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 Spring 2022 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 – 13 (pgs. 2-5) are open to any GE student. Projects #14 – 16 (pg. 6) 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>Primary Faculty <em>(Faculty Dept./Program)</em></td>
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<tr>
<td></td>
<td>Description of CI Project</td>
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</tbody>
</table>

During registration for Spring 2022 classes, students may directly add themselves to open sections of CI courses. There is no holding section. If consent of instructor is required, students must contact the instructor directly for permission to enroll. Students are added to the course when permission is granted.

There are a wide variety of CI courses offered by many departments across the University. For more information on Creative Inquiry and other current projects see: [https://www.clemson.edu/offices/institutes/watt/creative-inquiry/students/](https://www.clemson.edu/offices/institutes/watt/creative-inquiry/students/).

Questions, please contact Ms. Brandi Elliott, GE Special Projects Coordinator, at bwe@clemson.edu.
### Project 1 | Oyster Reef Restoration

| Dr. Caye Drapcho (*Biosystems Engineering*) | 2 Semesters - 1 credit | Thursdays, 5:00 - 6:00 pm |

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 | Incentivizing Litter Storage & Collection

| Dr. Todd Schweisinger (*Mechanical Engineering*) | 2 + Semesters – 1 credit | Days: 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 affecting the effectiveness.

### Project 3 | Clemson Engineers for Developing Countries

| David Vaughn (*College of Engineering, Computing, & Applied Sciences-Engagement*) | 2+ Semesters – 1-3credits | Fridays, 3:30 – 4:30 pm |

One of our signature global engagement programs is Clemson Engineering for Developing Countries (CEDC) which aims to serve the developing world while developing those who serve. CEDC operates as a translational research course in which teams of students from across the campus work together on long-term projects that benefit the Central Plateau of Haiti, Colombia, Guatemala, and South Carolina. Students who participate in the program can expect to develop project management, cross-cultural awareness, ethical responsibility, teamwork, leadership and professional skills. CEDC projects can last a few months to multiple years. Projects are intended to solve real problems, are defined in partnership with their community partners, and span the complete design process cycle.
Projects for General Engineering Students

**Project 4 | Development of Makerspace SOPs**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Course Code</th>
<th>Duration</th>
<th>Credit</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Todd Schweisinger and Kelsey Sheaffer <em>(Mechanical Engineering)</em></td>
<td>ENGR 1900-219</td>
<td>2 + Semesters</td>
<td>1 credit</td>
<td>TBA</td>
</tr>
</tbody>
</table>

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 5 | Bamboo Reinforced Concrete**

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<thead>
<tr>
<th>Instructor</th>
<th>Course Code</th>
<th>Duration</th>
<th>Credit</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Weichang Pang <em>(Civil Engineering)</em></td>
<td>CE 3990 – 002</td>
<td>1 + Semesters</td>
<td>1 credit</td>
<td>TBA</td>
</tr>
</tbody>
</table>

The overarching objective of this project is to use bamboo as a replacement for steel to build concrete and masonry structures. Bamboo is a sustainable (carbon negative material) and renewable building material. Some species of bamboo can achieve tensile strength as high as about 2/3 of that of steel rebar. Instructor consent is required.

**Project 6 | Microfluidics and Lab-on-a-Chip**

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<tr>
<th>Instructor</th>
<th>Course Code</th>
<th>Duration</th>
<th>Credit</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Xiangchun Xuan <em>(Mechanical Engineering)</em></td>
<td>ENGR 1900-031</td>
<td>1 + Semester</td>
<td>1 credit</td>
<td>TBA</td>
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</table>

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 7 | The Clemson Concrete Canoe Team (3CT)

<table>
<thead>
<tr>
<th>Dr. Brad Putman (<em>Civil Engineering</em>)</th>
<th>2 Semesters – 1 credit</th>
<th>Days: 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). Instructor consent is required.

### Project 8 | Steel Bridge Team

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

This CI project prepares students to compete in the annual Student Steel Bridge Competition organized by the American Institute of Steel Construction. The student will design and fabricate a scaled steel bridge to be compete in the annual regional competition (Carolinas and Georgia). At the competition, the team will be judged for efficiency of assembling the bridge under timed construction. The bridge will then be load tested and weighted. The scale-bridge is about 20-ft long and is expected to carry at least 2,500 lbs. Top ranked teams in the regional competition will advance to the national competition. Instructor consent is required.

### Project 9 | Deep Learning & Big Data

<table>
<thead>
<tr>
<th>Dr. Melissa Smith (<em>Electrical &amp; Computer Engineering</em>)</th>
<th>2+ Semesters – 1 credit</th>
<th>Days: TBA</th>
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</table>

Machine Learning/Big Data (ML/BD) can be applied to a wide variety of research problems, including problems in computer vision, bioinformatics, computational science, and others. The ML/BD team members will familiarize themselves with the various skills and best practices pertaining to ML and BD research, including (1) dataset manipulation and visualization, (2) high-level software implementation of ML systems, and (3) proper utilization of a high-performance computing (HPC) system. Prior coding knowledge is required (preferably Python). Instructor consent is required.

### Project 10 | Future Engineers

<table>
<thead>
<tr>
<th>Dr. Melissa Smith (<em>Electrical &amp; Computer Engineering</em>)</th>
<th>2 + Semesters- 1 credit</th>
<th>Days: TBA</th>
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</table>

Clemson students visit two area elementary schools once a week for 6 weeks. They plan and conduct STEAM activities with a group of approximately 20 fourth and fifth graders who vary each semester. Schools dismiss at 2:30 pm. The project provides an after-school snack after which CU students conduct the activities from 2:45 – 3:45 pm. Instructor consent is required.
## CI Projects for General Engineering Students

### Project 11 | Drinking Water Quality  
**EES 4900 – 011**  
Dr. David Ladner (*Environmental Engineering & Earth Sciences*)  
1 Semester – 1 credit  
Tuesday, 3:30 – 4:30 pm  

Students will do field sampling, laboratory measurement, and/or data analysis to evaluate drinking water and source water quality. This includes measuring pH, temperature, conductivity, E-coli presence, alkalinity, nitrate, and other parameters. A goal is to create an organization where citizens can send in their private well water for analysis.

### Project 12 | Advanced Manufacturing by Ultrafast Lasers  
**ME 2900– 037**  
Dr. Xin Zhao (*Mechanical Engineering*)  
1 + Semesters – 1 credit  
Days: TBA  

Due to the significant advances of lasers, laser-based manufacturing and material processing have been widely used in many industry sectors, including energy, automotive, electronics, bioengineering, medicine, aerospace/aeronautics, etc. Ultrafast lasers are one of the most advanced laser machines which offer extremely high laser intensity, short pulse duration, and introduce ultrafast phenomena during laser-matter interaction. It is an ideal tool for high precision manufacturing processes of materials which are difficult to be processed by traditional methods. This project aims to understand the fundamentals of ultrafast lasers and laser-matter interaction, and explore its applications in micromachining, material strengthening, and multi-functional surface processing. The project length is expected to be 2 semesters. Instructor consent is required.

### Project 13 | Preparation for UG Research Experience  
**ECAS 1990-0301**  
Dr. Kennedy, Dr. Alper, Ms. Allard (*Electrical & Computer Engineering*)  
1 + Semesters – 1 credit  
Monday, 9:00 – 9:50 am  

Research is the development of knowledge that is not just new to you, but new to your discipline. This course will help you understand what research is, is not and how to participate. It is open to all students who have not conducted research previously and would like some guidance prior to applying for an experience through a Creative Inquiry team, a National Science Foundation Research Experience for Undergraduates (REU) program, or any one of many ways to participate in research as a Clemson undergraduate. This will be a 1 credit course, where students prepare for applying to a research group and gain the skills needed to conduct research. The course will be split into the following topics:

1. What is research?  
2. Undergraduate research opportunities and how to apply to them  
3. Skills and best practices for conducting research  
4. STEM degrees and graduate programs.

The course will be limited to 30 students.
## RISE CI Projects

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

### Project 14 | Design for All Abilities  
**ENGR 1900 – 020**

**Professor** Matt Miller *(General Engineering)*  
**Credit** 1 Semester – 1 credit  
**Schedule** Asynchronous Online

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 15 | Filament Recycling  
**ENGR 1900 – 028**

**Dr. Will Martin (General Engineering)**  
**Credit** 2 Semesters – 1 credit  
**Schedule** Days: Friday, 1:25-2:15 pm

The CI will focus on looking at the feasibility and set up of a campus filament recycling system that will first be tested and optimized for PLA, the most commonly used 3D printing filament on campus. There will be aspects of engineering, sustainability, entrepreneurship, and public outreach. Instructor consent is required.

### Project 16 | Green Roofs, Rainwater Cisterns, and Urban Agriculture  
**ENGR 1900 – 024**

**Dr. Will Martin (General Engineering)**  
**Credit** 2 + Semesters – 1 credit  
**Schedule** Days: Friday, 3:35-4:25 pm

This project explores the possible synergy between utilizing green roofs, rainwater cisterns, and rooftop agriculture. Green roofs have many benefits, but their impact on reducing storm water runoff quantity from larger 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. This practice 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. Instructor consent is required.