

# LIGHT PLAY



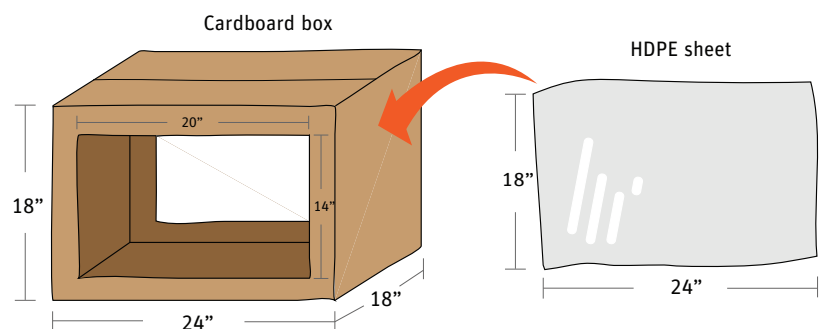
Light Play is an exploration with light, shadow, and color by constructing a kinetic art vignette. Everyday objects are used as shadow makers with simple to use light sources and slow-moving motors to create graceful light and shadow scenes. At the end of the activity a collaborative wall of illuminated kinetic creations is made from the individual investigations.

## BUILD IT!

Before learners start experimenting and building with light, you need to collect, assemble, and build a core set of materials for learners to use (most will be reusable each time you lead this activity). If you are trying this on your own, or for the first time, we suggest building a single Light Play stage and collecting the core materials for your own light play exploration (see below). When you are ready to facilitate this activity with a group of learners you can build additional stages, and collect enough materials for your group.

### Core Materials for Light Play:

**Light Play Stages** are made from large individual cardboard boxes where the front and back sections have been cut out. We then insert a HDPE (High Density Polyethylene) screen on one side. We usually ask two people work together at one stage; to create the final collaborative piece, we simply stack several boxes on top of each other.



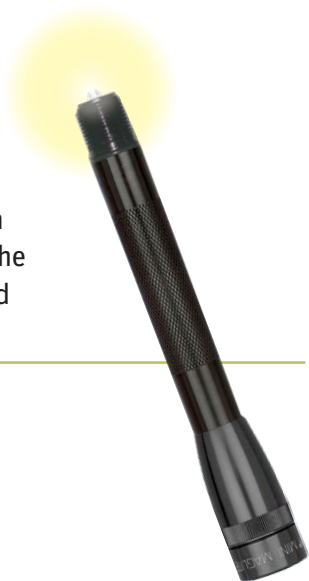
We use a 24" x 18" X 18" box, with two 20" x 14" windows cut out of the largest sides. We cover one of the openings with a sheet of translucent HDPE that fits just inside the box.

*TIP: We get our HDPE screen material from Tap Plastics, a local supplier of plastic, plexiglass, and Delrin®.*

the  
tinkering  
studio

- **Light sources** are pre-built, and offered to each group (usually two or three lights are supplied for each stage). It's important to have point sources as lights (as opposed to diffused ones) that are easily moved and adjusted. Point sources create clean crisp shadows, and moving lights allow exploration of size and scale. Here are some solutions we have tried:

**MagLite® bulb holder:** This is a Mini Maglite® flashlight with the head removed (unscrewed) and used as the base.



**Super Bright LED** light sources: We created our own light sources for the activity using a flexible stand, a wooden base, and a variety of colored LEDs. The detailed construction guide and parts list are here:



<https://www.instructables.com/id/Light-Play-Set/>

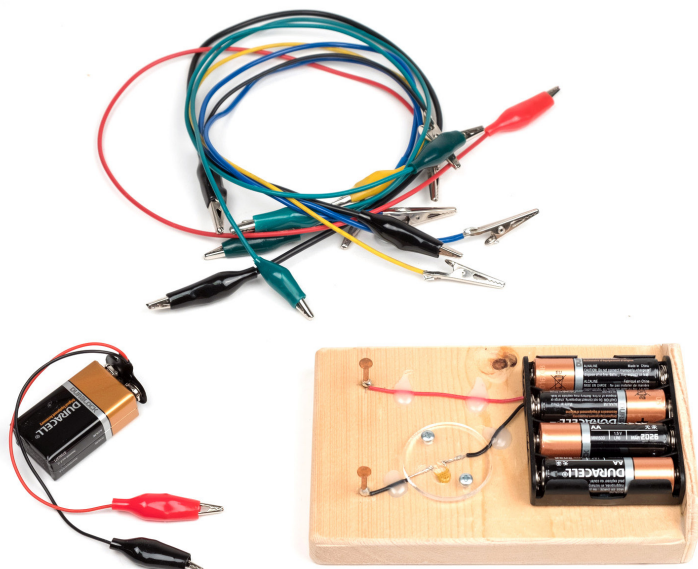
- **Slow-moving motors** are geared-down DC motors that turn at 4-6 revolutions per minute (RPM). We use surplus automotive motors because they are quiet and very slow. We have one or two available for each stage. We also laser-cut small and large platforms that fit over the motor's axle to support Light Play materials.

*TIP: If you find a 12Volt DC motor that is faster than 4-6 RPMs you might be able to power them with 6 volts or less, which may cause the motors to slow down.*



- **Power supplies** and alligator clip leads are important to power the light sources and/or slow motors. We offer both 9-volt and AA power supplies mounted on wood blocks. These power supplies are the same ones we use for the Circuit Boards activity.

<http://tinkering.exploratorium.edu/circuit-boards>



## General materials for light play:



## Helpful tools:



## Objects to reflect, bounce, and transform the light:

Once you have the main light play tools and materials collected, it's time to collect colorful, translucent, and/or reflective materials for learners to build shadow and light constructions with. These objects and materials fall into three categories:

### 1) Shapes, grids, and repetitive patterns

Many familiar objects create interesting shadow patterns when turning on a slow-moving motor relative to a stationary light source. We use transparencies with printed shapes or patterns, window screening material, colanders, cheese graters, strawberry baskets, pegboard, mesh pencil containers etc. These grid-like shapes and shadows are also interesting to explore with multiple light sources.



### 2) Reflective objects and materials

Find objects and materials that reflect light in interesting ways. These things include: Mylar, the shiny interior of potato chip bags, small plastic mirrors, sequined fabric, holiday ornaments, toy disco balls, and anything else that you can find that reflects light and could be worked into a construction of some kind.



### 3) Colorful translucent gels and objects

Colored light and shadows bring an interesting and beautiful aspect to the activity. We use scraps of colored translucent plexiglass, acrylic shapes, colored kitchen wrap, plastic cups and bowls, textured fabric, iridescent cellophane, dichroic film, clear bottles filled with water, and food coloring, etc.



Collect enough of these things so that several people can experiment with different aspects of Light Play at the same time.

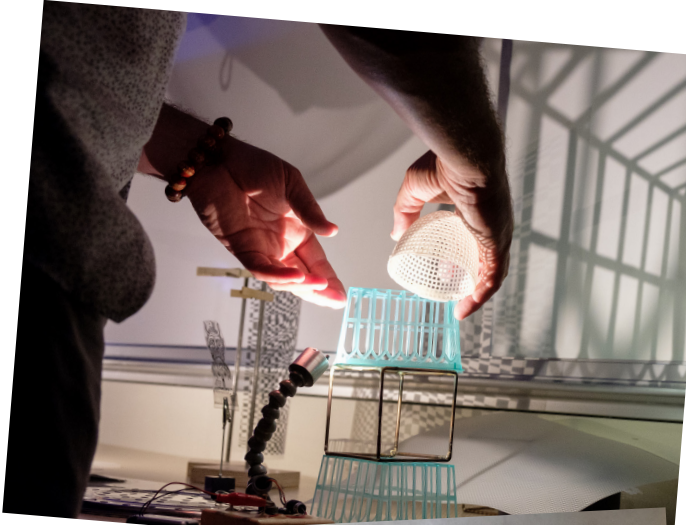
## TRY IT!



The most important first step for Light Play is to make sure that you have spent some time experimenting with the light and shadow materials yourself, in order to develop a basic understanding about what the components do, and how you can get them to work.

**In a Workshop** We often begin workshops by asking participants to divide into three groups and spend 5 minutes at each of three starting point stations that explore different aspects of the activity. This is an opportunity for all of the participants to experience both the main components (motors, lights, screens, etc.) as well as a sampling of different possible light play materials (gels, mirrors, shadow objects, etc.)

**Starting Point Station One** utilizes the grids, transparencies, patterned shapes, slow-moving motors and multiple light sources. Participants at this station will have a chance to familiarize themselves with how to use the motors and lights while paying special attention to grids, shapes, and repetitive shadow patterns. Multiple lights at this station encourage experimentation with overlapping grids.



**Starting Point Station Two** highlights reflective objects and materials. Slow moving motors and both white and colored light sources are available for people to pay close attention to the way that the reflections and caustic images can be manipulated and interact with colored lights. Materials at this station might include mylar scraps, reflective fabrics, mirrors, sequins, and other shiny objects.



**Starting Point Station Three** focuses on colored objects and white lights: learners experiment with making various colors and colored shadows by filtering light through gels, plastic wrap, plexiglass scraps, and other translucent objects.

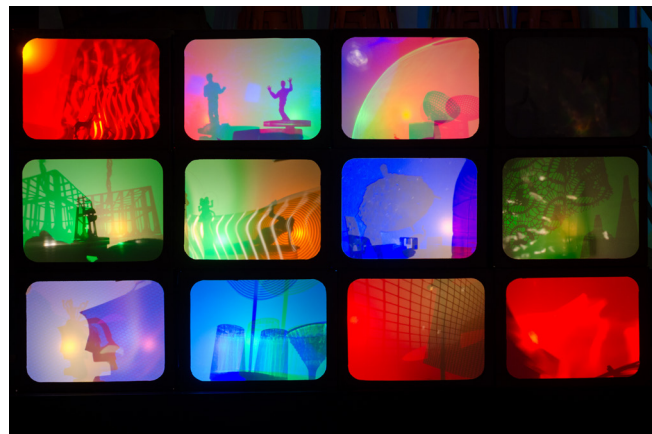
*TIP: Although it's possible to create colored LED light sources, we prefer white light sources because it encourages participants to explore colored filters and translucent objects in order to cast colored light into their scene. We do typically provide a few colored lights but find that white lights encourage subtle effects rather than overwhelming the scenes with a color wash.*



**In a Drop In Setting** When we host Light Play in the Tinkering Studio we don't start everyone at the same time, so we skip the starting point stations and instead point out some of these things to each person or small group as they get started. We might show them a few examples of how different materials create interesting light and shadow reflections, and encourage everyone to experiment as a way to get a sense of the possibilities, before starting to construct their light and shadow vignette.

## Making The Light And Shadow Vignettes:

After the learners have been experimenting with the materials for a little while, we offer a new set of materials to use as building elements (wood blocks, cardboard, string, clothespins, etc..), and ask participants to construct a kinetic light play vignette, either on their own or in teams of two. Ultimately, the light play vignette boxes will be stacked together, so each individual vignette will contribute to a larger display. It's usually helpful to show a simple example of kinetic light play vignette to give a sense of the possibilities of the activity. The example should hint at the complexity and goals of the project without becoming too compelling or complicated (we don't want learners to feel intimidated by the example). It's often better to start with an example that could be easily improved upon.



We usually allow 1-2 hours for learners to delve deeply into the construction of their kinetic scenes. We offer tips and suggestions for construction, and point out interesting visual effects that we notice. And we encourage experimentation through trial and error as much as possible. It's important that learners are allowed to linger with the phenomena, and get a chance to understand the relationships between the light source, the shadow maker, and the shadows or reflections on the screen. The activity is designed for learners to grapple with the complexity of size, shape, position, and geometry of the shadow and reflections.

## Sharing the Light Play Vignettes:

When each group has completed their vignette we ask them to move it from the tabletop (or wherever they are building) and add it to the collective wall. We take some time to admire the arrangement of light and shadow vignettes as a group.



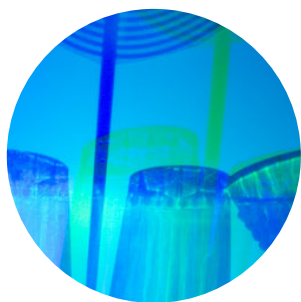
We ask each participant (or team) to say something about their vignette that they are especially proud of, or something that was particularly challenging (and what they did to solve that problem). We often begin the conversation by asking each team to come up with a name or title for their individual vignette.

*TIP: This type of group discussion is sometimes not possible when we host the activity in the Tinkering Studio, but as facilitators, we do ask everyone these questions because it is an opportunity for reflection about the experience in a direct and meaningful way.*

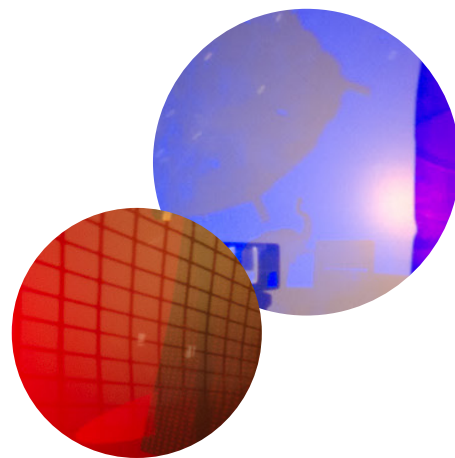
## TAKE IT FURTHER



Develop a series of light play vignettes based on a particular theme or style. Offer the extra challenge of focusing on something in particular like the color blue, or outer space, or microscopic life.



Try incorporating homemade switches (from circuit boards or paper circuit activities) into the vignettes to make the motor start and stop, or change direction, or to make the lights flash from time to time. We might challenge participants to create a series of switch-powered events that don't seem too regular in order to create a sense of surprising movement and activity.



Pair this activity with a hand-made musical instrument project where learners would construct a variety of percussive, stringed, and reed instruments from unusual materials, then perform an improvised soundtrack as the kinetic light wall is illuminated.

# EDUCATOR ADDENDUM

A note on our philosophy: The Tinkering Studio is based on a constructivist theory of learning, which asserts that knowledge is not simply transmitted from teacher to learner, but actively constructed by the mind of the learner. Constructionism suggests that learners are more likely to make new ideas while actively engaged in making an external artifact. The Tinkering Studio supports the construction of knowledge within the context of building personally meaningful artifacts. We design opportunities for people to “think with their hands” in order to construct meaning and understanding.

**Tinkering Studio activities and investigations are designed to encourage learners to complexify their thinking over time. The variety of materials and variables available for experimentation allow for learners to enter at a point where they are comfortable starting, and then alter and refine their designs as they develop new ideas. Tinkering activities are often fun, whimsical, inspired, and surprising.**

## **Activity Design (decisions and designs that support a tinkering experience)**



Light Play is an activity that emphasizes the importance of “messaging about” with the effects of light and shadow as a way to develop a stronger understanding of the phenomena. It’s an aesthetically beautiful activity which highlights the unusual shapes and patterns of light and shadow.

The starting point stations (or an introduction that includes such explorations) are an important part of the activity in order to give learners a chance to become familiar with the parts, and develop a sensibility about the materials before being asked to create something personally meaningful. The open-ended exploration allows for initial discoveries, rapid prototyping, and quick investigations with the component parts.

The collaborative nature of the activity is important. Teaming two people to work on each vignette offers opportunities to share their new ideas and insights, ask questions, and point out the interesting things that are being noticed. The larger group display of the vignettes is an opportunity for participants to contribute to something larger than their own project. Participation at all of these levels both takes some pressure off the individual, and challenges people to keep working through problems to create their part of the larger construction.

It is often surprising how diverse the light and shadow images can be when created from a similar palette of physical objects. This activity reinforces the notion that each learner develops their own path of understanding and exploration, while all are utilizing a similar set of starting point materials.



## Environment (the elements of the space that support tinkering)

In the Tinkering Studio there are many things that we keep in mind when setting up an environment for a successful tinkering activity.

Since learners often work with us for an extended period of time, we try to create a warm and welcoming workspace with comfortable seating, sturdy worktables, and good lighting. We often display exhibits, or examples from past projects and current activities throughout the space to seed ideas and provide an introduction to what is happening that day. Materials are easily accessible and in close proximity to the tinkerers, and we often work at large, communal activity stations to enable cross-talk and invite collaboration between participants, allowing them to look to each other for answers and solutions.



This activity is one where learners spend a lot of time in focused thought. Because of this we often play instrumental background music as an accompaniment to the atmosphere of investigation and building. The combination of the beautiful light creations and compelling music helps to create a comfortable, engaging atmosphere to build in.

One of the most compelling details of the Light Play environment is that everyone is working together in the dark (literally). New ideas about light and shadow are formed as new glowing creations emerge in front of your eyes—and fill the walls, floor and ceiling of the workshop area with ambient moving light!

We offer lighted material stations and tool benches for learners to meet around, work at, and walk past, noticing the other creations as they do this. We often set up two or three Light Play screens at each work table group in order to encourage cross-pollination of ideas.

The light play vignettes offer a level of creativity and inventiveness that is beautiful when viewed from the front of the screen, and highly compelling when viewed from the back, where the mechanisms and parts are visible. It is important to provide an opportunity for each creation to be viewed and valued on both the aesthetic qualities of the projected light and shadow images, as well as the imaginative construction of the mechanical vignettes.



In the Tinkering Studio, where not everyone starts and stops at the same time, we try to maintain a similar effect by maintaining compelling examples in a display case, and encouraging participants to add to the collection. We've found that it gives a great sense of pride for visitors to have their work on display in the gallery.

## Facilitation (the things we say and do to support learning through tinkering)

Facilitation is a way of teaching where you support the learner's own investigations, questions, and ideas within the framework of an activity. In the Tinkering Studio, we strive to practice a kind of facilitation that respects the individual path of the learner. As facilitators, we watch and wait until the precise moment to jump in and offer a hint, a material, or a new way of looking at a problem. As educators, we allow learners to feel frustration and encounter moments of failure as they work with real materials to try to solve their own challenges.

There are many ways that the facilitator can influence the interactions with participants in an activity. We help people get started with the activity by giving a quick sense of the goals. We invite them into the space, and introduce the materials and tools they might use. We spark interest and sustain learner's engagement by asking questions about their work and responding to their answers. We support multiple outcomes of the activity and are open to the possibility of new ideas, different solutions, and changing goals of the individual learners. We try to practice a style of facilitation where we are not teachers who transmit knowledge to passive learners, but rather are guides and co-learners on a path to understanding.

Light Play facilitation is a combination of helping with construction techniques at different points in the activity, mixed with an opportunity to be a co-learner and co-observer of the compelling phenomena displayed on the screens.

We get people started by asking everyone start messing around with the materials and become familiar with the components. This is an important first step because people often feel more comfortable working in an open-ended way at the beginning. As their confidence grows, they become more secure in their ideas and ambitions about what to build.

We also try to encourage learners to look around at what other people are experimenting with early in the activity, to support the idea of sharing ideas and learning from one another in this situation.

Sometimes learners are interested in constructing a mechanism that replicates what their hands are doing (like moving a light source forward and backward), but we may not have the right materials or know how to accomplish the task with what's available. In that situation we try to facilitate new ways of imagining how to achieve the result of the intended effect. For example, a facilitator may point out a way to move the object (instead of the light source) and use these moments as a way to highlight the overall relationship between the light source, shadow maker, and screen which are all critical aspects of the exploration of the activity.

Facilitation toward in the mid-part of the activity often involves observing and pointing out interesting subtleties of the projected images. For example, multiple light sources combined with complex patterns and objects often result in umbras and penumbras in the image; when observed, these features of the images allow learners to focus more on the relationship of the light source to the shadow maker, and the direction and path of shadow outlines. Additionally, many aspects of the finished creation only reveal themselves once-in-a-while, when the slow-moving motors and lights reach a critical alignment. Facilitators often encourage extended observation of the displays and point out the fleeting elements that only appear once per rotation.



Finally, facilitation toward the end of the activity includes an informal conversation with the group, or individual makers about the parts of their vignette that they are particularly fond of, or about the parts that were especially difficult to create, or how they created solutions to problems encountered along the way. We have found there is often more to explore, even at the end of an experience, so we frame the questions in terms of what they are working on as a work in progress, and not as a final project.

# RELATED TINKERING ACTIVITIES

## Activity Connections

Try these related activities to develop your own repertoire of tinkering experiences.

**Toy Take-Apart:** Collect discarded mechanical stuffed toys and dissect them to find battery packs, switches, sensors, and motor-driven mechanical elements. You can test the things that you find inside, repair broken toys, or repurpose them using your imagination and a few tools to create new and original playthings.

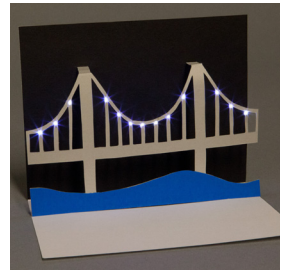
<https://tinkering.exploratorium.edu/toy-take-apart>

**Paper Circuits:** Paper circuits is an exploration of electrical circuits inspired by artist Jie Qi that incorporate traditional paper-folding techniques into electronic projects. In this activity you can use copper tape, surface mount LEDs, and watch batteries to bring a greeting card or piece of origami to life. The copper tape switches demonstrate a basic way to make switches that can be incorporated into light play vignettes.

[tinkering.exploratorium.edu/paper-circuits](https://tinkering.exploratorium.edu/paper-circuits)

**Chain Reaction:** Build a contraption in a domino-style chain reaction that will trigger the next contraption! Make your machine comical and whimsical using variety of materials such as bowling ball, pulleys, slow motors, mechanical toys, cowboy hats, balloons, ropes, mousetraps, gears, and more.

<https://tinkering.exploratorium.edu/chain-reaction>

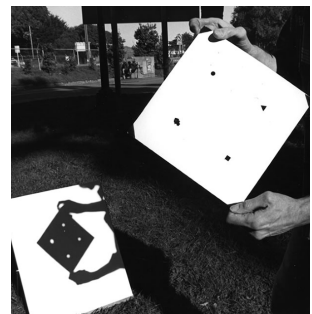


## ARTIST CONNECTIONS

inspiring connections to the Light Play activity

Bob Miller first started taking friends outside the Exploratorium to show them his discoveries about images and sunlight in the summer of 1975. At the time, he was building an exhibit called *Holes In A Wall* and was fascinated with the way single images of the sun that shone through pinholes could combine in so many unexpected ways. It wasn't long before Bob became convinced that all light is in the form of images. Over the years, Bob's Image Walk has evolved into a classic Exploratorium experience.

[http://www.exploratorium.edu/sln/light\\_walk/](http://www.exploratorium.edu/sln/light_walk/)



Rashad Alakbarov from Azerbaijan uses suspended translucent objects and other found materials to create light and shadow paintings on walls, often filling entire rooms with light paintings. These jaw-dropping light paintings, made with an array of colored gels are on display at galleries around the world.

<http://www.thisiscolossal.com/2012/01/rashad-alakbarov-paints-with-shadows-and-lights/>