Regulated Research Institutional/Industrial Setting Form (1C)

This form must be completed AFTER experimentation by the adult supervising the student research conducted in a regulated research institution, industrial setting or any work site other than home, school or field.

Student's Name(s) Katherine Zhang

Title of Project Dialdehyde Cellulose Nanocrystal Hydrogel Synthesis for Antibiotic Remediation

To be completed by the Supervising Adult in the Setting (NOT the Student(s)) after experimentation:

(Responses must be on the form as it is required to be displayed at student's project booth: please do not print double-sided.)

The student(s) conducted research at my work site:

1. Did you or your proxy (e.g. graduate student, postdoc, employee) mentor or provide substantial guidance to the student researcher? ☑ Yes ☐ No
   a. If no, describe your and/or your institution's role with the student researcher and his/her project (e.g. supervised use of equipment on site without ongoing mentorship and sign below.

   I am Katherine's mentor and provided minimal guidance in her research study. My primary role in her study is to provide support for her and guide her based upon meeting discussions. During weekly group meetings, Katherine created professional presentations and presented to the lab group with post-docs, senior scientists, and graduate students. After her presentations, the lab group would give feedback and ask questions to help shape her discussion. Katherine independently collected all the experimental data or her study and was supervised by a graduate student, Xiangyu Huang, who helped in equipment training and also in supporting and guiding her, but did not collect data for her.

   b. If yes, complete questions 2 – 5.

2. Is the student's research project a subset of your ongoing research or work? Use questions 3, 4 and 5 to detail how the student's project was similar and/or different from ongoing research or work at your site. ☐ Yes ☑ No

3. Describe the independence and creativity with which the student:
   a. developed the hypotheses or engineering goals for the research project

Katherine developed the idea for her project based upon her prior research experience in working with hydrogels to prevent leachate (liquid waste) from contaminating water. Upon reading one of the journals published by my lab, Katherine reached out to me proposing the synthesis of a cellulose-based hydrogel for water remediation. My previous work had a secondary pollution limitation when using dialdehyde cellulose nanocrystals (DCNC) that Katherine's proposed idea could help solve. Prof. Ben Hsiao and I helped Katherine shape her idea of creating a sustainable cellulose-based hydrogel to include dialdehyde cellulose nanocrystals, which I had been working with while Katherine provided thoughtful and helpful insight when developing her study. Katherine further proposed to apply the DCNC hydrogel for antibiotic remediation with a plethora of literature review of why the rationale would be a valuable study. My lab has not previously studied antibiotic remediation, but with Katherine's extensive literature search, we allowed her to conduct this study.

   b. designed the methodology for his/her research project

Katherine designed the procedures of her study based upon reading scientific journals of adsorbents and synthesis of hydrogels. She found common experimental procedures among most adsorption studies: adsorption isotherm, kinetics, pH studies, and reusability. She modified all the studies to materials/equipment available and to suit antibiotic remediation accordingly. Based on her thorough previous research in hydrogels, it was evident that Katherine was very experienced and put together a comprehensive procedure composed of preparing varying concentrations of the dialdehyde cellulose nanocrystal to sodium alginate to form the hydrogel, finding the most common hydrogel preparation parameters in literature, and designing the reusability portion of her study. The prepared materials were also characterized via Fourier Transform Infrared Spectroscopy (FTIR), X-ray diffraction analysis (XRD), scanning electron microscopy (SEM), zeta potential analysis, and thermogravimetric analysis (TGA).

   c. analyzed and interpreted data

After data collection, Katherine always promptly analyzed her data using Microsoft Excel and created very comprehensive, organized, and professional figures. Katherine utilized equations from literature searches in order to analyze adsorption isotherm data with the Langmuir and Freundlich models; and to analyze adsorption kinetics with the pseudo-first and pseudo-second models. After calculating the values needed for those models, Katherine used Excel's built-in functions to study the best curve fitting and trends within the data. Katherine was successfully able to interpret her data. She prepared a DCNC-SA hydrogel that showed high efficacy in the adsorption of Doxycycline Hydrochloride (Doxy) and was able to elucidate adsorption mechanisms for the hydrogel. Her study showed promising potential of DCNC-SA and she was able to design relevant applications and future investigations. For example, she designed a prototype of a universal filtration device embedded with DCNC-SA hydrogels to be used in households and in wastewater treatment. Her interpretations were very clear and concise when it came to professional presentations in front of the whole lab group (four senior scientists, two post-docs, eleven PhD students, two master students, and four undergraduate students, and seven other high school students over the summer).

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Regulated Research Institutional/Industrial Setting Form (1C) Continued

Student's Name(s) Katherine Zhang

4. Detail the student's role in conducting the research (e.g. data collection, specific procedures performed). Differentiate what the student observed and what the student actually did.

Katherine started extensively searching prior studies in the synthesis and efficacy of cellulose-based hydrogels for water remediation of persistent pollutants during early March 2018. When she came into the lab, she displayed a deep understanding of the chemistry and experimental procedures. Katherine came everyday Monday through Friday from July 1 until August 20. Including transportation, she would dedicate at least 10 hours to conducting research. On weekdays, her primary focus was on preparing and conducting experiments. On weekends, Katherine would work on her research report, create presentations, and conduct further literature searches. After school started, Katherine has continuously made an effort to communicate with her mentor for feedback on her work. Katherine started a new research application in my study and collected all the data for her study. This includes the preparation of dialdehyde cellulose nanocrystals (DCNC), the synthesis of the DCNC-sodium alginate (SA) hydrogel, material characterization, all adsorption studies, the hydrogel dosage study, and the hydrogel reusability test.

5. Did the student(s) work on the project as part of a group? ☐ Yes ☑ No
If yes, how many individuals were in the group and who were they (e.g. high school students, graduate students, faculty, professional researchers)?

Katherine conducted an independent project. My lab has four senior scientists, two post-docs, eleven PhD students, two master students, and four undergraduate students. There were a total of seven high school seniors in my lab over the summer and each worked on a distinctly different project. Katherine researched the synthesis of a dialdehyde cellulose nanocrystal hydrogel for antibiotic water remediation. No other high school student synthesized the same material nor had the same target pollutant that Katherine introduced to the lab. Katherine was regarded as very skilled and helpful to others- she always offered to help others with their presentations and suggested experiments that would be beneficial to their projects. The students developed friendly relationships and would often study together at the library. Especially at the weekly meetings, it was evident that Katherine developed a good relationship with everyone.

I attest that the student has conducted the work as indicated above and that any required review and approval by institutional regulatory board (IRB/IACUC/IBC) has been obtained. Copies are attached if applicable.
I further acknowledge that the student will be presenting this work publicly in competition and I have communicated with the student research regarding any requirements for my review and/or restrictions of what is publicized.

Xiangyu Huang	Xiangyu Huang Digitally signed by Xiangyu Huang Date: 2019.09.01 15:32:00 -07'00'	PhD Student
Supervising Adult's Printed Name	Signature	Title
Stony Brook University		09/01/2019
Institution		Date Signed (must be after experimentation) (mm/dd/yy)
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