



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

**Senior Design Project Description**

<b>Company Name</b>	<i>Kaleideum – sponsored by the Bosch Community Fund</i>	<b>Date Submitted</b>	08/21/2020
<b>Project Title</b>	<i>Design and Develop an Interactive Physics Exhibit</i> <b>(KALEID_EXHIBIT)</b>	<b>Planned Starting Semester</b>	Spring 2021

**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	3	Electrical	1
Computer	1	Systems	
Other ( )			

**Company and Project Overview:**

Kaleideum was formed in 2016 with the merger of two beloved educational and cultural institutions in Winston-Salem: SciWorks (a science museum) and The Children’s Museum of Winston-Salem. Kaleideum’s mission is to inspire wonder, curiosity, and lifelong learning in their children and community through interactive play and discovery. They achieve this through the overlapping lenses of literacy, the arts, and STEM.

Kaleideum is a community leader in creating opportunities for open-ended, self-directed, and interactive learning about Science, Technology, Engineering, Art, and Math (STEAM). Kaleideum utilizes a learner-centered educational approach and provides North Carolina visitors with STEAM school-group programs, field trips, STEAM summer camps, multigenerational family programming, and interactive STEAM exhibits for all ages.

Kaleideum currently has two locations, Kaleideum North and Kaleideum Downtown, as it constructs a new building for their merged institution. Together, these two locations serve 200,000 people annually and more than 2,000 member families. Kaleideum primarily serves the Winston-Salem, High Point and Greensboro areas of North Carolina, which together form the Piedmont Triad area. More information is available at [Kaleideum.org](http://Kaleideum.org).



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Kaleideum is seeking new exhibits that enable children and adults to interactively explore scientific principles. The UNC-Charlotte Senior Design project will provide a new STEM exhibit. This project is financially supported by the Bosch Community Fund. The Bosch Community Fund, the corporate foundation for Bosch in North America was established in 2011 to provide community engagement and philanthropic support on behalf of our company. The Fund focuses on the enrichment of science, technology, engineering and math (STEM) education and advancing environmental sustainability initiatives. We partner with 501(c)(3) organizations and educational institutions across the country to provide quality project-based learning hands-on learning opportunities for students and professional development for teachers.

### **Project Requirements:**

The project will produce an exhibit that helps visualize a physics principle that is often unintuitive. This exhibit will allow visitors to experiment with the principle for themselves in a way that makes a memorable impact.

The student-designed-exhibit will be associated with the PhysicsWorks gallery in the Kaleideum North museum location. In this gallery, visitors discover principles of the physical world with hands-on experiments involving machines, light, motion, color, electricity and more. This student-created exhibit will demonstrate the dissociation between vertical and horizontal motion components for projectiles. This exhibit should illustrate how two items dropped simultaneously, one that drops straight down and one shot horizontally, hit the ground at the exact same time.



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Initially, students of physics often push back on this idea. It doesn't line up with their expectations of projectiles. This exhibit will let visitors verify this truth for themselves.

The engineering students will need to create an exhibit that meets multiple design criteria. The exhibit must clearly demonstrate this principle of physics. The items dropped, the mechanisms used, and the methods of measurement are all open to the students' creativity and design. The exhibit must contain a way to clearly visualize the moment of impact for two different objects, and the clearer and more memorable the visualization, the better. The exhibit must be functional and safe to operate for all museum visitors, including small children, senior citizens, and visitors with sensory or mobility constraints. The exhibit must fit within a constrained space in the gallery, which is an indoor area that is roughly 4'x13' of floor space. The longer dimension is against a wall. And the exhibit must be sturdily built to handle high use for the next three years within their given materials budget.

Kaleideum staff will give design feedback to students and help steer them toward an interactive that is likely to be successful in the museum environment. If time and space allow, Kaleideum staff will also coach engineering students on how to obtain, interpret, and act on feedback about their prototypes from others, especially middle school students, who are frequent museum visitors.

### **Expected Deliverables/Results:**

- A stand-alone interactive physics exhibit that will be associated with the PhysicsWorks gallery of the Kaleideum North museum.
- Unit to be solidly constructed to be able to withstand 3 years of heavy use by thousands of visitors each year.
- Educational material and functionality to be appropriate for grades 2-8.
- Unit to be safe to operate with children and not pose any physical risk.
- Unit interface to floor to be developed based on Museum direction (ie. Mounted to floor, mounted on casters, etc).
- Size to be determined by discussions with museum but expected to be in an envelope of 13 ft wide by 4 ft deep by 3-4 ft high (height dimension has some flexibility). The length of the exhibit will be against a wall.
- It is highly recommended that the exhibit be designed so that visitors interact with the exhibit along (facing) the 13ft dimension. We anticipate that there will be roughly 3ft of additional space along the long dimension for visitor use and circulation beyond the edge of the 4 ft exhibit space.
- The exhibit must clearly demonstrate the principle of physics that gravity works on projectiles equally, regardless of how much horizontal force acts on the projectile. The items dropped, the mechanisms used, and the methods of measurement are all open to the students' creativity and design.
- The exhibit must contain a way to clearly visualize the moment of impact for two different objects, and the clearer and more memorable the visualization, the better. This visualization method must clearly show the impact to the floor is at exactly the same time.
- The exhibit must be functional and safe to operate for all museum visitors, including small



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children, senior citizens, and visitors with sensory or mobility constraints.

- The exhibit must be sturdily built to handle high use for the next three years within their given materials budget.
- Text for instructions for using the exhibit and for science interpreting/explaining the exhibit should also be prepared by the students. If budget allows team should consider a video display that provides physics background information to the principle being demonstrated.
- If possible, working prototypes should be evaluated with people outside the design team. Ideally, this test group of subjects would include K-12 students, especially in grades 2-8. Feedback on functionality, fun, safety, and science understanding should be addressed and incorporated into the final design.

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

Hardware developed will be delivered, installed and training performed within 5 days of the Expo.

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

- Travel to the Kaledium Museum will be required at the beginning of the first semester to understand the Museums approach to exhibits. Travel will also be required to deliver and install the exhibit and possibly for test and verification. Travel will be in compliance with CDC and University guidelines.
- Interest in completing all aspects of a STEM exhibit to deliver a functional exhibit that can be immediately installed and education children for a minimum of 3 years.