Creative Inquiry (CI) is the imaginative combination of engaged learning, cross-disciplinary interactions and undergraduate research that is unique to Clemson University. Team-based investigations are led by faculty mentors and typically span a year or more. Students take on problems that spring from their own curiosity, from a professor’s challenge or from the pressing needs of the world around them. These invaluable experiences produce exceptional graduates.

The following list of CI projects in the College of Engineering, Computing, and Applied Sciences (CECAS) has been compiled for Fall 2020 General Engineering (GE) students. All projects on this list are appropriate for freshmen and new transfers. This list is comprised of several projects that are two or more semesters, meaning it can be continued once you have transitioned to your engineering major. Other projects may only last one or two semesters. Many of these CI projects are interdisciplinary, and provide exposure to multiple fields of engineering (e.g. civil engineering, environmental engineering, electrical engineering, etc.).

Projects #1 – 14 (pgs. 2-6) are open to any new GE student, and projects #15 – 19 (pgs. 7-8) are only available to students in the Residents in Science and Engineering (RISE) Program. Projects with a “TBA” time, mean the faculty will work with students to decide on a meeting time. Information for each of the CI projects is presented as follows:

<table>
<thead>
<tr>
<th>Project #</th>
<th>Title</th>
<th>Project Course Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Description of CI Project</td>
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At orientation registration for Fall 2020 classes, interested students should register for the CI holding section (ENGR 1900-999, 1 credit hour). To join an actual CI project in Fall 2020, General Engineering students are asked to submit their top three project choices via a Google Form that will be sent to their Clemson email address during orientation.

**Please note:** Students who register for the CI holding section MUST submit their project choices by 4 PM the day after their orientation session (for sessions ending on Friday, students will have until Monday) to remain enrolled in the ENGR 1900-999 holding section. Students who register for the holding section and fail to submit their CI project choices via the Google Form will be dropped from the holding section. Students will be notified of their project placement following the last orientation session and before the start of the fall semester.

Questions, please contact Ms. Lib Crockett, GE Special Projects Coordinator, at crockee@clemson.edu.
## CI Projects for General Engineering Students

### Project 1 | Oyster Reef Restoration

**Dr. Caye Drapcho (Biosystems Engineering)**

| 2 Semesters - 1 credit | TBA |

Globally, 85% of the world’s oyster reefs have been depleted due to over harvesting and/or poor water quality. Our team seeks solutions to restore oyster reefs through design of structures for oyster spat attachment.

### Project 2 | Open Educational Resources

**Dr. Rachel Getman (Chemical and Biomolecular Engineering)**

| 1 Semester – 1 credit | TBA |

This project investigates ways to implement Open Educational Resources (OER) in STEM classes at Clemson University, in order to minimize or eliminate out-of-pocket costs associated with taking classes at Clemson University.

### Project 3 | LEAD Forward

**Dr. Steve Sanders (College of Engineering, Computing, and Applied Sciences)**

| 2+ Semesters – 2 credits | TBA |

LEAD Forward is a student-led organization focusing on empowering CECAS undergraduates to be servant-leaders. LEAD forward is a three-semester program; the first semester provides instruction and practice on empowering yourself, the second on empowering others, and the third on an intensive application of the lessons learned. A servant-leader focuses primarily on the growth and well-being of people and the community to which they belong, which requires that LEAD Forward be extremely interactive with other people and the community. To accomplish this interaction, LEAD Forward has partnered with a local school district where the LEAD Forward students develop, implement, and assess programs to provide career exploration and character development for the district’s students.

### Project 4 | Drinking Water Quality

**Dr. David Ladner (Environmental Engineering and Earth Sciences)**

| 1 Semester – 1 credit | Tuesday, 3:30 pm |

Students monitor water quality of local streams that feed into our drinking water source, Lake Hartwell. They go into the field with the team to measure pH, temperature, dissolved oxygen, and other parameters. The team is also working on nitrate measurements for the state of South Carolina, including public sources and private wells.
### Project 5 | Industrial Assessments

<table>
<thead>
<tr>
<th>Dr. Elizabeth Carraway (Environmental Engineering and Earth Sciences)</th>
<th>1 Semester – 1 credit</th>
<th>TBA</th>
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</table>

This project is dedicated to training students to help with Clemson’s Industrial Assessment Center (IAC) which is part of a national Dept. of Energy program specializing in energy assessments of small to medium sized manufacturing industries. Students will learn about energy use in major building systems around campus and potential energy efficiency projects. Meetings generally involve tours and explanations of major energy systems at Clemson University that are similar to industrial operations: boilers, chillers, etc. Students may find opportunities to become interns with the Clemson IAC. Tours must be scheduled during regular business hours, so it is necessary to set a CI weekly meeting time based on schedules of participants each semester; therefore the meeting time is TBD.

### Project 6 | Engineering Biology of Arthropods

<table>
<thead>
<tr>
<th>Dr. Kostya Kornev (Materials Science and Engineering)</th>
<th>2 + Semesters – 2 credits</th>
<th>TBA</th>
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</table>

We explore structural and organismal features of insects from the physics and materials science point of view looking at the physical determinants of the materials performance and evolution of insect fibrous materials. We are interested in mechanisms of nano and micro fluid movements, sensitivity of insect antennae, mechanisms of silk formation by insects and analysis of structural and physical properties of butterfly proboscis. Check out these videos: [https://www.youtube.com/watch?v=5JcIOOWm8w8](https://www.youtube.com/watch?v=5JcIOOWm8w8) or [https://www.youtube.com/watch?v=QHDbdKj8NuM](https://www.youtube.com/watch?v=QHDbdKj8NuM)

### Project 7 | Microfluidics and Lab-on-a-Chip for Point of Care Technology

<table>
<thead>
<tr>
<th>Dr. Xiangchun Xuan (Mechanical Engineering)</th>
<th>1 + Semesters – 1 credit</th>
<th>TBA</th>
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Microfluidic lab-on-a-chip devices have been increasingly used to accomplish various steps in cellular and molecular analyses for numerous applications. However, samples (cells and molecules) are still processed primarily off-device using expensive traditional sample preparation methods. A variety of force fields have been demonstrated in microfluidic devices to bio samples, among which electric and magnetic forces are the most common used. In this proposed Creative Inquiry (CI) project, we will explore and exploit the hydrodynamic, electro-kinetic and magnetic transport phenomena in engineered microchannels to develop a general-purpose microfluidic biochip for cellular and molecular analyses.
CI Projects for General Engineering Students

Project 8 | Development & Assessment of Makerspace SOP

| Dr. Todd Schweisinger (Mechanical Engineering) | 2+ Semesters – 1 credit | TBA |

The Clemson University Makerspace regularly purchases new equipment to introduce it to the Clemson making community for research, courses, and personal projects. Training for users is offered for all equipment to any Clemson student, faculty, or staff. The ultimate goal of this CI project will be to create training for the new equipment that can be conducted safely with as little employee input as possible, and to revise and update training on existing equipment to improve effectiveness. The students will first learn to use the machines to develop their ability and skills, and to explore the capabilities and limitations of the equipment.

Project 9 | Development of a System to Incentivize Litter Storage & Collection in Developing Areas

| Dr. Todd Schweisinger (Mechanical Engineering) | 2+ Semesters – 2 credits | TBA |

Widespread litter, comprised in large measure of plastic bags, plastic beverage containers, paper, and assorted refuse, vexes large parts of the world, particularly under-developed regions where there is no centralized trash and garbage collection. A practical means of involving the local population in collecting and transporting accumulated litter to central collection points and establishing incentives for participation is a potential solution. An important component of such an approach is thought to be the development of a practical process to enable single individuals to compact litter into small, manageable units, for which they could be compensated on a piece by piece basis. Students will collaborate in teams to design, build, test, and evaluate methods to compact litter, and they will need to consider the possible socio-economic and cultural aspects impacting the effectiveness.
### Project 10 | The Clemson Concrete Canoe Team (3CT)  
**CE 1990 – 020**

<table>
<thead>
<tr>
<th>Dr. Brad Putman (<em>Civil Engineering</em>)</th>
<th>2 Semesters – 1 credit</th>
<th>TBA</th>
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</table>

3CT is a student-lead team that designs, builds, markets, and races a concrete canoe each year at regional and national competitions. Students learn and apply classroom knowledge and concepts to a real-world project, including project management, concrete mix design and materials, structural analysis/design, naval architecture, public relations, product performance/evaluation, sustainability, mentoring, and communication skills (oral and written).

### Project 11 | Clemson ENGAGE  
**CE 1990 – 050**

<table>
<thead>
<tr>
<th>Dr. Jenifer Ogle (<em>Civil Engineering</em>)</th>
<th>1 + Semesters – 1 credit</th>
<th>TBA</th>
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This CI project brings industry professionals, faculty, staff and students together to improve the living conditions of community partners in developing countries. Students work with faculty and industry team members on the technical aspects of the projects, simultaneously networking and learning real-world skills that apply to their future careers. Students tackle developing world problems in a diverse setting, learn to communicate their research to a wide array of audiences, as well as improve their own resumes and online presence throughout the semester. Students have opportunities to travel to Dominica for break trips and work on projects related to clean water, health improvement, elementary education, agriculture, redevelopment and ecotourism, among others.

### Project 12 | Bamboo Reinforced Concrete  
**CE 1990 – 102**

<table>
<thead>
<tr>
<th>Dr. Weichang Pang (<em>Civil Engineering</em>)</th>
<th>1 + Semesters – 1 credit</th>
<th>TBA</th>
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</table>

Efficient in-situ resource utilization is a critical component of NASA’s current and future Mars and Lunar exploration missions. In this CI project, the team aims to survey and explore innovative processes that could transform Martian and Lunar regolith simulants into construction materials for functional building blocks.
CI Projects for General Engineering Students

**Project 13 | Emagine – A STEM / STEAM Outreach Program for K-12**

| Dr. Brad Putman (Civil Engineering) | 1 + Semesters | TBA |

There is a critical need to extend engineering education to expose younger students (K-12) to the engineering process and careers. This CI team works with Clemson’s EMAGINE program to create activities designed to engage students and teachers in the engineering process and connect the dots between the concepts they are learning in their classes with practical applications. Student members of this team will also help deliver the content to K-12 students across South Carolina. This is a great service-learning opportunity where students will build communication and mentoring skills.

**Project 14 | Martian Soil Simulants**

| Dr. Qiushi Chen (Civil Engineering) | 1 + Semesters | TBA |

This project aims to explore various potentially Mars-compatible processes that synchronize novel composite materials from simulated in-situ Martian materials for the creation of functional building blocks. Examples of the processes the team has been or will be exploring include bio-cementation and thermoset polymeric materials. The created composites will be tested and characterized for their mechanical and physical properties.
RISE CI Projects

The following projects are restricted to students who are participating in the Residents in Science and Engineering (RISE) program.

Project 15 | Kitchen Chemistry

| Tania Houjeiry (Chemistry) | 2 Semesters | 1 credit | TBA |

In this CI, the students will be assigned some readings related to a food/dish we are going to make, my role will be facilitating learning about the chemistry of food and cooking, we will have a round table discussion of what the students found/read and then we can make the dish. Each meeting will have an edible experiment that will be accompanied with a homework assignment. The homework assignment is a set of questions related to the chemistry and history of the edible experiment, the HW will be completed during the class time, while waiting on the food to cook or bake.

Project 16 | Design for All Abilities

| Dr. Matt Miller (General Engineering) | 1 Semester – 1 credit | Thursday, 3:30 – 4:45 PM |

There are many individuals with physical and/or cognitive disabilities in the world, but their needs are often overlooked in the design of everyday things. This project will guide students through research on principles of universal design, identification of a project with a local impact, and development of prototype solutions to improve the accessibility and utility of the Clemson campus. Students will participate in activities that allow them to gain first-hand experience with some of the challenges individuals with disabilities face on a daily basis. This experience will enable students to empathize with people different from themselves, providing a unique design perspective and ability to think outside the box when developing solutions to meet the needs of a wide range of stakeholders.

Project 17 | Using an Arduino

| Dr. Will Martin (General Engineering) | 2 Semesters – 1 credit | Friday, 10:10 – 11:00 AM |

This project teaches students to use Arduinos to allow students to develop their own prototypes. An Arduino microcontroller is an easy to learn interface between electrical hardware and programming. After students have learned the basic concepts, they will be allowed to brainstorm and create a device of their choosing and design which utilizes an Arduino to solve a problem.
RISE CI Projects

The following projects are restricted to students who are participating in the Residents in Science and Engineering (RISE) program.

Project 18 | Green Roofs, Rainwater Cisterns, and Urban Ag

Dr. Will Martin (General Engineering)  
2 + Semesters – 1 credit  
Tuesday, 12:30 – 1:00 PM

This project is exploring the possible synergy between utilizing green roofs, rainwater cisterns, and roof top agriculture. Green roofs have many benefits, but their impact on reducing storm water runoff quantity from larger design storms is limited. While including a cistern can be a way to improve this, a cistern is not a reasonable approach if there is no use for the stored water. Urban agriculture is the link that we will use to couple these two best management practices (BMPs), as the stored water can be used to irrigate the plants in the green roof, which expands the types of plants which can be grown to crops which can be harvested and produce a source of revenue as well as a source of locally produced food.

Project 19 | Survey of Clemson Infrastructure

Dr. Will Martin (General Engineering)  
2 Semesters – 1 credit  
Monday, 10:10 – 11:00 AM

"Restore and Improve Urban Infrastructure" is one of the 14 Engineering Grand Challenges and this CI will explore what infrastructure is and it’s role in our lives. Through a collaboration with Clemson University’s Facilities, we will be conducting an inventory of the storm water system to assist with University’s MS4 program. This is great experience for students interested in Civil Engineering, Biosystems Engineering, or Environmental Engineering though all students are welcome.