

# STEM field-to-field transitions for a better workforce

*A new scheme called OPEN-NJ at Montclair State University (MSU) means more students will be able to gain interdisciplinary research skills by transitioning from Biology to Chemistry or Biochemistry subjects for graduate-level study. Students in New Jersey with an interdisciplinary education are at an advantage when entering the STEM workforce because the state is home to some biochemical industry giants. Dr Nina Goodey and her collaborators Drs Herbert, Kasner, Krumins, and Siekierka, and Gennae Hinson, have been evaluating the scheme's impact so that other universities can learn from the model.*

This year, millions of students in the United States will make a life-changing decision: choosing a subject for their major.

The sheer number of possibilities is enough to overwhelm, and any decision has implications that will last well beyond the end of their degree. By the time a student graduates, many opportunities in further education may be closed off to them simply because of their major. Even within Science, Technology, Engineering and Mathematics (STEM), a student holding a Bachelor's in one subject will struggle to enrol in a Master's course in another, even if the subjects are closely related and the student has all of the necessary skills to complete the course. For universities, allowing students to transfer to a new specialism

can be too much of a risk: the challenge of learning new material is enough that a student making a field-to-field transition could struggle to achieve high marks, or possibly even drop out before graduating.

## A GROWING PROBLEM

In New Jersey, as is the case in the US nation-wide, there is a shortage of STEM professionals. New Jersey has booming biotechnology and pharmaceutical industries that include the likes of Bayer, Johnson & Johnson and Merck & Co., as well as many smaller companies, all of whom need a steady supply of graduates. These industries are a major component of the state's economic output, and the companies provide job prospects for many New Jersey STEM graduates.

When looking for work in these industries, New Jersey STEM graduates benefit from having an interdisciplinary university education – but often students won't be able to find this kind of opportunity available to them, and so continue in the same specialism at graduate level.

## OPEN-NJ: A NEW TRACK

Dr Nina Goodey, Professor in the Department of Chemistry and Biochemistry at Montclair State University (MSU), and her collaborators Drs Herbert, Kasner, Krumins, Siekierka, and Ms Gennae Hinson, are running a scheme at MSU which creates a new track through university – one that allows students to transition to another discipline between Bachelor's and

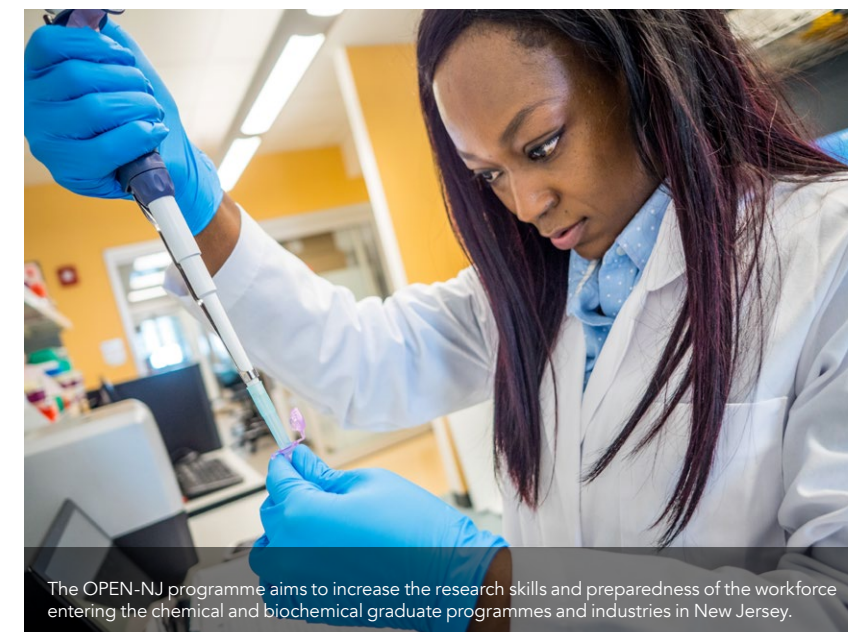


OPEN-NJ fosters interdisciplinary training for their students.

Master's level degrees. To achieve this seemingly simple process has required a multi-faceted approach.

The programme, called 'Opening Pathways, Engaging, and Networking in Chemistry in Northern New Jersey' (OPEN-NJ) has a primary goal to offer a pathway for students to change fields from Biology and related fields to Chemistry and Biochemistry, with a specific goal of fostering interdisciplinary knowledge in their students, so that the New Jersey STEM workforce is well-educated, skilled and diverse.

The bulk of the programme involves creating a Master's level course where talented graduates who majored in Biology can achieve at the same level as those who majored in chemistry. This is tricky because most Biology graduates will not have taken many of the advanced-level Chemistry courses currently required for entrance onto the standard Chemistry Master's programme. Chemistry majors starting the Chemistry Master's programme at MSU score on average 47% on the General Chemistry ACS exam, a test used nationally. In comparison, non-majors score are at a significant disadvantage, answering only 37% of the questions correctly.



The OPEN-NJ programme aims to increase the research skills and preparedness of the workforce entering the chemical and biochemical graduate programmes and industries in New Jersey.

To counter this disparity, Dr Goodey has created a three-year track at MSU for Biology majors, the first year of which – known as the transition year – includes courses in Biochemistry, Analytical Chemistry, Physical Chemistry and Instrumental Analysis. Before the year, students also undergo a self-paced review of General Chemistry II using an online system, alongside a small amount of work with a tutor.

## HOLISTIC APPROACH

But the scope of the OPEN-NJ project goes beyond just a course-restructure: its aim is to increase the skill and diversity of the workforce entering the biochemical industries in north New Jersey, meanwhile

session to enhance their career prospects. Students have additional exchanges with career mentors to learn about career options. The focus of the project is heavily directed at preparing students to have excellent career options at the end of their graduate study.

Another major objective of the programme is the provision of mentoring and counselling services to ensure Master's students reach their potential. Students that can show financial need are accounted for through a scholarship scheme. The approach is therefore a holistic one, taking into account many of the various factors that might hinder students transitioning between disciplines at this level.

## REVIEWING THE PROGRAMME

Dr Goodey and her colleagues have performed a review of the programme, with the intention of discovering trends

that can be disseminated in the STEM education community and inform practices in other STEM field-to-field transitions. She hopes that this will mean scholarship and support programmes will emulate the best practices from the MSU example to become as effective as possible.

The data coming out of the evaluation stage of the programme is promising:

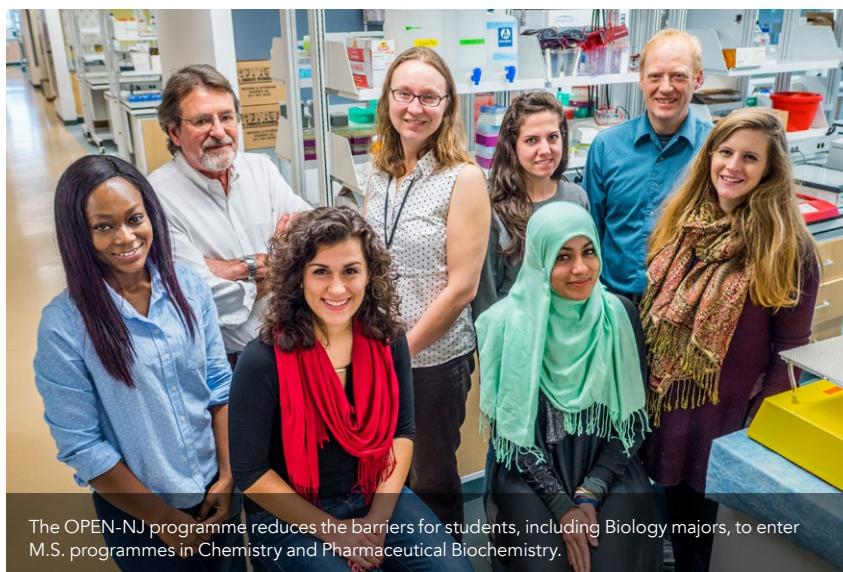
**[OPEN-NJ] goes beyond just a course-restructure: its aim is to increase the skill and diversity of the workforce entering the biochemical industries in north New Jersey.**

increasing the career prospects of its members. In order to create career opportunities, students on the programme are given a rounded provision of professional development career-based workshops covering everything from resume preparation to interview practice to professional networking. Once a year, students on the programme meet with professionals from local industries in a professional career panel and networking



OPEN-NJ students at the annual Alumni Networking Event.





The OPEN-NJ programme reduces the barriers for students, including Biology majors, to enter M.S. programmes in Chemistry and Pharmaceutical Biochemistry.

after completing the transition year, in a small sample, Chemistry non-majors achieve an average of 57% in the General Chemistry ACS – 20 percentage

points higher than students who haven't undertaken the transition year and 10 percentage points higher than even the Chemistry majors. Dr Goodey and her colleagues have found that a review of General Chemistry II was useful – and pinpointed that Physical Chemistry can be one of the biggest sticking points

## New workshops are being integrated into the curriculum which include manuscript writing, mock interviews and public speaking.

a stronger Maths background has had a major influence on retention rates, which sat at 33% in the first year. After making the changes, this became 80% in the second year and is now reaching heights of 90%. Students are overwhelmingly positive about the programme – almost all the current students in an anonymous

survey said they would recommend the programme to a friend or colleague. Particularly, students noted that the programme provided practical and professional help with a high level of interaction, and that the events were informative, helpful, and workshops were insightful.

### FUTURE AND INFLUENCE

But work is not done here – Dr Goodey is still fine-tuning the programme to ensure students have all the support necessary. In the upcoming year, students will get more notice on workshops and won't be required to repeat attend workshops in every year of their study. Students will have more social opportunities to meet other students on the programme. Dr Goodey is also planning to expand regular unofficial mentoring sessions to all OPEN-NJ students. On top of all these, new workshops are being integrated into the curriculum which include manuscript writing, mock interviews and public speaking.

And so that more students can join onto this programme, Dr Goodey is visiting local feeder school campuses, which has already resulted in more applications. This year she is planning how the programme can be advertised through career fairs, social media and other streams.

Dr Goodey is now in the process of writing a manuscript to describe the emerging trends from the programme so that other institutions can learn from their experiences.

In the meantime, the course is having an impact beyond simply providing Northern New Jersey with a well-equipped interdisciplinary workforce; it is also enabling access to education students who wouldn't otherwise necessarily have that option. The programme and the accompanying financial support are already attracting a more diverse cohort, including African-American and Hispanic students. First-generation college students and immigrants are less likely to consider graduate-level study, and Dr Goodey hopes that the programme will be able to boost numbers of these under-represented minorities. And once the review of the program is complete, many more students are set to benefit from the approach.



OPEN-NJ students and alumni catch up at the Annual Networking Event.



# Behind the Research

## Dr Nina Goodey

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### Research Objectives

Dr Nina Goodey's research centres on biochemical research and education.

### Detail

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### Bio

As a Ph.D. student with Dr Stephen Martin, Nina Goodey investigated the substrate selectivity of Phospholipase C. As a postdoctoral researcher in the laboratory of Stephen Benkovic, she studied protein engineering and allosteric interactions. She is currently a Professor in the Department of Chemistry and Biochemistry at Montclair State University. She teaches Chemistry courses and supervises student laboratory research.

### Funding

National Science Foundation Grant Number DUE - 1458499

### Collaborators

- Katherine Herbert
- Marc Kasner
- Jennifer Krumins
- John Siekierka
- Gennae Hinson



### References

Goodey, N. (2018). Preview of Award 1458499 - Annual Project Report: Opening Pathways, Engaging, and Networking in Chemistry in Northern New Jersey (OPEN-NJ). Available at: <https://www.montclair.edu/csam/programs-and-opportunities/open-nj/>

Goodey, N. (2019). NSF S-STEM Grant: Opening Pathways, Engaging and Networking in Chemistry in Northern New Jersey. [online]. Montclair State University. Available at: [www.montclair.edu/csam/programs-and-opportunities/open-nj/](http://www.montclair.edu/csam/programs-and-opportunities/open-nj/)

### Personal Response

**At this point in your investigation, what recommendations would you give to others hoping to create field-to-field transition programmes in other institutions?**

Many graduate students have family obligations, need to work due to high cost of living in northern New Jersey, or commute long distances. The scholarships alleviate some of these challenges but, as the funds only cover tuition, most students in the programme are forced to work to cover living expenses. Larger scholarships, perhaps as a match from the institution, or eliminating the full time requirement by the National Science Foundation would alleviate these challenges.

Some Biology undergraduates who pursued a MS degree in Chemistry or Biochemistry reported a lack of sense of inclusion in the Chemistry and Biochemistry Department. Having informal mentoring meetings with students, encouraging them to join research labs and the Chemistry Club, and including them in departmental outreach events can help students feel more integrated in their new department and discipline.

Students in northern New Jersey, many of whom are first generation college students and immigrants, do not necessarily otherwise get exposed to the idea of pursuing a graduate degree. I would recommend strengthening ties between local institutions to make it possible to support students and provide information about graduate programmes using expertise in both their undergraduate and graduate institutions.