

The background of the slide is a complex, abstract pattern of overlapping, organic shapes in various shades of yellow and orange. These shapes resemble a network of cells or a molecular structure, with some areas being more solid and others more open, creating a sense of depth and movement.

BIOTECHNOLOGY

Emergent Research Disciplines at LSU A&M / LSU AgCenter

LSU

This report was prepared by the LSU Office of Research & Economic Development (ORED) in coordination with a committee comprised of faculty experts at LSU A&M and LSU AgCenter, in the College of the Coast & Environment, College of Engineering, College of Science, and School of Veterinary Medicine.

Opportunity for (Re)invention: Biotechnology

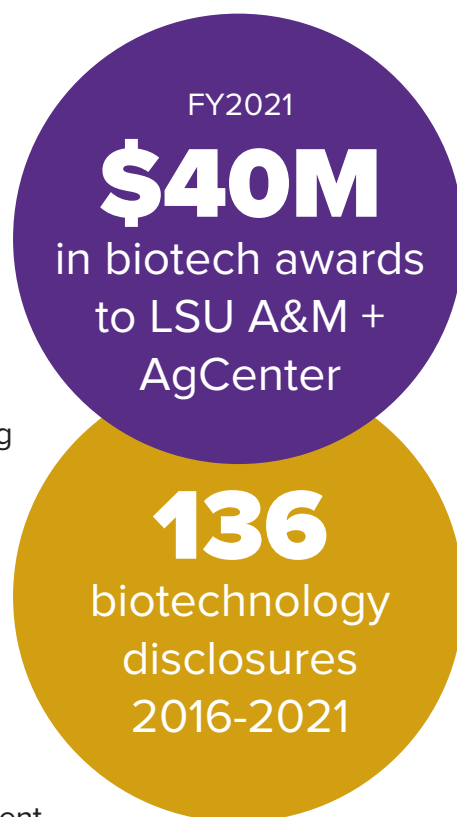
LSU A&M and the LSU AgCenter have reached critical mass in terms of active and funded faculty working in the broad area of biotechnology. Through the creation of a university-wide **LSU Biotechnology Institute (LBI)**, ORED aims to help better coordinate and leverage these efforts, increase collaboration and sharing of resources (including administration, equipment, and facilities), and pursue more and larger research grants. A biotechnology institute anchored at LSU A&M/LSU AgCenter would also serve the entire LSU system by creating increased synergy with Pennington Biomedical Research Center, LSU Health New Orleans, and LSU Health Shreveport, and align the entirety of the LSU research enterprise to better address many of Louisiana's greatest challenges.

Scanning the Horizon

In the fall of 2020, the LSU Office of Research & Economic Development (ORED) charged a committee of select faculty and administrators with both research and industry experience to evaluate the need, potential, and possible structure for a new LSU institute for biotechnology research; present a concise report to ORED on these topics; and if needed, prepare a first draft of documents for the Board of Regents to establish such an institute.

The committee—faculty from two LSU campuses representing five colleges/schools plus four advisory members from ORED—met at roughly two-week intervals from September 2020 to February 2021. The committee members were: Wade Baumgartner (AgCenter); Aixin Hou (Coast & Environment); David Constant (Engineering, committee chair); Jim Moroney (Science); and Gus Kousoulas (Veterinary Medicine); along with ORED advisory members Stephania Cormier, Graca Vicente, Greg Trahan, and Holly Carruth.

The committee members assessed the current status of biotechnology research at LSU (listing individual faculty and collaborative projects in each of their respective units); surveyed the structure and function of existing biotechnology institutes elsewhere in the U.S. to establish best practices and identify key elements of success and potentially related and complementary disciplines, such as analytics and computational science; thus determining a roadmap for the creation of a new **LSU Biotechnology Institute**.



Biotech Awards at LSU A&M + Ag

Cumulative awards show an upward trend.

COLLEGES / SCHOOLS

AG CENTER

COAST & ENVIRONMENT

ENGINEERING

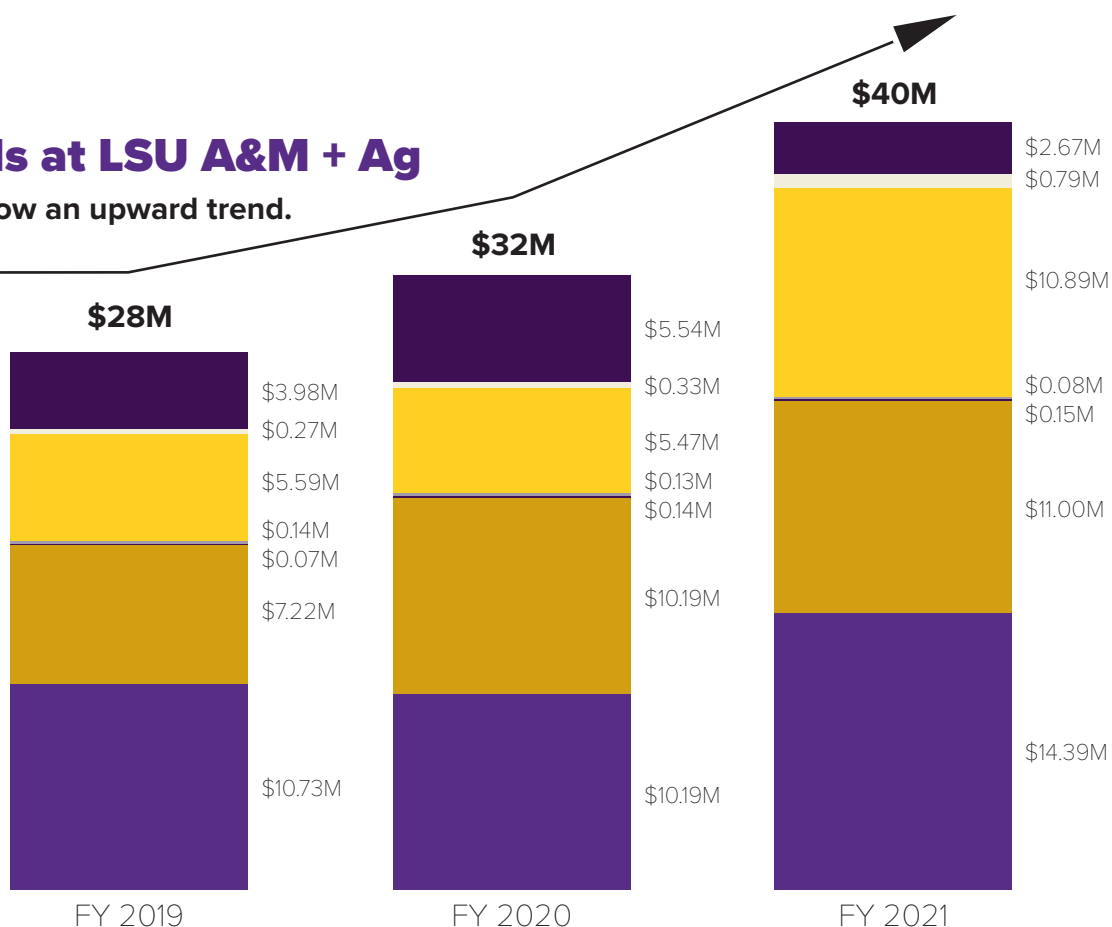
HUMAN SCIENCES & EDUCATION

HUMANITIES & SOCIAL SCIENCES

SCIENCE

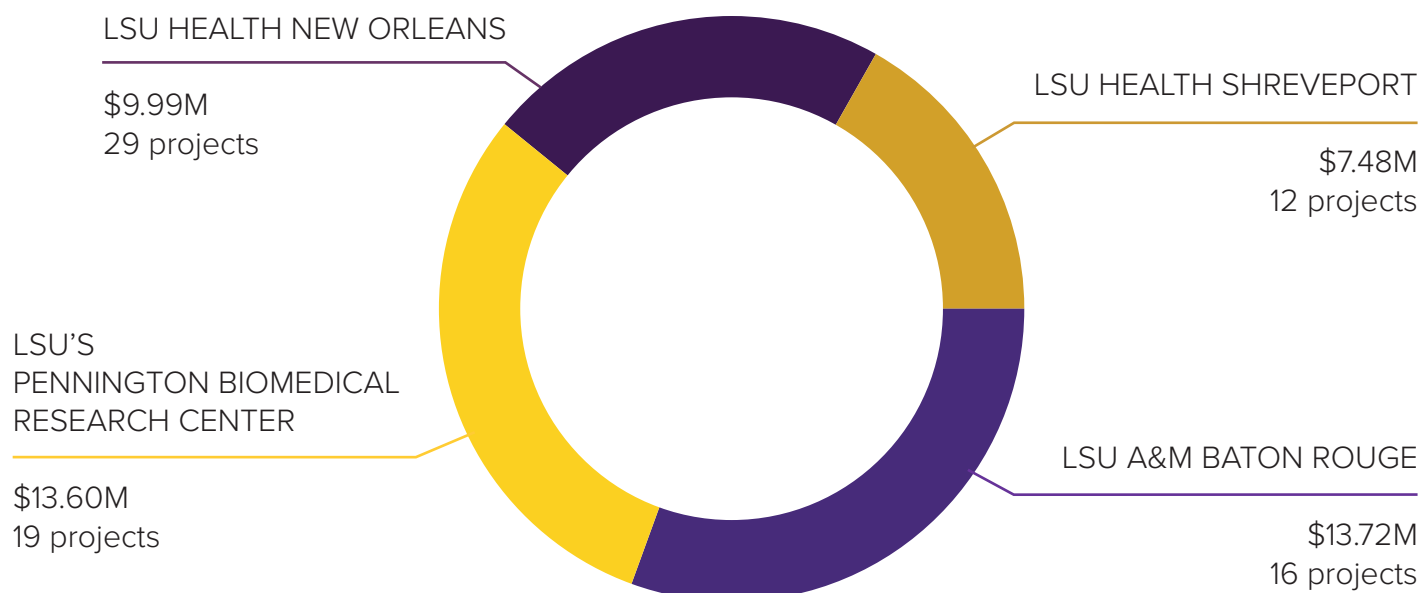
VETERINARY MEDICINE

(including human
biomedical science)



A Balanced Research System

National Institutes of Health (NIH) funding in 2021 is well-balanced across peer institutions in the LSU system, but research efforts in biotech could be better coordinated and connected to support cross-campus collaboration.



Broad Impact

LSU has a large community of researchers who conduct research that can be defined broadly as “biotechnology.” This work ranges from basic research on fundamental questions to translational research focused on solutions to human problems, from drug design to environmental contaminant remediation. Despite this breadth, there is no organizing structure for this community to facilitate collaboration and exchange (whether formal or informal) across departments and colleges at LSU.

This extensive base of research begs the question: “Is it possible that a biotechnology research institute that spans multiple colleges and schools could not only facilitate collaboration, but also act as a catalyst for innovation and accelerate basic and applied research and technology transfer, especially for major external opportunities?”

Current Work, College by College

Across multiple campuses, colleges, and disciplines, the committee was able to identify and capture biotechnology-related research across the entirety of the research enterprise. The breadth of the work suggests significant opportunities for interdisciplinary research and technology development.

LSU College of Agriculture and the LSU AgCenter are engaged in biotechnological research in what’s easily grouped into human, animal, and plant application areas. Existing expertise spans drug development and delivery, therapeutics, cancer, insect physiology, livestock reproduction, and plant germplasm research, to name a few. *(17 faculty identified)*

LSU College of the Coast & Environment works on challenges found in food and energy supplies and animals in the critical ecosystems of the Gulf of Mexico, including wetlands. Significant funding from NOAA supports many of these research initiatives. Key issues reside in the seafood industry, bioengineering, and fragile Gulf Coast ecosystems. *(20 faculty identified)*

LSU College of Engineering has an extensive, established biotechnology database with strategic research initiatives refined to five major focus areas. Research ranging from drug design to robotics, and focusing on biomechanics, biomaterials, bioprocessing and manufacturing, bioinformatics, diagnostics and instrumentation, and community health and safety. *(59 faculty identified)*

LSU College of Human Sciences & Education has several faculty in kinesiology working in the field of exercise physiology and behavioral neuroscience. Some of these faculty members focus on the influence of supplements on performance while others focus on behavioral effects of neurological disease and trauma. *(8 faculty identified)*

LSU College of Humanities & Social Sciences has several faculty working in the area of neuroscience, cognitive and brain sciences. Much of their work falls into the major focus area of drug design, testing, and delivery, and combines behavioral research, computational modeling, machine learning, and brain imaging, including for improved neuropsychological assessment. *(5 faculty identified)*

LSU College of Science has a wide range of biotechnology research underway, ranging from genomics to drug development, delivery, and design; biosensors, biological imaging, radiation and radiotherapy, computation/modeling, and plant biotechnology, including energy conversion through photosynthesis. *(73 faculty identified)*

LSU School of Veterinary Medicine has an extensive array of biotech projects focused on improving human and animal health. The School is home to the Louisiana Biomedical Research Network and several active Centers of Biomedical Research Excellence (COBRE), including the Molecular Biology Core Laboratory, the Center for Pre-Clinical Cancer Research, and the Center for Lung Biology and Disease. Faculty are engaged in basic, clinical, and translational research of a collaborative nature in the areas of infectious disease and molecular diagnostics, toxicology, pharmacology, drug development and delivery, bioengineering and bioprinting, and numerous disease models. *(54 faculty identified)*



200+
faculty engaged in
biotech research
at LSU A&M
+ AgCenter

... in more than
30
academic
departments

Convergent Opportunity

There are at least 200 faculty who are seriously engaged in fundamental and applied biotechnology research in more than 30 academic departments. Through their analysis and discussion, the committee was able to determine all units engaged in this study could be viewed as elevating three major emergent focus areas: (1) Bioengineering, (2) Functional Genomics and Informatics, and (3) Translational Research. Thus, the committee recommends that LSU label these areas as having the breadth and depth of expertise to build upon through a campus-wide multidisciplinary **LSU Biotechnology Institute**.

Mission and Vision

An **LSU Biotechnology Institute** would serve as a cross-campus coordinating function for biotechnology and bioscience research initiatives, working to advance collaborative research and innovation and increase the competitiveness of LSU researchers across three main focus areas: Bioengineering; Functional Genomics and Informatics; and Translational Research.

It would serve key stakeholders: 1) faculty, staff, and students on LSU's campuses (internal); 2) external partners in innovation and application of innovation—anyone who wants to advance current practice and knowledge in their respective fields. It would also serve as a catalyst to improve health and well-being, a core objective of the LSU Strategic Plan and a critical issue for the State of Louisiana and beyond.

The institute's role will include coordination, engagement, and advocacy for all biotech-related activities on campus. It will initiate and define research within the focus areas; identify state and federal funding opportunities that align with its own defined R&D thrusts; facilitate connections between researchers and with funding partners/opportunities; curate repositories of research assets, facilities, and capabilities to enhance proposals; create toolkits to assist researchers in proposal development; connect researchers with speaking and promotional opportunities; promote biotech-related efforts through new and established communication channels; and coordinate with state and industry stakeholders on R&D and workforce development efforts.

Beyond serving as a collaborative function, a core goal of the **LSU Biotechnology Institute** will be to accelerate technology transfer and commercialization and produce translational research, where LSU expertise leads to findings, solutions, and products that can directly impact health and well-being.

LSU A&M Invention Disclosures

| | FY2017 | FY2018 | FY2019 | FY2020 | FY2021 |
|---------------------------------------|------------|------------|------------|------------|------------|
| Biotech, general | 14 | 10 | 13 | 17 | 12 |
| Therapeutics | 0 | 0 | 2 | 4 | 2 |
| Software | 2 | 4 | 3 | 2 | 2 |
| Instrumentation, devices, diagnostics | 1 | 8 | 7 | 6 | 5 |
| Tools, reagents, chemicals | 0 | 8 | 5 | 1 | 2 |
| Agriculture | 0 | 0 | 4 | 0 | 2 |
| TOTAL biotech disclosures | 17 | 30 | 34 | 30 | 25 |
| TOTAL for all disciplines | 73 | 60 | 79 | 71 | 71 |
| % of disclosures in biotech | 23% | 50% | 43% | 42% | 35% |

Inventions in biotechnology represents a significant portion of all invention disclosures at LSU A&M.

Roadmap

The short-term target will be to focus university resources within the three established target areas to achieve early successes in research, leading to step changes in technology in application and a significant increase in support from government and industry.

On a tactical and operational level, LSU would need to evaluate existing core facilities and decide which are functional and which ones could be incorporated into a new **LSU Biotechnology Institute**; enable sharing and cross-campus coordination; build toolkits and boilerplates; establish processes; facilitate movement

of intellectual property and technology transfer between stakeholders; curate university assets, experts, and “membership”; assign working groups; identify investors; invite partners; and launch communications.

A long-term goal recommended by the committee is to establish a named LSU College of Biotechnology with both resident and adjunct faculty as well as graduate, post-doctoral, and perhaps undergraduate programs. Non-degree certificates should be offered, including online, as well as a seminar program.

Structure

The institute will facilitate collaborative efforts among faculty across the LSU system, with other institutions, and industry. Member and adjunct faculty will be able to access seed funding and graduate assistant support from LSU, receive proposal development support, share F&A returns, and obtain subsidies for shared facility/equipment use. This should encourage faculty to participate, and lead to a structure governed by a director and internal board, with an external advisory board for technical direction and external support development. Non-member individuals and units could use any of the facilities and equipment services, which would operate as standard university cost centers.

The institute must be able to administer sponsored projects across units and campuses. The goal is for the institute to become self-sustaining by allowing credit to be attributed to the institute—through sponsored projects, the negotiation of a special facilities and administration policy, and innovation. The institute must be able to rapidly establish MOUs and interagency agreements and have a clear voice in intellectual property management and technology licensing.

Initially, the collaboration would be supported by ORED and primarily involve faculty focused on one or more of the three identified areas of strength.

Leadership

A director should be hired who has significant experience in biotechnology research, funding, and management. This individual should be nationally and internationally recognized and have significant funding in-hand upon appointment. It is absolutely critical this individual be a facilitator of research growth beyond their own area, willing to make their work a core of the shared effort. This will require significant support from LSU.

Institutional Support

LSU should provide project startup funds to launch new and novel research as well as support graduate assistant stipends and tuition coverage. A substantial portion of F&A recovered should be returned to the institute to encourage participation.

Significant savings would be possible through coordinated, wider use and maintenance of shared equipment, and through institutional support to also provide the LSU biotech community with state-of-the-art instruments and technical support staff.

Key Elements of Success

In a review of about 12 biotechnology institutes at other institutions, the following characteristics were found to be important to success:

- Institutional support
- Senior and experienced leader
- External advisory board and internal governing council
- Focus on specific research areas and problem(s) to solve
- Large and diverse number of funded faculty involved—not focused on one or a few faculty
- Long-term federal program support at the core (EPSCoR, NIH, etc.)
- Short- and mid-term wins help to ramp up major support/funding
- Advanced instrumentation and core facilities
- Strategic, active partnerships with industry, government, and healthcare partners

Based on shared experience, the exploratory committee also recommends increasing or establishing:

- Seed funding for novel projects
- Special F&A return to the institute and dedicated administrative support
- Shared facilities, equipment, and technical support staff, and subsidized rates for use
- Ability to administer multicampus projects with a minimum of issues in regards to proposals and contracts
- Broad access to the same software across campuses/units
- A voice in intellectual property linkages

Facilities and Capabilities

ORED has compiled a [list of facilities and equipment](#) at LSU A&M that could be used on a collaborative basis to support a biotechnology institute. It has not yet been determined whether all of these are able to serve more than one or two labs/units, but in sum, LSU already has significant resources available for an **LSU Biotechnology Institute**.

Examples of core facilities for which experts are available to design experiments and analyze data:

Clinical research

—obesity, diabetes, cardiovascular and pulmonary disease, and cancer
—health disparities and social sciences to improve outcomes in underserved populations
—motor behavior, cognition, and dementia
—orthopedics

Pre-clinical research

—drug design, testing, delivery
—inhalation toxicology
—aquatic toxicology
—infectious disease modeling and lung function
—imaging
—pathology/histology services

- biocontainment facilities for BSL 2 and 3 work (on biohazards, biotoxins)
- medical and health physics

-omics

- genomics
- lipidomics
- metabolomics
- proteomics

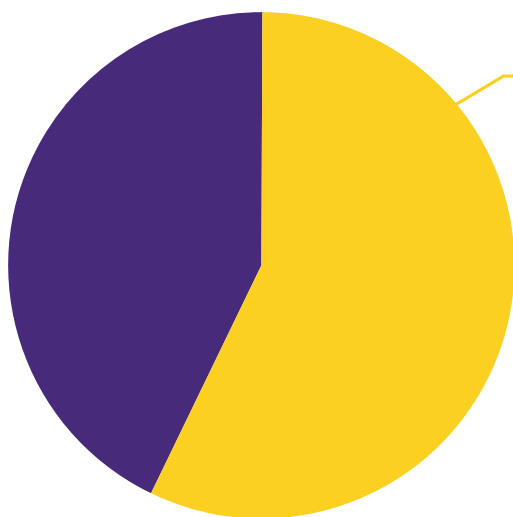
Microfabrication and materials analysis

- synchrotron radiation research center
- production center for advanced manufacturing technologies for lightweight composite and metallic materials in support of the NASA space program and adjacent industries
- advanced light and fluorescence microscopy, electron beam microscopy and microanalysis, x-ray spectroscopy, and sample preparation equipment

Increase in NSF CAREER Awards to LSU: National Recognition of Emerging Expertise in Biotechnology

[Seven assistant professors](#) within their first few years as researchers in the LSU College of Engineering and the LSU College of Science received early-career faculty development (CAREER) awards from the National Science Foundation (NSF) this year, a most impressive number. Among them, four—a majority—are conducting research in biotech. NSF CAREER awards are the most prestigious grants for individual faculty members and aim to provide solid, long-term support for emerging talent on the cutting edge of their research disciplines.

4 out of 7 NSF CAREER awards to LSU in 2021 are in bioengineering



LSU Mechanical Engineering Assistant Professor [Manas Gartia](#) received \$500,005 to establish a novel method to image lipids, or fatty acids, in brain cells and tissues. This could lead to new therapeutics to **improve outcomes in Alzheimer's, heart disease, and cancer patients.**






LSU Biological Engineering Assistant Professor [Philip Jung](#) received \$442,451 to engineer designer proteins to stimulate the proliferation of healthy cardiac muscle cells, to **help with recovery after a heart attack.**

LSU Civil & Environmental Engineering Assistant Professor [Samuel Snow](#) received \$534,860 to design the first smart ultraviolet LED systems for **cheaper and better treatment of wastewater**, including handheld devices in remote places.

LSU Division of Electrical & Computer Engineering Assistant Professor [Jian Xu](#) received \$500,000 to develop **new imaging techniques that can outperform and eliminate ionizing radiation.**

Three Emergent Focus Areas in Biotechnology Research

Faculty representation in each college/school; examples of work.

| LSU COLLEGES / SCHOOLS | Bioengineering | Functional Genomics & Informatics | Translational Research |
|---|---|--|--|
| AG CENTER | 10-15 faculty  | 5-10 faculty Adam Famoso breeds better rice for Louisiana and the world | 17 faculty |
| COAST & ENVIRONMENT | 3-5 faculty Crystal Johnson works on marine bacteria and pathogens, including those that might affect humans | 15-20 faculty  | 20 faculty |
| ENGINEERING | 50-60 faculty | 5-10 faculty Supratik Mukhopadhyay and the LSU DeepDrug team uses artificial intelligence to rapidly discover new drugs | 59 faculty |
| HUMANITIES & SOCIAL SCIENCES | 5-10 faculty  | - | 8 faculty Alex Cohen adapts biobehavioral technologies; such as automated mental health status updates on cell phones |
| HUMAN SCIENCES & EDUCATION | 5-10 faculty | - | 5 faculty Marc Dalecki studies how the brain controls movement and the effects of hyperoxygenation on performance |
| SCIENCE | 15 faculty  | 30 faculty Maheshi Dassanayake sequences and decodes plant genomes for sustainable agriculture and bioenergy crops | 73 faculty |
| VETERINARY MEDICINE (incl. human health) | 10-15 faculty | 1-2 faculty Alexandra Noel works on long-term health effects of electronic cigarette use | 54 faculty  |

LSU A&M and AgCenter Biotechnology Research News

AgCenter

Adam Famoso: Breeding Better Rice

<https://www.lsuagcenter.com/profiles/tblanchard/articles/page1626269538071>

New Nanodelivery System Could Help Soybean Seeds Combat Fungus

<https://www.lsuagcenter.com/profiles/aiverson/articles/page1600217887816>

College of the Coast & Environment

Sinking Louisiana: Is It Too Late to Save Louisiana's Coast? LSU Professors, Researchers Weigh In

https://www.lsureveille.com/news/sinking-louisiana-is-it-too-late-to-save-louisiana-s-coast-lsu-professors-researchers-weigh/article_1827822a-2881-11eb-ae06-fb5789b2b284.html

LSU researchers granted \$1.3M for clean energy research

<https://www.brproud.com/news/local-news/lsu-researchers-granted-1-3m-for-clean-energy-research/>

College of Engineering

Collaborative Champion: Marwa Hassan

<https://www.lsu.edu/research/news/2019/1028-marwahassan.php>

LSU DeepDrug Team Uses Artificial Intelligence to Discover New Treatments for Coronavirus

<https://www.lsu.edu/research/news/2020/0327-deepdrug.php>

Stopping the 'Bullies': LSU BE, ChE Students Research Breast Cancer Cells

<https://www.lsu.edu/eng/news/2020/10/bechebreastcancer.php>

College of Humanities & Social Sciences

Collaborative Champion: Melissa Beck

<https://www.lsu.edu/research/news/2019/1111-melissabeck.php>

College of Human Sciences & Education

LSU Senior Briasha Jones Receives National Biomedical Research Award

https://www.lsu.edu/chse/kinesiology/news/briasha_jones_award.php

College of Science

Feeding Our Future Planet

<https://www.lsu.edu/research/news/2020/1020-feedingtheplanet.php>

Interdisciplinary LSU Superfund Team Receives \$10.8M to Fight Pollution from Waste Sites

https://www.lsu.edu/research/recent_grant_successes/2020/0406-superfund.php

LSU Goes to the Moon

<https://www.lsu.edu/research/news/2021/0504-tiger-eye-1.php>

School of Veterinary Medicine

LSU Veterinary School receives \$11 Million COBRE Grant to Establish Center for Pre-Clinical Cancer Research

https://www.lsu.edu/vetmed/vet_news/cobre_cancer.php

Getting to the Heart of Vaping

https://www.lsu.edu/research/recent_grant_successes/2020/0401-alexandranoel.php

Ten Minutes with Rainmaker Samithamby "Jey" Jeyaseelan

<https://www.lsu.edu/research/news/2020/0317-samithambyjeyaseelan.php>

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