Resources

EXPLORATIONS

Cardboard Exploration

Cardboard is a simple material with endless opportunities for exploration. Children can quickly become engineers by designing, shaping, creating, and building.

Try It

1. Present children with various recyclable cardboard items: boxes, egg cartons, flat cardboard sheets, or any size cardboard pieces you can find. Try to find both a thin box board and a thicker "multi-ply" board to experiment with.
2. Provide various types of connectors: plastic screws and hinges, different types of tape (duct, plastic, masking, paper), child-safe glue guns, etc.
3. Offer children things with which to decorate the boxes (markers, paper letters, paper to draw on, etc.) and measuring instruments, such as rulers or tape measures.
4. Have on hand tools that can cut through heavy cardboard, such as child-safe saws or scissors.
5. *Option #1:* Just let the children play with the materials provided, and see what they build naturally.
   Option #2: Provide a directed activity question, such as: Can you build a tall building, or make a tower, or design a room, or put together some other creation with your cardboard pieces?

TINY TIP!

Wearing aprons with pockets can help you keep track of the cutting tools you don't want kids to have unsupervised access to.

Learning Opportunities

Children become engineers and problem solvers every time they spend time building. Be sure to include different sizes, thicknesses, and shapes of cardboard to help children see the relational differences in scale: bigger, smaller, taller, shorter, longer, wider, etc. Just by playing, they'll practice spatial awareness and learn the language of geometric shapes: square, rectangle, circle, cone, tube, etc. If you're using measuring instruments, like a ruler, discussions on inches and feet happen naturally when talking about size differences. Feel free to also use nonstandard measurements (like number-of-hands tall and number-of-books wide) to practice these skills.

Open-Ended Questions

- What kinds of things are made out of cardboard? (Have examples ready to show if needed.)
- How do you think that box is made?
- What happens if cardboard is thicker or thinner?
- How can we add one piece to another to build something new?
- What shapes do you see?

TINY TIP!

This activity is exciting for many adults too! Be mindful when adults start to take over a child's project, and guide them to take the role of "helper" or "assistant engineer" instead.

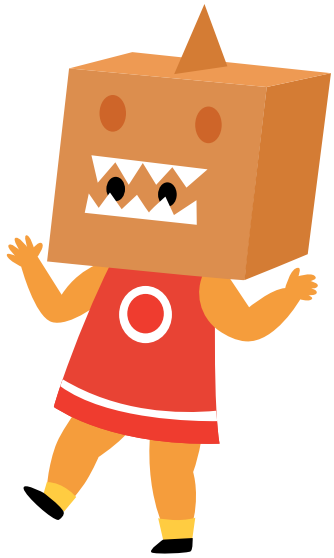
WORDS AND CONCEPTS TO EMPHASIZE

- Build
- Stability
- Balance
- Foundation
- Construction
- Measurements
- Relational sizes (smaller, bigger, taller)
- Shape names (circle, square, diamond)
- Tool names

Cardboard Exploration *at Home*

Take home a book like:

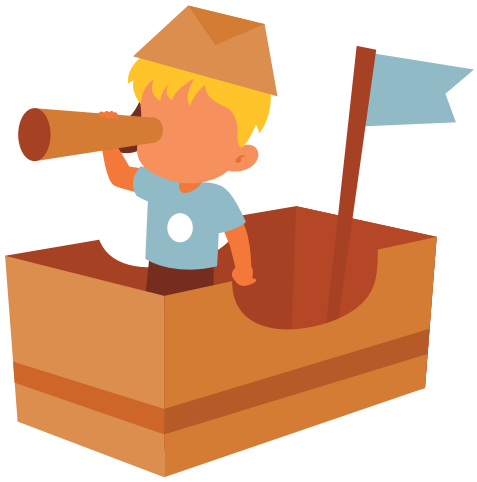
- *Big Box for Ben* by Deborah Bruss
- *Not a Box* by Antoinette Portis
- *The Big Brown Box* by Marisabina Russo
- *What to Do with a Box* by Jane Yolen & Chris Sheban
- *The Nowhere Box* by Sam Zuppardi



Explore and tinker with cardboard with your child. Remember to use the same language you used and heard at the library to emphasize the concepts learned.

Ask your child questions like:

- What can we build today?
- Why do you think the boxes fell over?
- Which one is bigger or smaller?
- Can you point to the tube, rectangle, etc.?
- How long is that piece?



Circuit Exploration

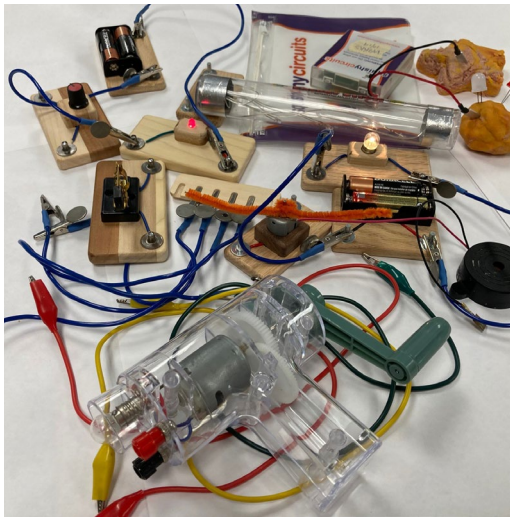
Exploring electricity with young children can be somewhat intimidating, but keeping it simple allows children to develop a solid basis for understanding electricity as they get older. The objective is for them to explore, observe, and make predictions.

Try It

1. Provide children with a variety of tools and materials such as: circuit blocks, various alligator clip wires, battery packs, switches, buzzers, spinners, squishy circuits (conductive and non-conductive clay), small light bulbs (different colors), or a Makey-Makey banana piano with a computer station.
2. Allow children to explore using the alligator clips, attaching to batteries, and seeing what they can get to light up, make a sound, etc.
3. Use analogies to help children understand the basics of electricity. A train analogy is a great one to use: The train must leave the station before the next one arrives, but things can stop the train on the tracks so that it won't move unless a switch is thrown or the flow is allowed to continue. The vocabulary of circuits—open circuit, closed circuit, etc.—can make more sense when discussed through this analogy.
4. Talk to children about the flow of electricity and that both ends of the battery must be connected for the electrons to flow. As the children explore, adult participants can explain that there must be a complete circuit for anything to happen.

TINY TIP!

Try starting this activity with a take-apart of a simple flashlight or cheap electric toothbrush to help children see the real-world application of circuits.



Learning Opportunities

The flow of electricity may seem like the stuff of magic at such a young age, but simply by playing with materials and exploring how to complete a circuit to make something happen, children are gaining valuable foundational learning for electrical engineering and mathematics concepts.

Book Recommendation:
Switch On Switch Off by Melvin Berger

Open-Ended Questions

- How does electricity flow?
- What connections need to be made for the circuit to be complete?
- What do batteries and bulbs do?
- What do we need to do to make something happen (the bulb light up, the switch turn on, or the spinner spin)?
- How can we connect things to make this work?
- What if it doesn't work? What can we try?

TINY TIP!

Try using an energy stick to quickly demonstrate closed circuits using your own body as a conductor!

WORDS AND CONCEPTS TO EMPHASIZE

- Circuit (open or closed)
- Conductor
- Battery
- Electricity
- Insulator
- Counting (number of bulbs that light up)
- Patterns (putting colored bulbs in a pattern)

Light and Shadow Exploration

Playing and exploring with light and shadows is an interactive, fun way to introduce young children to making predictions and observations. The activity can be very simple by using flashlights or sunlight outdoors. Or, it can be made more complex using other mediums, such as colored filters and an overhead projector.

Try It

Option #1: Outside

If you're able to go outside in the sunlight:

1. Children can use their shadows on the ground to discover that their body is blocking the light.
2. They can trace the shadow using chalk and learn math terms such as long, short, tall, wide, etc.
3. Discussions can be shaped around objects being translucent, transparent, and reflective, as well as predictions on which objects will produce a shadow.

Option #2: Indoors

If you're indoors:

1. Give children flashlights and objects to place in front of the light.
2. Put paper on the wall so children can trace their shadows or the shadows of shapes they're putting in front of the flashlight.
3. When shining the flashlight, move it to help them understand the difference between the light being close, making a smaller shadow, and the light being farther away, creating a giant shadow.
4. Use colored filters, such as cellophane or transparent color pages, to explore with the children. Do the colors appear on the wall or stay black like their shadow? What happens if you mix the colors together?
5. If you're using an overhead projector, explore the relationship between the light shining up and what's the same and different about how the image appears on the wall.

Learning Opportunities

However you decide to do your explorations, children will be gaining awareness about different light sources and exploring the following ideas and concepts:

- Shadows are created when you block the light source.
- You can change the size of a shadow.
- Colors can be combined and filtered through a light source.
- Some materials are translucent while others are opaque.

Open-Ended Questions

- How can we make a shadow?
- What can we do to change the shape of a shadow?
- Where does the light come from?
- How do the colors of shadows change?
- How can we change the shape of a shadow?

WORDS AND CONCEPTS TO EMPHASIZE

- Shadow
- Light source
- Filter
- Translucent
- Transparent
- Opaque
- Reflection
- Bigger, smaller, closer, farther, larger, taller, shorter
- Prediction
- Observation

Light and Shadow Exploration ***at Home***

Look around your house for everyday items that can be used to explore light and shadow, such as nightlights, flashlights, headlamps, or just the sunlight shining through windows. Explore together with your child, encouraging a sense of wonder.

Explore with flashlights together and discuss why the light shines through some things but not others, continuing to investigate the terms transparent, translucent, and opaque. You can even create a visual graph of the number of items in your house that fall into one of those three categories.

Experiment with making shadows on different surfaces, such as a wall, a curtain, a table, or the floor. What do you notice when you hold the flashlight close to and far away from your object?

Take a walk outside on a sunny day and look for shadows. What do you find? Find your shadow and trace it with chalk and decorate it.

Tip: It's easier to find shadows if you take a walk a few hours before or after 12 noon.

Ramps Exploration

Exploring with ramps looks like play, but the concepts behind what's happening are absolutely science! By experimenting with designing and building ramps, children become mini engineers. And by exploring and observing how different objects move or remain static on the ramps, they're introduced to concepts in physics (friction, energy) and math (speed, angles, measurements).

Try It

1. Provide various materials that can be used to build ramps, like blocks of any kind, sandbags, anything flat and long (like wooden or rubber moldings), cardboard tubes, furniture (to provide height), fasteners, etc.
2. Also provide varied items to use on the ramps. There should be items that roll naturally (balls of various sizes and weights, round containers, plastic lids, etc.), toys with wheels, items that don't roll naturally (rocks, toy animals, seashells, etc.), and anything else that you can find that children can test on their ramp.
3. Let the fun begin! Children seem to naturally want to build a ramp when the materials are available. Let them experiment with using different materials to build the ramp itself and then let them play with trying to roll various items down the ramp.

TINY TIP!

Start with balls and move on to using cars later. The balls help younger children focus on how the ramp is working without the distraction of the car itself.

Learning Opportunities

Children will learn about how things roll down an incline, remain motionless on a flat surface, or might require a push (or other force applied) to move. The concept of friction—the resistance of motion when two objects rub against one another—can also be explored. When using a ramp, the wheels or round objects that roll down the ramp produce energy in the form of motion. They meet resistance (friction) while rolling, which eventually slows them down.

Open-Ended Questions

- What height ramp do you need to get something to roll down it?
- How can we make a longer ramp?
- How far can you get that _____ to go? How can you move it farther?
- What materials make the _____ move faster on the ramp?
- How can we put a curve in the ramp? Can you make a ramp like a roller coaster with a loop-de-loop?
- How can you make the ramp go over something and under something else?

When the children are experimenting to see what items go down the ramp, questions could include:

- Why do you think that _____ didn't go down the ramp?
- Why did the _____ fall off of the loop?
- Why didn't it go around the curve?
- Why is it slower on that ramp than on that one (if there are contrasting materials on each ramp or if they're at differing heights)?

TINY TIP!

Give this activity as much room as possible. Ramps encourage cooperative play; the more kids, the more space is needed. Be creative with the space you use and don't be afraid to include places like the library stacks as well.

WORDS AND CONCEPTS TO EMPHASIZE

- Design
- Construction
- Friction
- Motion
- Energy
- Speed
- Angles
- Distance measurements

Ramps Exploration *at Home*

Bring home a book like *Roll, Slope, and Slide: A Book About Ramps* by Michael Dahl.

Go to a local park that has a slide and gather materials found in the park to roll down the slide. These can be the children themselves, rocks, pinecones, or any other exciting materials they want to experiment with.

Time the items as they roll down the slide. Ask children why they think the amount of time is different for each item.

If the child went down the slide, ask them if they feel it would take longer or shorter if the adult went down the slide? How about a friend? You can chart the items and their times.

On the next trip to the park, bring various types of balls and send them down the slide. Make sure to mark and measure the distance, as well as keep time.

Questions to ask could include: Which do you think will travel the longest distance off the bottom of the slide? Why?

Try to find things that won't roll down the slide and ask why.

Suggest that your child climb up the slide in different types of shoes and ask which pair was harder. Ask: Why do you think the different shoes affect your ability to climb up the slide?

Simple Machines Exploration

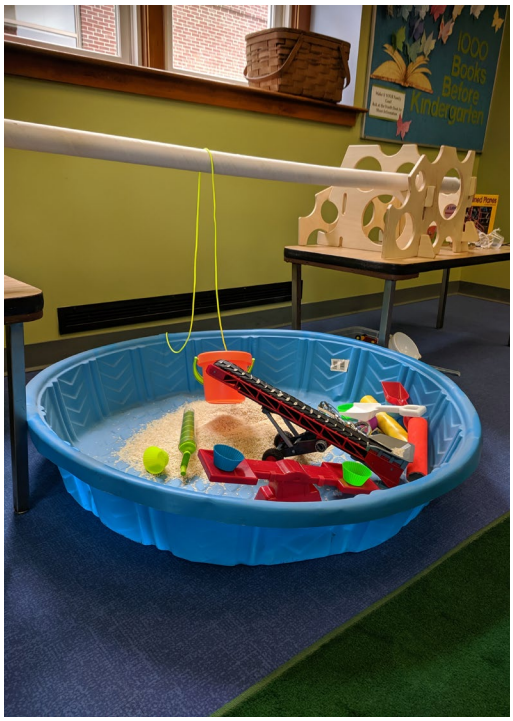
Free play with levers, pulleys, and conveyor belts allows for experimentation and discovery. Many children are amazed by how a simple machine, which has very few moving parts, can make work a lot easier!

Try It

1. Set up a sandbox area or simply a large box filled with sand, pebbles, rice, beans, or other material that's safe for the children to handle.
2. Allow children to explore moving the materials using toy trucks (front loaders, backhoes, etc.), buckets, and shovels.
3. Consider placing a dowel with a pulley system attached to it across the top of your boxed-in area. Have children try out the pulley system and ask if it's easier or harder to lift the bucket with the pulley than without.
4. Provide materials for making levers, such as pencils, popsicle sticks, spoons, rubber bands, tape, etc. Invite children to build a catapult and experiment with this form of a lever. Have on hand various soft items that can be launched. Whatever you use, enable children to play, and test to see whether the length of the lever or where the fulcrum is placed makes a difference in how far the load can be launched.
5. If you have access to a small conveyor belt, demonstrate turning the crank to move the loads from one side to the other and back again. Place a basket or bucket on the end of the conveyor belt and have children experiment with moving things along the conveyor belt and having them land inside the bucket or basket.

TINY TIP!

Relating a lever to a teeter totter can be helpful as you explore!



Learning Opportunities

The main concept is that "Machines can make work (pushing, pulling, lifting, or hauling) easier." Basic engineering and physics principles, like balance and force, as well as math concepts related to weight and distance, become real for the children through hands-on exploration coupled with discussion.

Book Recommendation:
How Do You Lift a Lion? by Robert E. Wells.

Open-Ended Questions

- How can we lift something that weighs more than we do?
- How can we make a simple machine to move something without using our muscle power?
- What can you design to move an object?
- What does a conveyor belt do?
- How does a catapult work?
- How does a pulley work?
- How does a lever work?

WORDS AND CONCEPTS TO EMPHASIZE

- Balance
- Leverage
- Pulley
- Fulcrum
- Lever
- Conveyor belt
- Weight (heavy vs. light load)
- Load distribution (too much on one side or another)
- Counting (how many pieces can be moved at one time)
- Distance (how far one item gets when catapulted and which item went farther)

Wind Tunnel Exploration

Exploring with wind and air is both fun and exciting for young children, partly because wind is everywhere around them in their daily lives. Children learn that air and wind aren't visible, but their effects are!

Try It

1. Present children with pre-sorted bins of various materials such as balloons, beach balls, scarves, stuffed animals, bean bags, parachutes, tissues, different weight fabrics, etc. The bins can be labeled or unlabeled. If marked, the labels might be heavy, light, fast, slow, float, etc.
2. Use a wind tunnel if you have one or set up some electric fans around the space. You can also have the children make hand fans or give them straws to blow through to move the various objects. Whatever wind source you use, ask the children to try to move the object with the wind.
3. When a child picks up an object, have them predict and observe:
   - What will it do?
   - Will it move, roll, fly, or float in the air?
   - What goes the highest?
   - Which goes the farthest?
4. They can then test the objects and see if the original labels were accurate.
5. Ask: Can we find a way to make something that is heavy fly or move in the wind? Have them tinker with attaching a parachute to a heavier object.
6. You can also attach streamers to a fan to explore how things move. Ask the children how it's the same or different and to describe what they see.

TINY TIP!

You can DIY your own wind tunnel with an appliance-sized cardboard box and a box fan. We also built a ramp coming out of it, so children could experiment with how their objects would move on different textures or surfaces.

Learning Opportunities

By exploring which objects move in the wind and which don't, children come to understand the impact wind can have on the objects around them. Beneath the surface of

the play are concepts of science and mathematics, like speed, force, measurements, weight, and scale. Intentional play coupled with open-ended questions and use of specific words lays the foundation for this knowledge-building.

Open-Ended Questions

- How does the wind move things?
- Why do some things float and others don't?
- How can we make something that is stationary move in the wind?
- If the wind direction or force changes, how does it change the object being moved?

WORDS AND CONCEPTS TO EMPHASIZE

- Air pressure
- Force
- Speed
- Surface
- Scale measurement
- Farther
- Shorter
- Faster
- Slower
- Higher
- Heavy
- Light

Wind Tunnel Exploration ***at Home***

Take home a book like *Leaf Man* by Lois Ehlert.

There are many extensions to the learning at the library. You can explore and ask: Do dried leaves fly better than green leaves? You can design leaf characters and create their adventures. Where will the wind take them?

You can test objects at home with a hand fan or straw. Which objects move and which ones don't? Why?

Try to use a straw or just your breath to blow on water or sand. What senses can you use to notice the effects of wind? What happens when you blow softly or for a long period of time?

Go out and fly kites. Make your own or purchase one. How does it react in the wind? How is that different from a balloon? Why do you think that is?

Bubbles are a great way to explore wind at home. Why does your breath make the bubbles move a certain way? Why do the bubbles slowly sink and not float forever?

Woodworking Exploration

Young children enjoy the process of hammering, screwing, sawing, and being empowered to use tools in general. Often they can even design and build something to take home. There's always a great deal of trying and experimenting with wood and how it can be attached to itself or other things using glue, nails, or screws. This trial and error is essential to a young child's process of discovery.

Try It

First, a few important points to keep in mind as you set up the space for exploration:

- It's essential to have tools that fit a child's hands.
- The area where your woodworking activity takes place should be laid out to maximize safety.
- Having tables and chairs at child height is important for these activities.
- Wood should be clamped tightly to tables.
- Use stationary and movable tables or shelves to create a safe sawing area.
- Even when hammering, the amount of room necessary for a reliable swing should be considered.

Tools and materials to use: Safety goggles/glasses, gloves, sanding blocks, sandpaper in varying grits, tools sized to fit small hands (hammers, screwdrivers, mallets, etc.), clamps placed in strategic places so children have ample room and won't hit anyone, child-safe hand saws of different types, hand drills, and hardwoods and softwoods (balsa, pine, oak, etc.) of varying lengths, thicknesses, and sizes.

TINY TIP!

You can start an exploration of woodworking without any tools! Providing various types of scrap pieces of wood along with craft materials and glue allows for open-ended exploration and helps ease the transition to exploring with new materials in the future.

1. Monitor the work area carefully when children and caregivers enter. Safety rules and equipment should be given to each participant every time they come into the space.
2. Begin with a slow introduction to the tools. You might even begin with just the sanding of various wood types, move on to putting out screwdriver sets and pegboards with mallets, and later bring out saws and drills with softwoods and hardwoods for comparison. Techniques for using each tool should be demonstrated to both caregivers and children before using it.

3. When children are sawing or hammering, there should be adult and facilitator supervision. The facilitator must circulate and monitor each child's activity.
4. New tools can be introduced depending on the children's needs.
5. Teach children that tools must be returned to where they were taken from, and they should clean their work area for the next person.

TINY TIP!

Children may be more concerned with watching what others are doing or seem so interested in another child's activity that they neglect their work, but this is all part of the exploratory process. Just let it flow naturally.

Learning Goals

Exploring with wood and tools can be very empowering for children. Through play and experimentation, children are introduced to concepts of mathematics, like measurement and angles. They also get to try their hand at being engineers, designing and building an object of their own creation. You can emphasize the rudiments of measuring and making things a particular size. Children will also practice perseverance and focus, gain hand-eye coordination and fine motor skills, become problem-solvers, and achieve personal satisfaction.

WORDS AND CONCEPTS TO EMPHASIZE

- Length
- Measurement
- Angles
- Design
- Construction
- Names and uses of differing tools
- Joining
- Sanding
- Grit

Open-Ended Questions

- How can we change wood?
- How long is it? Can you make it shorter? By how much?
- How do we construct something or take it apart?
- How can we change the texture of wood?
- What can we learn about the strength of different types of wood?

Woodworking Exploration *at Home*

Take home a book such as *Old MacDonald Had a Woodshop* by Lisa Shulman.

Continue to call out the names of the tools in your home environment and use appropriate ones together. This helps your child develop independence, confidence, and competency with woodworking.

Discuss the importance of safety when using tools. But remember that you can start an exploration of woodworking without any tools by providing various types of scrap pieces of wood along with craft materials and glue to explore and attach.

Challenge children to create something new with wood and other craft materials attached by nails, glue, or screws. Ask: How might you connect those two things together? What will work best?

Use a tape measure or ruler to help them make things bigger or smaller.

When sanding, ask: How is the wood changing? How does it feel in your hands before and after sanding it? Why do you think this happens?

Criteria for Selecting Little Maker Books

Keene Public Library had many books on the topics we selected for our Little Makers activities. Many of these titles were gleaned from Best Of lists on the web or from print sources. When making book selections, we used typical best practices and the following as our starting point:

- Followed our policies and procedures, based on ALA guidelines
- Read through many book review resources
- Consulted librarians, preschool teachers, and blogs
- Considered patron recommendations

One of the main factors we considered when selecting books for our program was the age of the children. The span was from 2 years old to 6 years old. The National Science Teaching Association (NSTA) provides excellent suggestions for choosing science books for this age range. One essential question NSTA asks is "Is the book fun to read?" Always keep that in mind when purchasing books for preschool children!

TINY TIP!

Search and explore our extensive annotated bibliography of Little Makers books on our website.

Our primary considerations when selecting books include:

- Developmentally appropriate for children ages 2–6
- Fun, captivating, and engaging story
- Highlights or models the Learning Dimensions of the maker mindset
- Integrates STEM disciplines and has factually correct depictions of science, technology, engineering, or mathematics content
- Features illustrations that enhance the text and provide an alternate way of telling the story and illustrating the concepts presented in the book
- Includes culturally diverse people, ethnicities, and languages
- Provides meaningful connections to children's real-world, authentic problems
- Incorporates ideas around divergent thinking, assimilation of new ideas, teamwork, exploration of multiple solutions, or acknowledgement of failure as a reality that can be mitigated or surmounted

Exploratorium Learning Dimensions

Initiative & Intentionality	Social & Emotional Engagement	Creativity & Self-Expression	Conceptual Understanding	Problem Solving & Critical Thinking
• Setting one's own goal • Taking intellectual and creative risks; working without a blueprint • Complexifying over time • Persisting through and learning from failures • Adjusting goals based on physical feedback and evidence	• Building on or remixing the ideas and projects of others • Teaching and helping one another • Collaborating and working in teams • Recognizing and being recognized for accomplishments and contributions • Developing confidence • Expressing pride and ownership	• Responding aesthetically to materials and phenomena • Connecting projects to personal interests and experiences • Playfully exploring • Expressing joy and delight • Using materials in novel ways	• Controlling for variables as projects complexify • Constructing explanations • Using analogues and metaphors to explain • Leveraging properties of materials and phenomena to achieve design goals	• Troubleshooting through iterations • Moving from trial-and-error to fine tuning through increasingly focused inquiries • Developing work-arounds • Seeking ideas, assistance and expertise from others

The Exploratorium's Learning Dimensions of Making and Tinkering one-pager is freely available in a number of languages on their site.

DIMENSIONS OF LEARNING FOR MAKING AND TINKERING

Levels of Agency	Initiative & Intentionality	Social & Emotional Engagement	Creativity & Self Expression	Conceptual Understanding	Problem Solving & Critical Thinking
Responding Initial interactions and observations	Initial Engagement	Working Side by Side	Browsing Materials	Noticing the Phenomena	Making Initial Observations
	Active Participation	Building Together	Personalizing Projects	Asking Questions	Engaging in Trial-and-Error
Exploring Probing the problems, variables, and possible solutions	Expressing Intentionality	Modeling for Others	Playfully Exploring	Observing the Variables	Learning Through Failure
	Persisting in the Problem Space	Collaborating with Others	Striving to Create a Unique Solution	Seeking Explanations	Honing in On Key Variables
	Taking Intellectual and Creative Risks	Mentoring Others	Applying Aesthetic Solutions to Achieve Design Goals	Expressing Tentative Theories	Testing more Focused Solutions
Owning Taking intellectual risks, applying understanding, and contributing to the community	Shifting Project Goals	Co-Leading Group Activities	Recognizing the Creative Work of Others	Constructing Explanations	Applying Unique Solutions
	Planning a New Idea	Creating New Activities	Re-mixing and Re-building	Expressing Conceptual Understanding	Eager to Find a new Problem to Solve

Initiative & Intentionality:
Actively leading the learning pathway

Level of Agency	Actions / Intentions	Indicators
Responding Developing an initial idea	Active Participation	• making adjustments • seeking help • showing curiosity
	Initial Engagement	• identifying initial interest • participating in a step-by-step activity • copying an example
Exploring Complexifying over time	Taking Intellectual and Creative Risks	• trying a solution that may not work • pursuing ideas without checking with a "teacher" first
	Persisting in the Problem Space	• staying engaged when something doesn't work • valuing info from failed experiments • solving a problem and moving onto a new one
	Expressing Intentionality	• testing tentative ideas • sharing ideas and goals with others • setting one's own goal
Owning Pursuing new ideas	Planning a New Idea	• sketching or planning the next idea • pursuing project ideas between contexts (i.e. home, school, museum)
	Shifting Project Goals	• adjusting goals based on physical feedback and evidence • following pathways of personal interest

Social & Emotional Engagement:
Collaborating with and contributing to the community

Level of Agency	Actions / Intentions	Indicators
Responding Entering the community	Working Side-by-Side	• building alongside others • noticing what others are making • sharing space, tools, and materials
	Building Together	• working individually on a collaborative project • adding to a group construction • expressing pride and ownership
Exploring Interacting with the community	Modeling for Others	• being recognized for ideas • developing / displaying confidence • giving and receiving feedback
	Collaborating with Others	• physically and intellectually connecting with another project • working with someone on a shared vision • collaboratively working in teams
	Mentoring Others	• becoming a repeat participant • teaching and helping one another • applying understanding to someone else's project
Owning Becoming central to the community	Co-Leading Group Activities	• co-facilitating activities • recruiting others to participate • planning and preparing the activity setup
	Creating New Activities	• developing / leading new activities for others • making a space for new group experiences • documenting the experiences for other learners & educators

Creativity & Self Expression:
Responding aesthetically to materials and phenomena

Level of Agency	Actions / Intentions	Indicators
Responding Noticing aesthetic possibilities	Browsing Materials	• manipulating materials or mechanisms • finding familiar and unfamiliar materials • expressing joy and delight
	Personalizing Projects	• decorating or modifying an example • expressing personal narratives • connecting projects to personal interests and experiences
Exploring Exploring aesthetic affordances	Playfully Exploring	• responding aesthetically to materials and phenomena • project focus is inspired by materials • participating with enthusiasm
	Striving to Create a Unique Solution	• testing the unique qualities of materials • identifying related project problems in other people's work • using metaphor and analogy as design input
	Applying Aesthetic Solutions to Achieve Design Goals	• using materials in novel ways • prioritizing aesthetic choices • explaining purposeful design decisions
Owning Harnessing aesthetic applications	Recognizing the Creative Work of Others	• noticing the aesthetic choices of others • engaging in critical aesthetic dialogue • acknowledging relationships between different project outcomes
	Re-mixing and Re-building	• modifying one project into another • freely expanding the palette of materials • utilizing materials from other places

Conceptual Understanding:
Developing understanding over time

Level of Agency	Actions / Intentions	Indicators
Responding Identifying the concept(s)	Noticing the Phenomena	• observing and noticing • initial interactions
	Asking Questions	• noticing the unexpected • expressing confusion • striving to understand
Exploring Probing the concept(s)	Observing the Variables	• playing with key variables • keeping track of the results
	Seeking Explanations	• controlling for variables as projects complexify • testing new ideas for confirmation of understanding
	Expressing Tentative Theories	• testing a design solution • sharing an "aha" moment (articulating insights) • recognizing the limits of a current design
Owning Mastering the concept(s)	Constructing Explanations	• carrying out research online • creating models to further conceptual understanding • identifying related real-world ideas
	Expressing Conceptual Understanding	• applying solutions to new problems • using analogues and metaphors to explain • defending or arguing current understanding

Problem Solving & Critical Thinking:
Troubleshooting through iteration

Level of Agency	Actions / Intentions	Indicators
Responding Identifying a problem	Making Initial Observations	• noticing affordances of materials and phenomena • becoming intrigued by the phenomena
	Engaging in Trial-and-Error	• testing and observing • evaluating initial tests • trying something more than once
Exploring Iterating solutions to a problem	Learning Through Failure	• identifying areas of surprise • seeing similar problems in others' work • noticing what's not working
	Honing in on Key Variables	• troubleshooting through iterations • dissecting problem components • describing the problem to others
	Testing More Focused Solutions	• stepping back to reflect on the problem • identifying what NOT to focus on • seeking specific ideas/tools/materials to solve the problem
Owning Resolving a problem	Applying Unique Solutions	• materials used in unexpected ways • solutions are varied • developing work-arounds
	Finding a New Problem to Solve	• ability to finish one project, take something apart, and start again • eager to engage in the process again

Facilitator Reflection Form

Facilitator name: _____ Date: _____

Program Title: _____

Other Staff: _____

Attendance: Children _____ Caregivers _____

List the activities or stations you facilitated or supported today and approximately how many children and caregivers you engaged with at each.

_____

_____

_____

_____

While making or tinkering, children often engage in these learning dimensions:

- Initiative and intentionality
- Social and emotional engagement
- Problem solving and critical thinking
- Creativity and self-expression
- Conceptual understanding

Please describe examples you observed. Be as specific and descriptive as you can.

Dimension: _____ Description: _____

_____

_____

_____

Dimension: _____ Description: _____

_____

_____

_____

Dimension: _____ Description: _____

What is one thing that you felt worked well? Why?

What is one thing that you felt didn't work well? Why? What would you do differently next time?

Overall, how do you feel today's activities were received by the attendees? How do you know? Feel free to include any quotes from interactions/conversations/brief interviews.

Parent/Caregiver Interview Guide

Interviews are a great way to discover ideas and perspectives that you didn't already know, suspect, or consider. When conducting a discovery-oriented interview, your main goal is to create a welcoming conversational space for the interviewee(s) to share what they really think. The first step is always to establish trust and rapport. Consider recording the conversation (with permission) or taking detailed field notes. If you're recording the conversation, a transcription tool like Otter.ai can help save time when it comes to reviewing the interview.

This interview guide offers a starting point for formal, in-depth, systematic data collection for a specific group of participants. Quick response questions are usually the best place to start when pursuing a particular idea or topic. The digging deeper questions are useful when an interviewee demonstrates a particular interest in or experience with the topic. For easy reference, we have also pulled out the brief, quick response interview questions you might ask on the fly when the opportunity presents itself.

Brief Interview Questions

1. Which library program activities have you and your child participated in, both in the library and at home?
2. How has this program affected you personally (as a parent, teacher, facilitator, or otherwise)?
3. What is the main thing your child has learned from this program?
4. How would you summarize the value of this program for you and/or your child?

In-Depth Interview Questions

INTRODUCTION

- Thank you for participating! Your observations and opinions are invaluable.
- Our main purpose is to get the kind of rich detail that only a family member/caregiver can provide.
- I'm asking these questions on behalf or as a representative of [fill in the blank].
- The decision to participate is completely voluntary, and you can end the conversation at any time.
- Your responses will remain confidential. May I request permission to record?
- Do you have any questions or concerns?

QUESTIONS

Topic: Program Participation

Quick response: Which library program activities have you and your child participated in, both at home and in person?

Digging deeper:

- Why did you choose to participate in this program?
- What were the biggest factors in that decision?
- How new are these types of activities for you and your child?
- How regularly does your child do tinkering, making, or STEM type things on their own?
- In an average week, how much time would you estimate you and your child engage in making, tinkering, or STEM activities?

Topic: Parent/Caregiver Outcomes

Quick response: How has this program affected you personally (as a parent, teacher, facilitator, or otherwise)?

Digging deeper:

- What's one thing that you felt worked well and why? What's one thing you felt didn't work well and why?
- Do you feel more or less confident than before this program when helping your child with tinkering, making, or STEM activities and learning? What, if anything, changed?
- How often do you find yourself engaging in meaningful dialogue with your child about tinkering, making, or STEM activities? What are those conversations like? How has this program changed those conversations?
- What's your opinion about activities that are hard or about letting your child fail?

Topic: Parent/Caregiver Perceptions of Child Outcomes

Quick response: What is the main thing your child has learned from this program? (Make sure to have this graphic of the Exploratorium's Learning Dimensions printed and ready to show, if needed.)

Digging deeper:

- [Levels of Agency] Overall, would you describe your child's engagement more as "responding" (initial interactions and observations), "exploring" (probing the problems, variables, and possible solutions) , or "owning" (taking intellectual risks, applying understanding, and contributing to the community) in their making/tinkering?
- [Learning Dimensions] Which, if any, of the learning dimensions in the graphic (initiative & intentionality, social & emotional engagement, creativity & self-expression, conceptual understanding, problem solving & critical thinking) did you see examples of in your child's making and tinkering?

Topic: Parent/Caregiver Perceptions about the Program and the Library

Quick response: How would you summarize the value of this program for you and/or your child?

Digging deeper:

- How critical was the library program for instigating tinkering, making, or STEM activities/learning?
- What would be missed if the program were not available?
- Where do you intend to look for STEM activities for your child in the future?
- How could the program be improved?
- What have you or would you share with other families/caregivers about the program?
- What would cause you to participate again or not?
- If applicable, please compare the online versus in-person at the library versions of the program. Which do you prefer? Why?

Final Questions: Is there anything else you would like to share? What have we missed?

Note: Despite how inconsequential this final question might seem, it often generates the most useful data if you just give interviewees a lighthearted second or two to reflect.

Thank you!