

## Senior Design Project Description

<b>Company Name</b>	<i>Catawba Science Center</i>	<b>Date Submitted</b>	<i>10/25/18</i>
<b>Project Title</b>	<i>Design of a STEM Exhibit Requiring Learning Demonstration Prior to Exhibit Activation (CSC_STEM)</i>	<b>Planned Starting Semester</b>	<i>Spring 2019</i>

### Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

<b>Discipline</b>	<b>Number</b>	<b>Discipline</b>	<b>Number</b>
Mechanical	2	Electrical	2
Computer	0	Systems	0
Other ( )			

### Company and Project Overview:

The Bosch Community Fund (BCF) was established in the U.S. in 2012. A portion of the profits of Bosch Corporation are donated to the Fund to do charitable work in the communities where Bosch has operations. This funding is targeted at scientific, technological, and environmental initiatives. The Industrial Solutions Laboratory is teaming with the BCF to fund this project for the Catawba Science Center. The project will design and develop a new type of STEM exhibit for the Science Center.

### Project Requirements:

See Attachment

### Expected Deliverables/Results:

See Attachment

### Disposition of Deliverables at the End of the Project:

After demonstration at the Expo, students are to safely transport the exhibit to CSC, install it and demonstrate the operation to CSC staff along with maintenance information.

### List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- None



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**UNC Charlotte  
William States Lee - College of Engineering  
Senior Design Program**

**Application for Bosch Community Fund Grant**

**Development of a STEM Exhibit on Motion Using Advanced  
Student Engagement Methods**

**In Cooperation with the Catawba Science Center**

## **Overview**

The William States Lee College of Engineering is part of the University of North Carolina Charlotte system and is located in Charlotte NC. The College has an enrollment of nearly 4000 engineering students and awarded 810 degrees in a variety of Engineering disciplines. UNC Charlotte is a non-profit organization and part of the UNC system. As part of the curriculum, Engineering students are required to complete a Capstone project where they exercise their engineering training to accomplish a design and build effort for an industry, university or non-profit sponsor.

For this grant application, we are submitting a project to design and build a STEM exhibit for the Catawba Science Center in Hickory, NC. The Catawba Science Center (CSC) was founded in 1975 and is incorporated as a 501 (c) 3 non-profit with a mission of changing lives of children to inspire learning through science and wonder. See the CSC Mission and Vision Statements in Appendix A.

Catawba Science Center, located on the SALT Block is truly a cultural destination. Science and Arts organizations have come together under the roof of a refurbished high school to provide a renowned cultural facility for the region. Catawba Science Center occupies over 32,000 square feet (including 18,000 sq. ft of exhibition halls)



spread over a three building campus. The Planetarium/Aquarium building (pictured) houses a 65 seat planetarium, salt and fresh water aquaria and other exhibit areas.



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Catawba Science Center (CSC) is incorporated as a 501 (c) 3 non-profit with a mission of changing lives and inspire learning through science and wonder. Located in Hickory, NC, CSC offers informal science education to the general public and school groups throughout the Catawba Valley, primarily Alexander, Burke, Caldwell, Catawba and Lincoln counties. Exhibits, programs, teaching collections and “hands-on” activities provide both fun

and education in multiple fields of science. CSC is governed by a Board of Directors representing the community. The staff of thirteen full-time and over thirty part-time employees is led by an Executive Director and Assistant Director.



During the most recent fiscal year, ending June 30, 2018, Catawba Science Center hosted 113,545 individuals through on- and off-site programs. As the North Carolina’s largest general science center west of the Gastonia/Charlotte region, Catawba Science Center serves an important role in hands-on science experiences for all members of our community. Special scholarship, reduced admission and free admission programs

served over 10,000 children and their families during the past year. Tactile programs and activities are aligned to the Common Core and Essential Standards, thus supporting teachers by bring academic lessons to life through practical applications. This included 1,294 programs delivered to 34,495 children and teachers from over twenty NC counties.



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Programs are supported by over 18,000 square feet of exhibition hall space that introduce visitors to a variety of science topics. Whenever possible, exhibitions are hands-on and designed to engage participants in thought-provoking interactions. Treehouse Adventures introduces pre-K children to the four seasons of nature with activities to plant vegetables, learn about birds, squirrels and bees, and shop in a local market. The naturalist center allows children to learn the difference between reptiles and mammals by touching animal skins, turtle shells and examining



skeletons and live animals. Other exhibition areas are designed for older audiences – immersing youth in physics - understanding the differences between kinetic and potential energy and other subjects. Saltwater and freshwater aquaria provide an opportunity for families to introduce children to animals that they might otherwise never know existed. Other exhibition areas include a 65-seat planetarium, human body exploration center, and featured exhibition hall.

More information about the history of the museum can be found in Appendix B. The Museum's website is <http://catawbascience.org/>

### **Senior Design Project**

Catawba Science Center is seeking new exhibits that continue to excite children about science and place them on the pathway to a fulfilling science career. The UNC-Charlotte Senior Design project will provide a new STEM (Science, Technology, Engineering and Mathematics) exhibit. The project is planned to be started in January 2019 and be completed by December 2019. The project will be staffed by a team of UNC-Charlotte Senior engineering students. These students will be supported by a Faculty mentor and a member of the museum's staff. The student labor would be provided by UNC-Charlotte as part of the Senior Design Program. The estimated labor hours provided without charge from the students would be 1,000 to 1,500 hours. The grant funding would be for non-labor expenses such as materials, travel costs, and program expenses. The grant funding impact would be magnified as the labor cost would normally require grant funding, so by enabling only the material and expense cost, the Grant would also trigger the donation of a substantial amount of labor capital. For more information about the UNC-Charlotte Senior Design program, refer to Appendix C.



### **Project Specifics:**

The project will explore ways to invite visitors to participate in exploratory science through more advanced engagement methods than currently used in Catawba Science Center's existing exhibits. Currently, visitors can choose to read signs that help explain a scientific concept, but they are not required to review the signs before engaging in the exhibit. As children tend to speed through exhibit activation, they don't always stop to actually read the exhibit information that is required to understand the physical exhibit. In this project, UNC-Charlotte senior engineering students will design and build and exhibit where the student visitors will be required to initiate a lesson and then demonstrate some level of understanding before the reward (playing with the physical exhibit) is allowed. Since the concept involves several questions and tactile activities, the students will also have to develop ways to entice visitors to explore new questions.

The activity for the exhibit is founded on a popular exhibition that involves balls and tracks. An exhibition area, currently called Raceways, is the planned location for this new exhibit. This area introduces visitors to the concept of roller coasters or any item that contains mass and through its interaction with gravity exhibits principles of potential energy, acceleration, directional forces, and deceleration. The science concepts could begin with simple states of energy and advance to more advanced concepts. The engineering students will be challenged to research these concepts and determine how they can be incorporated into a single exhibition.

Through their research the senior design students will be addressing many questions; such as,

- What concepts are involved when a ball is at rest, but has the potential to move to a lower location?
- How many different concepts can be explained and demonstrated in this exhibit?
- Can an exhibit be designed that begins with simple concepts and builds to more advanced concepts?
- How to design the exhibit to require demonstration of learning before the "play/fun" part of the exhibit can be activated.
- How can visitor responses activate different elements of the exhibit?
- Can this exhibit be modeled after video games that post high scores and thus encourage visitors to play multiple times – reinforcing correct information and concepts?

A variety of challenges will be encountered in the design of this project. UNC-Charlotte students will need to interview the "client" to determine needs and learn from the client's experiences. The full scope of the project will be determined through cost-analysis of the project. Negotiations between the design team and the client will help the students understand concepts such as "cost-plus" contracts. This project has potential to introduce the students to real-life, applied engineering concepts that they will encounter later in their careers.

The initial statement of work will be given to the UNC-Charlotte Senior Engineering team as a starting point for the project definition. The engineering students will be encouraged to use their creativity to fully define this concept in a way to maximize the interactive STEM education benefit of the exhibit.

During the first semester (January to May 2019), the engineering students will develop conceptual designs for the interactive exhibit and during design reviews, present the details to their faculty mentor and the museum educator. After selection of the design concept, the students will work to fully design the exhibit including drawings and bill of materials. At the end of the first semester, the students will exhibit their design accomplishments at the senior Design Expo on the UNC Charlotte campus. This Expo is open to the public and will serve to define what has been accomplished for the design phase and what is planned for the build phase in semester 2.

During the second semester (August – December 2019), the students will implement their design by ordering parts, making parts and building the exhibit. If possible (depending on size constraints), the students will exhibit their work at the December 2019 Senior Design Expo at UNC Charlotte. Once the Expo is complete, the exhibit will be transported to Catawba Science Center, in Hickory, to be installed in its new home location. Student team will provide written operational instructions, a maintenance sheet and all source code and design documentation such that museum staff can operate and maintain the equipment on an ongoing basis.



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## **Appendix A**

# **Vision and Mission Statement for the Catawba Science Center**



## MISSION AND VISION STATEMENT of CATAWBA SCIENCE CENTER

Catawba Science Center's (CSC) vision is to change lives and inspire learning through science and wonder. This vision challenges our organization to create entertaining and engaging STEM (Science, Technology, Engineering and Mathematics) experiences that enlighten the public about science and place many on a pathway to a career in one of many fields of science.

CSC's mission is accomplished through interaction with exhibits located at CSC's home location including 18,000 square feet of exhibitions, through on-site and off-site programs. While Catawba Science Center has traditionally been a significant provider of curriculum aligned programs for public, private and homeschool groups, it also offers programs and activities for adults and families. These activities, collectively, have the potential to engage the entire community in an understanding of science and establish the foundation of the future's workforce.



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## **Appendix B**

### **History of the Catawba Science Center**



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## 1975: The Opening

Our institution opened its doors in 1975 as the Creative Museum for Youth, founded by the Service League of Hickory (a local volunteer organization) in the historic John Cilley house, a 4,000 sq. ft. Victorian-era structure.

In 1978, the name was changed to the Catawba Science Center (after Catawba County) to reflect a mission of science education for a broader spectrum of the public. Staffed initially by volunteers, the Museum provided visitors with a variety of small exhibits and activities in science and art.





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## Early '80s: A New Facility

With growing attendance and increasingly cramped quarters, the Board determined that the Museum should move to a new and more adequate site. The Hickory community (population 25,000 in 1980s) came together to support the development of a new facility, not only for CSC, but for the primary cultural organizations in the area. By 1986, a community coalition had identified the old Hickory High School as an appropriate facility for renovation and raised the \$3 million needed to complete the structure.

Catawba Science Center (CSC) moved into the space in April of 1986 with several other cultural organizations: the Hickory Museum of Art, the Catawba County Council for the Arts (offices), the Western Piedmont Symphony (offices and rehearsal area), and the Hickory Choral Society.

As a result of this achievement and the vigor of the Hickory community, the city won an All-American City Award from the National Chamber of Commerce in 1986.

CSC began by hosting the Structures hands-on traveling exhibition on building, having community volunteers build copies of interactive science exhibits from the Exploratorium, and borrowing some exhibits from the Historical Society to fill space until new exhibits were developed. CSC soon developed its own interactive science exhibits and began to host three traveling exhibitions per year.

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## 2007: The Millholland Planetarium & Aquarium

Today, Catawba Science Center is a 35,000 sq. ft. science technology museum whose purpose is to change lives and inspire learning through science and wonder.



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[The Millholland Planetarium](#) is a state-of-the art digital planetarium theater, offers a variety of immersive programs including full-dome video, traditional star talks and laser light shows in a variety of music genres.



[Saltwater and freshwater aquarium galleries](#) feature a large shark & stingray touch pool, a Coastal Carolina touch pool and Expedition Amazon, a collection of rare fish, turtles, snakes, birds and other species found in the Amazon River Basin and other Central and South American freshwater habitats.



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## **Appendix C**

# **UNC Charlotte Senior Design Program Information**



## Senior Design Program

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At UNC Charlotte, our mission is to graduate innovative, world-class engineers. But we can't do it without you.

Industry partners are critical to our success and play an integral role in the development of high quality engineering graduates.

The Lee College of Engineering's senior design program brings together students and industrial partners in a collaborative research environment. As they tackle real-world engineering projects, the students and their industry supporters are afforded unlimited possibilities for learning and achievement. Our engineering and engineering technology students develop critical skills while working in multi-disciplinary teams tackling problems in Electrical, Computer, Mechanical, Systems and Civil engineering technologies.

**Students....**our bright, energetic, and objective engineers will make your project a top priority throughout their senior year.

**Teamwork...**we encourage multi-disciplinary project teams with a typical team of four to six students.

**Mentorship...**a faculty advisor for each team provides the right balance of instruction and coaching-enabling students to learn by doing.

**Resources...**students have access to state-of-the-art design and collaboration tools, multiple fabrication facilities and design labs.

**Timing...**projects begin in both the fall and spring semesters. Teams devote two full semesters-approximately 250 hours per student-to their projects.

**Coursework...**teams receive instructional support in relevant subject areas: project management, design principles, intellectual property, communication and meeting management.

More information available at [www.isl.uncc.edu](http://www.isl.uncc.edu).