PROJECT OVERVIEW
PIEZO EXPLORATIONS

Piezo Explorations is the working title for a new activity focused on exploring sound from our surroundings and everyday objects through contact microphones. We invite learners to mess about with sounds, investigate how they are created and ultimately see sound as a material to tinker with.
Piezo microphones allow learners to slow down and pay close attention to common phenomena, like the sound of a slinky, or marbles rolling inside a bowl; this creates curiosity to explore a world of sounds and noises. Becoming immersed in the phenomenon in turn inspires stories and ideas for creating audio-visual narratives involving digital tools and programming.

In this report, we are sharing our current observations and findings about materials, environments, software tools, and activity prompts to support open-ended and playful investigation of sound.

Disclaimer: This is not a “how to” activity guide. It is a summary of the experiments and findings of an extended period of research and development around tinkering in the digital world, with a focus on investigating sound with pic-up microphones. By sharing this, we hope to inspire discussions and provide ideas for projects and tinkering activities in this area.

Piezo Explorations is a collaboration between the Tinkering Studio, MIT’s Lifelong Kindergarten group, LEGO Foundation, and Reggio Children Foundation.

the tinkering studio

exploratorium

MATERIALS, TOOLS AND HARDWARE

Everyday materials as sound sources

A selection of everyday materials suited to create a wide range of percussive, harmonic, high and low pitched sounds are laid out on a table for learners to touch and play with. We carefully curated materials that reward exploration with a contact microphone. The best objects for sound are familiar but used in a new way. They don't produce a loud sound unless they are amplified, and can be activated or "played" in a variety of ways.

A slinky or a metal spring is a good example. A wide range of unexpected sounds is hidden in a spring that only becomes audible using the contact microphone as a tool. We categorized the different materials into groups not by the sounds they make (we leave that for learners to discover) but by the way one can manipulate them: plug, shake, tap, scratch, etc.

Material examples:

-plastic sheets, sand paper, and foil with different textures

-metal and glass bowls, wooden boxes to fill with balls or beads

-resonators with rubber bands or metal pieces to plug

-different sized pieces of wood to tap

-crumpled up foil, parchment paper, and leaves

-springs and slinkies

-marbles, small ball bearings and wooden balls

-glasses and bottles

-small strikers and mallets

Piezo microphones with IPads or amplifiers

A piezo microphone

A piezo microphone (https://makezine.com/projects/make-38-cameras-and-av/piezo-contact-mic/) is also known as a contact microphone, and will amplify tiny movements and vibrations of any surface it is in contact with. The piezo microphone is paired with an amplifier that sends the sound signal to headphones or to a digital device (iPad) to record it.

Partner headphones

One of the values we see in the tinkering approach is naturally emerging collaboration and communication with co-learners. Wearing headphones can isolate participants from facilitators and make it hard for others to connect to their experience. We quickly found that two pairs of headphones connected to an amplifier via a headphone splitter allow participants to closely work together in pairs, that way discoveries are shared and discussed between partners. Spelling out ideas and hypothesis and reflecting on observations together results in a deeper learning experience.

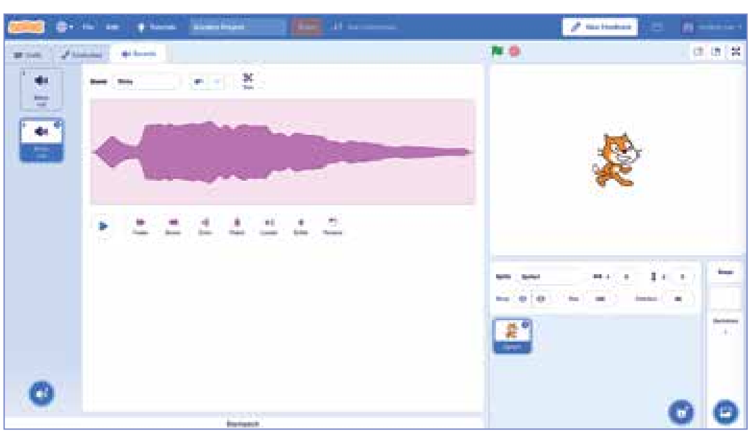
Recording station

A recording station for two participants: Next to the laptop with headphones and piezo microphone, the black velvet mat on the table provides a space for the objects learners choose to investigate. Cards with drawings invite learners to find an object from the materials selection and try to move it to create a certain sound.

SOFTWARE

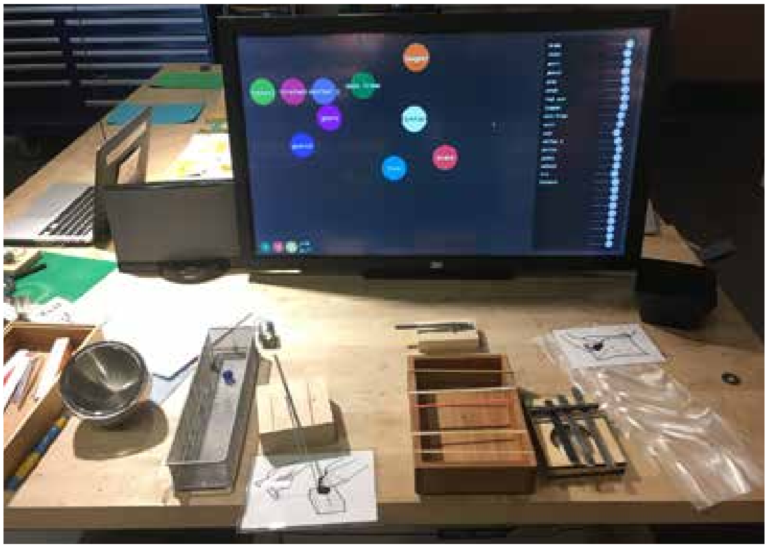
During our prototyping sessions with visitors we saw a natural progression from exploring sounds to recording/collecting sounds and finally naming them as they were recorded. To deepen their exploration, we introduced a variety of options to work with the sounds after they'd been collected. Software plays a role as both a tool to collect and organize sounds as well as to create with sounds. We experimented with two software tools.

Scratch 3.0



The Scratch programming environment is a visual block-based coding platform. It is designed to invite experiments with code and a playful approach to programming (https://scratch.mit.edu/educators/). For this activity we are taking advantage of a new, intuitive sound editor included in the latest Scratch release (Version 3.0) that allows to record and manipulate sounds, add them to a library of sprites, and then use them in Scratch animations.

"Sound field" software

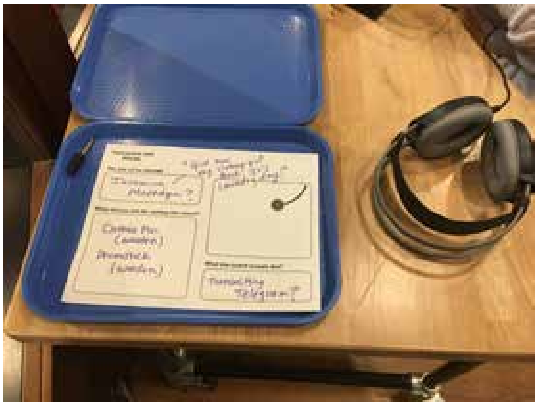


Sound Field is a custom software we created for Ipads and laptops when we realized that a non-disruptive tool for recording sounds was needed. The simple and compact interface allows to record and store short sound snippets with one button press while keeping learners focused on exploring the materials in front of them.

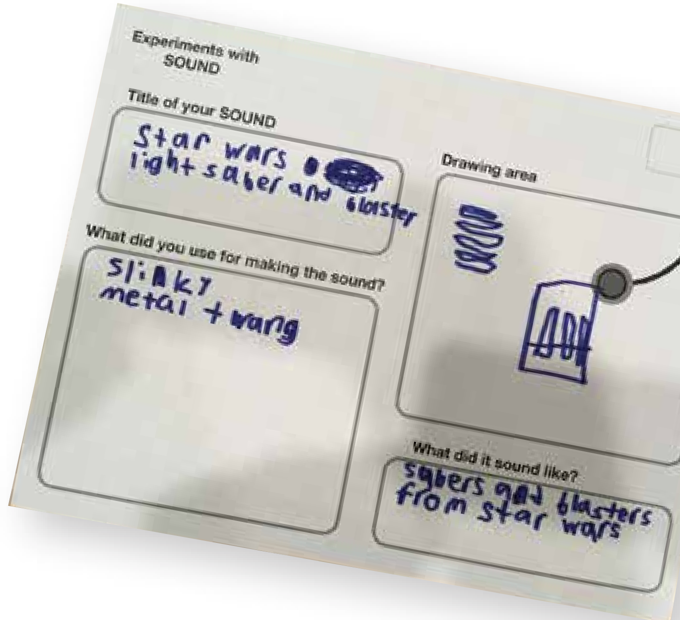
INITIAL INVESTIGATIONS - SOUND HARVESTING

It is highly immersive to listen to amplified sounds, especially with headphones on. "Sound Harvesting" was the first activity prototype that we tested with visitors, focused on encouraging immersion in and observation of noises and sounds. Discoveries of unexpected sounds — for example from a slinky or a marble in a metal bowl — drive this activity and encourage open exploration and experimentation.

We discovered that sound harvesting and exploration was rich enough and complex enough to hold visitors' attention. Initial prototyping sessions showed that there was much to discover and get lost in when looking for sounds. Some visitors set challenges for themselves, like making a sound similar to a lightsaber, others started combining materials to create more complex sounds; others spent a long time with the sound editor in Scratch experimenting with slowing down or speeding up, adding echo, and distorting it.



During the early stage of R&D in this new area we wanted to get a read on how learners make meaning of the new sounds they discover and whether the process spurs learners imagination and motivates narratives and project ideas.



We introduced a worksheet to encourage visitors to reflect and document their ideas. Many of them connected to personal interests and experience, we see this as a first step to taking ownership of the experience and exploring a topic in more depth.

DEVELOPING TOOLS, SOFTWARE, AND AN ENVIRONMENT TO SUPPORT THE ACTIVITY

Good tinkering activities invite participants to explore a topic area and in the process develop their own ideas for projects. After the first studies of " Sound Harvesting," we focused activity development on adding context that encourages creating personally meaningful projects which include recorded sounds. Possibilities include interactive sound collages and visual animations that incorporate sounds using the Scratch visual programming platform, and sound sequencers/ loopers that the sounds can be added to.

To guide and support the explorations we strive for, we developed a workshop environment, as well as hardware and software tools, for tinkering with sound. Introducing new tools and materials — and carefully observing how they affect the tinkering experience — is a core part of our iterative activity design process.

A portable recording device

After testing different hardware solutions, we found that a contact microphone with an IPad amplifier and headphones work best for the purpose. Visitors can use this contact mic like a stethoscope to closely listen to otherwise inaudible sounds. We often describe it as a magnifying glass for sound. We observed curiosity and delight as visitors moved around the workshop area on a "Sound Safari" to discover and record unexpected sounds from everyday materials.

A portable recording device that also allows to store sounds supports the investigations visitor’s naturally gravitate towards. It makes it easy to roam around in the workshop area and sample sounds from objects placed on tables as well as the surroundings.

A software tool for collecting sound samples

We wanted to make the sound recordings shareable between participants, since it's conducive to the tinkering process to share and build on the ideas of others. On a small scale, we found that working in pairs with headphones makes for great collaborations and supports the exchange of ideas. However, it remained challenging to share sounds this way with facilitators and the recordings themselves needed a home to be stored and remixed. We prototyped a custom software tool to address this.

Sound Field tool

During the first visitor tests we found that participants would become engrossed in exploring sounds — however, recording them wasn't as interesting. We set up a recording station that could be used by two people with "Sound Field," a custom software tool created by our collaborator Keina Konno. We found that this arrangement significantly changed the way visitors were exploring sound.

https://vimeo.com/327123518

Just like materials in the physical world, the software environment guides the investigation. In this case the software is set to record short 5 second sound samples, each sound is represented by a circle. Individual sounds can be played back by touching them with the mouse pointer or a whole sequence of sounds can be played as a bar scrubs over the screen from left to right. This set-up encourages visitors to collect sound snippets and jump back and forth between arranging sounds and recording more. We saw a few visitors thoughtfully name their sounds and arrange them on the screen, and some made discoveries about combining and layering sounds by playing them back in a sequence.

ENVIRONMENT

Providing entry points to the exploration

We found that having an introduction station helps learners to become comfortable with the tools and materials offered, and to open up to the idea of spending a longer amount of time working at one of the recording stations.

We set up a table with a selection of interesting and unusual materials, combined with a hand-held pick-up mic amplified by a small portable speaker. This invited visitors to explore right away guided by their own curiosity, before diving into an introduction to the recording tool with the facilitator.

When young learners work with amplified sounds for the first time, they might need ideas for how to produce sounds other than hitting the material. We found that drawings suggesting a movement that works well with the object support learners on their self guided explorations

We added another environmental touch to inspire visitors to work with amplified sound: a sound sculpture by artist Bryan Day that employs the same concept and tools. We placed the interactive sculpture near the entrance to the workshop area to introduce visitors to the idea of carefully investigating objects through sound. By playing with the sound sculpture, visitors explored the concept of amplifying otherwise inaudible sounds with pick-up microphones without needing an explanation by facilitators.

FUTURE DIRECTIONS

We would like to see more visitors create sound arrangements or even personal stories and sound collages. Our current tools and software don't quite support creativity with sound enough. We observed that most visitors couldn't sustain their engagement when they were done discovering new sounds. We see a rich area for future R&D in creating contexts for visitors to use their sounds in personally meaningful creations and providing a simple platform to mix and share sound recordings. With more focus on storytelling and creating with sound, we see potential for engaging in computational thinking concepts and practices through the activity, such as sequencing, modularizing and iterating.

Concrete tools to achieve this could be a microworld for sound in Scratch 3.0 or a custom sound collaging platform with a coding environment similar to Sean Hickey's Bricoleur.

Engaging young kids in sound explorations

One of the strong suites of Sound explorations with piezo microphones that continued through the different iterations is that younger visitors are immediately engaged and motivated to explore, often driving the exploration while collaborating with their parents. We would like to build on this and revisit the idea of sound harvesting with a software tool for younger visitors that allows to capture video or images together with sound recordings.

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