

Hiking Hacks: Workshop Model for Exploring Wilderness Interaction Design

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ABSTRACT

This paper describes a methodology for conducting interaction design research workshops within wilderness locations.

In biological field expeditions, scientists travel to areas with minimal infrastructure to conduct research in environments featuring unique, naturalistic interactions. Digital interaction design is growingly important to field biologists as a way to develop new forms of scientific exploration and experimentation. Ideally field biologists would create their own interactive, scientific tools based upon their developing research questions. In practice, however, time and training constraints mean design is typically outsourced to specialized practitioners in dedicated laboratories.

The Hiking Hack model unites biologists and designers in collaborative, outdoor workshops. Hiking Hacks combine experiences and techniques from biological expeditions with Research Through Design methodologies.

This model has been refined and analyzed throughout several Hiking Hack expeditions. The result is an adaptable workshop structure considering gear, practices, and syllabi for exploring interaction design situated within wild environments.

Author Keywords

Hiking hacks; interaction design; field biology; ubiquitous computing; bioart; participatory design; critical making; digital naturalism; wearables; HCI; ethology; makerspaces

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INTRODUCTION

A Hiking Hack is a novel model for creating interactive technology in outdoor Research Through Design workshops. The key feature of a Hiking Hack is building electronics entirely at the site of the creatures' behaviors being studied. Hiking Hacks often involve traveling by foot for several days into remote, natural areas, and then collaboratively designing, building, and reflecting upon functional prototypes of digital-biological interaction devices. They originated as a way of fostering technological exploration within biological field expeditions, but this workshop format can serve many interactive design research projects with a focus on natural context.

CHALLENGE: FIELDWORK AND INTERACTION DESIGN

These workshops originated by confronting the challenge of integrating two fields of research: biological fieldwork and interaction design. Field biologists conduct research in uncontrolled, natural environments. Their fieldwork In contrast to controlled laboratory work, many scientists argue that wild creatures are inherently connected to their surrounding contexts and thus must also be studied in their natural settings [17,32]. The naturalist, Lorenz, describes the necessity of fieldwork, "one can only get to know...animals by letting them move about freely"[17]. The naturalist, Lehrman further emphasizes the role of scientist themselves creating a relationship with the environment when he argues the necessity of "building yourself into the situation" to truly understand the significance of animal behaviors [15].

These scientists also note the growing importance of digital, interactive technology to their work. Computational devices like Taylor *et al's* "Robofrog" let them conduct dynamic experimentation with living animals in unprecedented ways [13]. Projects like this, however, are commonly created as external collaborations with academic or professional interaction designers (in this case *Moey Inc.*[16]) due to the specialized knowledge and laboratories needed to manufacture the devices. This means devices are generally built off-site or wild animals have to be brought into labs for testing. Our previous technological surveys of field biologists [22][20], further iterate that much digital technology for these scientists is developed away from field sites externally via conventional, industrial, laboratory methodologies.

Dividing the contexts of a tool's creation and utilization can introduce unforeseen variables and undermine the integrity of the scientists' original research goals. Perhaps we could invert this practice, however, and situate the technological development of interactive, biological tools within the wilderness. Like Lehrman, Suchman describes the importance of context: "the only possibility for the creation of effective objects is through collective knowledge of the particular and multiple locations of their production and use"[31]. One way to create effective naturalistic tools is by making them while situated in natural environments.

Hiking Hacks seek to transition the site of digital-biological design practice out of the laboratory and into the field itself. The following methods were tested and refined in field-sites around the world. This paper presents the theory underpinning these workshops, their original development and analysis, and finally a detailed overview of this adaptable workshop model. The goal is that practitioners working in spaces between wilderness field work and interaction design can adapt the gear, practices, and syllabi of a Hiking hack into their work for generating new biological and technological knowledges.



Figure 1 Multiple participants designing art and science tools in the wilderness during a hiking hack in the Southeast USA.

Approach: Digital Naturalism's Research Through Design

The Hiking Hacks originally stemmed from research in "Digital Naturalism"[22] where we studied collaborations between biologist and technologist participants[21] to develop guidelines for creating engaging digital-biological devices. The Hiking Hack format was created as a way of evaluating Digital Naturalism's[22] theoretical foundation.

Methods

Like much contemporary interaction design research, Digital Naturalism follows a Research Through Design (RTD) – style approach. Following suit, these Hiking Hacks serve as a RTD implementation in their goal to allow scientists and designers to engage in "practice-based inquiry that generates transferrable knowledge"[9]. This hands-on inquiry is then driven by several analytical methods informed by HCI, Critical Making, and Reflective design.

The Hiking Hacks extend the push in much HCI research for context aware design with practitioners working "in the

wild" (meaning uncontrolled public spaces) [7]. Like the field biologists in the forest, the goal of these types of user centered design, and contextual participatory design practices [33] [26] [8] is to aid practitioners' understandings of complex socio-technological issues by immersing them in the web of relationships surrounding the design[6]. This work utilizes Matt Ratto's Critical Making concept for workshops with scientists and designers to unpack the relationships between research organisms, scientists, their tools, and the environments in which they carried out their experiments[20]. The Hiking Hacks similarly utilize this tool via participatory design prototyping workshops that integrate physical construction with the critical discussion of the things being built [25]. The workshops also invoke Senger's Reflective Design (RD). Like RD, the Hiking Hack model is designed for biologists and designers "actively building for co-construction of meaning between users, systems, and designers" with the goal of producing "open ended systems where the reflection itself is an irreducible part of the final experience"[28].

Digital Naturalist Guidelines

Digital Naturalism's four design guidelines work to embody the theory of these methods for combining critical analysis with hands-on practice. They include "Behavioral Immersion," "Open-Endedness" "Technological Agency," and "Contextual Crafting," [21]. The first three guidelines respectively encourage practitioners to create tools that viscerally engage participants, raise new questions, and are understandable and manipulable by users in the field.

The final guideline, "Contextual Crafting," urges such digital naturalists to build and test their interactive devices *in situ*. In the same way that an animals' behaviors evolve to fit the unique characteristics of their own environments [17], tools can similarly incorporate unexamined characteristics about the environments in which they were created [1]. Field biologists study their organisms in natural habitats to understand the role the environment plays in their development. Under the idea of "Contextual Crafting" designers and scientists, can similarly understand the hidden assumptions different settings may bring to their designs, and better develop their tools to meet the needs of a certain location. As we will discuss in later sections, the Hiking Hack model incorporates these principles into its very structure with "Contextual Crafting" as its driving factor.

DEVELOPMENT

The development of outdoor interaction design workshops came from examining others' prior work along with conducting direct action research via a series of expeditions in real wildernesses with real participants.

Prior Work

Similar groups of artists, designers, and scientists previously explored various models for outdoor workshops. Just some more recent examples include biological field expeditions and courses (like the *Ant Course* [34]), Earth Colab's art residencies at biological field stations[12], the many designs

of Steven Roberts's "Nomadic Research Labs" [30], Marko Peljan's Makrolab [4] prototype for a mobile art and science workstation, The Hackteria Network's outdoor DIY art-science workshops[35], American Arts Incubator's "Waterspace" Project building a floating art-science makerspace[24], Jacobs and Zoran's work with mobile digital craft labs and hunter-gatherer tribes in the Kalahari[11], and the Signal Fire Arts and Activism Residency that doubles as a backpacking trip [36].

These other outdoor design and research programs share varying alternative styles. These were also influential in contributing to a generalized model for wilderness interaction design workshops in differing environments with many forms of multidisciplinary field collaborations.

Research Expeditions

Three formal Hiking Hacks in Panama, Madagascar, and the U.S. took place for direct analysis within this research. Each workshop included mixed groups of field biologists, artists, and technologists prototyping biological interaction devices entirely in the wild. There was an overall gender ratio of 9 women and 9 men and ages ranging from 22 – 65. Each expedition took place over a minimum of 8 days with additional periods of preparation and debriefing. These official Hiking Hacks were held sequentially with evaluations (interviews and surveys) from previous voyages feeding into the design and refinement of latter ones.

Informal Programs

Several other informal expeditions also served to test and refine certain techniques and equipment. Examples include day trips for examining outdoor soldering techniques, carrying programmable robotic arms to mountaintops for endurance tests, or sailing expeditions to explore the utility of electronics organization gear in different modes of transportation. These also helped contribute to the final design of the Hiking Hack model.



Figure 2 Heading into a "Hiking Hack" campsite in the Southeast USA to search for synchronous fireflies and design new interactive tools and art projects.

Analysis

Participants from previous Hiking Hacks were encouraged to reflect upon this format for digital interaction design in the

wild. Rapid prototyping stood as the most salient benefit of this contextual design. As the participants noted, building onsite "allows for real-time interaction and flexibility" integral to ensuring the alignment of myriad factors in one's experimental design. Another researcher states, "This is very important as it keeps design close to goals and gives immediate feedback." One participant gave an example of this feedback: "When we wanted to check whether our ideas or designs were appropriate, we could easily test out our half-complete models in situ, even with our target organisms."

The scientists also appreciated how the context-based design yielded "situationally specific and situationally appropriate tools" which made "observation driven hypotheses [to be] formed easier." For one scientist, the importance of Contextual Crafting was not as much about the creation of new tools, but rather the ability to fix tools in the field, an advantage afforded by Hiking Hacks. She states, "I think the more important aspect is to be able to repair tools in the wild and to gather inspiration for new tools. Data collection time in the field is expensive." Figuring out the necessary components to rebuild or fix tools while in the field can save the researchers much time and money. Participants valued the immediate *in situ* tool construction as a possible solution to this dilemma.

A downside to the extreme version of the Contextual Crafting performed in these Hiking Hacks was that, no matter how well we planned, some crucial items might still be inaccessible. For instance, when a participant was building a device for sensing leaf-cutter ant aggressiveness by smell, the group was missing a technical document illustrating the proper wiring of the gas sensor. This prevented the participant from fully realizing this device. He claims, though, that his project only made it to this point in its design, due to the increased speed enabled by the contextual situation of our workspace: "Being so close to ants really sped up the design improvement iterations – build version 1, test it, didn't work, fix x, test it, didn't work, fix y, etc...." In this way, this attribute of Contextual Crafting also facilitated the agency and immersion of the participants.

The wilderness is not generally conducive to electronics engineering. This fact was incessantly present throughout different hikes. One participant describes the ongoing battle: "The heat and wetness of the jungle broke everything it could, from Arduinos to hot glue guns to lighters." Finding what tools and techniques were successful, however, streamlines the gear necessary for building, modifying, or repairing field equipment *in situ*. Over the course of just three expeditions, major innovations in the design of our wilderness hacking tools noticeably smoothed the earlier difficulties with construction in nature.

Additionally, many participants praised the strict limits placed on the technological access. They saw the restrictions as helping inspire creativity and maintain focus on the natural world. "Having limited sensors, lines of code,

batteries, etc. is another challenge/obstacle that forces you to think outside the box and come up with crafty solutions ... like using a lighter to [melt] hot glue because the hot glue gun isn't working," notes a scientist from a Panamanian Hiking Hack. Another participant concurred stating, "limitless resources can sometimes prevent people from thinking in new ways about problems and could also lead people to use unnecessary components in their designs. Though we sometimes lacked the tools we needed, we sure were streamlined and crafty."

Weight ended up being the most detrimental aspect of mobile hackathons for exploring ecosystems. Carrying too many supplies slowed some journeys, cutting into mental and temporal resources for exploring design. As a participant in an early Hiking Hack observed, "Nonstop hiking doesn't really allow for bonding with others." A teammate from the same expedition suggested that "ensuring the commitment of participants would be pretty helpful – more people could share the load better, meaning a less heavy, stressful hike." These problems of weight have largely been alleviated in more recent Hiking Hacks by refining the gear carried. These improvements demonstrate the Hiking Hack model's future potential in pushing Contextual Crafting without serious detriment to the design process.

RESULTS: HIKING HACK MODEL

The analysis of several previous wilderness interaction design workshops yielded a generalized model. Hiking Hacks follow the basic structure of a biological field expedition: *Journey-In, Basecamp Workshops, and Journey-Out*. Periods of preparation and debriefing bookend the expedition. Hiking Hacks typically involve a group of 10-14 individuals over 10 days, but this model is adaptable to variations in expeditions.

Preparation and Gear

The freedom and exploration afforded by Hiking Hacks often derives from careful preparation. Going in to intense environments and seeking to carry out socio-technological biology workshops and discussions can easily become overwhelming. Being unprepared to deal with the many-faceted complications that will arise can place more emphasis during the workshop on basic survival rather than allowing participants the chance to explore the natural and technological aspects of the environment.

In the time leading up to the Hiking Hack, participants should confer and review basic safety and logistics information. Participants should also discuss biological targets they wish to seek out in the area. Often these workshops are built around the biologists' field expedition, so their research targets tend to form the structure of the trip. The design aspects of the Hiking Hack can then be built around this schedule. For instance, in Madagascar, the Hiking Hack focused on entomologist, Brian Fisher's, expedition to collect unknown ants in the forest. The scientists had particular schedules they followed throughout the voyage to do their basic collecting, and then interactive and design

workshops were built around this. Participants may want to brainstorm about potential interactive devices they want to build, but emphasis should be put upon remaining open to inspirations encountered in the field.

Crucially, participants should sort and ready all the electronic gear needed for the rest of the Hiking Hack. Since internet resources will typically be unreliable, any hardware drivers, software libraries, or material reference sheets need to be collected beforehand. Sparkfun Electronics (sparkfun.com), for instance, provided our trip with offline, downloadable copies of all their product documentation.

Wilderness Workspace Needs

The distinctive feature of a Hiking Hack is the outdoor laboratory. Since they inherently require developing novel technology in areas of minimal human-infrastructure, these workshops need to be able to transport or recreate many aspects of labs and studios. Like the traditional survivalist's hierarchy of needs[3] including shelter, water, and food, experience with previous outdoor workshops has helped the Hiking Hack model delineate a hierarchy of needs for outdoor studios.

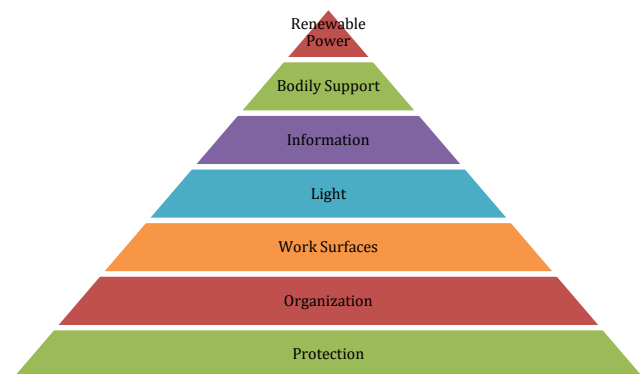


Figure 3 Hierarchy of Needs for mobile, outdoor laboratories

PROTECTION

The first immediate need is how to protect sensitive components in the wild. One quickly discovers that most laboratory equipment is not meant to face the harsh extremes of outdoor environments, much less the physical toll just transporting devices to the field can take. Thus, field practitioners from many disciplines (from film to field biology) can be seen transporting sensitive equipment in large waterproof, padded cases. Hiking Hackers can make use of dry-bags, and ultra-light Silnylon tarps to shield areas from moisture and utilize extra clothing and food as padding.

ORGANIZATION, WORK SURFACES

Once the delicate equipment can be protected, the question becomes how to easily access and utilize a variety of components. Organization and work surfaces are things that people working in traditional laboratories may take for granted. These are the next most important aspects, however, of a mobile lab. Most natural environments are messy and irregularly shaped. This makes it easy to lose things, and difficult to find adequate work surfaces.

LIGHT

Proper lighting can prove difficult to find in the field. At best you typically have only half of a day with free lighting provided by the sun. In areas with thick canopy coverage however, even daytime can be too dim to work. Complicating matters is that small, detailed, electronics work often requires bright, even illumination. At a minimum, a headlamp is required.

INFORMATION, BODILY SUPPORT, RENEWABLE POWER

If one has managed to tame the above aspects of a mobile laboratory, the remaining needs can help support longer-term design and construction. Information such as pin-diagrams, important formulas, stats about local animals can be printed on clothing or tarps and enhances the projects one conducts in the wild. Finding ways to make ergonomic furniture, or ways of working comfortably in the wild, is important to staying healthy and building projects over long periods of time. Finally, for lengthy trips, one cannot simply carry-in pre-charged devices, and thus should look for opportunities for renewable sources of energy- typically solar, and less often wind-, pyro-, or hydroelectric power.

WEARABLE STUDIO PRACTICE: PORTABLE, WEARABLE, NAKED

Designer, Perner-Wilson, has been addressing this hierarchy of needs by developing a “Wearable Studio Practice” [10] (stemming from a previous Hiking Hack). She creates and documents mobile gear for doing interaction design work in environments varying from deep jungles to parks and hotel rooms [23]. Her designs consist of techniques for transporting and using studio tools using no more infrastructure than one’s own body. She categorizes her designs along a gamut from “Portable” (Bags that turn into shelves and organizers), “Wearable” (clothes and accessories that hold tools constantly at hand and support construction directly onto one’s body), and “Naked” (body modifications that perform the tasks of laboratory tools and infrastructure such as wire-stripping nails, and tattooed datasheets).



Figure 4 (left) Lab space woven from natural materials at a Hiking Hack in Madagascar. **(right)** Lab space in Singaporean forest with a Perner-Wilson designed backpack that converts to tool organizer, light source, and work surface.

Hiking Hacks employ wearable studio principles as a way to as a way to optimize the design capabilities in the wild. Designs such as backpacks that can transform into ready-to-go tool organizers serve both to protect one’s gear and keep it well organized. Other wearable studio designs incorporate magnets and breadboards into clothing to keep one’s tools always ready and at hand.



Figure 5 Ecological artist, Michael Candy’s “Wearable Studio” components across Perner-Wilson’s spectrum. On the “portable” side he has a waterproof Pelican case attached to backpack straps, on the “naked” side he has a ruler tattooed onto his finger [5].

Wearable studios let common gear such as backpacks and clothing serve double duty as both traditional expedition gear, and laboratory gear. This reduces the amount of weight needed to carry into the field and opens up more opportunities for labs to adapt to any kinds of environments.



Figure 6 (left) heat-proof work surface built into one’s pants with magnets, sponges, and heat-proof Kapton film turn your lap into a workspace. **(right)** Perner-Wilson’s breadboard watches keep components at hand, and permit direct, wearable prototyping.



Figure 7 Designing wearable studio gear prototypes during a hiking hack. This design featured a backpack that could turn into a full table.

Wearable Studios are a nascent field ripe for continued exploration. Hiking Hacks are a good opportunity to explore this meta-discipline as well. Past Hiking Hacks explored and

expand upon the idea of wearable, mobile studios during the expeditions by creating and designing our own lab tools.

EQUIPMENT

Once one has a general plan for workspace infrastructure, it is time to determine how to stock this mobile lab. Bringing too much or too little gear can be detrimental for the expedition. Keep in mind that the additional burden of the lab and studio tools takes the place of extra food and camping supplies in a traditional backpacking trip.



Figure 8 Hand-made lab bench from sticks containing water-tight, modular storage boxes filled with electronics and sensors.

There is also a trade-off between supplying participants with a wide variety of tools and sensors to foster their open-ended exploration, being able to physically carry these things, and potentially becoming stifled by too much choice. The hardest mental task of the workshop can be deciding what to bring.



Figure 9 Portable robotic arm (uArm Swift Pro) with modular attachments for 3D printing, manipulation, laser cutting on a Slovenian mountain top. (right) Solar panel.

Provided here is a non-exhaustive list of many core items which have proven themselves useful on Hiking Hacks in different environments. Depending on the location chosen, some items can be substituted for naturally available resources. This list does not include basic survival essentials such as water filters, food, and sleeping bags.

Documentation and Design	Construction	Electronics
Cameras	Hot Glue	Electric and Butane soldering Irons
- Waterproof	Sculpting	Lead-free solder
- 360	Thermoplastic	Brass Sponge
- Multi-Lens	Super Glue	Protoboards/ Breadboards
Mini tripods	Popsicle sticks	Wire, Cutters, Strippers
Storage	Foam sheets	Heat-Shrink Tubing
- Redundant Hard drives	Silicone Caulk	E-textiles materials
- Camera Media	Lighters	
Journals	Razors	

Markers	Scissors	Common Components (transistors, diodes...)
Paint Pens	Mini-robotic arm with manipulation, laser engraving, and 3D printing attachments	
Clothes pins		
Workspace	Computing	Display
Silnylon Tarps	Laptop	Portable Projector
Ground Mats	E-ink reader with data reference sheets	Mini electronic displays
Cutting mats	- Micro-controllers: varying sizes: Attiny85 to Arduino Mega to Raspberry Pi	Speakers
Paracord		Piezo buzzers
Polyester Straps	Sensors	Addressable, Waterproof LED strips
Carabineers	- proximity, UV, gas, etc....	Vapor diffuser
LED lamps	Actuators	
Insect nets	- servos, buzzers, peltiers, LEDs, etc....	
Citronella candles		
Printed reference sheets		
Scientific	Power	Transport
Microscope	80W Foldable solar-panel	>60L Hiking Backpacks
Collection Vials	20Ah+ LiPo Batteries	Rain covers
Various chemical powders	AC Inverter	Plastic Water-tight organizers
Marking Powders (fluorescent, thermochromics, glowing)	DC Voltage Converters	Luggage Scale
	Electrical Adapters	Contractor Garbage bags
		Waterproof Sack

Table 1 Hiking Hack specific gear list. Does not include basic backpacking gear such as water filters, food, and clothing.

Daily Routine

Creating a simple daily routine before an expedition can help make an expedition more robust against the unknown variables involved in any field expedition. The basic Hiking Hack daily routine can accommodate most endeavors while supporting focus during hectic periods. Based around the routines of daily outdoors life (sleep, meals, and chores), the structure of the daily routine and its activities should adapt to movement-oriented days, as well as basecamp periods of the Hiking Hack.

A journaling activity is the first and last activity of each day. Prompts frame the day’s activities by inciting investigation, exploration, and reflection. Morning prompts can target new ideas and challenges to consider that day. Evening journaling tends to reflect upon ideas and things encountered that day.

In the morning, a team lead can then issue an open-ended exploration or creative challenge for the day. Example include, “design a simple video game based off the actions of a creature you observed on your hike,” “collect two natural objects whose physical structure leads to a specific

interaction (e.g. sticky burrs or flower and pollinators), or “record sounds from at least 5 living and 5 nonliving things.” This challenge can be formed to take place even during other more typical biological research taking place. The morning challenge is then often discussed and potentially modified during the lunch break. Finally, during the afternoon or evening break, participants share the results of their challenges, upon which a group activity may be based to facilitate reflection. Example activities include live programming, life-drawing, map-making, slide shows on portable projectors, design workshops, or theatrical skits.

While preparing for the day’s upcoming tasks, persons in the role of documentarian for the day can film brief interviews with participants.

Expedition Structure

Journey-In

During the *Journey In*, the group typically hikes far while carrying the heaviest loads of the expedition. These are the most exhausting segments of the trip. Fatigue and constant movement inhibits physically-intensive design challenges. Thus, this segment of the trips features simple exercises promoting awareness and reflection on the environment. Brief, non-physically challenging exercises (like “find a plant for every color of the rainbow”) help the participants explore their environment while rapidly trekking through it. The majority of exercises in these segments of the trip are designed for mental contemplation, group discussion, or specimen collection.

Basecamp Workshops

Once at basecamp, the participants are freer to explore, experiment, design, and build new devices. The basecamp provides rest following the physical toils of the previous days. This lets the group undertake longer-term biological studies, along with stationary tasks such as all-day hackathons.

While the basecamps in each Hiking Hack are distinct in activities, form, and location (a Madagascar trip included two separate basecamps), three types of basecamp days were important to its structure. These are modeled around the guidelines in Quitmeyer’s aforementioned Digital Naturalism design framework [21].

EXPLORATION DAY

Usually in the first day of basecamp, participants are encouraged to openly explore their surroundings. Contrasting the fast-paced *Journey-In*, challenges issued to the participants on this day foster ethology’s values for relaxed, open-ended investigation[14]. Activities like conducting life-drawings help the participants intently study their surroundings. This biological practice, known to “enhance engagement” in researchers, focuses the group’s attention on otherwise overlooked aspects of nearby creatures [2]. Open-endedness is thus the primary goal of the design framework targeted in “Exploration Day.”

CONSTRUCTION DAY

“Construction Day” is modeled after the tenets of Technological Agency and Behavioral Immersion[21]. Participants are challenged to design, build, and program functional physical computing projects. To promote Behavioral Immersion, the participants are usually challenged to make their devices both take input from the environment or neighboring animals and deliver some sort of physical output back.

DOCUMENTATION DAY

Based on the Digital Naturalism guideline for Technological Agency[21], an extra day at the end of basecamp is set aside for documentation. Participants are asked to document their inspiration for the devices, how they are built, concepts and hardships they discovered through the process, and suggested future additions and improvements. Such documentation builds agency in participants by enabling reflection on their own creations and offering critical analyses of each other’s designs developed throughout the trip. Sharing this documentation allows other researchers around the world build upon the work carried out at this Hiking Hack.

Journey-Out

Journeying out of the wilderness makes the group become mobile once more. The packs are lightest in this stage, since most food has been eaten. At this point, the participants are typically emotionally closest at this point, as the activities and hardships encountered generally build *communitas* amongst the group[27]. This period lets participants reflect upon their experiences and designs.

Debriefing

Following the return back from the wilderness it is useful to maintain a period of time for the group to debrief. During this time the group can finalize any ideas, sort gear, and wrap up any documentation of the trip.

Creative Challenges and Activities

Following the Critical Making methodology[25], design and discussion challenges are continuously issued to participants over the course of the expedition. The creative challenges aim to provoke exploration and discussion amongst participants concerning ecology, design, manufacture, and culture. Included in this section are some example activities built around Digital Naturalism’s design framework[21], which have proven themselves useful in prior expeditions. Hiking Hack leaders can incorporate these activities into their workshops while also designing their own, site specific, Critical Making style discussion probes.

Party Boat

The “Party Boat” challenge became a staple activity of the Hiking Hacks. It was originally developed in Panama during the first Hiking Hack as a way to give novice participants direct experience with as many different electronics as possible. The idea came to also use this opportunity to test out the effects of as many different stimuli upon the local

creatures as possible in order to discover any unusual responses.

The basic premise is to split the participants into small teams, set a time limit (typically 1 hour), and challenge them to create a device which generates as many different types of stimuli as possible. This project reflects a condensed version of naturalists' early exploration phase where they spend a field season conducting similar assays testing out the effects of various stimuli.



Figure 10 Two “party boat” creations generating multimodal stimuli. (Left) USA, (right) Panama.

Participants leave the multimodal devices to observe the effects they have on different animals' interests. Aspects of the party boat spur interactions with specific animals can then be isolated and used in different projects.

Cybiotic Interactions

The cybiotic interactions activity is actually a series of challenges that can build upon each other over multiple days. It starts with participants conducting an orientation and familiarization exercise to perform live drawings of at least four different creatures. Participants then label each creature with at least one action it can do and one type of stimulus it can sense (for instance a frog can hop and hear sounds).

Later, participants share their drawings with each other. These drawings are then collected and re-distributed at random to different groups of participants. Next, the participants have to create a story about the creatures in the drawings and involving the sensing and action abilities delineated in each picture. To help simplify the narrative task, teams are often given a specific genre they have to re-create with the creatures in their story such as “a heist,” “a tragic love story,” or “a horror story.” Finally, the teams have to physically embody the characters in their story and perform it to the rest of the campers. Sometimes this activity can be extended one level further to challenge participants to actually design an electronic mechanism that functions as one of the creatures.

This exercise functions well in multidisciplinary teams to familiarize participants with biological as well as programmatic concepts. By creating stories involving the different creatures, and connecting their various inputs and outputs participants learn about the natural systems while virtually “programming” these creatures' together, gaining a tacit understanding of the basic “Sense-Think-Act” basic paradigm of cybernetics [29] they might use in later projects with real electronics and natural systems. The constant re-contextualization of these creatures into drawings, diagrams, programmable characters, and finally physical movements

helps participants observe the many facets interplaying in digital interaction design. It works as a helpful primer before groups begin working on their projects.

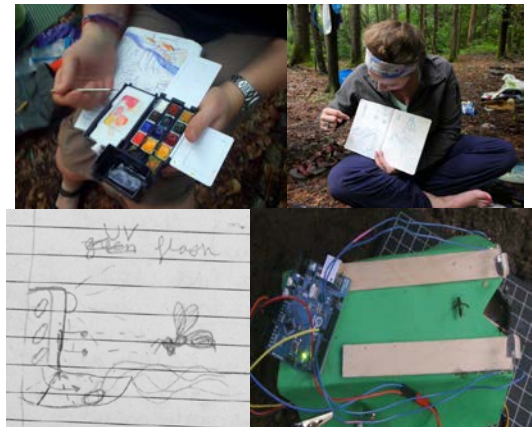


Figure 11 – Scenes from cybiotic interactions activity where participants draw lifeforms, label their inputs and outputs, create stories, and electronically craft the creature-characters.

Persistent Game

While many activities are one-offs, it is important to take advantage of the fact one has a group together for many continuous days. Thus, creating low-level activities that occur persistently over the workshops days can be a useful and unique tool. For example, we had a “situational orientation” game than ran continuously over the hiking hacks called “Mountain Lion.” A hide-and-seek style game, the 10 min- game could be activated by a group member at any time, forcing others to stop what they were doing, and examine their current surroundings for hiding spaces. These types of exercises are great to prevent participants from becoming overly fixated on a certain project or problem and remind them to constantly re-evaluate their physical context.

Core Project

The structure of the Hiking Hacks leads participants towards creating and documenting at least one core project. The beginning of the expedition first exposes participants to as much inspiration as possible, but then, during “Construction day” builds in time for them focus and iterate upon an idea that have developed over the Hiking Hack. The subject matter and functionalities of each person or group's core project is left open, but often the “cybiotic” guideline of “it should take at least 1 input and give 1 output to a non-human creature or environment” helps guide participants.

Examples of some projects that developed during hiking hacks include:

- Interactive wasp color display-food reward experiment systems
- Canopy coverage measuring hats which share data acoustically and visually
- Ground-Dwelling ant aggravation devices with built-in gas-sensors for trying to analyze aggression pheromones.

- Modular ant sensors made from fiber-optics and photoresistor that can be applied to track insects on arbitrary geometries.
- Electronic tongue displays which share sensor data ambiently to a user's tongue
- Digitally Interactive finger puppets which recreate and document animals encountered during expedition.
- Large-Animal Proximity Sensors made from capacitive touch sensing connected to local plants.
- Modular animal behavior recording and playback vests which aim to tie researcher's data to physicalized body memories.

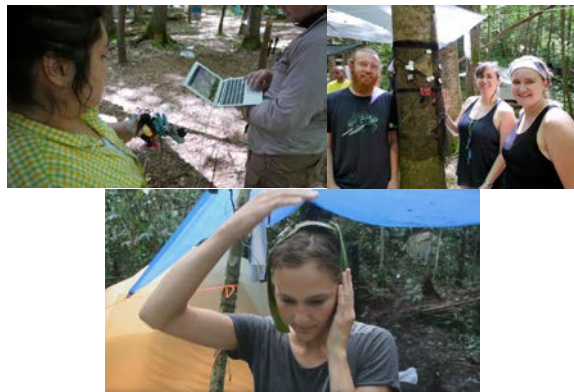


Figure 12 Example projects explore immersive, open-ended interactions with natural systems. (top left) robotic finger puppets which recreate the story of the hiking hack, (top right) ethology vest combines bodily interaction with data logging, (bottom) sensor monitors canopy coverage and sonifies data via speaker made out of the leaf itself.

Example Syllabus

This syllabus outlines a typical week-long Hiking Hack expedition. It includes additional days for preparation and debriefing. Expeditions longer than these minimum 10 days can accommodate this structure by spreading out the activities accordingly. Expeditions with multiple basecamps can similarly be adapted. Shortening the expedition, on the other hand, will require more significant planning and reduction of activities and projects to suit the needs of the condensed trip.

Days i and ii: Preparation

First Day	<ul style="list-style-type: none"> • Brainstorming ideas for technology and potential biological subjects. • Building two technological items as a group
Second Day	<ul style="list-style-type: none"> • Finishing selected devices for field use • Prepping programming computer with drivers and libraries • Sorting food, camping gear, and hacking gear

Day 1: Journey-In

Challenge	<ul style="list-style-type: none"> • Find an interesting organism while hiking
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Activities	<ul style="list-style-type: none"> • Hiking • Navigation • Set up mini-camp • Explain persistent game (e.g. "Mountain Lion")
Reflection	<ul style="list-style-type: none"> • Evening Journal Writing / Video Documentation

Day 2: Journey-In

Challenge	<ul style="list-style-type: none"> • Explore Structures: Find a biological structure that performs a function • Cybotic Life drawing (after arriving at Basecamp) • Draw an animal, plant, fungus, and ecosystem • label senses and actions taking place in the drawings
Activities	<ul style="list-style-type: none"> • Hiking • Procedural Experiences Design • Designing a non-embodied digital program (e.g. screen or smartphone-based game) that attempts to share the physical experience or mechanics of backpacking • Design and set up basecamp infrastructure (e.g. tarps, kitchen, food-bag elevators)
Reflection	<ul style="list-style-type: none"> • Cybotic Performances <ul style="list-style-type: none"> • Teams conduct performances based on creatures from life-drawings. Teams can be given genre-prompts to guide them (e.g. a fairy tale, a heist, or horror film.) • Map Making Activities <ul style="list-style-type: none"> • Participants create maps of their choice sharing experiences, physical passages, or campsite layouts formatted as maps • Evening Journal Writing / Video Documentation

Day 3: Base Camp - Exploration Day

Challenge	<ul style="list-style-type: none"> • Smell Adventure – Scent exploration around camp • Individuals explore the area and collect interesting smells
Activities	<ul style="list-style-type: none"> • Setup and organize hacking stations • Setup power generation spaces (e.g. solar, hydro, pyro...) • Party Boat Challenge • Teams battle to create devices that generate as many different stimuli as possible
Reflection	<ul style="list-style-type: none"> • Discuss ideas for devices to build • Evening Journal Writing / Video Documentation

Day 4: Base Camp - Construction Day

Challenge	<ul style="list-style-type: none"> • Main Project • Create a digital device that promotes interaction or exploration of local surroundings
Activities	<ul style="list-style-type: none"> • Card Sort: Collecting ideas, arranging concepts, in a non-reductive process • Prototyping Preparation: Natural speaker making
Reflection	<ul style="list-style-type: none"> • Morning Journal Writing: drawing detailing designs • Evening Journal Writing / Video Documentation

Day 5: Base Camp - Documentation Day

Challenge	<ul style="list-style-type: none"> ● Capture and explain device's use and functions on video ● Why you made it ● What does it do ● What are next steps / future improvements / ● What things you learned ● Create a Performance that involves or explains your device
Activities	<ul style="list-style-type: none"> ● Documenting ● Evening Performances sharing digital tools ● Planning for Hike Out (e.g. scouting paths back, planning re-packing)
Reflection	<ul style="list-style-type: none"> ● Morning Journal Writing ● Evening Journal Writing / Video Documentation

Day 6: Base Camp - Buffer Day

Challenge	<ul style="list-style-type: none"> ● Finish Documentation (including side projects or interesting findings)
Activities	<ul style="list-style-type: none"> ● Pack up hacker spaces ● Clean E-Waste ● Hiking Hack Gear Design Jam <ul style="list-style-type: none"> ● Teams prototype new ideas for Hiking Hack infrastructure equipment (e.g. portable soldering benches, wearable daypack tool-organizers)
Reflection	<ul style="list-style-type: none"> ● Contact: word game sharing ideas and common experiences ● Morning Journal Writing ● Evening Journal Writing / Video Documentation

Day 7: Journey-Out

Challenge	<ul style="list-style-type: none"> ● Mobility Test: Wear digital devices created on body or pack during return hike
Activities	<ul style="list-style-type: none"> ● Pack up rest of camp ● Additional campsite clean
Reflection	<ul style="list-style-type: none"> ● Morning Journal Writing

Day iii: Debriefing - Finalizing Workshop

Challenge	<ul style="list-style-type: none"> ● Document the following formatted both as a web-page and as a print-magazine layout ● a digital device you created ● an experience in the field ● an additional activity or device you made
Activities	<ul style="list-style-type: none"> ● Unsort gear
Reflection	<ul style="list-style-type: none"> ● Arrange after party social celebration

Context Considerations and Care

The context in which these projects are carried out is the most significant aspect of the Hiking Hacks. Therefore, paths and destinations should be researched and carefully considered. Participants are guests in these wildernesses, which makes it imperative to treat the areas with respect. All Hiking Hacks should encourage participants to be good stewards of the environment in which they live and work. Like any lab, Hiking Hacks generate e-waste. Having infrastructure (such as garbage bags, zipper pouches) to pack away debris is necessary for lessening the impact. In trips involving destinations through lands of indigenous peoples should also make an effort to obtain the approval of these peoples, and even use this as an opportunity to incorporate local crafting techniques into designs[11].

Finally, the choice of a theme, path, or destination can have motivational effects on the participants. For instance, a Hiking Hack in Panama followed a de-colonialization theme, tracking Balboa's ancient trading routes in reverse. One in Madagascar was motivated by a quest to find an unknown ant, and the U.S. hack toured parts of the Appalachian Trail in search for synchronous fireflies. Framing the journey with specific physical, scientific, or historical objectives can instill a greater sense of adventure and participation with the workshop attendees.

CONCLUSION

The Hiking Hack model for outdoor interaction design workshops is difficult to enact, but consistently rewarding. Hiking Hacks contribute an effective, tested model for RTD workshops that promote critical engagement between interaction designers and field biologists. These workshops have already helped many scientists directly explore and refine designs for new tools like Marting's ant-aggression stimulating robots[18], inspired designers to develop tools for engaging with nature (like Perner-Wilson's Wearable Studios), and even led to spin-off TV shows featuring mobile studios like Discovery's "Hacking the Wild" [19].

These adaptable, hyper-contextual approaches let Hiking Hacks contribute to interaction design's developing explorations the natural world. With this guide of Hiking Hack-specific gear, practices, and syllabi, practitioners studying both nature or interaction design can achieve new freedoms for creating new tools and experiences almost anywhere on earth. Go forth and hack the planet.

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