FORM D - IV A INSTRUCTION

The faculty member is encouraged to use a range of evidence demonstrating instructional accomplishment, which can be included in portfolios or compendia of relevant materials.

1. Undergraduate and Graduate Credit Instruction:

Record of instructional activities for at least the past six semesters. Include only actual participation in credit courses (on- or off-campus instruction) or virtual university on-line courses. In determining the "past six semesters," the faculty members may elect to exclude any semesters during which s/he was on leave; additional semesters may be included on an additional page. Fill in or, as appropriate, attach relevant print screen from CLIFMS*.

Semester and Year	Course Number	Credits (Number or Var)	Number of Sections Taught Lec	Rec	Lab	Number of Students	Number of Assistants**	Notes
Fall 2016	CHE481	3.0	1.0	0.0	3.0	47	1	141 SCHs.
Spring 2016	CHE201	3.0	1.0	1.0	0.0	40	1	120 SCHs.
Fall 2015	CHE481	3.0	0.0	0.0	3.0	42	1	SIRS 2.76/4.0 126 SCHs.
Spring 2015	CHE 891	3.0	3.0	0.0	0.0	7	0	SIRS 4.0/4.0 21 SCHs.
Fall 2014	CHE481	3.0	0.0	0.0	3.0	42	1	126 SCHs.
Fall 2013	CHE201	3.0	2.0	2.0	0.0	119	3	Instructor 357 SCHs.
Summer 2013	ME490	5.0	0.0	0.0	0.0	1	0	Faculty Advisor for [redacted] RWTH Exchange Program, Aachen, Germany 5 SCHs.
Fall 2012	CHE201	3.0	3.0	0.0	0.0	96	2	This was taught in two sections; I was the instructor for both sections 288 SCHs.
Spring 2012	CHE201	3.0	3.0	0.0	0.0	46	1	138 SCHs.

(1) Individualized Instruction.

I have taught courses at the Graduate and Undergraduate (Sophomore and Senior) level. The major course taught during the reporting period has been Material and Energy Balances (CHE201), the introductory chemical engineering course for the undergraduate curriculum. As evidenced by my overall effectiveness SIRS scores, the students judged me to be a very effective instructor. I received very high marks on accessibility and approachability. My weakest scores (e.g. FS 2012 1.5/4; 1 being highest) were in explanation of technical material.

I also implemented Honor's Option for CHE201. Students received an Honor's Option for my class if they analyzed and wrote a 5-10 page paper describing a system of interest using material and energy balances techniques learned in class. Five students completed the Honor's Option during SS2016 (the last semester I taught the course).

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[redacted]

FORM D - IV A INSTRUCTION

At the Senior Undergraduate level I have taught Biochemical Engineering Laboratory 3 times (FS2014 joint with [redacted], and FS2015 & FS2016 alone).

At the Graduate level I developed a new course in Synthetic Biology, which I taught for the first time in SS2015. Synthetic biology is a discipline with a stated goal of using engineering principles to redesign biological systems for objectives like enhancing human health, improving agriculture, and biological production of renewable fuels and chemicals. This course presented an overview of synthetic biology. The first weeks of the course established synthetic biology as a discipline separate from engineering and discovery biology. Key enabling technologies were described, and applications utilizing synthetic biology were covered. There were two seminar-style lectures per week, with one class period per week involving a journal club.

Comment on teaching assessment for CHE 481 (FS2015)

I have received above average to excellent teaching evaluations for all course and semesters except for CHE 481 FS 2015. CHE481 is a biochemical engineering laboratory whith 2 hours of lecture and 3 hours of lab per week. I had previously co-taught the course in FS2014 with Prof. [redacted] and received reasonable teaching evaluations. FS2015 was the first time that I taught the course alone. I made several changes to the course lecture content: I rearranged lectures out of order with the textbook used in the course; I gave several "case studies" for biochemical engineering based on real-world processes; I also reorganized the class so that less homework was assigned and the weight on homework assignments was a smaller proportion of the final grades.

The feedback from the course was that the students did not like the organization of lectures - they preferred the order to match book progression. Additionally, students preferred lecture to include more example problems and less emphasis on case studies. I also was severely dinged for cancelling lectures at the last minute. In once case in particular, I was asked to serve on an NSF panel the week before finals and cancelled lecture without informing the class ahead of time - this is the first time I have done something like this, and I have learned my lesson. Anecdotally, student performance on the homework was the poorest of any class I have had in my career, which I attribute to the low frequency and weight given on the homework assignments - I had previously had most of the students in CHE 201, and they performed well on homework assignments in that class.

Changes Made:
1. I modified the lectures so that they closely follow the textbook and have included extra problem solving during lecture.
2. I give the class plenty of advance notice and schedule extra office hours before I leave for conferences/ symposia/panels.
3. I have increased the weight and frequency of homework assignments.

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[redacted]

FORM D - IV A INSTRUCTION

SUMMARY OF SIRS DATA

Key: SA - Strongly Agree is valued as 1.0
A - Agree is valued as 2.0
N - Neither Disagree Nor Agree is valued as 3.0
D - Disagree is valued as 4.0
SD - Strongly Disagree is valued as 5.0

Q1: The instructor was available and willing to help the student.
Q2: The instructor explained course material clearly.
Q3: The instructor was well prepared for classes and other related course activities.
Q4: The instructor organized the course well.
Q5: Rate the instructor on a scale of 4.0, 3.0, 2.0, 1.0, 0.0 (where 4.0. is the best rating)

COURSE NUMBER: CHE481
SEMESTER: Fall 2016
ENROLLMENT: 47
NUMBER OF RESPONSES:

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:					

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Fall 2016

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.6	2.03	1.49	1.97	3.35
3XX	1.4	1.85	1.51	1.77	3.56
4XX	1.6	1.93	1.66	1.8	3.42
8XX / 9XX	1.65	2.2	1.84	2.09	3.15

COURSE NUMBER: CHE201
SEMESTER: Spring 2016
ENROLLMENT: 40
NUMBER OF RESPONSES: 29

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	1.41	1.48	1.31	1.34	3.57

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Spring 2016

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.74	2.04	1.68	1.9	3.24
3XX	1.8	2.12	1.87	2.01	3.22
4XX	1.36	1.7	1.64	1.83	3.54
8XX / 9XX	1.33	1.78	1.61	1.71	3.63

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[redacted]

FORM D - IV A INSTRUCTION

COURSE NUMBER: CHE481
SEMESTER: Fall 2015
ENROLLMENT: 42
NUMBER OF RESPONSES: 35

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	2.09	2.34	1.8	2.0	2.76

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Fall 2015

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.95	2.22	1.8	2.1	3.0
3XX	1.78	2.2	1.87	2.08	3.21
4XX	1.6	1.95	1.63	1.82	3.33
8XX / 9XX	1.7	2.34	1.81	2.27	3.14

COURSE NUMBER: CHE 891
SEMESTER: Spring 2015
ENROLLMENT: 7
NUMBER OF RESPONSES: 6

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	1.0	1.17	1.17	1.13	4.0

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Spring 2015

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.9	2.15	1.84	2.03	3.15
3XX	1.51	1.99	1.83	2.02	3.36
4XX	1.45	1.8	1.79	1.9	3.5
8XX / 9XX	1.29	1.68	1.57	1.62	3.7

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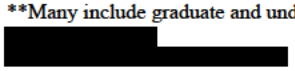

FORM D - IV A INSTRUCTION

COURSE NUMBER: CHE481
SEMESTER: Fall 2014
ENROLLMENT: 42
NUMBER OF RESPONSES:

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	1.7	2.03	1.47	1.87	3.48

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Fall 2014

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.53	1.84	1.59	1.79	3.4
3XX	1.76	2.33	1.84	2.34	3.1
4XX	1.71	2.07	1.74	2.04	3.35
8XX / 9XX	1.22	1.66	1.5	1.57	3.62

COURSE NUMBER: CHE201
SEMESTER: Fall 2013
ENROLLMENT: 119
NUMBER OF RESPONSES: 50

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	1.38	1.9	1.49	1.52	3.47

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Fall 2013

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.48	1.79	1.46	1.67	3.54
3XX	1.68	2.22	1.93	2.12	3.24
4XX	1.43	1.9	1.65	1.82	3.53
8XX / 9XX	1.53	1.95	1.61	1.9	3.46

COURSE NUMBER: ME490
SEMESTER: Summer 2013
ENROLLMENT: 1
NUMBER OF RESPONSES:

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:					

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Summer 2013
Departmental data is not available.

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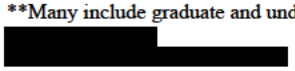

FORM D - IV A INSTRUCTION

COURSE NUMBER: CHE201
SEMESTER: Fall 2012
ENROLLMENT: 96
NUMBER OF RESPONSES: 65

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	1.28	1.51	1.18	1.45	3.72

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Fall 2012

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.69	1.89	1.62	1.75	3.47
3XX	2.06	2.16	2.07	2.28	3.09
4XX	1.36	1.61	1.46	1.48	3.62
8XX / 9XX	1.3	1.79	1.48	1.67	3.7

COURSE NUMBER: CHE201
SEMESTER: Spring 2012
ENROLLMENT: 46
NUMBER OF RESPONSES: 38

QUESTION:	Q1	Q2	Q3	Q4	Q5
AVERAGE:	1.42	1.84	1.47	1.47	3.5

COMPARATIVE DATA FOR ALL DEPARTMENTAL COURSES IN Spring 2012

COURSE LEVEL:	QUESTION				
	Q1	Q2	Q3	Q4	Q5
2XX	1.92	2.33	2.04	2.15	2.96
3XX	1.44	1.81	1.45	1.62	3.57
4XX	1.35	1.83	1.72	1.89	3.59
8XX / 9XX	1.31	1.61	1.32	1.49	3.65

STUDENTS COMMENTS FROM REPRESENTATIVE COURSES (all comments are shown)

CHE 961 SS 2015

The course is well-balanced in terms of appealing to bioth biology/biochem and chemical engineering students. Information & topics presented were basic enough to teach engineering topics to non-engineers and biology material to non-biologists. At the same time, the material was very useful. I was exposed to a lot of techniques and areas of research that I would never have looked into on my own. I would recommend spending slightly less time on gene circuits and nucleic acid assembly techniques and more time on computer-aided protein design or genome scale metabolic model assembly.

This easily has been by far my favorite graduate-level class in my career. [redacted] did a fantastic job teaching this class, and creating an open environment for discussion of topics, where conversations were

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[redacted]

challenging and rewarding. The same can be said of the homework and oral journal club presentations. I know this course has made me a better scientist overall, who is able to critically review primary literature and verbalize ideas in a clever fashion. I know when I look back in several years I will see this as a pivotal moment in my graduate career as a synthetic biologist.

I enjoyed this course a lot. Not an easy class. I felt very challenged, sometimes even frustrated, bit I learned a great deal about a topic I knew barely anything about. The amount of time I spent on assessments was substantial, it is hard to find the time with school and research. however, I can't easily point out which ones should be dropped as they were all good for learning something different. Overall, I will strongly recommend this course to others and hope to continue interacting with Tim over my graduate career.

Overall the class was extremely interesting and very educational. While I enjoyed the class periods my head hurt most days afterward. Maybe that's a good thing though personally, the review paper was the only part that could have been a little less involved. It was a good exercise and good practice but a lot of time and frustration for a paper that only slightly parallels my thesis work. I can see how those with more applicable objects would benefit though.

I liked that [redacted] provided us with multiple opportunities to present papers, independently in front of the class. I also appreciated him challenging the students to dig further into the literature and methodologies used within them in order to develop a better understanding of how scientific research should be done. I really appreciated his breadth of knowledge from both a biological and mathematical perspective, the latter holding more weight with me.

I really enjoyed this course; the course overall helped me improve not only my oral communication skills but also my ability to read & decipher scientific literature. In addition to improving technical skills, this class was a useful knowledge bank that completely broadened & increased my interest & understanding of the field of synthetic biology. Finally, [redacted] was very available after class, at office hours, or upon request to further help explain concepts in the course.

CHE 201 FS2013 Section 002

Kept class engaged by always asking questions, good pace for workload & good assessments of course understanding. Made material easy to learn and kept class interesting/relaxed.

Great teacher. I learned a lot. Not an easy course, but a good one. I never liked doing glossaries or having them due online before class.

Always had office hours and was eafer to help and explain. I just had a hard time personally understanding. Had lectures and questions prepared each day. All the material appeared in a logical order.

Made office hourse well known. Overall did well, although often over-estimated how much material could be covered in one class period.

He had plenty of office hours & was happy to help. He explained himself pretty well. He had an organized lesson plan. The material made sense in the order I learned it. I though it was a well taught and fair class. Working in groups for some of the class problems may have been useful.

Yes had lots of office hours. Good at lecturing in and posting notes online. [redacted] is super coooool.

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[redacted]

He was well prepared for each class, however he moved a little too fast with the material covered so it was hard to follow at times. This was all completely new material to me so I would have liked it if he could go a bit slower while covering material.

He was available for office hours & responded quickly to emails. Bad handwriting. A lot of work for a 3-credit course.

Held ample office hours during the week. Course was well-structured and easy to follow throughout the semester. Had lecture slides ready to go and kept on topic. Very easy to follow and keep up with the course progression.

He was very prompt at answering emails. The lecture was helpful, almost mandatory to do well in the course. He went through all the materials promptly. [redacted] style of dress was distinctly american; one might even say patriotic. I enjoyed how we went through problems in class; one of my favorite being the design of the "Punchkin".

Held office hours every week for students to come in and ask for help. Course was taught at sort of a fast pace but you had the chance to ask questions whenever you felt you needed to. The lectures were well presented. Followed the chapters in the book very well.

He always answers questions and held lots of office hours. He did a good job explaining the course material. He always came prepared to class. He posted all lectures online and made the class easy to follow.

Held regular office hours and would reply to emails quickly. Lectures were clear and easily understood, more examples would have helped. Always outlined what would be done in class at the start of class.

Plenty of office hours. It would be nice at some point in the semester to receive a grade update telling us where we stand, assuming a curve. Since quiz grades were consistently low, it was difficult to figure out how I was actually doing in the class.

For some of the first quizzes it seemed like there was too many questions and not enough time.

Office hours were abundant. Explaining topics in a more detailed form to help every student understand the materials.

Never hesitated to stop and help if you were lost. Thoroughly went through everything until the majority of the class understood. Uses his laptop to teach very well. Everything I needed was easy to find on Angel. Great way to start my CHE courses at State, awesome prof. Nothing much to say, he was a great teacher.

Offered adequate office hours and was helpful during that time. Lectures covered course material fairly well. Communicated well and had lectures always prepared. Distribution of assignments and pace of class covered material well.

Quizzes were challenging and the wording was hard to understand.

Tone down the level of difficulty of quizzes and use more problems on quizzes as well. Very good job this semester it was a pleasure to have you as a professor.

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[redacted]

He would stay after class for questions, had office hours. His handwriting was awful so that made it hard. Always organized with lots of past exams for practice. Angely was nicely organized. You need to work on your handwriting. Many times I was lost because I couldn't read it and then I would be left behind. Do not call on students. I was always so nervous about being celled on that I couldn't focus on the problems. Maybe make the written HW2 a little easier, my group spent 15 hours on it.

Lots of office hours. Seemed like a fast pace. Grading criteria with understanding of the material didn't appropriately match, in my opinion.

Had office hours regularly and often extended them. I think there needs to be a bit more lecture involved before working problems. Always had problems ready to work. Kept things in the order of the book. The homework needs to be more difficult because I was able to do it fairly well and then had problems with the quizzes.

[redacted] has an awesome vocabulary. He was lefit. Very good professor. Learning to make methamphetamine will be the most profitable thing I may learn.

Doing in-class problems was great, but we wasted a lot of time calling on students for answers to problems when the majority clearly didn't know. Book problems also didn't help at all. Lecture was too fast at times, and we were expected to make assumptions that no one know because this is an introductory course.

Sufficient office hours. Very knowledgable, typically clear in explanation and easy to understand. Whitehead stated that attendance was critical at start of semester: ended up being very true.

Provided office hours 2x a week, and additional office hours during exam/quiz weeks. Material was explained but oftentimes quiz and homework questions were WAY more in depth than the lectures. Lectures were always prepared ahead of time. Good breakdown of course. Good amounts of homework, fair amounts of quizzes. Amount of time spent outsider of class in attempt to learn concepts, do the homework assignments, etc was outrageous. Homework problems would take an hour (at best) to finish, with up to 7 problems per assignment. Presentability is key when teaching. [redacted] jumped & bounced around a lot which was slightly distracting. Sometimes, I received an arrogant, non-accepting vibe when trying to ask questions one-on-one.

Always welcome to questions. Good teaching. Whiteboard thing was cool. Yo went well.

Had great accessibility through office hours. Preluded into material with real world applications before giving lecture. Setup outlines of each lecture tasks and points to cover. Provided thorough reminders for all assignments. Some lectures seemed to be rushing the class along.

Office hours, Sloppy lecture notes, Online homework grading wasn't ideal....merry christmas.

He had good office hours as well as setting up review sessions with OXE. By his explanations the material was very easy to understand. The mark of preparedness is you never notice it. The course progresses naturally, but because it follows the textbook. That homework turnaround was uncanny.

He always tells us his office hours. Uses examples to better show what he just lectured. Although he forgot his lecture notes that one day, he continued to lecture through the book. Lecture correlates to the previous lectures we've had.

He had office hours and answered questions after class. Nothing was crammed in at the end.

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[redacted]

Held office hours answered questions after class. Step-by-step problems - logical, well-organized. Planed lectured well to allow for time to think out problems before example. Interesting examples, sufficient problem prep. Recitations could be restructured - perhaps grouping into teams to solve problems (to break the silence that the TAs often face, and more actively pool student insight). I liked this approach when it was used in lecture; it could be used more often, I think.

Honestly this is one of the best classes/prof. I've ever had. It makes me (whatever the opposite of regret is) going into the CHEME major. The only think I have to say is that I didn't get how much info while solving problems in class. Sapling helped me more when doing school problems.

He always had lots of office hours. It was a tough subject but he was able to explain everything pretty good. I think overall the class was taught very well. It was hard at first getting use to everything but it didn't take long to get in the swing of things.

Made a plethora of office hours.

Yes had extensive office hours. Yes I fell as if the lectures should have been longer than 50 minutes. There was a logical flow of information. I feel like this class should be 1 hour and 20 minutes long (I know this isn't your fault). I feel as more time would allow us to actually finish examples.

He offered office hours and time outside for schedule conflicts. At times yes however there was some confusion. There was always a clear idea of what we were learning. Everything was very organized. I believe he was well prepared for every class and tried to get everyone involved. He was very energetic about class and tried to get me to think vs. giving me the answer.

Yes but not always the most helpful. Kind of expected us to know some starting material. Was prepared for lecture but was kind of like a robot. Exams were a little much to do by our selves. I fell as though Prof [redacted] expected us to know more than what a lot of us actually know (ex. I haven't taken physics yet), also the exams were a lot to handle un such a short period of time. Realistically these problems were evaluated over longer periods of time and w/ more resources. I do not think my grade (2.0) reflects how much time, effort, and knowledge of this subject.

Good course structure, but I think [redacted] needs to teach more of an upper level course because I think he is too smart to teach this course - he cannot break it down. The quizzes are not a good measure of course mastery, they are too hard - harder than book problems and Sapling problems.

I felt this class should be fairly straightforward and after every lecture I was more and more confused. The online homework had nothing to do with the exams and did not help me in the class. The written homework was way to challenging and did not help either. The course material was confusing and not displayed well.

I thought the workload was appropriate and the concepts were explained clearly. Some of the homework problems online were pretty easy and felt like they didn't contribute to my understanding. Overall I thought this was a well-organized and taught class.

[redacted] moves very quickly in class. I couldn't keep up with him.

Held office hours often and was willing to work around student's schedules! Correctly emphasized the most important material and provided ample problems to learn it. There was never a question to whether

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[redacted]

he would show up on time with prepared material. Everything followed a logical order and the problems given helped with mastery of the material. I would gladly take another class with [redacted] he was understanding and concerned that anyone who wanted to learn the material could learn it.

Forced students to learn 1st. Slow down please! The course went to fast at times & feel a lot of people were left behind. Also I feel like discussion is great but maybe solve & example & explain 1st before asking students to solve. Slow down while doing that would help a lot! I just feel every class was us talking trying to figure it & not learning. Great job tho! I hope I pass!

CHE481 FS2014

The lab portion was unoganized and did not apply very well to the course

Please slow down for your students or post notes with annotations it is difficult to keep up when writing and if you do not get it all down it is gone forever. Also grade a little more leniently. Thank you.

Don't call out on people randomly in class to answer questions. Especially in morning classes!

Instructor was available outside of class but did not go out of his way to help students. No, often went on tangents of advanced material when more explanations of the basics were needed. The instructor was well prepared for classes. The instructor organized the course well. More example problems would be helpful. Labs did not apply material from the course they should have been more bio-based.

[redacted] was very passionate about teaching the class and shows great ambition for the future. However, in order to teach those who don't already know the material it would be helpful to slow down while teaching. Wait for everyone to grasp the idea and then move forward. Otherwise, great teacher!

[redacted] is an excellent professor. I have had him in a previous course so I took this course knowing it would be verty well-taught. The course itself was very useful for learning biochemical processes and their purposes in industry.

Speaks too fast sometimes, hard to understand.

He was helpful at times. Cared more about his own work at other times. Would explain a lot of friends stories. A lot of homework didn't relate that strongly to what was taught in class.

Always available in office hours. I really enjoyed [redacted] again. He is a great professor who explains course material at a level that I can understand. He is engaging during class and extremely helpful during office hourse.

[redacted] did a great job of clearly explaining concepts in a manner which kept me engaged and interested in the course material. He was also very helpful and willing to assist me on concepts and homework I was confused on.

Great in office hours. Used a lot of class involvement which worked very well. I enjoyed this course.

I enjoyed the course. In the future I would like more on what is currently being done like the NPR piece we did on HW5.

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[redacted]

FORM D - IV A INSTRUCTION

More examples please. Be more open/friendly.

Very informative and interesting class. [redacted] is very up-to-date with current biotechnology and extremely knowledgeable in the field.

In class material often very different and/or unapplicable to homework assignments.

2. Non-Credit Instruction:

List other instructional activities including non-credit courses/certificate programs, licensure programs, conferences, seminars, workshops, etc. Include non-credit instruction that involves international comparative, or global content delivered either to domestic or international groups, either here or aboard.

Workshops

Workshops attended, teaching essentials for MSU STEM faculty:
*Promoting Student Success in the Classroom
[redacted]
Thursday, March 24, 2016 12:00 - 2:00 PM
Lake Huron Room, Union

Non-Credit Domestic Instruction

*Faculty co-advisor of MSU internationally genetically engineered machines (iGEM) synthetic biology group. Initiated the group on campus, advised on student-directed research, and solicited research funding from University and College sources.
OUTCOMES: MSU iGEM team won a Bronze medal at the world iGEM competition; has been invited to submit a research article for the peer-reviewed Journal of Visualized Experiments.
11-06-2015

Biosystems Engineering 485 - leading two groups of three students apiece on Senior Design Projects. Formulated and proposed a unique biomedical engineering design project, advising students weekly, and grading bi-weekly assignments. (2013-2014)

Biosystems Engineering 485 - leading a group of three student on Senior Design Project.(2014-2015)

Biosystems Engineering 485 - leading a group of five students on Senior Design Project.(2016-current)
08-28-2013 - 04-22-2014.

• Biosystems Engineering Mentor, Senior Design Project – Dec 2012 – April 2013. Met with 3 students on a monthly basis to direct research for senior design project investigating improvements to DNA extraction from dried blood spots.
12-07-2012 - 04-19-2013.

3. Academic Advising:

a. Faculty member's activity in the area of academic advising. The statement may include commentary on supplementary materials such as recruitment activities, international student advising, evidence of peer recognition, and evidence of student recognition.

† Represents entries after last action.

Undergraduate:

*Consult departmental staff who are authorized to enter data on the web-based CLIFMS (Course Load, Instruction, Funding and Modeling System) system and can search for course sections and enrollments by faculty name, per semester.
**Many include graduate and undergraduate assistants, graders, and other support personnel.

[redacted]

FORM D - IV A INSTRUCTION

[redacted]

Graduate:

Ph.D. Students

[redacted]

MS Students

[redacted]

Graduate/Professional:

[redacted]

Other:

Visiting Student/Researchers

[redacted]

*Consult departmental staff who are authorized to enter data on the web-based CLIFMS (Course Load, Instruction, Funding and Modeling System) system and can search for course sections and enrollments by faculty name, per semester.
**Many include graduate and undergraduate assistants, graders, and other support personnel.

[redacted]

[redacted]

High School Students

[redacted]

Highlights for Undergraduate Researchers.

o 9 undergraduate/high school students have been co-authors on submitted or published peer-reviewed journal articles.
o 3 undergraduates/high school students have been 1st authors on peer-reviewed journal articles.
o 3 former undergraduates are currently enrolled in PhD programs.
[redacted] (current student) was 2015 Goldwater nominee for MSU and won honorable mention in the national competition.
[redacted] (current student) won best presentation at the Gulf Coast Undergraduate Research Symposium at Rice University Oct 2016.

Peer Recognition of Graduate and PostDoctoral Students

o [redacted] (postdoc) won a NIH postdoctoral fellowship.
o [redacted] won best poster award at the international conference peptalk (San Diego, CA Jan 2016).
[redacted] was 2016 Fitch Beach CHEMS nominee and won 3rd prize graduate student award for the College of Engineering.
[redacted] won a 2015 USDA NIFA predoctoral fellowship.
o [redacted] and [redacted] both won NIH T32 Plant Biotechnology Training Grant Fellowships.
o [redacted] won best poster award at Protein Engineering Canada (Ottawa, CA July 2016).
o [redacted] won DOE graduate student fellowship to conduct research at NREL in Golden, CO (Summer 2015)
o [redacted] won best poster award at AIChE national meeting (Food, pharmaceuticals, and bioengineering division) Nov 2016

b. Candidate's undergraduate advisees (if applicable to individual under review):

	Freshman	Sophomore	Junior	Senior
Number of current undergraduate advisees	1	0	1	1
Number of Honors Students (all years)	2	0	0	3

*Consult departmental staff who are authorized to enter data on the web-based CLIFMS (Course Load, Instruction, Funding and Modeling System) system and can search for course sections and enrollments by faculty name, per semester.
**Many include graduate and undergraduate assistants, graders, and other support personnel.

[redacted]

FORM D - IV A INSTRUCTION

c. Candidate's graduate/graduate-professional advisees (limit to principal advisor or committee chairpersonship status):

	Masters	Doctoral	Professional
Number of students currently enrolled or active	0	4	0
Number of graduate committees during the reporting period	0	6	
Degrees awarded during the reporting period	1	2	
Degrees awarded during career	1	2	

Number of Masters degree students as chairperson of advisory committee or as thesis/dissertation advisor

	Course Option	Project Option	Thesis Option
Number of students currently enrolled or active	0	0	0
Number of M.S. committees during the reporting period			0
Degrees awarded during the reporting period	1	0	0
Degrees awarded during career	1	0	0

4. List of Instructional Works:

List publications, presentations, papers, grants received (refer to Form D-IVE), and other works that are primarily on support of or emananting from instructional activity.)

5. Other Evidence of Instructional Activity:

Cite other evidence of instructional productivity such as works/grants in progress or under review (refer to Form D-IVE). Address instructional goals and approaches; innovative methods or curricular development; significant effects of instruction; and curatorial and patient care activities, etc. Include evidence of instructional awards and peer recognition (within and outside the university).

Curricular Developments

o I developed and taught a new Graduate course in Synthetic Biology. This course was taught in Spring 2015.

Instructional Awards and Peer Recognition

The MSU iGEM team that I advise was featured in MSUtoday on Dec. 21, 2016:

[redacted]

*Consult departmental staff who are authorized to enter data on the web-based CLIFMS (Course Load, Instruction, Funding and Modeling System) system and can search for course sections and enrollments by faculty name, per semester.

**Many include graduate and undergraduate assistants, graders, and other support personnel.

[redacted]

FORM D - IV B RESEARCH AND CREATIVE ACTIVITIES

1. List of Research/Creative Works:

Attach a separate list of publications, presentations, papers, and other works that are primarily in support of or emanating from Research and Creative Activities. Indicate how the primary or lead author of a multi-authored work can be identified. The list should provide dates and, in particular, accurately indicate activity from the reporting period. Items to be indentified:

1) Books
2) Book chapters
3) Bulletins or monographs
4) Reviewed archival journal publications
5) Other journal publications
    a) Non-reviewed publications
    b) Manuscripts accepted for publications
6) Reviewed conference proceedings
    a) Full publication review
    b) Abstract reviewed
7) Non-reviewed conference proceedings
    a) Invited papers/presentations
    b) Submitted papers/presentations
8) Technical reports
9) Reviews
10) Patents
11) Federally registered copyrighted software
12) Other creative works such as report, bulletins, and documented software packages (both unregistered protected and public domain)

The list should be in chronological order by category with the most recent work listed first. Place an asterisk (*) in the left margin on the first line of those entries, which were invited. Place a dagger (†) in the left margin on the first line of those entries completed since the previous action. Indicate the following co-authors with the following: students or post-doctoral students with a superscript (1), candidate's thesis adviser with a superscript (2), lead author(s) with a superscript (3). Scholarly works pertaining to teaching and public service should be included in this section; place a double dagger (‡) in the left margin on the first line of these entries.

Reviewed archival journal publications

[redacted] Deep sequencing methods for protein engineering and design," *Current Opinion in Structural Biology,* Vol. 45, No. 36, pp. 44, (2017)

[redacted] "Plasmid-based single-pot saturation mutagenesis," *Nature Methods,* (November 2016)

[redacted] "Determination of binding affinity upon mutation for type I dockerin-cohesin complexes from Clostridium thermocellum and Clostridium cellulolyticum using deep sequencing," *PROTEINS,* (October 2016)

4. † [redacted] **(3)** "Haplotype-phased synthetic long reads from short-read sequencing," *PLOS ONE,* Vol. 11, No. 1, pp. e0147229, (2016)

5. [redacted] "High-throughput evaluation of synthetic metabolic pathways," *Technology,* (2015)

[redacted]

[redacted] Introduction to RosettaCON Special Collection," *PLoS ONE,* (2015)

[redacted] "Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing," *Journal of Biological Chemistry,* pp. 26457--26470, (2015)

[redacted] "Removal and upgrading of lignocellulosic fermentation inhibitors by in situ biocatalysis and liquid-liquid extraction," *Biotechnology and bioengineering,* pp. 627--632, (2015)

[redacted] "Computational redesign of the lipid-facing surface of the outer membrane protein OmpA," *Proceedings of the National Academy of Sciences,* pp. 9632--9637, (2015)

[redacted] "High-Resolution Sequence-Function Mapping of Full-Length Proteins," *PloS one,* (2015)

[redacted] "Comprehensive sequence-flux mapping of a levoglucosan utilization pathway in E. coli," *ACS Synthetic Biology,* (2015)

[redacted] "Producing Glucose 6-Phosphate from Cellulosic Biomass STRUCTURAL INSIGHTS INTO LEVOGLUCOSAN BIOCONVERSION," *Journal of Biological Chemistry,* pp. 26638--26648, (2015)

[redacted] "Lignin triggers irreversible cellulase loss during pretreated lignocellulosic biomass saccarification," *Biotechnology for Biofuels,* Vol. 7, No. 175, Other Information: in press, (2014)

[redacted] "The interrelationship between promoter strength, gene expression, and growth rate," *PLoS ONE,* Other Information: DOI: 10.1371/journal.pone.0109105, (2014)

[redacted] "Computational design of novel protein binders and experimental affinity maturation," *Methods Enzymology,* Vol. 523, pp. 1-19, (January 2013)

[redacted] [3] "Optimization of affinity, specificity, and function of designed Influenza inhibitors using next generation sequencing," *Nature Biotechnology,* Vol. 30, No. 6, pp. 543-8, Other Information: doi: 10.1038/nbt.2214, (2012)

[redacted] "Community-wide assessment of protein-interface modeling suggests improvements to design methodology," *Journal of Molecular Biology,* Vol. 25, No. 414, pp. 289-302, (2011)

[redacted] "Computational design of proteins targeting the conserved stem region of influenza hemagglutinin," *Science,* (2011)

[redacted] [3] "Hotspot-centric de novo design of protein binders," *Journal of Molecular Biology,* (2011)

[redacted] [3] "Rosetta in CAPRI rounds 13-19," *PROTEINS,* Vol. 78, No. 15, pp. 3212, (2010)

[redacted]

[redacted] "Tying up the loose ends: circular permutation decreases the proteolytic susceptibility of recombinant proteins," *Protein Eng Des Se,* Vol. 22, No. 10, pp. 607-13, (2009)

[redacted] **(3)** "Biotemplated metal nanowires using hyperthermophilic protein filaments," *Small,* Vol. 5, No. 18, pp. 2038-42, (2009)

[redacted] "Mechanical nanosensor based on FRET within a thermosome: damage-reporting polymeric materials," *Angew Chem Int Ed Engl ,* Vol. 48, No. 31, pp. 5666-9, (2009)

[redacted] **(2) (3)** "Rational shape engineering of the filamentous protein gamma prefoldin through incremental gene truncation," *Biopolymers,* Vol. 91, No. 6, pp. 495-503, (2009)

[redacted] "Controlling the self-assembly of a filamentous hyperthermophilic chaperone by an engineered capping protein," *Small,* Vol. 4, No. 7, pp. 956-960, (2008)

[redacted] A filamentous molecular chaperone of the prefoldin family from the deep-sea hyperthermophile Methanocaldococcus jannaschii," *Protein Science,* Vol. 16, No. 4, pp. 626-634, (2007)

[redacted]
(2) (3) "Transcriptional profiling of the hyperthermophilic methanarchaeon Methanococcus jannaschii in response to lethal heat and non-lethal cold shock," *Environmental Microbiology,* Vol. 7, No. 6, pp. 789-797 , (2005)

[redacted] "Minimal protein-folding systems in hyperthermophilic archaea," *Nature Reviews Microbiology,* Vol. 2, No. 4, pp. 315-324 , (2004)

Other journal publications: Non-reviewed publications

[redacted] **(3)** "Interpreting deep mutational scanning data resulting from plate-based selections," *bioRxiv,* Vol. 087072, (2016)

Other journal publications: Manuscripts accepted for publication

[redacted] "Insights into cellulase-lignin non-specific binding revealed by computational redesign of the surface of green fluorescent protein," *Biotechnology & Bioengineering,* (October 2016)

Non-reviewed conference proceedings: Invited papers/presentations

[redacted] "Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing," *Cancer Immunology Havana, Cuba,* (October 2016)

[redacted] Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing," *PEGS, Boston, MA,* (April 2016)

[redacted] "High throughput conformational epitope mapping to guide design of structure-based vaccines," *Biochemical and Molecular Engineering Conference XIX, Puerta Vallarta, Mexico,* (June 2015)

Non-reviewed conference proceedings: Submitted papers/presentations

[redacted] "Improving Synthetic Metabolic Pathway Yields and Productivities Using a Hybrid Computational/Experimental Approach to Increase Enzyme Solubility," *International Conference on Biomolecular Engineering,* (2017)

[redacted] "Fitness Landscapes for an Enzyme on Multiple Substrates," *Annual Meeting of American Institute of Chemical Engineers,* (November 2016)

[redacted]
(3) "Using Protein Design to Evaluate the Relationship Between Protein Surface Potential and Protein-Lignin Binding for the Eventual of Low Lignin Binding Cellulases," *Annual Meeting of American Institute of Chemical Engineers,* (November 2016)

[redacted]

[redacted] "Enzyme Redesign is Unsurprisingly Difficult," *RosettaCON Leavenworth, WA,* (August 2016)

[redacted] "Studying TROP2 Activation Using Deep Mutational Scanning and Panels of Antibody Fragments," *Protein Engineering Canada (Ottawa, CA),* (July 2016)

[redacted] "Deep Sequencing Methods for Protein Engineering and Design," *Protein Society, Baltimore, MD,* (July 2016)

[redacted] "Deep Sequencing Methods for Protein Engineering and Design," *Protein Engineering Canada, Ottawa, Canada,* (June 2016)

[redacted] "High-throughout conformational epitope mapping by deep sequencing for antibody discovery," *Annual Meeting American Chemical Sociert BIOT Division, San Diego, CA,* (March 2016)

9. [redacted] "Deep sequencing-guided assessment and computational design of synthetic metabolic pathways," *Annual Meeting American Chemical Sociert BIOT Division, San Diego, CA,* (March 2016)

[redacted] "High-Throughput Conformational Epitope Mapping to Guide Design of Structure-Based Vaccines," *AIChE Midwest Regional Conference,* (March 2016)

[redacted] "Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing," *PepTalk, San Diego, CA,* (January 2016)

[redacted] "Deep sequencing-based protein engineering to optimize functional enzyme expression in synthetic metabolic pathways," *2016 Synthetic Biology: Engineering, Evolution & Design (SEED), Chicago, IL,* (2016)

[redacted] "Deep Sequencing-Based Protein Engineering To Optimize Functional Enzyme Expression In Synthetic Metabolic Pathways," *USDA NIFA Fellowship Project Directors' Meeting, Washington, DC,* (2016)

[redacted] "High-throughput conformational epitope mapping for antibody discovery," *MSU Innovation Celebration, East Lansing, MI,* (2016)

[redacted] "Designing Novel Wax Ester Synthases for Biodiesel Production," *Undergraduate Poster Competition AIChE Annual Meeting, Salt Lake City, UT,* (October 2015)

[redacted] "Exploring sequence-specificity determinants of enzymes through deep mutational scanning," *5th Annual Symposium on Plant Biotechnology for Health and Sustainability, East Lansing, MI,* (September 2015)

[redacted] "Rapid Fine Comprehensive Conformational Epitope Mapping. Poster.," *Symposium on "Plant Biotechnology for Health and Sustainability" October 9, 2015 East Lansing, MI,* (September 2015)

[redacted] "Using quartz crystal microbalance to correlate protein surface properties to nonspecific protein-substrate binding," *University of Michigan and Michigan State Chemical Engineering Blue Green Seminar, Ann Arbor, Michigan,* (August 2015)

[redacted] "Rapid Fine Comprehensive Conformational Epitope Mapping," *Blue Green Seminar September 17, 2015. Ann Arbor, MI,* (August 2015)

[redacted] "Rapid Fine Comprehensive Conformational Epitope Mapping. ," *Drug Discovery and Development in Michigan September 9, 2015. East Lansing, MI,* (August 2015)

[redacted]

[redacted] "Comprehensive sequence-flux mapping of metabolic pathways in living cells," *RosettaCON, Leavenworth WA,* (June 2015)

[redacted] (1) "Rapid fine conformational epitope mapping for antibody-antigen structure prediction," *RosettaCon July 30, 2015. Leavenworth, WA,* (June 2015)

[redacted] "Exploring sequence-specificity determinants of enzymes through deep mutational scanning," *RosettaCON, Leavenworth, WA,* (June 2015)

[redacted] " Conformational Epitope Mapping of the TNFalpha-Infliximab Interaction," *RosettaCON; Leavenworth, Washington.,* (June 2015)

[redacted] "Going deep with biomolecular engineering and design," *CHEMS annual research forum, East Lansing, MI,* (April 2015)

[redacted] "Exploring sequence-specificity determinants of enzymes through deep mutational scanning," *12th Annual ChEMS Department Research Forum, East Lansing, MI,* (April 2015)

[redacted] "High-throughput conformational epitope mapping to guide design of structure-based vaccines," Chemical Engineering and Materials Science Department Research Forum May 14, 2015; East Lansing, MI., (April 2015)

[redacted] "Designing Novel Wax Ester Synthases for Biodiesel Production," *UURAF (University Undergraduate Research and Arts Forum) Michigan State University, East Lansing, MI,* (March 2015)

[redacted] "Exploring sequence-specificity determinants of enzymes through deep mutational scanning," Graduate Engineering Research Symposium, East Lansing, MI, (March 2015)

[redacted] "Sequence Function Mapping of Full-Length Protein Sequences," AIChE National Meeting, Atlanta, GA, (October 2014)

[redacted] "Going Deep with Biomolecular Engineering and Design," AIChE National Meeting, Atlanta, GA, (October 2014)

[redacted] "Haplotype-phased synthetic long reads from short-read sequencing of homologous mixtures," *Blue/Green Forum, East Lansing, MI,* (October 2014)

[redacted] "Long read DNA sequencing technology," *MichBio Annual Conference, Detroit, MI,* (August 2014)

[redacted] "Identifying rare combinations of mutations in HIV patients to predict drug resistance," *MSU Board of Trustees, East Lansing, MI,* (July 2014)

[redacted] "Optimizing physical properties of enzymes using deep mutational scanning," *RosettaCON, Leavenworth, WA,* (July 2014)

[redacted] "Correlating surface properties to nonspecific binding: GFP as a tag in lignocellulosic biofuel production," *RosettaCON, Leavenworth, WA,* (July 2014)

[redacted] "High Resolution Sequence Function Mapping of Proteins," MSU Engineering Research Symposium, East Lansing, MI, (April 2014)

[redacted] "Correlating surface properties to nonspecific binding: GFP as a tag in lignocellulosic biofuel production," CHEMS Department Research Forum, Lansing, MI, (April 2014)

[redacted] "High-resolution sequence-function mapping of full proteins," *MSU Engineering Graduate Research Symposium, Lansing MI ,* (February 2014)

[redacted]

[redacted] "Optimizing pathway flux by simultaneous protein and promoter engineering," *Annual meeting of the American Chemical Society, Dallas, TX, BIOT section,* (February 2014)

[redacted] "Biochemical Production of High-Value Products From Pyrolyzed Woody Biomass By Design of Catabolic Pathways," *National Meeting of the American Institute of Chemical Engineers, San Francisco, CA* , (2013)

[redacted] "Deep mutational scanning as a new tool for protein sequence/function relationships," AIChE National Conference, Minneapolis, MN, (September 2011)

[redacted] "Computational design of proteins targeting the conserved stem region of influenza hemagglutinin," *AIChE National Conference,* Minneapolis, MN, (September 2011)

[redacted] "Leave no amino acid unturned: de novo design, directed evolution, and fitness landscape exploitation leads to potential Influenza therapeutics," *RosettaCON,* RosettaCON, Leavenworth, WA, (July 2011)

Patents

[redacted] "Plasmid-based single-pot saturation mutagenesis," PatentNumber: 62/380717, PatentStatus: Provisional, (August 2016)

[redacted] "Polypeptides for treating and/or limiting influenza infection," PatentNumber: 9388217, (July 2016)

[redacted] Methods for assembling and reading nucleic acid sequences from mixed populations," PatentNumber: 14947988, PatentStatus: Application, (November 2015)

[redacted] "Polypeptides for treating and/or limiting influenza infection," (2015)

[redacted] "Heterologous Expression of Extremophile Heat Shock Proteins and Chaperones in Microorganisms to Increase Tolerance to Toxic Compounds," Other Information: US Patent 8,685,729, (2014)

[redacted] "Polypeptides for treating and/or limiting influenza infection," Other Information: US Patent 8,765,686, (2014)

Publication Highlights:

Provide an annotated list of **up to five** most significant scholarly works. (Place a dagger (†) in the left margin on the first line of those entries that were completed since the previous action.) The annotation should very briefly describe the work and its special significance.

1. [redacted] **"Plasmid-based single-pot saturation mutagenesis ," *Nature Methods,* (November2016)**

In this publication we present Nicking Mutagenesis, a single-day, single-pot method for construction of user-defined mutagenesis libraries using routinely prepped plasmid dsDNA as input substrate. Reproducibility of the method is demonstrated through validation by an external research laboratory. Before publication the method was requested by 19 independent labs, including the NIH Vaccine Research Center and at academic institutions like UC-Berkeley, Univ. Washington, Stanford, and Johns Hopkins. Since publication, 4 institutions (including Oxford Univ.) have requested the positive control plasmid used in the work.

2. [redacted] **"Haplotype-phased synthetic long reads from short-read sequencing ," *PLOS ONE,* Vol. 11, No. 1, pp. e0147229, (2016)**

Next-generation DNA sequencing has revolutionized the study of biology. However, the short read lengths of the dominant instruments complicate assembly of complex genomes and haplotype phasing of mixtures of similar

[redacted]

sequences. In this manuscript we demonstrate a method to reconstruct the sequences of individual nucleic acid molecules up to 11.6 kilobases in length from short (150-bp) reads. We show that our method can construct 99.97%-accurate synthetic reads from bacterial, plant, and animal genomic samples, full-length mRNA sequences from human cancer cell lines, and individual HIV env gene variants from a mixture. This is important because our approach generates sequencing libraries in three days from less than one microgram of DNA in a single-tube format without custom equipment or specialized expertise.

[redacted] **"Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing ,"** ***Journal of Biological Chemistry,*** **pp. 26457--26470, (2015)**

Knowledge of the fine location of neutralizing and non-neutralizing epitopes on human pathogens affords a better understanding of the structural basis of antibody efficacy, which will expedite rational design of vaccines, prophylactics, and therapeutics. Here we show such an approach that combines comprehensive mutagenesis, cell surface display, and DNA deep sequencing. We develop analytical equations to identify epitope positions and show the method effectiveness by mapping the fine epitope for different antibodies targeting TNF, pertussis toxin, and the cancer target TROP2. In all three cases, the experimentally determined conformational epitope was consistent with previous experimental datasets, confirming the reliability of the experimental pipeline.

[redacted] **"Computational redesign of the lipid-facing surface of the outer membrane protein OmpA ,"** ***Proceedings of the National Academy of Sciences,*** **pp. 9632--9637, (2015)**

Advances in computational design methods have made possible extensive engineering of soluble proteins, but designed membrane proteins await improvements in our understanding of the sequence determinants of folding and stability. We applied a residue-level depth potential for membrane proteins to the complete redesign of the lipid-facing surface of E. coli OmpA. Designs with substitutions to up to 60% of the surface did support folding and membrane insertion. This is important because it shows design considerations for de novo membrane protein design.

[redacted] **"Comprehensive sequence-flux mapping of a levoglucosan utilization pathway in E. coli ,"** ***ACS Synthetic Biology,*** **(2015)**

Synthetic metabolic pathways often suffer from low specific productivity, and new methods that quickly assess pathway functionality for many thousands of variants are urgently needed. Here we present an approach that enables the rapid and parallel determination of sequence effects on flux for complete gene-encoding sequences. We use this method to determine the effects of over 8,000 single point mutants of a pyrolysis oil catabolic pathway implanted in Escherichia coli. One design incorporating fifteen beneficial mutations supported a 15-fold improvement in growth rate and greater than 24-fold improvement in enzyme activity relative to the starting pathway. This technique can be extended to improve a wide variety of designed pathways.

2. Quantity of Research/Creative Works Produced:

For each of the categories listed in question one above, list the number of research and creative works produced.

	1	2	3	4	5a	5b	6a	6b	7a	7b	8	9	10	11	12
During the reporting period	0	0	0	19	1	1	0	0	3	44	0	0	6	0	0
During career	0	0	0	28	1	1	0	0	3	44	0	0	6	0	0

[redacted]

FORM D - IV B RESEARCH AND CREATIVE ACTIVITIES

3. Number of Grants Received:
(primarily in support of research and creative activities; refer to Form D-IVE):

During the reporting period: 12 During career: 15

4. Other Evidence of Research/Creative Activity:
Cite other evidence of research and creative productivity such as: seminars, colloquia, invited papers; works/grants in progress or under review (refer to formD-IVE); patents; formation of research-related partnerships with organizations, industries, or communities; curatorial and patient care activities, etc. Include evidence of peer recognition (within and outside the university).

Seminars, Colloquia, Invited Papers

Seminars and Invited Presentations

[redacted] "Programming proteins by deep sequencing and design" Young Scientist Keynote, PEGS, Boston, MA May 2017

[redacted] "Programming proteins by deep sequencing and design" Johns Hopkins Univ. Chemical & Biological Engineering Colloquium Apr 2017

[redacted] "Programming proteins by deep sequencing and design" Wayne State University Chemical Engineering Colloquium Apr 2017

[redacted] "Programming proteins by deep sequencing and design" Univ. Puerto Rico at Cayey RISE program on computational chemistry Jan 2017

[redacted] (2017) "Programming proteins by deep sequencing and design" UC Riverside Chemical Engineering Colloquium Jan 2017

7. [redacted] "Rapid Fine Conformational Epitope Mapping Using Comprehensive Mutagenesis and Deep Sequencing" Cancer Immunology Havana, Cuba Oct 2016

[redacted] "High Resolution Sequence-Function Mapping", 2nd Annual Symposium on Plant Biotechnology for Health and Sustainability, Michigan State University, Oct 2013.

5. [redacted] "Constructing functioning proteins by deep sequencing and design", 2nd Annual Symposium on Plant Biotechnology for Health and Sustainability, Michigan State University, Oct 2013.

4. ([redacted] "High Resolution Sequence-Function Mapping", RosettaCON, Leavenworth, WA. July 2013.

3. [redacted] Constructing protein-protein binders by deep sequencing and design", Defense Threat Reduction Agency, Workshop on "A systems approach to cell-based sensing", Scottsdale, AZ. Dec 2012.

[redacted] "Constructing protein therapeutics by deep sequencing and design", NSF BEACON Center, Michigan State University, May 2012.

[redacted] "Leave no amino acid unturned: de novo design, directed evolution, and fitness landscape exploitation leads to potential Influenza therapeutics", RosettaCON, Leavenworth, WA. Aug 2011.

[redacted]

FORM D - IV B RESEARCH AND CREATIVE ACTIVITIES

Works in progress or under review

[redacted] Fine epitope mapping of two neutralizing antibodies neutralizing the Bordetella adenylate cyclase toxin", under revision at Biochemistry

[redacted] "Comprehensive sequence determinants to substrate specificity for an enzyme", under revision at Nature Communications

[redacted] "Trade-offs between enzyme fitness and solubility illuminated by deep mutational scanning", submitted manuscript under revision at PNAS

[redacted] "Negatively supercharging cellulases render them lignin-resistant", in preparation to ACS Catalysis

*My research group is writing two proposals for the DOE Synthetic Biology Division. These proposals relate to synthesis of recombinant DNA and are the equivalent of $200k per proposal.

Formation of research-related partnerships

I am a co-PI on a DOE pre-proposal in collaboration with [redacted] UC Riverside.

Title: "Plant Systems Design for Bioenergy".
My Contribution: $4 million/5 yrs.

Our work on the evolution of enzyme function has lead to the development of a research-related partnership with [redacted] at the Univ. of Montreal.

We are currently collaborating and plan to use our preliminary data to support grant proposals to:
*NSF BEACON Spring 2017
*NIH NIGMS R21 Spring 2017

Peer recognition

Research in the Press

o National Public Radio (NPR), June 2012. [redacted]

o Ivanhoe Broadcast News, June 2012. "Doctors in Depth" series. Aired in Chicago-area ABC affiliate WLS news, among others, Dec 2012.

o MSU Alumni Magazine, Fall 2012. "New Protein Against the Flu".

o MSU Daily Newspaper, May 2012 "MSU Professor Strives to Fight Flu".

o MSU Today, April 2013 "Faculty Conversations: [redacted]

o Biosystems Engineering Annual Newsletter, Fall 2013 "Writing the genetic formula for the next generation of biofuels"

2013 NSF Career Award

2015 Global Academy Fellow, MSU

2013 MSU Nominee, Beckman Young Investigator Award

Young Scientist Keynote, PEGS Meeting May 2017

Grants Under Review

1. ***High Resolution Protein Sequence-function Relationships,*** project funded by NATL INST OF HEALTH - NIH/ PHS. Co-PIs: [redacted]

[redacted]

2. ***Reconstitution of a platform tropane alkaloid pathway in yeast and tobacco enabled by engineering enzyme solubility ,*** project funded by National Science Foundation. [redacted]

[redacted]

FORM D - IV C SERVICE WITHIN THE ACADEMIC AND BROADER COMMUNITY

1. Service within the Academic Organizations:

a. Service to Scholarly and Professional Organizations:

List significant committee/administrative responsibilities in support of scholarly and professional organizations (at the local, state, national, and international levels) including: elected and appointed offices held; committee memberships and memberships on review or accreditation teams; reports written and submitted; grants received in support of the organization (refer to form D-IVE); editorial positions, review boards and ad hoc review requests; and programs and conferences planned and coordinated, coordinated or served on panel or chaired a session. Include evidence of contributions (e.g. evaluations by affected groups or peers).

Committee Membership and Administrative Responsibilities

Conference organization

o Co-organizer, RosettaCON, Leavenworth, WA Aug 2014. The other co-organizer is [redacted] Rutgers University. This 3-day annual conference detailing improvements and applications of the Rosetta macromolecular design code brings together ca. 170 researchers from over 25 international academic labs and industrial researchers from Biotech companies like Amgen and Genentech.

o Co-organizer, Annual Symposium on Plant Biotechnology, Michigan State University Oct 25-26th, 2016. Other co-organizers are [redacted].

o Co-organizer, 2nd Annual Symposium on Plant Biotechnology, Michigan State University Oct 25-26th, 2013. Other co-organizers are [redacted]

o Co-organizer, Inaugural Symposium on Plant Biotechnology, Michigan State University Oct 4-5th, 2012. Other co-organizers were [redacted]. This two-day symposium had ~160 participants with 6 outside speakers from industry and academia.

Conference panels

o Session Chair, American Institute of Chemical Engineers, Bioengineering Division (2013-2015)

o Session Chair, American Chemical Society, BIOT Division (2016-present)

o Session Chair, afternoon breakout session on “Energy and Sustainability”, MSU CHEMS Research Forum, East Lansing, MI May 2013

o Session Chair, Biomolecular Design I, RosettaCon, Leavenworth, WA July 2013

o Session Chair, Sat morning session, Inaugural Symposium on Plant Biotechnology, Michigan State University, Oct 5th 2012.

o RosettaCommons Executive Committee (2016-present)

Journal Paper and Textbook Review Duties

Ad hoc reviewer for journals
o Current Opinion in Biotechnology
o Genome Biology
o eLife
o ACS Synthetic Biology
o Biotechnology & Bioengineering
o Biotechnology & Bioprocess Engineering
o Biotechnology & Applied Biochemistry
o Proceedings of the National Academy of Sciences, India Section B: Biological Sciences

[redacted]

- o Protein Engineering Design Selection
- o ChemBioChem
- o Scientific Reports
- o PROTEINS
- o Bioresource Technology
- o PLOS ONE
- o Biotechnology Journal
- o Biotechnology for Biofuels
- o Journal Biological Chemistry
- o Energy&Fuels
- o Biochemical Engineering Journal
- o Biotechnology Progress

Review Panels (NSF, NIH, or other)

- o NSF Review Panel Member, Metabolic Engineering and Synthetic Biology, CBET (2013)
- o NSF Review Panel Member, Metabolic Engineering and Synthetic Biology, CBET (2014)
- o NSF Review Panel Member, Metabolic Engineering and Synthetic Biology, CBET (2015)
- o NSF Review Panel Member, Energy for Sustainability, CBET (2014)
- o NIH Review Panel Member, Special Emphasis Panel on Zika Complications (2016)
- o Ad hoc reviewer for Department of Defense Peer Review Medical Research Program Vaccine Development for Infectious Diseases (2016)
- o Ad hoc reviewer for Israeli Science Foundation (2014)
- o Ad hoc reviewer for Israeli Science Foundation (2015)
- o Ad hoc reviewer for Rosetta Licensing Funds (2015)

12-02-2013 - 12-31-2013

b. Service within the University:

List significant committee/administrative responsibilities and contributions within the University. Include service that advances the University's equal opportunity/affirmative action commitment. Committee service includes: appointed and elected university, college, and department ad hoc or standing committees, grievance panels, councils, task forces, boards, or graduate committees. Administrative responsibilities include: the direction/coordination of programs or offices; admissions; participation in special studies or projects; collection development, care and use; grants received in support ot the institution (refer to Form D-IVE), etc. Describe roles in any major reports issued, policy changes recommended and implemented, and administrative units restructured. Include evidence of contributions (e.g., evaluations by peers and affected groups).

College-Level Committees

- o CHEMS representative, Engineering Research Committee – FS2013-current

09-16-2013

- o Chairperson, Engineering Research Committee - FS2016-current.

University-Level Committees

- o NIH T32 Training Grant Executive Committee (2014-present)
- o Review Panel Member, Institutionally Limited (Dec 2014)
- o Science at the Edge seminar series, Engineering representative; Fall 2012-2014

Service to Students Organizations

Undergraduate:

- o Faculty Representative, Omega Chi Epsilon Chemical Engineering Honors Society, Fall 2013-
- o Faculty advisor and co-founder of MSU synthetic biology iGEM team (2016)

[redacted]

FORM D - IV C SERVICE WITHIN THE ACADEMIC AND BROADER COMMUNITY

2. Service within the Broader Community:

As a representative of the University, list significant contributions to local, national, or international communities that have not been listed elsewhere. This can include (but is not restricted to) outreach, MSU Extension, Professional and Clinical Programs, International Studies and Programs, and Urban Affairs Programs. Appropriate contributions or activities may include technical assistance, consulting arrangements, and information sharing; targeted publications and presentations; assistance with building of external capacity or assessment; cultural and civic programs; and efforts to build international competence (e.g., acquisition of language skills). Describe affected groups and evidence of contributions (e.g., evaluations by affected groups; development of innovative approaches, strategies, technologies, systems of delivery; patient care; awards). List evidence, such as grants (refer to Form D-IVE), of activity that is primarily in support of or emanating from service within the broader community.

Outreach

Outreach to Undergraduates

o 2012-current. Faculty presenter, Engineering Connect Program.
o 2012-current. Faculty advisor, Connector Faculty Program.
o 2012-current. Faculty mentor, Engineering Summer Undergraduate Research Experience.
o 2012-current. Faculty advisor, Professional Assistant program.
o 2013-current. Faculty advisor, Summer Undergraduate Research Academy.

Outreach to Pre-College Students

o 2012-current. Faculty Presenter, Alumni Distinguished Scholar Student Recruitment. Gave five talks in total.
o 2012-current. Faculty Presenter, High School Engineering Institute. Developed curriculum and taught over 6 workshops.
o 2012-current. Faculty mentor, High School Honors Program.

Outreach to Underrepresented Minority and Women Students

o 2013-current. Faculty advisor, Summer Research Opportunities Program

[redacted]

FORM D - IV D ADDITIONAL REPORTING

1. Evidence of Other Scholarship:

Cite evidence of "other" scholarship as specified on p.2 in the "summary rating" table (i.e., functions outside of instruction, research and creative activity, and service within the academic and broader community). Address the scholarship, significance, impact, and attention to context of these accomplishments.

Nothing to report

2. Integration across Multiple Mission Functions:

Discuss ways that your work demonstrates the integration of scholarship across the mission functions of the university - instruction, research and creative activities, and service within the academic and broader community.

Nothing to report

3. Other Awards/Evidence:

Cite other distinctive awards, accomplishments of sabbatical or other leaves, professional development activties, and any other evidence not covered in the preceding pages. (If the reporting period differs from the usual period, then justify and support that period here).

Nothing to report

[redacted]

FORM D - IV E GRANT PROPOSALS

List grant proposals submitted during reporting period relating to teaching, research and creative activities, or service within the academic and broader community. Include grants is support of outreach, international, urban, and extension activities.*

Name of Granting Agency (Grantor:) Focus of Grant (Focus:)	Start/ Submit Date	$ Amount Requested	Status			$ Amount Assigned to Faculty Candidate (if Applicable)	Principal/Co-Investigators
			Pending	$ Amt Funded	Not Funded		
Research/Creative Activity							
Grantor: ZOETIS **Focus:** Fine conformational paratope mapping for affinity maturation	10-03-2016/ 03-15-2017	$31,000		$31,000		$31,000 (100%)	[redacted]
Grantor: National Science Foundation **Focus:** REU Supplement to:CAREER: Programming proteins by deep sequencing and design	07-01-2016/ 04-30-2018	$12,000		$12,000		$12,000 (100%)	[redacted]
Grantor: MSU-DFI Discretionary Funding Initiative **Focus:** Deep sequencing of designed operons reveals Pareto optimal growth-associated metabolicpathways	12-02-2015/ 06-30-2017	$50,000		$50,000		$50,000 (100%)	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Plant Biotechnology for Health and Sustainability	09-11-2015/ 06-30-2016	$812,412		$272,722		$27,272 (9%)	[redacted]
Grantor: National Science Foundation **Focus:** REU Supplement to:CAREER: Programming proteins by deep sequencing and design	09-11-2015/ 04-30-2018	$12,000		$12,000		$12,000 (100%)	[redacted]
Grantor: US DEPT AGRICULTURE **Focus:** Development of an Optimized Fermentative Pathway from Levoglucosan to Isobutanol	09-01-2015/ 08-31-2016	$35,518		$35,518		$35,518 (100%)	[redacted]
Grantor: National Science Foundation **Focus:** REU Supplement to:Solving a Sticky Problem: Understanding Enzyme Binding to Lignocellulosic Biomass during Biofuel Production	07-31-2015/ 07-31-2016	$14,683		$14,683		$14,683 (100%)	[redacted]

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[redacted]

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			Pending	$ Amt Funded	Not Funded		
Grantor: MSU MTRAC **Focus:** De Novo Genome Assembly of Polyploids Using a Method for Assembling and Reading Large Contiguous DNA Sequences	01-01-2015/ 07-31-2015	$48,428		$48,428		$48,428 (100%)	[redacted]
Grantor: MICHIGAN INITIATIVE FOR INNOVATION AND ENTREPRENEURSHIP, MICHIGAN ECONOMIC DEVELOPMENT CORP **Focus:** Method for assembling and reading large contiguous DNA sequences from mixed populations	01-01-2014/ 10-31-2014	$69,280		$69,280		$69,280 (100%)	[redacted]
Grantor: JOHNS HOPKINS UNIVERSITY **Focus:** Engineering Nanobody Specificity to Outer Membrane Proteins	09-13-2013/ 08-31-2014	$58,567		$58,567		$58,567 (100%)	[redacted]
Grantor: NATL SCIENCE FOUNDATION **Focus:** CAREER: Programming proteins by deep sequencing and design	05-15-2013/ 05-15-2018	$416,970		$416,970		$416,970 (100%)	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Deep Sequencing to Screen Functional Antibody Epitopes	05-01-2013/ 05-31-2015	$410,036		$356,732		$178,366 (50%)	[redacted]
Grantor: NATL SCIENCE FOUNDATION **Focus:** Solving a Sticky Problem: Understanding Enzyme Binding to Lignocellulosic Biomass during Biofuel Production	09-07-2012/ 07-31-2015	$299,801		$299,801		$149,900 (49%)	[redacted]

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[redacted]

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			Pending	$ Amt Funded	Not Funded		
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Computational Design of Beta-barrel Membrane Proteins	08-20-2012/ 07-31-2013	$104,368		$52,190		$52,190 (100%)	[redacted]
Grantor: ZOETIS **Focus:** Conformational Epitope Mapping to Identify Epitope Walking	05-01-0016/ 12-31-0016	$72,000		$72,000		$72,000 (100%)	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** High Resolution Protein Sequence-function Relationships	11-04-2016	$1,792,678	X	$0		$0	[redacted]
Grantor: National Science Foundation **Focus:** Reconstitution of a platform tropane alkaloid pathway in yeast and tobacco enabled by engineering enzyme solubility	10-14-2016	$600,000	X	$0		$0	[redacted]
Grantor: US DEPT AGRICULTURE **Focus:** Computational Design And Engineering Of Cellulases That Resist Inactivation By Lignin	07-12-2016	$500,000		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** A computational and experimental tool to improve enzyme expression in synthetic metabolic pathways	06-14-2016	$399,510		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Rapid electrochemical assay for Zika, Dengue, and Chikungunya using custom protein binders	04-05-2016	$399,992		$0	X	$0	[redacted]

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[redacted]

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Name of Granting Agency (Grantor:) Focus of Grant (Focus:)	Start/ Submit Date	$ Amount Requested	Status			$ Amount Assigned to Faculty Candidate (if Applicable)	Principal/Co-Investigators
			Pending	$ Amt Funded	Not Funded		
Grantor: PUERTO RICO UNIV OF, NATL INST OF HEALTH - NIH/PHS **Focus:** Designing an improved Tissue-type Plasminogen Activator	03-29-2016	$43,392		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Protein receptors that sense low extracellular pH and activate metastasis	02-22-2016	$144,455		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** A platform technology to map rapid fine conformational epitopes against the Zika and related flavivirus envelope glycoproteins	02-11-2016	$399,932		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Rapid electrochemical assay for Zika, Dengue, and Chikungunya using custom protein binders	02-10-2016	$399,934		$0	X	$0	[redacted]
Grantor: National Science Foundation **Focus:** A computational and experimental tool to improve enzyme expression in synthetic metabolic pathways	11-16-2015	$943,350		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** Protein engineering and design for biosynthesis of alkaloids	09-04-2015	$1,585,383		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** High-throughput conformational epitope mapping to guide design of structure-based vaccines	06-01-2015	$1,583,277		$0	X	$0	[redacted]

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Name of Granting Agency (Grantor:) Focus of Grant (Focus:)	Start/ Submit Date	$ Amount Requested	Status			$ Amount Assigned to Faculty Candidate (if Applicable)	Principal/Co-Investigators
			Pending	$ Amt Funded	Not Funded		
Grantor: Gates, Bill and Melinda Foundation **Focus:** Microbiome editing using modular recruitment of bacteriophage	05-13-2015	$100,000		$0	X	$0	[redacted]
Grantor: MSU-SPG STRATEGIC PARTNERSHIP GRANTS **Focus:** De novo acrylic acid pathways from renewable biomass	02-06-2015	$400,000		$0	X	$0	[redacted]
Grantor: [redacted] **Focus:** Thermostable, Broadly Protective Vaccines for Newcastle Disease Virus using Rational Glycoprotein Immunogen Design	01-15-2015	$1,999,375		$0	X	$0	[redacted]
Grantor: National Science Foundation **Focus:** Collaborative Research: Modular Strain Engineering for Synthesizing Designer Biodiesels from Biomass-Derived Feedstocks	11-04-2014	$150,000		$0	X	$0	[redacted]
Grantor: National Science Foundation **Focus:** High Resolution Sequence Function Mapping of Synthetic Metabolic Pathways	10-30-2014	$300,001		$0	X	$0	[redacted]
Grantor: USDA - NATIONAL INSTITUTE OF FOOD AND AGRICULTURE **Focus:** Biochemical production of high-value products from pyrolyzed woody biomass by design of catabolic pathways	04-17-2014	$100,000		$0	X	$0	[redacted]

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			Pending	$ Amt Funded	Not Funded		
Grantor: MSU-SPG STRATEGIC PARTNERSHIP GRANTS **Focus:** Engineering Improved Hemiterpene Synthases	01-31-2014	$352,830		$0	X	$0	[redacted]
Grantor: NATL INST OF HEALTH - NIH/PHS **Focus:** NIH Pathway to Independence Award	11-07-2013	$945,493		$0	X	$0	[redacted]
Grantor: Beckman Foundation **Focus:** Illuminating fitness landscapes using long contiguous deep sequencing	10-01-2013	$750,000		$0	X	$0	[redacted]
Grantor: Beckman Young Investigator Program **Focus:** Illuminating fitness landscapes using long contiguous deep sequencing	09-30-2013	$750,000		$0	X	$0	[redacted]
Grantor: ENERGY US DEPT OF **Focus:** Bioenergy production by de novo design of metabolic pathways	11-26-2012	$750,000		$0	X	$0	[redacted]
Grantor: NATL SCIENCE FOUNDATION **Focus:** IGERT: Bioelectronic Innovations: From Fundamentals to Societal Challenges	10-12-2012	$3,498,860		$0	X	$0	[redacted]
Grantor: National Science Foundation **Focus:** EFRI-PSBR Preliminary Proposal: A Synthetic Cyanobacterial Co-culture Platform for Flexible Photosynthetic Production of Advanced Fuels and Chemicals	10-10-2012	$1,985,366		$0	X	$0	[redacted]

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Name of Granting Agency (Grantor:) Focus of Grant (Focus:)	Start/ Submit Date	$ Amount Requested	Status			$ Amount Assigned to Faculty Candidate (if Applicable)	Principal/Co-Investigators
			Pending	$ Amt Funded	Not Funded		
Grantor: SEARLE SCHOLARS PROGRAM **Focus:** Design of dynamic regulation and specificity in proteins	09-24-2012	$300,000		$0	X	$0	[redacted]
Grantor: SEARLE SCHOLARS PROGRAM **Focus:** Design of dynamic regulation and specificity in proteins	09-24-2012	$300,000		$0	X	$0	[redacted]
Grantor: NATL SCIENCE FOUNDATION **Focus:** Engineering Novel Isoprene Synthases for Commercial Isoprene Production	09-19-2012	$590,569		$0	X	$0	[redacted]
Grantor: NATL SCIENCE FOUNDATION **Focus:** Decentralized biomass upgrading to energy and commodities by integration of thermochemical, electrocatalytic and biological technologies	02-01-2012	$2,000,000		$0	X	$0	[redacted]
Grantor: National Science Foundation **Focus:** Engineering Novel Isoprene Synthases for Commercial Isoprene Production	09-16-2011	$50,000		$0	X	$0	[redacted]
Service							
Service - Academic Community							
Grantor: NSF BEACON **Focus:** MSU iGEM Synthetic Biology Team	06-01-2016/ 12-30-2016	$12,000		$12,000		$12,000 (100%)	[redacted]

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Promotion-Tenure Data for Fall 2016				
Faculty Name	**Dept**	**Fiscal Year**	**Total Research Expenditures**	**External**
[redacted]	**CHEMS**	**FY 15-16**	$ 278,046	$ 248,185
		FY 14-15	$ 323,726	$ 323,725
		FY 13-14	$ 308,307	$ 287,861
		FY 12-13	$ 102,546	$ 102,546
		FY 11-12	$ -	$ -
		FY 10-11	$ -	$ -
		FY 09-10	$ -	$ -
		FY 08-09	$ -	$ -
		FY 07-08	$ -	$ -
		FY 06-07	$ -	$ -
External = TOTAL minus (DFI, SPG,internal startup funds, govt funded (mostly foreign) students)				