential virus identifiers—a technique known as Surface-Enhanced Raman Scattering (SERS) has shown, with silver nanorods being employed as substrates, to be capable of identifying specific viruses in low concentrations. Research and biomedical engineering designs required to carry out a variation of this process in medicine would be costly, but this methodology could have a profound impact in healthcare by allowing for the earlier detection of viral infections such as HIV.

b. The most common methodology employed in HIV detection in the United States and other developing countries is a coupled method between an antibody assay known as ELISA (enzyme-linked immunoabsorbent assay) and a Western blot of a patient's serum antibodies against HIV proteins. When used in conjunction, these two assays collectively achieve an accuracy of well over 99%. Due to the dormant nature of HIV, however, the results from these two assays usually cannot be confidently relied upon until approximately three weeks have elapsed after a patient's potential exposure to the virus. The timing between exposure to HIV and the introduction of anti-retroviral drug courses in a patient can be crucial, and although attempts have been made to create rapid HIV diagnoses kits, these assays have a notorious tendency to declare false positives in patients. An average HIV detection course costs approximately $40, and when combined with the time required for a patient to receive a "confident" positive diagnosis, this represents a significant societal cost when applied to all potentially-infected HIV patients. The introduction of silver nanorod technology in identifying HIV at low bodily concentrations may greatly expedite the process of diagnosis and could economize costs for society.

5. Critical Documents

a. Cao G, Liu D. Template-based synthesis of nanorods, nanowires, and nanotube arrays. Advances in Colloid and Interface Science 2008; 136: 45-64.

b. Gu X, Nie C et al. Synthesis of silver nanorods and nanowires by tartrate-reduced route in aqueous solutions. Materials Chemistry and Physics 2006; 96: 217-222.

c. Irwin K, Olivo N et al. Performance Characteristics of a Rapid HIV Antibody Assay in a Hospital with a High Prevalence of HIV Infection. Annual Internal Medicine 1996; 125: 471-475.

d. Jacobs B, Mercer A. Feasibility of hospital-based blood banking: a Tanzanian case. Health Policy and Planning 1999; 14: 354-362.

e. Jana N, Gearheart L, Murphy C. Wet chemical synthesis of silver nanorods and nanowires of controllable aspect ratio. Chem Comm. 2001; 617-618.

f. Perez-Luna, Victor Hugo, Pravin Ajitkumar. **Nanoparticle-based thermal history indicators.** U.S. Pat. Appl. Publ. (2009), US 2009122829

g. Shanmukh S, Jones L, Driskell J et al. Rapid and Sensitive Detection of Respiratory Virus Molecular Signatures Using a Silver Nanorod Array SERS Substrate. Nano Letters 2006; 6: 2630-2636.

h. Zhu Y-p, Wang X-k et al. Sonochemical Synthesis of Silver Nanorods by Reduction of Silver Nitrate in Aqueous Solution. Ultrasonics Sonochemistry 2010; DOI: 10.1016/j.ultsonch.2010.01.003

D. Team Values Statement

1. Desired Behavior

a. Coherent communication through timely email responses

b. Proper observance of laboratory safety protocols, especially when dealing with hazardous compounds

c. Strong, consistent attendance

d. Creation of a friendly environment through respectful treatment of teammates

e. Willingness to share relevant ideas and research material

f. Compliance with formal scientific research citation formatting

g. Effective time-management skills

h. Follow through with promises

i. Take the project seriously

j. Desire to take initiative

2. Addressing problems

a. In addressing problems the group will make sure that active listening is used, information is gathered and issues are clearly identified, possible solutions will be brainstormed, and a solution will be negotiated. Problems will be firstly addressed by talking with a peer or a subgroup leader. If the problem is not resolved, then it will be addressed by the team leader and, finally, the IPRO advisor, Professor Perez-Luna. Problems will be prevented through open communication with other teammates, by meeting deadlines to the best of our abilities, and by relying on collective teamwork to complete large tasks. To reinforce these points, peer reviews will be conducted at multiple points throughout the semester.

II. Project Methodology

A. Work Breakdown Structure

1. Problem Solving Protocol

a. In order to best meet our team goals, the sub-teams will meet on a weekly basis to discuss their progress in meeting objectives and deadlines. The entire group will meet as a whole during class time on Tuesdays and Thursdays to discuss progress, collaborate between sub-groups, and discuss upcoming events and deliverables.

2. Team Structure

a. Team Leader

1. Elena Dorr

b. Lab Team

1. Anna Vassi*
2. Mat Dado
3. Joshua James
4. Edward Chiem
5. Daniel McClelland
6. Michael Sever
7. Charlie Sizer

c. Research Team

1. Shirley Nwangwa*
2. Amber Purcell
3. Aurash Mohaimani
4. Andre Colmenares

d. Ethics Team

1. Katie Lazicki*
2. James Cheever
3. Aurash Mohaimani
4. Erica Payne

e. Scale-up Team

1. Fernando Gomez*
2. Elena Dorr
3. Mat Dado
4. Matt Lumnitzer
5. Meghan Wiebe
6. Madeline Jensen
7. Ryan Tillman

f. Executive Administration Team

1. Willy Taracena*
2. Emannual Marcha
3. Andrew Raddatz
4. Erica Payne

B. Schedule

Subgroup	Task	Start Date	Due Date
Scale-up Team	Create a Process	1/19/10	2/22/10
	Current production in lab	1/19/10	2/01/10
	Research current process	1/19/10	2/04/10
	Create a process	2/04/10	*Midterm*
	Input from Experts	*Midterm*	*Midterm Pres*
	Test and Modifications	*Midterm*	4/16/10
	Cost Estimate	*Midterm*	4/02/10
	Obtain Lab Yields		*[Lab Dependent]*
	Theoretical Yields	*[Lab Dependent]*	*2 weeks later*
	Process Yield vs. Lab Yield	*[Lab Dependent]*	*2 weeks later*
	Analysis of Raw material Costs	*[Lab Dependent]*	*2 weeks later*
	Capital Costs of Equipment	*Post Analysis*	3/26/10
Ethics Team	Research 7 Layers of Integrity	1/19/10	2/02/10
	Applications to IPRO	2/02/10	2/09/10
	Present Findings to IPRO team		2/11/10
	Ethics Report		2/19/10
Lab Team	Write Lab protocols	1/28/10	1/29/10
	Perform First Lab Experiment	1/29/10	1/29/10
	Create a Suitable Ag batch	2/05/10	2/05/10
	Repeatability, quality	2/23/10	4/20/10
	Lifetime of Nanorods	2/08/10	4/21/10
	Parameters for Best production	2/08/10	4/21/10
	Better procedure	2/08/10	4/21/10
Research Team	Investigate Possible Applications	1/25/10	2/25/10
	Analyze applications and choose one application to focus on	2/25/10	3/02/10
	Compare chosen application with existing technology on the basis of cost, practicality, and performance	3/02/10	4/08/10
Budget Team	Specifically aid in cost analysis for Scale-up and New Technology Teams	1/25/10	4/08/10
	Poster/Brochure Design and Production		4/10/10

C. Expected Results

1. Details of Expected Activities

a. The lab group was assigned the task of coming up with an experimental protocol for the production of the silver nanorods. This protocol was completed in the first week of the project and was edited by Professor Perez-Luna. This experimental protocol was used successfully in

the lab to create the first batch of silver nanorods. This protocol will be used as a general guideline for the lab group as the members work towards achieving the other goals. The protocol will be modified according to the experimental results so that nanorod synthesis is improved over the course of this IPRO.

b. create a batch of silver nanorods with narrow size distribution, the lab group must be sure to follow procedures such that the amount of excess material (i.e. nanospheres, nanoplates and other shapes) in the final product is minimized. Proper mixing must occur in order for the batch to be consistent.

c. The lifetime of the nanorods is dependent upon many factors, including concentration of raw materials (especially CTAB), temperature, degree of mixing, and other characteristics. In order to create nanorods which have varying shelf lives, the lab group will need to experiment with different variables in the nanorod production process.

d. All final products must be tested using spectroscopy for quality, aspect ratio, and absorbance of the material. This is important in understanding the final product associated with the procedure used for creating such product. Once high quality batches are made and tested, the procedure can be repeated to create consistent batches.

e. The optimal conditions for silver nanorod production will result from reproducing successful experiments. This will provide the entire IPRO team with the knowledge and information needed for creating nanorods on a larger scale.

f. The scale-up team will be charged with the task of researching, designing, and testing processes with the possibility of producing and purifying silver nanorods on a larger scale. Information from the lab group will be useful to the scale-up team to assist them with research they accomplish via literature studies.

g. New technologies will be researched and studied for their possible need of nanotechnology, specifically silver nanorods. Medical, food, and other applications will be investigated by the research team in order to find possible applications of silver nanorods. The possible applications must be studied based on cost, practicality, performance, market need, environmental impact, and function. This research will be compared to other possible technologies in order to prove why silver nanorods would be the best possible solution for a given application.

h. The ChE 296 students will have an active involvement in the project, from learning about the entire IPRO program to presenting material, working in a lab setting, researching nanotechnology, and learning and applying the basics of HYSYS: a process simulation program widely used in the Chemical Engineering Department at the Illinois Institute of Technology.

i. The entire group must work together as a team in order to accomplish common goals. In order to do this, each member must understand the Seven Layers of Integrity and learn how to apply them while working on a group project. Members must be cooperative, conscientious, ethical, and able to solve problems together in order to accomplish team goals.

j. Each team member will have an enjoyable experience while learning about nanotechnology and working as part of a team. Problems will be addressed quickly and measures will be taken to prevent problems from happening or getting worse.

2. Expected Data

a. The lab group will obtain spectrometry data for each batch of silver nanorods made in the lab. This data will be used to compare batches and quality of the nanorods. The spectra will give

information such as length-to-diameter ratio, absorption intensity, and wavelength at which absorption occurs, which gives vital information about the quality of nanorods.

b. The spectra data should show two distinct peaks, one around 400-450 nm and the stronger peak at longer wavelengths depending on the aspect ratio of the nanorods. When peaks in the visible range are seen, the desired quality of the nanorods is met.

3. Potential Products

a. Thermal history indicators

b. Biosensors

c. Nanolabels

d. Nanomaterials for Surface Enhanced Raman Scattering (SERS)

4. Potential Outputs and Deliverables

a. A consistent batch of silver nanorods of good quality (narrow size distribution) that would be used by the scale up team to devise a laboratory scale up process.

b. An estimate of what a scaled up process would cost to implement, and produce the silver nanorods on a larger scale than is currently possible.

c. An ethics report that would analyze the ethical issues and concerns that result from the production and use of the silver nanorods. This report would cover various facets of the project and should provide a strong set of guidelines for how the nanorods can be ethically implemented.

d. To maintain a reasonable budget for the duration of the project; keeping costs from being too large while ensuring that enough capital is spent to accomplish the desired task.

5. Challenges and Risks

a. The main challenge will be to overcome the difficulties present in trying to produce consistent nanorods.

b. Finding a process that can produce the nanorods on a larger scale while simultaneously keeping production costs down.

c. Maintaining good communication between the various subgroups. This plays a vital role in getting tasks finished in a timely manner.

d. Lack of in-depth research on the topic of interest. In order to accomplish the team's goals it is necessary to have accurate information pertaining to the production of, use for, and ethical issues concerning the silver nanorods.

e. The market for a silver nanorod technology is not particularly large. The silver nanorod technology has not yet found a large scale application for use and creating such a market is difficult as companies are typically hesitant to invest on a new technology, however this offers an opportunity for venture creation because of limited competition.

f. There is very limited time with which to accomplish all of the necessary research. Furthermore, finding a market to which the silver nanorods can be adapted, and then incorporated into within the time period given to do so could be difficult.

g. Preventing clerical errors within the budget, and correcting them in a timely manner if present.

h. It is assumed that the laboratory procedure works well enough to produce consistent results.

i. It is assumed that the quantity of materials purchased for use for the duration of the project will be sufficient to provide the necessary consistent laboratory results.

j. Regulating factors such as temperature, pH, concentration, and other changes in the laboratory environment that affect the results of the experimental procedure.

k. It is difficult to produce consistent results because of the variations in performing the same experiment with different individuals.

6. Proposed Solution

a. Upon achieving consistently accurate results a procedure can be devised and recorded so that future IPRO's may use it to possibly produce a prototype process.

b. Devising a better laboratory procedure through consulting with research teams and implementing said procedure in the laboratory.

c. The budget will be provided within the final report of the project. This will allow those interested to examine the costs of the project and provide insight into whether or not the process is financially feasible.

d. Evaluate the existing technology and determine if it can provide a viable solution to a problem.

D. Project Budget

1. Plant Tours and Transportation

a. $ 150

b. Trip to local plant in which silver nanorods are manufactured

c. To local universities where silver nanorods are produced

2. Team Building

a. $ 250

b. Bog rental and pizza party

3. Laboratory

Vendor	Item Number	Item Name	Quantity	Price
Millipore®	UFC503024	Centrifugal Filter	1	$92.00
Sigma Aldrich®	Z239119	Pour Boats	1	$40.10
	Z190543	Scintillation Vials	1	$239.50
			Total Price*	$371.60

*After Taxes and Shipping Costs expected to be about $450

4. Miscellaneous

a. $50

b. Any spending that was not initially accounted for that the team might incur

5. Total Budget:

a. $900

E. Designation of Roles

a. Minute Taker: Katie Lazicki

1. Katie will take minutes and attendance during class time and post them to iGroups for reference. Each sub-team will be responsible for their minutes, which will be done by the subgroup leader and posted on iGroups under the sub-group folders.

b. Agenda Maker: Elena Dorr and Sub-Group Leaders
    1. Elena will be responsible for creating agendas for class time. Sub-group leaders will make agendas for their weekly meetings.

c. Time Keeper: Elena Door and Sub-Group Leaders

d. iGroups Moderator: Business Sub-Group
    1. The business group will be responsible for making sure that IPRO deliverables are completed on time and properly uploaded to the iGroups website. In addition they will help organize and keep track of the iGroups files and aid group members in uploading and updating files and timesheets.

III. Appendix

Name	Major, Year	Strengths	Desired new skills and knowledge	Expectations	Individual Tasks	Contact Information
Nwanga, Shirley	Chem, 3rd (Transfer)	• Writing • Organizational and leadership skills	Gain more of a "finesse" with following lab procedure sometime in the future and improve public presentation abilities	Having constant communication within the teams and seeing the project's potential come to life	• Research compatible technological applications that utilize silver nanorods • Gather an abundance of information relating to silver nanorods and inform sub-group members and IPRO team • Delegate tasks to sub-group members • Organize sub-group meetings outside of class	snwangwa@iit.edu (847) 912-0199
Dado, Mathew	ChE, 4th	• Lab experience • Technical report experience • Presentation and critical thinking skills • Leadership experience	Develop skills that will help to conduct experiments in a laboratory setting and learn how nanoparticles are made from raw materials, and be able to reproduce such processes in the lab.	Successful completion of the project, developing a process in which to create nanoparticles on a larger scale, and researching real-life problems where the use of nanoparticles could be a viable solution.	• Conduct experiments • Log lab data • Communicate results to scale-up team for testing purposes • Assist with testing	mdado@iit.edu (509) 528-9184
Cheever, James	ChE, 4th	• Presentation skills • Brainstorming • Communicating with others • Adaptability, and leadership	Gain a solid grasp of nanotechnology in general, as well as the specifics in the case of silver nanorods. Improving my ability to work in a team with individuals of multiple technical disciplines. Further improving my presentation skills.	A very good presentation and showing at IPRO day, and hopefully winning our track. Further expectations include, having an enjoyable yet productive IPRO experience, building new friends, and contacts for the future.	• Researching new applications for the existing technology • Presenting works	jcheever@iit.edu (708) 606-8415
McClelland, Daniel	ChE, 2nd	• Basic lab skills • Working in groups • Can use Matlab	Get some more experience in the lab and experience working as a team	Complete everything on time and not leave everything to the last minute; meet the goals that we set for ourselves and will complete everything in a professional manner.	• Assist lab team by analyzing new results and creating optimal solutions for experimental use • Learn HYSYS	dmcclell@iit.edu (612) 964-9204
Lumnitzer, Matt	ChE, 2nd	• Working in groups • Technical writing • Coming up with creative solutions	Become well-versed on the subject of silver nanorods and gain a better understanding of the IPRO program and what will be expected during future IPROs	Successful completion of required tasks in the time frame allotted	• Learn HYSYS • Research commercial continuous production, appropriate conditions, raw materials, and potential alternatives	mlumnitz@iit.edu (717) 798-4356

James, Joshua	BME/ChE, 3rd	• Previous lab experience • Strong background in biology	Learn new lab skills/techniques, gain knowledge of nano-particles and reactor design	Complete all tasks on time, produce a product that could potentially enter the market, and win at IPRO day	• Assist lab team by analyzing new results and creating optimal solutions for experimental use • Learn HYSYS	jj1008059@yahoo.com (630)-217-8444
Chiem, Edward	ChE, 2nd	• Cooperative and easy to work with • Very organized	Develop lab skills and learn how to make nanoparticles, and how their technology can be applied.	Communicate properly with group members and work together to obtain expected results while meeting given deadlines.	• Assist lab team by analyzing new results and creating optimal solutions for experimental use • Learn HYSYS	ed31490@gmail.com (773) 403-5042
Colmenares, Andre	ChE 3rd	• Creativity • Works well under pressure • Thinking ahead	Improve communication skills and leadership skills. I would also like to improve my research skills, particularly making my research more efficient and also conducting research as a team. I would also like to work on my presentation skills, especially the planning of larger presentations.	I hope that this project will introduce me to the ways in which projects are handled in the business/ professional world as a team. I would also like to understand the ways in which teams are managed. I would also like to meet all deadlines and have a successful project that is found interesting to the IPRO judges.	• Learn HYSYS • Perform research • Critically employ thinking skills	acolmena@iit.edu (847)401-0864
Dorr, Elena	ChE, 4th	• Leadership • Project management • Communication	Learn about emerging technology in nanoparticles, discover ways to scale-up the creation of nanotubes, improve leadership teamwork, and presentation skills, learn how to create an informative and aesthetically pleasing poster	Group members to listen to each other with an open mind, to follow through with their commitments, and to have fair distribution of work	• Managing deliverables • Leading IPRO meetings • Checking-in with sub-groups • Keeping IPRO team focused on goals • Aid in plug flow reactor research	edorr1@iit.edu (651) 263-2200
Gomez, Fernando	ChE, 4th	• Leadership • Communication • Research/Lab skills	Develop knowledge in the use of nanotechnology, and its applications; learn how nanoparticles are created, and how their creation can be scaled up. Improve public speaking skills and have a leadership position within the subgroup.	Having a competitive IPRO, and for everyone to get involved	• Assign tasks • Research capital estimate • Work on scale-up	fgomez@iit.edu (847) 977-4626
Jensen, Madeline	ChE, 2nd	• Strong leadership	Develop research skills, grow accustomed to working in situations where I have less preexisting knowledge, and to accept taking direction from others	Everyone to do their best work, in a timely manner	• Learn HYSYS • Research commercial continuous production, appropriate conditions, raw materials, and potential alternatives	mjensen@iit.edu (414) 324-0080
Lazicki, Katherine	ChE, 4th	• Works well in a group • Skilled at revising technical papers	Develop communication and presentation skills.	Find a practical way of making the nanorods well before IPRO day comes around, along with successfully presenting the information we get this semester	• Researching new applications for nanorods • Researching current technology used for research applications	klazicki@iit.edu (847) 338-9684

Marcha, Emmanuel	ChE/CS, 2nd	• Able to work in teams • Can use Photoshop and Illustrator • Can use Matlab	Expand on Matlab knowledge and lab techniques	Learn more about the IPRO experience and gain new skills to use in further IPROs	• Learn HYSYS • Format deliverables for final presentation • Design logo • Edit and present final budget	emarcha@iit.edu (773) 315-8114
Mohaimani, Aurash	MBB, 3rd	• Summarization and citation of gathered research • Revision of written work • Public speaking	Acquirement of greater finesse in conducting scientific research and both summarizing and citing sources, and becoming more familiar with research regarding silver nanorod nanotechnology and its potential applications.	Viable production of silver nanorods and potential prototyping of a continuous flow reactor; achievement of sound and cited scientific research regarding nanorods' formation, synthesis, and theoretical applications; project completion and execution of a solid presentation.	• Investigate silver nanorods and their potential applications in healthcare • Revise written work	amohaima@iit.edu (708) 954-7391
Payne, Erica	ChE, 2nd	• creative/artistic contributions • MS Powerpoint	Learn, and expand knowledge of MATLAB, and gain teamwork and time management skills	To come out of this class prepared to participate more in future IPROs	• Help create logo • Keep track of budget • Learn HYSYS • Help edit "Ethics Report"	epayne1@iit.edu
Purcell, Amberl	BME, 4th	• Experience with design concepts • Matlab • Filming and video editing	Learn more about engineering from other majors besides BME	Gain a solid understanding on the basics of nanoparticles/nanorods, learn about any existing medical applications of nanoparticles and/or figure out new applications for these particles, and create a reliable protocol for the production of nanorods.	• Research possible applications for nanoparticles, specifically concerning HIV virus detection • Learn HYSYS	apurcel1@iit.edu (618) 367-2355
Raddatz, Andrew	ChE, 3rd	• Proficient in Matlab • Efficient in MS Office	Ability to work patiently with others and working productively on a group task in such a way that everyone's skills and talents are used to their full potential.	Learning about the different aspects of an IPRO and much more about nano technology . Learning the skills necessary to be a fully active participant in future IPROs.	• Learn HYSYS • Format deliverables for final presentation • Create Matlab animations	araddat1@iit.edu (708) 567-2079
Sever, Michael	BME, 2nd	• Research/lab skills	Gain experience in the lab, produce large-scale amounts of silve nanorods, learn about the construction of nanorods on a molecular level, creating clean and efficient sets of data in the lab	Produce high-quality materials for further experimentation, research and devise new applications for nanorods, and complete tasks on time and with precision	• Work with lab group • Record data obtained	msever@iit.edu
Sizer, Charlie	AMAT, 4th	• Mathematical modeling/ problem solving • Team management skills	develop a broader undertsanding of nano particles and their applications, and ethical implications. Of particular interest is the planning behind scalling the synthesis process up to industrial production.	I expect to work well with an open and motivated team to accomplsh our stated goals while gaining valuable knoledge and experience	• Work in lab • Come up with model	csizer@iit.edu (630) 452-8359

Taracena, Willy	ChE, 4th	• Can use Matlab, MS Word, Excel, and Powerpoint	Develop more speaking skills and learn how to maintain and develop a team	Learning about Nano Technology	• Create and submit budget for approval • Manage Executive Administration Team	wtaracen@iit.edu (773) 344-6330
Tillman, Ryan	ChE, 2nd	• Communication • Leading a group	Learn more about the process of creating and modifying silver nanorods, as well as nanotechnology. Develop good teamworking skills and learn how to effectively lead and be a good member in an IPRO	To do very well on IPRO day, and have all materials prepared ahead of time. Learn many things about nanorods and have a good time.	• Aid in research for scale-up, specifically concerning plug flow reactors • Learn HYSYS	tillmanrj89@gmail.com (405) 639-07891
Vassi, Anna	ChE, 4th	• Communication • Previous lab experience • Can use MS Office and Aspentech Hysys	Learn how nanoparticles are made, be able to improve processess in the lab, and find out about the different applications where nanorods made in this IPRO can be used	Come up with a procedure to improve the quality of nanoparticles andextend their lifetime; good coordination with team members from the same or other disciplines	• Prepare lab schedules • Modify protocols • Coordinate with research groups • Work in lab	avassi@iit.edu
Wiebe, Meghan	ChE, 2nd	• Can use MATLAB, Excel, and PowerPoint • Can work in a group environment • Good at writing and proof reading	Learn how to apply the principles and concepts learned in class on real-life problems, gain exposure to research outside of course labs, increase critical thinking abilities, learn the importance of market demand and monetary resources, learn more about chemical engineering and the skills involved, develop communication skills (including public speaking),build on my ability to work as a successful team member, gain experience in order to take a leadership position in an IPRO in the future	Making a contribution to the area of study (Silver nanorods as indicators of thermal history), each group member to perform tasks on time and do the best of his or her ability; each group member to be open-minded and to take the time to consider the ideas and concerns of others, all work to be professional in its presentation	• Learn HYSYS • Research commercial continuous production, appropriate conditions, raw materials, and potential alternatives	mwiebe@iit.edu (410) 790-4454