

# Earth Hacks: A University Hackathon to Generate Interdisciplinary Solutions to Pressing Environmental Problems

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## Abstract

Hackathons, time-intensive events focused on solving real-world problems, are becoming an increasingly popular approach to rapidly generate solutions to various problems and promote creativity and innovation. Their prevalence among college campuses and corporate settings is increasing, with variation in timeframes and participants. While traditional hackathons began in software engineering, recent years has seen a flux in the diversity of students participating. Even with the expansion of hackathons, participants still remain primarily those within or entering the field of software engineering. With some prospective thought and planning, the hackathon concept can be applied to a diversity of problem areas and concurrently attract participation from individuals of diverse backgrounds and expertise to create interdisciplinary solutions to problems from a variety of fields. Herein we present a case study of the process of designing and implementing Earth Hacks, the first environmental hackathon in the state of

Virginia, dedicated to generating interdisciplinary solutions to pressing environmental problems. We discuss the ideation process and organizational structure of Earth Hacks, as well as strategies to make the hackathon itself an environmentally friendly event. We also detail the multidisciplinary approach we integrated into Earth Hacks from the onset of the planning and ideation process, as well as how we structured judging criteria to be able to take into account the multidisciplinary nature of the projects. We also share some lessons learned after successful completion of the first Earth Hacks event. Along with the case study, initial thoughts on establishing an organization and/or set of instructions in order to be able to have Earth Hacks events at other universities across the world is presented. We believe that hackathons can be a powerful tool to advance the Sustainable Development Goals and hope to be able to create a global community of student leaders dedicated to breaking down barriers in tech and applying their skills to solving environmental problems.

Key words: Environment, Hackathon, Environmental Technology, Innovation

## 1. Introduction

This paper discusses the creation of Earth Hacks, an environmental hackathon held by the Virginia Commonwealth University (VCU) College of Engineering and hosted its initial year by the Science Museum of Virginia. We will present the motivation for this event, as well as the challenges faced leading up to and during the event.

Earth Hacks was established with two main areas of focus. Firstly, to allow participants to develop and practice existing skills in ingenuity, problem-solving, and critical thinking. Secondly, to expose a diverse group of students to the current and potential impacts technology and interdisciplinary collaboration can have towards environmental issues.

There were two main goals for this hackathon. Firstly, to allow university students to develop and practice their skills, and secondly, to expose students to the environmental impact technology and interdisciplinary projects can have. We also used this pilot hackathon to see how interested students, sponsors, and mentors were in the possibility of having an environmental hackathon in order to develop the concept for a nonprofit organization dedicated to helping set up environmental hackathons first throughout the country, and then across the world. It was crucial to balance a positive student experience with the necessary environment to not only promote retention of participants for subsequent events, but also create practical solutions to environmental issues, along with providing resources to continue projects.

We start by providing a background of hackathons, in particular environmental. We then present a case study of Earth Hacks, detailing the ethos behind the development, as well as the planning process and outcomes. Lastly, we present data collected from participant and mentor feedback, as well as a discussion on lessons learned and future plans.

## 2. Background

### 2.1. Hackathon Definition

A hackathon is a defined time period of creative problem solving, ideation, and innovation within a specific theme or discipline. Students with different backgrounds and interests form teams and work together to develop an innovative and feasible solution to a proposed challenge. Traditionally, only those interested in software engineering or traditional programming participate in hackathons. However, in recent years hackathons have expanded to encapsulate a wide range of disciplines, including healthcare<sup>1</sup> and civic innovation<sup>2</sup>. Hackathons are particularly popular among universities, where they promote student entrepreneurship, integrative collaboration across disciplines, and school image. Unfortunately, the term "Hack" is still associated exclusively with programming, and in particular illegal activities such as cyber attacks. However, in the context of a hackathon, to "hack" means something completely different. As Major League Hacking, the official hackathon league known worldwide, defines it, "hacking has started to transition into a positive term describing the actions of innovators who are creating prototypes of their ideas<sup>3</sup>".

### 2.2. Environmental Hackathon

An environmental hackathon is an event that applies the hackathon innovation model to environmental problems<sup>4</sup>. The solutions to the problems do not always have to involve technology - they can be an innovative way of approaching a problem that has not been considered before, a reframing of an already existing solution, or a proposal within a non-technical sphere such as public policy.

### 2.3. Examples of Environmental Hackathons

Environmental hackathons have taken place before, notably CleanEarthHack at MIT<sup>5</sup>, Fishackathon, initially hosted by the US Department of State<sup>6</sup>, and Green Hackathons, developed by KTH Royal Institute of Technology in Sweden and implemented in major cities throughout Europe<sup>7</sup>. Some of the hackathons have been more educational in nature and thus have not encouraged their participants to continue their work on their projects after the hackathon ends, while others are focused more on driving innovation and follow up with participants after the event to explore the possibility of continuing their projects.

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<sup>1</sup> C. D'Ignazio, A. Hope, A. Metral, W. Brugh, D. Raymond, B. Michelson, T. Achituv, E. Zuckerman. "Towards a Feminist Hackathon: The 'Make the Breast Pump Not Suck!' Hackathon." *Journal of Peer Production* 8, 2016.

<sup>2</sup> N. Linnell, S. Figueira, N. Chintala, L. Falzarano and V. Ciancio, "Hack for the homeless: A humanitarian technology hackathon," *IEEE Global Humanitarian Technology Conference (GHTC 2014)*, San Jose, CA, 2014, pp. 577-584.

<sup>3</sup> Major League Hacking Parent Hackathon Guide <https://mlh.io/parent-hackathon-guide> (accessed 07/31/2018)

<sup>4</sup> J. L. Zapico, D. Pargman, H. Ebner, E. Eriksson, Hacking sustainability: Broadening participation through Green Hackathons, Fourth international Symposium on End-User-Development, June 10-13, 2013, IT University of Copenhagen, Denmark, 2013.

<sup>5</sup> Clean Earth Hack at MIT <https://cleanearthhack.mit.edu/> (accessed 07/31/2018)

<sup>6</sup> Fishackathon <https://fishackathon.co/> (accessed 07/31/2018)

<sup>7</sup> Green Hackathon <http://www.greenhackathon.com/> (accessed 07/31/2018)

There are commonalities between all these events that distinguish them as environmental hackathons. The defining characteristic of these environmental hackathons is that they apply the traditional hackathon model to current environmental problems. Most importantly, the simple act of applying the hackathon model to specific environmental problems. Distinctions between environmental hackathons primarily arise in the area of focus as well as their model - that is, whether the event is primarily educational or more focused on the creation of environmental solutions.

### 3. Case Study of Earth Hacks

#### 3.1 Case Study of Earth Hacks Event

The premise of Earth Hacks relies very strongly on interdisciplinary collaboration. Final project submissions are judged based on a variety of factors - including feasibility, impact, and originality - and not solely on technical acumen of participants and hacks.

The development of Earth Hacks began in 2017 in order to apply a novel approach to the realm of environmental innovation. The planning process followed a very similar procedure to Ram Hacks and Health Hacks, two previous hackathons at Virginia Commonwealth University. Using templates for a website, advertising, and sponsorship materials enabled us to expedite this process. We hosted the inaugural event in the Dewey-Gottwald Center, a subsection of the Science Museum of Virginia, allowing participants a unique environment to hack in as well as access to museum exhibits throughout the hacking period.

Logistically, the hackathon was held for twenty-four hours, with twenty devoted to hacking. The hackathon began with an opening ceremony that featured short speeches by mentors, sponsors, and other partner entities. During the opening ceremony, mentors and judges were introduced to the participants. There were three areas of focus for the challenges. As described on the 2018 event website, they are as follows:

- I. **Pollution:** Pollution is the interference of contaminants with the natural world, degrading natural resources and putting plant, animal, and human life in danger.
- II. **Conservation Technology:** Conservation Technology is the modernization and introduction of technology to the conservation fields, spurring ecological, agricultural, and wildlife-focused innovation.
- III. **Renewable Energy:** Renewable energy is power harvested from renewable resources that are not in danger or being depleted, such as wind, sunlight, geothermal energy, waves and tides, rain, and bio energy.

After introducing the categories, mentors, and judges to participants, a brief period of team formation followed while dinner was served; shortly thereafter, hacking commenced. Organized activities and talks were scattered throughout the duration of the hackathon to allow participants

to learn new skills and/or take a short break from hacking. The first organized activity of the hackathon was a talk on design thinking by event sponsor Conservation X Labs.

## Schedule

Saturday - March 17	Sunday - March 18
5:00 - 5:30 PM - Registration	12:00 AM - Midnight Snacks and Tightrope Walk Challenge
5:30 - 6:30 PM - Opening Ceremony	8:30 AM - Breakfast
6:30 - 7:00 PM - Team Building, Dinner, Meet Mentors	10:00 AM - Devpost Workshop
7:00 PM - Start Hacking	12:00 PM - How to Give a Pitch 101
10:00 PM - Design Thinking Workshop	1:00 PM - Lunch
	2:00 PM - Elevator Pitches Due on YouTube/Devpost
	2:55 PM - Hacking Ends
	3:05 - 3:45 PM - First Round of Judging
	3:55 - 4:25 PM - Final Round of Judging
	4:30 - 5:00 PM - Closing

Figure 1: Schedule of the inaugural Earth Hacks event, as seen on the event website

Hacking continued uninterrupted approximately from 12:00 am to 8:00 am. At 8:30 am, breakfast was served. At 10:00 am and 12:00 pm, workshops on project submission and delivering an effective pitch were held, respectively. Lunch was then served, with project pitches being due online shortly after. Hacking ended at 2:55 pm, and then judging began.

Fifteen teams consisting of two to four participants presented projects. Out of the fifteen, there were five projects in the pollution category, four in conservation technology, and six in renewable energy. All were original student projects conceived and developed during the hacking period.

When judging projects, we focused on the following factors:

- I. Creativity and feasibility
- II. Increment, innovation and Originality
- III. Impact, potential and sustainability
- IV. Presentation

There were two rounds of judging. The first round had a similar format to a children’s science fair, with category-specific judges only examining projects submitted to their category. The top three teams from each category then advanced to the final round of judging, with three overall hackathon winners and two honorable mentions.

The first place team developed “Project Hot Spot”, a model for decentralized geothermal stations to wean independence off nuclear power in Japan. The second place team, “M.O.S.S (Making Our Surroundings Sustainable)”, developed a project that designed moss panels on the sides of buildings in urban areas to create cleaner air. The third place team, “Name That Thing”, built a prototype of an app that allows users to identify wildlife that they are interacting with. There were also two equally ranked honorable mentions - Team “Windcoin”, who came up with an idea to harness energy from moving vehicles, and Team “‘Ohi’a Ohana”, who came up with a novel method to contain the Rapid ‘Ohi’a Death (ROD) fungal outbreak on Hawaiian ‘Ohi’a trees.

### 3.2 Data from Follow-up Surveys

Follow Up surveys were sent to both students and mentors. To incentivize more follow up responses next year, we plan to account for a prize giveaway in our budget.

The results from mentors are as follows:

Was this your first time mentoring a hackathon or similar event?

5 responses

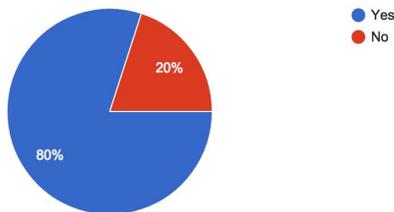


Figure 2: How many mentors completed their first hackathon

How many teams were you able to interact with?

5 responses

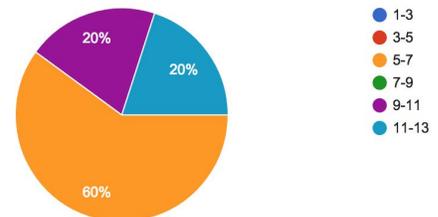


Figure 3: How many teams mentors were able to interact with

Would you mentor at Earth Hacks again next year?

5 responses

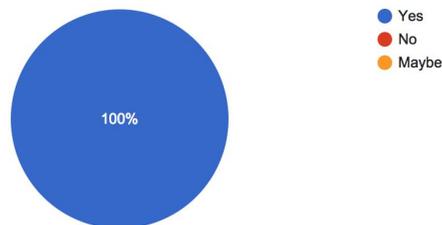


Figure 4: Percentage of mentors that would return to Earth Hacks

The results from students are as follows:

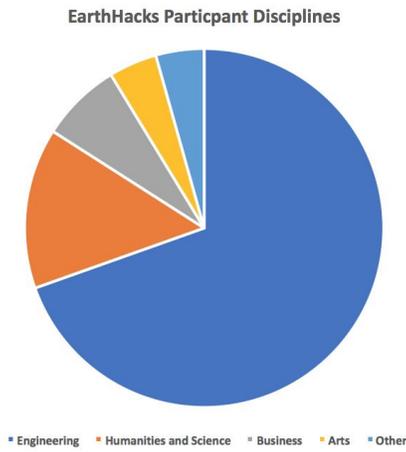


Figure 5: Breakdown of Participants by Discipline

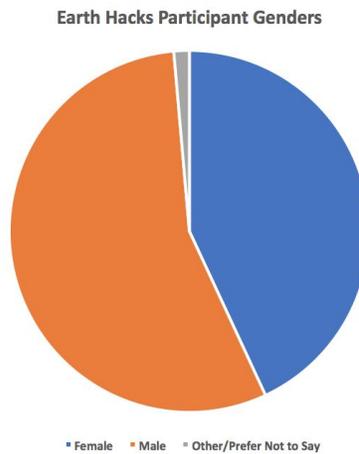


Figure 6: Breakdown of participants by gender

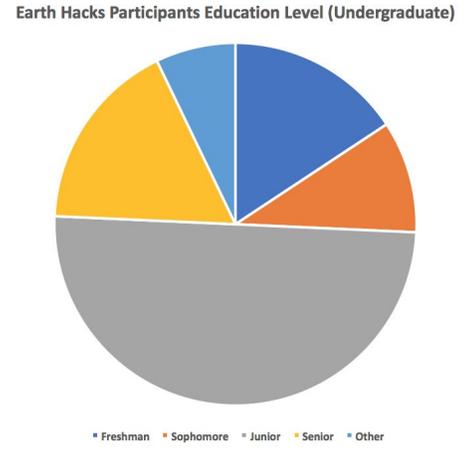


Figure 7: Breakdown of participants by year

Would you do EarthHacks again next year?

16 responses

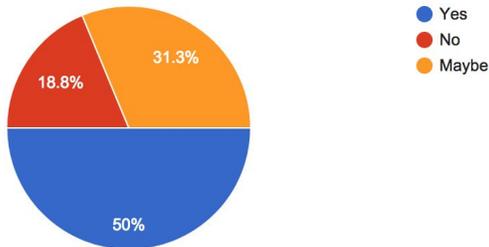


Figure 8: Participants who would return to Earth Hacks

Do you plan on continuing with your idea that you came up with at the event?

16 responses

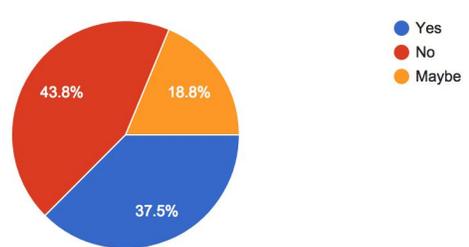


Figure 9: Percentage of participants planning to continue their hackathon project

Only slightly over 50% of students who responded to the survey said that they planned to or perhaps planned to continue with the idea they worked on during Earth Hacks. Because of this, we plan to create more rigorous follow up models so students feel less deterred pursuing their projects.



Figures 10 and 11: Hackathon participants and mentors working on and discussing their projects.

### 3.3 Implementation of Earth Hacks Nonprofit Organization

In order to further our mission of creating, organizing and supporting environmental hackathons, we are currently in the process of establishing a not-for-profit organization. This will allow us to have a centralized body through which to provide assistance to other students who aim to organize environmental hackathons, and allow us to provide and receive financial support for these endeavors.

## 4. Results and Discussion

Two of the main lessons learned from this event were to more clearly define the themes, and to set realistic expectations on deliverables and outcomes. The challenge in setting deliverable expectations applied to participants who were familiar with hackathons - as some projects didn't fit the traditional hackathon norm of having a physical product - and those who were new and unsure of what they could accomplish in such a short timeframe. Some further improvements we hope to incorporate are as follows:

- I. Increase organizational period by creating a timeline and allotting sufficient deadlines for tasks to be completed
- II. Create subcommittees in which certain team members are in charge to help maintain consistency in tasks
- III. Communicate expectations of hackers more thoroughly
- IV. Create a more thorough follow-up survey to increase data collection
- V. Increase the methods of transportation options and awareness in order to make the hackathon more accessible

## 5. Conclusion

This paper discusses the outcomes that were realized after hosting the first environmental hackathon in the state of Virginia, Earth Hacks. The hackathon was primarily aimed at undergraduate students, and focused on environmental innovation. Earth Hacks demonstrated the potential technology has to combat environmental issues. This allowed students to apply the hackathon model of innovative problem solving to problems related to pollution, renewable energy, and conservation technology. Environmental issues present a challenging obstacle for the 21st century, and novel solutions are needed to address them. Moving forward, the objective of Earth Hacks and other environmental hackathons will be to generate these solutions by providing a competitive and collaborative environment for students.

Real world problems require inventive solutions to properly address their complex nature. Hackathons can be a powerful tool to not only foster practical, innovative, and implementable solutions to real world problems, but also to advance the Sustainable Development Goals. In this context, we are grateful to have the opportunity to host Earth Hacks, because through it, and through events like it, we can further realize these ideals.

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