UNIVERSITY OF
SOUTH DAKOTA

OFFICE OF RESEARCH & SPONSORED PROGRAMS
FY22 ANNUAL REPORT

MISSION STATEMENT

The University of South Dakota offers undergraduate, graduate and professional programs within the South Dakota System of Higher Education. As the oldest university in the state, the University of South Dakota serves as the flagship and the only public liberal arts university in the state.

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LETTER FROM THE VICE PRESIDENT

USD's research and creative scholarship reflects the academic breadth found in the state's flagship and only public liberal arts university. True to our liberal arts foundation, our scholars and researchers continually ask, "What world do I want to live in?" Seeking answers to this question drives them to develop materials to improve energy efficiency and offer new treatments for diseases. Seeking answers to this question pushes them to seek out people on the margins, engage them where they are, and work with them to solve their problems meaningfully. A highlight of the past year was hosting the Department of Defense Established Program to Stimulate Competitive Research, "DoD Day," in July. The event educated researchers from as far away as Alaska about opportunities to work with the Department of Defense. The commitment of USD's researchers and scholars set a five-year high in funding, representing a year-over-year increase of 15%.

USD engages its undergraduate and graduate students in seeking answers to critical questions. Over the past few years, more than 800 unique students have been involved in research. Our students have shared their research with their peers at national conferences, with state legislators in Pierre, and on Capitol Hill in Washington, DC. These are tremendous opportunities for our students and demonstrate USD's commitment to providing students with ways to explore their fields that expand beyond classroom lectures.

We seek to have our research accomplishments be front-page news. Other essential elements of the Office of Research and Sponsored Programs often go unnoticed. USD's Environmental Health and Safety program ensures that all USD's workspaces, not just labs, are safe places to work. Our Human Subjects Protection program, the only accredited program in the South Dakota regental system, ensures that all research, whether a survey or medical intervention, is performed ethically and with respect for the subject.

The preceding paragraphs provide an extremely brief overview of a few highlights of the past year. This report provides more information about the activities of the Office of Research and Sponsored Programs at USD. Thank you for allowing me to share with you the activities of USD's Office of Research and Sponsored Programs.

Sincerely,
Dan Engebretson, Ph.D.
Vice President for Research & Sponsored Programs

OFFICE OF SPONSORED PROGRAMS

The Office of Sponsored Programs (OSP) supports university researchers with proposals, contracts, and awards for federal grants, foundation grants, and incoming and outgoing subcontracts.

The Office of Sponsored Programs aims to increase the quality and amount of research dollars and to help develop our principal investigators and grant administrative staff in proposal submission and award management. To further these goals, the office of sponsored programs has developed several programs and processes to educate and assist our principal investigators with proposal submissions.

PI RESEARCH DEVELOPMENT SERIES

The "PI Research Development Series" (PIRD) is designed to help principal investigators develop more competitive grant proposal submissions, build a community of researchers for more opportunities to collaborate on projects, and to develop our principal investigators' future grant proposals.
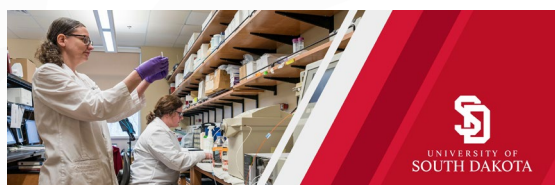
WELCOME WAGON

The "Welcome Wagon" or "Kick-off"meeting was developed to engage the principal investigators and administrative staff that will be included on the grant. The purpose is to facilitate a mutual understanding of sponsor requirements and to clarify roles and responsibilities. These meetings take place when the award is received. These meetings have been a great addition in the successful management of the award.

BROWN BAG SERIES

We are in the third year of the "Brown Bag Lunch Research Presentations" series. This has been a great opportunity for the research community to hear about the exciting research going on at USD. Some of the research that has been presented recently include using wastewater to better understand COVID, the future of AI, colorectal cancer research, and many others.

PROPOSAL AND AWARD RECOGNITION

This year, we started a proposal and award recognition program. On a monthly basis, we recognize those who submit proposals and those who are awarded. We understand the work involved with preparing and submitting proposals, and we are excited to recognize those efforts.

RESEARCH COLLABORATION

Our Facebook group was started in 2021 has over 150 members. The group, "Research Collaborations at USD," was formed for USD Faculty and Staff to have a centralized place to form collaborations for research. We use this page to inform researchers about upcoming funding opportunities; researchers can also post their own announcements in this group.

FY22 RESEARCH FUNDING HIGHLIGHTS

Top Proposals Submitted

12% Increase From FY21

$67M Sanford School of Medicine

$21M Arts & Sciences

$110M Proposals submitted

$5.5M Beacom School of Business

$10M School of Health Sciences

$4M School of Education
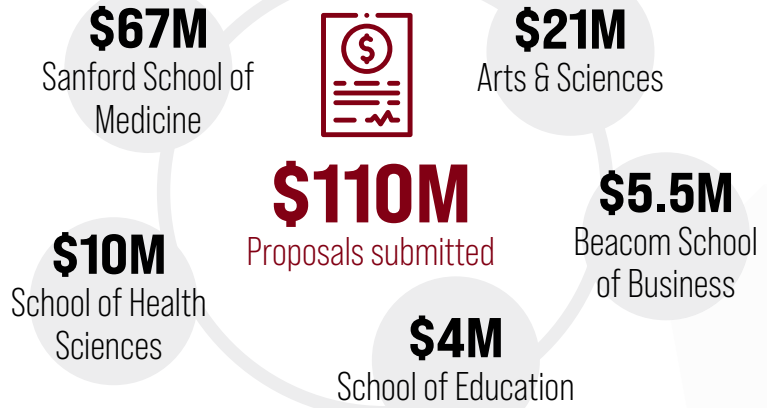
Government Funding

$32M Federal Research Funding

$5.3M State Funding

Top Federal Agencies

NIH
$19M NIH

$4.2M NSF

Top Research Funding Awards

$37M Total Research Funding Awards

Sanford School of Medicine **$16.7M**

Arts & Sciences **$6.5M**

Administration **$3.9M**

$3.8M School of Health Sciences

$3.6M School of Education

15% Increase From FY21
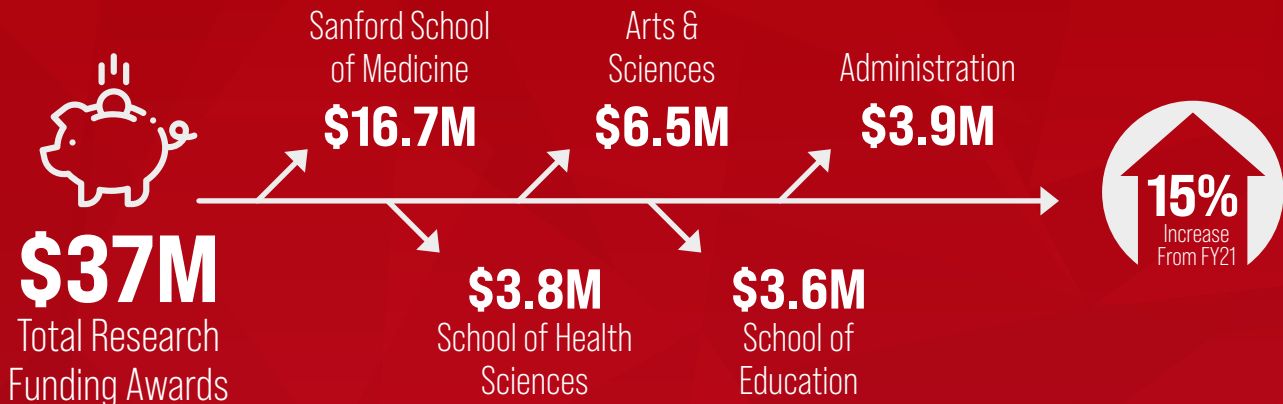
CHEMISTRY REU SEEKS TO CONNECT UNDERGRADUATE STUDENT RESEARCHERS

Eleven college students, including two from the University of South Dakota, will complete the chemistry department's Research Experience for Undergraduates program this summer. Funded by the National Science Foundation, the program helps connect undergraduate students from all over the country with research opportunities.

"Students work one-on-one with a faculty mentor for ten weeks during the summer," said Andrew Sykes, chair of the Department of Chemistry. "This experience shows them what it is like to be a chemist and hopefully reinforces their interest in chemistry. They work with state-of-the-art instrumentation and begin to work independently on a research project."

Research opportunities offered fall within the themes of photodynamics and nanomaterials, areas integrally linked to issues of national importance such as energy and remediation of the environment.

"Students work on a wide variety of organic, inorganic, analytical and physical chemistry research projects. Some students are investigating security printing applications using upconversion nanoparticles. Others are working on functional fluorinated materials for new battery technology. Others work on computational chemistry projects using super-computers, catalysis reactions involving 'nanoreactors' and environmental sensors for heavy metal ions," said Sykes.

In addition to the one-on-one mentoring, students are offered educational workshops, tours of local chemistry-related industries, a weekly seminar series and social activities, including a canoe trip down a stretch of the Missouri River.

The Department of Chemistry supports an additional REU program for undergraduate students through the Center for Security Printing and Anti-Counterfeiting Technology (SPACT). It supports two USD undergraduate student researchers. For additional information, please visit the Department of Chemistry's REU website.

CARAWAY, BOYD TO LEAD GRADUATE PSYCHOLOGY EDUCATION PROGRAM TO FILL STATE GAP IN MENTAL HEALTH CARE

The University of South Dakota is pleased to announce Jean Caraway, Ph.D., professor of psychology, and Beth Boyd, Ph.D., professor and director of Clinical Psychology, received funding for the new Graduate Psychology Education Program (GPEP) to train doctoral health service psychology students to provide quality behavioral health services in community-based primary care settings in high-need and high-demand areas throughout South Dakota.

By Madilyn Sindelar

Funding is provided by the Department of Health and Human Services and Health Resources and Services Administration (HRSA). Caraway and Boyd applied for the grant to help expand the number of mental health providers in the state of South Dakota, which has been decreasing. Since the COVID-19 pandemic, adults reporting anxiety and depressive disorders doubled and the number of reports for those with new or increased substance use due to stress elevated. In 2020, South Dakota ranked 39th in mental health availability, with only five of 66 counties having an adequate supply of mental health providers. With the new funding and program, USD will take the steps toward filling the gaps in mental health care coverage in South Dakota.

"South Dakota was substantially lacking mental health professionals to address these problems even before the COVID-19 pandemic," Caraway said. "Currently, many job openings for licensed psychologists in the state remain unfilled. Those that move to our state may be ill-prepared to serve South Dakota residents as few doctoral programs nationwide offer training in rural psychology. There is a need to increase the number of licensed psychologists and to improve the competence of those providing services to rural, underserved and Native American populations in the state."

Over the next three years, the Department of Psychology will receive over $1.3 million in funding and will use 50% of the funds to directly support the training of the students admitted to the program. Up to six students per year will be able to receive $25,000 for specialized training in the areas of focus, living expenses and to attend national conferences.

Student trainees in the USD-GPEP, along with their clinical supervisors, will focus on Substance Use Disorders (SUDS), Opioid Use Disorders (OUD), integration of behavioral health services with primary care, interdisciplinary settings, telehealth and resiliency training for mental health care providers.

"The GPEP transforms clinical training environments and is aligned with HRSA's mission to improve health and achieve health equity through access to quality services, a skilled workforce and innovative programs," Caraway said.

Graduate students in the program will also have more hands-on training and networking opportunities in South Dakota's communities, creating a pipeline of prepared mental health professionals for the state. The department plans to enhance its partnership with Lewis and Clark Behavioral Health Services in Yankton. Caraway is also working to develop a new training opportunity through Avera Behavioral Health in Mitchell and Brookings.

OFFICE OF RESEARCH & SPONSORED PROGRAMS AWARDED $400,000 FROM SOUTH DAKOTA BOARD OF REGENTS

The University of South Dakota is pleased to announce the Office of Research & Sponsored Programs was awarded $200,000 from the South Dakota Board of Regents (SDBOR) with a $200,000 match.

By Madilyn Sindelar

The total of $400,000 in funds will help USD build private-public partnerships with two companies: trū Shrimp and Synthetik. trū Shrimp is a U.S.-based company that produces superior quality shrimp that are traceable, sustainable and antibiotic-free. Synthetik is a fast-growing technology start-up that creates and develops breakthrough technology to mitigate the biggest threats to the world, including terrorism, extreme events and global environmental impacts.

"Our students will help those companies with some of their research and development goals in the next year," Daniel Engebretson, Ph.D., vice president of research and sponsored programs, said.

The funds awarded come from the SDBOR Research & Development Innovation (RDI) Grant program to strategically advance technology-based economic development in the region.

USD is using two approaches to build a STEM workforce through industry connections. The first approach is to engage existing companies in research and development projects in USD's areas of strength. Two research areas of strength for USD are artificial intelligence (AI) and biomaterials. USD will engage with Synthetik Applied Technologies in AI research and trū Shrimp in biomaterials research. The second approach is to invest in graduate students to develop technologies discovered by USD faculty.

This project will also help further the development of the Technology Readiness Acceleration Center (TRAC) program. Much of the funding will help the TRAC program better connect with companies in the state for customer discovery, Engebretson said.

Funds from the RDI grant and Synthetik Applied Technologies will be used to acquire and install upgrades to USD's Lawrence High-Performance Computing cluster.

Lawrence, located in USD's server room, was acquired with funding from a previous RDI grant. These upgrades will allow USD researchers to expand their AI research programs. These programs produce students that Synthetik has identified as a future workforce need.

In addition to co-founding the hardware acquisition, Synthetik has agreed to co-fund two graduate students in Computer Science. The RDI grant will provide for a student in 2023 that will be matched by Synthetik. Synthetik has been awarded 11 Small Business Innovation Research (SBIR) grants since 2018.

Funds from the RDI grant and USD's Department of Biomedical Engineering (BME) will fund undergraduate chemistry and BME students. This project will form the foundation for future research and development projects between USD and trū Shrimp.

AWARDS RECEIVED

TOTAL AWARD DOLLARS

College/School	FY18	FY19	FY20	FY21	FY22
Administration	$2,521,975	$3,223,036	$732,525	$2,419,176	$3,965,325
Arts & Sciences	$5,948,387	$8,609,680	$6,042,864	$5,230,932	$6,465,476
Business	$3,215,788	$4,302,360	$3,917,938	$1,694,288	$3,097,971
Education	$3,848,803	$3,138,461	$2,785,168	$6,718,208	$3,633,825
Fine Arts	$38,650	$54,500	$181,575	$960	$11,717
Health Sciences	$870,074	$1,162,501	$1,910,086	$2,009,500	$3,895,641
Law	$90,000	$90,000	$100,000	$100,000	$77,045
Medicine	$13,158,400	$16,101,097	$10,207,341	$13,724,639	$16,788,924
Total	**$29,692,077**	**$36,681,634**	**$25,877,497**	**$31,897,703**	**$37,935,923**

NUMBER OF AWARDS

College/School	FY18	FY19	FY20	FY21	FY22
Administration	21	20	13	16	19
Arts & Sciences	47	54	46	31	43
Business	16	23	10	6	8
Education	13	18	8	19	14
Fine Arts	3	4	2	1	6
Health Sciences	21	20	18	22	31
Law	2	1	2	2	1
Medicine	65	59	59	62	71
Total	**188**	**199**	**158**	**159**	**193**

COLLEGE OF ARTS & SCIENCES

Department	FY17 Amount	No.	FY18 Amount	No.	FY19 Amount	No.	FY20 Amount	No.	FY21 Amount	No.	FY22 Amount	No.
Anthropology (including Archeology)	$18,013	1	$24,973	1	$15,824	1	$109,822	2	$18,176	1		
Biology	$1,084,585	11	$1,388,412	8	$1,761,808	14	$968,992	10	$1,054,340	9	$1,297,126	12
Biomedical Engineering	$1,471,586	17	$1,497,298	12	$1,315,458	7	$2,248,866	8	$990,519	5	$1,247,990	6
Chemistry	$479,719	10	$1,580,732	10	$2,406,238	12	$1,309,180	7	$1,227,361	5	$756,135	5
Communication Sciences & Disorders	$280,573	3	$168,000	2	$192,000	3	$3,915	1	$261,600	2	$5,999	1
Contemp Media & Journalism	$1,000	1										
Earth Sciences	$110,224	5	$44,788	1								
English	$6,000	1	$10,184	4			$5,000	1			$6,425	1
History	$1,000	1	$2,000	1			$500	1				
Mathematics					$41,740	1						
Modern Languages	$3,500	2	$750	1	$3,375	1	$3,229	1	$958	1		
Physics	$294,880	3	$1,193,136	5	$2,696,695	8	$294,405	4	$933,554	1	$1,918,248	6
Philosophy							$375	1			$100,482	2
Political Science	$357,099	4			$37,195	1	$263,401	5	$72,172	3	$29,615	1
Psychology (including DMHI)	$116,939	6	$38,114	2	$107,084	3	$744,882	2	$575,630	1	$1,025,507	2
Sustainability & Environment					$32,263	3	$90,297	3	$96,622	3	$77,949	7
Total	$4,225,118	65	$5,948,387	47	$8,609,680	54	$6,042,864	46	$5,230,932	31	$6,465,476	43

SANFORD SCHOOL OF MEDICINE

Department	FY18 Amount	No.	FY19 Amount	No.	FY20 Amount	No.	FY21 Amount	No.	FY22 Amount	No.
Basic Biomedical Sciences	$9,388,739	34	$11,972,130	30	$5,260,153	26	$9,373,593	32	$11,128,282	36
Cardiovascular Research Institute										
Center for Disabilities	$3,168,829	17	$3,216,142	15	$3,400,917	15	$2,726,810	16	$4,001,313	23
Family Medicine	$264,911	8	$658,762	8	$1,213,173	7	$1,302,034	8	$1,290,469	6
Dean of the Med School					$54,000	2	$12,500	2		
Laboratory Medicine	$163,887	1								
Neurology										
Pediatrics	$34,914	1	$38,582	2	$56,500	1		1		
SSOM Faculty Research									$35,326	1
Surgery	$137,120	4	$215,481	4	$222,598	3	$309,703	3	$333,534	5
Total	$13,158,400	65	$16,101,097	59	$10,207,341	54	$13,724,640	62	$16,788,924	71

AWARDS BY SOURCE OF FUNDS

College/School	Federal		State		Other Non-Profit		Total	
	Amount	No.	Amount	No.	Amount	No.	Amount	No.
Administration	$3,602,770	11	$322,555	7	$40,000	1	$3,965,325	19
Arts and Sciences	$6,194,787	33	$234,692	8	$35,997	2	$6,465,476	43
Business	$2,299,474	5	$798,497	3			$3,097,971	8
Education	$3,342,909	7	$285,519	6	$5,397	1	$3,633,825	14
Fine Arts	$11,717	6					$11,717	6
Health Sciences	$2,320,747	14	$1,569,887	15	$5,007	2	$3,895,641	31
Law	$77,045	1					$77,045	1
Medicine	$14,570,535	57	$2,095,642	10	$122,747	4	$16,788,924	71
Total	**$32,419,984**	**134**	**$5,306,792**	**49**	**$209,148**	**10**	**$37,935,924**	**193**

Federal	$32,419,984
State	$5,306,792
Other Nonprofit	$209,148

State 14%
Other Nonprofit 1%
Federal 85%
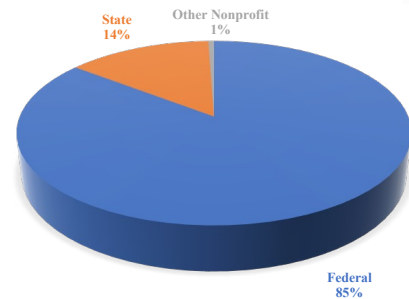
FEDERAL AWARD DOLLARS BY AGENCY

Federal Agency	FY18	FY19	FY20	FY21	FY22
Health & Human Services/PHS	$13,768,205	$17,432,089	$11,418,197	$18,430,992	$18,771,698
National Science Foundation	$4,705,038	$4,429,601	$3,383,954	$2,270,874	$4,246,321
Education	$821,940	$2,504,321	$139,366	$1,371,316	$3,215,056
Energy		$1,072,626	$16,000		$429,986
Defense	$208,996	$305,914	$499,124	$546,738	$353,285
NASA		$56,922	$105,038	$78,443	$89,093
All other agencies	$2,430,312	$4,046,375	$3,960,385	$2,900,577	$5,314,545
Total	**$21,934,491**	**$29,847,848**	**$19,522,064**	**$25,598,940**	**$32,419,984**
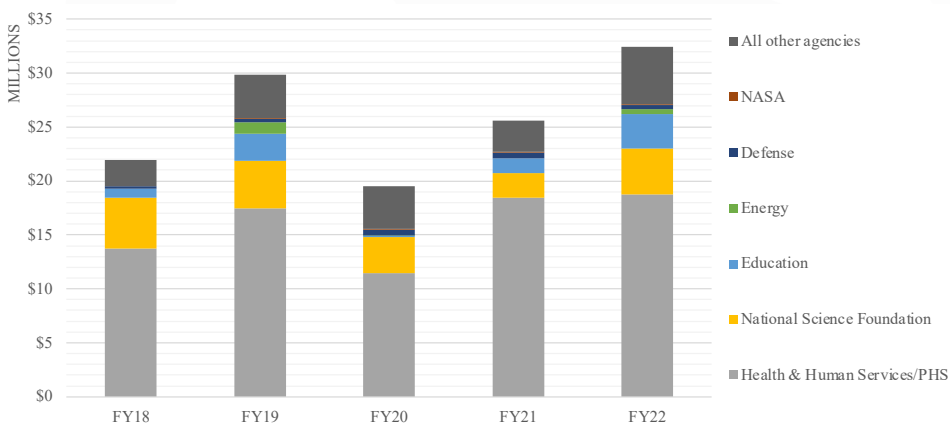
FEDERAL AWARDS BY AGENCY

Federal Agency	Amount	No.
Health & Human Services/PHS	$18,771,698	51
National Science Foundation	$4,246,321	8
Education	$3,215,056	7
U.S. Department of Justice	$705,000	4
U.S. Department of Defense	$353,285	2
NASA	$89,093	3
All Other	$5,039,531	59
Total	**$32,419,984**	**134**
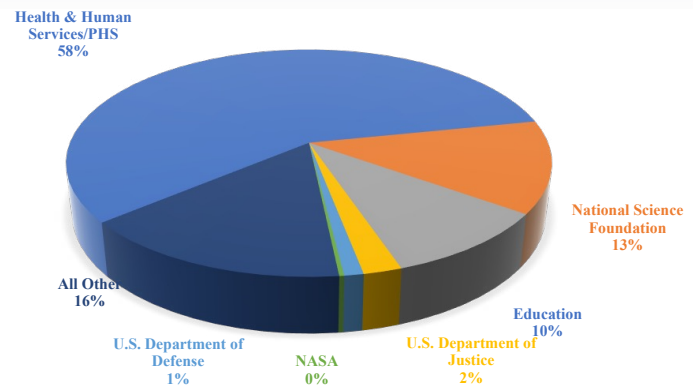
AWARDS BY TYPE OF PROJECT

Table 7

Project Type	Amount	Number
Research	$18,000,650	86
Public Service	$15,170,117	83
Student Services	$1,805,204	6
Instruction	$2,562,127	12
Institutional Services	$100,000	1
Other	$297,825	5
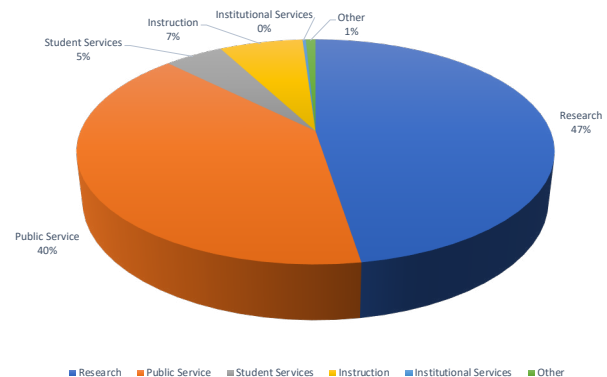
AWARD DOLLARS BY TYPE OF PROJECT

Figure 6

- Public Service 40%
- Research 47%
- Student Services 5%
- Other 1%
- Institutional Services 0%
- Instruction 7%
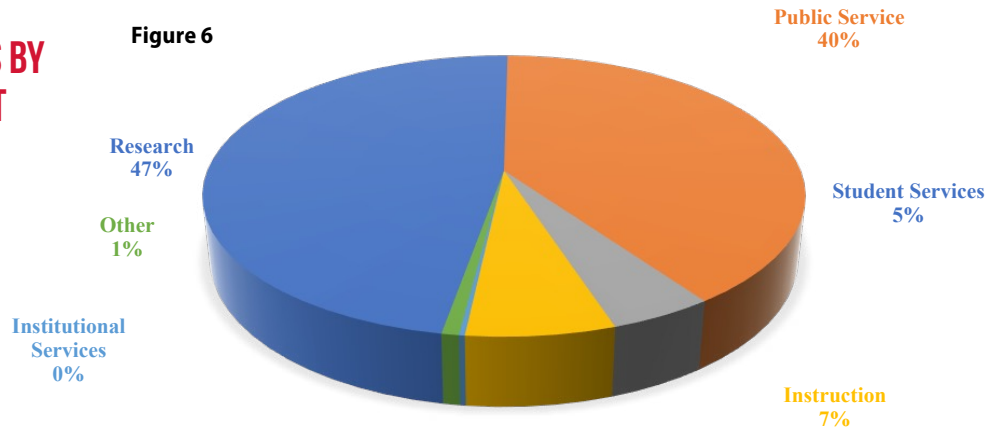
EXPENDITURES

FY	Awards	Millions $
FY18	$26,767,648	26.768
FY19	$27,684,938	27.685
FY20	$27,341,261	27.341
FY21	$27,662,015	27.662
FY22	$30,890,170	30.890

PUBLICATION RECORD

- 158 Gastroenterology Hepatology
- 124 Cardiac Cardiovascular Systems
- 105 Cell Biology
- 105 Chemistry Multidisciplinary
- 104 Biochemistry Molecular Biology
- 93 Medicine General Internal
- 93 Neurosciences
- 90 Oncology
- 84 Physics Particles Fields
- 66 Pharmacology Pharmacy
- 64 Surgery
- 63 Multidisciplinary Sciences
- 58 Education Educational Research
- 57 Public Environmental Occupational Health
- 55 Astronomy Astrophysics
- 62 Rehabilitation
- 55 Pediatrics
- 51 Substance Abuse
- 49 Sport Sciences
- 60 Psychology Clinical
- 54 Social Work
- 48 Endocrino Metabolism
- 59 Psychiatry
- 53 Computer Science Artificial Intelligence
- 47 Ecology

2022 UNDERGRADUATE RESEARCH AWARD WINNERS

EMILY EISENBRAUN

Hometown:	**Rapid City, South Dakota**
High School:	**Rapid City Central High School**
Class:	**Junior**
Major:	**Medical Biology**
Plans:	**Medical School**

BRADY SAMUELSON

Hometown:	**Sioux Falls, South Dakota**
High School:	**Harrisburg High School**
Class:	**Senior**
Major:	**Chemistry**
Plans:	**Ph.D. in Materials Chemistry**

HOLLY BLACK

Hometown:	**Rockton, Illinois**
High School:	**Hononegah Community High School**
Class:	**Senior**
Major:	**Biology and Sustainability**
Plans:	**Veterinary School**

ALEXIS SLACK

Hometown:	**Ankeny, Iowa**
High School:	**Ankeny High School**
Class:	**Junior**
Major:	**Biology and Neuroscience**
Plans:	**Ph.D. in Biology**

CALEB SWANSON

Hometown:	**Mitchell, South Dakota**
High School:	**Mitchell High School**
Class:	**Sophomore**
Major:	**Sustainability and Political Science**
Plans:	**Law School**

NICHOLAS RASMUSSEN

|	
Hometown:	**Vermillion, South Dakota**
High School:	**Vermillion High School**
Class:	**Junior**
Major:	**Computer Science**
Plans:	**AI Research or Data Science**

BRIANNA ZIMMER

Hometown:	Sioux Falls, South Dakota
High School:	Roosevelt High School
Class:	Senior
Major:	Criminal Justice and Political Science
Plans:	Work in Criminal Justice Field
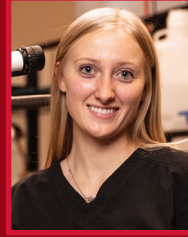
TIFFANY KNECHT

Hometown:	Sioux Falls, South Dakota
High School:	Harrisburg High School
Class:	Junior
Major:	Medical Biology
Plans:	Medical School
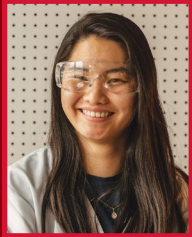
ABBIE WOODARD

Hometown:	Spearfish, South Dakota
High School:	Spearfish High School
Class:	Junior
Major:	Physics
Plans:	Undecided

JACOB RIDGWAY

Hometown:	Mitchell, South Dakota
High School:	Mitchell High School
Class:	Senior
Major:	Conservation Biology
Plans:	Ph.D. in Aquatic Ecology

KYLIE GROVES

Hometown:	Gretna, Nebraska
High School:	Gretna High School
Class:	Senior
Major:	Musical Theatre
Plans:	Pursue Performance in Chicago or NYC
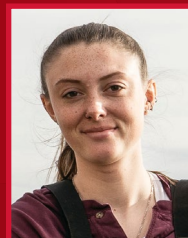
RUBY HAWKS

Hometown:	Hartford, South Dakota
High School:	West Central High School
Class:	Junior
Major:	Medical Biology
Plans:	Medical School

# USD STUDENT RUBY HAWKS SHOWCASED RESEARCH AT CAPITOL HILL

Ruby Hawks, a junior medical biology major at the University of South Dakota, was selected to present her research at the Council on Undergraduate Research (CUR) Posters on the Hill event, which was held virtually on April 26-27, 2022.

Posters on the Hill is CUR's signature advocacy event and is typically held in-person in Washington, D.C. Participants were given the opportunity to showcase their research as well as advocate for undergraduate research at the federal level by presenting their findings and engaging in discussions with members of Congress. Out of 300 applicants, only 60 students throughout the nation were selected to participate.

"I am excited to be representing the University of South Dakota at the national level and bringing attention to the phenomenal undergraduate research opportunities available to students here," said Hawks. "To have my work recognized in this way is a point of great pride for me!"

Hawks, a Hartford, South Dakota, native, came to USD as a Nolop Scholar. She is a 2021 UDiscover Scholar and a recipient of the 2021/2022 Undergraduate Research Award. In March 2022, she presented her research at the Pierre Poster Session.

"We are lucky to have Ruby in our department," said Jacob Kerby, Ph.D., Hawks' honors research advisor and chair of the Department of Biology. "She is a clear example of how our Nolop Scholarship is recruiting some of the best students in our state to USD. She represents the best of USD, and so it is only appropriate that she will be representing us at the capitol."
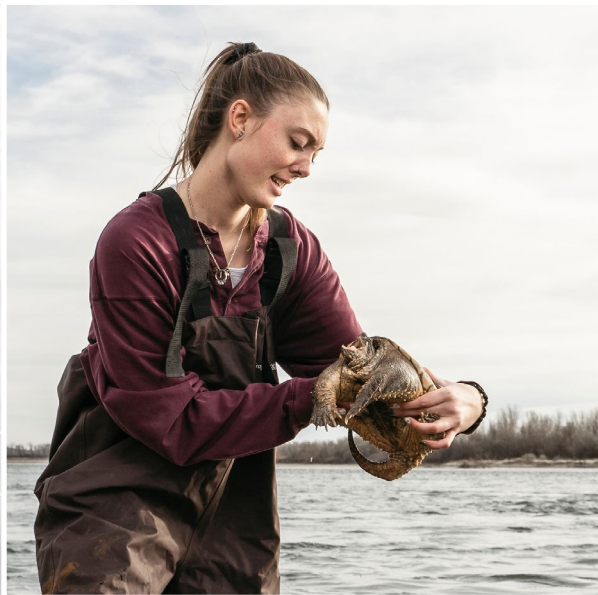
Hawks' studies the bioaccumulation of selenium and its role in synthesis of proteins in false map turtles in the Missouri River. Toxic metals and metalloids—selenium in particular—are becoming more prevalent in South Dakota lakes and reservoirs. High levels of selenium can change protein structure and function within affected organisms.

She tested the hypothesis that there is a difference in selenoprotein content between turtles downstream versus upstream due to the turtles' consumption of zebra mussels, which are an invasive filter feeding metal-bioaccumulating species.

"The bioaccumulation of selenium had not been a topic of concern until the invasive mussels showed their capacity for filter-feeding contaminants and passing them along to their predators," Hawks said. "I aimed to find whether high concentrations of selenium count in turn impact protein function in predators higher up the food chain."

Hawks randomly sampled false map turtles from upstream in Lake Francis Case and downstream in the 59-mile stretch of the Missouri River between Gavins Point Dam and Nebraska's Ponca State Park. Blood samples were selected from both sights and centrifuged for plasma samples, which were tested for selenoprotein concentration.

"I am proud that I was able to carry my own research project from start to finish," Hawks said. "I was able to draft my own grant proposal, conduct my own research on several trips and test my own samples."

She found that the turtles of Lake Francis Case are exposed to higher levels of selenium than those of the 59-mile stretch due to the consumption of invasive zebra mussels downstream. Hawks' work demonstrates the critical need to monitor the impacts of the invasive zebra mussel on threatened turtle species.

"The turtles are also used as a proxy for humans," Hawks said. "Bioaccumulation of toxins could also show up in our own food chain when we consume filter feeders and their predators."

After she graduates, Hawks plans to attend medical school at the USD Sanford School of Medicine and go into family practice or women's health.

IRB OFFICE

HUMAN SUBJECTS PROTECTION

The USD Institutional Review Board reviews all human subjects research studies taking place at USD or conducted by USD faculty across campus to ensure projects are in compliance with US and USD regulations and policies. The USD Office of Human Subjects Protection houses the IRB, and our staff works closely with faculty and student investigators throughout the year to ensure that any risks to the human participants in our research studies are as minimal as possible, and that research participants are properly informed about what enrolling in each study will involve.

The USD IRB is made up of 9 members and 10 alternate members, including faculty, staff, representatives from our VA affiliates, and members with specialized areas of expertise such as neuroscientists, a Native American representative, and researchers experienced in working with children. The USD IRB also reviews studies for the Sioux Falls Veterans Administration and the Fargo Veterans Administration, and is also the reviewing IRB for some studies conducted by researchers not affiliated with USD.
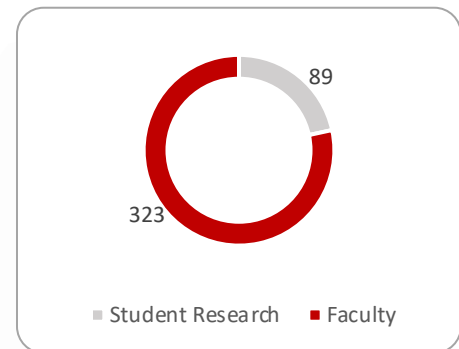
PROTOCOLS REVIEWED/APPROVED DURING FY 2021-2022

Protocols by Review Type

45
116
256

■ Exempt ■ Expedited ■ Full Review
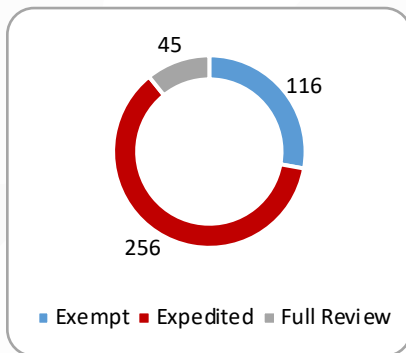
Total Protocols: **412**
New Protocols: **166**
Distinct Protocols: **262**

Student & Faculty-led projects

89
323
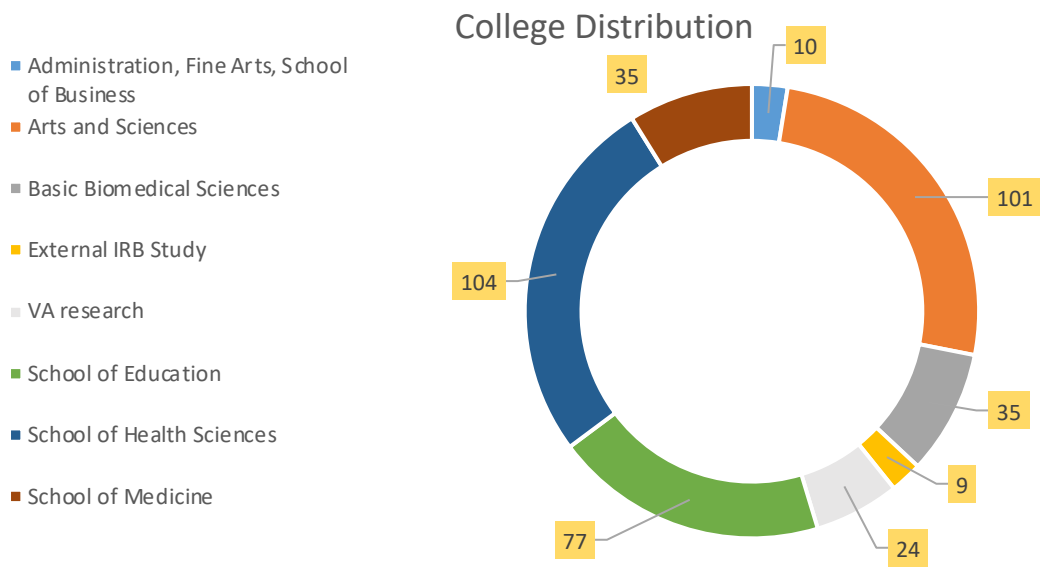
■ Student Research ■ Faculty

STUDENT & FACULTY INVOLVEMENT IN RESEARCH

Every individual who works with human subjects research is listed in on the approved study protocol so we know who might have access to private data from research participants. During FY 2021-2022, about 130 different faculty members – 25% of the USD faculty – have been listed as principal investigators or co-investigators on IRB-approved research projects, which includes faculty from 6 of the 8 colleges and schools. Since our current electronic filing system for human subjects research protocols went live in mid-2019, we have registered about 850 unique student users across campus as well, from undergraduate students working part time in a researcher's lab to graduate students designing and carrying out their own projects.

PREVENTING ADVERSE EVENTS & ENSURING COMPLIANCE

Since the core aim of the USD IRB is to protect human participants in research projects, the Office of Human Subjects Protection also audits approved protocols to make sure that once they are approved they remain in compliance, keep appropriate records, and report any incidents to our office. During FY 2021-2022, 49 approved protocols were audited, and those audits identified 8 instances of noncompliance. Most noncompliance we find is minor and inadvertent, and is quickly remedied by the researchers. During FY 2021-2022, we received no reports of harm to research participants.

College Distribution

Legend:
- Administration, Fine Arts, School of Business
- Arts and Sciences
- Basic Biomedical Sciences
- External IRB Study
- VA research
- School of Education
- School of Health Sciences
- School of Medicine

Chart values: 10, 35, 101, 35, 9, 24, 77, 104

RESEARCH COLLABORATIONS WITH OTHER INSTITUTIONS

The USD IRB also reviews research projects by USD faculty that include researchers at other institutions around the country and overseas. During the 2021-2022 fiscal year, the USD IRB served as the IRB of record for research taking place around the country including Louisiana, Massachusetts, Texas, Ohio, Nebraska, North Dakota, as close to home as South Dakota and as far away as Cairo University in Egypt.

TECHNOLOGY TRANSFER OFFICE

The University of South Dakota's Technology Transfer Office (TTO) is housed within the Office of Research and Sponsored Programs and aims to manage USD's innovative ideas for the public benefit, provide service to faculty, increase industry interactions, and grow economic development on both the state and local level. To further these goals, USD's Technology Transfer Office has developed several programs focused on integrating students into technology commercialization, raising faculty awareness of inventions and commercialization, creating processes and policies for IP disclosure, and conducting novelty evaluations.

Our goal is to plant seeds today within our talented research community that may grow into useful products tomorrow. Technology transfer occurs in many ways: through research publications, exchanges at scientific conferences, and informal and formal relationships with industry. Most importantly, technology transfer occurs via educated students entering the workforce. Thriving technology transfer efforts can create jobs in the region, attract and retain talented students, and integrate companies into USD's collaborative R&D efforts. Over the past several years, the USD TTO shifted focus from a patent-centric mindset to one that is more informed by a

technology's value proposition and benchmark comparisons with other, similar technologies on the market.

A key role of university technology transfer office is managing innovative ideas and technology for the benefit of society through commercialization. No matter where a technology is in its journey to maturity, our office provides resources for researchers and students. These technologies grow in communities friendly to entrepreneurship, and the USD TTO has cultivated a network of internal and external stakeholders who support and promote innovation. A thriving research enterprise contributes to student learning outcomes and regional economic development.

USD's invention disclosures primarily arise out of Chemistry, Basic Biomedical Sciences and Biomedical Engineering. Our office works with students, inventors and the IP Committee to determine whether to convert these invention disclosures into patents; this involves an evaluation of whether the patents are likely to be licensed and transformed into products, services, and dollars. The route to commercialization can take many years and a number of routes. The success of technology transfer offices broadly correlates with quantity and quality of research, involvement of the inventor in the transfer

Table D-3: Patent Grants and Allowances

Domestic and International Patent Grants and Allowances				
Patent No.	Location	Lead Inventor	Title	Grant Date
11,175,736	US	Kelene Fercho and Lee Baugh	Hybrid Brain Computer Interface	11/16/21
11,292,933	US	Stanley May and Aravind Baride	Stable Oil-in-Water Nanoemulsion Nanoparticles	04/05/22

Table D-4: Historical Summary of Intellectual Prooperty Actions

Historical summary of Intellectual Property Actions						
FY	Invention Disclosures	Provisional Patent Applications	Non-Provisional Patent Applications	Licenses & Research Agreements*	MTAs[‡]	NDAs/CDAs
FY18	6	4	3	1	13	24
FY19	4	2	2	1	16	20
FY20	13	6	3	28	15	16
FY21	4	2	5	33	24	39
FY22	12	1	1	37	14	52

* The method of counting licenses and research agreements changed in FY20 with the implementation of a new system, to include Inter-Instittuional Research Collaborations, MOUs and Cooperative Research Agreements with National Laboratories.

[‡] MTAs are material transfer agreements that allow for the protected exchange of IP, either "incoming" to USD researchers or "outgoing" from USD to external entities.

process, integrating students into moving the process forward, and the type of research (basic v. applied, engineering).

In addition to the transfer of technology for development and commercialization, much of a technology transfer office's daily work includes handling material transfer agreements, non-disclosure agreements, contract review, invention disclosures, patent maintenance, and license relationship management. Useful metrics for the transformation of technology to the marketplace include the amount of research funding, number of disclosures, patent applications, patents issued and licenses.

The Technology Transfer Office staff holds training and information sessions related to intellectual property and processes. Additional, one-to-one meetings were held with many faculty and staff to discuss new technologies and provide TTO services. Among the topics often discussed were copyright related issues, SBIR/STTR opportunities, potential markets or prior art related to faculty ideas.

Appendix D: Intellectual Property

Table D-1: New Intellectual Property Disclosures

ORSP Code	Lead Inventor	Title	Status
T2022-00127	Dan Engebretson	Targeted Drug Delivery System for Intracranial Ahterosclerotic Disease	Active: Provisional patent filed
T2022-00128	Ying Deng	Novel N-Halamine Co-Polymer	Closed: Low commercial potential
T2022-00129	Samuel Sathyanesan	New Mouse Model for Alzheimer's Disease	Active: IP committee to continue review
T2022-00130	Zhenqiang Wang	Method of Direct Air Capture Utilizing Metal Organic Super Containers	Active: IP committee to continue review
T2022-00131	Jing Liu	Portable High Purity Ge Detector	Closed: Low commercial potential
T2022-00132	Patti Berg	Method and Device for Diagnosing and Treating Joint Positional Error	Active: Gathering information for future IP committee review
T2022-00133	CY Jiang	New Semiconductor Nanoparticle	Active: Gathering information for future IP committee review
T2022-00134	William Chen	Biomarker System for Ischemic Disease	Active: Gathering information for future IP committee review
T2022-00135	Ying Deng	Biocidal Polymer for Surface Protection	Active: Provisional patent to be filed
T2022-00136	Ranjeet John	Multi-Scale Monitoring of Invasive Plant Species	Active: Gathering information for future IP committee review
T2022-00137	Reza Goljani Amirkhiz	Modeling and Mapping of Game Bird Species	Active: Gathering information for future IP committee review
T2022-00138	Jing Liu	Cryogenic Neutrino Detector	Active: Gathering information for future IP committee review

Table D-2: Provisional, Domestic and International Patent Applications

Domestic and International Patent Applications			
Filing Date	**Type**	**Lead Inventor**	**Title**
10/05/21	Provisional	Daniel Engebretson	Targeted Drug Delivery System for Intracranial Ahterosclerotic Disease
03/30/22	US Utility	Jose Pietri	Bacterial Bed Bug Control Compound

TRAC PROGRAM

The Technology Readiness Acceleration Center (TRAC) launched in June 2020 and has seen success in supporting entrepreneurship and developing research for market readiness since its birth. TRAC aims to train student apprentices in technology development and commercialization of technologies which will create a pipeline of entrepreneurs to help increase innovation, economic and workforce development in the state of South Dakota.

The program was initially built to support 8-9 students per year but has since greatly expanded. Currently, the TRAC program supports 20 students to work on different projects, and the program has supported over 30 students with Graduate Research Apprenticeship stipends since its inception. The TRAC funding also includes funding for tuition remission. The program allows both undergraduate and graduate students at USD an opportunity to participate in the program for two or three years. Students earning their masters at USD receive competitive stipends and spend their first year learning about intellectual property, entrepreneurship, technology development and laboratory skills development. Students then choose from a pool of technologies to focus on de-risking a research project for market application. The TRAC program pairs students with learning opportunities and a business consultant to help them develop the technology, seek further funding and either create a startup company or form partnerships with established industry partners. TRAC hosts workshops every month that cover a wide range of topics such as creating a pitch deck for investors to creating a business plan that showcases the technology's proposed value in the marketplace. The students also continue to grow their R&D knowledge while working in the lab, and TRAC participants graduate the program with a better understanding of applying tech-specific lab skills to build experimental plans for gathering relevant data.

The TRAC program has spent almost $10,000 in travel funding for participants to travel to relevant customer discovery conferences, helping the students to gain valuable contacts in the private sector. The TRAC program has taken students to Minnesota, Texas, Utah, Kansas, Oregon and Washington, DC. Before students leave for a conference, they work with the TRAC Director and business consultants on creating their elevator pitch, presentation pitch deck and building customer discovery protocols. TRAC participants are also trained in how to write a compelling grant application; they have won $24,500 from the SD Biotech FAST Launch program, $75,000 from the South Dakota Governor's Office of Economic Development and $1,000 from the South Dakota Governor's Giant Vision Competition.

The TRAC program has helped USD students, staff and faculty to make valuable connections with business and scientist advisors in our region. For example, collaborative R&D projects are ongoing with companies such as Inanovate, Francis Medical, TruShrimp, LifeScape, Synthetik Applied Technologies and Pirenzia. These private sector relationships have helped fund student stipends, encouraging non-profit partners such as Sanford Research to also contribute funding towards student stipends. Building this network has bolstered student's abilities to compete in business plan competitions, pitch to equity investors and pursue SBIR/STTR funding. These changes are made evident in USD's SBIR/STTR participation; from 2012 – 2020, USD partnered on 5 SBIR/STTR submissions. Since TRAC began in 2020, USD has been a partner in 9 SBIR/STTR submissions and 3 more will be submitted in September 2022.

The TRAC program receives direction from both an Academic Advisory Board and an Industry Leader Advisory Board. This has helped promote USD's students and initiatives to important stakeholder groups such as the South Dakota Legislators, the South Dakota Board of Regents, the Sioux Falls Development Foundation and the Sioux Falls City Council. The emphasis on economic development has enhanced press engagement events and assisted USD in building further connections with the Vermillion Chamber and Development Company, NUtech Ventures, Startup Sioux Falls, Avera's Innovation Institute and

Sanford Innovation. These contacts have helped USD students pursue their own innovations, and private companies have demonstrated great interest in USD's focus to encourage student-driven research.

T2L PROGRAM

USD has a newly funded program called Tech 2 Launch (T2L), which began accepting clients in May 2022. The funding for this program comes from the U.S. Small Business Association and Sanford Research to provide each client up to $6,400 in cost-reimbursable services for launching a tech-based startup.

Many inventors do not have the resources or knowledge of how to develop and commercialize their discoveries. When inventors embark on the process to create a company to move their tech development efforts into the marketplace, too often they can find themselves being bogged down by invoices from lawyers and accountants for business administration activities such as company formation, filing taxes, applying for patents and etc. T2L exists to help inventors focus on what's most important – developing their idea

The T2L program supports South Dakota's tech entrepreneurs by relieving the administrative burden so that inventors can focus on innovation. T2L works to connect entrepreneurs to available local resources so that they can launch their business with a plan to scale and secure financing from private and non-dilutive funding sources. T2L currently supports 10 South Dakota inventor clients by providing strategy in business operations, commercialization pathways, supportive frameworks, legal counsel and financial planning. Each client is paired with a business consultant mentor to start off the process of creating a needs assessment, and then subsequently linked with other professional vendors of the program to help create and build out the business.

The T2L program has built and strengthened further partnerships and ties to Sanford Research. The program also acts as an intersection and point of contact between the South Dakota Small Business Development Center, South Dakota Governor's Office for Economic Development, South Dakota Biotech, the Enterprise Institute, and the Graduate Education & Applied Research Center.

ENVIRONMENTAL, HEALTH AND SAFETY

The Environmental, Health and Safety (EHS) Office provides resources to help protect our campus community and prevent our work from causing harm to the environment. We are dedicated to the integration of safety and environmental compliance into our culture and our behavior. In addition, we offer personal services such as laboratory safety, radiation safety, industrial hygiene, biosafety, laser safety, waste disposal, ergonomics, to the 95 laboratories on campus.

EMERGENCY RESPONSE

EHS personnel discovered an old container of diethyl ether in Pardee Labs. Because diethyl ether tends to form explosive peroxides over time in the presence of oxygen and sunlight, extreme caution was warranted, and the laboratory was locked off. Coordination between the University Police, the FBI, Clay County Emergency Management and EHS staff allowed the safe disposed of a shock sensitive peroxide former without incident.

HAZARDOUS WASTE

In FY21, EHS personnel collected and processed 2,293lbs of hazardous chemical waste. This waste was consolidated by hazard class and shipped to EPA registered disposal facilities. In addition to hazardous chemicals, EHS Staff collected, containerized and disposed of electronic waste, radiological waste and biological waste in safe an environmentally responsible manner.

SHOWER/EYEWASH

USD campus has 104 eyewash/safety shower stations (EW/SS). EW/SS are required to be located near all areas where persons work with hazardous materials. EHS staff perform monthly inspections on these units to confirm they can provide clean and temperate water to remove hazardous chemical contamination from individuals in the event of an emergency.

FUME HOODS

Fume hoods are a crucial piece of equipment for maintaining a safe and productive laboratory. Without them, lab workers would have limited protection from fires, explosions, poisonous gases and corrosive chemicals, and performing daily tasks would become dangerous or even impossible. In FY21 EHS performed 103 fume hood inspections across Lee Medical, Patterson, Churchill-Haines, Pardee Labs and Akeley Science to verify proper operating airflows.
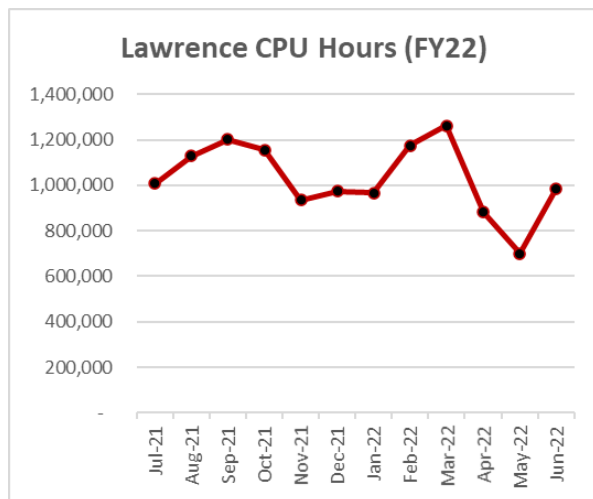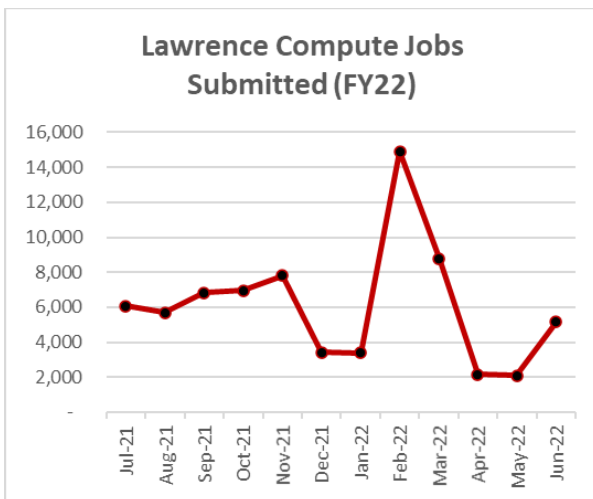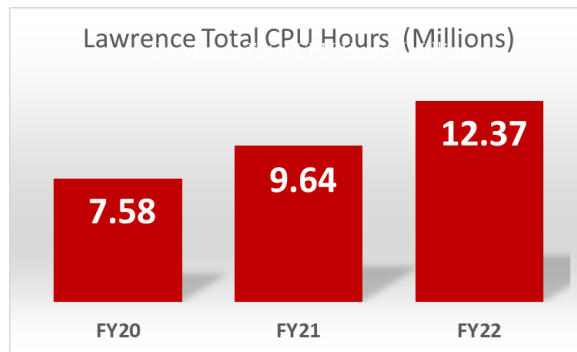
RESEARCH COMPUTING

USD's Research Computing Group works closely with the Office of Research and Sponsored Programs, providing computing and data storage services to USD researchers and their collaborators. USD's primary High-Performance Computing (HPC) cluster—Lawrence—has seen steady growth in usage over the past three fiscal years.

Lawrence is available to all USD faculty, staff, and students free of charge. It accelerates USD and BRIN research applications in the fields of Chemistry, Physics, Biomedical Engineering, Computer Science, Neuroscience, Biology, Sustainability, and Psychology. More than 80 unique users executed a total of 77,520 computing jobs in FY22, utilizing 12.37 million hours of CPU time.

Lawrence is entirely externally funded (via a combination of National Science Foundation and South Dakota Board of Regents grants), and currently consists of 90+ computing nodes, including 7 Graphics Processing Units (GPUs) critical for Artificial Intelligence and Machine Learning applications spanning multiple scientific domains.

Lawrence Total CPU Hours (Millions)

FY20	FY21	FY22
7.58	9.64	12.37

Lawrence Compute Jobs Submitted (FY22)

Lawrence CPU Hours (FY22)

A $140,000 expansion to Lawrence is currently underway, funded by an SDBOR Research & Development Innovation award – *Building STEM Workforce Through Connections to Industry* – led by Dr. Dan Engebretson. This expansion will add 8 general computing nodes and 2 GPU-enabled nodes, with all required matching funds provided by Synthetik Applied Technologies, a private company with whom USD has partnered since 2020.