FY2020 Research Report

Board of Trustees
September 2020

Dear Board of Trustees Members,

I hope you and all your loved ones remain healthy as the world works to slowly reopen safely, just as we are doing here at Clemson University. The images on the cover of this report illustrate some of the many ways our Clemson family members have lent their support during this pandemic. Faculty members raced to produce antibody tests. They jumped to donate personal protective equipment to health care professionals. They authored a book to help children, who have been removed from their classrooms and their friends, cope with this pandemic. They're working to apply artificial intelligence to the hunt for drug therapies. You can read more about some of this work on pages 24-40. I am proud to see how our Clemson researchers have responded while facing their own personal and professional hardship.


Tanju Karanfil

As you know, Clemson acted quickly in mid-March to reduce the risk to our students, faculty, staff, visitors and the community by moving all instruction online and working remotely wherever possible. For our research enterprise, we scaled down to only essential activity. Approximately 40 percent of grant-funded researchers - faculty, graduate students and postdoctoral fellows - have continued to access campus during this operational status. Researchers using facilities did so at limited times and on staggered schedules to promote public health. To help navigate this operational shift, we continue to update our COVID-19 Research Resources webpage with operating guidance and instructions for sanitizing equipment and limiting COVID-19 transmission in shared research spaces, along with important reminders and updates, lists of COVID-19 research funding opportunities, and answers to frequently asked questions.

Even during this pandemic, we have good news to report. Carnegie is expected to release its next classification in Janurary 2021, and based on our analysis of Clemson's performance among the classification metrics (see page 8), I am optimistic we will maintain our R1 rating. When measuring ourselves with our peers, Clemson proves to be a high quality, relevant and efficient research institution. I have included a brief overview of our quality, relevance and efficiency on page 4.

We also continue to see positive signs in our research metrics. Here are a few highlights:

- Total R&D expenditures, an important metric for Carnegie classification, were $219 million in FY2019, the latest year for this data. This represents a 2 percent increase (see page 10).
- Federal expenditures, which had been relatively flat for 15 years at Clemson, have been on a positive trajectory since 2016, indicative of the strong culture that has been building the past five years (see page 10).
- Competitive research expenditures were $105 million, topping our ClemsonForward goal of $100 million despite COVID-19 (see page 11).
- Competitive awards were $118 million, up 11 percent from the prior fiscal year (see page 12).
- Proposal submissions were $734 million, a high point for the last seven years (see page 13). Several colleges hit their proposal submission targets set at the beginning of the year (see page 15).
- Clemson faculty continue to pursue large projects valued above $1 million. Proposal submissions for projects valued above $5 million have been particularly strong in recent years, with 20 such proposals submitted in FY2020 (see page 14).

Our research enterprise has posted tremendous growth since 2016. We have earned distinction as a

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Carnegie R1 institution of the highest research activity and achieved our ClemsonForward goal of $100 million in annual competitive research expenditures seven years ahead of schedule. Despite the recent challenges presented by COVID-19, I remain optimistic and excited about our future.

As we work through these challenges, we continue to monitor guidance from federal agencies to understand how this will impact our awards, expenditures, and proposal submissions moving forward. We have also developed financial models to analyze the business impacts of COVID-19 and think through various mitigation measures for our research enterprise.

Additionally, we are aggressively pursing opportunities. The Coronavirus Aid, Relief, and Economic Security (CARES) Act provides federal agencies with more than $1 billion to support research on COVID-19 prevention, preparation and response. The Office of Research Development compiled an online list of funding opportunities currently available and is sharing information with faculty regularly. As of this letter, we have submitted 92 proposals totaling $52 million and earned 19 awards (see page 25).

Also, the Clemson University Research Foundation and Prisma Health are investing in medical innovations to combat COVID-19 through their collaborative Innovation Maturation Fund. To facilitate even more collaborations with Prisma and other health systems and private businesses, the Division of Research and the Clemson University School of Health Research developed a list of faculty members from each college with a diverse range of expertise to support research on COVID-19. Research topics cover prevention, preparation, response, social behavior, health disparities among ethnic groups, facilities planning, urban design, computational modeling, mental health, medical devices, drug therapies, and much more. The page has been viewed more than 1,500 times since launching in mid-April. You can read about our COVID-19 research on pages 24-40.

Lastly, I'd like to conclude this report with some examples of the great work of our Clemson faculty and students, who are receiving national recognition. In August, we announced our Researchers of the Year, recognizing junior and senior faculty nominees from each college (pages 44-45). Choosing just two faculty members to receive the award is incredibly difficult. This year, Clemson faculty members earned nine early career awards, the most prestigious awards junior faculty can receive (see page 46). You can read more about the many accomplishments of our faculty members in our Focus on Faculty section on pages 51-69, which highights junior faculty in this edition.

Our students have earned impressive accomplishments also. Four Clemson students earned Fulbright awards, the United States' flagship international education exchange program (see page 48). Six Clemson students received prestigious graduate research fellowships from the National Science Foundation (see page 49), and three students earned Goldwater scholarships (see page 50).

These are outstanding accomplishments and proof that our future is bright. Clemson Research is getting increasingly stronger and more impactful.

I appreciate your leadership and ongoing support of scholarship and discovery at Clemson. As always, the best is yet to come.

Respectfully submitted,

Tanju Karanfil, Ph.D., PE, BCEE, IWA Fellow

Vice President for Research, Clemson University

A Carnegie R1

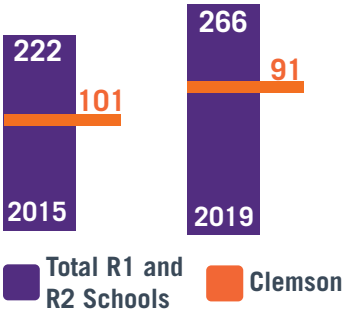
Research Institution

Quality, Relevance, Efficiency

We regularly analyze our quality, relevance and efficiency and measure against our peers. Some examples are below.

Quality

An improving R1 position



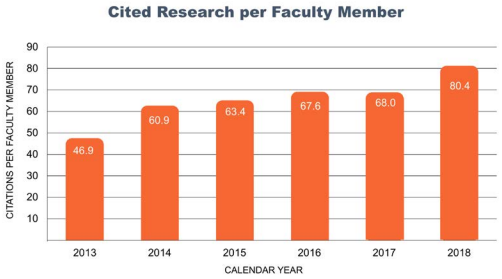
High value awards > $2M

46 projects of at least $2M won since 2015.

Total value of these projects is

$220M

Increased citations

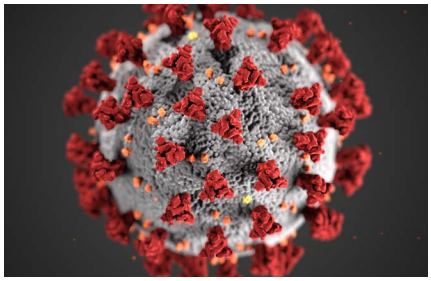


Relevance

Relevant discoveries

* According to Web of Science, a hot paper is defined as a paper with frequent citations relative to papers in the same field. Typically only 0.1% of papers earn this distinction

Addressing societal needs



Learn how Clemson researchers answered the call for research to battle the COVID-19 pandemic (see pages 24-40).

Recent high-value awards

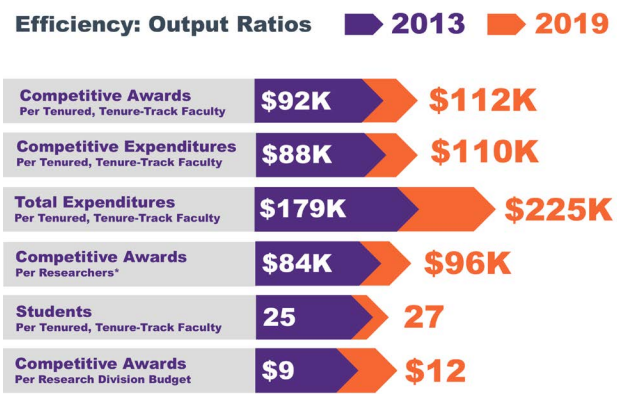
9 major projects of at least $2M won in FY2020.

Total value of these projects is

$39M

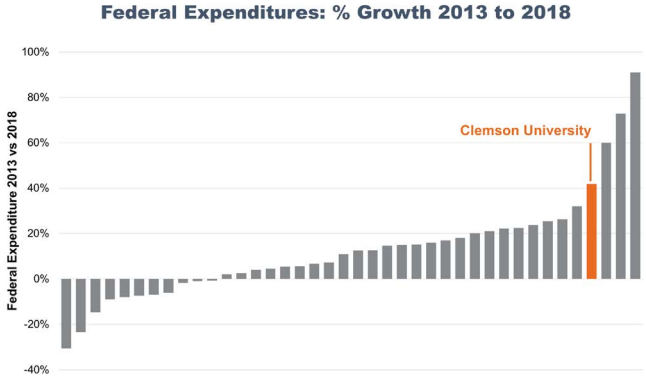
Efficiency

Strong per-capita growth



Among fastest growing R1 institutions

The chart compares growth at 39 peer R1 public universities without medical schools.



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4. COVID-19 RESEARCH

5. HONORS, AWARDS & NEWS

6. FOCUS ON FACULTY

Division of RESEARCH

This section reviews Clemson's performance in key Carnegie classification metrics.

EXECUTIVE SUMMARY

- Clemson's Carnegie R1 status is confirmed until 2021. This is a key goal of our ClemsonForward strategic plan. This distinction confirms Clemson's "very high research activity" and places us among the nation's top research institutions. The Carnegie R1 designation helps Clemson attract top-notch faculty and students and increases the university's competitiveness for high-value research projects.
- Clemson has submitted data for the next classification, which is expected to be released in January 2021 (see page 7).
- Clemson continued to penetrate deeper into the field of R1 schools in 2019, making significant progress toward becoming a perennial R1 university, according to internal analysis of Carnegie's classification metrics (see page 8).
- From 2018 to 2020, Clemson's performance in all but two Carnegie metrics improved (see page 8). Given our positive momentum, we feel confident Clemson will be reconfirmed as a Carnegie R1 institution in 2021.

NEXT CARNEGIE CLASSIFICATION WILL BE RELEASED IN 2021

Clemson's R1 status was reconfirmed in 2018. The next classification is expected be released in January 2021. Carnegie changed its classification cycle from 5 years to 3 in 2018, which essentially led to data collection happening one year earlier than anticipated. The table at the bottom of the page provides information on data submitted to Carnegie.

R1 confirmed until 2021

Clemson*Forward* goal: Become a perennial R1 institution

CARNEGIE DATA SUBMISSION SCHEDULE

The information below has been submitted for review and will be used in the Carnegie Classification expected to be released in January 2021.

Metric	Data Year	Survey	Submission Date	Status
1. Science and engineering expenditures	FY2019	NSF HERD	January 2020	Submitted
2. Non science and engineering expenditures	FY2019	NSF HERD	January 2020	Submitted
3. Post-doctoral researchers and research faculty and staff with a Ph.D.	Fall, 2019 snapshot	NSF GSS	February 2020	Submitted
4. Humanities doctoral degrees	AY2018-19	IPEDS	April 2020	Submitted
5. Social sciences doctoral degrees	AY2018-19	IPEDS	April 2020	Submitted
6. STEM doctoral degrees	AY2018-19	IPEDS	April 2020	Submitted
7. Other doctoral degrees	AY2018-19	IPEDS	April 2020	Submitted
FAC: Faculty size	Fall, 2019 snapshot	IPEDS	October 2019	Submitted

AY: Academic Year

FY: Fiscal Year, which runs from July 1 to June 30.

NSF HERD: The National Science Foundation's Higher Education Research and Development Survey

NSF GSS: National Science Foundation Survey of Graduate Students and Postdoctorates in Science and Engineering

IPEDS: Integrated Postsecondary Education Data System managed by the National Center for Education Statistics

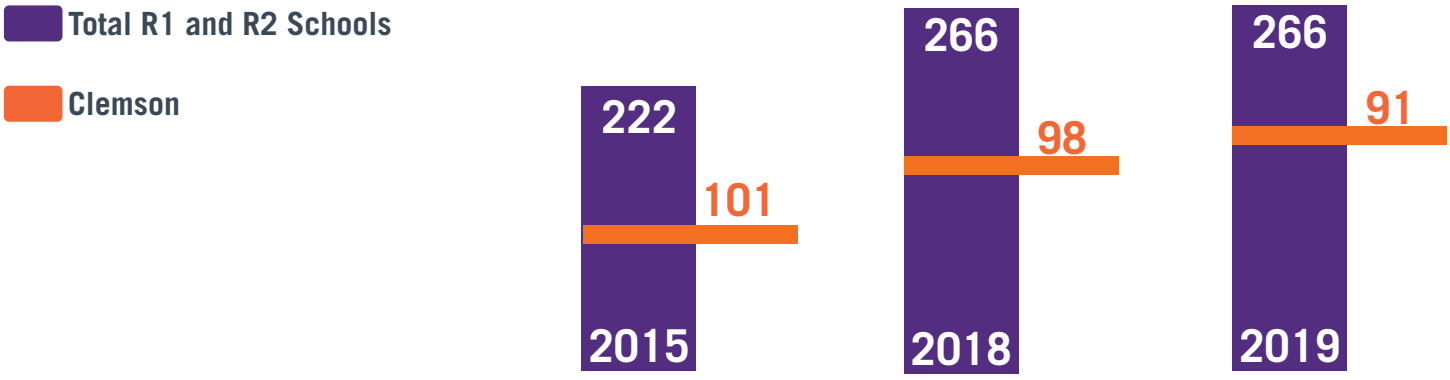
CLEMSON'S CARNEGIE METRICS

Clemson is showing improvement in nearly all delta metrics used in the Carnegie Classification. The table displays Clemson data in 2018 and 2020. As metrics improve, Clemson continues to solidify its position among Carnegie R1 schools, as shown in the graphic at the bottom of the page. Given Clemson's performance, particularly as compared to our peers, we are confident Clemson's R1 status will be reconfirmed in 2021.

Metrics	Clemson 2018	Clemson 2020	Δ Metric 2018-2020
Science & Engineering Expenditures	$145M	$165M	↑ $20M
Non-Science & Engineering Expenditures	$49M	$54M	↑ $5M
Postdoc & Non-Faculty Researchers	111	162	↑ 51
PhD Humanities	8	7	↓ -1
PhD Social Sciences	20	25	↑ 5
PhD STEM	170	156	↓ -14
PhD Other	33	55	↑ 22
Per Capita Science & Engineering Expenditures	$159K	$173K	↑ $14K
Per Capita Non-Science & Engineering Expenditures	$53K	$56K	↑ $3K
Per Capita Postdoc & Non-Faculty Researchers	0.122	0.170	↑ 0.048

CLEMSON AMONG CARNEGIE INSTITUTIONS

Carnegie does not rank schools. The rankings provided below are based on an internal analysis of metrics data for Carnegie institutions. In 2019, 266 schools were classified Carnegie R1 and R2. Of those, 131 were R1 institutions. Based on our analysis of Carnegie metrics at those institutions, average ranking of all Clemson metrics would be 91 out of 131 R1 universities. Clemson's average ranking of metrics have improved since 2015, as shown below.



This section covers research productivity with data on proposal submissions, awards and expenditures.

Pictured: Clemson's Timo Heister is working on new computational models to better understand geological events that lead to earthquakes, volcanic eruptions, or the formation of mountains.

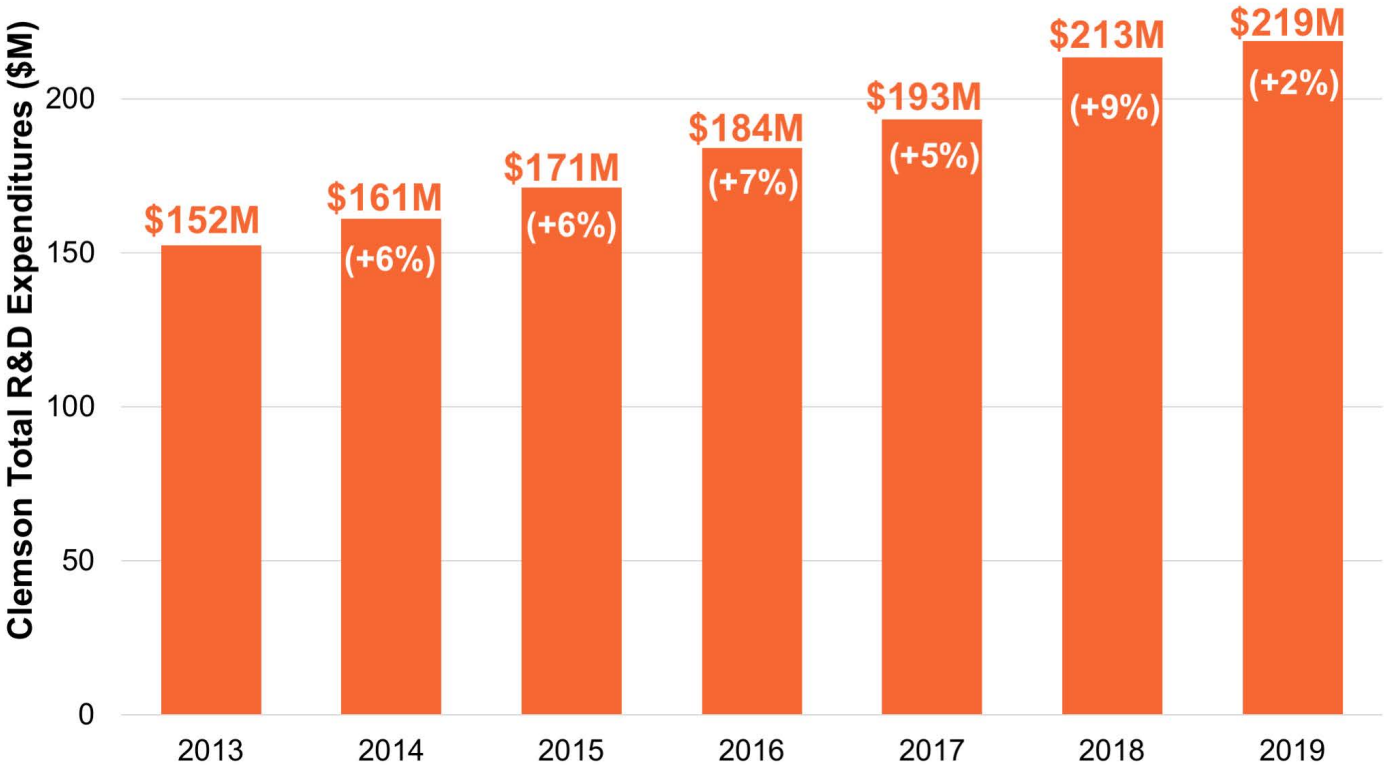
LEARN MORE

EXECUTIVE SUMMARY

- Total R&D expenditures, an important metric for Carnegie classification, reached $219 million in FY2019, the latest year for this data. This represents a 2 percent increase (see page 10).
- Competitive research expenditures were $105 million, topping our ClemsonForward goal of $100 million despite modified operations due to COVID-19 (see page 11).
- Competitive awards were $118 million, up 11 percent from the prior fiscal year (see page 12).
- Proposal submissions were $734 million, a high point for the last seven years (see page 13). Most colleges hit their proposal submission targets set at the beginning of the year (see page 15).
- Clemson faculty continue to pursue large projects valued above $1 million. Proposal submissions for projects valued above $5 million have been particularly strong in recent years, with 20 such proposals submitted in FY2020 (see page 14).
- Full details on proposals, awards and submissions by college and unit are in the Research Report Card (see pages 15-18).

Total R&D Expenditures FY2013-2019

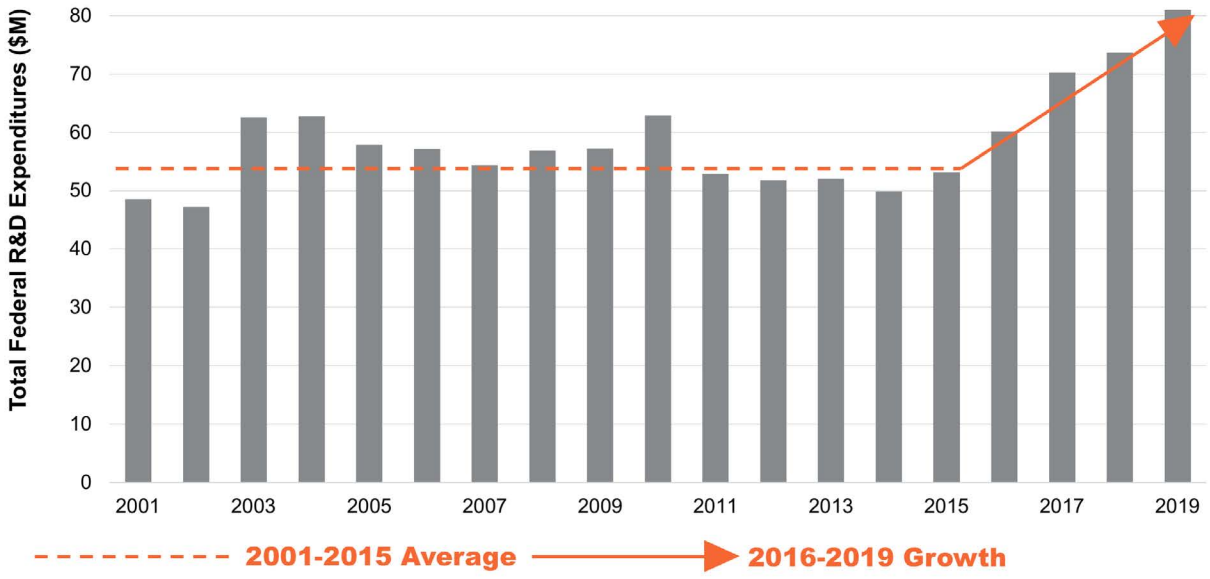
Total expenditures include competitive research awards, external research services, research gifts, institutional research support, state research support, etc., reported to the National Science Foundation (NSF). These totals are used for the Carnegie R1 classification.



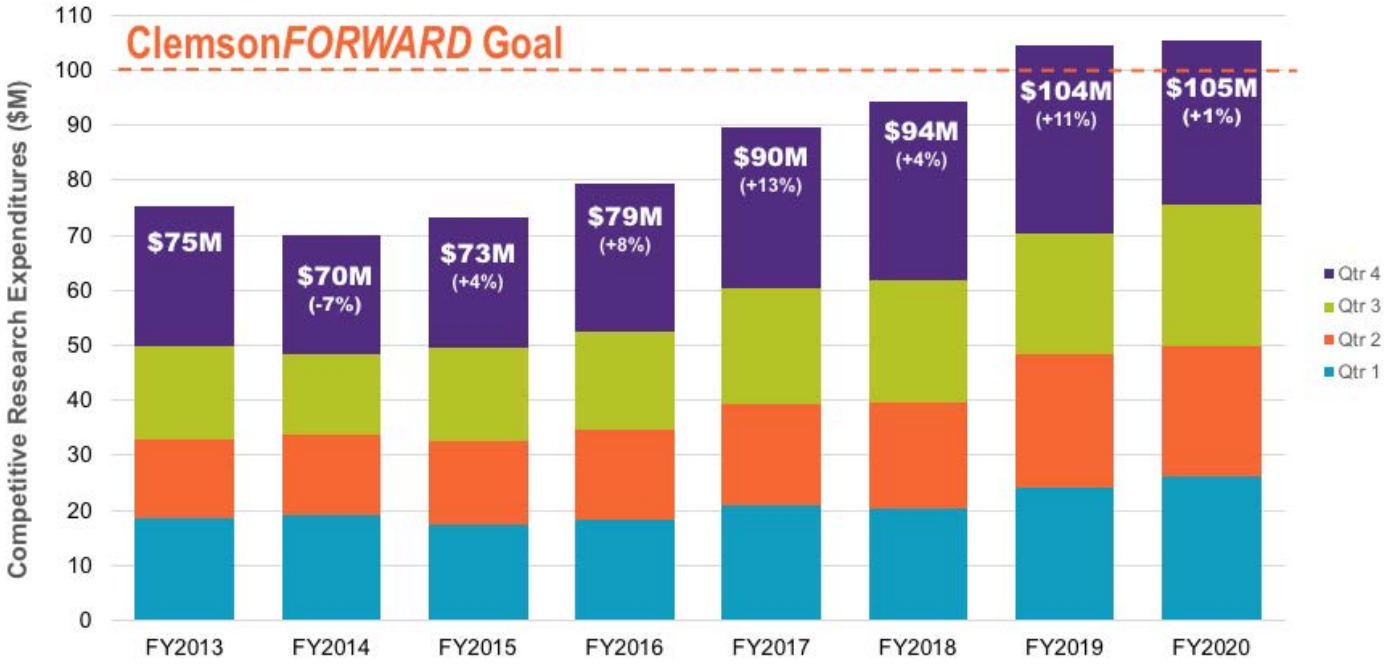
SOURCE: National Science Foundation Higher Education Research and Development Survey

FEDERAL EXPENDITURES ON UPWARD TRAJECTORY

The chart below shows federal expenditures at Clemson over the past two decades. Federal expenditures had been relatively flat for 15 years before a positive trajectory began in 2016. This signifies a culture shift with Clemson faculty and an increase in the competitiveness of their ideas in federal grant competitions.

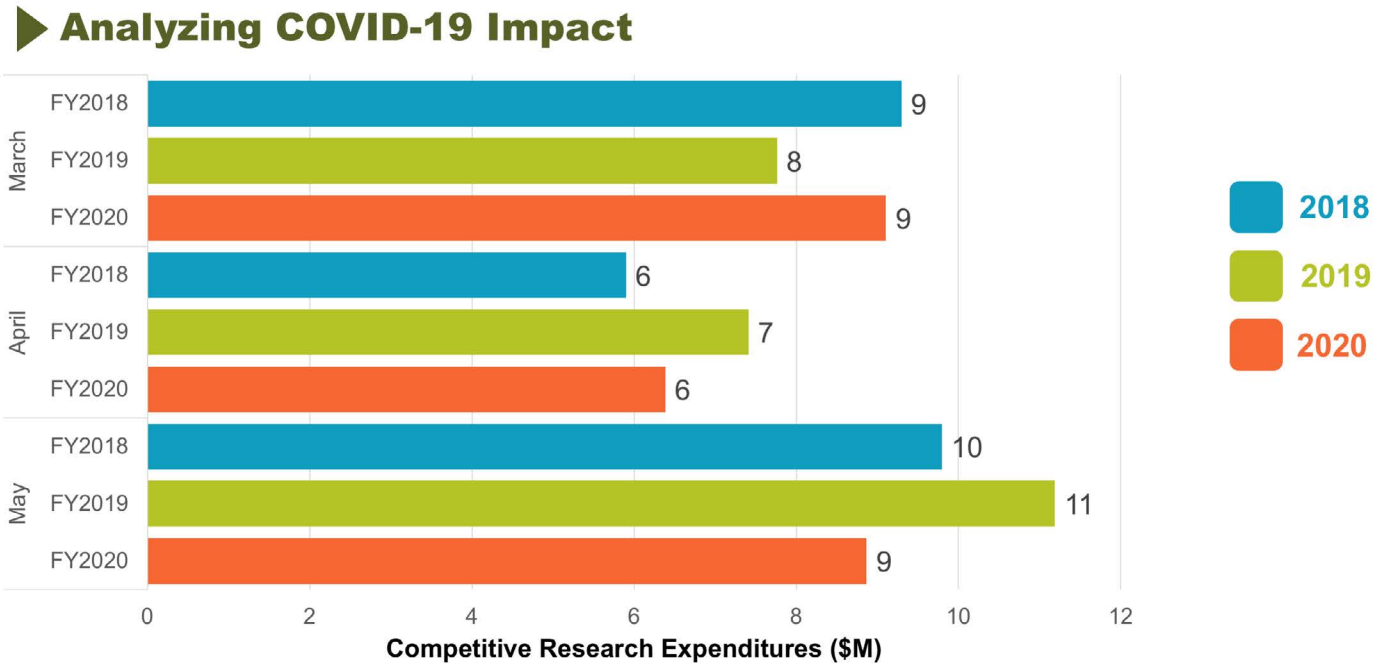


Competitive Expenditures FY2013-2020

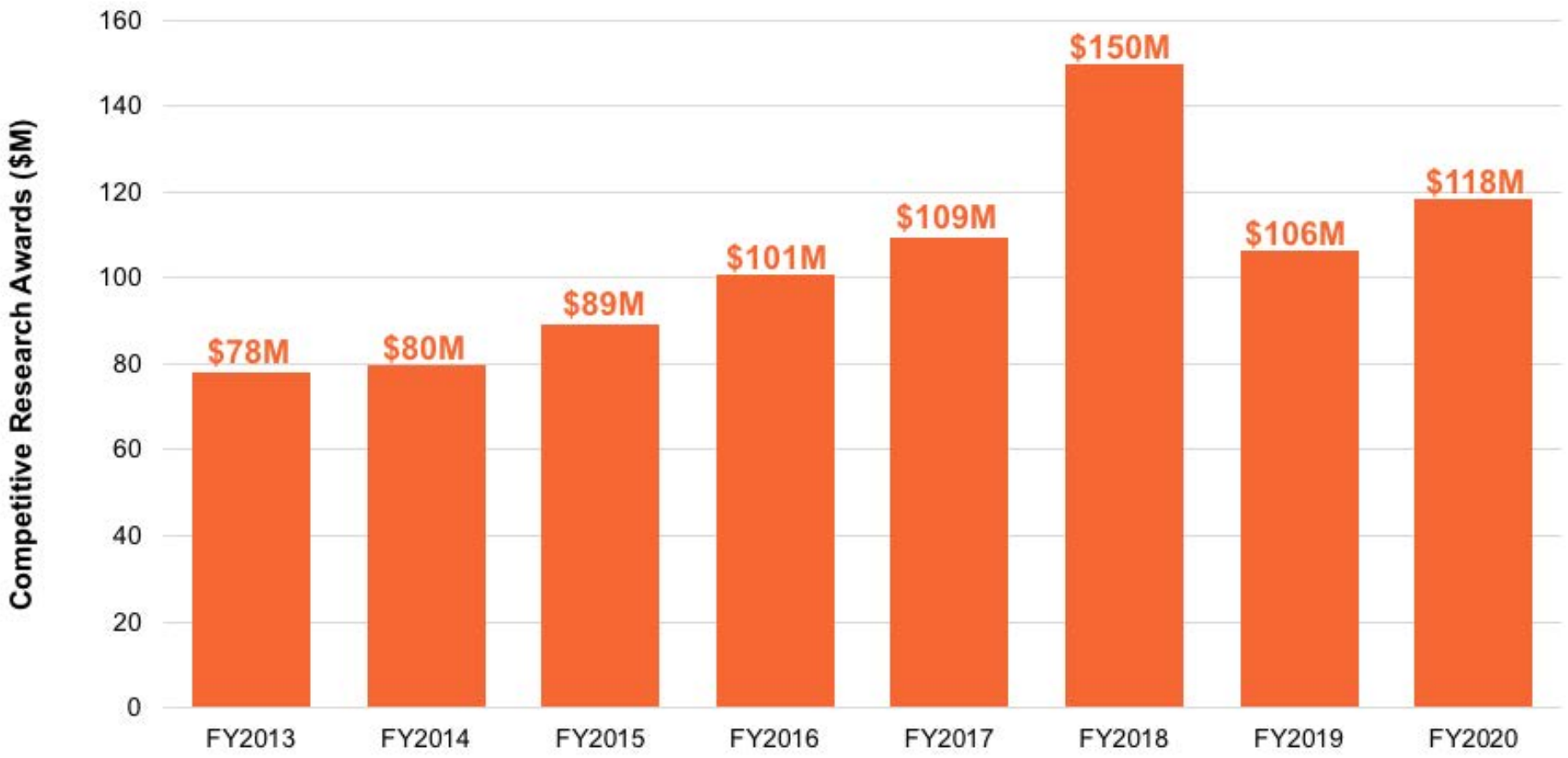


ANALYZING THE IMPACT OF COVID-19

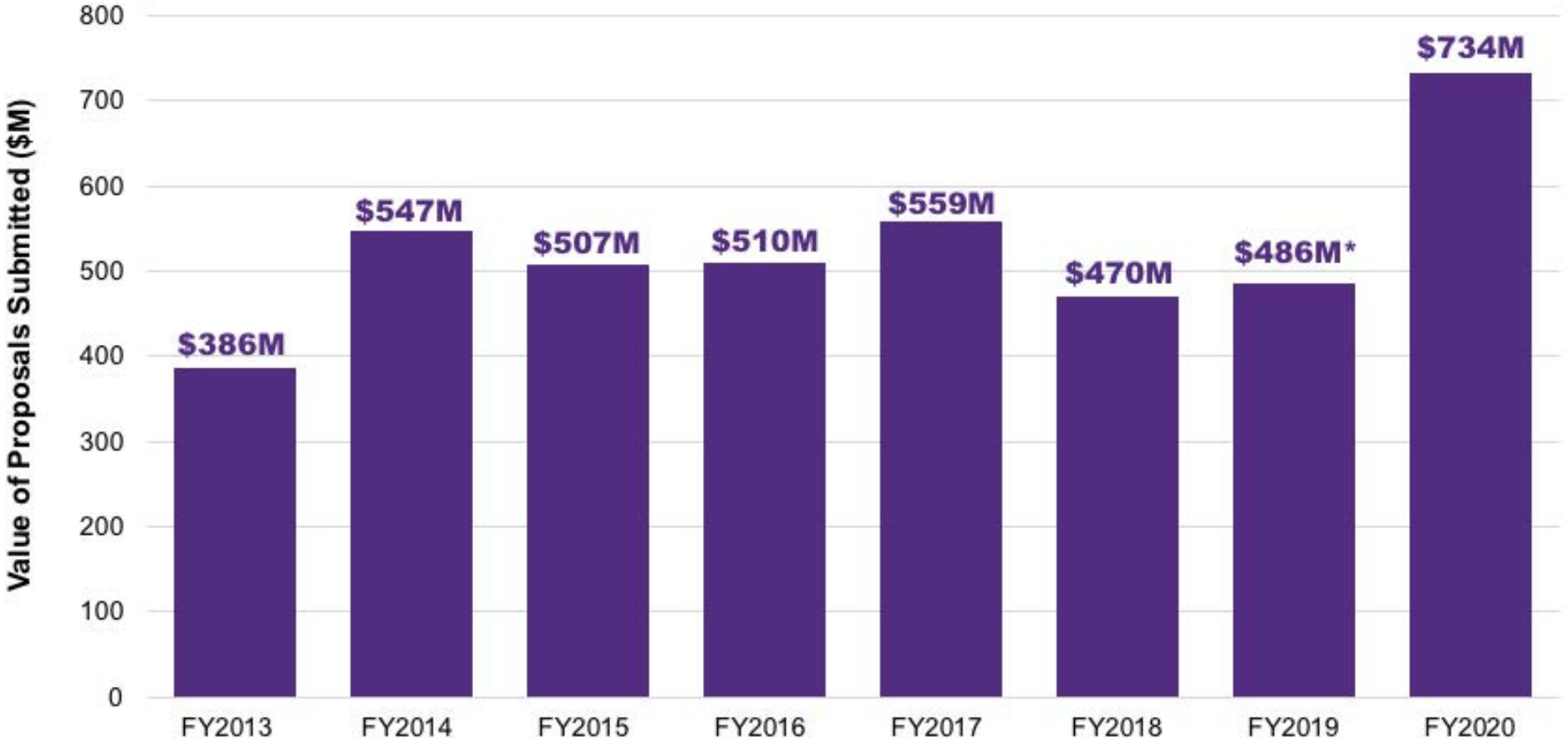
When Clemson modified operations in mid-March amid the COVID-19 pandemic, on-location research activity was limited to essential operations. This reduction of activity can be seen in Clemson's monthly expenditures data for April and May compared to 2019.



Competitive Research Awards FY2013-2020

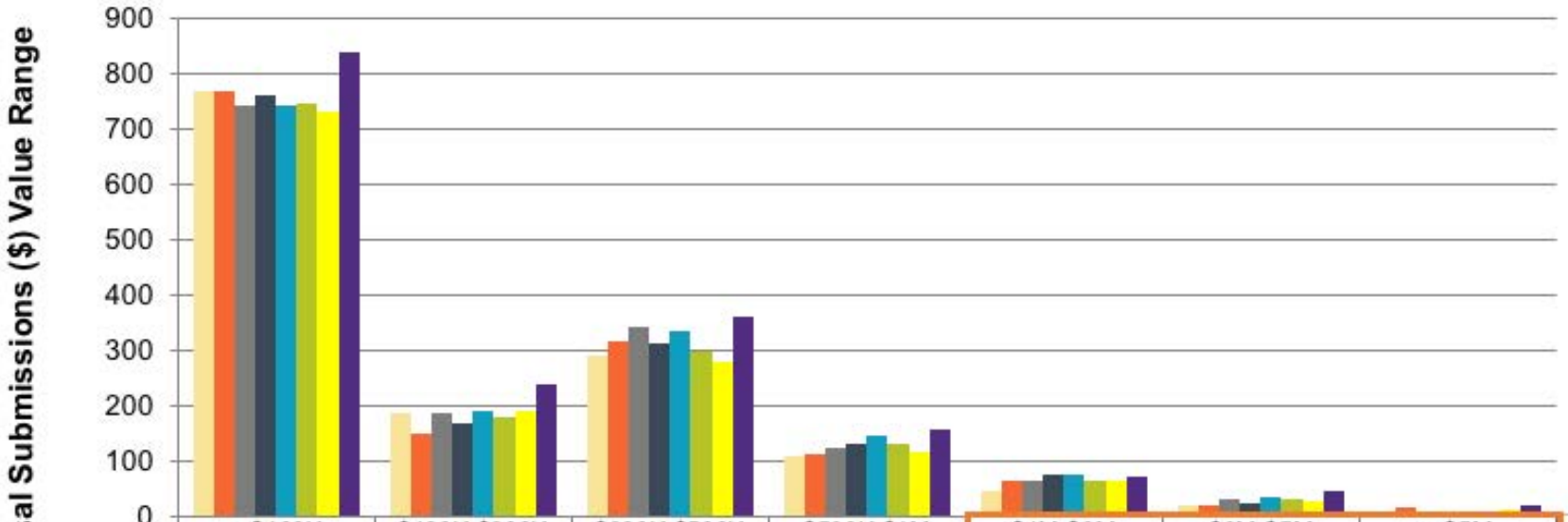


Proposal Submissions: $ Value FY2013-2020



*This chart excludes a large $107M multidisciplinary proposal submitted in FY2019

Proposal Submissions: $ Range FY2013-2020



	< $100K	$100K-$200K	$200K-$500K	$500K-$1M	$1M-$2M	$2M-$5M	> $5M	> $1M
FY2013	769	184	289	107	45	18	3	66
FY2014	769	147	317	112	63	20	15	98
FY2015	741	184	342	122	64	28	8	100
FY2016	762	169	313	131	73	23	7	103
FY2017	744	188	335	146	76	32	8	116
FY2018	747	178	299	131	62	28	6	96
FY2019	733	189	279	115	63	26	12	101
FY2020	839	239	361	157	70	43	20	133

Research Report Card

		2013	2014	2015	2016	2017	2018	2019	2020	
RESEARCH INPUTS										
a. Proposal Submissions by Number		1,414	1,443	1,489	1,478	1,529	1,451	1,417	1,729	
1	CAAH (College of Architecture, Arts & Humanities)	38	51	65	62	69	64	69	76	
2	CAFLS (College of Agriculture, Forestry & Life Sciences)	235	230	224	222	241	229	377	473	
3	CBSHS (College of Behavioral, Social & Health Sciences)	81	93	102	104	112	101	105	143	
4	CECAS (College of Engineering, Computing & Applied Sciences)	549	555	582	617	618	587	562	672	
5	COE (College of Education)	51	54	39	45	46	37	39	42	
6	COB (College of Business)	7	15	13	15	7	10	5	11	
7	COS (College of Science)	242	247	263	239	230	227	186	219	
8	CCIT (Clemson Computing & Information Technology)	12	12	6	3	5	1	1	1	
9	PSA (Public Service & Agriculture)	88	90	118	97	170	163	33	37	
10	VP for Res & Interdisc Inst	31	17	7	17	14	12	25	29	
11	All Other	80	79	70	57	17	20	15	26	
b. Proposal Submissions by Dollar Value (in millions)		$386M	$547M	$507M	$510M	$559M	$470M	$486M*	$734M	**FY 2020 Targets**
12	CAAH	N/A	N/A	$9.4	$8.6	$3.1	$5.7	$4.4	$5.9	**$5.5**
13	CAFLS	N/A	N/A	$42.6	$23.8	$43.4	$37.1	$64.1	$92.9	**$66.4**
14	CBSHS	N/A	N/A	$28.4	$40.1	$41.4	$25.9	$47.9	$41.1	**$49.6**
15	CECAS	N/A	N/A	$260.5	$281.2	$306.4	$235.5	$255.3	$405.9	**$283.1**
16	COE	N/A	N/A	$13.8	$14.7	$18.1	$19.1	$10.1	$18.9	**$12.2**
17	COB	N/A	N/A	$7.5	$4.3	$2.8	$1.8	$2.1	$2.9	**$2.2**
18	COS	N/A	N/A	$100.2	$111.3	$95.9	$100.4	$73.8	$129.3	**$84.7**
19	CCIT	N/A	N/A	$4.3	$2.0	$4.0	$0.9	$0.4	$3.0	
20	PSA	N/A	N/A	$23.3	$10.4	$31.3	$25.8	$11.4	$6.4	**$13.4**
21	VP for Res & Interdisc Inst	N/A	N/A	$5.6	$7.7	$6.0	$12.7	$9.5	$19.8	
22	All Other	N/A	N/A	$11.4	$5.6	$6.0	$5.0	$7.4	$7.7	

N/A - Data per college and unit was unavailable for fiscal years 2013 and 2014.

***This figure excludes a large $107 million proposal from a multi-disciplinary collaborative between Clemson and Prisma Health.**

Research Report Card

		2013	2014	2015	2016	2017	2018	2019	2020
RESEARCH INPUTS continued									
c. Research Awards (in millions)		$78.0M	$79.7M	$89.3M	$100.9M	$109.5M	$149.8M	$106.3M	$118.3M
23	CAAH	$0.2	$0.6	$0.7	$1.4	$0.5	$1.9	$2.0	$1.4
24	CAFLS	$7.3	$6.7	$14.1	$8.6	$10.9	$13.9	$14.2	$22.3
25	CBSHS	$2.7	$3.4	$4.8	$5.1	$4.6	$8.1	$5.9	$7.7
26	CECAS	$34.2	$37.7	$48.2	$45.5	$54.0	$80.8	$50.4	$48.0
27	COE	$2.6	$4.1	$3.2	$2.9	$2.8	$4.5	$3.3	$2.3
28	COB	$2.0	$1.1	$1.3	$0.8	$1.2	$1.1	$0.8	$1.2
29	COS	$10.3	$7.8	$9.9	$15.6	$19.9	$14.7	$18.7	$14.2
30	CCIT	$1.6	$5.7	$0.7	$0.8	$0.5	$1.3	$0.1	$0.3
31	PSA	$14.8	$12.3	$9.6	$13.0	$7.9	$6..6	$4.0	$4.1
32	VP for Res & Interdisc Inst	$1.8	$0.3	$0.6	$5.1	$5.0	$15.1	$6.2	$14.6
33	All Other	$0.3	$0.2	$1.2	$2.0	$1.2	$1.7	$0.7	$2.2
d. National Young Investigator Awards		4	3	4	7	8	7	6	9
34	NSF CAREER Awards (by start date)	4	1	3	5	7	7	4	6
35	Air Force Young Investigator Awards	-	-	1	2	1	-	1	-
36	Army Young Investigator Awards	-	-	-	-	-	-	-	1
37	DARPA Young Investigators Awards			-	-		-	-	1
38	EPA Earley Career Awards	-	-	-	-	-	-	1	-
39	DOE Early CAREER Awards	1	-	-	-	-	-	-	-
40	Department of Homeland Security	-	1	-	-	-	-	-	-
41	Dept. of Ed. Inst. of Educational Sciences	-	-	-	-		-	-	1
e. Supporting Workforce									
42	Graduate Student Enrollment	4,206	4,372	4,670	4,664	4,425	4,985	5,282	5,627
43	Sponsored Graduate Research Assistants	822	745	707	693	696	761	558	637
44	Postdoctoral Fellows	48	64	83	85	90	97	98	98
45	Research Faculty: Permanent 100% Non-E&G Funded	6	6	6	11	17	14	11	18
46	Research Faculty: Temporary 100% Non-E&G Funded	18	18	15	14	24	27	29	54

Research Report Card

		2013	2014	2015	2016	2017	2018	2019	2020
RESEARCH PROCESS									
f. Sponsored Research Expenditures by Business Unit (in millions)		$75.4M	$70.0M	$73.3M	$79.5M	$89.5M	$94.2M	$104.5M	$105.3M
47	CAAH	$0.5	$0.4	$0.4	$1.1	$1.3	$1.4	$1.7	$1.6
48	CAFLS	$8.8	$7.7	$6.8	$8.6	$11.1	$11.0	$14.1	$16.4
49	COB	$1.2	$1.2	$1.1	$1.0	$0.9	$0.8	$0.8	$0.7
50	CECAS	$35.0	$35.0	$35.0	$37.5	$42.9	$45.1	$50.3	$46.4
51	CBSHS	$3.1	$2.8	$3.7	$4.1	$4.4	$4.9	$5.3	$6.7
52	COE	$3.3	$3.3	$3.8	$2.5	$2.6	$2.2	$2.5	$2.4
53	COS	$13.2	$10.5	$9.3	$11.3	$14.8	$16.7	$17.2	$17.3
54	CCIT	$2.0	$1.6	$3.4	$2.8	$0.4	$0.6	$0.2	$0.1
55	PSA	$4.7	$4.9	$5.8	$5.6	$5.7	$5.9	$3.7	$3.9
56	VP for Res & Interdisc Inst	$1.9	$1.3	$1.9	$3.5	$3.9	$3.9	$7.1	$9.5
57	All Other	$1.7	$1.7	$2.2	$1.5	$1.5	$1.6	$1.5	$0.4
g. Sponsored Research Expenditures by Innovation Cluster (in millions)		$75.4M	$70.0M	$73.3M	$79.5M	$89.5M	$94.2M	$104.5M	$105.3M
58	Advanced Materials	$14.3	$11.3	$10.7	$10.4	$10.7	$12.1	$15.4	$13.5
59	Cyberinfrastructure & Big Data Science	$10.3	$10.5	$10.1	$8.9	$8.1	$9.6	$6.9	$4.4
60	Energy, Transportation & Advanced Manufacturing	$4.7	$5.7	$7.2	$7.6	$17.8	$16.8	$17.1	$14.5
61	Health Innovation	$13.1	$10.2	$10.2	$12.5	$16.3	$17.8	$23.8	$27.1
62	Human Resilience	$8.2	$7.7	$9.7	$9.8	$7.8	$8.6	$9.0	$9.7
63	Sustainable Environments	$18.3	$16.9	$17.9	$21.7	$18.9	$19.5	$20.6	$23.9
64	Other	$6.5	$7.6	$7.4	$8.6	$9.9	$9.6	$11.7	$12.1
h. Sponsored Research Expenditures by Funding Source (in millions)		$75.4M	$70.0M	$73.3M	$79.5M	$89.5M	$94.2M	$104.5M	$105.3M
65	Federal Government	$62.9	$56.9	$58.5	$65.1	$74.6	$78.2	$85.1	$85.2
66	Foundations, Societies, and Associations	$4.2	$4.3	$4.7	$4.1	$4.7	$5.1	$7.4	$6.9
67	Industry/Other	$4.9	$5.6	$6.1	$6.9	$6.8	$6.3	$5.3	$5.5
68	International	$0.8	$0.6	$0.8	$0.8	$0.5	$0.4	$0.3	$0.3
69	Local Government	$0.6	$0.6	$0.6	$0.5	$0.5	$0.5	$0.5	$0.5
70	State Government	$1.9	$1.9	$2.7	$2.0	$2.4	$3.7	$5.7	$6.8

Research Report Card

		2013	2014	2015	2016	2017	2018	2019	2020
RESEARCH PROCESS continued									
i. Sponsored Research Expenditures per T/TT Faculty by College									
71	CAAH	$3,299	$2,264	$2,343	$5,841	$8,177	$8,945	$10,159	$10,003
72	CAFLS	$88,570	$81,120	$69,612	$84,618	$105,396	$103,814	$134,555	$137,438
73	COB	$14,415	$13,047	$11,510	$9,683	$8,855	$8,269	$8,200	$6,991
74	CECAS	$169,754	$160,698	$163,406	$163,685	$194,323	$214,280	$225,620	$201,553
75	CBSHS	$27,982	$26,853	$33,764	$42,376	$34,751	$39,532	$40,301	$50,495
76	COE	$54,779	$51,688	$62,195	$38,037	$44,483	$40,197	$47,371	$47,742
77	COS	$95,724	$72,421	$61,912	$77,589	$95,956	$110,206	$118,600	$116,020
78	CU average (Total exp/Total T/TT faculty)	$83,858	$75,089	$78,826	$85,753	$84,297	$103,706	$99,125	$96,497
RESEARCH OUTPUTS/ OUTCOMES									
79	NIH RO1-Equivalent Awards (by start date)	-	-	2	2	2	3	6	1
80	Doctorates Awarded (Aug, Dec, May)	187	217	237	233	231	234	301	249
81	STEM Doctorates Awarded (Aug, Dec, May)	118	153	165	138	156	171	174	162
82	Disclosures	102	129	70	60	65	48	61	68
83	Patents	16	15	15	14	18	11	18	12
84	Licenses/Options	9	7	7	5	10	10	16	13
85	Licensing Revenue	$1,134,289	$762,811	$360,131	$354,827	$539,490	$388,751	$398,136	$315,578
86	Start-up Companies (based on licenses/options)	1	4	4	2	3	3	5	1

STRATEGIES

1 INVEST IN PEOPLE

- Incentivize research investment, activity and doctoral productivity.
- Hire world-class faculty.
- Support faculty competitiveness through proposal development support from the Office of Research Development and external reviews of proposals.
- Pursue high-value, high-quality research grants with help from external consultants.
- Continue to implement R-Initiative funding programs to invest in high-quality research ideas.

2 INCREASE PROPOSAL SUBMISSIONS

We have taken several steps to boost submissions and maintain momentum:

- Provost has set goals with college deans, establishing submission targets in order to reach ClemsonForward goals, and we are providing quarterly reports to help track progress (see Report Card on page 15).
- Vice President for Research meets regularly with college deans and associate deans for research to discuss research strategies.
- The Office of Research Development continues to support faculty in the development of large, complex proposals.
- We have hired an associate vice president for research development to lead research development efforts.
- CURF is working to support growth in federal and industry-funded research.
- The Office of External Affairs developed strategic initiatives to attract new industry research funding.

3 OPTIMIZE CAPACITY

- Complete the research space utilization study with the EVP for Finance and Operations to more efficiently utilize research facilities and equipment.
- Optimize the use of facility space and reduce downtime by incentivizing faculty use of equipment through our Clemson University Core Incentivized Access program.
- Implement new software solutions that will allow us to better manage facility usage and laboratory risk. This will greatly reduce workplace inconsistencies, redundancies and workloads, while helping to achieve safe, efficient laboratories.
- Align efforts with priorities and opportunities of federal funding agencies and industry, and pursue high-value grant projects, such as Centers of Biomedical Research Excellence (COBRE), Engineering Research Centers (ERC), and Science and Technology Centers (STC).
- Invest in research equipment that will be relevant to industry and funding agencies.

This section lists the largest competitive grants recently earned.

Clemson's Corliss Outley, left, and Harrison Pinckney, right, in the parks, recreation and tourism management department are leading a national discussion on race and play.

READ MORE

EXECUTIVE SUMMARY

CONSISTENTLY EARNING HIGH-VALUE AWARDS

- In FY2020, Clemson faculty earned nine awards of at least $2 million in value, for a combined value of $39 million.
- Clemson has consistently earned large awards over the past five years. Since 2015, Clemson has received 46 major research projects with a combined value of $220 million.
- These large grants are significant contributors to the growth of the university's research enterprise. As such, we continue to assemble faculty teams to strategically pursue high-value grant opportunities.
- The list of grants in this section represents a diverse range of academic disciplines, incuding education, agriculture, materials science, computing, genetics, energy and mathematics.

1 Curtiss Fox: $5.2M from an industry sponsor

Project Title: Collaboration agreement

Summary: Unique facilities and faculty expertise at Clemson University will support the development and testing of sustainable energy systems.

2 Eric Johnson: $4.5M from the U.S. Navy

Project Title: High Photon Density Spatiotemporal (OAM+SAM) Vector Beams for Maritime Environments

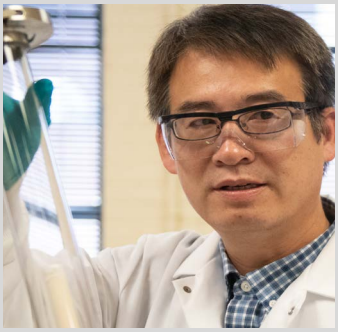
Summary: With established and recognized strengths in optical materials and advanced materials, Clemson University leads this complex project focused on improving the Navy's communication and navigation technologies. Clemson will be joined by the University of Southern California, University of North Carolina Charlotte, University of Central Florida, University of Rochester and Duke University as it strives to overcome challenges inherent to a maritime environment.

3 Dilrukshi Thavarajah: $2M from U.S. Agency for International Development

Project Title: Feed the Future Innovation Lab for Crop Improvement

Summary: Globally, hundreds of millions of children and pregnant women are affected by marasmus and kwashiorkor, diseases caused by micronutrient deficiencies. Global health experts remain concerned that populations in Asia are not able to meet the daily dietary requirement of amino acids. While lentil -- a staple food in Asia -- provides some protein, fiber and carbohydrates, it is not nutritionally complete. Clemson researchers will partner with breeders in Nepal to develop a more nutritionally complete lentil.

4 Jianhua Tong: $1.3M from the U.S. Department of Energy



Project Title: Electrocatalytically Upgrading Methane to Benzene in a Highly Compacted Microchannel Protonic Ceramic Membrane Reactor

Summary: Clemson partners with Oak Ridge National Laboratory to develop and deploy innovative materials to support the conversion of methane, a waste product of oil drilling that significantly contributes to carbon dioxide emissions, to chemical products useful in industrial applications.

5 Kara Powder: $1.2M from the National Science Foundation

Project Title: (NSF CAREER Award) Phenotypic and Developmental Effects of Enhancer Variation on Cichlid Craniofacial Evolution

Summary: Examining a facet of one of science's grand challenges, this project will explore how genetic variation brings about variations in an organism's physical form. Using CRISPR-Cas9 technologies, the researcher will examine craniofacial evolution in cichlids, a diverse family of fish. The researcher aims to examine the role of genetic enhancers in the determining facial structure.

6 Carlos Gomez: $851,000 from National Science Foundation

Project Title: (NSF CAREER Award) Understanding Latinx Students' Stories of Doing and Learning Mathematics

Summary: Hispanic and Latinx students face institutional barriers to academic success in elementary and middle school. These challenges present themselves when Latinx students must navigate the predominantly white landscape of the dominant culture in schools. This project will explore ways in which Latinx students develop mechanisms by which they can find success in mathematics classrooms in South Carolina.

7 Timo Heister: $678,000 from National Science Foundation

Project Title: (NSF: Collaborative Research) CSSI Frameworks/Software: Future Proofing the Finite Element Library Deal.II – Development and Community Building

Summary: Mathematical modeling in the physical sciences, engineering, finance and the social sciences relies on partial differential equations. Understanding the numerical solution of partial differential equations is central to accurately understanding, simulating and optimizing natural, human and engineered systems. This project develops a software library of mathematical tools to support modeling and simulation across science and engineering disciplines.

8 Ulf Schiller: $670,000 from the National Science Foundation

Project Title: (NSF CAREER AWARD) Multiscale Simulations of Nanofluid Assembly for Smart Materials Design

Summary: Using advanced computing and complex models and simulations, the project's principal investigator aims to explore the structure and properties of new materials. More specifically, this project will explore the design and development of novel soft materials that are able to respond to external stimuli using computer simulations of material behavior under a variety of different conditions.

9 Celeste Bates: $626,000 from the U.S. Department of Education

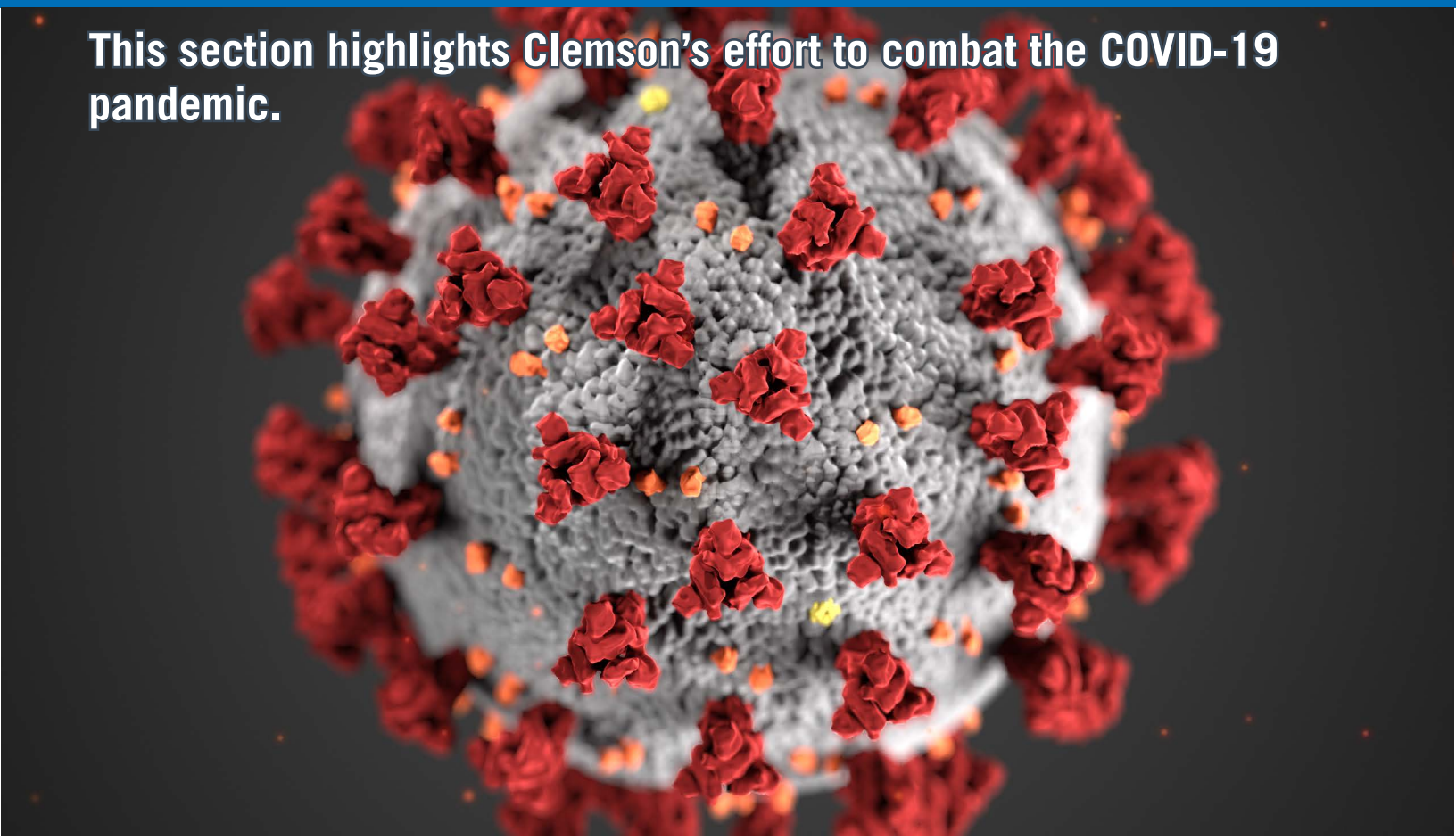
Project Title: Validating HEROES

Summary: HEROES is a multi-state, multi-university effort to prepare elementary school teachers with reading intervention strategies aimed at supporting students with Individual Education Plans (IEPs). Collaborating with Ohio State University, Clemson University will train 48 teachers of elementary school students with disabilities.

10 Marek Urban: $622,000 from the National Science Foundation

Project Title: Self-Healable Thermoplastic Copolymers

Summary: This project will examine the mechanisms by which self-healing copolymers, particularly acrylic-based copolymers, heal. Improved understanding of the self-healing polymer will lead to the development of environmentally sustainable plastics, polymeric coatings, paints and composites.



This section highlights Clemson's effort to combat the COVID-19 pandemic.

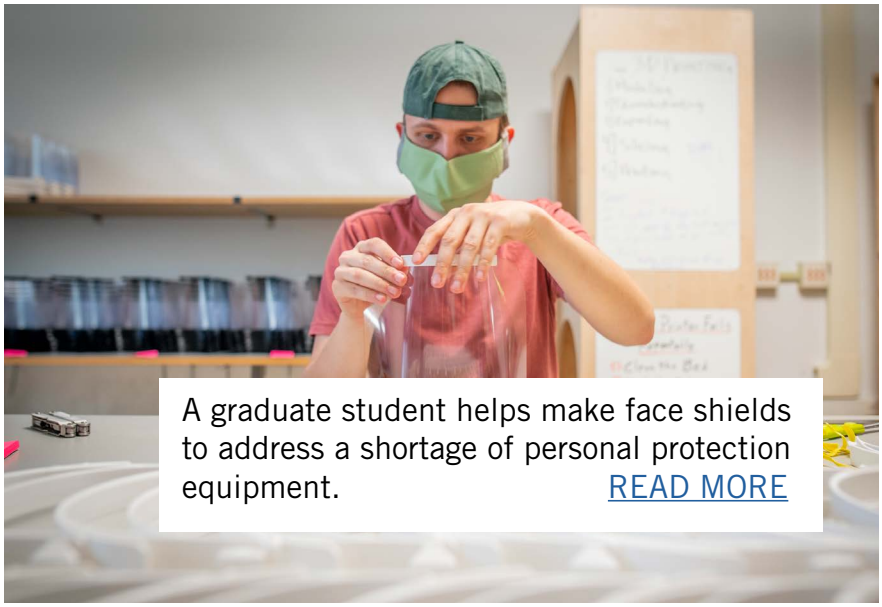
EXECUTIVE SUMMARY

- The Coronavirus Aid, Relief, and Economic Security (CARES) Act provided federal agencies with funding to rapidly invest in COVID-19 research, and the Clemson Office of Research Development is working to connect Clemson faculty to research opportunities (see page 25).
- Clemson faculty have submitted 92 COVID-19 research projects to federal agencies and other sponors (see page 25). Examples of funded projects are on pages 26-30.
- Beyond those funded projects, Clemson faculty have lent their expertise in numerous ways (see pages 31-33).
- The Health Sciences Center at Prisma Health has funded nine COVID-19 research projects involving Clemson faculty (see pages 34-38).
- The Clemson University Research Foundation partnered with Prisma Health to invest in COVID-19 related medical technologies through the new Innovation Maturation Fund (see pages 39-40).
- Hundreds of undergraduate students from across the state joined faculty and health care professionals from numerous institutions to participate in the Clemson COVID Challenge, a virtual research program aimed at addressing problems related to the COVID-19 pandemic (see pages 41-42).

COVID-19 Research Proposals

The Coronavirus Aid, Relief, and Economic Security (CARES) Act provides federal agencies with additional funds to support research on COVID-19 prevention, preparation and response.

The Clemson University Office of Research Development compiled an online list of funding opportunities currently available and notifies faculty of new opportunities weekly. The online list of funding opportunities have been **viewed nearly 3,500 times** since first published in early April.



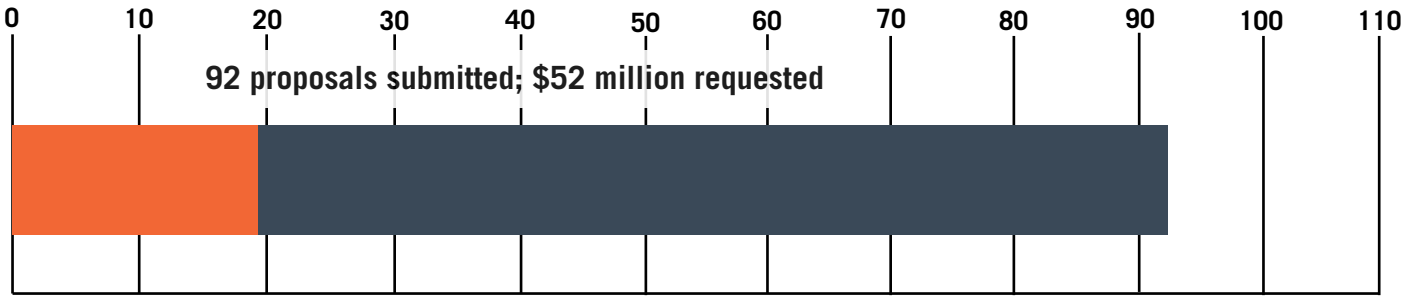
A graduate student helps make face shields to address a shortage of personal protection equipment. READ MORE

What to expect from the CARES Act:

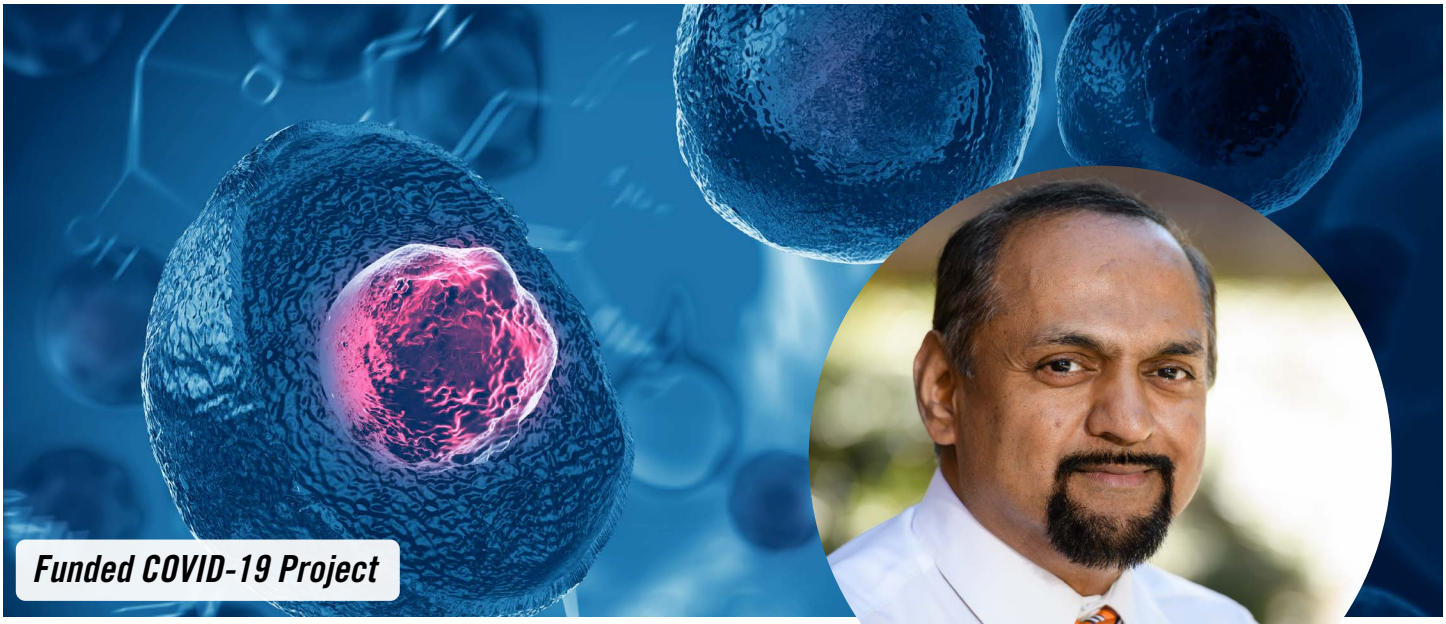
- $75 million in funding for the National Science Foundation (NSF) for RAPID grant awards.
- $945 million provided to the National Institutes of Health (NIH) for COVID-19 research.
- $99 million granted to the Department of Energy's Office of Science to support the national laboratory system's work on COVID-19.
- $60 million authorized to National Institute of Standards and Technology (NIST) with $50 million for the Hollings Manufacturing Extension Partnership to support manufacturing research and $10 million for Manufacturing USA to spend on pharmaceutical and biotech research.

COVID-19 research proposals submitted by Clemson faculty:

The Clemson University Division of Research is tracking proposals for COVID-19 research funding that Clemson faculty have submitted to federal funding agencies, as well as private foundations, health care systems and the private sector. The bar below shows the number of Clemson submissions along with the number of projects awarded funding as of Aug. 18. Many of these submissions are pending and could still be awarded.



19 projects awarded for a total of $1.6 million, as of Aug. 18; Other proposals are pending.



Repairing damaged lung tissue

Elastrin Therapeutics Inc., a Clemson technology based start-up company, is working to develop technologies that could prevent and repair lung damage caused by COVID-19.

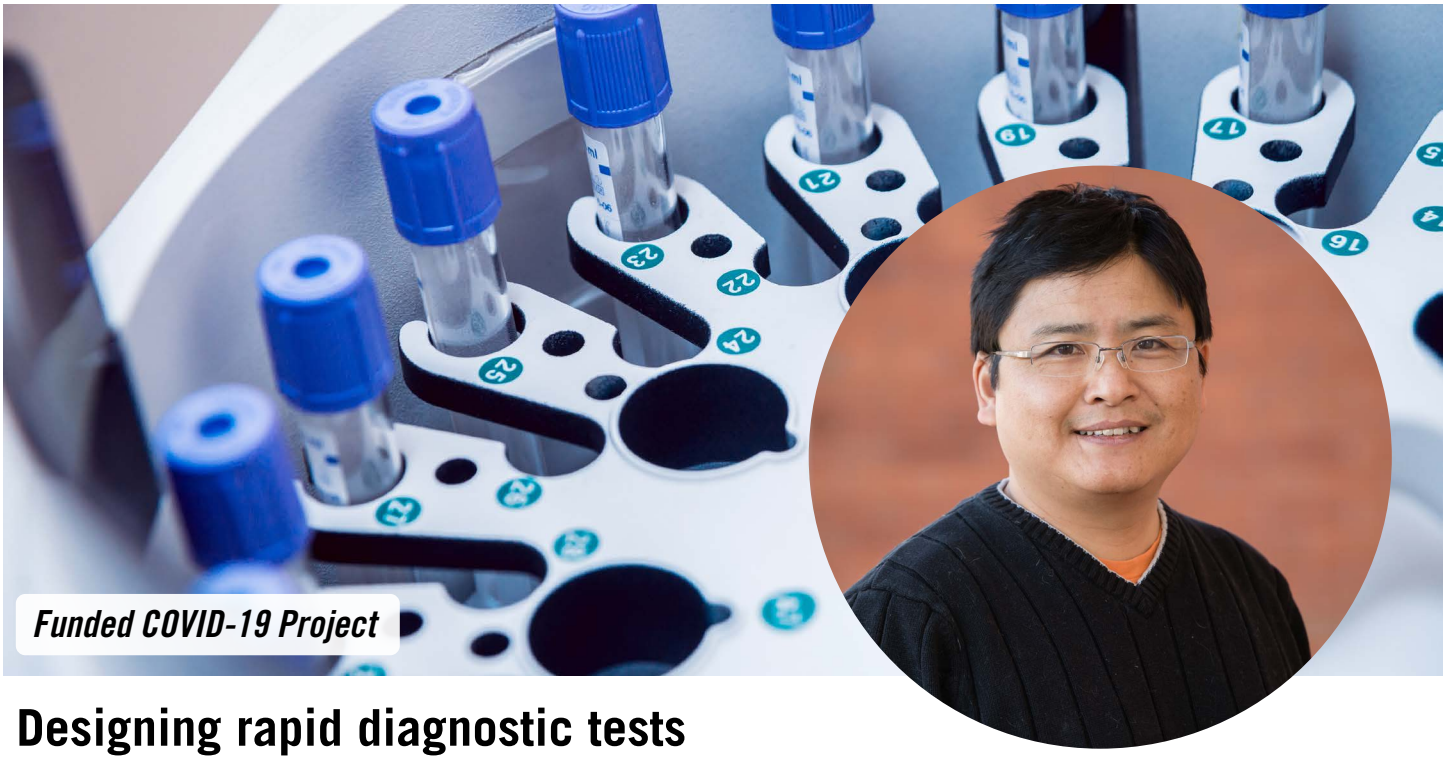
COVID-19 causes airway diseases such as acute lung injury and acute respiratory distress syndrome that damage lung tissue of young and old alike. These conditions often result in chronic immunological responses that induce acute crises and damage lung tissue over time.

This already is a significant health risk in the United States. Chronic obstructive pulmonary disease is the third leading cause of death in the U.S. Approximately 40-60% of all exacerbations are associated with viral infections.

One of the essential structural proteins in the lungs is elastin that provides balloon-like (elastic) properties that allow lung tissue to recoil during exhalation. Elastin rarely remodels and destruction of elastin in lungs is irreversible. Because older patients who have compromised lung function are more prone to lung damage, therapies are needed for such patients. This is especially relevant as the damage opens them to fatal episodes from infections such as coronavirus. While the immune system works to fight viral infection, we need to protect collateral lung damage, said Naren Vyavahare, co-founder of Elastrin Therapeutics and the Hunter endowed chair and professor of bioengineering at Clemson.

Vyahavare and Elastrin have developed nanoparticles with attached humanized elastin antibody that target only to degraded elastin matrix, sparing healthy tissue. As such, the nanoparticles can be targeted in fragmented elastin in disease states, making them effective for drug delivery. They are also working to develop associated drug therapies that could fill an unmet need for patients whose lung tissue could be severely damaged and who experience permanent disability.

With funding from SCRA (formerly the South Carolina Research Authority), Elastrin and Vyavahare will advance this research and work to develop a targeted therapy to prevent the progression of acute lung injury and to protect healthy lung matrix. They'll also test if they can repair lung tissue after the injury.



Funded COVID-19 Project

Designing rapid diagnostic tests

Rapid detection of SARS-CoV-2, the virus that causes COVID-19, has been proven to be the key to break the chain of viral transmission by identifying and isolating actively infected COVID-19 patients. Existing tests for active infections rely on the detection of virus genetic materials with amplification methods that often require long turn-around times in a centralized laboratory. This limited and delayed detection of SARS-CoV-2 infections has created a bottleneck for stopping the continued community transmission of the virus.

Feng Ding, associate professor of physics and astronomy, earned a COVID-19 research grant from the National Science Foundation to explore an alternative approach for faster detection of SARS-CoV-2.

He proposes to target the virus proteins that could be effective biomarkers for COVID-19. He aims to design and develop a novel sensor coupled with an imaging technique that could rapidly detect virus proteins of SARS-CoV-2 in real-time. This would allow faster screening and isolation of actively infected COVID-19 patients, a key to break the chain of transmission for stopping the pandemic.

Ding and his collaborators at Auburn University have already successfully applied their approach to design sensors for recognizing other immunoproteins. This experience will prove valuable as they now work to apply their method to specific proteins related to COVID-19.

Applying Artificial Intelligence to find COVID-19 treatments

It would take a human being years to read tens of thousands of scholarly articles, but an artificial intelligence system that can do it in a matter of minutes is about to go to work in the fight against COVID-19.

Ilya Safro, an associate professor of computer science at Clemson University, said that his team will soon roll out a new artificial intelligence system aimed at helping researchers explore the scientific literature as they strive for new discoveries to combat the novel coronavirus.

The system searches for words and phrases in the literature and looks for previously unknown connections between them. Then the system automatically generates hypotheses for scientists to test.

The number of queries the system can take is very big and could include questions about everything from genes and proteins to drugs and their side effects. The system will be able to search hundreds of millions of concepts and billions of potential connections, Safro said.

“What we really hope is that this system will help in the question of how drugs can be repurposed to treat COVID-19,” he said. “There is already knowledge of these drugs in the datasets. People have already collected the information. We can use this information to design a new drug or repurpose an existing drug for COVID-19.”

Safro is principal investigator on the new artificial-intelligence project, which has received COVID-19 research funding from the National Science Foundation. He is working on it with Ph.D. students in his lab, Justin Sybrandt and Ilya Tyagin, and co-principal investigator Michael Shtutman, an associate professor in the College of Pharmacy at the University of South Carolina.

Shtutman is helping make sure researchers ask the right questions and helping ensure they get biologically meaningful answers.

“The system will allow researchers to make fast clinical decisions,” he said. “You can’t imagine the amount of literature that is coming out now. The system will help to navigate through the literature.”

The team has received funding through the National Science Foundation’s Rapid Research Response program.

READ MORE

Developing solutions for agriculture

The COVID-19 pandemic is posing significant challenges to mitigating ongoing natural disasters such as drought in different parts of the world, including the United States.

In particular, COVID-19 will have significant impacts on multiple agricultural sub-sectors as farm prices will be impacted, supply chains will likely slow down, farm workforce disruptions will occur, and the odds of farm bankruptcies will increase. The reduction of demand for crops and the reduction of supply of labor is likely to reduce revenue and increase costs.

Drought conditions will further exacerbate the hardship of the broader agricultural sector as water availability declines due to drought and costs continue to rise. The resilience of agricultural systems in the face of natural hazards has improved over the decades but the ongoing COVID-19 pandemic presents a new and unexpected challenge to the farming community. The combination of drought and COVID-19 can lead to a compounding impact on farming sectors. Droughts reduce crop yield and create financial losses, and COVID-19 further compounds this challenge by impacting farm price, supply chains, health risk, and loss of farm work force.

Ashok Mishra, associate professor of civil engineering, is leading a National Science Foundation-funded study to evaluate how the combination of ongoing drought and COVID-19 will affect the agricultural sectors that play an important role in the nation's food security. The research team will investigate the consequences of compounding drought and COVID-19 on farmers' socio-economic indicators at the county scale and develop strategies farmers can implement to minimize the impacts. This project will advance knowledge of the combined influence of human hazard and natural hazard on agricultural sub-sectors and provide an opportunity to study the compounding effect of two different types of hazards in different parts of the U.S.

Research results will be used to develop strategies for improving awareness about this unique extreme compounding, allowing stakeholders to take precautionary measures for such events in the future. The research findings will be shared with key stakeholders (S.C. Department of Agriculture and Clemson Extension specialists, for example) and is targeted to benefit those most affected by this ongoing disaster in the U.S. and worldwide, assisting in the development of precautionary measures that can be taken in the near future.

Providing telehealth services across South Carolina

The New Morning Foundation, a nonprofit organization that provides family planning and reproductive health services to people across South Carolina, has been providing funding to the Joseph F. Sullivan Center for the past three years to improve access to high quality family planning services to South Carolinians in a project called "Choosewell." In addition to direct patient care, the funding also helps improve the knowledge among future healthcare professionals on long acting, reversible contraceptive methods (LARCs) so that they employ this knowledge into their future practice.

In the midst of COVID-19, many of the ChooseWell sites shut down family planning services. New Morning Foundation reached out to the Joseph F. Sullivan Center after hearing of their virtual medical visits and has agreed to fund a telemedicine pilot project.

The project provides funding for Sullivan Center nurse practitioners (NPs) to offer virtual medical visits to ChooseWell participants across the state. These NPs are utilizing a free platform called doximity, which sends a HIPAA compliant text message to the patient at the time of the visit. The patient clicks a link and is connected to the provider (very similar to a FaceTime call). Providers are able to address the patient's needs and send prescriptions electronically when warranted. This pilot project will continue through August and if successful, may continue into next year's funding cycle, said Caitlin Moore, director of outreach and wellness.

In addition to helping the New Morning Foundation, the Sullivan Center has partnered with the South Carolina Department of Health and Environmental Control to increase access to COVID-19 testing. The Sullivan Center provided COVID-19 mobile testing clinics in Oconee, Pickens and Chester counties in May and June, for example.

READ MORE

Additional COVID-19 Research

Testing N95 Mask Sanitation and Reuse

Melinda Harman, right, of Clemson University is volunteering her time to explore how hospitals could wash and sanitize medical masks without having to ship them elsewhere or buy an expensive piece of equipment.

A device that Harman designed to hold multiple N95 masks is central to her idea. It would help ensure the masks maintain their shape while being washed so that they continue to fit securely around the mouth and nose, said Harman, an associate professor of bioengineering and director of Clemson University's Medical Device Recycling and Reprocessing program, or GreenMD.

The masks help prevent healthcare workers from inhaling the novel coronavirus that causes COVID-19 and have been in short supply since the pandemic began.

As part of her work, Harman said she has engaged three leading healthcare companies that offer expertise in detergents and decontamination. She is testing different kinds of detergents to find the best solution for cleaning mucus and proteins from the masks.

The detergents are commercially available and already used by hospitals to clean other types of medical equipment.

Harman said that her goal is "to validate a cleaning process that is compatible with existing capabilities and equipment commonly available at hospitals in South Carolina and worldwide."

READ MORE

Technical partnerships help protect health care workers from COVID-19

A nationwide partnership of scientists and engineers, including Mark Johnson of Clemson University, is working on new methods of cleaning and sanitizing medical masks to help protect healthcare providers from COVID-19.

Highly pressurized carbon dioxide could be used as part of a process that not only sanitizes N95 masks by inactivating the novel coronavirus but also cleans the dirt and stains that result from normal use, said Johnson, the Thomas F. Hash Endowed Chair in Sustainable Development and director of Clemson University's Center for Advanced Manufacturing.

N95 masks are considered crucial protective medical equipment because they prevent healthcare providers from inhaling the virus. Masks are supposed to be discarded after one use and have been in short supply since the pandemic began.

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Additional COVID-19 Research

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Mark Johnson

"We want to make sure our healthcare providers are healthy because every one of them is taking care of other people," Johnson said. "The availability of masks has become a critical point – forcing the need to either get new masks from extended supply chains or by finding new ways to safely clean and reuse the masks."

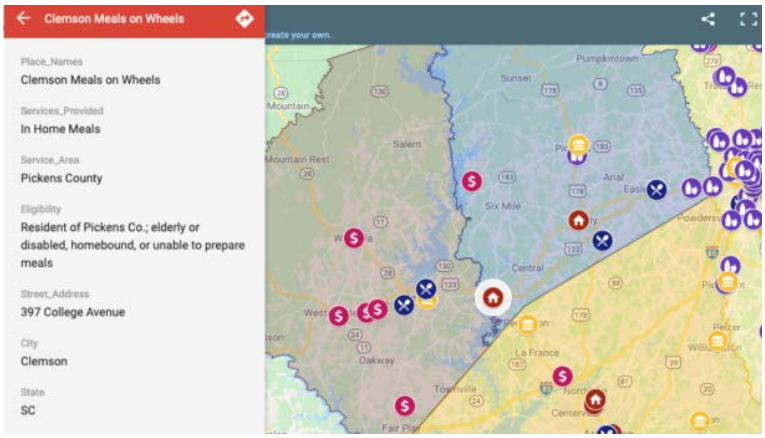
Johnson, a professor of materials science and engineering, said that when he first heard about mask shortages he connected with the University of South Carolina's Michael Matthews, who has conducted research in carbon dioxide technology, including medical sterilization and disinfection. He now serves as senior associate dean for research and graduate education in the University of South Carolina's College of Engineering and Computing and as a professor of chemical engineering and biomedical engineering.

Johnson said he and Matthews realized they could tap colleagues from across the country to address the mask problem. They called researchers at other universities, national labs, small-businesses and medical research facilities. In doing so, Johnson and Matthews pulled together a partnership of over 10 groups.

They also connected with researchers working on different ways to decontaminate masks. The researchers were affiliated with various higher-education institutions, including the Massachusetts Institute of Technology, Stanford University, Harvard Medical School, and universities in Nebraska and Iowa. Those researchers are working with various technologies, including ultraviolet light, hydrogen peroxide vapor and moist heat.

READ MORE

Interactive map to aid food insecure families during crisis



Clemson University faculty and staff in coordination with the United Way and Ten at the Top have created an interactive map that provides information on different food resources across the Upstate for individuals and families facing food insecurity.

Clemson's College of Behavioral, Social and Health Sciences created the Food Access Map as part of its efforts to aid Upstate residents facing hardships during the COVID-19 pandemic. The map includes nearly 400 providers across 10 counties complete with information on the type of assistance they provide as well as operating hours and availability.

According to Leslie Hossfeld, dean of the College of Behavioral, Social and Health Sciences, the Food Access Map will make the process of finding reliable information on food resources that much easier for people in need.

READ MORE

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Additional COVID-19 Research

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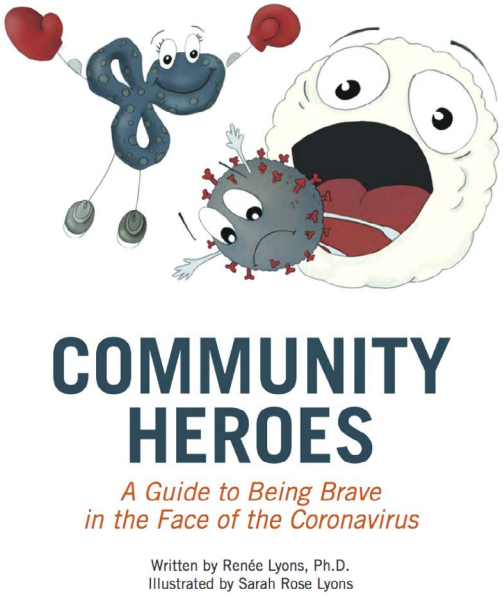
Coping with COVID-19

The Clemson University Life Sciences Outreach Center created this children's story for parents to use as they talk with their children about the coronavirus. Based on recommendations from medical professionals of Prisma Health, this story is both reassuring and encouraging. The story focuses on ways we can protect ourselves and our communities from COVID-19.

This story, "Community Heroes: A Guide to Being Brave in the Face of the Coronavirus," is presented in a flipbook format. English and Spanish versions are available.

The book was written by Renée Lyons, director of Science Education Outreach and the Life Sciences Outreach Center in the College of Science, and illustrated by her sister, artist Sarah Rose Lyons. READ MORE



Understanding the COVID-19 pandemic


Kos Qanungo

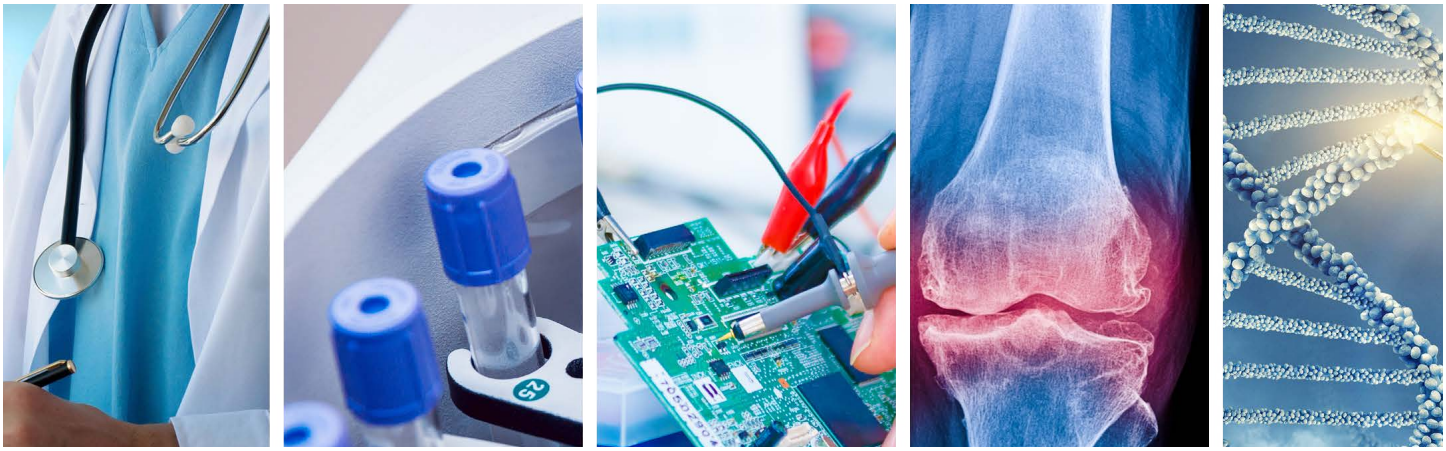

Matt Turnbull

Clemson University virologists Kaustubha "Kos" Qanungo and Matt Turnbull have spent much of their careers studying viral diseases in humans, plants and animals.

Qanungo, a lecturer in the College of Science's department of biological sciences, received his Ph.D. in molecular virology in 2003 from the Indian Institute of Technology in Kharagpur, India. He joined Clemson in 2019.

Turnbull, an associate professor in the department of biological sciences, received his Ph.D. in entomology in 2002 from the University of Kentucky in Lexington. He joined Clemson in 2003.

Given their expertise, both scientists have been following the COVID-19 global outbreak with intense interest. They are among many Clemson faculty members who have lent their expertise, spreaking with media organizations adn others about the pandemic. The two scientists took time to answer several common questions about COVID-19. How infectious is COVID-19? Are children and adults affected differently? Can pets and livestock be infected and spread the virus to humans? READ MORE



Clemson faculty awarded COVID-19 research funding from Health Sciences Center at Prisma Health

The Health Sciences Center (HSC) at Prisma Health released a special call for research focusing on COVID-related priorities such as disease etiology and epidemiology; health, social and economic impacts that populations experience; and innovative diagnostic and treatment interventions. The HSC awarded a total of $201,398 in funding to researchers of HSC's partners Clemson University, Furman University, Prisma Health and University of South Carolina.

The call for proposals is in response to the COVID-19 pandemic that has impacted the nation, and Clemson researchers have risen to the challenge of finding ways to fight this disease, said Clemson University Associate Vice President for Research Windsor Westbrook Sherrill.

"These faculty research projects will be very impactful to the local community and the nation in the fight against COVID-19," said Sherrill, who is also Chief Science Officer at Prisma Health. "I am proud of the Clemson faculty members who applied for this competitive funding, and I look forward to seeing the impact on health care from the research that was funded."

Jordon Gilmore, assistant professor of bioengineering, is collaborating with Prisma Health to develop new tools for COVID-19 screening that would reduce the reliance on lab equipment unavailable in some locations.

Jordon Gilmore

Currently, the main biosensing platforms for COVID-19 detection are molecular and serology tests, which require incubators, thermocyclers and other lab-based equipment. This can limit testing particularly in rural areas where equipment is unavailable.

Gilmore is working to develop a rapid point-of-care device that uses electrochemical impedance spectroscopy (EIS) to detect a specific protein that is an effective biomarker to screen for COVID-19. Additionally, he is evaluating methods to quickly and cost-effectively produce nanofiber-based biosensors that would be needed to develop the device.

His research could provide a solution to rapidly screen people living in rural and underrepresented locations for the novel COVID-19 disease.

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Clemson faculty awarded COVID-19 research funding from Health Sciences Center at Prisma Health

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Terri Bruce

Terri Bruce, director of the Clemson Light Imaging Center, is leading a team from Clemson, University of South Carolina, and Prisma Health to develop rapid diagnostic tests that could be conducted at home or any medical clinic that lacks the equipment required for current tests.

Current testing methods rely on uncomfortable deep-nasal sampling and require subsequent processing to extract and amplify viral genetic material, which must be supported by equipment only available at testing facilities, or at minimum, well-equipped medical practices or hospitals. Emerging "rapid" tests are serologically based, which come with appreciable overhead costs and low sensitivity.

Bruce's team is working to develop an autonomous lateral flow assay that would use capillary-channeled polymer (C-CP) films as low-cost platforms to isolate and concentrate coronavirus particles from saliva specimens. Such tests would have many advantages, including cost, speed, ease of use and distribution to locations where access to sophisticated medical equipment and personnel is limited.

Other Clemson researchers on the projects include chemistry professor Ken Marcus, bioengineering professor Delphine Dean, and David Bruce, professor and chair of chemical and biomolecular engineering.

Mark Blenner, associate professor of chemical and biomolecular engineering, is working to create COVID-19 tests taken from saliva.

Mark Blenner

Serologic testing for patient antibodies to SARS-CoV-2, the virus that causes COVID-19, is crucial for contact tracing, immunity studies, prevalence and vaccine development. Its widespread use would reduce the mental stress on essential workers, as they would know their COVID-19 immunity status and is widely considered a major strategy to get people back to work safely. Deploying antibody testing at a population scale has many challenges, including bottlenecks in blood sampling, the throughput of immunoassays, and the cost of testing.

Blenner is collaborating with Delphine Dean and Prisma to create tests that would replace blood draws with citizen-collected saliva samples. Additionally, this new test would replace immunoassays, a procedure for detecting or measuring specific proteins or other substances through their properties as antigens or antibodies, with next-generation DNA sequencing of specific SARS-CoV-2 antibodies.

Combined, these advances will enable citizens to collect their own saliva sample into tubes pre-coated with reagents that purify and barcode SARS-CoV-2 specific antibodies and send them to central labs that combine and sequence thousands of samples at once.

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Clemson faculty awarded COVID-19 research funding from Health Sciences Center at Prisma Health

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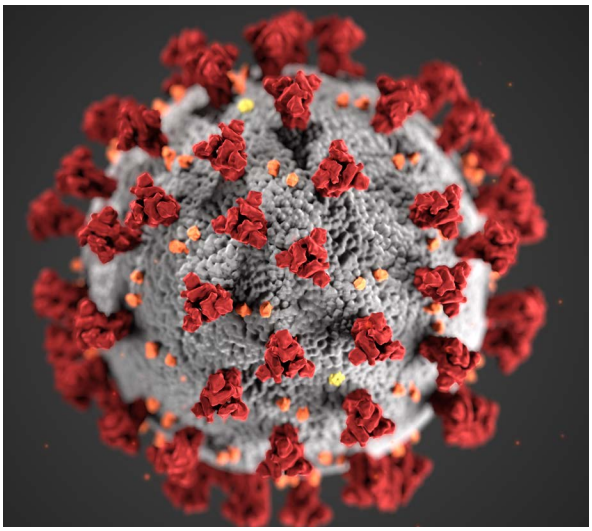
Lior Rennert

Lior Rennert, assistant professor of biostatistics, is working with Prisma Health to develop a database to help medical practitioners and researchers better understand the medical and socioeconomic patient-level factors associated with COVID-19. This is essential for improving patient care by targeting limited resources to the highest-risk patients.

Rennert's team will work to characterize potential biomarkers and health disparities in patients with COVID-19; assess optimal patient medications and management, long-term outcomes, disruption of chronic care, and care delivery systems; and explore potential novel therapeutics. The findings will be compiled into a comprehensive database, called the Prisma Health Rapid Innovation Task Force COVID-19 Registry.

The registry will serve as a functional, collaborative hub to simplify logistical challenges, prevent fragmented, duplicative work, and accelerate multidisciplinary research by providing vital information for practitioners while supporting concurrent and future research efforts conducted by Prisma Health and affiliated academic partners. This could spur further research and targeted outreach programs to support population health across the continuum of care.

Other Clemson researchers on the project include Lu Zhang, assistant professor of epidemiology, Corey Kalbaugh, assistant professor of public health sciences, Deborah Kunkel, assistant professor of mathematical and statistical sciences, and public health professor Sarah Griffin.



In another research project, Rennert is collaborating with Prisma and University of South Carolina School of Medicine Greenville to determine the prevalence of SARS-CoV-2, the virus that causes COVID-19, in the health care workforce at Prisma Health.

Asymptomatic and presymptomatic infection has been reported to be exceedingly common in otherwise healthy individuals. Health care workers are uniquely positioned to unwittingly become infected from hospitalized patients with COVID-19 or to bring SARS CoV-2 to the hospital or back to their families, potentially exposing vulnerable patients or loved ones at highest risk for severe disease and adverse outcomes.

The research team will use serology tests for antibodies and molecular assays to determine the prevalence of SARS CoV-2 infection in the workforce at Prisma Health.

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Clemson faculty awarded COVID-19 research funding from Health Sciences Center at Prisma Health

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Clemson food scientist Paul Dawson, Extension food safety specialist Julie Northcutt, and inorganic chemistry professor William Pennington are working with Furman University, Prisma, and the University of South Carolina School of Medicine Greenville to develop an inexpensive sensing platform to detect COVID-19.


Paul Dawson


Julie Northcutt


Bill Pennington

In particular, they are working on a platform that would help food processing facilities protect their workers and packaged products from COVID-19.

The team is designing sensing platforms for bacterial foodborne pathogens, particularly for detecting and eliminating surface contamination in food processing environments. To assist in the COVID-19 pandemic, they are working on sensors that could understand and control false positives caused by environmental effects. Their testing of sensors will facilitate the design of effective, deployable sensing platforms for COVID-19.


Marissa Shuffler

Marissa Shuffler, associate professor of industrial-organizational psychology, and psychology professor Thomas Britt are working with Prisma Health to address healthcare provider well-being during the COVID-19 pandemic.

More than 50 percent of U.S. physicians report burnout, which can lead to increased rates of medical errors, provider turnover, and even provider suicide. The current pandemic has escalated the potential for even more severe declines in clinician well-being and mental health. Shuffler and Britt will work to better understand the processes and actions being undertaken to address clinician well-being and burnout during the global challenge of COVID-19. This can help health care providers implement systemic interventions to reduce burnout and support clinician well-being within the context of the pandemic.

The research team will also recommend strategies for monitoring and acting upon feedback regarding clinician burnout and well-being, and develop an online assessment and reporting toolkit that can be rapidly adopted and implemented in other departments at Prisma Health as well as other healthcare systems that want to take actions to reduce clinician burnout and support well-being during the COVID-19 pandemic.

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Clemson faculty awarded COVID-19 research funding from Health Sciences Center at Prisma Health

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Numerous Clemson faculty members are working with Prisma Health to develop a portable negative-pressure hood to cover patients during medical procedures.

The portable negative-pressure protection hood

As hospitals have tried to limit the spread of COVID-19, they have canceled necessary but technically elective surgical procedures. A central impediment to a return to normal operations with full utilization of all standard treatments is the lack of negative pressure environments for patients. Currently, hospitals have a limited number of negative pressure rooms, each designed for individual patients and each designed to prevent viral spread outside the room. Unfortunately, these rooms do not prevent contamination of health care workers working inside the room and there is currently no way to make this environment portable, scalable, or adaptable for the varied clinical environments in the hospital.

The research team on this project has developed a prototype of their "COVER" device (Covering for Operations during Viral Emergency Response) for further testing.

COVER uses a transparent tent-like hood that covers the head and torso of the patient. This hood is then connected to a suction-generating system, drawing all air from within the hood across HEPA filters to remove 99.7% of all particles greater than 0.3 microns. For comparison, current guidelines recommend healthcare workers utilize N95 masks for high risk procedures and these masks only filter 95% of such particles. The hood is being designed to be cost-effective, portable, and comfortable.

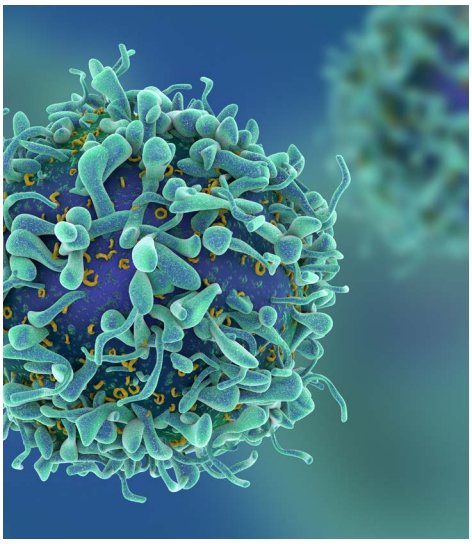
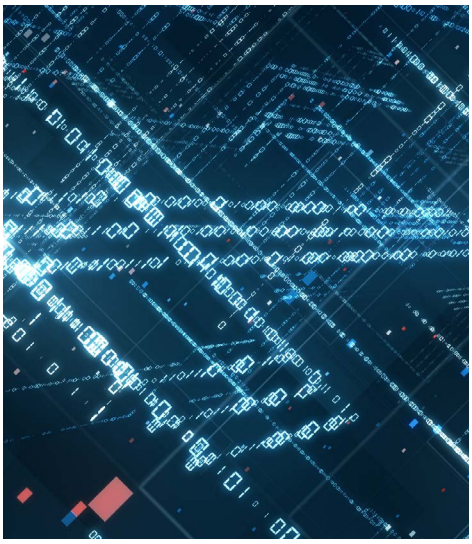
Clemson researchers on the project include bioengineering professors John DesJardins and Delphine Dean, mechanical engineering assistant professor Ethan Kung, electrical and computering engineering professor Hai Xiao, public health professor Sarah Griffin, and public health associate professor Joel Williams.

Jonn Foulk, adjunct professor of biosystems engineering, is working with Prisma Health and the USC School of Medicine to address the shortage of high-performance, N95-type medical masks.

Demand for the masks during the COVID-19 pandemic has out-stripped suppliers' ability to deliver masks. As a consequence, Prisma Health is exploring other routes to obtain equivalent masks, including recycling existing N95 masks, procuring masks that meet international specifications rather than U.S. specifications under federal guidance, and developing new mask technologies.

These alternative routes require verification of their impact on mask characteristics such as materials performance.

The research team on this project will analyze mask-recycling issues and work to identify alternative mask performance verification and alternative mask designs and technologies.

Maturation Fund nurtures COVID-19 medical innovation

Four Clemson University researchers have received funding to answer questions related to the COVID-19 pandemic, including how to monitor patients from home after discharge, how to efficiently sanitize a N95 mask for reuse, how to best develop antiviral therapeutics and how to best develop quick diagnostic tests.

The funding comes from the Innovation Maturation Fund, a joint effort of the Clemson University Division of Research and the Health Sciences Center (HSC) at Prisma Health. The Innovation Maturation Fund was developed to accelerate the commercialization of medical technologies and has been instrumental in assisting researchers with furthering their technological developments, said Chris Gesswein, executive director of the Clemson University Research Foundation, which manages the fund.

"In a time where advancements in health care are in high demand, this funding opportunity represents a critical step in fostering innovation in health sciences," Gesswein said. "Congratulations to the recipients for their continued dedication to improving health care and for the innovative contributions they have made to the Clemson University research enterprise."

The following projects were awarded:

Rapid Point of Care COVID-19 Diagnostics


Ken Marcus


David Bruce

Terri Bruce, academic program director and research assistant professor in the Clemson Department of Bioengineering, will work with her research team to develop a novel point of care test that can easily detect the COVID-19 virus with unprecedented levels of sensitivity. Her team consists of Kenneth Marcus, a professor in the Department of Chemistry, David Bruce, a professor and Chair of the Department of Chemistry and Biomolecular Engineering, Richard Hodinka, professor of microbiology at the University of South Carolina School of Medicine, Mark Call, MD, Vice Chair of Quality and Safety in the Department of Medicine at the UMG Division of Infectious Diseases, and J. William Kelly, MD, a physician in the UMG Division of Infectious Diseases. The team's goal is to make this test easily accessible for clinics that do not have equipment to process COVID-19 nasal swabs or even be done at home.

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Innovation Maturation Fund nurtures COVID-19 related medical technologies and health care solutions

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N95 Mask Cleaning System: Validation and Clinical Translation

Melinda Harman, an associate professor in the Clemson Department of Bioengineering, and Jim Kilton, the Manager of Performance Improvement at Prisma Health, will work to develop an efficient mask cleaning system that will enhance N95 respirator mask reprocessing. This new system will consist of a rack to hold bundles of N95 respirator masks during reprocessing and prevent mask deformation, as well as a cleaning process for removing soils without disrupting the filtering membrane, and a drying mechanism for removing rinsing fluids through heated air. The goal is to help hospitals combat low mask supplies and to act as an alternative to the current reprocessing system that takes time and manpower.

Melinda Harmon

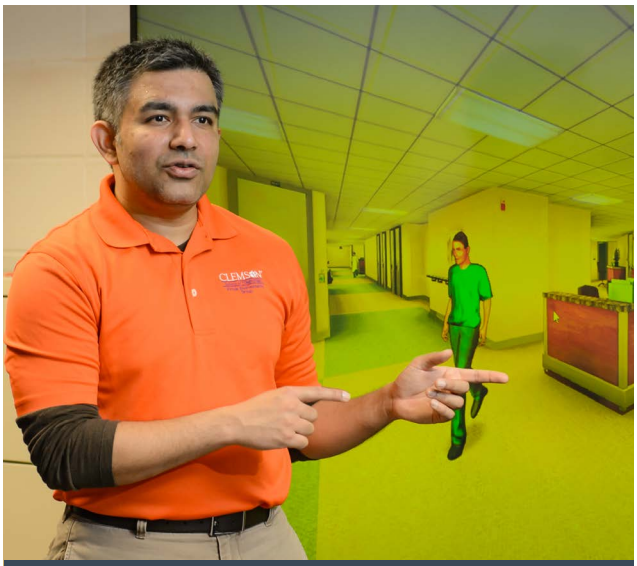
Dev Arya

Antiviral Susceptibility Screening of Topoisomerase Inhibitors

Dev P. Arya, a professor in the Clemson Department of Chemistry, and J. William Kelly, MD, a physician in the UMG Division of Infectious Diseases, will work to further develop a small library of compounds identified as topoisomerase inhibitors that can be expanded to aid in Coronavirus specific antiviral screening, with the potential to be broad spectrum therapeutics. They will work alongside Richard Hodinka, a professor of microbiology at the University of South Carolina School of Medicine, and Mark Call, MD, Vice Chair of Quality and Safety in the Department of Medicine at the UMG Division of Infectious Diseases.

mHealth Virtual Agent System for Remote Monitoring of Respiratory Distress and Hypoxia Mitigation in COVID-19 Patients

Sabarish Babu, an associate professor in the Clemson School of Computing, along with Jennica Siddle, an Emergency Department physician at Prisma Health, are continuing their work on a patient-centered self-management tool to support patients' self-care at home. This device can be used to provide real-time monitoring of COVID-19 patients recovering at home. Their goal is to provide constant monitoring of the patients, so they do develop respiratory distress and hypoxia while recovering at home after being discharged from the hospital.



Sabarish Babu

A team participating in the COVID-19 challenge meets virtually to discuss their research project.

Clemson COVID Challenge

Hundreds of undergraduate students accepted the challenge to battle the COVID-19 pandemic this summer through an innovative research project spearheaded by Creative Inquiry and Delphine Dean, the Ron and Jane Lindsay Family Innovation Professor.

The Clemson COVID Challenge is a summer virtual research and design opportunity that began in May. Teams of students worked with faculty mentors and graduate students to identify problems and propose new ideas and solutions. In mid-June, students submitted a pitch video of their ideas and competed for the opportunity to see their projects possibly continue to implementation.

Dean came up with the idea as undergraduate research, internships and study-abroad programs were being cancelled due to COVID-19. She wanted students to have continued opportunities to conduct research remotely, and students were looking to make an impact.

For the COVID Challenge, more than 400 undergraduate students worked with 97 faculty/staff and 32 graduate student mentors to form 82 teams. The teams represented a wide range of academic disciplines and institutions, including Clemson, University of South Carolina, College of Charleston, Furman University, the Medical University of South Carolina (MUSC), Prisma Health, Winthrop University, and Wofford University. Most of the teams included a mix of students and mentors from different institutions, which has already helped to spur some new statewide collaborations.

Each team had a month to craft their plan. The program provided some initial small funding for supplies to prototype or test ideas. The program also

More than

500

students and mentors participated

82

teams pitched ideas via 3-minute videos

80

volunteers from academia and industry judged entries

continued on next page

Clemson COVID Challenge

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featured weekly Zoom Seminars for professional development. The teams then submitted three-minute videos to pitch their projects. Projects covered a wide range of topics and were grouped into five categories: Communication; Education; Healthcare/Technology; Policy/Economy/Logistics; and Society/Community.

Some 80 volunteers from academia and industry judged the video pitch submissions, and the top eight teams presented their videos and answered questions during a virtual awards forum on June 29. The forum had 220 participants.

The first-place team, pictured at right, is developing a COVID-19 detection test they say would be more user friendly, faster, more dependable and more easily deployable than current testing methods. Led by Jeff Anker, the Wallace R. Roy Distinguished Associate Professor of Analytical Chemistry and Bioengineering at Clemson, the team is developing tests that would use buoyonic particles that rise to the surface of liquid and dark-colored magnetic particles. Both types of particles would have antibodies to bind to coronavirus-related proteins in saliva samples. Those proteins would then float to the surface, where they could be extracted with a magnet. The test could deliver results in about 10 minutes.

Watch videos on each of the awarded teams

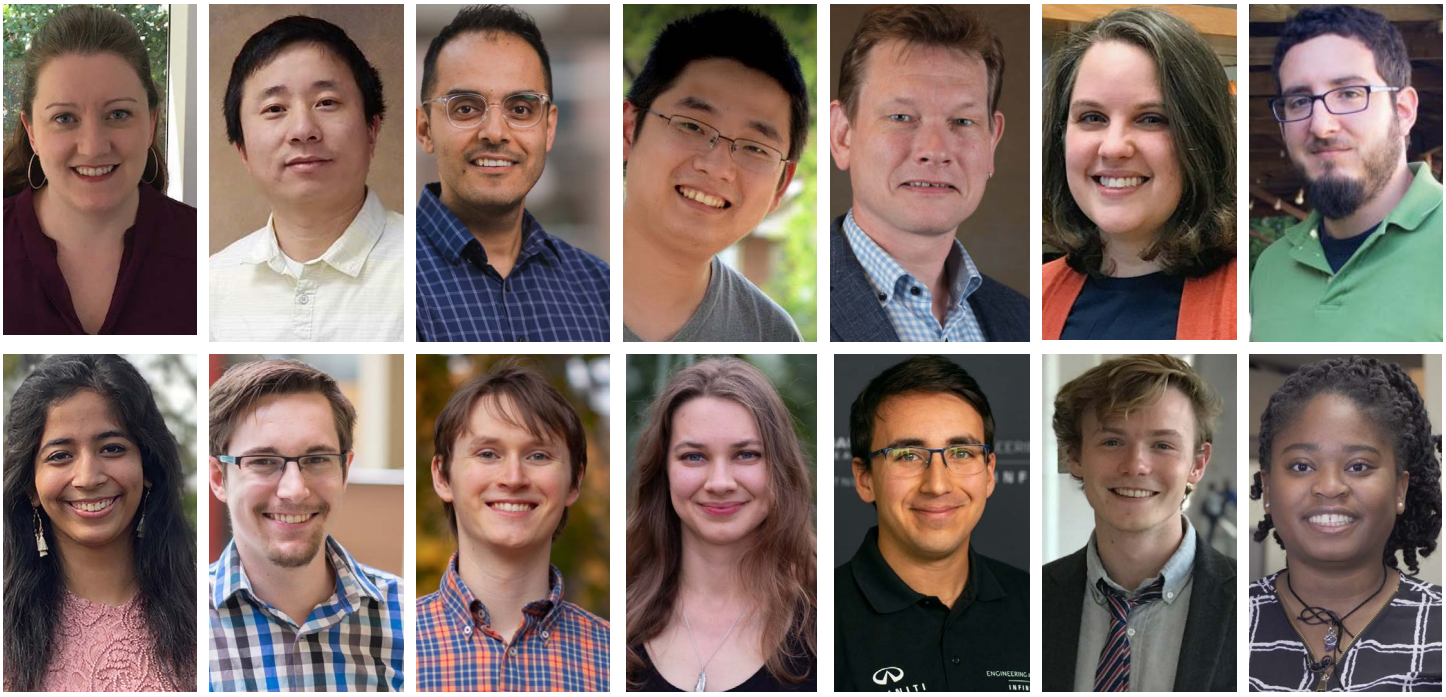
More details on this project and the others are posted online.

The Clemson COVID Challenge is supported by The Ron and Jane Lindsay Family Innovation Professorship, the Clemson College of Engineering, Computing and Applied Sciences Dean's Excellence Fund, the Vice President for Research, and the Creative Inquiry and Undergraduate Research Program, as well as the University of South Carolina.

Many of the teams will continue their work in the fall semester through Clemson Creative Inquiry and the U of SC Undergraduate Research Office. With this initial success, Dean said she is also working to set up this program for future summers and exploring options to expand its reach.

> "I was trying to come up with something to give students a good opportunity while still having them off campus."
>
> - **Delphine Dean,**
> Ron and Jane Lindsay Family Innovation Professor

This section highlights prestigious awards given to Clemson faculty and students and other news.



EXECUTIVE SUMMARY

- Clemson recognized its Researcher of the Year during a virtual ceremony in August (see pages 44-45).
- Nine Clemson faculty members earned early career awards in FY2020, the most prestigious award junior faculty members can receive (see page 46).
- Four Clemson students earned Fulbright awards, the United States' flagship international research and education program for students (see page 48).
- Six Clemson students received Graduate Research Fellowships from the National Science Foundation, a highly competitive grant aimed at building tomorrow's scientific and engineering leaders (see page 49).
- Three students earned 2020 Barry M. Goldwater Scholarships, the premier national award for students who have the potential to advance research in mathematics, natural sciences and engineering (see page 50).

RESEARCHER OF THE YEAR

The Researcher of the Year awards recognize the efforts of high-achieving faculty whose work is improving society through the generation and dissemination of new knowledge. Each college nominated a senior faculty member and a junior faculty member who received his or her terminal degree within the past 10 years. Winners were selected by an interdisciplinary faculty committee.

Click the portraits to learn more about each nominee.

JUNIOR FACULTY NOMINEES

Michael Giebelhausen
Associate Professor
Marketing
College of Business

Kai He
Assistant Professor
Materials Science & Engineering
College of Engineering, Computing and Applied Sciences

Shanna Hirsch
Assistant Professor
Education & Human Development
College of Education

Heather Kettrey
Assistant Professor
Sociology, Anthropology & Criminal Justice
College of Behavioral, Social and Health Sciences

Vincent Richards
Assistant Professor
Biological Sciences
College of Science

Mashal Saif
Assistant Professor
Philosophy & Religion
College of Architecture, Arts and Humanities

Rongzhong Ye
Assistant Professor
Plant & Environmental Sciences
College of Agriculture, Foresty and Life Sciences

SENIOR FACULTY NOMINEES

Bryan Denham
Professor
Communication
College of Behavioral, Social and Health Sciences

Feng Ding
Associate Professor
Physics & Astronomy
College of Science

Danielle Herro
Associate Professor
Education & Human Development
College of Education

Todd May
Professor
Philosophy & Religion
College of Architecture, Arts & Humanities

Francis Reay-Jones
Professor
Plant & Environmental Sciences
College of Agriculture, Forestry and Life Sciences

Zeki Simsek
Professor
Management
College of Business

Hai Xiao
Professor
Electrical & Computer Engineering
College of Engineering, Computing & Applied Sciences

And the winners are ...

RESEARCHER OF THE YEAR JUNIOR FACULTY

Vincent Richards

Assistant Professor, Biological Sciences
College of Science

Vincent Richards uses microbial genomics to further the understanding of the relationship between diverse microbial communities and human health. His most recent work has focused on the oral microbiome, specifically the bacterial and fungal microbial communities in the mouth that are associated with tooth decay. Richards' research has the potential to support the development of novel therapeutics and prevention strategies.

Richards has received more than $4.8 million in funding from the National Institutes of Health and has published 39 papers, including seven in the past two years.

Additionally, he is mentoring two PhD students, a master's student and two undergraduates.

RESEARCHER OF THE YEAR SENIOR FACULTY

Hai Xiao

Professor, Electrical & Computer Engineering
College of Engineering, Computing & Applied Sciences

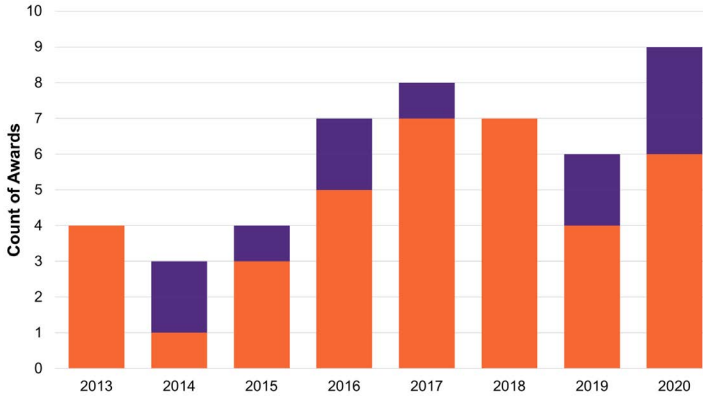
Hai Xiao's research interests focus on photonic and microwave technologies, novel devices and materials, imaging instrumentation and advanced manufacturing for applications in energy, intelligent infrastructure, clean-environment, biomedical sensing/imaging, and national security.

Xiao has organized and led several large multidisciplinary research projects at Clemson and currently serves as the principal investigator of seven projects with nearly $8.5 million in external funding.

He has published 88 peer-reviewed articles, earned 6 patents and graduated 10 PhD students since 2013. Xiao is currently mentoring eight PhD students and two master's students.

Young Investigator Awards

Nine junior faculty earned CAREER awards from the National Science Foundation (NSF), the U.S. Deparmtent of Education, and the U.S. Army, and the Defense Advanced Research Projects Agency (DARPA). These are the most prestigious awards young faculty can receive. The chart shows such awards received since 2013. NSF CAREER awards are marked in orange; other awards are listed in purple.



Fadi Abdeljawad
Assistant Professor, Mechanical Engineering

Army Young Investigator Program Award

READ MORE

Abby Allen
Assistant Professor, Special Education

Department of Education Early Career Development and Mentoring Award

READ MORE

Mark Blenner
Associate Professor, Chemical and Biomolecular Engineering

DARPA Young Faculty Award

READ MORE

Jon Calhoun
Assistant Professor, Electrical and Computer Engineering

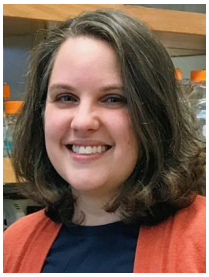
NSF CAREER Award

READ MORE

Carlos Gomez
Assistant Professor, Teaching and Learning

NSF CAREER Award

READ MORE



Kara Powder
Assistant Professor, Biological Sciences

NSF CAREER Award

READ MORE

Ulf Schiller
Assistant Professor, Materials Science and Engineering

NSF CAREER Award

READ MORE

Yin Yang
Associate Professor, School of Computing

NSF CAREER Award

READ MORE

Rongzhong Ye
Assistant Professor, Plant and Environmental Sciences

NSF CAREER Award

READ MORE

Historical Project at Woodland Cemetery

Ground-penetrating radar has revealed the possible locations of more than 200 unmarked graves in Woodland Cemetery on the Clemson University campus believed to date back more than a century.

The graves are thought to be those of enslaved people who worked from about 1830 to 1865 on John C. Calhoun's Fort Hill Plantation and later as sharecroppers and Black laborers, including convicted individuals involved in the construction of Clemson College from 1890 to 1915. All are believed to be African Americans.

The university has reached out to leadership in the local African-American community. Dr. Rhondda Thomas, the Calhoun Lemon Professor of Literature at Clemson whose research and teaching focuses on early African-American literature and culture, will be engaging with area families to better understand who might be buried in the Woodland Cemetery and to seek guidance on what steps the university should take moving forward to honor them.

The school has hired a dedicated historian to assist Dr. Paul Anderson, the university historian who is leading the research. All of the work will be published to a website Clemson started to document the university's role in Woodland Cemetery and give voice to the African Americans who are buried there.

"We are committed to taking all the critically important actions to enhance these grounds, preserve these grave sites and to ensure the people buried there are properly honored and respected," said Smyth McKissick, chairman of the Board of Trustees. "Clemson is dedicated to developing and sharing a full and accurate history of this area and to develop a preservation plan to protect it and those who rest here."

Testing shows disturbed soil roughly five feet beneath the surface indicating possible burial sites. Continued investigation of the cemetery could identify additional potential burial sites in the coming weeks and months.

Many of the possible graves are in an area of Woodland Cemetery to the west of the Calhoun family plots long thought to be the site of graves of African Americans dating back to the 1800s.

Clemson requested a court order in September 1960 approving the school's plan to locate graves in this area marked with field stones and to move them several hundred feet to an area to the south. The number of graves moved is not yet known, but it now appears many are still in their original location. Efforts to identify and preserve these original historic gravesites in 1992 and again in the early 2000s were inconclusive.

The school installed protective fencing around a roughly one-acre section to the south in 2002 and identified it as the "Site of Unknown Burials." Twenty-five of the grave sites recently revealed by radar are located within and around this fenced area.

Clemson erected historic markers at Woodland Cemetery in 2016 designating the area as the site of the Fort Hill Slave and Convict Cemetery and acknowledging the roles played by enslaved and convicted individuals buried here.

LEARN MORE

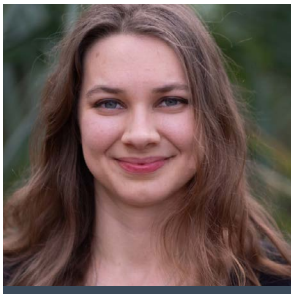
Four Clemson students earn prestigious Fulbright awards

The United States' flagship international education exchange program, the Fulbright U.S. Student Program, has selected four Clemson University students for the 2020-2021 year. The University has had 56 Fulbright Student recipients overall. Sponsored by the U.S. government, the program is designed to increase mutual understanding between the people of the United States and the people of other countries. The recipients, depending on their fields, will be serving as teaching assistants, enrolling in graduate degree programs, or actively pursuing independent research. Recipients are selected on the basis of academic or professional achievement, as well as demonstrated leadership potential in their fields. The four current students who received awards are:


Charles Dove

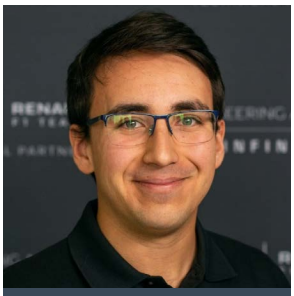
Charles Dove, College of Engineering, Computing and Applied Sciences

Dove, a member of the Honors College, is a recent graduate in electrical engineering and received the Fulbright Program's Switzerland Study-Research Award. He received an Honorable Mention from the National Science Foundation's Graduate Research Fellowship in 2020, a 2019 Astronaut Scholarship and was the recipient of the 2019 W.M. Riggs Award, given to the top student in Electrical Engineering on the basis of outstanding academic achievement, character, and leadership. Dove is one of only ten research award recipients nationally in 2020 to study in Switzerland.


Jessica Baron

Jessica Baron, College of Engineering, Computing and Applied Sciences

Baron is a Ph.D. student in computer science, visual computing. She received the Fulbright Program's Switzerland Study-Research Award. She is currently a Graduate Research Assistant in 2D and 3D facial analysis and a Graduate Teacher of Record for Digital Production Arts. Baron has maintained a 4.0 GPA throughout her computer-science graduate studies at Clemson and her undergraduate at the University of North Carolina at Wilmington. She is one of only 10 research award recipients nationally in 2020 to study in Switzerland.


Jonathan Vogel

Jonathan Vogel, College of Engineering, Computing and Applied Sciences

Vogel is a recent graduate in mechanical engineering and received the Aston Martin Coventry University Automotive Award. This is the first year this award has been offered by Fulbright, and Vogel was selected as the single recipient. It covers the first year of his master's degree program and includes an industry placement with Aston Martin upon completion. At Clemson Vogel was a member of the Honors College and a National Scholar.


McKinnon Reece

McKinnon Reece, College of Engineering, Computing and Applied Sciences

Reece is a recent graduate in mechanical engineering and received the Taiwan English Teaching Assistantship from the Fulbright Program. A member of the Honors College, he has a minor in Mandarin Chinese and was previously selected for the Critical Language Scholarship from the U.S. State Department to study Chinese. He will be a teaching assistant, and will work with local English teachers in elementary, middle or high schools.

Six students earn coveted research fellowships

Three Clemson University seniors and three graduate students received Graduate Research Fellowships from the National Science Foundation, a highly competitive grant aimed at building tomorrow's scientific and engineering leaders. The fellowship provides three years of support for the graduate education of recipients, including a $34,000 annual stipend and a $12,000 cost-of-education allowance. Fellows have access to a wide range of professional development opportunities over the course of their graduate careers.

The fellowship program, the oldest of its kind, supports outstanding graduate students who are pursuing full-time research-based master's and doctoral degrees in science, technology, engineering and mathematics (STEM) fields. The highly competitive program has an annual acceptance rate of approximately 16 percent, from among more than 12,000 applicants.

Laura McCann, College of Science, is a senior majoring in chemistry. Throughout her time at Clemson, she has been involved in a number of research projects, which helped her determine her preferred field of study – nuclear chemistry. She is also a 2019 recipient of the Barry M. Goldwater Scholarship, a premier national undergraduate award for the fields of mathematics, natural sciences and engineering. McCann envisions working at a national laboratory exploring the structural properties of the nucleus, the chemistry of radioactive elements and the overall chemistry of heavy elements.

Megan Pitz, College of Engineering, Computing and Applied Sciences, is a doctoral student in the bioengineering department. Her studies focus on local drug and RNAi delivery methods for glioblastoma multiforme. Pitz works in the Nanobiotechnology Lab, where she is developing a peptide-based delivery system for chemotherapy and gene therapy for treatment of glioblastoma multiforme.

Margaret Elpers, College of Engineering, Computing and Applied Sciences, is a senior bioengineering and biomedical engineering major. During her time at Clemson, she has been involved in a number of research projects, as well as serving as an undergraduate researcher in the Clemson Bioengineering Nanobiotechnology Lab.

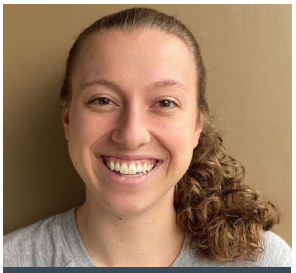
Tyler Grimm, College of Engineering, Computing and Applied Sciences, is a doctoral student in the automotive engineering program. His research focuses on incremental forming, machining freeform surfaces and joining through friction element welding. Grimm aims to improve advanced manufacturing processes for rapid implementation into domestic industries.

Britney Hudson, College of Engineering, Computing and Applied Sciences, is a doctoral student in the bioengineering department. Her current research goals involve exploring the role of chemical and mechanical stimuli in bladder dysfunction.

Allison Kaczmarek, College of Science and College of Engineering, Computing and Applied Sciences, is a senior dual-enrolled in materials science and engineering, and chemistry. During her time at Clemson she served as President of the College of Engineering, Computing and Applied Sciences Student Advisory Board. She also served as an undergraduate researcher on several projects. Kaczmarek will pursue her doctoral studies at the Massachusetts Institute of Technology with a focus on materials science and engineering.


Laura McCann


Megan Pitz


Margaret Elpers


Tyler Grimm


Britney Hudson


Allison Kaczmarek

Three Clemson students earn Goldwater scholarships

Three College of Science undergraduates are recipients of the 2020 Barry M. Goldwater Scholarships, the premier and highly competitive national award for students who have the potential to advance research in mathematics, natural sciences and engineering.

In all, 396 students nationwide received scholarships this year. They were selected from a pool of more than 5,000 candidates, which resulted in 1,350 nominations from 461 schools. Each university could only nominate up to four students. The Clemson students who received awards are:


Paul Copeland

Paul Marston Copeland, a junior physics student, plans to pursue a Ph.D. in theoretical nuclear physics. He worked for a year with Clemson assistant professor Joan Marler on experimental atomic physics projects.

Copeland helped develop a 3D printed ion deflector as a possible replacement for more expensive metal devices in ion optic experiments. He presented the results of this research at an American Physical Society regional meeting and was co-author on a journal paper.

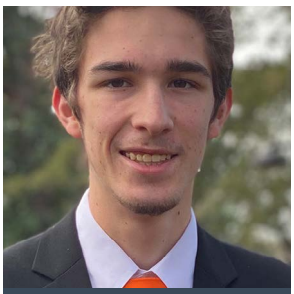
He also helped Marler's group build a low-cost apparatus to measure the emission spectra of different heavy metals, which is important for understanding which elements are involved in neutron star explosions.


Shaoni Dasgupta

Shaoni Dasgupta, a junior biological sciences student, has been conducting research in the lab of genetics and biochemistry professor Kerry Smith on Cryptococcus neoformans, the fungus that can cause fungal meningitis in individuals with compromised immune systems.

Scientists have identified three possible gene sequences for a critical enzyme, carnitine acetyltransferase, that is involved in acetate metabolism. Dasgupta is using CRISPR-Cas9 gene editing techniques to eliminate the gene encoding the third form of the enzyme. Examining the gene knockouts of the enzyme will aid in understanding the pathogenesis of C. neoformans, as carbon metabolism, particularly acetate metabolism, is essential in the virulence of the fungus.

She presented a poster explaining her research progress at a national conference last fall.


Carson Wood

Carson Wood, a sophomore mathematics student and Virginia native, came to Clemson because of the opportunities for undergraduate research. After he graduates, he will pursue a Ph.D. in mathematics in either combinatorics or mathematical modeling at a major research university.

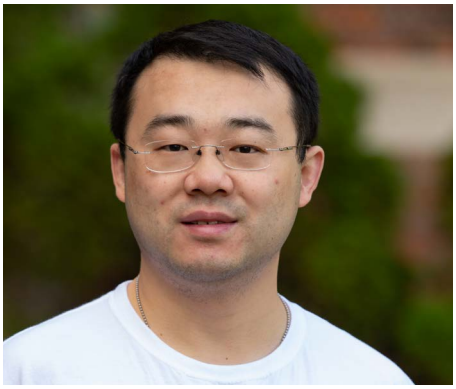
A member of the Calhoun Honors College, Wood worked in the lab of computer science professor Brygg Ullmer the summer before his freshman year, developing news ways to display and interact with data through the EUREKA! program. He continued on the project during the entire academic year.

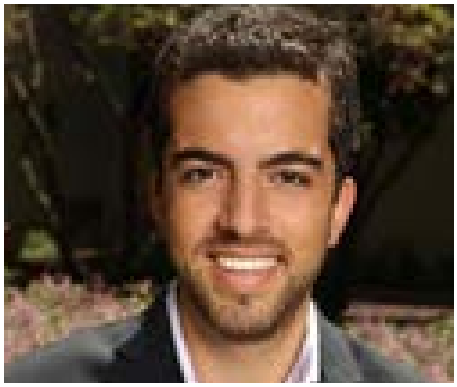
Last summer, he conducted research on number theory at Auburn University through the National Science Foundation Research Experience for Undergraduates program. This work resulted in three peer-reviewed journal papers.

READ MORE

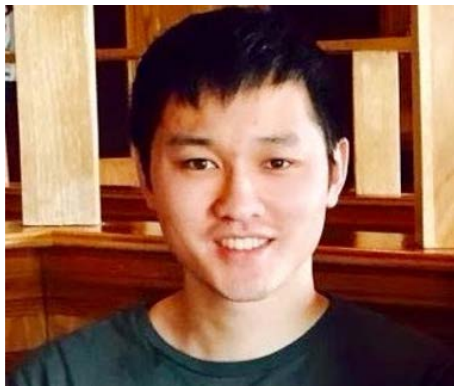
This section highlights the achievements of junior faculty members. Entries were provided by the colleges.








Ahmed Ali, PhD

Assistant Professor
Animal & Veterinary Sciences

Ahmed Ali earned his doctorate degree in animal behavior and welfare from Michigan State University and Cairo University's College of Veterinary Medicine in Egypt in 2016. Ali focuses on examining the impacts of management practices and environment on the behavior and welfare of production animals. He also researches practical approaches to solve behavior and production problems and to improve animal welfare on farms.

Examples of his novel research can be found in his recent collaboration with the Animal Behavior and Welfare Group lab at Michigan State University. He examined how laying hens adapt individually and as flocks to non-cage aviary systems, which are proposed as an alternative to traditional cages for improved health and production. Ali also explores non-invasive, automated methods for collecting animal behavior and welfare data (i.e., triaxial accelerometers).

Ali has published numerous articles in journals such as Poultry Science, Journal of Veterinary Behavior, Applied Animal behavior science, PloS one, and Animals.

Selected Accomplishments

Courses:

- Domestic Animal Behavior (undergraduate level)
- Animal Welfare (undergraduate level)
- Animal and Veterinary Sciences Teaching Experience (undergraduate level)

Research Activity:

- Examining the influence of environmental enrichment on health, behavior, and welfare of fast growing broilers.
- Investigating the effects of manipulating dietary calcium and scotophase period to improve egg production and quality, laying hen welfare and performance.

Service (society memberships):

- International Society of Applied Ethology
- Poultry Science Association
- International Society for Equitation Science

Bulent Koc, PhD

Assistant Professor

Agricultural Sciences

Bulent Koc is an agricultural machinery system engineer with a PhD in agricultural and biological engineering from Penn State University.

His past research accomplishments include the use of low-intensity ultrasound for monitoring bioprocesses and biofuel production and high-intensity ultrasound for processing bioenergy crops.

His current research focuses on the use of unmanned aerial systems for the assessment of water quality, monitoring of pasture quality and quantity with field robotics, and developing mechanisms for root collar excavation to minimize the effects of Armillaria root rot on peach production.

The goal of Koc's research program is to develop precision agriculture technologies in agricultural machinery systems to increase crop production and reduce waste while minimizing the impact of agriculture to the environment.

Selected Accomplishments

Courses:

- Advanced precision agriculture technologies (graduate level)
- Agricultural applications of unmanned aerial vehicles (undergraduate and graduate level)
- Mobile power (undergraduate and graduate level)
- Mechanical and hydraulic systems (undergraduate and graduate level

Research Activity:

- Principal investigator on a project to develop field robotics for the assessment of pasture quality and quantity (U.S. Department of Agriculture)
- Principal investigator on a project investigating the effect of power ultrasound vibrations on soil cultivation (S.C. Peanut Board)
- Principal and co-investigator on projects related to mechanizing root collar excavation to control Armillaria root rot in peaches (S.C. Peach Council and Pennsylvania Department of Agriculture)

Service:

- Chair of the American Society of Agricultural and Biological Engineers (ASABE) Robotics Student Design Competition Organizing Committee
- Founding advisor of the Clemson Agriculture Robotics and Automation Student Club since 2016. The club placed second in 2016 and third in 2018 in the American Society of Agricultural and Biological Engineers robotics competitions.

Elizabeth "Libby" Cieniewicz

Assistant Professor

Plant & Environmental Sciences

Libby Cieniewicz is a plant virologist who earned her PhD in plant pathology from Cornell University in 2019.

Through collaboration and interdisciplinary research, Cieniewicz strives to uncover virus epidemiology and ecology and to develop novel means for managing crop diseases stemming from viruses. Her research interests include virus evolution at the landscape scale, understanding mechanisms of virus movement from wild hosts to crops, and virus-crop-insect vector interactions.

She works closely with Clemson Extension agents and growers to help manage virus diseases in specialty crops like fruit trees and vegetables. She mentors both undergraduate and graduate students in her laboratory and encourages them to develop confidence in their research abilities and to conduct impactful research.

Cieniewicz has published in several peer-reviewed journals, contributed a book chapter, and co-authored Extension articles.

Selected Accomplishments

Courses:

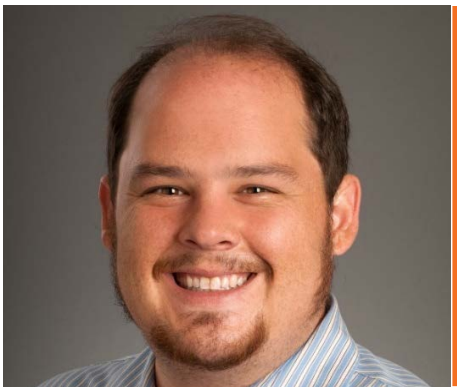
- Plant Virology (undergraduate level)
- Plant Virology (graduate level)
- Plant Disease Diagnosis (undergraduate level)
- Plant Disease Diagnosis (graduate level)

Research Activity:

- The Cieniewicz Lab at Clemson University focuses on three areas: virus ecology and epidemiology; virus-vector interactions; and disease management.

Service:

- Director of the Southeastern Budwood Program affiliated with the U.S. Department of Agriculture National Clean Plant Network. This program ensures the supply of virus-indexed peach budwood for the eastern United States.
- Member of the American Phytopathological Society
- Member of the International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG)



Matthew Rhodes-Purdy, PhD

Assistant Professor

Department of Political Science

Matthew Rhodes-Purdy joined the faculty of the Department of Political Science at Clemson University in 2018. He studied comparative politics (with a focus on Latin America) and political methodology at the University of Texas at Austin, completing his postdoctoral training at Washington University in St. Louis.

He specializes in the study of how political behavior and the quality of democracy influence one another. Purdy has published or presented work on support for democratic regimes, populism, conspiracy theories, and economic inequality. His articles have appeared in Comparative Politics, Latin American Research Review, Political Research Quarterly, the Journal of Experimental Political Science, Democratization, and Political Studies.

Selected Accomplishments

Awards & Honors:

- Juan Linz Best Dissertation in Democratization Prize (Honorable Mention); Rockefeller Center for Latin American Studies (Harvard University) Best Dissertation Award; Fulbright Student Fellowship (Chile)

Courses:

- Latin American Politics; Democratization; Populism in Comparative Perspective

Research Activity:

- Author of Regime Support Beyond the Balance Sheet (Cambridge University Press), a study of democratic regime support and democratic quality in Chile and Venezuela.
- Co-Principal Investigator of a major research effort on the connection between economic threat, cultural discontent and backlash, and antisystem political behavior. This project has thus far produced an application for National Science Foundation funding for a nine-country public opinion study, six working papers (on topics such as populism, ethnonationalism, conspiratorial ideation, among others), and preliminary plans for two books.
- Principal Investigator of a Creative Inquiry project involved in coding the social media rhetoric of populist leaders and tracing the process of charismatic bond formation between the followers and leaders of populist movements.

Corey A. Kalbaugh, PhD, MS, MA

Assistant Professor

Department of Public Health Sciences

Corey Kalbaugh is an epidemiologist in the Department of Public Health Sciences. His academic training is in the areas of cardiovascular disease and epidemiologic methods. He has 19 years of experience in epidemiology and health services research related to vascular diseases.

The animating objective of his current research is to provide clinicians with the best evidence to support the care of patients with peripheral artery disease. His work broadly aims to reduce racial disparities in peripheral artery disease-related treatment and outcomes. Kalbaugh is actively engaged in presenting, publishing, and receiving grants for research in these areas.

Selected Accomplishment

Awards & Honors:

- Junior Faculty Development Award at University of North Carolina

Courses:

- Health Research I: Design & Measurement (MS, PhD Students); Special Topics: Dataset to Manuscript (PhD students)

Recently Awarded Grants:

- Principal Investigator on National Institutes of Health/National Heart Lung and Blood Institute K01 career development award (5 years; 2020-2024, $710,000, 75% effort)
- Principal Investigator on American Heart Association career development award (3 years; 2019-2022, $232,000)
- Co-Principal Investigator for Prisma Health Seed Grant (2020, $18,000)

Recent Peer-Reviewed Publications:

- Poor Glycemic Control Is Associated with Significant Increase in Major Limb Amputation and Adverse Events in the 30-day Postoperative Period Following Infrainguinal Bypass. Journal of Vascular Surgery. March 2, 2020.
- Treatment of Superficial and Perforator Reflux and Deep Venous Stenosis Improves Healing of Chronic Venous Leg Ulcers. Journal of Vascular Surgery: Lymphatic Disorders. Feb. 20, 2020.
- Operative Strategies for Inferior Vena Cava Reconstruction in Oncologic Surgery. Journal of Vascular Surgery: Venous and Lymphatic Disorders. Dec 13, 2019.

Service:

- Editorial Board, Wound Repair and Regeneration; Member, Graduate Committee; Member, Ad-Hoc Committee for Tenure and Promotion Review; President, UNC Epidemiology Alumni Association; Member, National Research Advisory Council for Vascular Quality Initiative.

Mary E. Wright, PhD, APRN, CPNP-PC

Assistant Professor

School of Nursing

Mary Ellen Wright is an advanced registered nurse practitioner in the specialty areas of pediatric and women's health. Her 37 years of clinical practice have been in the areas of caring for pregnant women, infants and children in settings serving families with complex social and health needs.

Wright's current research focus is on support for families affected by substance-use disorder with a special interest in pregnant/parenting women and the effects on infants/children. Wright is actively engaging in multiple externally funded research studies in which she is the principal or co-principal investigator.

Selected Accomplishments

- Co-Principal Investigator on a project funded by the Substance Abuse and Mental Health Services Administration (SAMHSA) called EMPOWER: educate medical students and nurse practitioner students to serve individuals with substance use disorder.
- Co-Principal Investigator on SAMHSA-funded project TRANSFORM: to develop and provide on-line nationally distributed modular education on substances of misuse.
- Co-Investigator on a project funded by the Health Resources & Services Administration (HRSA) called ANEW: to increase nurse practitioner workforce to rural areas.
- Atlas ti Classroom award to fund creative inquiry project of qualitative study on stories of mothers with addiction. Book: Authored: I Do Love My Baby, Stories of Mothers with Addiction and Recovery. Proceeds to create a research foundation on the topic through Clemson University Research Foundation (CURF).

Teaching:

- Undergraduate and Graduate Courses in Nursing Research; Creative Inquiries

Service:

- Elected to Board of Directors International Association on Human Caring; Expert Panel on National Extension Services on Response to Opioid Crisis
- Duke University School of Nursing Advisory Board

Kevin Chase, PhD

Assistant Professor

Marketing

Kevin Chase is an assistant professor of marketing who studies organizational buying and selling behavior in business-to-business markets.

Building off of his recently published work, his current research adopts emerging text analytics technologies to evaluate written communications in the sales proposal process.

Chase currently teaches Introduction to Personal Selling and Applied Selling in the newly established Sales Innovation Program (SIP). In addition to teaching in the SIP, he also coaches the SIP competition teams, which have recently competed in the E&J Gall Sales Competition hosted by the University of Missouri, as well as the the International Collegiate Sales Competition hosted by Florida State.

Selected Accomplishments

- Lead Article "Selling to Barricaded Buyers" in the Journal of Marketing, November 2019
- Society for Marketing Advances Best Paper Award, 2017
- Finalist for the Institute for the Study of Business Markets (ISBM) Doctoral Research Award, 2017
- University of Kentucky Department of Marketing Outstanding Student Research Award, 2017
- American Marketing Association-Sheth Doctoral Consortium Fellow, 2016
- University of Kentucky Department of Marketing and Supply Chain Teaching Award, 2016.

Jorge Garcia, PhD

Assistant Professor

John E. Walker Department of Economics

Jorge Garcia is an assistant professor in the John E. Walker Department of Economics at Clemson University. Prior to joining Clemson, Garcia was a graduate student at the University of Chicago, where he studied under Professor James Heckman, the 2000 recipient of the Nobel Memorial Prize in Economics.

Garcia is an applied labor economist whose research focuses on the design of social policies and quantifying the long-run impacts of these policies. His research has been published in leading journals, including the Journal of Political Economy (one of the top three journals of all of economics), the European Economic Review, and the Journal of Labor Economics.

Garcia received his Ph.D. (2018) and M.A. (2012) in economics from the University of Chicago and a B.A. from the Centro de Investigación y Docencia Económicas ("Center for Research and Teaching in Economics"; CIDE) (2010).

Selected Accomplishments

- Since arriving at Clemson in 2018, he has published three papers in highly regarded economics journals.
- Overall he has published five papers in leading economics journals.
- In addition to his journal articles, he has written three policy papers on the long-term benefits of high-quality early childhood education programs.
- Professor Garcia's research has been cited nearly 500 times! (according to Google Scholar).
- He has presented his research at the University of Chicago, Harvard University, the University of Michigan, the University of Zurich, KU Leuven, and the Federal Reserve Bank of Atlanta.
- He already has served on the Ph.D. committees for five graduate students.
- Garcia a fellow with the Schaeffer Center Health Policy and Economics (University of Southern California), the Social Science Research Institute (Duke University), and the Human Capital and Economic Opportunity Global Working Group

Chad C. Navis, PhD

Associate Professor

Entrepreneurial Leadership Management

Chad Navis is the Arthur M. Spiro Professor of Entrepreneurial Leadership at Clemson. His award-winning research regularly appears in the premier management and entrepreneurship journals, including Administrative Science Quarterly, Academy of Management Review, Journal of Management Studies, and Journal of Business Venturing.

His work blends qualitative and quantitative methods to examine entrepreneurship in nascent market categories, including in such varied settings as satellite radio, local telecommunications, online groceries, and craft micro-distilleries.

Navis also has a strong passion for teaching. He earns exceptional teaching ratings each semester and has developed innovative courses at the undergraduate and PhD levels. Navis also holds several critical service roles. He oversees the Management Department's entrepreneurship curriculum, entrepreneurship scholarship, and entrepreneurship PhD seminars. He also works closely with the Spiro Institute and as a Watt Fellow to forge inter-disciplinary collaborations that bolster the University's entrepreneurship ecosystem.

Selected Accomplishments

- Published five articles in Academy of Management Review (9.4 impact factor).
- Re-elected to Administrative Science Quarterly editorial board.
- Winner of two IDEA "thought leader" awards for best published entrepreneurship paper in a given year (peer voted by the Academy of Management's Entrepreneurship Division division).
- Awarded a Watt Faculty Fellowship in consecutive years.
- Awarded an Erskine Fellowship (University of Canterbury, Christchurch, NZ).
- Revamped the ELE entrepreneurship curriculum to be more accessible to all student majors; comprehensive in content; and applied and project-based in nature.
- Oversaw the near doubling of students in the Entrepreneurship Minor and Emphasis Areas, including the recruitment of three new instructors to support its rapid growth.
- Developed course in which student teams identify and begin to pursue a new business concept, one of which (Kanga) made it onto ABC's "Shark Tank" and was funded.
- Developed two new research seminars in entrepreneurship.
- Earned an average teaching rating of 4.81, based on last 10 course sections taught.
- Collaborated with Spiro Institute leadership and its board of advisors to support and enhance Clemson's entrepreneurship ecosystem.
- Served on numerous curriculum committees, including with the Spiro Institute (Chair, ENTR); Management Department (Chair); Watt Center (Member, INNO), College of Business (Representative); and Graduate School (Representative).

Natasha N. Croom, PhD

Assistant Professor

Higher Education Leadership and Student Affairs Educational and Organizational Leadership

Natasha Croom engages as a scholar of higher education leadership and student affairs striving to work in and with communities to support the creation of practices and policies constructed from equity-based ideologies. She accomplishes these projects as a critical race feminist scholar-practitioner, committed to identifying and disrupting interlocking systems of oppression that manifest within and are reinforced by institutions of higher education.

Croom has co-edited two books and a special issue: (a) Critical perspectives on Black women and college success, (b) Envisioning critical race praxis in higher education through counter-storytelling, and (c) Centering the diverse experiences of Black women undergraduates. She has also published in premier journals for her field, such as The Review of Higher Education, Journal of Student Affairs Research and Practice, and the NASPA (National Association of Student Personnel Administrators) Journal About Women in Higher Education.

Croom is an active member of professional and academic societies critical to her field, such as ACPA (formerly American College Personnel Association): College Student Educators International; American Educational Research Association (AERA); Association of College and University Housing Officers – International (ACUHO-I); Association for the Study of Higher Education (ASHE); and NASPA (formerly, National Association of Student Personnel Administrators).

Selected Accomplishments

- College of Education Award of Excellence in Service
- Program Coordinator for the PhD in Educational Leadership
- CU Tigers ADVANCE Mini-Grant (2019), ADVANCE-ing Women to the Full Professorship at Clemson University: A Case Study
- Moderator and Host, ASHE Woke Research Methodologies Webinar Series
- Coalition for Women's Identities Research and Scholarship Award. ACPA: College Student Educators International

Kristen E. Duncan, PhD

Assistant Professor

Teaching and Learning

Kristin Duncan is an assistant professor of Secondary Social Studies Education. Her research focuses on the perspectives and experiences of black teachers, the perspectives and representation of black women in social studies curricular materials, and historical narratives that incorporate black history. She primarily uses critical race theory and black feminist thought as the theoretical perspectives for her research.

Her current research projects focus on the ways black teachers discuss issues of race in their classrooms and the teaching of slavery at historic plantation sites. Duncan currently teaches both elementary and secondary social studies teaching methods courses. She serves on the Department of Teaching & Learning's curriculum committee, reviews manuscripts for three journals, reviews proposals for numerous conferences, and regularly presents her research at the National Council for the Social Studies (NCSS) and the American Educational Research Association (AERA). She is currently participating in a Faculty Learning Community on Digital Tools and also serves as faculty advisor to the student chapter of the Association for Supervision and Curriculum development while maintaining sole responsibility for the Secondary Social Studies Education program.

Selected Accomplishments

- Elected to serve on College and University Faculty Assembly (CUFA) of National Council for the Social Studies (NCSS) Executive Board.
- Served as CUFA Scholars of Color Faculty Forum Chair.
- Served as AERA Social Studies Research Special Interest Group (SIG) Communications Chair
- Gave invited talk titled "Toward Emancipation: An Epistemologically Drivel Research Agenda," along with a Lunch & Learn and workshop at University of Georgia.
- Invited to present research at Spencer Foundation-funded conference on History Education and Racial Literacy at Hunter College in New York.
- Published a journal article in Educational Studies and one book chapter.
- Invited to co-author the foreword for a book titled Marking the Invisible: Articulating Whiteness in Social Studies Education and Research (book is in press).
- Invited to speak on NCSS panel about people of color in social studies education research.
- Organized Scholars of Color Faculty Forum research session and mentoring sessions at annual CUFA/NCSS conference.

Matthew J. Madison, PhD

Assistant Professor
Education and Human Development

Matthew Madison is a quantitative methodologist who specializes in the development of analytical tools for educational assessment data. His research agenda is driven by the idea that large-scale standardized tests provide far too little information for how often they are used. To that end, Madison uses his training in mathematics, statistics, psychometrics, educational psychology, and educational assessment to develop assessment models to increase the utility of standardized test scores for K–12 teachers.

Madison's current research, which is supported by the National Science Foundation, examines novel psychometric methodology for evaluating learning progressions. He recently applied for an Institute of Educational Sciences Statistical and Research Methodology in Education grant to develop diagnostic psychometric models for evaluating educational interventions. In addition to his methodological research, he has also collaborated with applied educational researchers on several grant proposals.

Madison currently teaches courses in educational research methodologies, including experimental design, linear regression analysis, multivariate statistical models, and applied psychometrics. To expand his methodological training, he recently applied and was accepted into the new online Masters of Data Science and Analytics program.

Selected Accomplishments

- Awarded a Methods, Methodology, and Statistics research grant from the National Science Foundation for $230,000.
- Awarded the Paul L. Beasley TRIO Trailblazer McNair Alumni Award from the University of South Carolina TRIO programs.
- Awarded the Outstanding Dissertation Award from the American Educational Research Association Cognition and Assessment Special Interest Group.
- Awarded the Owen W. Scott Award for Academic Merit and Professional Promise from the University of Georgia Department of Educational Psychology.
- Published articles in Psychometrika, Journal of Educational Measurement, and Educational Measurement: Issues and Practice.
- Served as Program Chair for the American Educational Research Association Cognition and Assessment Special Interest Group.
- Served as Membership Chair for the Northeastern Educational Research Association.

Jon C Calhoun, PhD

Assistant Professor

Electrical and Computer Engineering

Jon Calhoun is a computer engineer who studies all aspects of high-performance computing (HPC) systems and applications. His current work focuses on two primary areas: fault tolerance and reliability for HPC applications, and lossy data compression for scientific data. In the first area, he devises novel software-based failure detection and recovery techniques to ensure applications complete correctly and in a timely in the presence of failures. The second focus area improves data transfer times and storage requirements using lossy data compression that trades small inaccuracies in the data for large reductions in data volume. Reducing the data volume results in less data to be communicated, which results faster application execution. Additionally, lowering storage requirements enables more data to be archived for post-processing and analysis.

Calhoun collaborates with Clemson researchers from Genetics and Biochemistry, Materials Science and Engineering, School of Computing, Automotive Engineering, and Civil Engineering, as well as researchers from Argonne National Laboratory, Los Alamos National Laboratory, and the Jülich Supercomputing Centre, to understand how to integrate lossy data compression into their applications and workflows to enable larger and more detailed simulations without the need for additional memory and storage. Thus, his collaborators can improve the speed and quality of their research by more effectively using HPC systems.

Calhoun's work is supported by the National Science Foundation and the U.S. Department of Energy's Exascale Computing Project.

Calhoun teaches a graduate level course on fault tolerance for HPC systems and an undergraduate course on data structures and algorithms. He is developing a graduate level course based on his work on HPC data compression. His Creative Inquiry course seeks to broaden STEM undergraduates' use and understanding of HPC by engaging students to build/design/use the next generation of HPC systems and applications and preparing them with the cross-disciplinary skills needed to succeed in on-campus research opportunities, graduate school, and the modern workforce. Calhoun's research group contains two Ph.D. students, two master's students, and seven undergraduate students.

Selected Accomplishments

- Principal Investigator for an NSF CAREER award in 2020 and an NSF Computing and Communication Foundations Core Small award in 2019
- Principal Investigator for Argonne National Laboratory subcontracts
- Author or co-author of nine articles published or in print in journals or peer-reviewed conferences since joining Clemson in 2017, along with several others in review and in development
- Review board member for the Institute of Electrical and Electronics Engineers Transactions on Parallel and Distributed Computing

Judson D. Ryckman, PhD

Assistant Professor

Electrical and Computer Engineering

Judson Ryckman received the B.E. and Ph.D. degrees in electrical engineering in 2008 and 2013, respectively, from Vanderbilt University. Following his graduation, he joined Intel Labs as a research scientist in the silicon photonics organization. In his work at Intel, he supported the development of next generation silicon photonic components for datacom applications. Through that position he worked closely with world-class fab and packaging partners while contributing in the transition of silicon photonics from research into commercial products.

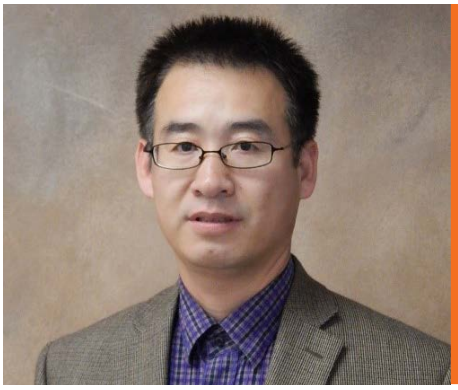
Ryckman serves on the committee of technical conferences such as Institute of Electrical and Electronics Engineers (IEEE) Optical Interconnects and is a reviewer for numerous journals published by IEEE and The Optical Society (OSA).

He has recently developed a new course entitled "Silicon Photonic Integrated Circuits" wherein undergraduate and graduate students learn to design photonic circuitry – their designs are then fabricated in a state-of-the-art clean room and tested through a multi-university program established at University of British Columbia.

Ryckman's research interests lie in the development and application of photonic platforms to solve problems in areas of sensing, biomedicine, and computing/communications. His research has been supported by the Southeastern Center for Electrical Engineering (SCEEE), the National Science Foundation (NSF), and the Air Force Office of Scientific Research (AFOSR) with awards totaling $900,000 since 2017.

Selected Accomplishments

- Received the AFOSR Young Investigator Program Award (YIP) 2019 ($450,000).
- Served as chair of the Optical Interconnects committee for IEEE Photonics Conference 2019 and 2020.
- Has received a total of eight awarded patents with multiple recent applications currently pending.
- Principal Investigator for an NSF Award, "Fabrication of High Performance Metasurfaces by Nanoimprinting of Refractive Index," which seeks to develop a novel low-cost and high-performance route toward manufacturing emerging optical metasurface technologies.
- Received an NSF supplement award, which will fully fund a six-month graduate student internship/collaboration with Intel's silicon photonics group.



Jianhua "Joshua" Tong, PhD

Associate Professor

Materials Science & Engineering

Joshua Tong is a material scientist in the field of energy materials and devices. He leads the Sustainable Clean Energy Laboratory (SCEL) at Clemson.

His research focuses the creation, synthesis, understanding, and engineering of energy materials (e.g., mixed oxides, conductive glasses, and nanocomposites) and the design, fabrication, demonstration, and modeling of energy devices (e.g., membrane reactors, fuel cells, electrolysis cells, solid state photoelectrochemical cells, thermochemical reactors, electrochemical sensors, and all solid state batteries). His research methodologies include additive manufacturing (3D printing), laser processing, reactive sintering, electrochemical synthesis, polymer-derived synthesis, additive-assisted synthesis, and machine learning. His research applications are hydrogen production, solar fuel production, sustainable ammonia synthesis, natural gas to value-added chemicals, carbon dioxide capture/utilization, biomass conversion, electrochemical sensing, organic waste to energy, nuclear isotope separation, nuclear waste management.

As a Principal Investigator and Co-Principal Investigator, he has helped to secure approximately $7 million research funding during his four years at Clemson. Tong is the lead PI of a $2 million U.S. Department of Energy (DOE) project for "laser 3D printing of highly compacted protonic ceramic electrolyzer stack." He is also starting a new DOE project of "Electrocatalytically Upgrading Methane to Benzene in a Highly Compacted Microchannel Protonic Ceramic Membrane Reactor."

Tong has published more than 80 peer-reviewed papers and six book chapters and has filed 13 patents. He has a total citation of more than 4,800 times and an h-index of 31. He serves as a reviewer for more than 50 journals, including Nature Materials, Nature Energy, and Advanced Energy Materials. He is also the executive committee member of the high-temperature division of electrochemical society.

Selected Accomplishments

- Established Clemson's national leadership on additive manufacturing of solid oxide fuel cells, solid oxide electrolyzer, catalytic membrane reactors by securing multiple million research projects from DOE.
- Established extensive research collaborations with national labs.
- Awarded the Ross Coffin Purdy (2017) from American Ceramic Society because of the publication of "Readily processed protonic ceramic fuel cells with high performance at low temperatures" in Journal Science.
- Awarded a University Research, Scholarship, and Artistic Achievement Award (URSAAA) from Clemson University (2019) because he had a paper cited more than 1,000 times.
- Published in high-impact papers such as Science (1), Energy & Environmental Science (3).

Matthew H. Koski, PhD

Assistant Professor

Biological Sciences

Matthew Koski is an evolutionary ecologist studying the drivers of diversity in plant reproductive strategies. He is particularly interested in examining how plants respond to changing climates and altered pollinator communities.

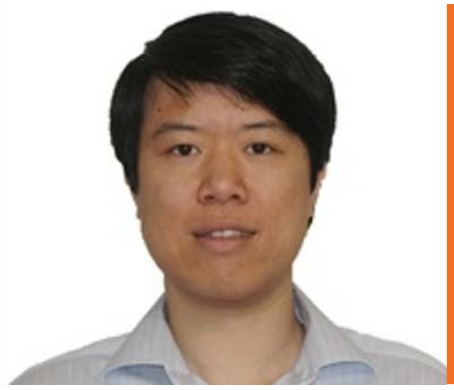
While much of his work has taken a global perspective, his current research takes place in the Southern Colorado Rocky Mountains. Arriving at Clemson just under a year ago, he and his lab have started new projects in Upstate South Carolina, including sites in the invaluable Clemson Experimental Forest.

His current work on the evolution of floral thermoregulation is supported by the National Science Foundation (NSF).

Koski teaches Evolutionary Biology at the undergraduate-level and co-teaches a graduate core course in Ecology and Evolution. He runs a Creative Inquiry program to engage undergraduate biology majors in hands-on research and is starting up an educational outreach program at the South Carolina Botanical Garden. Koski's lab consists of one PhD Student, a lab manager, three undergraduate researchers and, starting in Fall 2020, one to two postdoctoral researchers.

Selected Accomplishments

- Awarded three-year National Science Foundation grant for $455,000 as sole Principal Investigator (2020-2023).
- Awarded two-year National Science Foundation grant for $200,000 as Co-Principal Investigator (2018-2020).
- Published five peer-reviewed articles in the past year with an additional four currently in review or revision.
- Published the cover image for the Journal of Evolutionary Biology April 2020 volume.
- Serves as vice chair of the Plant Population Ecology Section for the Ecological Society of America.
- Co-organizer of 2019 Southeastern Population Ecology and Evolutionary Genetics Conference held at Clemson's Outdoor Lab.
- Presented research at University of Georgia's Plant Biology Department Seminar and South Carolina Native Plant Society Upstate Chapter 2020 meeting.



Yuyuan "Lance" Ouyang, PhD

Assistant Professor

Mathematical & Statistical Sciences

Yuyuan "Lance" Ouyang is a mathematician who studies the theoretical analysis and numerical algorithm design of mathematical models with large number of decision variables. His research results contribute to better understanding of efficient and accurate problem solving and have applications in statistics, medical imaging, and data analytics.

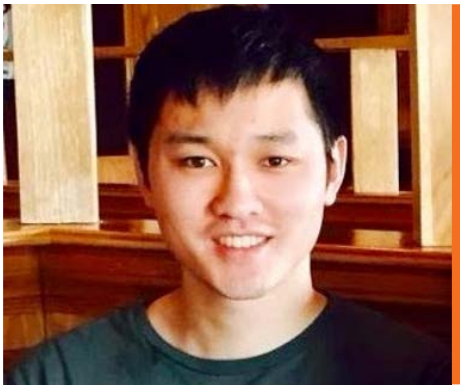
Current research projects are supported by the National Science Foundation, the Department of the Air Force, and the Office of the Naval Research.

In the 2019-2020 academic year, Ouyang taught courses in undergraduate-level honors Multivariate Calculus and graduate-level Machine Learning and Optimization, and he led a Creative Inquiry Undergraduate Research Project on Topics of Industrial Mathematics. He co-developed the curriculum of a two-semester graduate-level course sequence Machine Learning I & II. He is currently the mentor of three students from the South Carolina Governor's School for Science and Mathematics on the 2020 Summer Program for Research Interns at Clemson University.

Ouyang has graduated four Master's students and advised a two-semester undergraduate student project. He is currently advising two PhD students.

Selected Accomplishments

- Awarded the 2019 School of Mathematical and Statistical Sciences Faculty Teaching Award.
- Nominated for the 2020 INFORMS Optimization Society Prize for Young Researchers (nomination currently under review).
- Received a $515,917 research grant (2/1/2020-1/30/2023) from the Office of Naval Research (Principle Investigator).
- Received a $316,000 equipment grant (6/1/2019-5/31/2020) from the Office of Naval Research (Principle Investigator).
- Received a $243,756 research grant (7/1/2019-6/30/2022) from the National Science Foundation (Principle Investigator).
- Received a $50,000 research grant (8/14/2019-2/8/2021) from the Department of the Air Force (Principle Investigator).
- Published nine peer-reviewed journal articles and three conference proceedings.
- Served in the Organizing Committee of the 2020 INFORMS Optimization Society Conference (200+ submitted oral presentations; postponed to 2021 due to COVID-19).
- Served in various committees, including the Search Committee of the Founding School Director and the Strategic Planning Committee of the School of Mathematical and Statistical Sciences.



Boshi Yang, PhD

Assistant Professor

Mathematical & Statistical Sciences

Boshi Yang is an applied mathematician who studies the methodology behind problems in the area of Operations Research. His research in quadratically constrained quadratic programming, mixed-integer programming, and conic optimization explore novel convexification techniques to deal with difficult optimization problems and enhance the geometric understanding of nonconvex problems in various subfields in mathematical optimization. Current research projects are supported by the Office of Naval Research.

In the academic year of 2019-2020, Yang taught undergraduate-level honors Single-variable Calculus, Linear Programming, and graduate-level Mathematical Optimization. He also developed and taught a special topic course in Conic Optimization for advanced graduate students. He serves as faculty advisor for the Clemson student chapter of the Society of Industrial and Applied Mathematics.

Yang has graduated two master students and is currently advising one PhD student and two master students.

Selected Accomplishments

- Received the Faculty Teaching Award (2020) from the School of Mathematical and Statistical Sciences.
- Received the Outstanding Service to Graduate Students Award (2019) from the School of Mathematical and Statistical Sciences.
- Received a $299,998 research grant (2020-2023) from the Office of Naval Research (Principal Investigator).
- Received a $316,000 equipment grant (2019-2020) from the Office of Naval Research (Co-Principal Investigator).
- Published four peer-reviewed journal articles.
- Invited as speaker for the Mixed Integer Programming (MIP) workshop (approximately 20 speakers each year, worldwide)
- Chaired technical sessions in various national and international conferences.

Board of Trustees Research Report
September 2020