

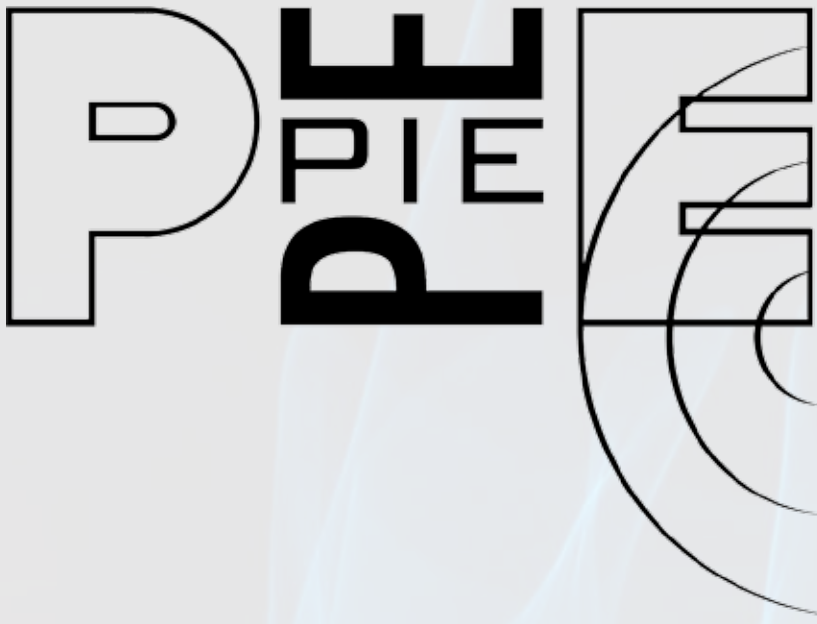
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ATELIER DOCUMENTATION

ART MACHINES  
AT THE EXPLORATORIUM

AUGUST 28 - SEPTEMBER 1, 2006





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

## ART MACHINES

August 28 - September 1, 2006  
At the Exploratorium  
San Francisco, CA

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The PIE Institute is made possible by the National Science Foundation under Grant No. ESI-0452567. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



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.

The Art Machines Atelier brought together museum and out-of-school educators interested in combining art, science, and technology in exhibits, workshop activities, and museum public programs.

Participants explored art-making activities as learners, then deconstructed the projects in order to better understand how they are developed and tailored for diverse educational and audience needs. Ultimately, participants created new art-making activities to try with learners in their home institutions. Projects included painting with light, mark-making robotic contraptions, handmade film, and other activities.







Clockwise from top: Barry turns the tables on a hand-cranked generator; Sherlock on the floor with his scribbling machine; Close-up of a mark-making contraction.

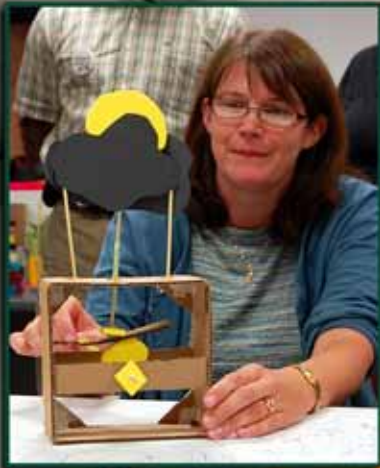
We explored the **Scribbling Machines** activity as a way to get everyone comfortable working in a materials-rich studio environment, and to share a few ways that we introduce technology as part of a PIE activity.



*“Everything in kid’s lives today is becoming so high tech, sometimes it’s nice to go back to elementary ideas of technology.”*  
Kathy (LIGO)







*Clockwise from left: Becky examines the mechanism of a cardboard automaton; Robert tests his sound contraption; Deborah builds a rain-stick; John investigates the sound-making potential of found objects.*



Creating **Cardboard Automata** gave us an opportunity to explore cams and other simple mechanical movements. Then we experimented with more complex mechanisms and used them as inspiration for the **Scratch Film Sound Automata** activity.



*"You can have an idea, but to have an idea with a glue gun, some wood, and some screws, and then to make something – that's a whole other level." John (LIGO)*





## WHAT HAPPENED WEDNESDAY

The day started with a collaborative performance of our Scratch Film Sound Automata. This led to a discussion about the role of workshop facilitators, the design of the environment, and the use of tools and technology in PIE activities.



We spent the afternoon “sensing the environment” by introducing more PicoCricket sensors and experimenting further with Pico programming. We also incorporated sensors and relays that were salvaged from discarded machines.



*“The cricket was just another tool. You had to understand how to use the drill press well enough to make a hole. You had to know how to use the skillsaw well enough to cut your board. And so you also had to know how to program a Cricket.” Robert (St. Louis Science Center)*





## WHAT HAPPENED THURSDAY

We introduced two new PIE activities, Light Painting as an activity that utilized the Pico tricolor LEDs, and Scratch, a Pico-related software program used to create computer animation and interactive on-screen programs.



We had an in-depth group discussion about the pedagogical and philosophical issues related to PIE activities.



*"For me, it was about thinking outside the box. It blurs the academic divisions of subjects, and adds in the realms of creativity and problem solving."*

*Keith (Children's Museum of Houston)*





As a final group activity we explored a number of listening exercises, and created new sounds with a piezo microphone and found objects.



Our final discussion was an opportunity for everyone to share the big ideas from the week that they were bringing back to their home institutions.

*"Before I got here I thought I was thinking outside the box. My perception of my own perception has changed."* Melanie (Children's Museum of Houston)

*"I realized that we were only a half an hour into the day at one point and everyone was completely engaged and focused. You have to ask: How did they set up the day? It's about designing activities that draw out intrinsic motivations."* Saafir (Fort Worth Museum of Science and History)



## Atelier Goals

- To share a set of established PIE activities
- To invite participants to improve and expand upon the basic formats
- To make new connections and evolve new ideas for use at each participant's institution

## Atelier Context

Technology has an important role in PIE philosophy and practice, but 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 natural phenomena. Technologies, whether mechanical or digital, are introduced to advance ideas that begin with more basic explorations.



## MONDAY OVERVIEW

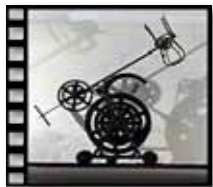
### Monday's Theme

Mark Making: Inputs, outputs, and a little logic

### Monday's Goals

Atelier Introduction. Participants become familiar with PIE activities. Use simple electronic parts as the base for a complex artistic activity. Model how to utilize the museum exhibit floor. Begin experimenting with PicoCrickets.

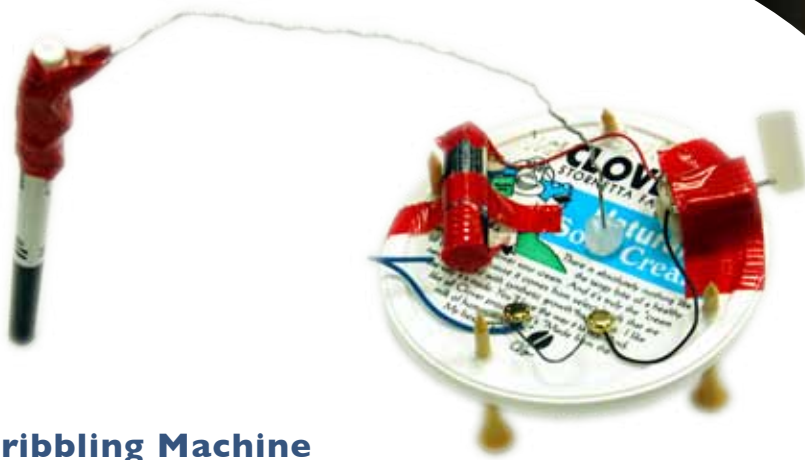
### Morning Film



Arthur Ganson Machines  
(1978-2004, 70min)  
by Arthur Ganson

[www.arthurganson.com](http://www.arthurganson.com)





### Scribbling Machine

Download the [Scribbling Machine PDF](#) for a materials list and step-by-step directions. We started the activity with an expanded set of motors, including small pager motors ([www.pagermotors.com](http://www.pagermotors.com)), a variety of batteries, and Genecon hand-crank generators, part #WL2410 ([sargentwelch.com](http://sargentwelch.com)) .



### Mark-Making exhibit floor walk

Barry led a Mark-Making exhibit floor walk for participants to explore unusual ways that exhibits make marks. [Download the map](#)



### PicoCricket introduction

Some participants in the group utilized the PicoCricket, motor, and touch sensor to create computerized mark-making machines. ([www.picocricket.com](http://www.picocricket.com))

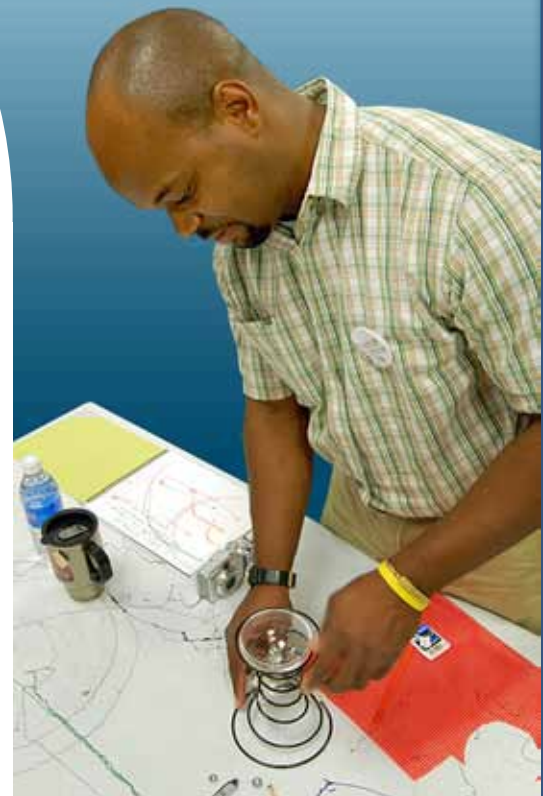


## From Facilitators

“Starting out with simple materials like motors, batteries, and wires sets the stage for more complex explorations later in the activity.” (Karen)

“The idea of the day was to introduce the tools and materials, alongside a very simple use of the Cricket. That is, we start low tech and move to higher tech. There are a lot of kinds of sensors in the Cricket kit that we didn’t use today, but we’ll experiment with them later in the workshop.” (Mike)

“We wanted to immerse the participants in a materials rich, inspiring environment for inventing and learning.” (Karen)



## From Participants

“It was a comfortable environment for trying out new things.” (Keith)

“You started us at a point that was comfortable for a lot of us, but still challenging.” (Robert)

“Everything in kid’s lives today is becoming so high tech, sometimes it’s nice to go back to elementary ideas of technology.” (Kathy)

## Tuesday's Theme

Automata: Design technology and construction

## Goals

Use complex automata artwork to inspire and inform the construction of simple machines. Build on the simple machines and create more complex projects. Build on the initial understanding of PicoCrickets.

## Morning Film

Cabaret Mechanical Video (1991, 43min) by Gary Alexander

[www.automatashop.co.uk](http://www.automatashop.co.uk)

## Cabaret Mechanical Theatre Automata

Artist's work from the Cabaret Mechanical Theatre is the main source of inspiration and models for exploring automata. [www.cabaret.co.uk](http://www.cabaret.co.uk)



# TUESDAY ACTIVITIES

## Cardboard Automata

Download the [Cardboard Automata PDF](#) for a materials list and step-by-step directions. We started the activity by looking at a variety of models and actual artwork from the Cabaret Mechanical Theatre artists. A video catalog of the Cabaret Mechanical Theatre can be found at [www.automatashop.co.uk](http://www.automatashop.co.uk)

## Sound Automata

Download the [Sound Automata PDF](#) for a materials list and step-by-step directions. We combined the sound automata activity with the Scratch Film activity.

## PicoCrickets

Each participant utilized a PicoCricket, motor, and light sensor to create computerized triggers for their sound automata. [www.picocricket.com](http://www.picocricket.com)



# TUESDAY THOUGHTS

## From Facilitators

"These activities allow each person to explore their own ideas, at their own pace, within the overall theme." (Mike)

"The digital technology, the PICO Cricket, is important to this activity, but not an overwhelming focus or distraction from the intention of creating sound makers." (Karen)

## From Participants

"A simple idea isn't always that simple." (Melanie)

"There was more time to take an original idea and pursue it fully." (Elena)

"You can have an idea, but to have an idea with a glue gun, some wood, and some screws, and then to make something - that's a whole other level." (John)



## Wednesday's Theme

Responsive Environments: Sensing the world around you

## Goals

View the scratch film, sound automata performance. Discuss the role of tools, materials, facilitation, and technologies in the first set of PIE activities. Build upon initial sensor explorations by constructing PicoCricket devices that respond to the environment.

## Morning Film

Light Play: Black-White-Grey (1930, 5min) by Laszlo Moholy-Nagy  
Available to rent or purchase on 16mm film from [www.moma.org](http://www.moma.org)

## Scratch Film/Sound Automata Screening

Alex Nischelwitzer recorded the Scratch Film/Sound Automata performance and posted the movie at <http://www.nischelwitzer.com/index.php?id=158>



# WEDNESDAY ACTIVITY

## Responsive Environments: Sensing the world around you

It's exciting to think about Cricket projects on a human scale: sensors that are triggered by a person's movement, and lights, sound, and movement that change the way a space feels. In this activity, we worked in groups of 2-4 to make installations that were triggered by people for the Exploratorium classroom and exhibit space. This activity is inspired by the work of **Diane Willow**, and other artists who transform spaces with light, sound, and movement.

# DISCUSSION

## PIE facilitation, materials, tools and technology discussion

We asked participants to step back and reflect on the first set of PIE activities.

## Discussion Prompt

"What role did the design of the environment, the available tools and materials, the facilitation by workshop leaders, and digital technology play in your experience as a learner in the first set of PIE activities?"

## Discussion Responses

"The activities made me push myself to do something that I didn't know how to do." (Keith)

"The Crickets were seen as just another tool." (John)

"The other participants were important to helping me solve problems and push my ideas." (Robert)

"It's a luxury to have the time to actually formulate an idea and then carry it out myself." (Keith)

"The activities were personally meaningful to me because I chose what I wanted to build." (Lucinda)

"The activities and the room are rich in experimental variables." (Elena)

## From Facilitators

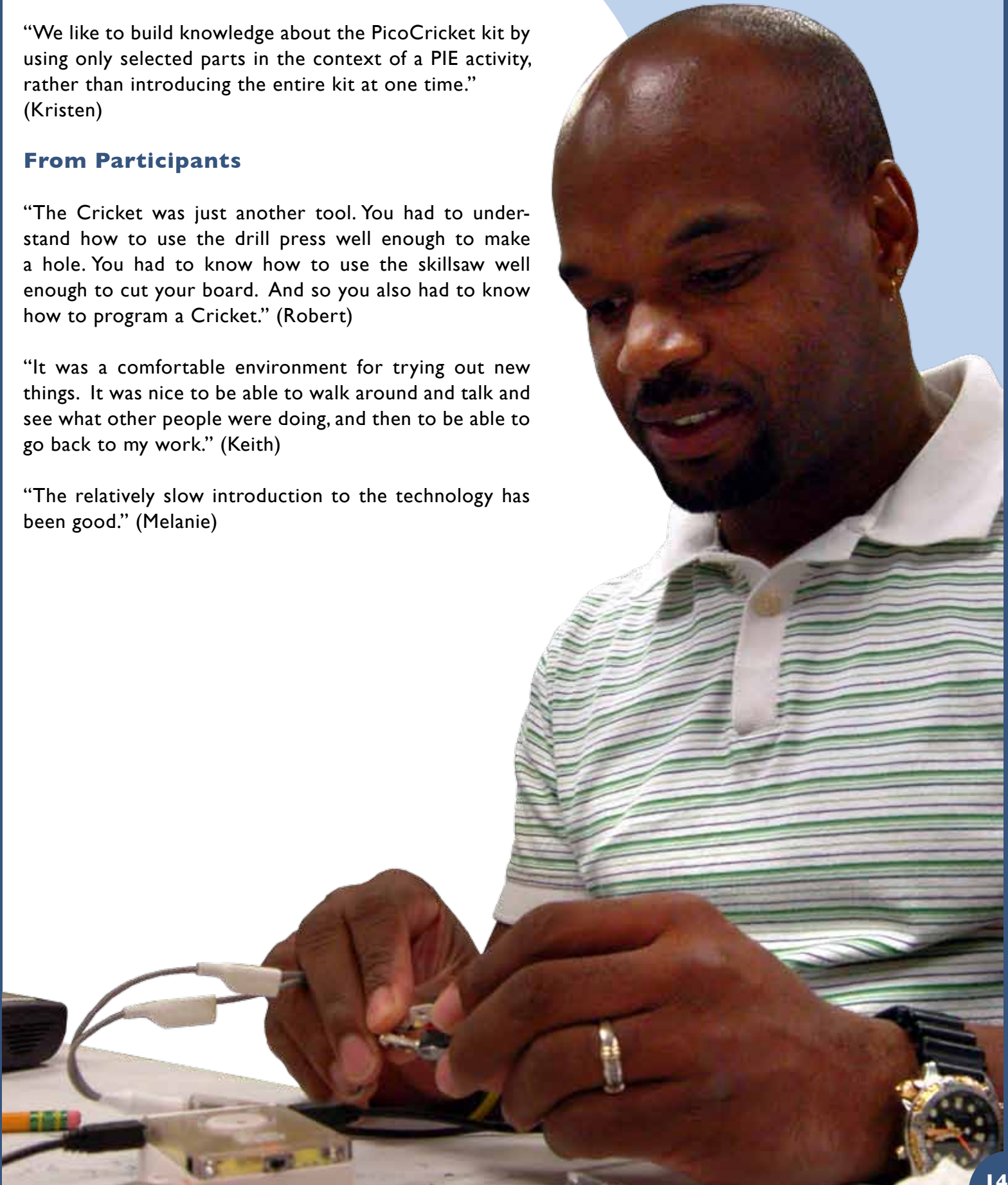
“We like to build knowledge about the PicoCricket kit by using only selected parts in the context of a PIE activity, rather than introducing the entire kit at one time.”  
(Kristen)

## From Participants

“The Cricket was just another tool. You had to understand how to use the drill press well enough to make a hole. You had to know how to use the skillsaw well enough to cut your board. And so you also had to know how to program a Cricket.” (Robert)

“It was a comfortable environment for trying out new things. It was nice to be able to walk around and talk and see what other people were doing, and then to be able to go back to my work.” (Keith)

“The relatively slow introduction to the technology has been good.” (Melanie)





**Thursday's Theme**

Studio explorations, activity reflections.

**Goals**

Introduce two new PIE activities. Participants revisit previous explorations. A group discussion about science learning connections to PIE activities.

**Morning Film**

100 watts, 120 volts (1977, 9 min) by Carson Davidson



## THURSDAY ACTIVITIES

**Light Painting**

Download the [Light Painting PDF](#) for a materials list and step-by-step directions.

**Scratch Programming**

Scratch is a new programming language that lets you create your own animations, games, and interactive art. (See the sidebar for more...)

**SCRATCH PROGRAMMING**

Like PicoBlocks, it is a graphical programming language: you connect instruction blocks together to create programs.

Participants got acquainted with Scratch by experimenting with programming interactive drawings and animations. We also looked at sample projects made by youth and adults, and tried using the Scratch board, which lets you use sensor input in Scratch projects.

## DISCUSSION

**Learning from PIE Discussion**

Barry led a whole-group discussion about the learning that happens during a PIE activity. He shared a [Power Point](#) presentation and a [handout](#) with the group.

**Discussion Prompt(s)**

“What are the content, skills, and attitudes learned in PIE activities? What would you like your audience to get out of a PIE activity?”

**Discussion Responses**

Participant responses were recorded on the board during the discussion, and later as a PDF file. Download the [Discussion Responses PDF](#)

## THURSDAY THOUGHTS

**From Facilitators**

“This was our first chance to discuss the pedagogical principles related to PIE, and to begin to make the case to others.” (Mike)

**From Participants**

“How am I going to get buy-in at my institution? It looks like we’re playing. People are going to ask where’s the learning? Where’s the science?” (Robert)

“For me, it was about thinking outside the box. It blurs the academic divisions of subjects, and adds in the realms of creativity and problem solving.” (Keith)

Scratch is being developed by the Lifelong Kindergarten research group at the MIT Media Lab. A beta version of Scratch is currently available to download. (<http://scratch.mit.edu/beta>)

MIT also maintains a Scratch blog. (<http://scratch.mit.edu>)

**Friday's Theme**

Listening technologies. Taking it all home.

**Goals**

Final group listening activity led by Kitundu, utilizing piezo technology. Atelier wrap-up, reflections, and next steps.

**Morning Film**

Solar Do-Nothing Machine (1957, 2 min) by Charles and Ray Eames  
(From The Films of Charles & Ray Eames, Volume 6)

[www.image-entertainment.com](http://www.image-entertainment.com)



FRIDAY ACTIVITY

**Piezo Listening Exploration**

Learning Studio artist in residence Walter Kitundu led an activity that began with having participants listen carefully to every sound in their environment. After getting attuned to the sonic world, people began investigating the sound making properties of everyday materials, such as cups, wood scraps, springs, paper, chairs, etc.

After exploring the audible sounds, we introduced piezo electric microphones to highlight the quiet internal sounds of materials. Participants used their sound sources to collaboratively create music by using a phrase sampler and by conducting live improvisations.

For more on the Piezo Listening Activity, including a description by Kitundu, a materials list, and a guide to the technology.

Download the [Piezo Activity PDF](#)





## PIE Reflections Planning and Discussion

This two-part discussion explored participants' descriptions of PIE activities, and their plans to continue PIE investigations at their home institutions.

### Discussion Prompts

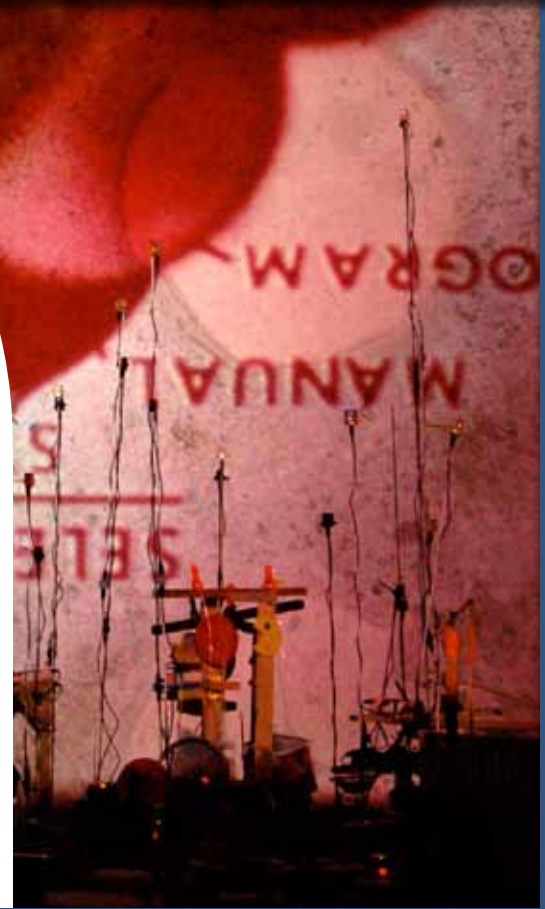
Part One: Finish the sentence, "A PIE activity is ..."

Part Two: Think about how you plan to continue PIE activity at your institution. What will you do on Monday? What will you do someday?

### Discussion Responses

Participant responses to "A PIE Activity is..." are compiled in a PDF file called [A PIE Activity Is...](#)

Participant plans for continued PIE development at their institutions are compiled in the [Someday, Monday PDF](#) file.



## FRIDAY THOUGHTS

### From Facilitators

"The piezo microphone activity is a great way to introduce a new technology in a playful and inventive way." (Karen)

"The aesthetic value of PIE is in the experience, not just the outcome." (Kristen)

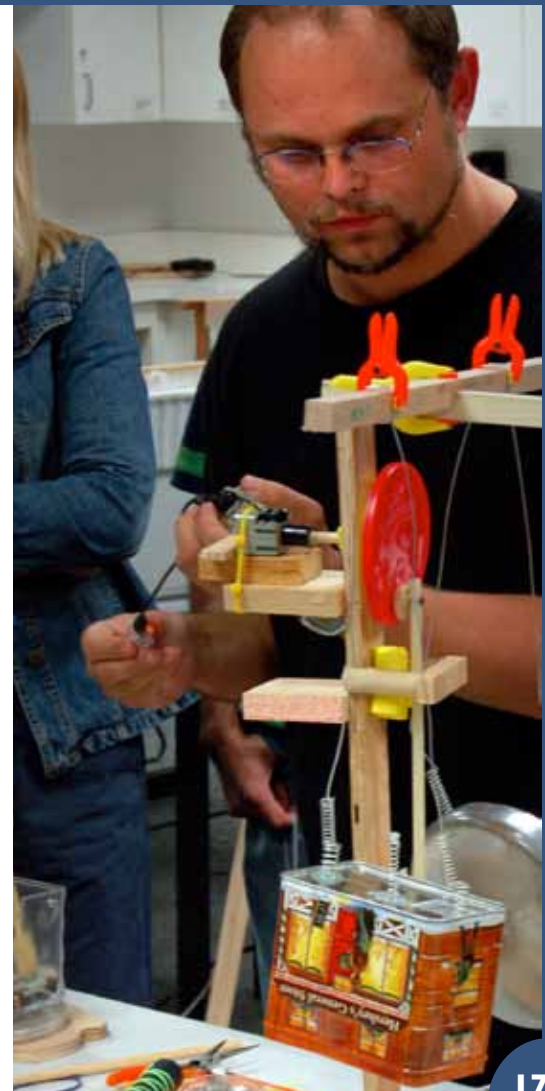
### From Participants

"Taking an idea from imagination to realization - that's not something that I get to do at work." (Betsy)

"The mechanical stuff was simple for me. I'm pretty good with my hands. The challenge was to be more creative." (Robert)

"Every activity supported all levels of learners. I had a really limited knowledge of a lot of the things we worked with. But the instruction and facilitation supported me." (Betsy)

"Before I got here, I thought I was thinking outside the box. My perception of my own perception has changed. A simple idea is not always that simple." (Melanie)



## ARTIST RESIDENCIES

PIE works with artists to explore new ways of using materials, new approaches to design problems, and new techniques for presenting phenomena. Bernie Lubell and Douglas Repetto participated as artists in residence in the Art Machines Atelier, presenting their own investigations of mark-making contraptions. Other artists were represented through projects on view in the Learning Studio

**Walter Kitundu** is a sound and visual artist, graphic designer, composer, and instrument builder. He uses an interdisciplinary approach to develop compositions-installations-instruments that blur the boundaries between media. To reconnect the technology of new music to fundamental principles drawn from the natural world, he constructs elemental instruments and turntables that use wood, water, fire, and earthquakes to compel timbre and pitch. He is a multimedia artist at the Exploratorium.

[www.kitundu.com](http://www.kitundu.com)

**Bernie Lubell** makes interactive installations that provoke the silly and playful kinesthetic comprehensions of childhood in service of philosophical explorations of the nature of consciousness and the origins of life. Working in an adamantly low-tech mode, he constructs sculptures from wood, latex, wire, and rope. The works use neither computers nor motors, but are rather entirely powered by visitors. As people work together to animate the mechanisms, their rocking, pressing, pedaling, cranking, pulling and breathing engages bodies as well as minds in constructing understandings.

<http://blubell.home.att.net>

**Douglas Repetto** is an artist and teacher whose work includes sculpture, installation, performance, recordings, and software. He is the founder of a number of art/community-oriented groups including dorkbot: people doing strange things with electricity, ArtBots: The Robot Talent Show, organism: making art with living systems, and the music-dsp mailing list and website. He is director of research at the Columbia University Computer Music Center.

<http://music.columbia.edu/~douglas>

**Bruce Shapiro** is an expert at repurposing computers and scrap high-grade motion-control components into “art machines.” His art machines use computer programming and motion-control components to create fluid designs sketched on eggs, cut into steel, or drawn in the sand. Sisyphus, installed in the Exploratorium’s Learning Studio, is a sand-plotting machine that uses a robotic arm and a magnet to drag a metal ball through the sand, creating complex geometrical patterns.



15 string Phonoharp  
Walter Kitundu



“And the Synapses Sweetly Singing...”  
Bernie Lubell



Giant Painting Machine  
Douglas Repetto



Sisyphus (detail) - Bruce Shapiro



## Supplemental materials

Browse the list below to download documents from the Art Machines workshop. You can also review all the websites referenced in the text of this document along with other connections we find inspiring.

## WEBSITES

Pie Website	<a href="http://www.exploratorium.edu/pie">www.exploratorium.edu/pie</a>
Scratch beta	<a href="http://scratch.mit.edu/beta">http://scratch.mit.edu/beta</a>
Eames film	<a href="http://www.image-entertainment.com">www.image-entertainment.com</a>
Scratch blog	<a href="http://scratch.mit.edu">http://scratch.mit.edu</a>
Alex's film	<a href="http://www.nischelwitzer.com/index.php?id=158">http://www.nischelwitzer.com/index.php?id=158</a>
Light Play film	<a href="http://www.moholy-nagy.org">http://www.moholy-nagy.org</a>
PicoCricket	<a href="http://www.picocricket.com">www.picocricket.com</a>
Cabaret Mechanical Theatre	<a href="http://www.cabaret.co.uk">www.cabaret.co.uk</a>
Cabaret online store	<a href="http://www.automatashop.co.uk">www.automatashop.co.uk</a>
Douglas Repetto	<a href="http://music.columbia.edu/~douglas">http://music.columbia.edu/~douglas</a>
Bernie Lubell	<a href="http://blubell.home.att.net">http://blubell.home.att.net</a>
Walter Kitundu	<a href="http://www.kitundu.com">www.kitundu.com</a>
Hand crank generators	<a href="http://www.argentwelch.com">www.argentwelch.com</a>
Pager motors	<a href="http://www.pagemotors.com">www.pagemotors.com</a>
Aurthur Ganson	<a href="http://www.arthurganson.com">www.arthurganson.com</a>
Diane Willow	<a href="http://artdept.umn.edu/faculty/facProfile.php?UID=willow">http://artdept.umn.edu/faculty/facProfile.php?UID=willow</a>

## IMAGE GALLERY

VIEW AND DOWNLOAD IMAGES FROM

## THE ART MACHINES GALLERY

<http://www.exploratorium.edu/pie/gallery/artmachines>



## DOWNLOADS

### Resources

- [Art Machines Journal](#) (9.8 mb)
- [Participant List](#) (512 kb)
- [Short Schedule](#) (964 kb)
- [Barry's Floor Walk Map](#) (972 kb)
- [Monday Someday Discussion](#) (128 kb)
- [Learning From PIE Handout](#) (352 kb)
- [Learning From PIE Discussion](#) (124 kb)
- [Learning From PIE Powerpoint](#) (868 kb)
- [A Pie Activity is...](#) (96 kb)

### Activities

- [Scribbling Machine](#) (4.9 mb)
- [Light Painting](#) (6.3 mb)
- [Cardboard Automata](#) (11.3 mb)
- [Sound Automata](#) (6.7 mb)

