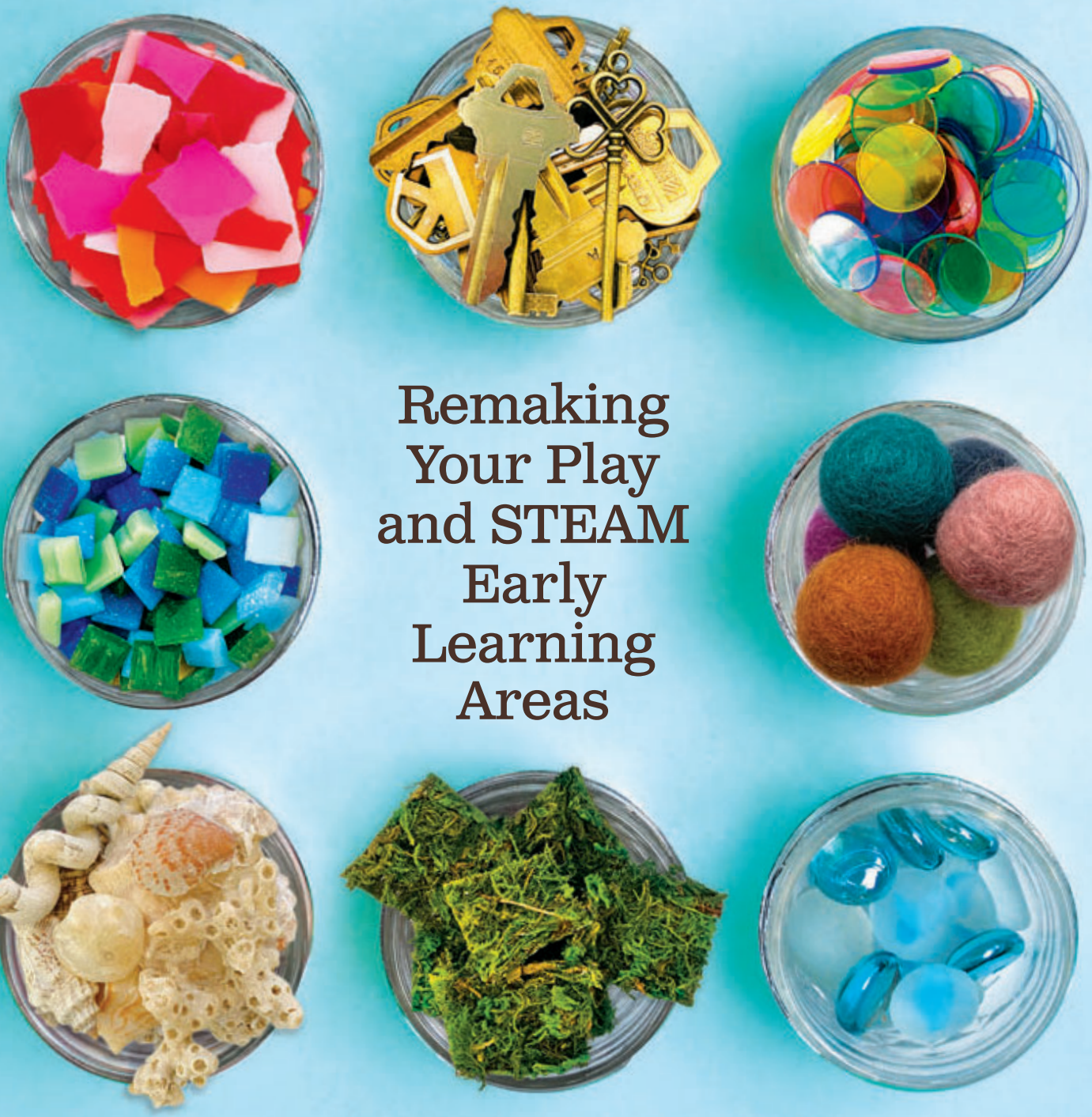
Makerspaces



Remaking Your Play and STEAM Early Learning Areas

Robin Chappele Thompson, PhD and Michelle Kay Compton, MA

MAKERSPACES

Other Redleaf Press Books by Michelle Kay Compton and Robin Chappele Thompson

StoryMaking: The Maker Movement Approach to Literacy for Early Learners

Makerspaces

Remaking Your Play and STEAM Early Learning Areas

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For each of LaLa's future makers.

—RCT

For my two little makers who invite me into their

world of playing and making each day.

—MKC

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Acknowledgments

Michelle, we are a true testament to the Maker Cycle as together we imagine the possibilities, play with our ideas and dreams, and make it all a reality as we get to share our makerspaces. I'm thankful that your boys are willing participants, for they bring joy to my days with their imaginations and adventures. I am thankful for your brilliant mind and most especially that you keep me laughing through it all. As you know, you are loved by my entire family, and we consider you and yours as part of the family.

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— Robin

First, I want to thank you, Robin, for continuing to bring inspiration and support to our dream of creating innovative and powerful makerspaces so children are free to imagine, play, make, and share using everyday materials. I appreciate your friendship, your collaborative spirit, and your emphasis on family first throughout our work, no matter what deadline we may be facing. I wouldn't want to tinker, hack, and repurpose ideas in our pursuit to create the best possible resource for educators with anyone else. I look forward to sharing many more ideas, projects, and adventures as we continue our journey to empower educators and parents to believe that any space can truly be a makerspace!

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—Michelle

Materials to inspire you from each of our categories (wood, nature, plastic, glass, metal, textiles, and paper)

INTRODUCTION

A Book for All Makers

I am a maker and a thinker.
I imagine, play, hack, and tinker.
Empty spaces and stuff are all I need
to showcase my ideas for the world to see.

Making, or the maker movement, has recently made its way to both formal and informal learning environments. We initially engaged our young learners in the maker movement through StoryMaking, using its practices as the framework for learning. We found that our young makers use the Maker Cycle to imagine, play, make, and share not only stories but also ideas, projects, opinions, and thinking. Through our research and observations (in classrooms, centers, museums, libraries, and homeschool communities), we have discovered that all young children can identify as makers, given the resources and spaces for making.

Makers, Makerspaces, and Materials

As we learned more about the maker movement, its learning practices, and the development of a maker mindset, our teachers wanted to create makerspaces in their classrooms. We define a *makerspace* as any place where children of all ages use materials and tools to imagine, play, make, and share their ideas, projects, stories, or thinking. Any place can be a makerspace. A *maker* is anyone who uses materials to make something important or interesting to them. In our makerspaces children are the makers: artists, collagists, builders, sculptors, performers, inventors, weavers, storytellers, and writers who interact with open-ended materials. Given opportunities to explore a variety of materials in makerspaces, they take on the identity of makers.

Making can seem intimidating to educators because much of the information on it addresses older children, targets technology, and seems to focus on coding, robotics, and other topics that might require special expertise. We learned that our colleagues at museums, schools, libraries, universities, and child care centers wanted to design inviting makerspaces but either didn't know where to begin or didn't know how to sustain the makerspaces they set up. This book will ensure that

"What Is a Maker?"
Anchor chart

the maker movement is accessible to all those who work with young children, ages two to eight, in informal (libraries, museums) and formal (classrooms, home care providers) settings, at universities with early childhood and elementary education departments, and at home in families. We provide a foundation for the design and setup of inviting makerspaces and suggest developmentally appropriate inspirations, materials, and tools. We also provide lots of photos of different makerspaces in a variety of settings, step-by-step suggestions, and ideas for sustaining interest and learning in each of the makerspaces, as well as lesson plans for use as you develop your own makerspaces.

We have experimented with making and makerspaces in schools, libraries, museums, and other learning spaces. We've tinkered with ideas, tried them out, iterated, reflected, and tried again. We've worked with toddlers, preschool children, and early elementary students. We understand that if you work in a formal educational setting, there may be expectations for achieving proficiency in accordance

with standards. This book provides ideas for converting typical areas and spaces found in educational settings, both informal and formal, into sustainable makerspaces that use open-ended materials—materials that do not have a right or wrong expectation for use—so young children can enact the learning practices of the maker movement.

Why Are Makerspaces Important?

The maker movement in education includes "creating the physical, mental, and social conditions for a child to learn through real-life experiences that are personal and meaningful" (Dougherty 2016, x). The *physical* conditions are the learning spaces, which can serve as the third teacher. Makerspaces offer inspiration and support for new learning while also ensuring access to materials and resources that scaffold this learning (Biermeier 2015; Ceppi and Zini 1998; Compton and Thompson 2018; Malaguzzi 1998; Peppler, Halverson, and Kafai 2016). The *mental* conditions are goals that support academic proficiency on developmental milestones and standards, as well as the embodiment of a maker mindset. It has been suggested that makerspaces are communities of practice that provide multiple pathways for learning, opportunities for developing fluency and competence for the learning goals, and open-ended materials that encourage self-expression, promote creativity, and support the development of agency and character (Blikstein and Worsley 2016; Brahms and Crowley 2016; Clapp et al. 2017; Peppler, Halverson, and Kafai 2016; Wardrip and Brahms 2015). The *social* conditions include the collaborative learning culture found in makerspaces, where materials and resources are shared, children have opportunities to contribute to one another's work, and both processes and products are shared and celebrated (Brahms and Wardrip 2016; Resnick, Eidman-Aadahl, and Dougherty 2016; Wardrip and Brahms 2014).

Developing a Maker Mindset

A mindset is "a way of seeing and being in the world" (Clapp et al. 2017, 87). Researchers have defined characteristics of a maker mindset, or positive qualities we hope to cultivate in children (Barell 2013; Dougherty 2016; Regalla 2016). We combined this research with what we observed in classrooms, libraries, museums, and centers and developed the following list of indicators for use as you work toward the development of a maker mindset in your young children:

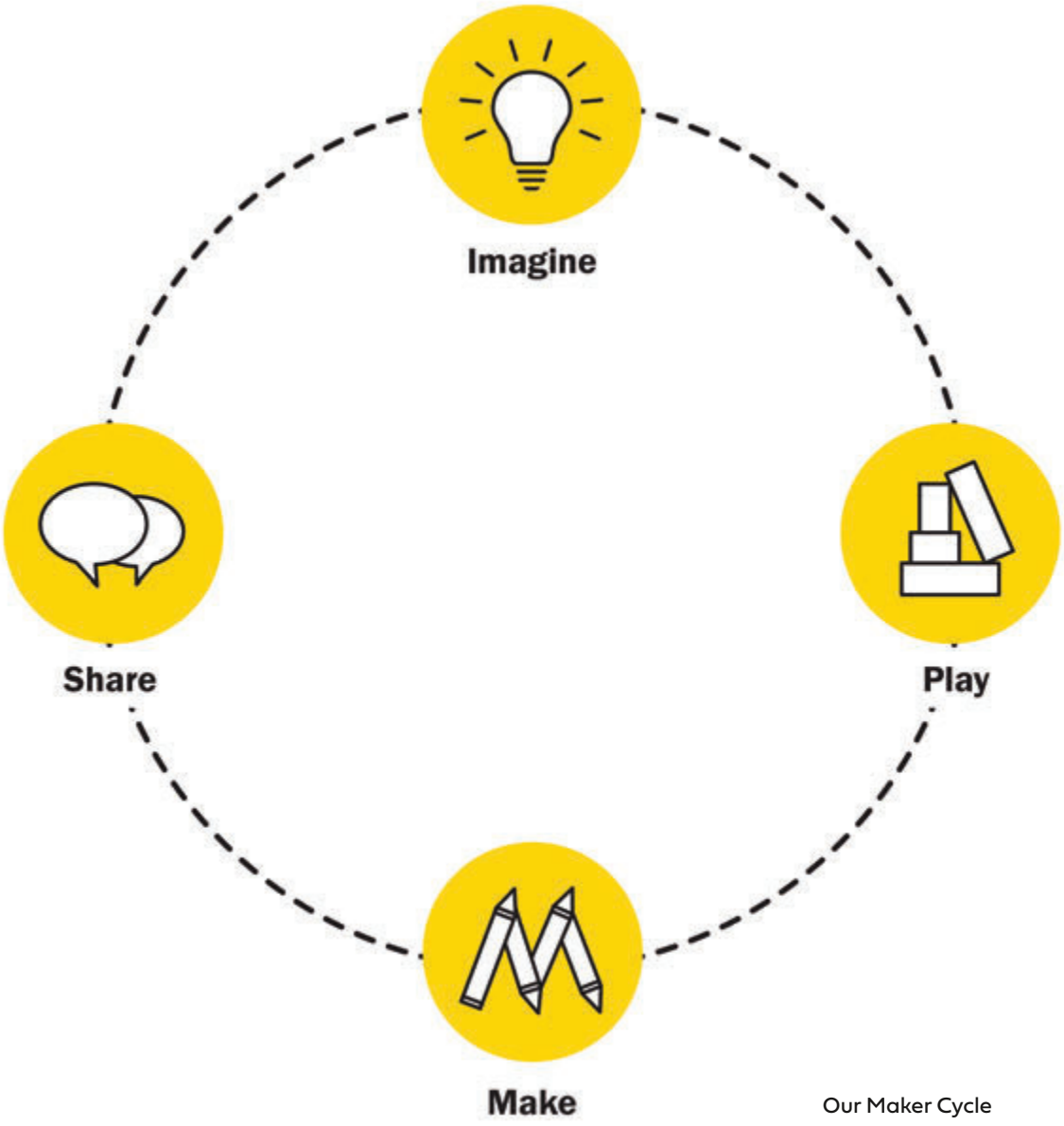
- Makers exhibit a sense of wonder. Our young children "exhibit curiosity when they play with new materials, explore new spaces, and investigate their worlds" (Compton and Thompson 2018, 53). Children are naturally curious about their worlds, and as we design our makerspaces we want to consider the materials and spaces that "give children the opportunity for wonder, mystery, and

discovery; an environment that speaks to young children's inherent curiosity and innate yearning for exploration" (Heard and McDonough 2009, 8).

- Makers are mindful observers. As children become keen observers, they notice details in their worlds. They learn to focus their attention and spend time thinking about their surroundings. Learning to look closely can be practiced in many ways. "Students might draw, make lists, or name the parts of a particular object; they might verbally describe intricacies. . . . These practices also cultivate a habit of slowing down" (Clapp et al. 2017, 131–32). Our goal is to develop mindful observers who become deep thinkers.
- Makers are STREAM innovators. Our young children make discoveries about themselves and their worlds as they innovate with materials, spaces, and processes. They discover new uses for common materials, invent representations for unfamiliar materials, and develop ideas for processes as they play and make. They cross-pollinate among learning spaces and materials, creating opportunities for interdisciplinary learning. Introducing STREAM (science, technology, reading/literacy, engineering, arts, and math) topics and focus lessons gives them the tools to think across disciplines, one of the essential qualities of a successful innovator (Wagner 2012).
- Makers develop social-emotional efficacy. Social-emotional competence is built when children work and play together. They need opportunities to learn and practice sharing, taking turns, and self-regulating. Bailey (2015) encourages educators to notice helpful and kind acts, both publicly and one-on-one with children. As children practice these acts, they are internalizing social-emotional efficacy.
- Makers enact a growth mindset. "A growth mindset promotes the belief that capabilities can be continuously developed, improved, and refined through experiences that involve success, mistakes, and persistence" (Regalla 2016, 267). Children have opportunities to build and enact a growth mindset as they imagine, play, make, and share. They build an "I can" attitude as they make choices, select materials, and create things that are meaningful to them. They persevere and figure out the hard parts, gain self-efficacy, and build character. Finally, they get to reflect and share with an inclusive community, discussing their mistakes, asking for help when they need it, and celebrating their successes.
- Makers share and collaborate. When children have the opportunity to share what they are making in a maker talk, they can draw on their community to ask for advice and celebrate their processes and products. The maker movement uplifts others' efforts and promotes a culture of sharing ideas so each person can innovate and accomplish their imagined goals. Regalla states, "Through exchanging ideas, helping one another succeed, and celebrating both successes and challenges, a culture of collaboration and sharing is cultivated" (2016, 267).

The Maker Cycle

Our Maker Cycle is where the inquiry process starts for teaching and learning, as the children engage with materials, one another, and their imaginations. During the cycle children encounter authentic problems ("How can I make this fit?" or "I can't make this work. How do I do it?"). Our conception of the maker movement includes igniting children's imaginations and following their interests; engaging them with interesting and open-ended materials through playing and making; and celebrating each child's ideas, stories, projects, and histories by sharing with one another and their communities (classroom, families, local community). This teaching and learning process is represented by our Maker Cycle.



Our Maker Cycle

- Imagine: We provide children with provocations and invitations that inspire them to wonder and inquire. We use unusual and interesting materials, common materials experienced in new ways, children's literature, a focus lesson, or anything else that inspires young children.
- Play: It has been shown again and again that young children learn through play. During play they interact with materials and one another, become familiar with the forms and functions of materials, and start to develop social-emotional efficacy (Christakis 2017; Edwards, Gandini, and Forman 1998; Gopnik 2010; Heard and McDonough 2009; Mraz, Porcelli, and Tyler 2016; NAEYC 2009; Resnick 2016; Wohlwend 2008).
- Make: After playing for a sufficient amount of time, children begin to create and build what they've imagined. During this time they develop agency, build character, and enact the learning practices of the maker movement (Brahms and Crowley 2016; Clapp et al. 2017; Resnick 2016; Wardrip and Brahms 2014).
- Share: Often children are excited to share what they've made or how they've made it, whether it is an idea, project, or story. They share in languages other than oral (painting, dance, sculpture) to demonstrate their learning and celebrate their successes with one another during maker talks.

Learning Practices of the Maker Mindset

Researchers have described the learning practices embodied during participation in making within a framework (Brahms and Crowley 2016; Compton and Thompson 2018; Wardrip and Brahms 2015). These learning practices are the behaviors enacted by children in our Maker Cycle that indicate they are learning. Children may exhibit them in the order presented or skip around, depending on the context of their imagining, playing, making, and sharing. In the Maker Cycle, children enact the following learning practices of the maker movement:

- inquire
- tinker
- seek and share resources
- hack and repurpose
- express intent
- develop fluency
- simplify to complexify

Each learning practice encapsulates aspects of what it takes to develop a maker mindset, our overarching goal. It's impossible to enact the learning practices without growing a maker mindset, as they are inextricably linked. Below we identify the learning practices of the maker movement and highlight associated elements of simultaneously developing a maker mindset.

INQUIRE

Young children naturally have a sense of curiosity and wonder about their worlds. Their openness and willingness to explore and question leads to deep learning and discovery. When children are awed by their everyday worlds, you will hear, "What is that?" or "How can I make it do that?" Development of a sense of wonder is one of the characteristics of a maker mindset, and creating opportunities for children to explore, ask questions, and be inspired aids that process.

TINKER

When children play around with materials and tools, figuring out their forms and functions, they are tinkering. Karen Wilkinson and Mike Petrich define *tinkering* as "thinking with your hands and learning through doing" (2014, 13). Children may try several iterations of one idea or representation before they are satisfied with the outcome. In the process they are often evaluating the properties of the materials and tools. You will know children are tinkering when you notice them manipulating and interacting with materials, trying to figure out their affordances, saying, "This won't bend" or "I'm trying to make a castle with blocks, but it keeps falling." Self-awareness and self-management come to the fore when things don't work as planned. Development of social-emotional efficacy through play is characteristic of a maker mindset.

SEEK AND SHARE RESOURCES

Learning spaces for young children offer an abundance of resources and materials. The children may use each other as resources during playing and making, asking, "Where did you get that idea?" or "How did you make that?" This indicates recognition of their not-knowing and shows a desire to learn. Materials can also serve as resources for children by inspiring questions and discovery and accommodating manipulations as the children figure out materials' affordances and limits. Books offer good information as children try to solve problems, study, figure things out, and get inspired. Anchor charts showing techniques for using materials and tools provide the information and reminders children need to move forward in their thinking. As children share their materials, tools, and expertise, they develop social-emotional efficacy by building relationship skills, making responsible decisions, and developing a disposition to share and collaborate. Development of social-emotional efficacy and a disposition to share and collaborate are components of a maker mindset.

HACK AND REPURPOSE

Children use materials and tools in innovative ways. They often assign new uses and representations to a familiar material, disassociating it from its original purpose. A craft stick can be a fort wall, a character's body, or a tool to stir paint. Children can easily repurpose open-ended materials, which do not have a specific

purpose or intent. Reusing and recycling materials during playing and making can lead to conversations about conserving resources and sharing what we have. This builds a disposition to share and collaborate and encourages a growth mindset, building confidence and an "I can do it" attitude, all part of a maker mindset.

EXPRESS INTENT

Some children express intent shortly after they are inspired by a story or material. It might sound like, "I want to make a robot today!" or "I want to go to the construction makerspace." Other children do not make a short- or long-term plan until after they've investigated materials and had some time to play and explore. Children's identities are developed through playing, making, and sharing, and with that comes a sense of agency and a growth mindset. You might hear, "I can do this!" or "I did it all by myself!" Offering choice helps children make decisions about where they want to play and make and provides opportunities for them to develop agency and character. A growth mindset is a characteristic of a maker mindset.

DEVELOP FLUENCY

As children practice playing and making with materials and tools, they develop fluency with their uses. They develop self-efficacy and begin to take risks and innovate. As children become proficient with materials and tools, they become resources for other children and move forward in their own thinking for deeper and more complex learning. Becoming fluent with the uses of materials and tools takes practice, effort, and persistence and contributes to building a growth mindset, one of the characteristics of the maker mindset.

SIMPLIFY TO COMPLEXIFY

As children become familiar with the tools and materials found in different makerspaces, you might see them borrowing materials from one makerspace and combining them with tools and materials from another to make their idea or project. Combining simple materials from various spaces and contexts creates new meanings and complex representations. For example, we had watercolor in the arts makerspace and wood and fabric materials for puppets in the performance makerspace. Cornelia decided to paint her wooden puppet's body with the watercolors and created a unique character who was "feeling blue." This interdisciplinary approach or STREAM innovation is part of creating a maker mindset. As children explore materials, they become mindful observers, studying the parts, purposes, and complexities in order to represent their unique ideas, stories, and projects (Clapp et al. 2017). While every maker's process is different, the stages of the Maker Cycle typically align with the learning practices and the development of a maker mindset as shown in the following chart.

Learning Practices and Development of a Maker Mindset through the Maker Cycle

Maker Cycle	Imagine	Play and Make						Share
Learning Practices of the Maker Movement	Inquire	Tinker	Seek Resources	Hack and Repurpose	Express Intent	Develop Fluency	Simplify to Complexify	Share
Maker Mindset	Sense of Wonder	Mindful Observation Social-Emotional Efficacy Enactment of a Growth Mindset STREAM Innovation						Share and Collaborate

Activity versus Investigation

When planning your makerspaces, we advocate for a focus on the powerful learning practices of the maker instead of creating activities for a specific science or mathematical standard, as Chalufour and Worth (2004) illustrate in their Young Scientist series. There are some key differences between an activity-based thematic study and an in-depth investigation. When an educator notices an interest among the children (such as cars) or a specific topic in standards or curricular programs (such as three-dimensional shapes), they might select materials and a particular type of block for an activity. Toy cars and boats and unit blocks might accompany a question such as "How can you build a bridge for these cars to cross over the river?" The children will engage in this activity, of course, but the teacher did all the imagining and thinking for this space. The toys selected to accompany the building activity—the materials—were not open-ended. The car represents a car and the boat a boat. The task will help children make connections to math and science topics, but it has little to do with the exploration of scientific and engineering concepts within the Maker Cycle.

An open-ended approach to makerspaces allows children to be creative thinkers. The educator can observe what information the children learn and communicate as they make. To create an investigation rather than an activity, incorporate loose parts, a subcategory of open-ended materials that we define as any open-ended, recyclable, or found item that can be transported, manipulated, innovated, and used for exploration and multiple representations in a variety of contexts (Daly and Beloglovsky 2015). Stimulate thinking by presenting loose parts to symbolize the vehicles and asking open-ended questions, such as "What structures can you make with these materials?" An in-depth investigation of bridges in the building makerspace allows children to communicate what they know and express interest in other topics as well. When you allow children to express their intentions for making with

open-ended materials, you are not only engaging them in an inquiry process (the Maker Cycle) but also developing the maker mindset. Research supports the use of open-ended materials in growing a maker mindset, as any open-ended material can inspire stories, ideas, and projects. And all areas can be remade into makerspaces that build the maker mindset (Daly and Beloglovsky 2015; Gauntlett and Thomsen 2013; Heard and McDonough 2009; McGalliard 2016).

The Important Role of Materials in Our Makerspaces

Research suggests that materials can inspire children to learn as they go through our Maker Cycle and enact the learning practices of the maker movement (inquire, tinker, seek and share resources, hack and repurpose, express intent, develop fluency, and simplify to complexify) as they develop a maker mindset. The maker movement is grounded in Seymour Papert's constructionism: "the building of artifacts, be it a program, robot, or sand castle, that can be shared with others" (Peppler, Halverson, and Kafai 2016, 5).

Not only can materials inspire children as they make, but we observed that interactions with materials often resulted in the enactment of the learning practices. Research supports the integral role of materials in learning as children think through making and engage with materials (Dolphijn and van der Tuin 2012; Ingold 2012; Kind 2014; Penfold 2019; Taguchi 2011). Evidence of learning from these encounters with materials and one another can be found in the learning practices of the maker movement. Learning is not necessarily the result of one encounter; rather, multiple encounters form a network of connections and interactions between children and materials. Materials lend themselves to different types of learning, depending on what the child brings to the encounter (history, background knowledge, interest) and the attributes of the material (form, function). Humans and materials dialogue with one another throughout an encounter: for example, "Hey. Why won't you bend? I'm trying to bend you. I will break you in two instead." The materials do not actually speak, of course, but they present forces and flows in interaction with children, who become active participants as they learn from and are transformed by materials. Connections, interactions, and transformations with materials lead children to new understandings about themselves, one another, and the world, understandings reflected in the assemblages children imagine, make, and share. The development of a maker mindset through the enactment of the learning practices of the maker movement depends on materials and their contribution to the learning and development of our children (Dolphijn and van der Tuin 2012; Ingold 2012; Penfold 2019; Taguchi 2011). The selection and exploration of materials are so important to our makerspaces that we have begun each chapter with a story documenting children's first encounter and interactions with the materials in the featured makerspace.

STEAM Learning in the Makerspace

Many books and programs drawing on the maker movement have adopted STEM (science, technology, engineering, and math) or STEAM (science, technology, engineering, arts, and math) learning as part of the learning activities they suggest. When we refer to technology, it's important to realize that the first step toward proficiency is developing a fluency with concrete tools and understanding how they work prior to playing and making in the digital world. We added the *R* to represent reading and literacy. We can't leave that out! Literacy is an important component to our children's learning.

Makerspaces are a natural setting for STEAM learning; therefore, we highlight in each chapter some specific, research-based connections to the STEAM disciplines in the featured makerspace (NGSS Lead States 2013; NSTA 2014; Texley and Ruud 2018). This section also shows that you do not need a separate STEAM area outside of your makerspaces. Our goal is to help you integrate learning across the domains within your makerspaces and show how you can present an interdisciplinary approach to learning in your makerspaces.

What to Expect

If you are new to the maker movement and have not yet experimented with setting up makerspaces, this book offers a chronological plan for transforming existing classroom areas into makerspaces for children from toddlers to eight years old. If you are an experienced makerspace creator already, are planning a makerspace on a particular topic, or want to set up a pop-up makerspace—a temporary makerspace in an informal learning environment—feel free to skip to the relevant chapter. Detailed lists and photos will aid you in replicating a makerspace for your purposes. Imitation is the first stage of learning, right? However, we challenge you to internalize the components of our makerspaces in order to invent your own. These are the components that form part of each chapter's structure:

1. Inspiration and support: ideas, images, charts, focus lessons, children's literature, and techniques
2. Main material: the first material used, often a foundation or canvas
3. Loose parts: open-ended materials introduced to complexify the main material
4. Tools and attachments: items used to modify, manipulate, and connect materials

A thorough understanding of these components will help you become the innovators and designers of your makerspaces.

Chapter 1 provides an overview of the design and setup of new makerspaces, including supplies that you probably have in your classroom already, and presents a template for the remaining chapters. Each chapter begins with notes on a child interacting with materials from that makerspace, a discussion of the makerspace's purpose and place in the chronological progression, and its STREAM connections. We then identify relevant materials and tools along a continuum from low-tech arts and crafts to high-tech explorations such as coding and robots. These continuums will help you plan materials and next steps for your makerspaces. We then invite you to "Imagine Making" your makerspace, giving examples of inspiration, materials, loose parts, and tools that have worked well in our makerspaces and providing photos of different "Spaces for Playing and Making." We offer examples of how to document learning in makerspaces, share a sample focus lesson and some books to inspire makers, and recommend next steps for growing your makerspace.

Chapter 2 starts with the art area and shows how to use inspiration, main materials, and tools to transform it into an arts makerspace. It combines process- and product-based approaches to focus on the elements of art while also considering aesthetics and beauty. Chapter 3 builds on the arts makerspace and suggests a new makerspace, collage. Collage is a three-dimensional fine art in which materials or loose parts are assembled on a surface. Collage is an inexpensive, inspiring, and easy makerspace to set up, and we think you'll love it. Chapter 4 explains how to transform your block area into a construction makerspace, offering numerous suggestions for materials, from different types of blocks and cardboard to woodworking, Lego bricks, and codeable moving blocks. Chapter 5 shows how to turn your playdough area into a sculpture makerspace, including suggestions for making three-dimensional sculptures with playdough, clay, foil, wire, and products, such as Squishy Circuits. Chapter 6 adds movement, dialogue, and action to the previous makerspaces and turns your housekeeping or dramatic play area into a performance makerspace, complete with costume design, set design, props, and character development. Chapter 7 transforms your sensory area into magical small worlds where makers become inventors of new landscapes, inhabitants, and worlds. Chapter 8 looms on the horizon with threading, lacing, weaving, and sewing, transforming your lacing boards and activities into a fiber arts makerspace celebrating children's efforts as they play and make with these unfamiliar materials. Since our Maker Cycle emphasizes the importance of sharing with peers, family, or other like-minded makers, chapter 9 expands on maker talks as a means of encouraging discourse developing a supportive maker community. We also highlight an idea for a maker talk in the "Share" section of the focus lesson at the end of each chapter.

Next Steps in Transforming Spaces

We've thrown a lot at you in this introduction, but do not be afraid. Please stick with us! You can transform your play areas into makerspaces using what you already have in your space. You do not need to spend a bunch of money, become a technology guru, or get rid of all your current stuff. With a few simple tweaks, you can create beautiful and productive makerspaces for your children. And this transformation does not have to happen all at once. We recommend doing a little bit at a time. Choose a favorite space and add one new idea to ignite children's imaginations, or remake a tired space that the children no longer frequent. We'll show you some simple changes that will invite children back into that space. Do it in a way that makes you comfortable. We have lots of inspiration for you, but it's up to you to decide which ideas you want to use, how you want to use them, and when you want to try them out. We just ask that you keep us posted and show us how you hack and repurpose our ideas to build your own makerspaces!

You are the maker, the designer, the tinkerer of your own spaces. The examples, photos, descriptions, and tips you will find in these pages are intended to inspire you in creating makerspaces that will meet the needs of the children you serve. As you plan and teach, you, too, are participating in our Maker Cycle and engaging in the learning practices of the maker movement. We invite you to join our maker community and share your discoveries and makerspaces on our website (www.storymakers.us) and with your colleagues. Let's begin our journey together, right here, right now, and imagine powerful makerspaces where children can have a better education, rooted in play, and opportunities to grow as artists, collagists, builders, sculptors, performers, inventors, storytellers, and writers . . . makers.

Materials brought from home that inspired children as they imagined, played, made, and shared

CHAPTER 1

Designing and Setting Up Your Makerspaces

As I explore materials in front of me,
My imagination awakes with possibility.
As a maker, I discover new ways to create.
My materials guide and help me communicate.

Stories to Inspire Making

They looked like plain white paper bags. Nothing special. Some were a bit crumpled, for their adventures had been rough on them. But to the children, they were so much more than plain white bags. They were bags full of secrets—treasure bags, bursting at the seams. The children, imagining magical riches within, couldn't wait to investigate.

An invitation for children to imagine, play, and make with found materials

Paper bags brought from home, filled with found materials, recyclables, and loose parts

Materials inspire wonder and awe.

Finally, it was time to peek into the bags and discover the jewels, precious metals, and other materials. What wonders did these treasure troves hold?

Everyday objects became magical to children as they scavenged through the loot: shiny parade beads of every color and sticks and broken necklaces with sparkling jewels and shells and screws of all sizes. Discussions of pirates and mermaids and underwater adventures began immediately. Then everyone gathered around as another bag was emptied into the large, transparent plastic bin. There were shoelaces and pipe cleaners and string and bottle caps and cardboard and paper clips and

As more children brought in materials, we moved them to a larger bin.

Children exploring, tinkering, hacking, and repurposing materials brought from home

twine and rocks and straws. Each child was invited to fill a container and take it to their table to play, explore, sort, organize, stack, dump, and make.

Each child placed their treasures on a metallic cookie sheet that further reflected their precious bits and pieces. They played and cut and touched and sorted and traded and arranged and talked about their favorites. They made swing sets at the park, built trucks, went on pretend journeys with their materials, and shared their adventures with their friends. They were awed by the materials and their worlds. The materials had conveyed to them that they were going to make wonderful discoveries together.

Each picture captures the contents of one of the treasure bags.

This was the beginning of a wonderful adventure with materials. The children imagined, played, made, and shared the stories, ideas, projects, and thinking that were inspired by the materials they had gathered, collected, brought from home, explored, questioned, investigated, and organized. At the close of the adventure, the materials found homes in containers in each of the makerspaces.

We introduce each chapter with children's interactions with materials because we have found that the "desire to construct meaning with visual materials is often inspired by the materials themselves. Beautiful, interesting, and appealing materials call out to be touched, used, and played with" (Massey 2017, 7). This introduction, focused on how materials lead to discovery and learning, launches the makerspace highlighted in the chapter. This first story featured excitement about the materials our students and families gathered and brought to the classroom at the beginning of the year.

Why Create Multiple Makerspaces?

Just as you probably have multiple centers, STEM challenge areas, or play spaces in your current learning space, we suggest that you design and set up multiple makerspaces in your current spaces with materials you already have on hand. Not to worry: we will provide inspirations along the way.

You will transform one space at a time, using what you already have. By transforming your current areas into makerspaces, you are simply adding intention and

purpose to your play areas. Using the space you already have, the inspirations—ideas, examples, lessons, questions, children's book recommendations—in this book, and simple materials that you probably already have, you will spark children's curiosity, invite them to notice and pay attention to their environments, inspire them to think across domains, encourage social-emotional learning, and celebrate as they share and collaborate, building a maker mindset.

Remaking Classroom Spaces into Makerspaces

In this section we offer examples of how you can transform your existing spaces into the makerspace featured in each chapter. Follow these steps to get started:

- Select an area to transform. Do you want to transform an area that your children do not use often? A space that your children love? A new space?
- How many children do you anticipate playing and making in that space? This will determine what materials and space you will need.
- Inspiration and Support: Select a children's book and create a question that matches your purpose for the makerspace.
- Main Materials: Take an inventory of the main materials you have on hand and select one or two to place in the space at first. Consider removing, storing, or reorganizing items that can be introduced as a new main material later in the year to sustain play and interest.
- Loose Parts: Consider the loose parts you have and choose one to three to incorporate into the children's playing and making at first.
- Tools and Attachments: Select tools, if any, that will support making with the main materials and loose parts.

Ideally your initial makerspace setup will interest the children for several weeks. Over time, or if you see children's interest waning, add a new or different main material or select a new category of loose parts to replace the current offering. New loose parts spark wonder and curiosity for making. There is no right or wrong. Use whatever you have that aligns with your current unit of study or theme and will instill a sense of wonder in your children.

Organization/ Aesthetics

We organize our main materials and loose parts by composition. Our categories include plastic, textiles, metal, nature, wood, glass, and paper. If this helps you, try it. If not, use a system that works for you.

Maker's Continuum of Playing and Making for New Makerspaces

Arts and Crafts ⟷ High Tech		
Consider whether your materials are closed-ended (have an intended right or wrong use) or open-ended (can represent many things; no prescribed use). The goal is to slowly introduce more open-ended materials and eventually put aside closed-ended materials that do not hold children's interest until you have more open-ended than closed-ended materials in your transformed areas.	Notice that children are in the makerspaces for longer periods of time and remain more engaged with the open-ended materials. Notice and document the enactment of the learning practices as the children play and make. Consider introducing more complex tools and attachments as the children gain fluency with the main materials and loose parts.	If you notice the children getting bored, rotate in some new and interesting materials or have a focus lesson on a new technique. Analyze the learning practices children have enacted and notice their growth toward a maker mindset. Introduce more complex materials, such as take-aparts, digital apps, and high-tech options as available.

STREAM Learning in Makerspaces

Elements of STREAM learning can be found throughout each makerspace, and we provide targeted language stems for use with your students as they go deeper with their learning. We also highlight opportunities for interdisciplinary learning and innovation in each makerspace. We begin here with some overarching goals aligned with each of the STREAM domains.

Prompts to Ensure STREAM Learning Connections

Science	Makers will do the following: • Explore the world around them ("What can you imagine making with these materials?")
Technology	• Select and use appropriate tools with fluency ("What tools can you use as you play and make with these materials?")
Reading/Literacy	• Grow their identities as readers and authors and communicate with others ("How would you like to share your project, idea, thinking, or story?") • Find meaning in read-alouds and recognize story structure ("What stories can you imagine with these materials?")
Engineering	• Encounter problems and figure out possible solutions ("What techniques can you use to figure out how to work with these materials?")
Arts	• Identify and apply the elements of art in a developmentally appropriate way ("How have you used your knowledge of color/shape/line/space/design as you make?") • Grow their maker and artist identities ("What can you imagine making with these materials as an artist/painter/collagist/sculptor?")
Mathematics	• Recognize shapes, count, measure, and compare ("What [tools, measurements, shapes, amounts] can you use to make what you imagined?")

Imagine Making a New Makerspace

Imagine is the first step of the Maker Cycle for teachers and young children alike. The "Imagine Making a Makerspace" section of each chapter highlights goals or purposes for the makerspace; resources for inspiration and support in the design and setup; and the main materials, loose parts, tools, and attachments that might be used in each makerspace. We present photos to document a makerspace that we designed and then discuss some of the many possible adaptations and variations.

In accordance with the premise of backward design, we begin our setup of makerspaces with the end in mind. Our goal is to engage young children in these spaces in interactions with interesting materials, tools, and attachments in order to build their identities and develop their capacities for multiple ways of knowing and deep thinking; improve potential for representation of their thoughts, feelings, and perceptions; and offer opportunities to enact creativity, imagination, and flexible thinking (Eckhoff 2017).

The first step in planning a new makerspace is identifying its purpose, which is related to growing the identities of our young makers (artists, collagists, builders, sculptors, performers, inventors, weavers, storytellers, and writers). Your purpose may be based on a learning practice you want to focus on, a characteristic of the maker mindset, or a current curricular or social-emotional learning goal. You know what your children need and what their interests are, so you are the best person to determine your goals. We provide examples of our goals to inspire you and give you ideas, but possibilities are limited only by your imagination and resources.

A makerspace to build and make with performance materials: 1. Inspiration and support (sign, book) 2. Main material (wood) 3. Loose parts (moss, mulch, acorns, stones, and other natural items) 4. Tools and attachments (scissors, glue sticks, liquid glue)

The purpose of the makerspace shown here is to grow our children's performer identities as they develop a character, focusing on details. Josveen is imagining a character he can make with the open-ended nature materials.

INSPIRATION AND SUPPORT

The next step is to provide inspiration and support toward the achievement of your goal. Our goal in this section is to provide specific inspirations for you as you design productive makerspaces to ignite your children's imaginations. Each chapter includes a sign for you to post in your makerspace featuring photos of materials and open-ended questions to inspire the children. Feel free to visit www.storymakers.us to download a copy of the signs for use in your makerspaces.

Sources of inspiration include the following:

- an invitation to explore the materials
- a shared read-aloud
- a new and interesting material
- a focus lesson
- guiding questions asked or posted

The goal is to ignite children's imaginations, encourage curiosity, and provoke wonderings. For this makerspace we recommend the book *Dress Like a Girl* by Patricia Toht and a sign inviting, "What character can you imagine designing with nature materials?"

Sometimes a form of support is the best inspiration. Supports include the following:

- an anchor chart displaying specific steps for using a new tool or technique, supported by visuals (Anchor charts "are charts that you create collaboratively with the students during focus lessons to anchor their thinking" [Compton and Thompson 2018, 20].)
- guiding questions that prompt student explorations across disciplines (STREAM)
- models or photographs of other children's projects or stories created in that makerspace
- fiction and nonfiction books with illustrations that can serve as models or examples

Josveen is curious about the moss. He is studying it and noticing its properties.

We offer different examples of inspiration and support in each chapter so that you will have an array of possibilities for inspiring your children.

MAIN MATERIALS

The main material is the first material you choose. In most makerspaces it serves as the base for playing and making. In the highlighted makerspace, the main material was wood craft sticks, which served as the base for the puppet design.

We provide examples of different main materials used in the variety of makerspaces set up in each chapter. The photos show how a main material might be used to accomplish learning goals in each space and what main materials might be found in each makerspace. The following chart lists some basics to begin the transformation of your current play areas:

Common Makerspace Materials that You May Have on Hand

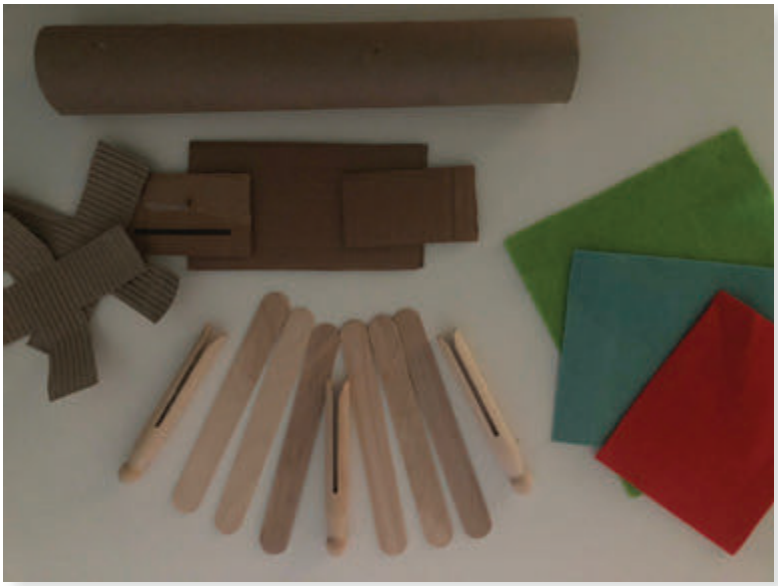
Makerspace	Common Main Materials
Arts	Paper (watercolor, construction, copy, card stock)
Collage	Felt, construction paper, scrapbook paper, large photos, placemats
Construction	Wood blocks, cardboard brick blocks
Sculpture	Playdough
Performance	Wood craft sticks, clothespins, cardboard, paper, fabric, scarves, felt
Small World	Sand, water, dried beans, dried rice
Fiber Arts	Yarn, ribbon, fabric

Main materials from arts makerspaces

Main materials from collage makerspaces

Main materials from construction makerspaces

Main materials from sculpture makerspaces



Main materials from performance makerspaces

Main materials from small world makerspaces

Main materials from fiber arts makerspaces

LOOSE PARTS

We have lots of different categories for loose parts. Selecting a particular category of loose parts enables children to notice and more easily make connections to textures, balance, colors, forms, functions, and innovations of that type of loose part. Providing many possibilities within one category invites children to go deeper with their learning about the material and its properties and uses. With each unit we select a specific category of materials; we therefore suggest sending a letter to children's families as needed throughout the year to stock or replenish your makerspace resources (see appendix A).

We use loose parts to complexify, enhance beauty, and make thinking visible in makerspaces. The categories of loose parts we use are

- nature objects,
- wood,
- paper,
- textile,
- plastic,
- glass, and
- metal.

Nature and wood loose parts

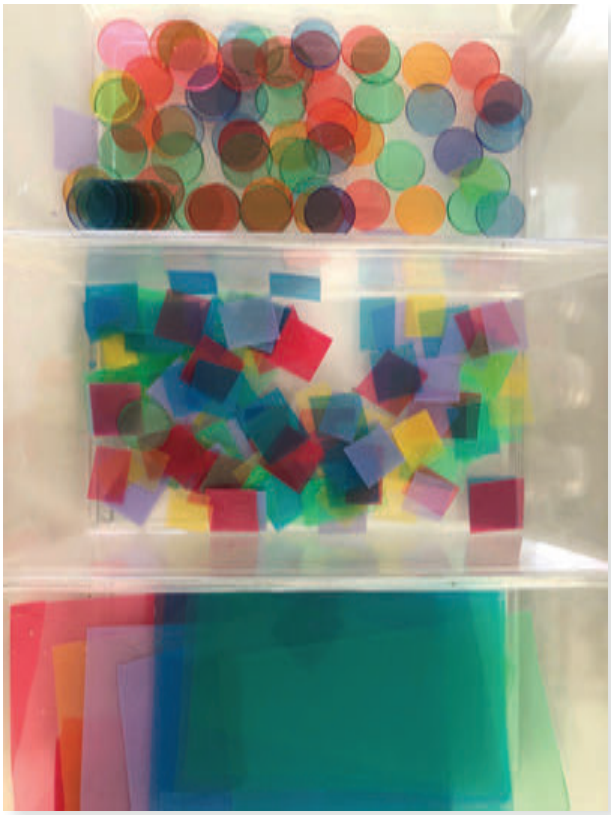
Wood loose parts

Adaptations for the Youngest Makers

For our youngest learners, we typically recommend starting with one or two loose parts and building up to collections of three to five different loose parts. Working with limited numbers allows young children to investigate the loose parts more deeply, learning about the parts' forms and functions so they can more easily tinker with, hack, and repurpose them.

Paper loose parts

Textile loose parts



Plastic loose parts

Glass loose parts

Metal loose parts

Organization and Aesthetics

The loose parts storage in clear containers from the atelier at Kinderoo Children's Academy in Ocala, Florida, is not only beautiful but also allows easy access for teachers to imagine possibilities for the designing of beautiful makerspaces.

Loose Parts List

Nature	Wood	Paper / Cardboard	Plastic	Metal / Reflective	Textiles	Glass
acorns bark clam shells coconut shells driftwood feathers flower petals flowers (seasonal) helicopter pods leaves logs moss nests nuts pine cones pumpkins/ gourds rocks/pebbles/ stones sea glass seashells seeds sponges sticks/ branches straw vines walnut halves wood cookies	clothespins corks golf tees matchsticks palettes wood chips wood cookies wood craft sticks wood doll pins wood flooring tiles wood knobs wood spools	cardboard mailing tubes envelopes magazines manila folders newspaper old cards paper egg cartons paper towels paper tubes sticky notes tissue boxes tissue paper	acetate shapes bag clips balloons beverage caps bingo chips buttons CD cases cellophane coffee pods color paddles curtain rings dice dominoes drink stirrers glow sticks grocery bags gutters (ramps) hair rollers marker caps math manipu latives old film rolls packing bubbles ping-pong balls plastic beads and necklaces plastic cups plumbing connectors pony beads pool noodles PVC piping straws tape rolls (empty) thread spools (empty)	air ducts aluminum canning jar lids aluminum foil binder rings clips bottle caps brad fasteners bread ties circuit boards keys metal screen Mylar nails nuts, bolts, and washers paper clips pipe cleaners screws silverware soda tabs springs watch parts	beanbags blankets burlap cotton balls doilies embroidery thread/ string fabric strips felt flannel lace pom-poms ribbon rope scarves stretchy bands tarps twine wool yarn	doorknobs gems glass beads magnifying glass marbles mirrors mosaic tiles prisms sea glass window blocks

TOOLS AND ATTACHMENTS

Tools are items used to manipulate materials. Common tools in our makerspaces include the following:

- scissors
- straightedges or rulers

Attachments are connectors that enable children to attach two or more objects—typically loose parts—together during their making. Typical attachments include the following:

- glue
- tape
- wire
- binder and paper clips
- pipe cleaners
- string/twine

We list specific tools and attachments for each makerspace and suggest brand names of specific tools and attachments that we have found to be reliable and useful. This section also includes safety tips as appropriate.

The "Imagine" section of our Maker Cycle and of each chapter gets children's imaginations engaged. Now let's start playing and making!

Organization and Aesthetics

The possibilities for organizing and displaying your loose parts are endless. Reuse everyday items or upcycle materials found in packaging to beautifully store and display your loose parts. Select clear containers that close for storing loose parts. For displaying loose parts in the makerspaces, open and easily accessible containers or small containers with lids work best. When materials are poured into these containers, they become "idea jars" ready for children to imagine, play, make, and share.

Spaces for Playing and Making

This section provides a documentation story from the highlighted makerspace. Each story emphasizes the purpose for the makerspace, an explanation of how a child enacted the learning practices as they went through the Maker Cycle, and photos capturing it all. We then show pictures of many different materials, tools, and attachments and their uses in the featured makerspaces. One photograph per chapter features the development of social-emotional efficacy in the makerspace and is captioned "Making a Mark."

Here is your first documentation story of the power of the everyday materials and loose parts the children collected and their effects on the learning of these young makers.

It was a busy day in this public school prekindergarten classroom, with many makerspaces to choose from. As we traveled from makerspace to makerspace, the students were engaged, intrigued, interactive, and collaborative in their playing and making. In the arts makerspace, the children investigated circles, using different circular loose parts as inspiration.

The children were invited to play and make with circles in the arts makerspace.

Hunter is curious and stacks the plastic lids.

Hunter studies the materials as he begins to tinker.

After tinkering with the materials, Hunter uses paint to play with circles.

When new materials are introduced, children often tinker, mess around, and stack and dump (literally!) the new materials. They need to figure out each material's form and function before they can start making something. On this day Hunter was most curious about the plastic lids he had discovered in the collage makerspace, where the children were using plastic loose parts to make their collages. "Why are these here? What are these for?" Hunter had never considered the possibility of using plastic lids for playing and making. He decided he wanted to paint the plastic lids. He took them to the arts makerspace, creating an opportunity for cross-disciplinary learning.

Hunter made several attempts to get the paint to stick to the plastic before figuring out that he needed the paint to be thick, with very little water added. Finally, success! He loved his new painting and decided to give it to his mom for her birthday, after it dried.

This painting made the perfect birthday gift for Hunter's mom, showing his talents as an artist and maker.

Below are the observable indicators of enactment of the learning practices during this learning engagement in the arts makerspace.

Documenting Learning in a Makerspace

Learning Practices that Lead to the Development of a Maker Mindset	Indicators of Learning through Enactment of the Practices
Inquire	• Hunter was curious about why there were bottle caps in the makerspace. He asked, "Why are these here? What are these for?"
Tinker	• Hunter stacked and played with the bottle caps, trying to get them to balance.
Seek and Share Resources	• Hunter used the materials (bottle caps) as a resource to help him figure out the properties of paint and how to use tools to paint surfaces. He shared his new knowledge during his maker talk.
Hack and Repurpose	• The bottle cap was hacked and repurposed as a painting tool used to make circles.
Express Intent	• Hunter said he wanted to "make a lot of circles."
Develop Fluency	• The longer Hunter stuck to it and tried to figure out how to get the paint to stick to the lids, the more fluent he became.
Simplify to Complexify	• Hunter combined two simple materials (plastic bottle caps and paint) to create opportunities for perseverance, complex thinking, and growing his identity as an artist.

More Spaces to Inspire Your Making

This section provides additional pictures of different main materials and loose parts used in the highlighted makerspace. It's an opportunity for you to get inspired with the variety of possibilities and ideas!

Making a Mark by organizing and sorting materials to make it easier for classmates and friends to find and use materials

Sharing Our Thinking

In each chapter we share a lesson that you might like to try out in your makerspace.

FOCUS LESSON FOR MATERIALS BROUGHT FROM HOME

Objective: Children will engage their imaginations by wondering, collecting, exploring, and organizing materials.

MATERIALS

- letter home
- bags for treasures
- large pieces of construction paper or white paper, or cookie trays, or any container for loose parts (we used individual plastic cereal containers from the cafeteria)
- "What Makers Do" and/or "What Is a Maker?" anchor chart drawn on chart paper
- markers
- camera for documentation
- your own bag filled with three to five loose parts and found materials

Focus and Explore

Connect: *"Good morning, makers! Do you remember yesterday when _____ shared what materials she used in her playing and making? She made me curious about materials. I wondered about what new materials we could place in our makerspaces. I am always curious about new materials and what I can make using those materials."* Give the children an opportunity to share their wonderings about materials. *"So today we will engage our imaginations by thinking about what interesting materials we may be able to find at home to add to our makerspaces for playing and making."*

Teach: *"Guess what, makers? Makers have eyes to notice and observe their surroundings. Do you know what that means?"* Give children an opportunity to think and share while reflecting on the "What Is a Maker?" anchor chart and charting their words. *"Yes, makers use their eyes to find and look closely at things. This is a wonderful feature of what makes us all makers. Now let's discuss what makers can do."* Reveal new anchor chart and highlight how makers wonder. *"Let's practice wondering by observing and imagining what we can make."* Pull out a loose part from your treasure bag. *"Look what I found when I took a walk in my neighborhood!"* Pull a rock out of the bag. *"A rock! What do you notice about this rock?"* Give children a chance to notice characteristics, forms, and functions (hard, brown,

smooth). *"Makers also listen and learn from other makers to imagine new ideas and what they can make with materials. I wonder how we could use this rock in our makerspaces. Everybody, close your eyes. Think about how you would use this rock when you're playing and making. Think, think, think."* Give some time for thinking. *"Turn to your partner (or someone next to you) and share how you would use it in an idea or a project or a story."* Allow time for them to share ideas with one another.

Continue to pull items out of your bag and talk about them, naming your observations and noticings and possibilities of what you could make with them. (For example, *"I'm noticing that this stick is brown. And it can break in half."* Break it. *"Oh,*

"What Makers Do" anchor chart

I have an idea. These two pieces of my stick can be walls of my tent in my story." Give the children time to share how they might use the materials and what they notice about them.

Active Involvement: *"I had fun sharing my materials with you. You are each going to get a chance to gather treasures for your bag. You are going to get a bag just like this to take home! When you take your bags home, you and your families can wonder about and notice the treasures in your house and in your backyard and in your neighborhood, and put them in your bags. You are going to look for bits and pieces that you want to use in our makerspaces."* Refer to the What Makers Do chart and explain that makers wonder and are curious about the materials in their world and what they can become.

"What are you imagining you will collect on your treasure hunt?" Have the children share with their neighbors about the materials they are thinking about. As they do that, document what materials they want to explore and what materials or makerspaces they are going to use.

Imagine

Ask children to pause and think about what materials they want to explore today. Record their ideas on the Class at a Glance form to document frequency in use of materials and ideas (see appendix C).

Play and Make

Document the learning practices children exhibit while making by taking pictures and dictation and using the Learning Practices Documentation form (see appendix B). This form may help you identify the enactment of the learning practices as you observe your children playing and making. An easy place to start is identifying children's inquiries as they express curiosity, show excitement, and ask questions.

Share

Select a child who used simple, everyday materials to give a maker talk. Have the child gather all materials and tools prior to the maker talk, or take a photo of the project. During the talk, prompt the child with questions, such as "This is a picture of what you have been making. Can you tell us about the materials you used?" or "Can you point to the parts of your construction (or sculpture, collage, and so on) and tell us how you made it?"

Adaptations for Makers with Special Rights

If you have nonverbal children, provide them with options during their sharing. You could narrate the processes, projects, or stories as they point to different materials to ensure that they get to participate in maker talks.

SUGGESTED BOOKS TO INSPIRE MAKERS

We love using books to inspire our makers! Each chapter has a list of recommended children's books relevant to the featured makerspace. Here are books about making and makers that you can use with any of your makerspaces:

Rosie Revere, Engineer by Andrea Beaty
What If . . . by Samantha Berger
Papa's Mechanical Fish by Candace Fleming
Be a Maker by Katey Howes
Have Fun, Molly Lou Melon by Patty Lovell
Little Robot Alone by Patricia MacLachlan and Emily MacLachlan Charest
Little Engineers by Haig Norian
Anywhere Artist by Nikki Slade Robinson
The Most Magnificent Thing by Ashley Spires
Made by Maxine by Ruth Spiro
With My Hands: Poems about Making Things by Amy Ludwig VanDerwater
What Do You Do with an Idea? by Kobi Yamada

Next Steps in Transforming Spaces

By creating intentional makerspaces for playing and making where children enact the learning practices of the maker movement, you are building a maker mindset in your young makers. As you transform your play areas to makerspaces and grow comfortable introducing new or different materials, make sure your makerspaces are developing your makers' mindsets. In this section of each chapter, we provide examples of how the learning practices build a maker mindset and pose questions for you to consider with your colleagues as you reflect on the children's growth. The Learning Practices Documentation form (appendix B) will help you document the enactment of learning practices. For example, you may notice your children using the read-aloud books as inspiration. Children also use one another and the materials to generate ideas. Note these behaviors under "Seek and Share Resources" on the form. Seeking resources builds a growth mindset as children learn that they can be successful by getting help and seeking resources.

Take a moment to have a maker talk with your colleagues to share, collaborate, and consider next steps in the transformation of your makerspaces.

- Examine the Learning Practices Documentation form. Discuss it with your colleagues. How will you use it to document the enactment of the learning practices in your children?
- What is the first space you plan to transform? What ideas do you have? How can your colleagues support you as you think it through and get started?
- How will you organize your loose parts for your makerspace? What containers have worked for you?
- What STREAM learning connections would you like to emphasize that would guide your language prompts and selection of materials, loose parts, tools, and attachments?