

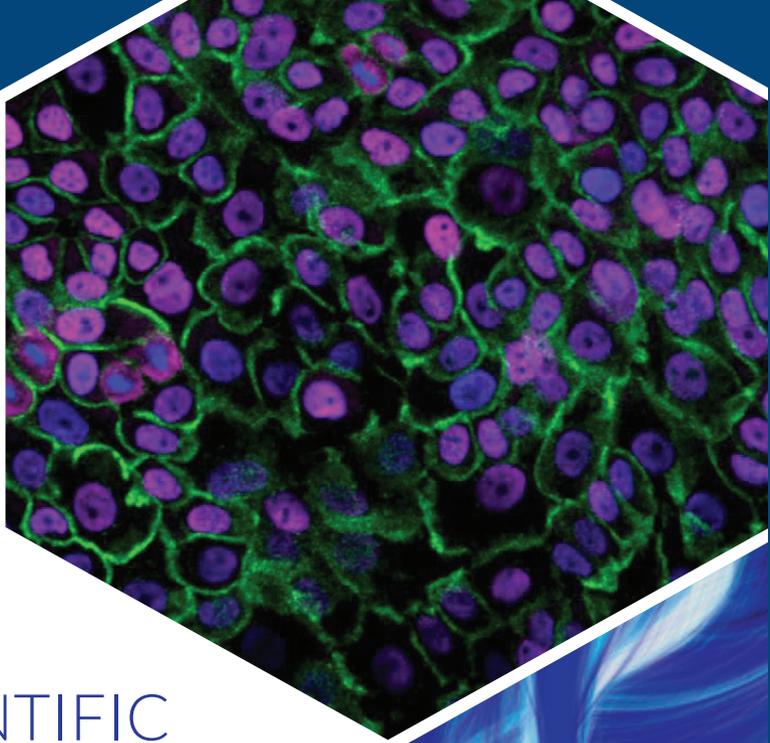


# KINSC

2019

HAVERFORD  
COLLEGE

The Marian E. Koshland  
Integrated Natural Sciences Center

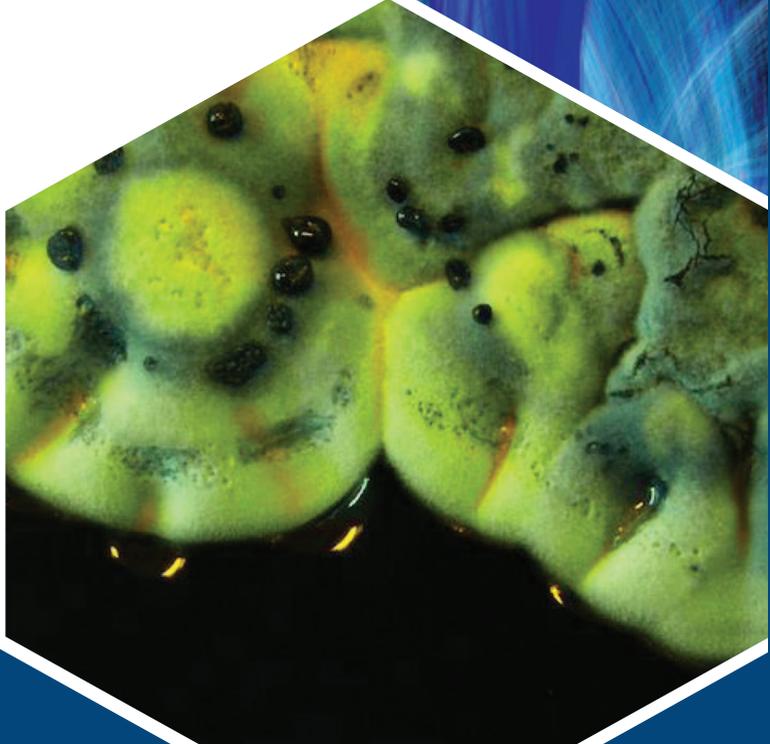


# SCIENTIFIC IMAGING CONTEST

The KINSC Scientific Imaging Contest is an annual contest for student-submitted images from experiments or simulations that are scientifically intriguing as well as aesthetically pleasing.

To see the award winners, visit:

<http://hav.to/2no>



## MAJORS

Astronomy  
Astrophysics  
Biology  
Chemistry  
Chemistry – ACS Certified  
Computer Science  
Environmental Studies (NEW!)  
Geology (at Bryn Mawr)  
Interdisciplinary Physics  
Mathematics  
Physics  
Psychology

## MINORS

Astronomy  
Chemistry  
Chemistry – ACS Certified  
Computer Science  
Environmental Studies  
Health Studies  
Mathematics  
Neuroscience  
Physics  
Psychology  
Statistics

## CONCENTRATIONS

Biochemistry  
Biophysics  
Computer Science  
Geoarcheology (at Bryn Mawr)  
Geochemistry (at Bryn Mawr)  
Mathematical Economics  
Mathematics Education  
Scientific Computing

## DEGREE PARTNERSHIPS

4+1 Bioethics with UPenn  
4+1 Engineering with UPenn  
3+2 Engineering with CalTech

The Marian E. Koshland Integrated Natural Sciences Center (**KINSC**) catalyzes and facilitates programs that maintain Haverford's position at the leading edge of academic excellence in the sciences.

To achieve this end, the KINSC promotes scientific scholarship involving close collaboration between faculty and students and provides opportunities for these activities to expand beyond the borders of the Haverford campus.

The KINSC is unique among Haverford's three academic centers in that **it is both a building and a program**. The 185,000 square foot building is the epicenter of natural science research at Haverford. It was constructed to facilitate sharing of ideas, instruments, and expertise across disciplines and to contribute to a climate of cooperative problem solving and investigation.

The KINSC includes the departments of Astronomy, Biology, Chemistry, Physics, Psychology, Mathematics and Statistics, and Computer Science. To supplement the efforts of the departments, the KINSC **supports interdisciplinary interactions**. In addition to directly funding students and faculty, the Center supports academic activities initiated with outside grants and individual faculty awards.

The KINSC funds individual research projects and sponsors symposia, seminars, curricular initiatives, student conference and research travel, courses, and scholarly projects that go **beyond the bounds of a single discipline** and involve students and faculty from multiple departments.



The range of programs supported by the KINSC is limited only by the imagination of the Haverford science community.

Currently, the KINSC supports the following activities:

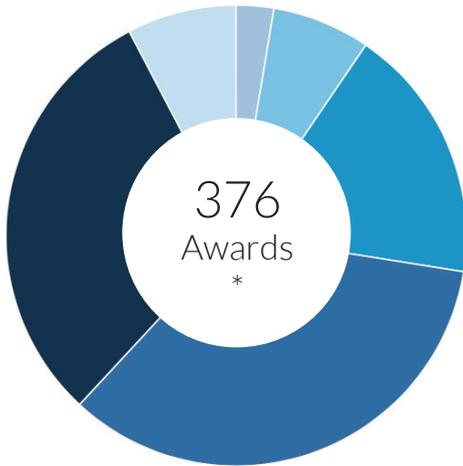
- ▶ Summer research opportunities for students, on campus or at other institutions
- ▶ Fall research symposium, showcasing work by students from Haverford, Bryn Mawr, Swarthmore, and other area colleges
- ▶ Travel for students to pursue research during the academic year with collaborators in labs within the U.S.A. or abroad
- ▶ Travel for students to attend conferences, to present research or to gain experience applicable to future careers (in collaboration with the Green Fund)
- ▶ Student and faculty training in new science-related techniques
- ▶ Special projects initiated by science faculty
- ▶ Events such as research talks, film screenings, and panels
- ▶ Annual career panel for science majors, in collaboration with the Center for Career and Professional Advising
- ▶ Annual Student Scientific Imaging Contest
- ▶ Mentoring and Student Teaching Program (MAST)
- ▶ Research and travel for students from groups underrepresented in the sciences, through the Access and Achievement Fund.

We are committed to supporting a wide variety of creative ideas in the sciences; students should not feel limited by the categories listed.

# KINSC BY THE NUMBERS

2019

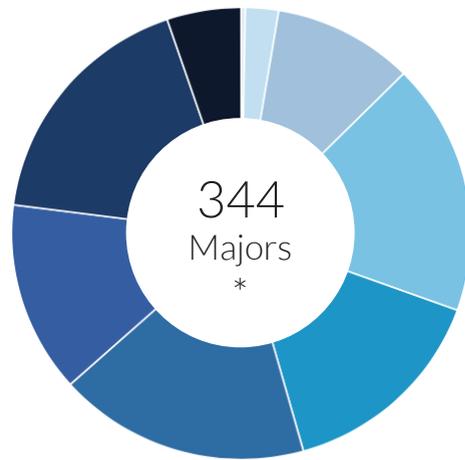
Awards to fund research opportunities



- Frances Velay Women's Science Research Fellowship
- KINSC Summer Scholars
- Off-Campus Conference
- Summer Research with Faculty
- Academic Year Research with Faculty
- International Research Travel

Student research opportunities are funded through the KINSC and through individual faculty grants from the NSF, NIH, etc.

Distribution of students in the sciences



- Astronomy
- Astrophysics
- Physics
- Computer Science
- Mathematics
- Chemistry
- Psychology
- Biology
- Environmental Studies

\*This figure captures juniors and seniors who have declared a major in the sciences. Students do not declare majors until the end of the sophomore year.

27

On-campus faculty supervising student researchers

100%

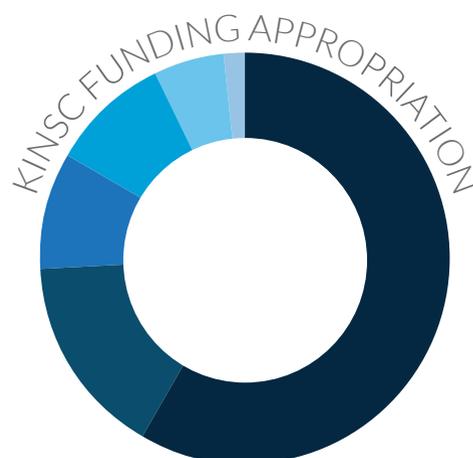
Science majors who graduate with research experience

\$5.5 M

External funding for research by our natural science faculty

# KINSC FUNDING INITIATIVES

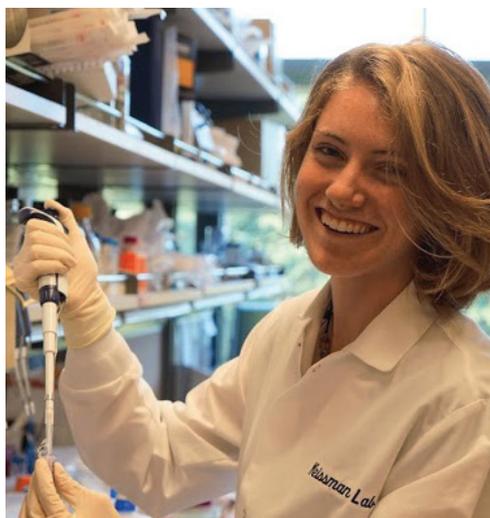
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- STUDENT SUMMER RESEARCH
- STUDENT TRAVEL GRANTS
- FACULTY SPECIAL PROJECTS
- MAST PROGRAM
- EVENTS AND SYMPOSIA
- FACULTY TRAVEL GRANTS

## STUDENT RESEARCH

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### KINSC SUMMER SCHOLARS

In 2019, the KINSC supported 26 students **for 10-week summer research projects** at Haverford and at other colleges and universities across the country. Twelve of these students worked with faculty on-campus, while fourteen worked off-campus in locations such as France, Germany, Sweden, Massachusetts, California, Ohio, as well as the Philadelphia area. Selected student profiles from the 2019 Summer Scholars are featured on pages 16–18.

## STUDENT RESEARCH FUND

The Student Research Fund provides **travel support for research conducted outside the Philadelphia area**. The KINSC funds domestic or international student research during breaks in the academic year. Preference is given to those applying for support related to senior thesis research. Students traveling to present their research may also receive support from the Louis Green Fund, administered by the Provost's Office.

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## ACCESS AND ACHIEVEMENT ENDOWED FUND

The Access and Achievement Endowed Fund **supports diversity in the sciences** and provides an additional source of funding for science students from underrepresented groups to attend conferences, perform research, take off-campus courses, attend workshops, and participate in activities that will enhance their scientific experience as students at Haverford. Six students received funding for research through the Access and Achievement Endowed Fund in 2019.

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## INTERNATIONAL TRAVEL STIPENDS

KINSC faculty maintain collaborations with scientists at other institutions throughout the world, creating **opportunities for our students to travel abroad in the course of their research**. International travel stipends are provided by the KINSC or through external funding for faculty projects. In 2018–19, six Haverford students traveled internationally to perform research.

- ▶ **Daniel Feshbach '20** traveled to Madrid, Spain to present research at the International Conference on Intelligent Robots at the Universidad Carlos III de Madrid.
- ▶ **Tristan Reasor '19** and **Graham Peet '19** traveled to the Institut Curie in Paris, France to work with Dr. Filippo Del Bene and Dr. Roshan Jain to research behavioral mutant Zebrafish as part of their senior theses.
- ▶ **Mallory Kastner '21** spent the summer at the University of Strasbourg, France working on the gene drive development for Anopheles mosquitoes against malaria.
- ▶ **Nathan Merrill '20** conducted his summer research in Germany at the Aachen University Institute of Technical Acoustics working on the distribution of direct sound in different auditoria.
- ▶ **Isabelle Angstman '20** traveled to Lund University for summer research in Sweden to study the effects of endcapping and truncation of a hydrogel-forming peptide.

# STUDENT CONFERENCE TRAVEL

Conferences students attended with funding from the KINSC:

- ▶ Grace Hopper Conference
- ▶ International Pulsar Timing Array
- ▶ Mercury Conference
- ▶ International Conference on Intelligent Robots
- ▶ Joint Mathematics Meeting
- ▶ Geological Society of America
- ▶ Conference on Functional Programming
- ▶ American Physical Society
- ▶ American Astronomical Society
- ▶ National Collegiate Research Conference
- ▶ American Chemical Society National Meeting
- ▶ Minority Health Conference
- ▶ Association for the Sciences of Limnology and Oceanography
- ▶ Undergraduate Women in Mathematics
- ▶ Society for Neuroscience
- ▶ Undergraduate Women in Physics
- ▶ Scheme and Functional Programming Workshop
- ▶ National Diversity in STEM Conference

## 5<sup>TH</sup> ANNUAL PUBLIC POLICY FORUM

The KINSC co-sponsored this annual event for current Tri-College students interested in pursuing social sector careers. Students presented their policy-related research and had opportunities to speak with alumni about their questions and findings. The day included alumni panel discussions on topics including k-12 education, health, law and justice, and renewable energy.



# APRIL FOOLS' DAY

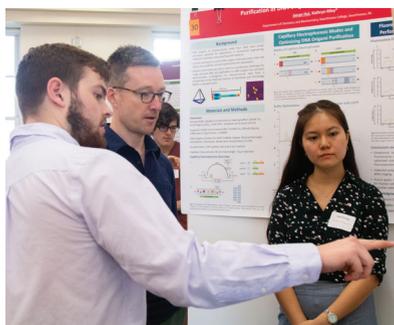
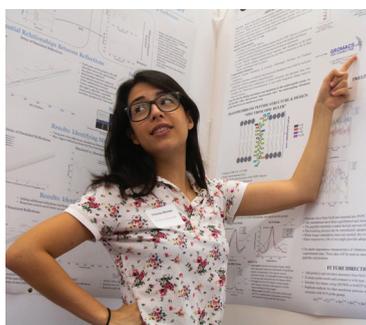
## A KINSC TRADITION

Students celebrated April Fools' Day by decorating the KINSC in a variety of themes. This year, the building was transformed into scenes from videogames, TV shows, and movies including *Mario Brothers*, *Kirby*, *Zelda*, *Game of Thrones*, *Harry Potter*, and *Spongebob Squarepants*.



# 2019 FALL RESEARCH SYMPOSIUM

Every year, the KINSC hosts a fall research symposium showcasing the summer work of students from Haverford, Bryn Mawr, Swarthmore, and other area colleges.





## OUT OF THIS WORLD

Studying the final frontier is no small step for mankind, but Professor and Chair of Physics and Astronomy Andrea Lommen and her students are making giant leaps look easy.

Lommen's research focuses on neutron stars, an extraterrestrial state of matter that cannot be replicated on earth. Using a high-precision x-ray telescope called the Neutron Star Interior Composition Explorer (NICER) that lives on the International Space Station, Lommen and her students were part of a group of international scientists who were able, for the first time ever, to measure the ratio of the mass to the radius of a neutron star. A recent paper, co-authored with Reilly Milburn '19, Sergio Montano '21, Jesse Zeldes '22, and Haverford Research Associate Wynn Ho, is part of a suite of papers published in *The Astrophysical Journal* that announced the findings.

"A neutron star is basically a macroscopic nucleus," said Lommen. "Neutron star material is so dense that one teaspoon of it would weigh as much as all of humanity. The paper that my group is a part of is part of a suite of papers that represents the first measurement of the 'equation of state' of neutron star material. In other words, the NICER team just made the first measurement of the pressure and density of neutron star material."

**"Neutron star material is so dense that one teaspoon of it would weigh as much as all of humanity."**

Lommen leads the timing working group in NICER, a collection of researchers who are interested in what the cadence and length of neutron star pulses can reveal about the dense matter. This new publication is the first in a series about the impact of NICER data for the teams of scientists who use it.

Professor Andrea Lommen leads the timing working group in NICER, a collection of researchers who are interested in what the cadence and length of neutron star pulses can reveal about the dense matter.

"These papers are a detailed analysis of the pulse shape, but they require excellent timing in order to best detect the pulse shape," said Lommen, whose students analyzed the NASA data.

How does such astronomical data make its way back down to earth? The students' analysis is performed via computer programming. The data was downloaded from the International Space Station and stored on a server at NASA Goddard Space Flight Center. The Haverford students transferred the data from Goddard and analyzed it using software that was written, in part, by the NICER science team and, in part, by the students themselves.

"We worked on maintaining and gathering data through the NICER pipeline--the complicated set of procedures through which voltages in detectors on the spacecraft are converted into times of arrivals which can be used for scientific purposes," said Montano.

Montano and Zeldes began working on this project through summer internships in Lommen's lab, building upon work begun by Milburn, who is now earning his Ph.D. in physics and astronomy at the University of North Carolina at Chapel Hill. Being published in such a prestigious journal and a part of NASA's large-scale research is no small feat, and the students look forward to continuing to grow as astrophysicists and researchers.

"It means a lot to us and it is amazing to be a part of this research project because of the exciting new insight that this will bring to the field of pulsar timing," said Zeldes. "I would love to continue doing research in this field and am fascinated by the fact that we have a neutron star equation of state. This result is only a forebearer of many more exciting properties of neutron stars that could be observed by NICER in future years."



A new paper by Professor and Chair of Physics and Astronomy Andrea Lommen, Reilly Milburn '19, Sergio Montano '21, and Jesse Zeldes '22 measures pulsar timing made observable for the first time by NASA's Neutron star Interior Composition Explorer (NICER).

**WORKING WITH NASA** ←

The SpaceX Falcon 9 rocket launching from NASA's Kennedy Space Center in Cape Canaveral, Florida, Saturday, June 3, with Professor Andrea Lommen's NICER telescope on board. Photo by NASA/Bill Ingalls.



I've loved working on the NICER team!"

For Lommen, teaching her students about the world of scientific publishing is an essential part of preparing the next generation of researchers for life beyond Haverford.

"I think it's really important for students to see what the publication process is like," she said. "I tend to think of it as an endurance test. These manuscripts are scientific records and they need to be precise, complete, and they need to hold up to intense scrutiny. I also think it's really important for students to understand that, to put it bluntly, research doesn't matter until it's in the public record. You can do all sorts of cool things that are totally interesting and thoroughly excite you, but until they're published, nobody knows about them. Publication allows further results to be built upon your discoveries. Publication is what creates knowledge."

Milburn also shares in his collaborator's excitement.

"NASA is doing some really cool stuff to forward scientific discovery, and being a part of that discovery through our contribution to this publication truly is a dream come true," he said. "NASA's space exploration missions within and outside our solar system have been an inspiration to me as an astronomer, and really got me interested in the field in the first place. Now when I wear all the NASA gear I've been accumulating over the years, I can say, 'I worked with NASA!' I think that is pretty rad." ★



(From left) Jesse Zeldes '22 and Sergio Montano '21.



Reilly Milburn '19.

# ANDREA LOMMEN APPOINTED TO DECADAL SURVEY ON ASTRONOMY AND ASTROPHYSICS

Haverford  
Professor and  
Chair of Physics  
and Astronomy  
Andrea Lommen  
will help shape  
the next decade  
of astrophysics  
research in the  
United States as  
a member of the  
Panel on Particle  
Astrophysics and  
Gravitation.



Haverford Professor and Chair  
of Physics and Astronomy  
Andrea Lommen

Every 10 years, a group of leading experts in physics and astronomy gather to determine the future of mankind—or, at least, the future of how mankind studies the universe. Sponsored by NASA, the National Science Foundation, and the Department of Energy, the Decadal Survey on Astronomy and Astrophysics (Astro2020) makes decisions over a six-month period about how policymakers, federal agencies, and the scientific community should approach their research in the field for the next 10 years.

As a member of the Panel on Particle Astrophysics and Gravitation (PAG), Lommen will be applying her expertise on gravitational wave detection and pulsar-timing capabilities to this leadership role. She and her fellow panelists will be reading white papers, which are concise descriptions of or proposals to address large-scale problems written by collaborations, or organizations who feel their research should be considered a priority for the study of astrophysics.

“We have to figure out how to prioritize the projects in a way that is best for the future of the field and the future of humanity,” said Lommen. “I suppose it sounds a little bold to say this has to do with the future of humanity, but I really do think that I as an astrophysicist am in the business of satisfying our deepest human desires to understand the world

we live in. So I believe deeply that giving funding appropriately will have ripples—no pun intended—in how we experience ourselves as humans.”

Lommen is only the third professor from any private undergraduate institution nationwide to be appointed to one of the Decadal Survey’s panels, and Haverford Emeritus Professor of Astronomy Bruce Partridge was the second.

The Astro2020 survey is particularly exciting for scientists like Lommen because of recent breakthroughs in the detection and study of gravitational waves.

As a PAG panelist during this unique historical moment, Lommen is certainly taking a giant leap for mankind.

“This is a really exciting time for the field, since gravitational waves were only detected for the first time three years ago, so the field is absolutely exploding with energy and knowledge,” she said. “This moment in science is in some ways analogous to the moment Galileo turned his telescope to the sky and started unraveling what he saw. It was the first time we, as humans, used the electromagnetic spectrum to study the universe. Now, right now, is the first time we, as humans, are using the gravitational wave spectrum to study the universe.” ★

# COOL CLASSES



## “Chemical Dynamics”

Taught by: Professor of Chemistry

Casey Londergan

Here’s what Londergan has to say about his course:

“Chemical Dynamics” is an introductory chemistry course that introduces students to the rules of thermodynamics and then uses them to explain and predict things at many levels, from systems as small as atoms and molecules to the entire planet. It starts with the basic idea of probability—that the more probable outcomes are the ones that tend to happen—and then expands to using energy and entropy to predict the outcomes and rates of chemical reactions and, ultimately, what makes the world work and behave the way it does. It also provides a stark and fundamental underpinning for understanding climate change and some possible strategies to combat it.

My department created this course as an alternative to more typical introductory chemistry classes, which tend to skip around between topics in a broad “survey” approach.

We wanted a fundamentally correct, “building up” course that could directly address the most important problems that we as chemists, and citizens of the world, are facing.

“We wanted a fundamentally correct, “building up” course that could directly address the most important problems that we as chemists, and citizens of the world, are facing.”

The laboratory for this course (coordinated by Dr. Kelly Matz) includes projects on biofuel synthesis, plastics identification, and hydrogen fuel cell construction, so the students also directly participate in some of the strategies and technology for changing how we handle energy and dealing with the consequences of how we currently depend on fossil fuels and their chemical products. By the end of this course, students should have a good idea of where the largest changes could originate in the future, and what sorts of strategies can make a large, world-scale difference in the future of the planet and our species. And it all comes down to using probability and two physical laws that have been known for over 200 years at this point.

This course has now been offered every year for the past 10 years and is a central and fundamental part of the curricular landscape at Haverford. In most years we have a total of about 120 students, mainly first-year students, taking some version of this course—there are three sections this spring, taught by myself, Jessica Stuart, and Kristina Streu—which serves as a prerequisite and central course for all pre-med students and essentially all chemistry and biology majors. Environmental studies students also often take this course. This course is, however, unique in the outside world: very few colleges or universities offer an introductory course that takes this “building up” approach to thermodynamics and its applications in the current world.

*Cool Classes is a recurring series on the Haverblog that highlights interesting, unusual, and unique courses that enrich the Haverford College experience.*

# OUTREACH

Sharing Science with the Community

## PUBLIC OBSERVING EVENTS

### WHAT WILL YOU OBSERVE?



In the northwest corner of campus, the double-domed Strawbridge Observatory is, by day, a classroom, library, and lounge space. After sundown, however, the building opens its doors four times a semester to continue a Public Observing Program, which for years has offered a bridge between the College and the surrounding community. At the astronomy-centered gatherings, a team of Bi-Co students provide presentations, children's programming, craft projects, and viewing of celestial objects with the observatory's two telescopes, making for all-ages fun that anyone can enjoy.

"Public Observing is a really unique program at Haverford," said Katie Billings BMC '19, who has been involved with it for about two years. "For students like me who help create it, it provides a chance to share science with others, improve my organizational and public-speaking skills, and it connects me with the larger local community. For the local community, it provides an opportunity to learn about science and to engage with students and the work they are doing. And for students who attend our programs, it gives them a chance to engage with this awesome resource that is the Strawbridge Observatory."

Public Observing activities vary from night to night, but when weather permits, students locate planets, nebulas, or star clusters using the 16-inch and 12-inch telescopes that sit atop the building. Downstairs, crafts activities (like building rocket ships or designing planets) are popular with the younger visitors. And after an hour or so, Haverford students practice distilling astronomical knowledge into broadly understandable terms by presenting on their research or something astronomy-related in the news.





## THE HAVERFARM

The Haverfarm is a year-round farming and educational space designed to integrate sustainable food and agriculture into the academic and extracurricular lives of Haverford students, faculty, staff, and community members.

With a focus on interdisciplinary and experiential learning, the Haverfarm invites students and other members of the community to engage with issues of food justice and local, progressive agriculture.

In the fall of 2019, three student-farmers worked to develop an independent study at the Haverfarm. These students worked under the guidance of Professor Helen White to create a course tailored to their interests. In ENVS 480, the students studied soils, integrated pest management, and ethnobotany. Additionally, the students traveled to Ohio State University's student farm to learn about their farm program and bring new ideas back to the Haverfarm.

## MAST PROGRAM

The Mentoring And Student Teaching program is a long-standing outreach program at Haverford College. The program provides laboratory experiences and writing tutorials for 20-25 Philadelphia area middle school students who come from backgrounds traditionally underrepresented in the sciences.

The young students come to the Haverford campus for five Saturdays in the spring semester and spend the day engaging in scientific experiments and science communication. Haverford and Bryn Mawr College students prepare the course curricula and work with the middle school students in small groups. Haverford College faculty act as advisers for this program.

# STUDENTS IN THEIR OWN VOICES

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*Kelsey Chai '21, a chemistry major with a minor in environmental studies is investigating the local herring population in the Prince William Sound in Cordova, Alaska.*

*“The measurements I take could provide important insight into the growth of herring in the Prince William Sound and what might be affecting them, especially in relation to a major decline in their population since 1993. This database could be used to learn more about what caused the collapse in population and what is hindering them from recovering back to previous levels.”*

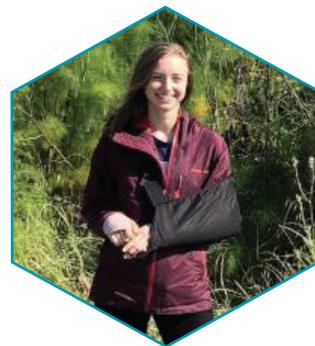


*Physics major Nathan Merrill '20 (they/them) researched the physics of sound waves at the Institute for Technical Acoustics (ITA) in Aachen, Germany. Merrill is working with a complicated dataset, gathered from a collection of microphones that were set up in several halls across Europe. By examining this data, they're able to analyze soundwaves from different positions as they travel through space in order to learn more about a phenomenon known as the "seat dip effect."*

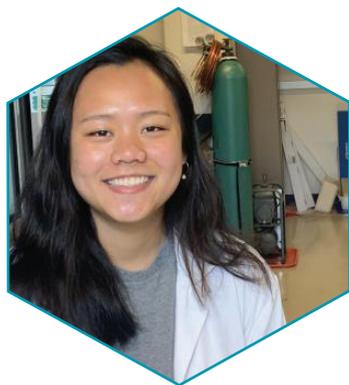
*“While doing that work, I have had a lot of exposure to many areas of acoustics, including room acoustics, speaker acoustics, and electroacoustics,” they said. “This summer opportunity has let me help to connect the academic work that I do with my other major interests.”*

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*This summer, environmental studies major Griffin Kaulbach '21 is rolling up her sleeves and sinking her hands into some nutrient-filled soil. As a KINSC-sponsored research assistant in Britt Koskella's integrative biology research lab at the University of California, Berkeley, she's studying how the nuances of a plant's root environment impact its growth and health.*



*“Manipulation of the plant microbiome has the potential to reduce plant disease, increase agricultural production, reduce the use of chemical inputs, and reduce emissions of greenhouse gases.”*



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*Lin is studying particular types of compounds, called ligands, that give rise to metal complexes. Her lab is interested in the biological applications of such molecules—Lin's current project involves trying to produce ligands that are stable in water and still perform the preferred functions so that they can be useful in biological systems.*

*“My research experience at Haverford has given me many opportunities to conduct different kinds of chemistry research. From ‘Superlab’ to the multitude of research tutorial courses that professors offer, I think that I’ve gotten an idea of what kind of research I’m passionate for. The absolute dream is to be published— isn’t everyone’s?—but I hope that my research will result in compounds that are more relevant in intracellular conditions. I love the challenges and excitement that come with making new compounds that other labs have not yet made.”*

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*Johanna Fowler '21 worked for Dr. Jennifer Punt, who is the associate dean of One Health and a professor of immunology at the University of Pennsylvania School of Veterinary Medicine. Her research investigating the role of insulin-like growth factor 1 (IGF1) on immune cells in dogs. By analyzing canine blood samples, the researchers hope to pinpoint the specific effects of the hormone on the animal's immune system. Though still in an early stage, the research has the potential to treat fatal illnesses in dogs while also informing studies on their human counterparts.*

*“Dogs are increasingly being focused on as models for human diseases, like cancer, because they share much of our environmental exposures and are more closely related to humans evolutionarily than mice, which are commonly used in medical research. This means that any research done on dogs could have applications in human medicine too. This work is giving me a great opportunity to see what veterinarians can do besides clinical practice as well as giving me a chance to develop my research skills.”*

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*Prospective biology and environmental studies major Poppy Northing '22 is studying the biological nuances of an urban farming initiative in the Bowles agroecology lab at the University of California, Berkeley.*



*“My career goal is to help find ways for community to reverse climate change and improve sustainability through nature,” said Northing. “Agriculture, especially in an urban setting, is a huge part of this, and I would love to be able to make a recognizable impact with urban farming.”*

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## KINSC Staff

### Helen White

Director, Koshland Integrated Natural Sciences Center, Associate Professor of Chemistry and Environmental Studies

### Marielle Latrick

Associate Director, Koshland Integrated Natural Sciences Center

## KINSC Steering Committee

### Joanne Brown

Science Stockroom Manager

### Daniel Grin

Assistant Professor of Physics and Astronomy;  
Coordinator of Scientific Computing

### Alexander Molot

Director, Academic Resources and Foundation Relations

### Jeff Tecosky-Feldman

Senior Lecturer of Mathematics and Statistics

Cover image by Harry Taussig '22 shows a perlin noise based flow field followed by colored particles. As the particles move, they group together and change color



For more information about studying in the natural sciences at Haverford College, please visit:

[haverford.edu/KINSC](https://haverford.edu/KINSC)



**HVERFORD**  
COLLEGE

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