PIE

ATELIER DOCUMENTATION

SENSOR GARDEN

SCIENCE MUSEUM OF MINNESOTA

SEPTEMBER 4-7, 2007

exploratorium

ATELIER DOCUMENTATION

The PIE Institute is a museum collaboration offering professional development opportunities for informal educators to explore new approaches to teaching science, art, and technology.

http://www.exploratorium.edu/pie

SENSOR GARDEN

September 4–7, 2007
At the Science Museum of Minnesota
St. Paul, Minnesota

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Workshop Overview

Workshop Details

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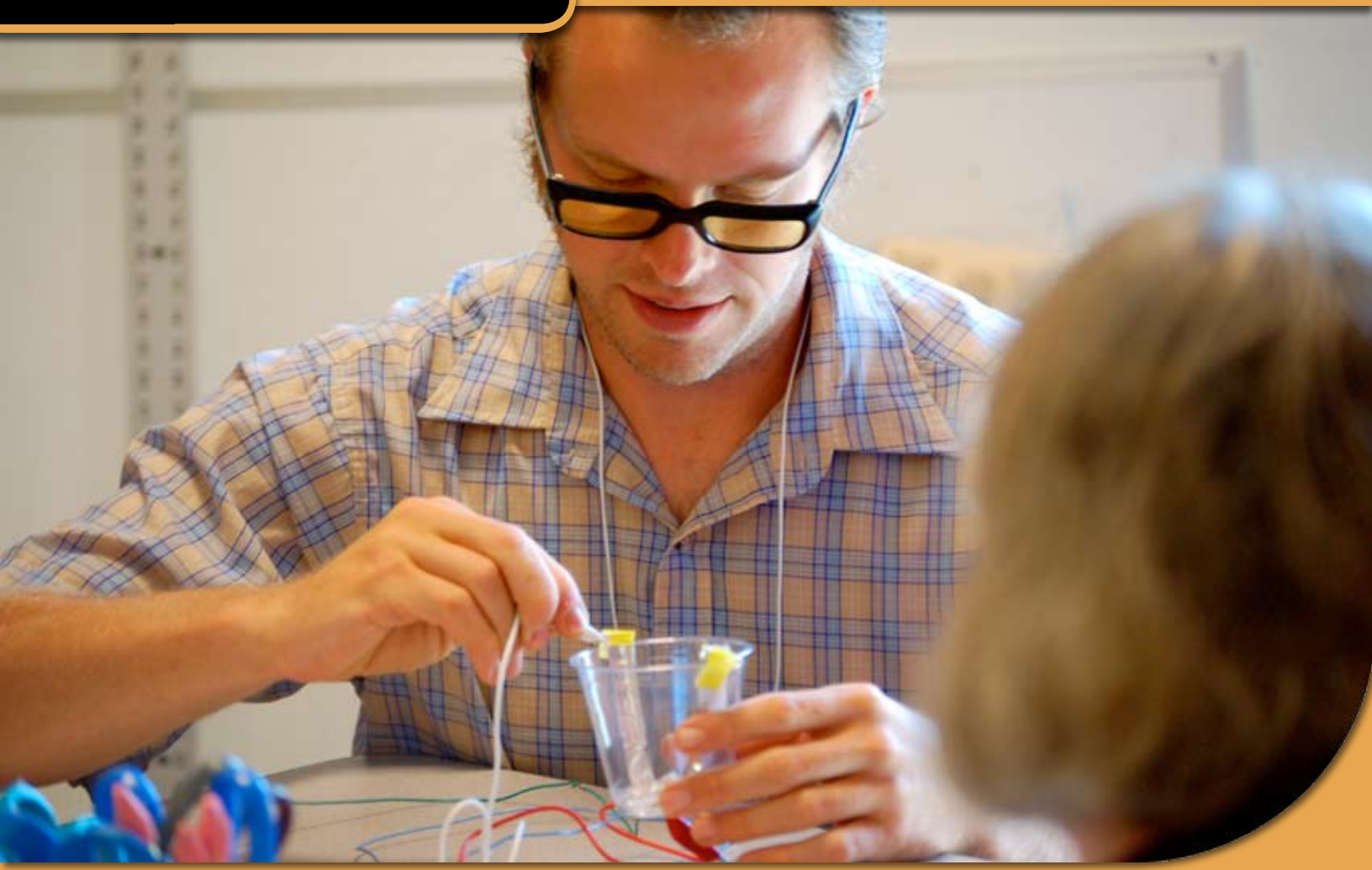
a~te*lier
/n. [F] a workshop;
a studio for an artist
or designer.

PIE Institute Ateliers explore new educational activities utilizing digital technologies, and provide opportunities to share the PIE philosophy of teaching and learning.

Sensor Garden Atelier participants included museum and out-of-school educators, and program and exhibit developers, looking to blend art, science, and technology in their workshops, public programs, and exhibits.

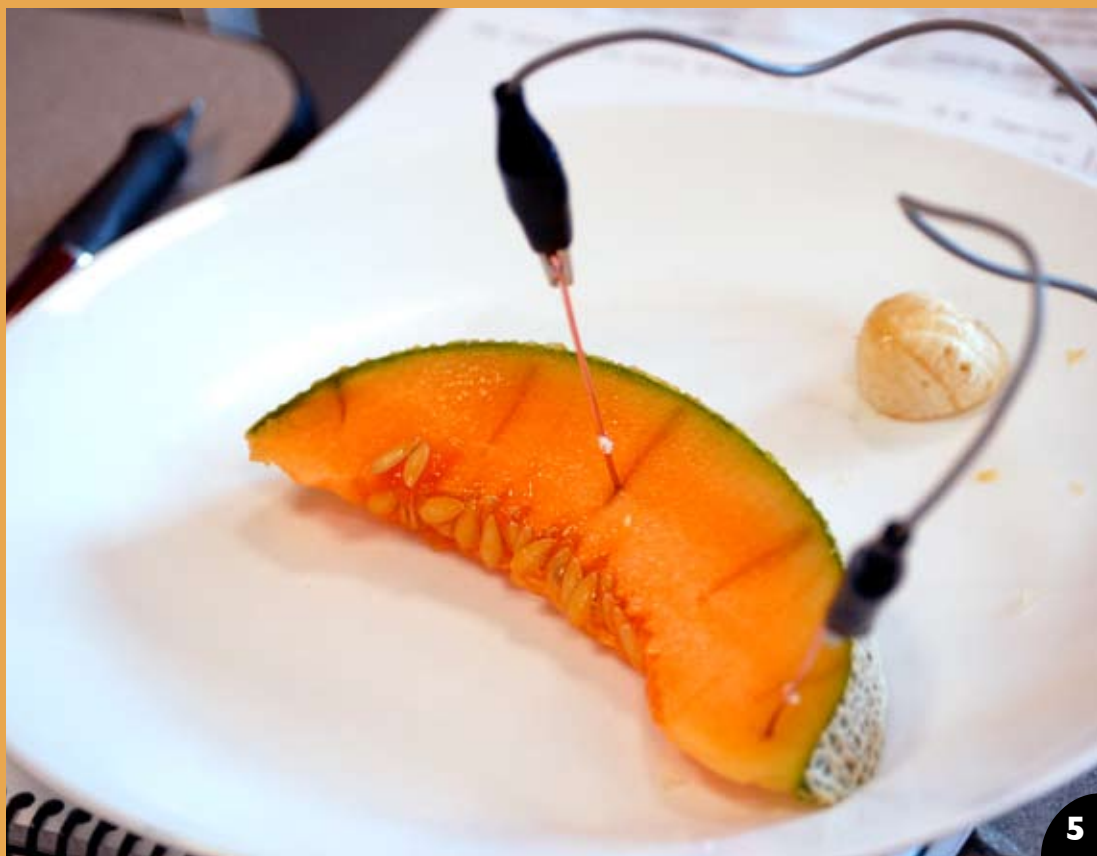
During the four-day workshop, participants explored ways of making sensors and switches, and expressing the sensed changes in light, sound, and movement. Activities included making LED Wearables and Musical "Graphiti," and building a Sensor Garden. Discussions about the philosophy and intention behind these activities allowed participants to think about how PIE activities are developed and how they will implement PIE work at their home organizations.



We experimented with LEDs, batteries, wire, and cardboard to make simple circuits and homemade switches. Then we incorporated these ideas into wearable inventions, adding in PicoCricket technology for additional possibilities.

We started the day exploring the phenomena of conductance by making music with graphite drawings, finger paintings, Crickets, and resistance sensors.

We continued to explore conductance using other materials, including milk, PLAY-DOH, melon, pickles, and ice.

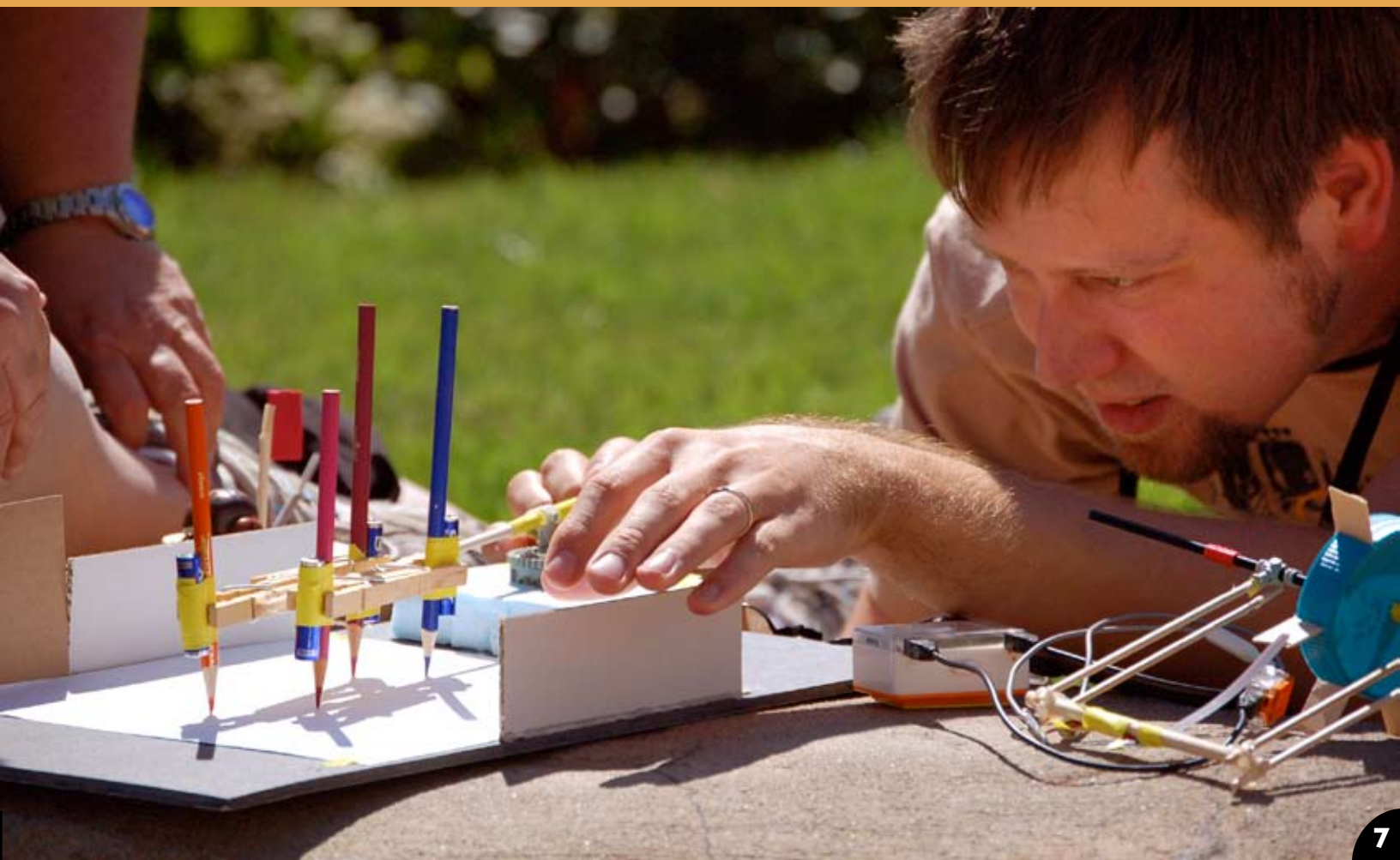


WHAT HAPPENED THURSDAY

We took a trip to the PIE-famous Ax-Man Surplus Store to look for switches, sensors, motors, lights, and all kinds of other odds and ends.

We spent the rest of the day working on projects for the Sensor Garden, exploring our purchases, and taking apart toys and electronics to scavenge parts.

We continued working on sensor-triggered devices, both whimsical and practical, for the Sensor Garden, and shared our progress with each other. We ended the day and the workshop by packing up projects and materials – graphite sticks, conductance boards, scavenged parts, and homemade switches and sensors – to continue playing at home.



Goals for Atelier Participants

• Experience three PIE activities that highlight various ways of detecting and sensing, and that express core PIE ideas: availability of rich materials, learner-centered projects, inspiration from artists and scientists, and collaborative learning environments.

• Build comfort with basic battery-powered circuits as well as with the PicoCricket, and learn how to build switches and sensors that extend both these circuits and the Cricket kit.

• Meet peers and other members of the PIE Network, and share an immersive learning experience with them.

Atelier Context

Technology has an important role in PIE philosophy and practice, but digital technology is not the main focus or even the main tool of PIE's work. PIE Ateliers offer opportunities to gain greater understanding and facility with digital technologies such as the Cricket, computers, cameras, and cell phones, as well as with power tools such as drills and skill saws.

Technological skills and literacy are important to the pedagogical goals of PIE, but they are just two aspects among many. The emphasis in PIE is on working with simple materials and real phenomena. Technologies, whether mechanical or digital, are introduced to advance ideas that begin with more basic explorations.

TUESDAY OVERVIEW

Tuesday's Theme Circuits and Switches

Tuesday's Goals

• Develop a basic understanding of circuits and switches, including how to use common materials in their construction

• Build something wearable that incorporates a switch and a circuit

• Begin getting acquainted with the PicoCricket and its parts, especially the LEDs and connection sensor

SIMPLE CIRCUITS

We started the day by making simple circuits with wire, button batteries, LEDs, and making switches out of cardboard tubes and foil.

Adding Control

To make our circuits more interesting, participants broke into two groups to explore homemade switches and PicoCrickets in more depth.

Station 1: Homemade switches, some inspired by industrial or commercial designs, can be used to complete a circuit in interesting ways. Participants tried using pre-made examples in their circuits, and looked at materials that are useful in switch building (including cardboard, copper tape, springs, and brass paper fasteners).

Station 2: Participants began using the PicoCricket to turn on the kit's tricolor LED, and explored some of the interesting things it can be programmed to do, like light up in many different colors, flash, and get brighter and dimmer.

Designing a Wearable Circuit

Participants worked individually or in small groups to create functional and whimsical circuits that they could wear, and homemade switches made the LEDs respond to their movements.

Janet Groenert's LED Obi

Artist and Science Museum of Minnesota staff member Janet Groenert shared her Obi, a wearable artwork covered in 700 LEDs that are programmed to create patterns inspired by chrysanthamum-patterned textiles and bursting fireworks. Read more about Janet on page 16.

TUESDAY THOUGHTS

From Facilitators

"Keith's example about human motion, and how we can use that motion to turn on lights, really helped the participants think about using motion that is not mechanically or electronically produced." -Asia

From Participants

"I like the idea of not using the parts contained in the PicoCricket Kit, and instead using handmade switches. What also appealed to us was working with found objects—taking all these parts and then bringing them together. By working with the found objects, kids can think about the world around them." -Lenore

WEDNESDAY OVERVIEW

Wednesday's Theme Playing with Resistance

Wednesday's Goals

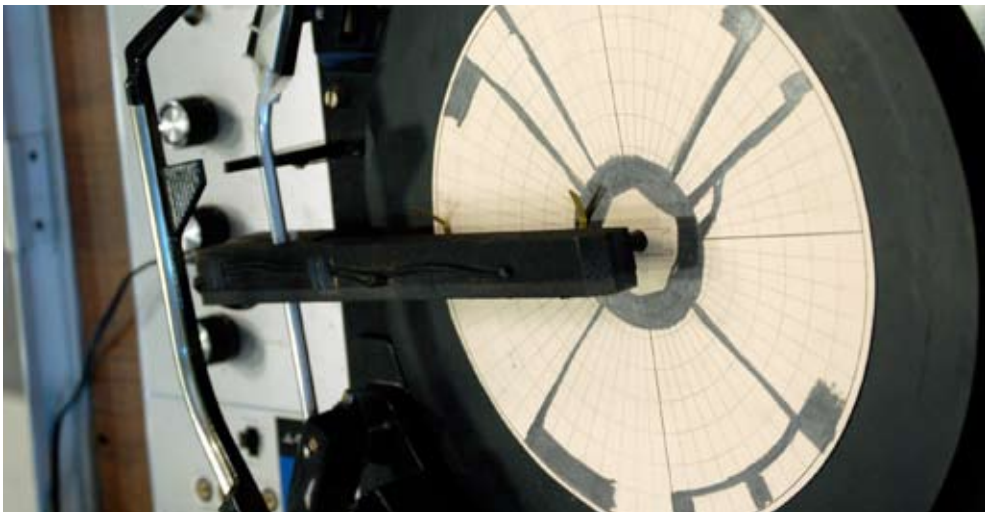
• Explore materials that vary the resistance in a circuit, and play with ways of hearing and seeing these changes.

• Use these materials and other resistive sensors to build sensors that detect changes in a garden.

• Reflect on the first two days and the qualities of PIE activities and experiences.

Musical "Graphiti"

Musical "Graphiti" is a walk-up activity in which you make music with graphite drawings or finger paintings, using the Cricket and the resistance sensor. We started the day with this activity, and then explored resistance and conductance in circuits using other materials: batteries, buzzers, melons, Twinkies, ice, wet sponges, and more. We experimented "hearing" and "seeing" changes in the conductance in these circuits, using Crickets, the sound box, and the tricolor LEDs.



Caleb Coppock's Resistive Record Player

Caleb, an artist from Lincoln, Nebraska (formerly from Minneapolis/St. Paul), shared his Resistive Record Player. He used a turntable, electronics, and "records" (paper discs covered with graphite-drawn patterns) to create a player that buzzes and bleeps based on the resistance it measures. Read more about Caleb on page 16.

Moving Outdoors: Sensing in a Garden

In the afternoon, we moved outside to the museum's outdoor exhibit, The Big Back Yard. After spending some time observing the garden's plants, insects, flowing water, changing light, and breezes, we began to build sensors that could detect some of these changes.

Facilitation, Environment, and Materials Discussion

We also spent some time reflecting on our experience so far, through a conversation about *facilitation*, *environment*, and *materials*.

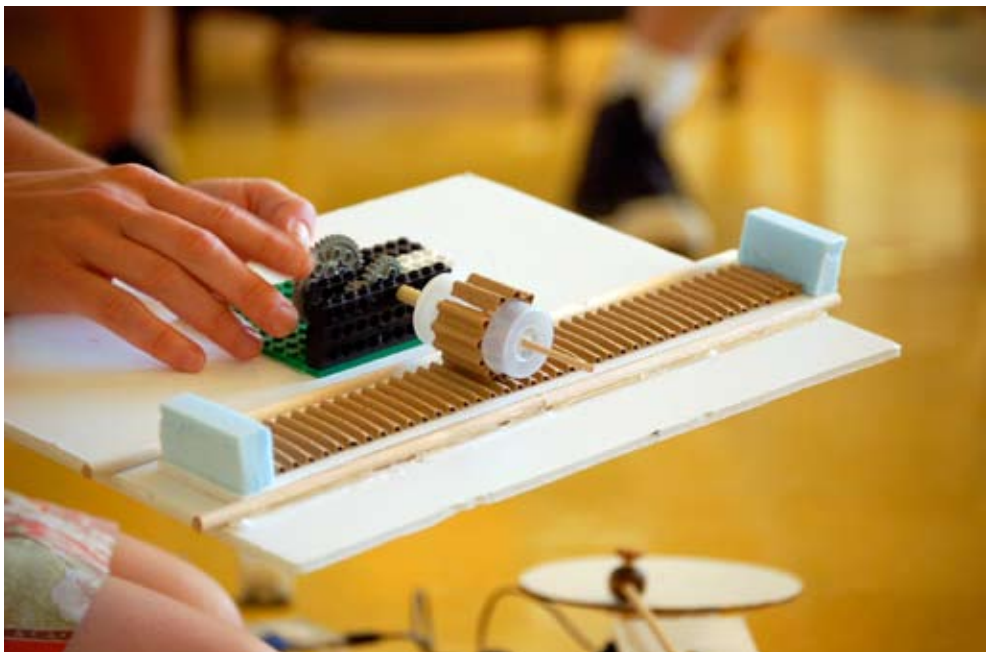
Prompt 1
In the activities we've done to this point, what impact did the elements of facilitation, environment and materials have on your experience?

Prompt 2
How would you describe the experience to a friend or colleague, in terms of these three elements?

WEDNESDAY THOUGHTS

From Facilitators

"We don't often articulate how to play. Experimenting with milk, batteries, and buzzers to make circuits does that really well." -Keith



From Participants

"I enjoy the type of instructors at this workshop—artists and teachers with experience using Crickets creatively. And you don't give us answers—we have to problem solve." -Mary Ellen

"I liked the silliness of the materials. I see the range of the materials now, they're all sorts of things that are wet!" -LaJean

THURSDAY OVERVIEW

Thursday's Theme

Getting Inspired by Scavenged and Surplus Parts

Thursday's Goals

• Use surplus stores and second-hand toys and electronics as sources for interesting supplies and materials.

• Begin working on projects that use sensors or switches, and motors, sound, or lights to detect and respond to a change in the garden.

THURSDAY ACTIVITIES

We continued working in the Big Back Yard and the Science House (an eco-friendly building in the garden that houses a classroom and library), creating projects that respond to the garden environment.

Participants looked at several examples of motion, triggered by sensors: a Calm Chime that uses a stirring spoon in a glass of ice water to create cool, tinkling sounds on a breezeless day; and a Train Scribbler that uses the vibration created by a passing train to make scribbly drawings on a piece of paper.

Ax-Man Surplus Store Field Trip

Ax-Man Surplus is a Twin Cities institution—a favorite source of funky and useful materials, from knife switches to magnets, DC motors to doll heads. We ventured to the store to search for switches, sensors, buzzers and lights, and other inspiring junk. Participants brought along preprogrammed Crickets to test surplus inputs (switches and sensors) and outputs (motors, lights, and buzzers).

THURSDAY DISCUSSION

Computer as Paintbrush Discussion

We read and discussed Mitchel Resnick's article, "Computer as Paintbrush," using these prompts:

Prompt 1

What aspects of the article stood out to you that you would like to mention to the group?

Prompt 2

What things in the article are most like or unlike the way you teach now?

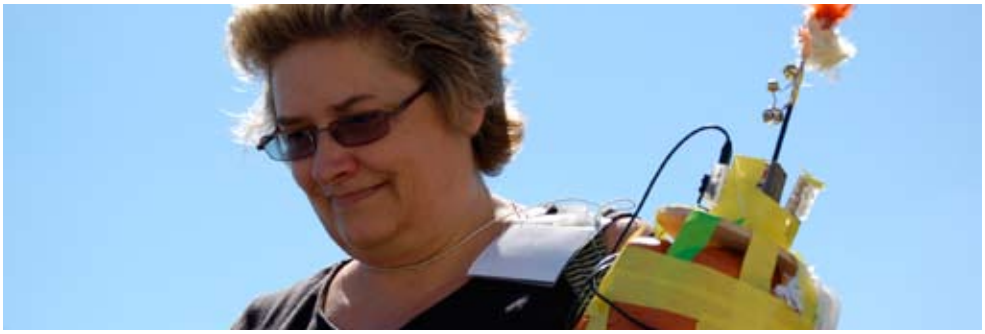
(Download the Mitchel Resnick article)

THURSDAY THOUGHTS

From Facilitators

"A PIE Atelier might be the first time that participants get to play like this. In planning the workshop, we try to provide the right amount of time and right sequence of experiences for people to become comfortable playing and with the openness that will come later." -Mike

"I loved the transition to the outdoors today. One of our big goals of this atelier is to get participants thinking about connecting Crickets to materials beyond the kit, LEGOs, and other standard parts. That's why we're spending time playing with circuits, making homemade switches, shopping at surplus stores, and taking toys apart to reuse parts. Working outdoors is an extension of that – these projects don't have to happen in a classroom, you can find inspiration anywhere!" -Kristen



From Participants

"I'm glad that we were given lots of materials, and had time to work with them on our projects. The workshop was very hands on, and it gave us lots of time for play." -Mary Ellen

"As we were talking about exploration and play I was reminded of a *Journal of Medicine* article on the justification of play – it was amazing – this was in article in a journal of medicine!" -Rachel

FRIDAY OVERVIEW

Friday's Theme

Creating a Sensor Garden

Friday's Goals

• Work on projects that detect and respond to changes in the garden, by combining inputs (sensors and switches) and outputs (motors, sound, and lights).

• Try our hands at disassembling toys and at soldering, scavenging old parts to create new ones.

FRIDAY ACTIVITIES

Participants continued working on their projects for the Sensor Garden. Some projects were installed outdoors, among the plants, or in a stream table exhibit. Others were inspired by the outdoors or natural materials, and were presented inside the Science House. At the end of the day, participants shared their work with the group, and packed up examples and projects to take home.

Take-Apart Table

During the day, participants were invited to take a break from their projects and visit Asia Ward at the take-apart table. There, they could disassemble a toy, removing circuits, switches, lights, and motors. They could also practice soldering by making a homemade motor connector cable

FRIDAY THOUGHTS

From Facilitators

"I enjoy teaching how circuits work by disassembling toys and other electronics, then creatively reassembling, but this is the raw view of basic circuits. This way does not let the students control the programming; it just lets the student know how to make things work via switches and buttons through a basic circuit. The Cricket gives students the control over the programming, and lets them experiment with the potential of that control: light, motion detectors, motors, handmade, pre-made switches. I believe it is good to learn both, and helpful when coming up with creative ideas." -Asia

From Participants

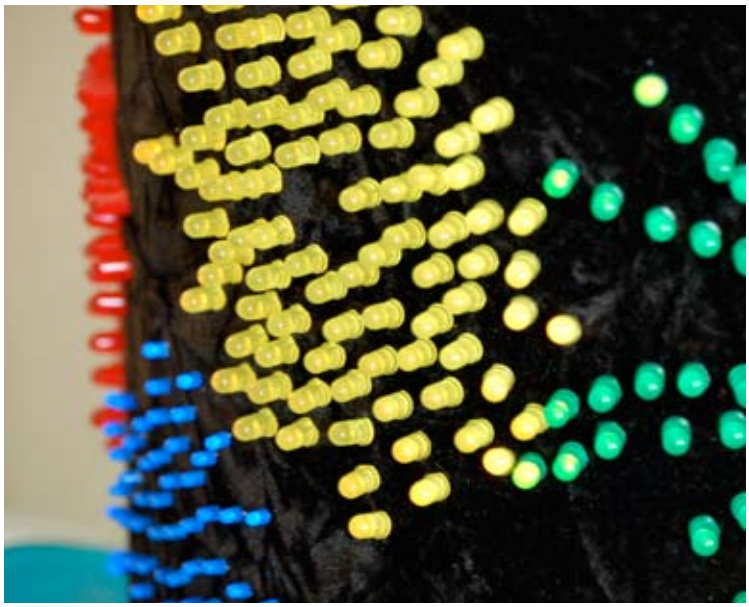
"Crickets at first seem bland, but because of the PIE Sensor Garden workshop, my understanding of their capabilities has expanded." -Jon

"I don't want to leave the museum—this is the first time I've been able to see people learn to think outside the box. It's too bad more educators can't have this kind of experience!" -Josh

ARTIST RESIDENCIES

PIE works with artists to explore new ways of using materials, new approaches to design problems, and new techniques for presenting phenomena. We invited two artists, Janet and Caleb, to share their work with participants and work alongside them during the week. Both Caleb and Janet's work connected with projects we worked on during the week: making sound with electrical current, and making wearable circuits.

Janet Groenert



Electronic Obi and *Caution Tape Flowers* by Janet Groenert

Caleb Coppock

Graphite Sequencer - by Caleb Coppock (2007)

Supplemental Materials

Browse the list below to download documents from the Kinetic Contraptions workshop. You can also review all of the Web sites referenced in the text of this document alongwith other connections we find inspiring.

WEB SITES

PIE Web site	www.exploratorium.edu/pie
PicoCricket	www.picocricket.com
Janet Groenert	www.mnartists.org/artistHome.do?rid=66129
Caleb Coppock	www.calebcoppock.com
Ax-Man Surplus Store	www.ax-man.com
PIE Things to Try	www.pienetwork.org/a2z/
Learning Technologies Center Website	www.smm.org/ltc
All Electronics	www.allelectronics.com
Jameco	www.jameco.com

IMAGE GALLERY

VIEW AND DOWNLOAD IMAGES FROM THE

SENSOR GARDEN

GALLERY

www.exploratorium.edu/pie/gallery/sensorgarden

DOWNLOADS

Resources

Participant List (50 kb)

Homemade motor connector cable (1.0 mb)

Mitchel Resnick article (50 kb)