2020-2021 High School Innovation Challenge Guidelines

Introduction

The High School Innovation Challenge at Red Rocks Community College (RRCC) is a competition that recognizes and rewards designs for sustainable change. We invite teams of 3-5 high school students, grades 9-12, to participate in a real-world design challenge that will propose innovations around sustainable energy, water, food, and environment. Student teams can either come up with their own problem related to the theme, or work on one that the teacher has chosen for the team. Each team will be required to state what problem they're trying to solve, what is the potential impact of their solution, and how society will benefit. Additionally, each team is required to make a short video about their design, as well as a physical prototype in the school's makerspace or other area designated by the school. If access to the school's makerspace is unavailable, teams may get permission from their teacher to make a prototype at home using common household materials (cardboard, tape, popsicle sticks, etc.)

The top three design teams from each high school will present their design solutions at the Final Challenge on **Tuesday May 3, 2022** beginning at 5:00pm on the Red Rocks Community College campus. RRCC scholarships and prizes will be awarded to the top three solutions.

Design Theme – Sustainable Designs in Energy, Water, Food, and Environment (or COVID19 related project)

Engineering is the profession of acquiring and applying scientific knowledge to balance the social (people), economic (profit), and environmental (planet) impacts when designing and building structures, machines, devices, systems, materials, and processes. Balancing the economic, social, and environmental impacts of a design makes it sustainable. As human populations continue to increase in Colorado and around the world the need for sustainable development has never been greater. The United Nations defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. Securing a prosperous future for humanity depends on the contributions that science, engineering, and education will make towards building sustainable pathways to meet the energy, water, and food needs of future generations. This theme calls for STEM projects that develop new or improve existing sustainability pathways.

What is Sustainability?

The technical definition of sustainability is "the ability for something to be maintained at a certain rate", and "the avoidance of depleting natural resources" [2]. These are valid definitions of sustainability, as it involves concerns for future generations from an environmental and ecological standpoint. In addition to these concerns, social, cultural, and economic contexts play a role in what constitutes a technology or process as sustainable. This makes sustainability, and achieving it, complex because sustainability does not always look the same. Sustainable design in Colorado might look a lot different than sustainable design in Peru or London or West Africa.

The materials readily available in Colorado are not going to be available in different states, countries, or continents - it is important to keep this in mind when defining problems and designing solutions.

Sustainable development requires an engineer or scientist to incorporate social consideration of the area in which they are developing. Social considerations seek to technically fill user's needs while also considering cultural, religious, or community demographics for the population they are designing for. What may seem like a solution to your team, might not be a solution to the community you are working with because it does not work within their culture or religion. This is especially important in international development work because our understanding of international societies is more limited than for our own. For example, a technically advanced solution might end up being a burden because a community does not have access to mechanics, technicians, or parts to maintain the device or system. This is why, as engineers and scientists, we must understand the social contexts of any community in which we develop, so as to ensure the solution is truly useful to the community or population we are designing for.

As you begin to brainstorm problems you would like to address, here are some resources that you and your team should consult:

Resources:

- Sustainable Community Development - Bridger and Luloff
- National Academy of Engineering Grand Challenges
- 17 Sustainable Development Goals
- Tools for design and sustainability
- Projected world population 1950-2050
- Colorado Department of Natural Resources Statewide Water Supply Initiative Report
- United Nations Sustainable Development Knowledge Platform
- NSF-funded Sustainable Healthy Cities Project
- Arizona State University Global Institute of Sustainability
- International Development Projects Gone Wrong

Rules

Each team is required to get input on their design from a Project Partner. A project partner could include someone from business, engineering, a university professor, or a community organization.

- Maximum prototype budget is $200. Prototype material lists and receipts will be collected as part of the design challenge submission. Materials that have been donated should be counted as part of the prototype budget.
- Materials that have recycled or repurposed into your prototype will not be included in the prototype budget. Recycled and repurposed materials are defined as materials previously used for purposes not related to the project.
- Digital and Written submissions are due no later than midnight **April 19, 2022**.

Project Submissions

Digital Submission

Engineering design teams are required to submit a 90 second video (minimum 720p video quality) describing their project. The problem, solution, impacts and college partner roles must be clearly identified.

Example Submissions: See past HS Innovation Challenge videos at https://www.rrcc.edu/idea/K-12-outreach

More examples:

- Denitrification of Farmland Wastewater https://www.youtube.com/watch?v=0j3yZMepeAg
- Solar Powered Water Well and Irrigation System https://www.youtube.com/watch?v=tVzXDkbgxtQ
- Plant Growth Stimulation and CO2 Reduction https://www.youtube.com/watch?v=35jV7Fu42pc

Written Submission

In addition to the digital submission, design teams must submit a written description of their designs. The written description should detail a solution that includes the following information:

Problem Statement	Identify your problem. (Must be a real world problem!) - Who told you about it, or where did you learn about it? - Does your team provide background information on the problem? Problem Definition - If your problem is about composting, define composting and its process (do not assume the knowledge of your audience)
Design Solution	Describe your design solution - How will it operate and function? Discuss the science and technology your design will involve - What level of knowledge is required to operate your solution? - What materials does your solution require?
Design Schematic	Provide a detailed schematic image and a process diagram if applicable of your design solution. Your design schematics should be completed in some form of CAD (SolidWorks, AutoCAD, etc.).
Sustainability	How will you measure the impacts of your solution?

Considerations - Environment	What benefits will be realized if your solution is implemented? Is access to materials you use readily available in the community? - Understand the local contexts! Are the materials you are using environmentally responsible?
Sustainability Considerations - Social Budget	Some questions to guide your sustainability considerations include: Where will your technology be implemented? - How do you understand the local context of where you are implementing your technology? - Do you live there? - Research? - Community engagement? What are the social dynamics of the community? - How do they implicate your technology? Does your solution need routine maintenance? - How will the communities maintain your solution? - What level of knowledge is required to maintain your solution? Can your solution be equitably accessed? - How much does your design solution cost? Prototype Design - Provide a detailed list of all money sources and expenses for your prototype, submit all receipts for materials purchased to your teacher. Full Scale Design Considerations - Provide a detailed explanation of important design considerations you will need to consider with the implementation of a full-scale product (i.e. performance, costs, impact, etc.)
Project Partner Engagement	Identify your project partner and describe how your partner has been involved in your project. Did they provide technical advice? Did they help your team identify potential design solutions?
Reflection	What iterations did you make in your design process? What resources or circumstances could have made your design process/solution better?

Prototype

A prototype of each design team’s solution is required. The prototype is not required to be full scale but it should show the science behind how the solution works. It is strongly encouraged that design teams interact with their high school makerspace to create their prototypes. Prototypes must be constructed only on school grounds (special consideration will be given to teams who lack access to an adequate build space).

Final Challenge

Three design teams from each participating high school will be given an opportunity to pitch their proposed design at the **High School Innovation Challenge from 5:00-7:00 on the Red**

Rocks campus. Members of industry, RRCC faculty and representatives from other colleges will be present to judge finalists. While we hope to have an in-person challenge this year, we will move to a virtual challenge if needed. This will be communicated to teachers and students in April.

Prizes for winning teams will be handed out at the Challenge. Each team member of winning teams will receive the following

1st Place
$1,500 Red Rocks Community College Scholarship and other prizes

2nd Place
$1,000 Red Rocks Community College Scholarship and other prizes

3rd Place
$500 Red Rocks Community College Scholarship and other prizes

References

[1] "Urban Infrastructure Solutions | Sustainable Healthy Cities." *Sustainable Research Network*. N.p., n.d. Web. 13 July 2017.
[2] https://www.oxfordcollegeofprocurementandsupply.com/how-sustainable-is-sustainability/#:~:text=The%20current%20definition%20of%20sustainability,term%20depletion%20of%20natural%20resources%E2%80%9C.