



# Family Activities Workbook

# STEM Family Activities Workbook

*The STEM Family Activities Kit is a collaboration between the Boston Children’s Museum and the Massachusetts Department of Early Education and Care. This work is funded by the federal Race to the Top—Early Learning Challenge grant, awarded to the Department of Early Education and Care in 2012. The goal of the STEM Family Activities Kit is to provide information and activities for families and to support them in focusing and refining the naturally inquisitive behaviors of infants to five-year-olds on science, technology, engineering, and math (STEM). The content and activities are aimed at both children and their families, who can initiate and extend STEM learning at home.*

## MEET THE PARTNERS

### **Boston Children’s Museum**

Boston Children’s Museum (BCM) is a welcoming, imaginative, child-centered learning environment that supports diverse families in nurturing their children’s creativity and curiosity. BCM promotes the healthy development of all children so that they will fulfill their potential and contribute to our collective well-being and future prosperity. BCM builds brains every day! Come visit our Peep’s World exhibit, where children develop basic science skills like observing, predicting, and problem solving by playing with water, and shadows.

### **Department of Early Education and Care (EEC)**

The mission of the Massachusetts Department of Early Education and Care (EEC) is to support all children in their development as lifelong learners and contributing members of the community and to support families in their essential work as parents and caregivers. EEC is responsible for the licensing and regulation of approximately eleven thousand family, group, and school-age child-care providers, as well as nearly seven hundred residential care programs and adoption/foster care placement agencies. EEC also administers financial assistance for over fifty thousand children, enabling them to access high-quality early education and out-of-school time programs that support their developmental success; provides additional parenting resources and services for families; and supports the professional development of educators in the early education and care field.

### **ResourcesforEarlyLearning.org**

The Massachusetts Department of Early Education and Care (MA EEC) recognizes the importance of providing early childhood educators and families with the skills, training, knowledge, and understanding needed to help young children grow and learn. To that end, the MA EEC has partnered with the WGBH Educational Foundation to create ResourcesforEarlyLearning.org, a new website filled with media-rich educational resources designed to support early learning. Developed by a team of curriculum experts, educators, and parents, the website consists of three main sections—Educators, Parents, and Children—and features a comprehensive, standards-based ELA/STEM curriculum for preschool, professional development modules, activities and “best practice” videos for parents, and developmentally appropriate media for young children. parents, and developmentally appropriate media for young children.



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## THE PARTNERS REMIND YOU THAT:

- Preschool is the perfect time to cultivate positive attitudes about learning.
- Very young children are quite capable of doing science.
- Preschoolers naturally have many of the capabilities of scientists.
- Preschool is the perfect time to develop science process skills.

# What is STEM All About?



**STEM** is an acronym. It was used originally by the U.S. government to describe fields of study that helped immigrants get work visas: science, technology, engineering, and math. Today, educators are linking these areas together in what is called STEM curriculum. When we break down the acronym into its parts, we see that early childhood programs practice STEM activities every day. **Science** activities include exploring water and sand, comparing and contrasting natural materials like rocks and soil, blowing bubbles, and planting a garden. **Technology** activities include computers, but also identifying simple machines like scissors, gears, wheels, and pulleys and looking through a magnifying glass to count the legs on a bug. **Engineering** regularly happens in an open space with blocks. Playing with blocks allows children to plan and design structures with minimal adult direction. In addition to planning and constructing buildings, children create ramps and roll balls across the floor. **Math** activities include counting and matching shapes and making patterns. Measuring is easy too, especially with unit blocks, which come in standard sizes, each size twice as large as the next smallest.

As their children's first teacher, parents/caregivers\* can expand their children's science learning by leading them toward discovery; encouraging their natural curiosity; noticing how they play with water, shadows, or sand; and encouraging them to observe the world. Modeling curiosity about everyday occurrences—"I wonder what will happen when I put the water into the pancake mix" or "I wonder what the moon will look like tonight"—can be a big help to children's science learning. As children get older, families can build on their interests by asking open-ended questions: "What are you working on now?" "What do you notice about how that bug is moving?" "What else have you seen other kids try?" Writing down their thoughts and ideas and taking photos of their exploration are good ways to document their growth in science discovery.

### **STEM Education Must Start in Early Childhood**

In an article published in Education Week, J. D. Chesloff neatly sums up the case for starting STEM education in early childhood:

"It is my feeling that you can't start early enough: Young children are natural-born scientists and engineers. Like STEM, investment in early-childhood education is a workforce-pipeline issue. Research has shown that high-quality pre-K cuts the rate of children being held back a grade in half; decreases juvenile arrests by a third; and increases high school attendance by a third, college attendance by a whopping 80 percent, and employment by 23 percent. High-quality early-learning environments provide children with a structure in which to build upon their natural inclination to explore, to build, and to question."

J.D. Chesloff is the executive director of the Massachusetts Business Roundtable, chair of the of the Massachusetts Board of Early Education and Care and chair of the executive committee of the governor's STEM advisory council.

*\*We use the word parent or parent/caregiver in the most inclusive way. This may mean a grandparent, foster parent, or other guardian or caregiver.*



The following chart illustrates how young children can experience age-appropriate science learning at home. Below are suggestions for families that educators can give workshop participants. Encouraging the science attitudes of curiosity, divergent thinking, playfulness, observation and exploration will prepare children for later learning.

SCIENCE ATTITUDES	SUGGESTIONS FOR FAMILIES
Asking questions is very important in science. Questions help lead scientists to answers in the world.	Ask your child lots of questions as you go about your day. Ask, "What do you think?" This question indicates there is no right or wrong answer and that you are interested in your child's opinion.
Scientists don't always find the answers to all of their questions, but they ask lots of questions anyway.	Keep the conversations going, no matter what the answer. After some exploration, you might say, "Oh, interesting. What do you think now?"
Scientists keep data logs to observe changes over time.	Together you can create a notebook, photos, or drawings to illustrate what your child has discovered.
Scientists use special tools to improve observations.	Provide ruler, scissors, a thermometer, a stopwatch, and a magnifying glass to extend your child's senses. These tools help children do what they cannot do by themselves.
Scientists develop explanations using observations (evidence) and what they already know about the world. Good, reasonable explanations are based on evidence from investigations.	When children offer an explanation, they should be encouraged to use their observations and their documentation to support their explanation. This way, children can reflect on their experiences and deepen their understanding. If an explanation is scientifically incorrect but reasonable from your child's experience, there is no need to correct him/her right away. Change in thinking takes place over time, after many experiences.
Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.	Help your child compare his/her own answers to evidence that already exists. Either you can show that your child is on the right track, or you can do some research together on the Internet or in the kitchen!
Scientists make the results of their investigations public; they make their discoveries known to everyone.	Post your child's observations, discoveries, and evidence on the refrigerator or in drawings or photos around the house.



## WHY TEACH SCIENCE TO YOUNG CHILDREN?

The best answer to this question comes from local expert Karen Worth, who wrote the book *Worms, Shadows, and Whirlpools*:

“The goal of science is to understand the natural world through a process known as scientific inquiry. Scientific knowledge helps us explain the world around us, such as why water evaporates and plants grow in particular locations, what causes disease, and how electricity works. Scientific knowledge can help us predict what might happen: a hurricane may hit the coast; the flu will be severe this winter. Scientific knowledge can also help solve problems such as unclean water or the spread of diseases. Science can guide technological development to serve our needs and interests, such as high-speed travel and talking on the telephone.

Some people, when they think of people doing science, imagine laboratories filled with scientists in white coats mixing chemicals and looking through microscopes. Such images are real, but there are other images of scientists charting the course of a hurricane, studying the behaviors of wolves, searching the skies for comets. But scientists are not the only people who do science. Many jobs involve science, such as electrician, farmer, architect, and car mechanic. And people of all ages learn about the world through actions that begin to approximate scientific practice—for example, when an amateur gardener asks a question, “How much light do my tomatoes need to grow?” tries out different locations, and observes the results. These activities, by scientists and nonscientists, whether happening in the laboratory, in the field, or at home, have in common the active use of the basic tools of inquiry in the service of understanding how the world works. Children and adults, experts and beginners, all share the need to have these tools at hand as they build their understanding of the world.

Scientific inquiry provides the opportunity for children to develop a range of skills, either explicitly or implicitly. The following is one such list:

- Explore objects, materials, and events.
- Raise questions.
- Make careful observations.
- Engage in simple investigations.
- Describe (including shape, size, number), compare, sort, classify, and order.
- Record observations using words, pictures, charts, and graphs.
- Use a variety of simple tools to extend observations.
- Identify patterns and relationships.
- Develop tentative explanations and ideas.
- Work collaboratively with others.
- Share and discuss ideas and listen to new perspectives.



In many settings, the new knowledge about children’s cognitive potential is not being used to broaden and deepen the science curriculum to include more in-depth and challenging experiences. Instead, the increasing concern about reading has reinforced the almost singular focus on learning basic skills of literacy, numeracy, and socialization. It also is bringing to the early childhood setting increased pressure for accountability, leaving little room for children’s rich play and exploration of the world around them.

The exploration of the natural world is the stuff of childhood. Science, when viewed as a process of constructing understanding and developing ideas, is a natural focus in the early childhood program... Children’s inquiry into appropriate phenomena is not only the place to build foundational experiences for later science learning, it is fertile ground for the development of many cognitive skills. It also is a context in which children can develop and practice many basic skills of literacy and mathematics. Finally, science is a collaborative endeavor in which working together and discussing ideas are central to the practice.”

Worth’s important statement, “The exploration of the natural world is the stuff of childhood,” has inspired the collaboration between BCM and EEC through the Race to the Top—Early Learning Challenge grant to develop and distribute this new STEM Sprouts Family Activities Kit. This kit is intended to inspire families to focus on observation and exploration as natural ways for their children to learn about the world.

# **Massachusetts Pre-K STE (Science, Technology, Engineering) Standards**

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Early childhood educators often worry that when formal educational standards emerge, what eventually follows will be a “trickle down” of inappropriate expectations from the primary grades and that some of the joy of early childhood may be lost. However, when used properly and articulated with understanding, standards can be an effective ally in defending appropriate early childhood science practice.

An adult familiar with the Massachusetts STE Pre-K Standards can discuss how children’s water play represents early investigations of the properties of matter, whereas an adult with less knowledge of the standards might describe water play as something children need to explore for dramatic play, for “sensory” experiences, or to stay engaged. The traditional areas of the early childhood classroom—the water table, the block corner, the playground—are valuable for both the science content and dramatic play. These are the places where young children gain valuable, new, early science experience, especially when the grownups playing with them have enough knowledge to encourage their investigation, ask productive questions, and guide their discovery. The overall goals of children’s development in science are to deepen their conceptual understandings of the world around them, to increase their comprehension of how science is practiced, and to develop their abilities to conduct scientific investigations. Adults can help children achieve these goals with a supportive environment. Familiarity with STE standards can help guide the adult’s coaching.

Massachusetts has been in the forefront of developing early childhood standards for STE. Currently, we have draft STE standards that represent good early childhood practice. These standards are meant to be integrated with young children’s play.

**Here are a few things to keep in mind about the STE pre-K standards:**

- These standards are intended to emphasize the importance of STE in pre-K, as a way to guide teachers and other adults as they plan meaningful experiences for children.
- They are intended to be representative of the materials and phenomena that young children naturally encounter on a daily basis, through their play and with the guidance of teachers or other adults.
- As written, they are not intended to define curriculum or pedagogy. They are learning outcomes – what children need to know and be able to do.

As we compare this new set of standards with the 2003 Guidelines for Preschool Learning Experiences (“The Green Book”), we see that there is a significant overlap between the two. (See “Crosswalk between the 2013 Prekindergarten Standards in Science, Technology and Engineering and the Guidelines for Preschool Learning Experiences in the Massachusetts STEM Standards” in the Appendix).

Science content can no longer be separated from how science is practiced. This suggests that we no longer want to encourage science teaching and learning as only the memorization of facts, but rather the learning of content while actually doing science in a developmentally appropriate way.

Helping children engage in the world of science can feel somewhat daunting, especially if you aren’t confident in your science knowledge. Many people didn’t excel at science or math in school and feel they don’t know enough about these subjects to help the children in their care. Those who do know the world of science may be confused about how to help very young children learn about complex concepts. So, let’s embrace the science standards that are available to us in Massachusetts and use them to make children’s experience with science meaningful and memorable.

# Brain Building 101

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Recent research in neuroscience and other developmental sciences shows us that the basic architecture of a child's brain is constructed through an ongoing process that begins before birth and continues through adulthood. Like the construction of a home, the building process begins with laying the foundation, framing the rooms, and wiring the electrical system in a predictable sequence. A child's early experiences literally shape how the brain gets built. A strong foundation in the early years increases the probability of positive outcomes such as school readiness and social/emotional skill development. A weak foundation may require remedial education, clinical treatment, or other interventions that are less effective and more costly than providing crucial brain-building interactions early in life.

Children need guidance and assistance with new ideas. The role of adult family members is to be on the sidelines, offering support when needed to help children develop new skills and facilitating their interaction with the environment. Adults do not need to be the only source of input and exploration for children. Playing indoors, outdoors, in libraries, and in museums will provide children with a wide array of learning experiences.



## BRAIN BUILDING FOR STEM

**Science is a way of thinking.** Science is observing and experimenting, making predictions, sharing discoveries, asking questions, and wondering how things work.

**Technology is a way of doing.** Technology is using tools, being inventive, identifying problems, and making things work.

**Engineering is a way of doing.** Engineering is solving problems, using a variety of materials, designing and creating, and building things that work.

**Math is a way of measuring.** Math is sequencing (1, 2, 3, 4...), patterning (1, 2, 1, 2, 1, 2...), and exploring shapes (triangle, square, circle), volume (holds more or less), and size (bigger, less than).

**The Brain Building in Progress campaign** is a public/private partnership of the Massachusetts Department of Early Education and Care, United Way of Massachusetts Bay and Merrimack Valley and a growing community of early education and child care providers, academic researchers, business leaders and individuals. Check the website for more information.

# More Questions than Answers: Why is the Sky Blue?

You've probably noticed that once children start talking, a common phrase learned very early is "Oh, look!" This is the start of the important skill of inquiry or observation. Children are constantly learning with their senses: touching, tasting, smelling, hearing, and seeing objects of interest. The youngest babies first reach out to touch everything they see; then they want to put it all in their mouths to explore it more. Their first question might sound like "Whaasis?"



Most parents/caregivers feel stumped when their children begin asking them common questions like “What is air? Where does water come from? Why do the stars shine at night? What makes the lights go on?” A child’s curiosity often does not show itself as spontaneous questioning, but is a statement of their interest or observation of some phenomenon. Some adults are comfortable saying, “I don’t know,” and others will make up an answer. Most will get on the Internet and look up the answer to share with their child. Encouraging families to embrace all their children’s questions will help them develop their ability to engage with their children in scientific inquiry.

### **PRODUCTIVE QUESTIONS TO ASK CHILDREN**

Sometimes it feels as if no one person could have all the answers to children’s questions. But we have good news for you—you don’t need to have all the answers to create memorable STEM experiences. In fact, the key to effective STEM learning at the preschool level is asking great questions right along with the kids!

In the book *Primary Science: Taking the Plunge*, contributor Jos Elstgeest suggests that there are “right” and “wrong” questions to ask children. “Wrong” questions are wordy and seem to have only one answer found in a textbook. “Why” questions can also be “wrong” when they imply that there is a correct answer and that the child is being tested. For example, if you ask, “Why is the magnet sticking to that kind of metal?” you may be just as unable to answer as the child is.

Families should be encouraged to ask “right” questions that are stimulating, pique their children’s curiosity, and invite them to look closer, explore more, or try something again. “The right question leads to where the answer can be found: to the real objects or events under study, there where the solution lies hidden,” Elstgeest says. “The right question asks children to show rather than to say the answer: they can go and make sure for themselves.” He calls these “productive” questions.

**Here are some categories of productive questions to model for families:**

#### **Attention-focusing questions**

These are questions of observation: “Have you seen . . .” and “Did you notice . . .” types of questions. Children frequently take care of these questions themselves when they say, “Look here!” The “what” questions closely follow: “What is it?” “What does it do?” “What happens when . . .” “What do I see, feel, hear . . .?” Simple observation questions is the route to the first simple answers, which will be followed by more complicated questions.

#### **Measuring and counting questions**

Questions like “How many?” “How long?” and “How often?” are measuring and counting questions. Older children can check their answers themselves.

#### **Comparison questions**

“Is it longer, stronger, heavier, more?” These are the comparison questions that come naturally after the measuring questions. Objects can differ in many respects, such as shape, color, size, texture, structure, and markings. Comparison questions can help young children begin to classify and assign attributes to things: “What is the same about the seeds? What is different about the seeds?”



### Action questions

These are the “what happens if” questions that can always be definitively answered. These involve a simple experiment, and then you have your answer. “What happens if you add more pennies to the tin foil boat? Will it sink? Will it float?” An exciting addition to solving “what happens if” questions is the challenge to predict the outcome. Initially children will guess, but with more experience, their ability to predict the actual outcome will be improved, and they will become increasingly able to tackle more complicated problem-solving questions.

### Problem solving questions

After practicing the above questions, children are ready for a new type of question: the more sophisticated “can you find a way to” question. This type of question sets up a real problem-solving situation to which children enthusiastically respond, provided it makes sense to them. For young children building with blocks, this question is appropriate after they have explored the materials for some time. “Can you find a way to stack the blocks as tall as you are?” “Can you find a way to stack them even taller?” These questions are appropriate when children’s curiosity is going strong and their science understanding begins to make real progress.

### LET’S TRY IT OUT

Here is an example of how to use observation, investigation and productive questions with children in an everyday way. Imagine that you are the parent and you have two young children under 5. One day you decide to visit the Farmer’s Market in your neighborhood. Many towns now have an outdoor market in the summer (possible indoor market in winter) where farmers bring their fresh produce, meat, cheese, flowers and more. It’s a strong, sensory experience to see all the colors and textures of the vegetables and fruit. As they walk among the food stalls, the mother can ask her children a variety of productive questions.

TYPE OF QUESTION	QUESTIONS TO ASK
<b>Attention-Focusing</b>	<i>“Wow, can you see lots of colors?”</i> <i>“Do you smell those strawberries? Do you see that huge watermelon?”</i> <i>“How does that cheese taste?”</i>
<b>Measuring and Counting</b>	<i>“How many apples should we buy?”</i> <i>“How much does the cabbage weigh?”</i> <i>“How many are in the bag now?”</i>
<b>Comparison</b>	<i>“What color are the tomatoes?”</i> <i>“Are all the tomatoes red?”</i> <i>“What is different about the tomatoes?”</i> <i>“What is the same about the tomatoes?”</i>
<b>Action</b>	<i>“What happens if we put one more potato on the scale?”</i> <i>“How much did that potato weigh?”</i> <i>“How much do you think two potatoes will weigh?”</i>
<b>Problem-Posing</b>	<i>“Can you find a way to stack the strawberry boxes?”</i> <i>“Can you stack the boxes as tall as you are?”</i>



Once the family is home, the mother finds some magazines and store circulars with pictures of fruits and vegetables, and the children cut them out and paste them onto paper. They play a sorting game with fruit-shaped cutouts, read the book *The Ugly Vegetables* by Grace Lin, and decide to plant a garden. That afternoon, they create their own farmers' market in the corner with pretend fruits and vegetables, and they use paper bags for pretend shopping. Then the children help make tomato sauce for dinner.

Activities like these are a perfect way to show parents how easy it is to have conversations that promote STEM learning with their children. New research on the "language gap" by Anne Fernald, a psychologist at Stanford University, showed that at eighteen months, children from wealthier homes could identify pictures of simple words they knew—dog or ball—much faster than children from low-income families. By age two, the study found that children from affluent families had learned 30 percent more words in the intervening months than children from low-income homes. Early childhood educators know that describing fruit at the supermarket or pointing out the shape of a stop sign are all part of a young child's literacy education. Parents can easily enhance their children's vocabulary by focusing on science questions, answers, and the fascinating conversations that take off from there.

Young children are naturally curious. They wonder what things are called, how they work, and why things happen. The foundations of scientific learning lie in inquiry and exploration—these are the tools of active learning. Fostering young children's sense of curiosity about the natural world around them can promote a lifelong interest in it.

# Family Workshops

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**The key to success in teaching the four STEM workshops is to bring to them your own sense of curiosity, ability to ask good questions, and enthusiasm for the topic. Find your own inner scientist and have fun!**

These workshops are designed to be delivered as a series of four sessions of one hour each. However, there is enough material and specificity to deliver the content in other ways, depending on the needs of your participants. If children are attending the workshop with their grown-ups, there is an “I Am a Scientist” workbook that can be used with all four workshops.

The first section of each session explains why preschool STEM is important. Setting the context for science activities in general lays a foundation for motivating families to focus on their child’s interests and to encourage them to spend time observing and exploring the world together. Observing and exploring are the main skills young children use as they try to make sense of what happens and build theories to explain what they see.

Each workshop includes a definition of the specific area of focus, a list of materials to have on hand, a connection to the Massachusetts STE Pre-K Standards, The Massachusetts Curriculum Frameworks for Mathematics, and activities to engage participants. The STEM Kit includes a flash drive with videos you will use for each session. Make sure you have read the complete workbook so you can fill these sessions with facts, examples, and stories from your own experience as a parent, educator, or naturalist.

# Session 1: Science

The purpose of this session is to inspire families to engage their children in science by offering activities that allow the children to observe and explore, by integrating STEM vocabulary in everyday activities, and by guiding the children to reflect on new understandings.

Science is a way of thinking. Science is observing and experimenting, formulating questions to be answered by an investigation, making predictions about what the answers might be, sharing discoveries, and then comparing the findings with the predictions. Science activities include comparing and contrasting natural materials like liquids and solids, blowing bubbles, and planting a garden.



## Connection to the Massachusetts STE Standard

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

### Materials Needed

- Masking tape
- Straws
- Pom-poms
- Bubble solution and bubble makers
- Flashlights
- The Science Process Skills Worksheet (make copies and have one at each seat before the workshop begins)

### Open the Session: Introduction, Objectives, and Overview—5 Minutes

Introduce yourself to the group. Your introduction may include a brief statement about your experience, the topic, how often the group will meet, and one or two goals.

You don't need to be a scientist to help your child make discoveries about science in the world around you. You are doing it already when you play in the bathtub with soap and bubbles and splash water; when you give your child pots and pans and wooden spoons while you cook in the kitchen; and when you explore outdoors, finding bugs, smelling the flowers, and enjoying a sunny day. All you need is an open mind and a willingness to join the exploration. It's fun, and it's a great way to support your child's science learning.

Young children are curious. Like scientists, they are full of questions and excited to learn. They love to explore, investigate, try things out, and "experiment" with what they see, hear, smell, taste, and touch. Everything you show and share with your child—whether baby, toddler, or preschooler—will give her new information, allow her to solve problems, and help her develop basic science skills.

### During this session, we will . . .

- Watch children explore the world in a video.
- Share science stories from our own families.
- Play with materials and practice doing science activities.
- Create a plan for doing more science at home.

### After this session, you will be able to . . .

- Summarize the best practices for engaging young children in science.
- Recognize and design activities that invite children to observe, explore, investigate, problem-solve, and experiment.
- Plan ways to integrate STEM language into activities to help children think and act like scientists.
- Identify strategies for helping children reflect on new understandings.

### Set the Stage: Mini Lecture—4 Minutes

*Let's start by watching a video. But before watching . . .*

You are your child's first and most important teacher—and the world is your classroom. Children are naturally curious and like to explore everything around them, ask lots of questions, and experiment with objects and ideas. Preschoolers (and babies and toddlers too) have many of the attributes of real scientists! Through everyday explorations, children discover science and math concepts such as cause and effect, gravity and balance, measuring, colors, shapes, patterns, and numbers. They also build math-

and science-related vocabulary, words like explore and investigate, more than and less than, and float and sink. As children make new discoveries and successfully explore the world around them, they also build confidence and problem-solving skills that will help them thrive in everything they do. In this video, you'll meet children from four families who are doing just what I mentioned:

- Kash (four months) explores with his senses.
- Ronan (two years) builds math and science skills on a nature walk.
- Siblings Aliyah (six years) and Lamarques (three years) and their cousin Rosonn (seventeen months) discover shapes while playing with dough.
- Ange-Yolette (three years) and her brother Gregory (six years) do experiments with water and learn about science.

**Watch the learning that happens as they explore the world.**

**Watch the Video—Exploring 5.48 Minutes**

**After Watching: Mini Lecture and Discussion—20 Minutes**

**The World Is Your Classroom.** Children are natural scientists, eager to investigate and learn from everything in their world. In the video, Ange-Yolette experiments with colors as her mom blows green bubbles, Lamarques learns about gravity and balance as he builds a block tower, Ronan investigates ice on a walk outside, and baby Kash learns about objects and how they move as he watches and reaches for the objects on his mobile. Ask the group, “What objects does your child like to explore?” “Where does she do most of her investigating?” and “What senses does she use as she explores?”

**Try this at home:** Encourage your child to use all of her senses as she investigates an object. Give her a wooden spoon, an eggbeater, a flashlight, or an old radio. Ask her, “What do you think this is?” and “What do you think this does?” Then let her figure it out on her own (with a little help from you, but only when asked).

**Follow the Leader.** It is much easier to engage young children—no matter what their age—if you follow their lead. Encourage participants to watch to see what their children are interested in and to build their explorations around the objects and experiences that capture their attention. In the video, Ange-Yolette is interested in pouring, so her mom sets up a “lab” where she and her brother can conduct water experiments. Ask participants, “What are your child’s interests? What does she want to know more about?”

**Try this at home:** On your next walk outside, ask your child, “Do you notice the blue sky?” and “What do you notice?” Then investigate the thing that he mentions. If he notices a leaf, take the time to touch it and smell it. Talk about its shape and color. See if you can find the tree that the leaf came from. Take a few leaves home and “amp up” the learning with some science fun. Try turning your kitchen into a “leaf lab.” You can trace the leaves, do leaf rubbings, and find out if the leaves float or sink in water.

**Everyday, Everywhere Learning.** Everyday routines and common objects offer great opportunities for exploration and learning. In the video, Ange-Yolette and Gregory sort colors and count in both English and Spanish. Ronan discovers shapes as he helps prepare lunch. Ask participants, “What are your daily routines? What does your child learn during these everyday moments?”

**Try this at home:** The next time you do laundry, have your child be your helper. She’ll learn about colors and compare sizes as she matches socks or helps you organize items into piles. Point out patterns on the clothes that you fold, count how many pants and shirts you have, and give her the chance to figure out how the different buttons, snaps, and zippers work.

## **Developing Scientists**

Let's break it down developmentally for your children. Who has babies? Who has toddlers? Who has preschoolers? Remember, your child is growing up each day, so the toys he plays with, the questions you ask, and the experiences you share with him should change every few weeks. Keep it interesting and unique.

### **Babies (0–15 Months)**

Before your baby can move around on her own to explore, you'll need to help her experience the world by bringing it to her. By introducing objects and experiences that engage the five senses—hearing, touching, seeing, smelling, and tasting—you'll help your baby discover and learn.

Your baby will be especially interested in things that she can hold in her hands and put in her mouth. Make sure that everything within your baby's reach is safe for her to put in her mouth. She might also be content to learn just by watching and listening. Give her a chance to explore in her own way and in her own time.

Everything you show and share with your baby gives her information about her surroundings. This knowledge helps build her confidence to explore and learn more. Share your own enthusiasm with your baby as you explore the world together.

### **Activities for Babies**

**Touch and Feel.** Babies love to reach, grab, and touch everything! Help your baby safely explore with her sense of touch.

**What's That Sound?** Your baby likes to hear a variety of sounds, and she will be amazed to discover that she can also make sounds happen.

**Peekaboo.** Playing peekaboo is not only fun, but it also helps your baby make an exciting discovery: Things are still there when she can't see them!

### **Toddlers (15–36 Months)**

Children are full of questions and excited to learn. One of the first steps in learning is exploring. Exploring lets your toddler learn about different objects and how to solve problems. It helps him answer his own questions about how things work.

As your toddler explores, he gets to use all his senses, which help him discover and learn how things are different. He also uses his whole body to explore. Toddlers love to run, climb, and jump to get to new objects to investigate!

Everything is of interest to your toddler, and it is natural that he wants to test his surroundings. Although it is important to let him explore, it should always be in a safe place with you or another caring adult at his side.

### **Activities for Toddlers**

**What Happens If . . .** With a few pans or buckets, your toddler-scientist can experiment and explore!

**Sort It Out.** Sorting by color, size, texture, or any other attribute helps your toddler learn how things are alike or different.

**Nature Walk.** Talking a walk together outside—in the city or the country—offers many ways to explore, learn, discover, and investigate!

### **Preschoolers (36 Months–5 Years)**

Preschoolers are learning to incorporate their real-life experiences into pretend play. This is one way of figuring out the world around them. As your preschooler explores, he gets to use all his senses, which help him discover and learn how things are different. Preschoolers are developing their observation skills. Asking your child questions like “Do you see . . . ?” or “Did you notice . . . ?” will help him pay attention to details he might otherwise miss. Preschoolers often exclaim, “Look here!” You can be ready to go to the next level of observation by asking “what” questions. These include “What is it?” “What does it do?” “What happened?” and “What do you see, feel, hear?”

**Ask participants to look at the Science Process Skills Worksheet.**

**Here are some science process skills that children begin to develop around three years of age:**

Observe	Experiment	Problem-solve
Describe	Predict	Collaborate
Categorize	Generalize	Use tools
Communicate	Relate to prior and/or	
Record	current experience	

### **Preschoolers learn**

- through trial and error
- by figuring things out for themselves
- through persistence
- through their senses
- by observing others and imitating their play

### **Activities for Preschoolers**

**Use Science Language.** Use some of these “juicy” words to ask, “Can you describe the flower?” (Tell me what it looks like or feels like.) “Can you predict what will happen?” (Tell me what you think might happen.) “Let’s record what you saw.” (Write down what happened.)

**Find Out Your Child’s Ideas.** Encourage your preschooler to use his words and say what he really thinks. Ask, “Why do you think we eat food?” The question “What do you think?” allows your child to practice communicating, generalizing, and problem-solving without feeling that the question requires a correct answer.

**Practice Observation.** Observation is an important skill for preschoolers. You might have heard your child say, “Oh, look!” Observation is used to raise questions, to link to earlier experiences, to gather information, and to find patterns and relationships between things. Encourage your child to tell you what he sees (or feels or hears or smells) or to draw what he observes. Ask him, “Do you see the big, blue sky?” “Do you see . . . ?”

### **Science Hands-on Activities—15 Minutes**

Experiments help children develop basic science skills like observing what is happening, using words to describe what they notice, and repeating an action to compare results. In the physical sciences, investigating natural forces and the basic elements in natural substances helps children use their inherent curiosity to find out about air, water, movement, and light and shadows.

### **Let's experiment!**

**Air Can Move Things.** Put two lines of masking tape on the floor or a table. Give everyone a straw. Choose two people to go first. Use the straws to have a pom-pom race, blowing the pom-poms from one end of the tape to the “finish line.” Ask participants, “Whose pom-pom went faster?” Learning to blow out rather than suck in teaches children a new skill and strengthens the small muscles of the mouth to help with making sounds.

**Try this at home:** Ask your child to blow air on her hands and to wave her hands in the air. Ask her, “What do you feel?” and “Can you hold air?” Line up floating toys in the water. Use a straw to blow a toy across the water. Repeat the activity. Ask your child, “What happened when you blew on the toy?”

**Bubbles Have One Shape.** Have participants experiment with blowing fast and slow to make bubbles. Ask, “Which method works better?” Have participants look at the shape of the bubble maker before they use it. Ask, “What shape do you think the bubble will be?” No matter what shape the bubble maker, the bubble will always be round due to liquid surface tension. Blowing bubbles is a great distracter for infants and toddlers. Suggest that participants always keep a small bottle of bubble solution around to make a toddler happy.

**Try this at home:** In a bucket or tub, make a bubble solution with dish soap. Using a variety of oddly shaped objects—such as a loop of string and a straw—teach your child how to dip her object in the water and blow through it to make a bubble. Ask your child, “What happened when you made a bubble?”

**Shadows Have Changing Shapes.** Shut off the lights in the room. Have one person hold an object in front of a flashlight to project a shadow on the wall. Explore the shape of the shadow by moving the light closer to the object or farther away from it. Keeping the light steady, move the object closer to the wall or farther away from it. Ask participants, “Does the shadow have sharp edges or fuzzy edges?”

**Try this at home:** Outside on a sunny day or inside a darkened room with a flashlight, create a shadow and ask your child, “What do you need to create a shadow?” The answer is light, an object, and a place for the shadow to fall. Using chalk on the sidewalk, outline the shadow of a hand, arm, or whole body. Ask your child, “What will the shadow look like with your hand close to the ground?”

### **Resources**

WGBH has two valuable online resources for families and educators. Check out the Peep and the Big Wide World website at <http://peepandthebigwideworld.com> for more on shadows, water, plants, color, sound, and balls and ramps. Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) for more activities and videos. This web portal was built by WGBH with funding from Race to the Top—Early Learning Challenge and the Massachusetts Department of Early Education and Care.

### **Talk Back and Make an Action Plan—5 Minutes**

Spend a few minutes talking about what science exploration might be appropriate for your participants to do at home. Babies? Reaching out and exploring anything! Toddlers? Learning to blow bubbles or blow through a straw. Preschoolers? Experiments, cooking, mud pies, sand and water play. Give participants a few minutes to use their Science Process Skills Worksheet to create a Science Action Plan to take home. Ask participants to share something about their plan.

### **Collect Evaluations and Pass Out Take-Home Handouts—5 Minutes**

Ask workshop participants to fill out an evaluation and leave it on the table. Make tip sheets available to take home.

# Science:

## Air and Wind



### LEARNING GUIDELINES

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

*You can't see the wind, but you can see what it is doing. This activity encourages children's curiosity and observation skills indoors and outdoors with air that moves things.*

### MATERIALS

- \* Indoor air and wind activities:
  - o Straws
  - o Assorted objects to blow on: feathers, pom-poms, corks, paper, salt, rocks
- \* Outdoor air and wind activities:
  - o A windy day!
  - o Leaves, a kite, light objects found in nature

## SETUP

- The goal of this activity is for children to explore the properties of air and wind and to understand that air can move things.
- For indoor play, assemble objects and straws.
- For outdoor play, go outside together on a windy day.

## DO IT TOGETHER

- For indoor play, ask your child to blow on his hands and wave them in the air. “What do you feel? Blow hard, blow soft, wave hard, wave soft. Does that change what you feel?” Talk about what air is. “Can you see air? Can you hold it? What happens to the object when you blow on it?” Talk with your child about how, when you blow air, it becomes wind, and about how wind can push things.
- Encourage your child to use descriptive words like faster and slower.
- Have your child choose different objects to blow on with the straw. “What happens to the feather? The rock?” Have your child try out different ways to create wind besides blowing. “Can you move the paper by waving your hands?” Experiment with blowing objects on different surfaces—for example, a rough carpet or the grass.

## DO MORE OF IT!

- **Runway Races.** Make a runway race game by sticking painter’s tape on the floor or on a tabletop to create a track. The track can be wider for younger children and narrower for older. Set your child up with a straw and pom-poms at the head of the track and see how fast he can blow his pom-pom to the finish line. For more challenges, try other kinds of objects, such as a cork or a paper ball.
- **Float Your Boat.** Line up floating toys in the water. You can use bathtub toys or make your own boats out of tinfoil. Use a straw to blow the toy across the water. Do this a few times, blowing harder and softer. “What happens when you blow on the toy?” See if your child notices if the toy moves, stays still, falls over, or goes faster. You and your child can experiment with changing the shape of your tinfoil boat to help it catch more wind or not tip over as easily.

## BOOKS

- *The Wind Blew* by Pat Hutchins
- *I Face the Wind* by Vicki Cobb
- *Wind* by Erin Edison
- *Where Does the Wind Blow?* by Cindy Rink

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Science:

## Bubbles



### LEARNING GUIDELINES

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

*Everyone loves bubbles, so it's easy to engage children in observing and experimenting while they are blowing bubbles and watching them pop! This activity helps strengthen mouth muscles (by learning to blow) and introduces all the properties of bubbles.*

### MATERIALS

- \* Bubble solution. Gently mix together in a large bowl or tray:
  - o 1 gallon water
  - o 1 cup dishwashing liquid
  
- \* Assorted objects for bubble blowing
  - o String
  - o Drinking straws
  - o Cookie cutters
  - o Slotted spatula

## SETUP

- The goal of this activity is to support children’s curiosity and observation skills by introducing them to the many properties of bubbles through experimentation and play.
- Place the bubble solution container on a surface, indoors or out, and let your child choose what she’d like to start experimenting with. Make sure you set up this activity in an area that can handle an occasional spill.

## DO IT TOGETHER

- Encourage your child to try out all of the bubble tools. “Can you think of something we could do with the straws to blow bubbles? How about the string and straws?” Show your child that she can dip the straw into the bubble solution, cover the top with her finger so the solution doesn’t spill out, bring it up to her mouth, uncover, and blow! (Make sure she blows out and does not suck in.)
- Have your child slide a piece of string, about 12 inches long, through two straws and then tie a knot. Show your child how to pull the straws apart to form a rectangle with the straws on the sides and the string on the top and bottom. Put the straws together, dip into the solution (with the straws still touching), and pull them out. Now, spread the straws apart. “What do you notice?” (There should be a flat “bubble” in the straw-string frame your child has created.) “What happens when you wave the bubble frame around? What happens if you wave it faster? Slower? Does anything change when you blow through it instead of waving it?”
- Ask your child, “What shape is a bubble?” Challenge her to blow a square bubble. “What have you observed from the different shaped bubble blowers?” Have your child blow bubbles onto a flat countertop or into the tub to see if that changes the shape. No matter what the shape of the bubble blower, bubbles are always round! This is because bubbles work on a principle called surface tension.
- As you and your child explore the world of bubbles together, you can talk about an interesting science idea: Bubbles start as a liquid and become a solid surrounding a gas when you blow on them. If your child is interested, brainstorm other things that change their state, such as water to ice or steam. Spend some time at your local library or using the Internet to learn more about this.

## DO MORE OF IT!

- **Pop It.** When do bubbles pop? Explore this question with your child by trying different ways to pop and not pop your bubbles. “What happens if you stick your finger into a bubble? How about something sharp? Try doing this very slowly. Does that make a difference? Try touching your bubble with a wet finger. What happens?” A wet finger can penetrate a bubble without popping it! Bubbles also pop without anything touching them—the moisture in bubbles evaporates quickly, making them too thin to maintain their shape. That’s why bubbles last longer on cool days (especially right after a rainstorm) than on hot, sunny day.

## BOOKS

- *Pop! A Book about Bubbles* by Kimberly Brubaker Bradley
- *Different Colored Bubbles* by Dolores Sanchez
- *Gilberto and the Wind* by Marie Hall Ets

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Science:

## Shadow Play



### LEARNING GUIDELINES

**PreK-LS1-4:** Use their five senses in their exploration and play to gather information.

*Shadows are made when light is projected around an object. This activity encourages children's curiosity and observation skills as they play indoor and outdoor games to make shadows.*

### MATERIALS

- \* Indoor shadow play:
  - o Flashlight or movable lamp
  - o Flat wall or screen
  - o Assorted objects
  - o You!
  
- \* Outdoor shadow play:
  - o A sunny day
  - o You!

## SETUP

- The goal of this activity is to introduce children to the properties of light and shadow through experimentation and play.
- For indoor play, set up your light source in a darkened room, with a projecting area. Have your assorted shadow objects on hand.
- For outdoor play, go outside together on a sunny day.

## DO IT TOGETHER

- For indoor play, take turns shining the light onto your child and yourself, and see how the shadows change. Try wiggling and moving your whole body as well as different body parts. “What do you see? Let’s move closer to the light and then farther away. Does that change your shadow shape? How does it change?”
- Make animal shapes with your hands, and try to guess each other’s animals. “Can you make a quacking duck? A swimming dolphin? A flapping bird?” Make some animal noises as a clue to guess the animal. “Is it easier to see the animal if you hold your hands closer to the wall or closer to the light? How can we get the most detail?”
- For outdoor play, take a walk with your shadows. “Where is your shadow? Can you see which is mine and which is yours?” Jump up and down, wiggle your legs, and wave your arms. “What happens to our shadows when we jump? Can we make our shadows disappear?” Notice what happens to your shadows when they fall on a wall, some steps, or a bench. “Do our shadows get bigger or smaller? Do they change their angle or their shape?”
- Help your child discover shadows everywhere. “Look under that flower. Is there a shadow? How about the tall building or the car? Does the shadow look like the object? What other shadows can you see, and where else can we find them?”

## DO MORE OF IT!

- **Create a Shadow Play.** Using card stock, scissors, markers, and holders, have your child create or trace different shapes to cut out. Cookie cutters (for example, dinosaurs or gingerbread people) and play dough forms work well as templates. Glue or tape popsicle sticks or drinking straws onto the base as holders. When you have a full “cast of characters,” create a simple play with your child. You can jazz it up by playing music to help your characters move and dance.
- **Create a Shadow Mural.** Go outside with your child at different times of day and trace your shadows onto the sidewalk or driveway with sidewalk chalk. Ask your child to describe what you’ve drawn. “How is your shadow like you? How is it different? How did your shadow change during the day?” Your child can finish his mural by coloring it in and adding imaginative details, such as facial features or other characters.

## BOOKS

- *Guess Whose Shadow?* by Stephen R. Swinburne
- *Nothing Sticks Like a Shadow* by Ann Tompert
- *What Makes a Shadow?* by Clyde Robert Bulla

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
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# Session 2: Technology

The purpose of this session is to inspire families to engage their children in technology by offering activities that allow the children to observe and explore, by integrating STEM vocabulary in everyday activities, and by guiding the children to reflect on new understandings.

Technology is a way of doing. Technology is using tools, being inventive, identifying problems, and making things work. Technology activities often include computers, but in preschool we use simple machines like scissors, gears, and wheels and pulleys, and we look through a magnifying glass to count the legs on the bug that we caught outside.



## Connection to the Massachusetts STE Standard

PreK-LS1-4: Use their five senses in their exploration and play to gather information. Use their senses and simple tools to observe, gather, and record data (e.g., dictate, draw, photograph, write).

### Materials Needed

- Child scissors
- Recycled paper
- Small pitchers
- Plastic cups
- Dry materials: Styrofoam peanuts or confetti
- Magnifying glasses
- Plastic bag of feathers and other items from the STEM Kit
- The Science Process Skills Worksheet (make copies and have one at each seat before the workshop begins)

### Open the Session: Introduction, Objectives, and Overview—5 Minutes

Welcome the group back for Session 2—Technology.

*If new folks are joining you, customize an introduction and overview that include what is important from Session 1—Science.*

Introduce yourself to the group. Your introduction may include a brief statement about your experience, the topic, how often the group will meet, and one or two goals.

You don't need to be a technology expert to help your child make discoveries about technology in the world around you. You are doing it already when you play in the bathtub with a cup, pouring water and splashing; when you give your child pots and pans and wooden spoons while you cook in the kitchen; and when you explore outdoors, looking at bugs through a magnifying glass. All you need is an open mind and a willingness to join the exploration. It's fun, and it's a great way to support your child's science learning—with a focus on technology.

Children are natural scientists, full of questions and excited to learn. They love to explore, investigate, try things out, and “experiment” with what they see, hear, smell, taste, and touch. Everything you show and share with your child—whether baby, toddler, or preschooler—will give her new information, allow her to solve problems, and help her develop basic science skills.

### During this session, we will . . .

- Watch children explore the world in a video.
- Share technology stories from our own families.
- Play with materials and practice doing technology activities.
- Create a plan for doing more technology at home.

### After this session, you will be able to . . .

- Summarize the best practices for engaging young children in technology.
- Recognize and design activities that invite children to observe, explore, investigate, problem-solve, and experiment.
- Plan ways to integrate STEM language into activities to help children think and act like scientists.
- Identify strategies for helping children reflect on new understandings.

### **Set the Stage: Mini Lecture—4 Minutes**

*Let's start by watching a video. But before watching . . .*

As you watch the video, focus on the activities in which kids use “tools” to explore. Make notes about what you think technology means for young children. Think about the tools your child uses to explore the world. As you watch our young friends in the video, write down what you think technology is.

*Don't forget . . .*

You are your child's first and most important teacher—and the world is your classroom. Children are naturally curious and like to explore everything around them, ask lots of questions, and experiment with objects and ideas. Through everyday explorations, children discover science and math concepts such as cause and effect, gravity and balance, measuring, colors, shapes, patterns, and numbers. They also build math- and science-related vocabulary, words like explore and investigate, more than and less than, and float and sink. As children make new discoveries and successfully explore the world around them, they also build confidence and problem-solving skills that will help them thrive in everything they do.

### **Review for New Participants**

In this video, you'll meet children from four families who are doing just what I mentioned:

- Kash (four months) explores with his senses.
- Ronan (two years) builds math and science skills on a nature walk.
- Siblings Aliyah (six years) and Lamarques (three years) and their cousin Rosonn (seventeen months) discover shapes while playing with dough.
- Ange-Yollette (three years) and her brother Gregory (six years) do experiments with water and learn about science.

**Watch the learning that happens as they explore the world.**

**Watch the Video—Exploring 5.48 Minutes**

**After Watching: Mini Lecture and Discussion—20 Minutes**

**The World Is Your Classroom.** Children are natural scientists, eager to investigate and learn from everything in their world. In the video, Ange-Yollette experiments with colors as her mom blows green bubbles, Lamarques learns about gravity and balance as he builds a block tower, Ronan investigates ice on a walk outside, and baby Kash learns about objects and how they move as he watches and reaches for the objects on his mobile. Ask the group, “What objects does your child like to explore?” “What tools does he use to get things done?” and “What tools did you notice the kids in the video using?”

**Try this at home:** Encourage your child to use all of her senses as she investigates an object. Give her a wooden spoon, an eggbeater, a flashlight, or an old radio. Ask her, “What do you think this is?” and “What do you think this does?” Then let her figure it out on her own (with a little help from you, but only when asked).

**Follow the Leader.** It is much easier to engage young children—no matter what their age—if you follow their lead. Encourage participants to watch to see what their children are interested in and to build their explorations around the objects and experiences that capture their attention. In the video, Ange-Yollette is interested in pouring, so her mom sets up a “lab” where she and her brother can conduct water experiments. Ask participants, “What are your child's interests? What does she want to know more about?”

**Try this at home:** On your next walk outside, ask your child, “Do you notice the blue sky?” and “What do you notice?” Then investigate the thing that he mentions. If he notices a leaf, take the time to touch it and smell it. Talk about its shape and color. See if you can find the tree that the leaf came from. Take a few leaves home and “amp up” the learning with some science fun. Try turning your kitchen into a “leaf lab.” You can trace the leaves, do leaf rubbings, and find out if the leaves float or sink in water.

**Everyday, Everywhere Learning.** Everyday routines and common objects offer great opportunities for exploration and learning. In the video, Ange-Yolette and Gregory sort colors and count in both English and Spanish. Ronan discovers shapes as he helps prepare lunch. Ask participants, “What are your daily routines? What does your child learn during these everyday moments?”

**Try this at home:** The next time you do laundry, have your child be your helper. She’ll learn about colors and compare sizes as she matches socks or helps you organize items into piles. Point out patterns on the clothes that you fold, count how many pants and shirts you have, and give her the chance to figure out how the different buttons, snaps, and zippers work.

### **Developing Scientists**

Let’s break it down developmentally for your children. Who has babies? Who has toddlers? Who has preschoolers? Remember, your child is growing up each day, so the toys he plays with, the questions you ask, and the experiences you share with him should change every few weeks. Keep it interesting and unique.

### **Babies (0–15 Months)**

Before your baby can move around on her own to explore, you’ll need to help her experience the world by bringing it to her. By introducing objects and experiences that engage the five senses—hearing, touching, seeing, smelling, and tasting—you’ll help your baby discover and learn.

Your baby will be especially interested in things that she can hold in her hands and put in her mouth. Make sure that everything within your baby’s reach is safe for her to put in her mouth. She might also be content to learn just by watching and listening. Give her a chance to explore in her own way and in her own time.

Everything you show and share with your baby gives her information about her surroundings. This knowledge helps build her confidence to explore and learn more. Share your own enthusiasm with your baby as you explore the world together.

### **Activities for Babies**

**Touch and Feel.** Babies love to reach, grab, and touch everything! Help your baby safely explore with her sense of touch.

**What’s That Sound?** Your baby likes to hear a variety of sounds, and she will be amazed to discover that she can also make sounds happen.

**Peekaboo.** Playing peekaboo is not only fun, but it also helps your baby make an exciting discovery: Things are still there when she can’t see them!

### **Toddlers (15–36 Months)**

Children are full of questions and excited to learn. One of the first steps in learning is exploring. Exploring lets your toddler learn about different objects and how to solve problems. It helps him answer his own questions about how things work.

As your toddler explores, he gets to use all his senses, which help him discover and learn how things are different. He also uses his whole body to explore. Toddlers love to run, climb, and jump to get to new objects to investigate!

Everything is of interest to your toddler, and it is natural that he wants to test his surroundings. Although it is important to let him explore, it should always be in a safe place with you or another caring adult at his side.

### **Activities for Toddlers**

**What Happens If . . .** With a few pans or buckets, your toddler-scientist can experiment and explore!

**Sort It Out.** Sorting by color, size, texture, or any other attribute helps your toddler learn how things are alike or different.

**Nature Walk.** Talking a walk together outside—in the city or the country—offers many ways to explore, learn, discover, and investigate!

### **Preschoolers (36 Months–5 Years)**

Preschoolers are learning to incorporate their real-life experiences into pretend play. This is one way of figuring out the world around them. As your preschooler explores, he gets to use all his senses, which help him discover and learn how things are different. Preschoolers are developing their observation skills. Asking your child questions like “Do you see . . . ?” or “Did you notice . . . ?” will help him pay attention to details he might otherwise miss. Preschoolers often exclaim, “Look here!” You can be ready to go to the next level of observation by asking “what” questions. These include “What is it?” “What does it do?” “What happened?” and “What do you see, feel, hear?”

**Ask participants to look at the Science Process Skills Worksheet.**

**Here are some science process skills that children begin to develop around three years of age:**

Observe	Experiment	Problem-solve
Describe	Predict	Collaborate
Categorize	Generalize	Use tools
Communicate	Relate to prior and/or	
Record	current experience	

### **Preschoolers learn**

- through trial and error
- by figuring things out for themselves
- through persistence
- through their senses
- by observing others and imitating their play

### **Activities for Preschoolers**

Use Technology Language. Use some of these “juicy” words to ask, “What can you do with a spoon? Can you describe what happened to the flour when we poured in the milk? Can you choose another tool to mix up the batter?”

**Find Out Your Child’s Ideas.** Encourage your preschooler to use his words and say what he really thinks. Ask, “Why do you think we use a spoon?” The question “What do you think?” allows your child to practice communicating, generalizing, and problem solving without feeling that the question requires a correct answer.

**Practice Observation.** Observation is an important skill for preschoolers. You might have heard your child say, “Oh, look!” It is used to raise questions, to link to earlier experiences, to gather information, and to find patterns and relationships between things. Encourage your child to tell you what other tools he likes to use—his pretend toolbox, a real hammer, scissors, markers, your smartphone, a computer?

### **Technology Hands-on Activities—15 Minutes**

When you hear the word technology, you might think of computers and smartphones, but for very young children, technology refers to using tools like scissors and developing fine and gross motor skills. Tools can help children develop eye-hand coordination and strengthen their hand and finger muscles for writing, typing, and drawing.

Experiments help children develop basic science skills like observing what is happening, using words to describe what they notice, and repeating an action to compare results. Technology and engineering involve finding out how things are constructed and how they work, and thinking about what can make them work differently or better. Science tries to understand the natural world; the goal of engineering is to solve practical problems by developing technologies. Technologies developed through engineering include the systems that provide our houses with water and heat; roads, bridges, tunnels, and cars; airplanes and spacecraft; cellular and mobile devices; televisions and computers; many of today’s children’s toys; and systems that create special effects in movies.

Preschool children can begin to understand that tools help people do things better or more easily or do things that could otherwise not be done at all.

### **Let’s do it!**

**Scissor Skills.** Have each participant choose a buddy. One partner pretends that she doesn’t know how to use scissors; the other partner teaches her. Switch partners and make sure everyone has a chance to play both roles. Give each pair some paper to practice new scissor skills either by using the “Follow the Line” activity or the “Basic Shape Cutout” activity described below.

**Try this at home:** Show your children how to hold scissors. The thumb goes in the top hole and the pointer (index) finger should be placed in the lower hole. The middle finger should rest just below the rim of the lower hole to support the scissors. The ring and little finger are not used in cutting. Tell your child, “Take your time. Scissors are tricky.” Cutting with scissors takes practice! It’s hard work for a child, so stay positive and encouraging.

**Follow the Line.** Try this at home: Draw a simple wide line from the top to the bottom of a sheet of paper. Direct your children to cut right above the line. Remind him that the thumb should always be up (in the top hole of the scissors). Tell him, “Wow! You are a good cutter.” Applaud every effort, even if the lines or shapes are jagged.

**Basic Shape Cutouts.** Try this at home: Draw three basic shapes on paper (square, circle, and triangle), and let your child cut them out. Save the cutouts (and scraps) for use in other projects. Tell your child, “Try cutting out these shapes.” Give him some choices of what to cut, or just provide some recycled paper and let your child cut any way he wants.

**Practice Pouring.** Have each participant choose a buddy. One partner can fill the pitcher with dry material and hand it to the other partner to practice pouring into the plastic cups. Make sure there are some spills so that everyone can practice saying, “It’s OK. Let’s clean it up!”

**Try this at home:** Let your child learn how to pour using a small plastic pitcher and a few plastic cups. Tell him that the cups are empty and that he should pour water from the pitcher into the cups until they are full. Try emptying the pitcher to fill the cups, and then try emptying the cups to fill the pitcher. Experiment with different-size cups. Ask your child, “Will the cup hold more water?” Have him make a prediction.

**Scooping.** Try this at home: Using scoops for the beach, have your child practice moving dry material like sand or dirt from one container to fill another. Try not to spill any of the sand between the containers. If there’s an accident, say, “It’s OK. Let’s clean it up!” Spills and messes are part of learning to do things yourself.

**Observe Closely.** Have participants find a partner to share a magnifying glass. Ask them to walk around the room and find interesting items to look at. The hair on an arm? The carpet? The surface of the table? Offer the items from the small plastic bag in the STEM Kit.

Try this at home: Using a simple magnifier, have your child look at something without the magnifier and then look at it up close. Ask, “What do you see without the magnifier? What do you see with it?”

### **Resources**

WGBH has two valuable online resources for families and educators. Check out the Peep and the Big Wide World website at <http://peepandthebigwideworld.com> for more on shadows, water, plants, color, sound, and balls and ramps. Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) for more activities and videos. This web portal was built by WGBH with funding from Race to the Top—Early Learning Challenge and the Massachusetts Department of Early Education and Care.

### **Talk Back and Make an Action Plan—5 Minutes**

Spend a few minutes talking about what technology exploration might be appropriate for your participants to do at home. Babies? Reaching out and exploring anything! Toddlers? Using big markers, finger painting, water play. Preschoolers? Using scissors, magnifying glasses, simple tools, and pitchers for pouring.

Give participants a few minutes to use their Science Process Skills Worksheet to create a Science Action Plan to take home. Ask participants to share something about their plan.

### **Collect Evaluations and Pass Out Take-Home Handouts—5 Minutes**

Ask workshop participants to fill out an evaluation and leave it on the table. Make tip sheets available to take home.



# Technology:

## Magnets: Push and Pull



### LEARNING GUIDELINES

**PreK-LS1-4:** Use their five senses in their exploration and play to gather information.

*Magnets attract different kinds of metals to themselves. Children can learn about technology by exploring magnets and magnetic properties.*

### MATERIALS

- \* Assorted magnets
- \* Assorted objects that do and do not have magnetic properties. These can include buttons, coins, paper clips, corks, paper, cotton balls, cloth, and keys.
- \* Paper plates or trays

## SETUP

- The goal of this activity is to introduce children to magnets and magnetic properties through exploration and play.
- Place assorted objects in a container, and have your child choose which objects he wants to start exploring.

## DO IT TOGETHER

- Make sure your child has a few items on his paper plate. Let him choose what to explore. “What happens when you hold the magnet near the coin? Near the feather?”
- If needed, you can show your child how to hold the magnet and demonstrate that if you touch certain objects, they will stick to the magnet.
- “What did you see happen with the different objects? Did the magnet attract some things? Did some not stick at all? What happens if you hold more than one object up to the magnet?” Acknowledge your child’s ideas about why some objects stick and some don’t. With young children, there is opportunity to describe what happens and test out some new ideas. Ask your child to put the magnet close to an object. Now put it far away. What happens?
- Have your child guess which other objects on the table might stick, and have him try out his ideas. Try using all of the different magnets. “Do you notice any differences between what sticks to the magnets and what doesn’t?”
- If your child wants to know what magnets are, you can explain that they are a material that can be formed or found in nature that attracts one particular kind of metal: iron.
- Challenge an older child to predict which objects will be attracted. Then you can ask, “Why do you think some objects are attracted and some aren’t?” See if your child discovers opposite polarity on his own. If he doesn’t, point it out to him with two magnets. Show him how some magnets repel each other.

## DO MORE OF IT!

- **Magnetic Explorer.** Play a game in which your child walks around a room and guesses which objects will be attracted to a magnet, then tests out his ideas. Objects can include jewelry, glasses, a table or even your body. You can extend the activity by sorting the objects into two groups according to their “sticky” and “nonsticky” properties.
- **Refrigerator Magnets.** Buy number and letter refrigerator magnets to encourage your child to play with magnets in a different way. Leave some regular magnets on the refrigerator to encourage your child to explore on his own.

## BOOKS

- *Sid the Science Kid: Earth Day Fun* by Jennifer Frantz
- *What Magnets Can Do* by Allan Fowler
- *The Science Book of Magnets* by Neil Ardley

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Technology:

## Magnifying Magic



### LEARNING GUIDELINES

**PreK-LS1-4:** Use their five senses in their exploration and play to gather information.

*Magnifying glasses make things look bigger. This activity encourages children to use this valuable tool to view objects up close and to observe the details of their environment.*

### MATERIALS

- \* Magnifying glasses (the stronger the lens, the more you will be able to see)
- \* Assorted objects with tiny parts to view, such as flowers, bark, shells, textured paper, and cloth.

## SETUP

- The goal of this activity is to introduce children to magnifying glasses and to get them excited about and comfortable using this wonderful observation tool.
- Set up the table with magnifying glasses and an assortment of objects to view.

## DO IT TOGETHER

- Children love magnifying glasses and the experience of “making things bigger.” Whether they’ve used them before or not, they’re going to want to just grab them and start looking at things. Give your child some time to try them out and play. Your child may need guidance on how to hold the magnifying glass (children tend to bring them up too close to their face), so have your child practice holding the magnifying glass near and farther away to see where she gets the clearest view.
- Join in the fun and use your own magnifying glass. Use descriptive language when you tell your child what you observe. “I see two little hairy things poking out from under the leaf. There are tiny holes all over this shell!”
- When your child discovers something interesting about her object, it is a good time to ask “what” questions: “What do you think the black specks are for?” Your child’s answer is not as important as getting her to think about what she is seeing. She may draw on past experience (two black dots on top must mean eyes), or come up with a wild guess (they keep the top on); there is no wrong answer as long as your child is exploring and observing. You can help your child think more deeply: “What do you think a leaf would have ‘fur’ for? Could it be to hold on to more water?”
- If your child wants to know what magnifying glasses are made of, you can explain that it’s a special type of glass or plastic lens that is made in a curved (“convex”) shape and has magnifying properties. Searching the Internet will help you find an appropriate answer for your child. Encourage your child to talk about her observations and what she experienced. “Was there anything that surprised you? Confused you? What else would you like to do with your magnifying glass?” Share what you learned as well.

## DO MORE OF IT!

- **Collecting Walk.** Take a collecting walk outside or through your house. Bring a small basket or box and a pair of tweezers to pick up delicate things. See if you or your child can find any dried insects. These are very interesting to children and are full of tiny parts to examine and try to identify. If your child is particularly excited about some of her objects and what she sees, get books out of the library or use the Internet to follow up on her interest. Play a game where you both guess what the tiny parts are or what they might be for, and then look them up. Be sure to collect a variety of leaves, dried plants, seed cases, rocks, and other complex natural objects.

## BOOKS

- *Some Bugs* by Angela DiTerlizzi
- *Miffy’s Magnifying Glass* by Dick Bruna
- *What Do You See? Magnifying Glass and Storybook Set* by Publications International and Eric Carle
- *You Can Use a Magnifying Glass* by Wiley Blevins

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Technology:

## Shape It Up!



### LEARNING GUIDELINES

**PreK-LS1-4:** Use their five senses in their exploration and play to gather information.

*Strengthen the muscles in little hands and develop fine motor skills by giving children scissors, markers, crayons, and other writing tools. This activity gives children time to practice their writing skills using tools that help get things done.*

### MATERIALS

- \* Paper stencils: cut out a circle, square, triangle, rectangle, oval, and diamond shape from card stock or a paper plate
- \* Paper for drawing and cutting
- \* Child-safe scissors
- \* Tape
- \* Crayons and markers

## SETUP

- The goal of this activity is for children to practice their early writing and scissors skills by tracing familiar shapes as well as drawing and cutting them out.
- Set up the table with the stencils, paper, scissors, crayons, and markers.

## DO IT TOGETHER

- Show your young child how to hold her scissors. (The thumb goes in the top hole, pointer finger in the lower hole. The middle finger rests just below the rim of the lower hole to support the scissors.) Draw a simple wide line from the top to bottom of the paper. “Can you cut along the line?” Remind your child that the thumb should always be in the top hole of the scissors.
- Let your child choose a stencil to trace. She may want to spend some time exploring the way the stencil shapes feel. “Try feeling the circle with your eyes closed. Slip the square on your arm and turn it to feel the different kinds of edges. Can you trace the diamond with your fingertips?” This helps your child learn about the shapes, which in turn can help her feel more comfortable drawing and cutting them.
- When your child is done tracing, she can cut out her shape. Remember that cutting proficiency will vary. Very young children may simply make little “feathering” snips at the edges while you hold the paper, while the oldest may be able to cut out a complex shape. You can support your child’s efforts by saying things like “Take your time; scissors are tricky! How does it feel? You’ve made a lot of progress on that square!”

## DO MORE OF IT!

- **Art Lesson.** Read an Eric Carle or Leo Lionni book together (see the books listed below). Talk about the illustrations; both authors use shapes that they have traced and cut out. With your child, look at the author videos (see the resources listed below) to get ideas for doing your own drawing, tracing, cutting out, and collaging projects. Work with your child to make up a story and illustrate it with your child’s own shape cutouts.

## BOOKS

- *My First Book of Cutting* (Kumon Workbooks)
- *Frederick* by Leo Lionni
- *The Mixed-Up Chameleon* by Eric Carle
- *My Very First Book of Shapes/Mi Primer Libro de Figuras* by Eric Carle

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).
- Learn how Eric Carle traces, cuts, and glues his lively illustrations by watching the short video at [http://www.eric-carle.com/slideshow\\_collage.html](http://www.eric-carle.com/slideshow_collage.html).
- Learn how Leo Lionni traces, cuts, and glues his mouse illustrations by watching his narrated “Leo Makes a Mouse” video at <http://www.randomhousekids.com/brand/leo-lionni/videos>.
- Visit the Eric Carle Museum of Picture Book Art in Amherst, Massachusetts to see lots of examples of tracing, cutting, and collaging work. See <http://www.carlemuseum.org>.

# Session 3: Engineering

The purpose of this session is to inspire families to engage their children in engineering by offering activities that allow the children to observe and explore, by integrating STEM vocabulary in everyday activities, and by guiding the children to reflect on new understandings.

Engineering is a way of doing. Engineering is solving problems, using a variety of materials, designing and creating, and building things that work. Children engage in engineering when they design a habitat for the snails they brought indoors, when they make a wind toy, like a windmill or a streamer, and when they move water through tubes at the water table and call it a “lemonade factory.” In preschool, engineering happens when children plan and design structures with little adult direction. When playing with blocks, they are planning their building, creating ramps, and rolling balls across the floor.



### **Connection to the Massachusetts STE Standard**

PreK-ESS3-2: Observe and discuss the impact of people’s activities on the local environment. Obtain, evaluate, and talk about information. Use firsthand interaction with objects and organisms, media, and books to gather information.

### **Materials Needed**

- Recycled materials: boxes, egg cartons, plastic bottles
- Light blocks: Lego blocks, bristle blocks, unit blocks
- 8½” x 11” sheets of paper to make airplanes
- Paper clips
- Instructions for making a simple paper airplane (print out for participants before workshop begins)
- The Science Process Skills Worksheet (make copies and have one at each seat before the workshop begins)

### **Open the Session: Introduction, Objectives, and Overview—5 Minutes**

#### **Welcome the group back for Session 3—Engineering.**

*If new folks are joining you, customize an introduction and overview that include what is important from Sessions 1 and 2—Science and Technology.*

Introduce yourself to the group. Your introduction may include a brief statement about your experience, the topic, how often the group will meet, and one or two goals.

You don’t need to be an engineer to help your child make discoveries about engineering in the world around you. You are doing it already when you and your child build with blocks; when your child creates something with recycled boxes; and when you explore outdoors, looking at structures and buildings. All you need is an open mind and a willingness to join the exploration. It’s fun, and it’s a great way to support your child’s science learning—with a focus on engineering.

Children are natural scientists, full of questions and excited to learn. They love to explore, investigate, try things out, and “experiment” with what they see, hear, smell, taste, and touch. Everything you show and share with your child—whether baby, toddler, or preschooler—will give her new information, allow her to solve problems, and help her develop basic science skills.

#### **During this session, we will . . .**

- Watch children explore the world in a video.
- Share engineering stories from our own families.
- Play with materials and practice doing engineering activities.
- Create a plan for doing more engineering at home.

#### **After this session, you will be able to . . .**

- Summarize the best practices for engaging young children in engineering.
- Recognize and design activities that invite children to observe, explore, investigate, problem-solve, and experiment.
- Plan ways to integrate STEM language into activities to help children think and act like scientists.
- Identify strategies for helping children reflect on new understandings.

### **Set the Stage: Mini Lecture—4 Minutes**

Let's start by watching a video. But before watching . . .

As you watch the video, choose some activities that you think reflect engineering. Think about how your child likes to explore the world. As you watch our young friends in the video, write down what you think engineering is.

### **Don't forget . . .**

You are your child's first and most important teacher—and the world is your classroom. Children are naturally curious and like to explore everything around them, ask lots of questions, and experiment with objects and ideas. Through everyday explorations, children discover science and math concepts such as cause and effect, gravity and balance, measuring, colors, shapes, patterns, and numbers. They also build math- and science-related vocabulary, words like explore and investigate, more than and less than, and float and sink. As children make new discoveries and successfully explore the world around them, they also build confidence and problem-solving skills that will help them thrive in everything they do.

### **Review for New Participants**

#### **In this video, you'll meet children from four families who are doing just what I mentioned:**

- Kash (four months) explores with his senses.
- Ronan (two years) builds math and science skills on a nature walk.
- Siblings Aliyah (six years) and Lamarques (three years) and their cousin Rosonn (seventeen months) discover shapes while playing with dough.
- Ange-Yolette (three years) and her brother Gregory (six years) do experiments with water and learn about science.

### **Watch the learning that happens as they explore the world.**

#### **Watch the Video—Exploring 5.48 Minutes**

#### **After Watching: Mini Lecture and Discussion—20 Minutes**

**The World Is Your Classroom.** Children are natural scientists, eager to investigate and learn from everything in their world. In the video, Ange-Yolette experiments with colors as her mom blows green bubbles, Lamarques learns about gravity and balance as he builds a block tower, Ronan investigates ice on a walk outside, and baby Kash learns about objects and how they move as he watches and reaches for the objects on his mobile. Ask the group, "What objects does your child like to manipulate?" "Where does he do most of his investigating?" and "Does your child incorporate experiments into his dramatic play?"

**Try this at home:** Encourage your child to use all of her senses as she investigates and manipulates objects and watches what happens. Have her repeat what she did and see if the same thing happens each time.

**Follow the Leader.** It is much easier to engage young children—no matter what their age—if you follow their lead. Encourage participants to watch to see what their children are interested in and to build their explorations around the objects and experiences that capture their attention. In the video, Ange-Yolette is interested in pouring, so her mom sets up a "lab" where she and her brother can conduct water experiments. Ask participants, "What are your child's interests? What does she want to know more about?"

**Try this at home:** On your next walk outside, ask your child, "Do you notice the blue sky?" and "What do you notice?" Then investigate the thing that he mentions. If he notices a leaf, take the time to touch it and smell it. Talk about its shape and color. See if you can find the tree that the leaf came from. Take a few leaves home and "amp up" the learning with some science fun. Try turning your kitchen into a "leaf lab." You can trace the leaves, do leaf rubbings, and find out if the leaves float or sink in water.

**Everyday, Everywhere Learning.** Everyday routines and common objects offer great opportunities for exploration and learning. In the video, Ange-Yolette and Gregory sort colors and count in both English and Spanish. Ronan discovers shapes as he helps prepare lunch. Ask participants, “What are your daily routines? What does your child learn during these everyday moments?”

**Try this at home:** The next time you do laundry, have your child be your helper. She’ll learn about colors and compare sizes as she matches socks or helps you organize items into piles. Point out patterns on the clothes that you fold, count how many pants and shirts you have, and give her the chance to figure out how the different buttons, snaps, and zippers work.

### **Developing Scientists**

Let’s break it down developmentally for your children. Who has babies? Who has toddlers? Who has preschoolers? Remember, your child is growing up each day, so the toys he plays with, the questions you ask, and the experiences you share with him should change every few weeks. Keep it interesting and unique.

### **Babies (0–15 Months)**

Before your baby can move around on her own to explore, you’ll need to help her to experience the world by bringing it to her. By introducing objects and experiences that engage the five senses—hearing, touching, seeing, smelling, and tasting—you’ll help your baby discover and learn.

Your baby will be especially interested in things that she can hold in her hands and put in her mouth. Make sure that everything within your baby’s reach is safe for her to put in her mouth. She might also be content to learn just by watching and listening. Give her a chance to explore in her own way and in her own time.

Everything you show and share with your baby gives her information about her surroundings. This knowledge helps build her confidence to explore and learn more. Share your own enthusiasm with your baby as you explore the world together.

### **Activities for Babies**

**Touch and Feel.** Babies love to reach, grab, and touch everything! Help your baby safely explore with her sense of touch.

**What’s That Sound?** Your baby likes to hear a variety of sounds, and she will be amazed to discover that she can also make sounds happen.

**Peekaboo.** Playing peekaboo is not only fun, but it also helps your baby make an exciting discovery: Things are still there when she can’t see them!

### **Toddlers (15–36 Months)**

Children are full of questions and excited to learn. One of the first steps in learning is exploring. Exploring lets your toddler learn about different objects and how to solve problems. It helps him answer his own questions about how things work.

As your toddler explores, he gets to use all his senses, which help him discover and learn how things are different. He also uses his whole body to explore. Toddlers love to run, climb, and jump to get to new objects to investigate!

Everything is of interest to your toddler, and it is natural that he wants to test his surroundings. Although it is important to let him explore, it should always be in a safe place with you or another caring adult at his side.

## Activities for Toddlers

What Happens If . . . With a few pans or buckets, your toddler-scientist can experiment and explore!

**Sort It Out.** Sorting by color, size, texture, or any other attribute helps your toddler learn how things are alike or different.

**Nature Walk.** Talking a walk together outside—in the city or the country—offers many ways to explore, learn, discover, and investigate!

## Preschoolers (36 Months–5 Years)

Preschoolers are learning to incorporate their real-life experiences into pretend play. This is one way of figuring out the world around them. As your preschooler explores, he gets to use all his senses, which help him discover and learn how things are different. Preschoolers are developing their observation skills. Asking your child questions like “Do you see . . . ?” or “Did you notice . . . ?” will help him pay attention to details he might otherwise miss. Preschoolers often exclaim, “Look here!” You can be ready to go to the next level of observation by asking “what” questions. These include “What is it?” “What does it do?” “What happened?” “Did it do the same thing the last time?” “What do you see, feel, hear?” Ask participants to look at the Science Process Skills Worksheet.

**Here are some science process skills that children begin to develop around three years of age:**

Observe	Experiment	Problem-solve
Describe	Predict	Collaborate
Categorize	Generalize	Use tools
Communicate	Relate to prior and/or	
Record	current experience	

## Preschoolers learn

- through trial and error
- by figuring things out for themselves
- through persistence
- through their senses
- by observing others and imitating their play

## Activities for Preschoolers

**Use Science Language.** Use some of these “juicy” words to ask, “Can you describe your building?” (Tell me what it looks like or feels like.) “Can you predict what will happen if you put one more block on top?” (Tell me what you think might happen.) “Let’s record what you saw.” (Write down what happened).

**Find Out Your Child’s Ideas.** Encourage your preschooler to use his words and say what he really thinks. Ask, “Why do you think the ball rolls faster on your ramp?” The question “What do you think?” allows your child to practice communicating, generalizing, and problem solving without feeling that the question requires a correct answer.

**Practice Observation.** Observation is an important skill for preschoolers. You might have heard your child say, “Oh, look!” It is used to raise questions, to link to earlier experiences, to gather information, and to find patterns and relationships between things. Encourage your child to tell you what he sees (or feels or hears or smells) or to draw what he observes. . Ask him, “Do you see the big, blue sky?” “Do you see ...?”

## Engineering Hands-on Activities—15 Minutes

Engineering is a physical science. It is a way of doing. Engineering occurs when someone designs and makes something that solves a problem. Playing with blocks and other building materials develops engineering skills, helping children learn about gravity, balance, shapes, and problem solving.

Big companies are betting on the new emphasis on science, especially engineering, in preschools to turn out more engineers for the workforce in twenty years. In a recent article in *The Boston Globe*, academic expert Karen Worth of Wheelock College says that the most effective way to teach young children about the sciences is to have adults guide them as they experiment with the simplest objects, such as using blocks to construct a mountain. While she supports increasing science-related teaching at the preschool level, Worth says it should not be done in service of turning out more engineers. Education experts stress that preschools need to strike the right balance between play and instruction. And, many say, unstructured time on the playground is an important part of early education.

Preschool engineering starts with small blocks, unit blocks, large Legos, and plenty of recycled items such as plastic bottles, egg cartons, and boxes of all sizes. Supplementing building blocks with small cars, trucks, animals, and people supports imaginative play. Building ramps and rolling balls down them are a popular preschool engineering activity.

### Let's build it!

**Mix It Up.** Ask participants to work with a buddy to build a house for an imaginary friend, perhaps someone their children would build a house for. Using recycled materials, they should design and build a home. Choose one or two pairs to share something about their building. Ask participants, "Will the imaginary friend fit? Can he invite friends over? Will they fit? How could you make it bigger? Smaller? Cozier? Taller?"

**Try this at home:** Use mixed sets of materials to build things. With a younger child, use smaller and softer materials; use larger and heavier materials as your child gets older. Try mixing building blocks with Legos, or foam bricks with cans.

**Recycle It.** Use cardboard boxes, plastic bottles, egg cartons, and empty food containers as building materials.

**Try this at home:** Work with your child to make a house for your child's doll or action figure, pet rock, or stuffed animal. Create a plan: What materials will you use? How big should it be? Will it be comfortable?

**Fly an Airplane.** Teach participants how to make a simple folded paper airplane. Fly the planes around the room and experiment by putting a paper clip on the nose of the plane to see how it will affect the plane's flight.

**Try this at home:** Paper airplanes are a simple and fun way to explore engineering with young children. If you need instructions, search the Internet for "paper airplanes," and many ideas will come up. Help your child create and carry out experiments to see how a change in the design of the plane will affect the flight. For instance, will a plane with a paper clip on the nose go farther than a plane without a paper clip? Will a different type of paper affect the flight?

**Resources**

WGBH has two valuable online resources for families and educators. Check out the Peep and the Big Wide World website at <http://peepandthebigwideworld.com> for more on shadows, water, plants, color, sound, and balls and ramps. Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) for more activities and videos. This web portal was built by WGBH with funding from Race to the Top—Early Learning Challenge and the Massachusetts Department of Early Education and Care.

**Talk Back and Make an Action Plan—5 Minutes**

Spend a few minutes talking about what engineering exploration might be appropriate for your participants to do at home. Babies? Reaching out and exploring anything! Toddlers? Using large cardboard blocks or boxes and recycled items. Preschoolers? Legos, unit blocks, bristle blocks, cardboard boxes, recycled items, ramps, and balls.

Give participants a few minutes to use their Science Process Skills Worksheet to create a Science Action Plan to take home. Ask participants to share something about their plan.

**Collect Evaluations and Pass Out Take-Home Handouts—5 Minutes**

Ask workshop participants to fill out an evaluation and leave it on the table. Make tip sheets available to take home.



# Engineering:

## Build It: Towers!



### LEARNING GUIDELINES

**PreK-LS1-4:** Use their five senses in their exploration and play to gather information.

*Engineering activities encourage brain development.*

*Children solve problems, use a variety of materials, design, create, and build things that work.*

### MATERIALS

- \* Assorted stackable building materials: blocks, empty yogurt containers with lids tightly taped on, plastic storage containers with lids, plastic or wooden spools, paper towel tubes, or toilet paper tubes
- \* Assorted small toy props such as cars, animals, or people
- \* Open floor space

## SETUP

- The goal of this activity is for children to use problem-solving skills to design tower structures out of a variety of materials.
- Set up a clear area on the floor with the building materials to one side. Small parts and toys can be grouped together in a box or other container.

## DO IT TOGETHER

- Let your child explore the building materials by handling and talking about them. “Look at all these different materials! How will you start your structure? What goes next?”
- If your child is very young, you could suggest that he build a tower for the toy people to live in, then you can work on the structure together. Be sure to let him pick out the pieces and try them out before you suggest something different.
- As your child tries out different designs and ways of stacking the materials, you can support his learning by asking, “Can you make a tower as tall as you are? What would happen if you removed some of the pieces? Can you make a tower with a tunnel that this toy car could drive through?”
- Your child may want to include the toys into his play rather than focus only on building towers. This is a great opportunity to encourage imaginative play during an engineering design challenge. “How big will the barn door opening need to be for the horse to fit through? How many yogurt containers will you need for the walls?”
- If the tower tumbles down unexpectedly, ask, “What do you think happened? Is there something different you’d like to try? What do you think will happen if you move this big piece down lower?” Be sure to jump in with a helping hand if your child seems too frustrated to keep going or would like some support.

## DO MORE OF IT!

- **Build-It Buildup.** Put aside a box to start a collection of building materials. Save a variety of recycled containers of different sizes and shapes, such as empty shoe or cereal boxes or plastic jars.
- **Build It Up—Knock It Down.** Children love to build towers and knock them down. Find a safe place to let your child build all kinds of structures and knock them down. Try using lightweight materials such as Styrofoam packing material, cardboard boxes, empty cylindrical oatmeal containers, and big plastic jugs. You can also add beans or marbles to the plastic containers, seal them well, and enjoy the extra sound effects when the structure tumbles down.

## BOOKS

- *Block Building for Children: Making Buildings of the World with the Ultimate Construction Toy* by Lester Walker
- *Block City* by Robert Louis Stevenson
- *Changes, Changes* by Pat Hutchins

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Engineering:

## Construction Zone: Building a Paper Bridge



### LEARNING GUIDELINES

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

*Children have an opportunity to practice their engineering skills while they design and build bridges made out of paper. This activity gives children the opportunity to imagine a bridge, create a bridge, and recreate it if it doesn't work.*

### MATERIALS

- \* Paper: 8½" x 11" sheets cut into thirds widthwise to make 8½" x 3 ½" strips
- \* Empty storage containers or small buckets that are less than 8" across the top
- \* Small weights, such as plastic animals, dice, or small magnets

## SETUP

- The goal of this activity is for children to create a bridge from one side of a container to the other that will support at least one of the weights.
- Set up a clear area on the floor or a table with the paper strips and buckets out. The weights can be on the side in a container.

## DO IT TOGETHER

- Start your child off with one paper strip and ask him to see if he can use it to create a bridge across two containers. “Now choose a weight to put on your bridge. What happens?” If the bridge collapses, you can suggest that he experiment with other weights or try rebuilding the bridge. “Why do you think the bridge fell? What could you do differently?”
- If your child is having trouble creating a bridge, suggest modifications such as folding, crumpling, tearing, or ripping the paper. “Would drawing on the paper make a difference in the structure?”
- Encourage your child to understand that lots of different kinds of bridges will work, and there is no one right way to do this activity. Have him think about bridges he has seen or driven over. “Do you remember what the bridges look like? What shapes did you see in them? Do you have a favorite bridge?”
- For your very young child, it’s fine if he just wants to crumple the paper or play with the animals. You could set up a little bridge and help him move the animals back and forth over and under it.
- For your older child, once he has completed a weight-bearing bridge, challenge him to build a bridge with certain attributes, such as one that has an arch or railings or that can hold more weight.

## DO MORE OF IT!

- **Try It Out.** Try making other types of bridges using materials from around your home and yard, such as twigs, string, tinfoil, or rocks. Explore your recycle bin as well for larger building materials. What ideas can your child come up with, and how can you help him design and build them? When you and your child have got a bridge built, encourage him to try getting different objects (toy vehicles, people, or animals) to stand on or cross the bridge. Talk with your child about what works and what doesn’t, and why.
- **Bridges Everywhere.** Point out bridges as you walk or drive around with your child. Talk about the experience of building your own bridges. Share observations about how the bridges you see are made, how they are shaped, how long they are, and how they stay up. Notice who or what is traveling on them—for example, footbridges, train bridges, highway bridges. You can also encourage your child to go back to the original bridge-building activity and see how much more he can do.

## BOOKS

- *A Day in the Life of a Builder* by Linda Hayward
- *The Three Little Javelinas* by Susan Lowell

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).
- Paper Tower: A Family Science Activity  
<http://www-tc.pbskids.org/zoom/printables/activities/pdfs/newspapertower.pdf>

# Engineering:

## Recycle Art Build



### LEARNING GUIDELINES

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

*This activity encourages children to build 3-D sculptures from recycled household objects in a creative and fun way.*

### MATERIALS

- \* Base materials to build from: paper plates, paper towel tubes
- \* Assorted types of paper: construction paper, wrapping paper, wallpaper
- \* Assorted materials to glue, layer, and build with: stiff ribbon, bottle caps, corks, buttons, felt, tinfoil
- \* Contact paper or stickers
- \* Scissors
- \* Glue sticks
- \* Hole punch
- \* Yarn, string, or narrow ribbon

## SETUP

- The goal of this activity is for children to explore a wide variety of recycled household materials to create and build a 3-D sculpture.
- Set up the table with the paper, containers of materials, glue sticks, and scissors. Have your child choose a base material to start her sculpture from.

## DO IT TOGETHER

- Encourage your child to handle and touch the materials as she chooses what to use. Younger children may spend the entire time just playing with the materials. This is an important learning experience by itself!
- Show by doing it yourself! Start to build your own sculpture, and don't say a word. Let your child observe or just jump in on her own!
- Ask your child, "What would you like to start with? Do you want something flat or round? If it's round, how will you attach it to the plate?"
- Encourage different ways to handle the materials. "Would you like to try scrunching, tearing, or folding your paper instead of cutting it? Can you make your paper into a tent? An arch? A fan?"
- Encourage your child to work on building her project up and out. "Could you use the felt to make your project higher? How could you add cork or buttons to make your sculpture wider?"
- Ask your child to talk about her project. "Is there a part of it you really like? Is there something else you might have liked to try? Do you have any stories about any of the pieces?"

## DO MORE OF IT!

- **Try It.** Introduce the hole punch as another tool; your child may like to punch holes to weave the yarn or ribbon through for hanging her finished project. You can also suggest using the contact paper or stickers to hold things together rather than glue: Could you use these stickers to attach the string to the cork? This creates an interesting design challenge that has many solutions.
- **More Materials.** What recycle materials can you discover at home? Make an adventure out of looking for interesting materials together. Use an old shoebox as your family's recycle art box to store interesting items for later use. Projects can also be kept and added to over time, as your child enjoys the ongoing adventure of looking for recycled materials and finding new ways to attach them to her sculpture.
- **Recycle Art Boxes.** Introduce your friends to recycle art by creating recycle art boxes as gifts. Create a gift for your child's friend by decorating an empty shoebox and adding some markers, stickers, a glue stick and pair of scissors.
- **Local Recycle.** Go online with your child and research interesting products made from recycled materials, such as park benches and playground equipment. See if you can find these items being used in your neighborhood.

## BOOKS

- *Recycle! A Handbook for Kids* by Gail Gibbons
- *The Big Messy\* Art Book: \*But Easy to Clean Up* by MaryAnn F. Kohl
- *The Art Lesson* by Tomie dePaola

## OTHER RESOURCES

- Get books on recycling, recycle art, or building from your local library or bookstore.
- Visit recycle art exhibits in local museums or galleries.

# Session 4:

# Math

The purpose of this session is to inspire families to engage their children in mathematics by offering activities that allow the children to observe and explore, by integrating STEM vocabulary in everyday activities, and by guiding the children to reflect on new understandings.

Math is a way of measuring. Math is sequencing (1, 2, 3, 4 . . .), patterning (1, 2, 1, 2, 1, 2 . . .), and exploring shapes (triangle, square, circle), volume (holds more or less), and size (bigger, smaller, less than, greater than). Math activities include counting and matching shapes and making patterns. Measuring is easy too, especially with unit blocks where two of one size equal one of the next size up.



## Connection to the Massachusetts Math Standards

The Massachusetts Curriculum Frameworks for Mathematics are found in <http://www.doe.mass.edu/frameworks/math/0311.pdf>. The pre-K standards are on pages 23–25. What follows is a quote from the document that describes the standards for preschoolers.

In preschool or pre-kindergarten, activity time should focus on two critical areas: (1) developing an understanding of whole numbers to 10, including concepts of one-to-one correspondence, counting, cardinality (the number of items in a set), and comparison; and (2) recognizing two-dimensional shapes, describing spatial relationships, and sorting and classifying objects by one or more attributes. Relatively more learning time should be devoted to developing children’s sense of number as quantity than to other mathematics topics.

## Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for an express regularity in repeated reasoning.

## Materials Needed

- Plastic fishbowl or other see-through container
- Random collection of small items that share attributes (color, size, shape, texture); some items can be identical
- Fabric swatches cut into squares, colored paper cut into shapes
- Beads or counting bears that can be sorted by color or size
- Ball of yarn
- Masking tape
- Random items to count
- The Science Process Skills Worksheet (make copies and have one at each seat before the workshop begins)

## Open the Session: Introduction, Objectives, and Overview—5 Minutes

*Welcome the group back for Session 4—Math.*

If new folks are joining you, customize an introduction and overview that include what is important from Sessions 1, 2, and 3—Science, Technology, and Engineering.

Introduce yourself to the group. Your introduction may include a brief statement about your experience, the topic, how often the group will meet, and one or two goals.

You don’t need to be a mathematician to help your child make discoveries about math in the world around you. You are doing it already when you play in the bathtub counting how long it takes to fill up the tub; when you give your child pots and pans and wooden spoons while you cook in the kitchen; and when you explore outdoors, finding a variety of leaves and enjoying a sunny day. All you need is an open mind and a willingness to join the exploration. It’s fun, and it’s a great way to support your child’s science learning.

Children are natural scientists, full of questions and excited to learn. They love to explore, investigate, try things out, and “experiment” with what they see, hear, smell, taste, and touch. Everything you show and share with your child—whether baby, toddler, or preschooler—will give her new information, allow her to solve problems, and help her develop basic math skills.

**During this session, we will . . .**

- Watch children explore the world in a video.
- Share math stories from our own families.
- Play with materials and practice doing math activities.
- Create a plan for doing more math at home.

**After this session, you will be able to . . .**

- Summarize the best practices for engaging young children in math.
- Recognize and design activities that invite children to observe, explore, investigate, problem-solve, and experiment.
- Plan ways to integrate STEM language into activities to help children think and act like scientists.
- Identify strategies for helping children reflect on new understandings.

**Set the Stage: Mini Lecture—4 Minutes**

*Let’s start by watching a video. But before watching . . .*

As you watch the video, choose some activities that you think reflect mathematics. Think about how your child likes to explore the world. As you watch our young friends in the video, write down what you think math is.

**Don’t forget . . .**

You are your child’s first and most important teacher—and the world is your classroom. Children are naturally curious and like to explore everything around them, ask lots of questions, and experiment with objects and ideas. Through everyday explorations, children discover science and math concepts such as cause and effect, gravity and balance, measuring, colors, shapes, patterns, and numbers. They also build math- and science-related vocabulary, words like explore and investigate, more than and less than, and float and sink. As children make new discoveries and successfully explore the world around them, they also build confidence and problem-solving skills that will help them thrive in everything they do.

**Review for New Participants**

**In this video, you’ll meet children from four families who are doing just what I mentioned:**

- Kash (four months) explores with his senses.
- Ronan (two years) builds math and science skills on a nature walk.
- Siblings Aliyah (six years) and Lamarques (three years) and their cousin Rosonn (seventeen months) discover shapes while playing with dough.
- Ange-Yolette (three years) and her brother Gregory (six years) do experiments with water and learn about science.

**Watch the learning that happens as they explore the world.**

**Watch the Video—Exploring 5.48 Minutes**

**After Watching: Mini Lecture and Discussion—20 Minutes**

**The World Is Your Classroom.** Children are natural scientists, eager to investigate and learn from everything in their world. In the video, Ange-Yolette experiments with colors as her mom blows green bubbles, Lamarques learns about gravity and balance as he builds a block tower, Ronan investigates ice on a walk outside, and baby Kash learns about objects and how they move as he watches and reaches for the objects on his mobile. Ask the group, “What patterns does your child notice?” “Does she sort or categorize objects?” and “How do you count with your child?”

**Try this at home:** Encourage your child to use all of her senses as she investigates an object. Give her a wooden spoon, an eggbeater, a flashlight, or an old radio. Ask her, “What do you think this is?” and “Can you find another one of these?” Then let her figure it out on her own (with a little help from you, but only when asked).

**Follow the Leader.** It is much easier to engage young children—no matter what their age—if you follow their lead. Encourage participants to watch to see what their children are interested in and to build their explorations around the objects and experiences that capture their attention. In the video, Ange-Yolette is interested in pouring, so her mom sets up a “lab” where she and her brother can conduct water experiments. Ask participants, “What are your child’s interests? What does she want to know more about?”

**Try this at home:** On your next walk outside, ask your child, “Do you notice the blue sky?” and “What do you notice?” Then investigate the thing that he mentions. If he notices a leaf, take the time to touch it and smell it. Talk about its shape and color. See if you can find the tree that the leaf came from. Take a few leaves home and “amp up” the learning with some science fun. Try turning your kitchen into a “leaf lab.” You can trace the leaves, do leaf rubbings, and find out if the leaves float or sink in water.

**Everyday, Everywhere Learning.** Everyday routines and common objects offer great opportunities for exploration and learning. In the video, Ange-Yolette and Gregory sort colors and count in both English and Spanish. Ronan discovers shapes as he helps prepare lunch. Ask participants, “What are your daily routines? What does your child learn during these everyday moments?”

**Try this at home:** The next time you do laundry, have your child be your helper. She’ll learn about colors and compare sizes as she matches socks or helps you organize items into piles. Point out patterns on the clothes that you fold, count how many pants and shirts you have, and give her the chance to figure out how the different buttons, snaps, and zippers work.

## **Developing Scientists**

Let’s break it down developmentally for your children. Who has babies? Who has toddlers? Who has preschoolers? Remember, your child is growing up each day, so the toys he plays with, the questions you ask, and the experiences you share with him should change every few weeks. Keep it interesting and unique.

### **Babies (0–15 Months)**

Before your baby can move around on her own to explore, you’ll need to help her experience the world by bringing it to her. By introducing objects and experiences that engage the five senses—hearing, touching, seeing, smelling, and tasting—you’ll help your baby discover and learn.

Your baby will be especially interested in things that she can hold in her hands and put in her mouth. Make sure that everything within your baby’s reach is safe for her to put in her mouth. She might also be content to learn just by watching and listening. Give her a chance to explore in her own way and in her own time.

Everything you show and share with your baby gives her information about her surroundings. This knowledge helps build her confidence to explore and learn more. Share your own enthusiasm with your baby as you explore the world together.

### **Activities for Babies**

**Touch and Feel.** Babies love to reach, grab, and touch everything! Help your baby safely explore with her sense of touch.

**What’s That Sound?** Your baby likes to hear a variety of sounds, and she will be amazed to discover that she can also make sounds happen.

**Peekaboo.** Playing peekaboo is not only fun, but it also helps your baby make an exciting discovery: Things are still there when she can’t see them!

### **Toddlers (15–36 Months)**

Children are full of questions and excited to learn. One of the first steps in learning is exploring. Exploring lets your toddler learn about different objects and how to solve problems. It helps him answer his own questions about how things work.

As your toddler explores, he gets to use all his senses, which help him discover and learn how things are different. He also uses his whole body to explore. Toddlers love to run, climb, and jump to get to new objects to investigate!

Everything is of interest to your toddler, and it is natural that he wants to test his surroundings. Although it is important to let him explore, it should always be in a safe place with you or another caring adult at his side.

### **Activities for Toddlers**

**What Happens If . . .** With a few pans or buckets, your toddler-scientist can experiment and explore!

**Sort It Out.** Sorting by color, size, texture, or any other attribute helps your toddler learn how things are alike or different.

**Nature Walk.** Talking a walk together outside—in the city or the country—offers many ways to explore, learn, discover, and investigate!

### **Preschoolers (36 Months–5 Years)**

Preschoolers are learning to incorporate their real-life experiences into pretend play. This is one way of figuring out the world around them. As your preschooler explores, he gets to use all his senses, which help him discover and learn how things are different. Preschoolers are developing their observation skills. Asking your child questions like “Do you see . . . ?” or “Did you notice . . . ?” will help him pay attention to details he might otherwise miss. Preschoolers often exclaim, “Look here!” You can be ready to go to the next level of observation by asking “what” questions. These include “What is it?” “What does it do?” “What happened?” “What do you see, feel, hear?”

**Ask participants to look at the Science Process Skills Worksheet.**

**Here are some science process skills that children begin to develop around three years of age:**

Observe	Experiment	Problem-solve
Describe	Predict	Collaborate
Categorize	Generalize	Use tools
Communicate	Relate to prior and/or	
Record	current experience	

### **Preschoolers learn**

- through trial and error
- by figuring things out for themselves
- through persistence
- through their senses
- by observing others and imitating their play

### **Activities for Preschoolers**

Use Science Language. Use some of these “juicy” words to ask, “Can you find another flower? What is different about the two flowers? How are they the same? Let’s record all the flowers we found.” (Draw the types or colors of the flowers you saw.)

**Find Out Your Child’s Ideas.** Encourage your preschooler to use his words and say what he really thinks. Ask, “How many oranges do you think are in the bag?” The question “What do you think?” allows your child to practice communicating, generalizing, and problem solving without feeling that the question requires a correct answer.

**Practice Observation.** Observation is an important skill for preschoolers. You might have heard your child say, “Oh, look!” It is used to raise questions, to link to earlier experiences, to gather information, and to find patterns and relationships between things. Encourage your child to tell you what he sees (or feels or hears or smells) or to draw what he observes. . Ask him, “Do you see the big, blue sky?” “Do you see...?”

### **Math Hands-on Activities—15 Minutes**

Research from Professor Greg Duncan from the University of California, Irvine, confirms that early math skills are a better predictor of later academic success than early reading is. His study examined math, literacy, and social-emotional skills at kindergarten entry and found that “early math concepts, such as knowledge of numbers and ordinality, were the most powerful predictors of later learning.”

Young children have a surprising capacity to learn substantial mathematics. Helping them notice patterns, shapes, and categories, sort, and count at an early age helps build the foundational skills that lead to later success in math. Given the importance of mathematics to academic success in all subjects, all children need a robust knowledge of mathematics in their earliest years.

When children play, they are often doing much more than just having fun. Almost all children engage in substantial amounts of premathematical activity in their free play, and preschoolers can learn to invent solutions to solve simple arithmetic problems. Sorting and counting are great ways to develop logic and learn basic math skills. Through play with blocks, colors, and shapes, children begin to learn concepts such as classification and ordering.

### **Let’s count it!**

Likes Go Together. Fill a plastic fishbowl or other container with random, small items, making sure that some of them can be “categorized” by color, size, shape, or texture; you may want to include some

identical items. Have a few participants choose five items out of the container and explain how they are alike. Ask them to put the things that are alike close together and show everyone their “collection” of things.

**Try this at home:** Assemble a set of toys, and have your child find the matching ones: cars with cars, blocks with blocks. Repeat using different criteria: Match colors, sizes, or shapes.

**Design a Quilt.** You can use fabric squares in a variety of patterns, or triangles and squares cut out of construction paper. Create patterns in a design to mimic a quilt.

**Patterns.** Try this at home: Using beads, shapes, or colored blocks, help your child create color patterns (for example, blue, red, blue, red, blue, red). You can cut shapes from paper and make shape patterns, too (circle, square, circle, square, circle, square).

**Body Measurements.** Ask participants to stand against the wall and measure one another by cutting a length of yarn to the person’s height. Tape the pieces of yarn to the wall in order of height. Make name tags for each piece of yarn so you know which piece belongs to each person. Use one person’s yarn to measure a table. How many pieces of that person’s yarn does it take to measure the length of the table? Have participants measure other things in the room.

**Try this at home:** Your child can measure her height with a piece of yarn. How many pieces of her yarn does it take to cross the room? Your child can also measure by using her hands. Ask, “How many hands high is that tower?” and “Is your hand the same size as mine?”

**Counting.** Ask participants to share all the ways they count with their children. Choose a couple of participants to count some things in the room—the number of people present, the number of women or men, the number of chairs or tables.

**Try this at home:** Your child can count everything, including the fingers on her hands and the toes on her feet! Ask your child, “How many ears do you have? How many noses?”

### **Resources**

WGBH has two valuable online resources for families and educators. Check out the Peep and the Big Wide World website at <http://peepandthebigwideworld.com> for more on shadows, water, plants, color, sound, and balls and ramps. Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) for more activities and videos. This web portal was built by WGBH with funding from Race to the Top—Early Learning Challenge and the Massachusetts Department of Early Education and Care.

### **Talk Back and Make an Action Plan—5 Minutes**

Spend a few minutes talking about what mathematical exploration might be appropriate for your participants to do at home. Babies? Give them one, two, three items, counting them out loud. Toddlers? Using items that are the same and different, work with patterns, sort the items, and count them. Preschoolers? Puzzles, shapes, patterns, and counting are all key to developing math skills.

Give participants a few minutes to use their Science Process Skills Worksheet to create a Science Action Plan to take home. Ask participants to share something about their plan.

### **Collect Evaluations and Pass Out Take-Home Handouts—5 Minutes**

Ask workshop participants to fill out an evaluation and leave it on the table. Make tip sheets available to take home.



# Math:

## Be a Color and Shape Detective



### LEARNING GUIDELINES

**PreK-LS1-4:** Use their five senses in their exploration and play to gather information.

*Colors and shapes are everywhere!*

*This activity helps children learn early math skills by investigating colors and shapes just like a detective!*

### MATERIALS

- \* Paper stencils: cut out a circle, square, triangle, rectangle, oval, and/or diamond from card stock or a paper plate
- \* Large colorful pipe cleaners
- \* Crayons and markers

## SETUP

- The goal of this activity is for children to learn about shapes by exploring their outlines and playing the shape detective game. The activity can be played the same way to explore colors.
- Set up the table with the stencils, pipe cleaners, paper, and markers.

## DO IT TOGETHER

- Let your child spend some time exploring the way the stencil shapes feel. “Try feeling the circle with your eyes closed. Slip the square on your arm and turn it to feel the different kinds of edges. Can you trace the diamond with your fingertips?” Handling a shape object is an important step in learning about shapes.
- For color exploration, let your child handle and play with the colored pipe cleaners. “What’s your favorite color? Can you show me the green one? Let’s pick out all of the red ones and line them up!”
- To become a shape detective, work with your child to create a “shape finder” (like a magnifying glass) in whatever geometric shape she would like. For your very young child, you can make it for her and talk her through the process. “See how I’m making this nice straight line and then—pop! I bend it to make a new side. This is how we make a circle. It goes round and round.”
- To make a color finder, let your child pick out a pipe cleaner and help her bend it into a magnifying glass shape. You can add more of the same color pipe cleaners to make it stronger, and talk with your child as you or she makes it. “Would you like to add another color? Can you find any more blues we can add to fill in the center more?”
- Now you and your child are ready to do some detective work! Take your finders and look around. Explore the room you are in, or head outdoors to match shapes and colors. “What shape are our buttons? Do they match your shape finder? Let’s look in the refrigerator and see what shapes we can find! How many red objects can you find in your room? Does your finder match anything that you’re wearing?”

## DO MORE OF IT!

- **Shape Detective.** Play a game with a group of your children’s friends where a leader holds up a shape finder and everyone helps to identify it. Then the children look for that shape on themselves; whoever has the shape steps out in front. As each shape is shown, more and more children can step out. If there are any children remaining, help to show them a shape anywhere on themselves (the palm of your hand can be square, a shirt sleeve can be a rectangle). The game can also be adapted so that children locate shaped objects in a room.

## BOOKS

- *Round Is a Mooncake* by Roseann Thong
- *Shape Capers* by Cathryn Falwell
- *Color Zoo* by Lois Ehlert
- *My Very First Book of Shapes/Mi Primer Libro de Figuras* by Eric Carle
- *Mouse Paint* by Ellen Stoll Walsh

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Math:

## Fishbowl Math



### LEARNING GUIDELINES

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

*Sorting and categorizing are important early math skills. In this activity, children have fun playing with assorted small toys while getting lots of practice sorting, categorizing, and organizing.*

### MATERIALS

- \* Plastic fishbowl or other clear container
- \* Assorted 1"–2" child-friendly objects: five or ten each with common attributes, such as shape (toy bird) or color (green pom-pom), and a few individual items, such as a green plastic tree or a toy car

## SETUP

- The goal of this activity is for children to practice organizing, sorting, and seeing patterns by looking at and arranging small toys.
- Set up the fishbowl or other container on the table or floor.

## DO IT TOGETHER

- You can begin this activity by either emptying the contents of the fishbowl onto the table or floor, or letting your child put her hand in and select five to ten objects from the fishbowl. You should also select objects so you are both playing the game.
- Spend some time looking at and handling your objects. Talk about what you see in your own collection and each other's. Ask questions like "What color is your little fish? Great! Do you see any other toys that have yellow in them? Do you see any other fish?" You can let your child decide which category she would like to put her fish into: color (yellow) or animal (fish).
- In this activity, your child may want to talk about the objects, make up little stories, or just play with them. These are all valid ways to explore and get familiar with the objects and have a lot of fun too! If your child has a little car that she is rolling around on the floor, you could ask, "Can my car ride along with your car? Can you find any other cars that would like to join our parade?"

## DO MORE OF IT!

- **Family Fishbowl.** Create and expand your family fishbowl by looking for objects from around the house to add to your collection. Ask your child to find a few items she wants to include. You can add all kinds of small, child-safe objects such as ribbon, cork, shells, and crayons. Make the sorting game a family activity where you trade with one another to get as many objects of a particular type in your own collections as possible. If your child is having trouble coming up with categories, ask her to pick out her favorite object and identify all of its characteristics: color, shape, texture, number of parts (legs, eyes, wheels), use, and so on.
- **Sorting Everywhere.** Whenever you find yourselves stuck in a long line at the supermarket or waiting in traffic, remember that you can play the sorting game wherever you are! Think of a category like pets, toys, the color blue, or sneakers. Together, you and your child locate as many items in that category as you can find around you. You can be very creative with your choices. Is a stuffed animal a pet? Can a shopping basket be a toy? This is a great way to really dig in to thinking and talking about categories.

## BOOKS

- *Sort It Out!* by Barbara Mariconda
- *Sorting at the Market (Acorn: Math Around Us)* by Tracey Steffora
- *Heads* by Matthew Van Fleet

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Math:

## Teddy Bears' Picnic



### LEARNING GUIDELINES

PreK-LS1-4: Use their five senses in their exploration and play to gather information.

*Counting is a basic math skill. This activity allows children to explore the basic concepts of numbers and counting by playing a picnic game.*

### MATERIALS

- \* Picnic cloth or blanket
- \* Plastic food
- \* Enough plastic dishes, glasses, and so on to create at least ten settings
- \* Two boxes or baskets to store food and dishes
- \* Stuffed animals, puppets, or dolls

## SETUP

- The goal of this activity is for children to learn about numbers and counting by playing a picnic game.
- Set up the “picnic” area by spreading the cloth on the table or floor. Have the two containers ready with the food and dishes.

## DO IT TOGETHER

- Sit down at the picnic area with your child, and talk about what you’d like to do. “How many friends (stuffed animals) should we have at our picnic?” If your child isn’t counting yet, have him pull the stuffed animals over and count them together 1, 2, 3 . . . as he shows you.
- Next, work together to put out settings. “How many plates will we need for everyone? There’s you and me, and our three friends.” If your child can count that out, let him do it. If not, count together again and tap each as you count 1, 2, 3, 4, 5!
- Let your child pick out the foods everyone will eat and put them on the plates. You can work numbers into every step of this activity—for example, “I would like two more pieces of cake. Can you get them for me, please? Oh, look! Three more bears have come to eat with us! How many more plates do we need to put out?”
- It’s good to have a lot of place settings so you can work up to the number 10 in different ways during the game. “Wow! Now we have ten friends at our picnic! Let’s see how many pieces of fruit are in the basket to give them. Oh, one strawberry, two oranges,” and so on. Let your child take the lead as much as possible with counting out and serving so he can physically handle the items. This will help him understand the relationship between numbers and what they stand for.

## DO MORE OF IT!

- **Story Time Math.** Choose one of the books below (or another counting/food book) to borrow from your library or purchase, and enjoy a read-aloud story time with your child. Have some of the picnic or other food props on hand, and as you read the book together you can count out the foods into a basket (as in the book *Feast for Ten*), or do any of the other activities in the book together. You can even do this in your kitchen and have your child locate the real items to bring over and be part of the story. This is also a super interactive way for you and your child to combine literacy, imaginary play, and learning numbers.

## BOOKS

- *One Hungry Monster: A Counting Book in Rhyme* by Susan Heyboer O’Keefe
- *Feast for Ten* by Cathryn Falwell
- *Piglet’s Picnic: A Story about Food and Counting* by Jessica Souhami
- *The Teddy Bears’ Picnic* by Jimmy Kennedy

## OTHER RESOURCES

- Visit your local library.
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).
- Visit your local museum, nature center, zoo, or aquarium.
- Check out Brain Building Zones for local events in Massachusetts at <http://brainbuildinginprogress.org/event-calendar>.
- Check out [www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org) and [www.peepandthebigwideworld.org](http://www.peepandthebigwideworld.org).

# Appendix

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## WHAT'S IN THE KIT?

The following materials are included in the STEM Family Activities Kit:

- \* **Magnet wands**
- \* **Paper clips**
- \* **Magnifying glasses**
- \* **Exploring baggie**
- \* **Sound bottles**
- \* **Smell bottles**
- \* **Color Paddles**
- \* **Flashlights**
- \* **Straws and straw bubble blowers**
- \* **Scissors**
- \* **Eye Droppers**
- \* **Mouse Paint by Ellen Stoll Walsh**
- \* **Flash drive that includes the STEM workbook, activity sheets, family tip sheets, and videos**

If you need to purchase additional materials, check out your local dollar store or other inexpensive retail outlet. The following websites also carry most of the items listed above:

<http://www.lakeshorelearning.com/>

<http://www.orientaltrading.com/>

<http://www.usplastic.com/>

<http://www.amazon.com/>

# Massachusetts STEM Standards

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## **Glossary of Terms**

### **EARTH AND SPACE SCIENCES**

The Earth and Space Sciences describe the properties of the earth, ocean, atmosphere, and universe (what things are called; what they do; how they look, act, and react to various stimuli). It includes geology and astronomy. Observe and describe or represent scientific phenomena meaningful to children's lives that have a repeating pattern.

### **INQUIRY SKILLS**

Record observations and share ideas through simple forms of representation such as drawings.

### **LIFE SCIENCES**

The Life Sciences include the study of living things (what they are, how they survive, their life cycles, how they change). Young children need concrete experiences that enable them to observe, categorize, compare, and contrast living things. The three major components of the life sciences are biology, physiology, and ecology. Observe and describe seasonal changes in plants, animals and their personal lives.

### **MATHEMATICS**

Explore and describe a wide variety of concrete objects by their attributes.

MA Curriculum Frameworks for Mathematics can be found here: <http://www.doe.mass.edu/frameworks/math/0311.pdf> pages 21-25.

### **PHYSICAL SCIENCES**

The Physical Sciences investigate natural forces and the basic elements in natural substances. Investigate and describe or demonstrate various ways the objects can move.

### **TECHNOLOGY AND ENGINEERING**

Demonstrate and explain the safe and proper use of tools and materials.

The Guidelines for Preschool Learning Experiences

The Guidelines for Preschool Learning Experiences are based on the standards for prekindergarten and kindergarten (or prekindergarten through grade 4) in the approved revisions of the Massachusetts Curriculum Frameworks. It is commonly referred to as "The Green Book". It can be found online at [http://www.eec.state.ma.us/docs1/curriculum/20030401\\_preschool\\_early\\_learning\\_guidelines.pdf](http://www.eec.state.ma.us/docs1/curriculum/20030401_preschool_early_learning_guidelines.pdf)

### **Pre-K Science, Technology and Engineering Standards from the MA Department of Early Care and Education**

The Pre-K Science and Technology/Engineering Standards (STE) are based on the Next Generation Science Standards. The Pre-K (STE) standards for preschool children, ages 2 years and 9 months through 5 years old, are the highest quality early learning and development standards for young children that articulate multi-domain expectations for children's growth and support continuity in early education from birth through kindergarten. At the same time, these early learning and development standards will provide a foundation for creating learning and growth opportunities for children across all communities and families and across both informal and formal environments. Find them here: <http://www.mass.gov/edu/docs/eec/2013/20131009-pk-sci-tech-standards.pdf>

# Earth and Space Sciences

<b>PreK-ESS1. Earth's Place in the Universe</b>	
<b>PreK-ESS1-1. Demonstrate awareness that the moon can be seen in the daytime and at night, and of the different apparent shapes of the moon over a month.</b> [Assessment Boundary: Assessment does not include names for moon phases or sequencing moon phases.]	
<b>PreK-ESS1-2. Observe and use evidence to describe that the sun is in different places in the sky during the day.</b>	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> .	
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>
<b>Asking Questions and Solving Problems/Designing Things (Engineering)</b> <ul style="list-style-type: none"> <li>Observe and ask questions about observable phenomena (objects, materials, organisms or events). (PreK-ESS1-1), (PreK-ESS1-2)</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Look for and describe patterns and relationships. (PreK-ESS1-2)</li> </ul>	<b>ESS1.A: The Universe and Its Stars</b> <ul style="list-style-type: none"> <li>Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (PreK-ESS1-1, PreK-ESS1-2)</li> </ul>
<i>Connections to other DCIs in pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i>	
<i>ELA/Literacy – Mathematics- shapes</i>	

<b>PreK-ESS2. Earth's Systems</b>	
<b>PreK-ESS2-1. Raise questions and engage in discussions about how different types of local environments (including water) provide homes for different kinds of living things.</b>	
<b>PreK-ESS2-2. Observe and classify non-living materials, natural and human made, in their local environment.</b>	
<b>PreK-ESS2-3. Explore and describe different places water is found in the local environment.</b>	
<b>PreK-ESS2-4. Use simple instruments to collect and record data on elements of daily weather, including sun or clouds, wind, snow or rain, and higher or lower temperature.</b>	
<b>PreK-ESS2-5. Describe how local weather changes from day to day and over the seasons and recognize patterns in those changes.</b> [Clarification Statement: Descriptions of the weather can include sunny, cloudy, rainy, warm, windy, and snowy.]	
<b>PreK-ESS2-6. Understand the impact of weather on living things.</b> [Clarification statement: Make connections between the weather and what they wear and can do and the weather and the needs of plants and animals for water and shelter.]	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> .	
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>
<b>Asking Questions and Solving Problems/Designing Things (Engineering)</b> <ul style="list-style-type: none"> <li>Observe and ask questions about observable phenomena (objects, materials, organisms or events). (PreK-ESS2-1)</li> </ul> <b>Planning and Carrying Out Investigations</b> <ul style="list-style-type: none"> <li>Use their senses and simple tools to observe, gather, and record data (e.g., dictate, draw, photograph, write). (PreK-ESS2-2), (PreK-ESS2-3), (PreK-ESS2-4)</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Look for and describe patterns and relationships. (PreK-ESS2-5)</li> </ul> <b>Make Meaning from Experience and Data</b> <ul style="list-style-type: none"> <li>Apply their ideas to new situations (PreK-ESS2-6)</li> </ul>	<b>ESS2.A: Earth Materials and Systems</b> <ul style="list-style-type: none"> <li>The materials on the land, provide homes for living things. (PreK-ESS2-1)</li> </ul> <b>ESS2.B: Plate Tectonics and Large-Scale System Interactions</b> <ul style="list-style-type: none"> <li>Rocks, soils, and sand are present in most areas where plants and animals live. There may also be rivers, streams, lakes, and ponds. (PreK-ESS2-2)</li> </ul> <b>ESS2.C: The Roles of Water in Earth's Surface Processes</b> <ul style="list-style-type: none"> <li>Water is found in the ocean, rivers, lakes, and ponds. (PreK-ESS2-3)</li> </ul> <b>ESS2.D: Weather and Climate</b> <ul style="list-style-type: none"> <li>Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (PreK-ESS2-4), (PreK-ESS2-5)</li> </ul>
<i>Connections to other DCIs in Pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i>	
<i>ELA/Literacy – Data recording</i>	
<i>Mathematics: measurement of temperature</i>	

<b>PreK-ESS3. Earth and Human Activity</b>	
<b>PreK-ESS3-1. Engage in discussion and raise questions using examples about local resources, (including soil and water) humans use to meet their needs.</b>	
<b>PreK-ESS3-2. Observe and discuss the impact of people's activities on the local environment.</b>	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> .	
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>
<b>Engaging in Discussion/Argument from Evidence</b> <ul style="list-style-type: none"> <li>Engage in discussion before, during and after investigations. (PreK-ESS3-1), (PreK-ESS3-2)</li> </ul> <b>Obtain, Evaluate, and Talk About Information</b> <ul style="list-style-type: none"> <li>Use first hand interaction with objects and organisms, media, and books to gather information. (PreK-ESS3-2)</li> </ul>	<b>ESS3.A: Natural Resources</b> <ul style="list-style-type: none"> <li>Living things need water, air, and resources from the land, and they try to live in places that have the things they need. Humans use natural resources for everything they do: for example, they use soil and water to grow food, wood to burn to provide heat and clay and wood to build shelters. (PreK-ESS3-1)</li> </ul> <b>ESS3.C: Human Impacts on Earth Systems</b> <ul style="list-style-type: none"> <li>Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things—for example, by reducing trash through reuse and recycling. (PreK-ESS3-2)</li> </ul>
<i>Connections to other DCIs in Pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i>	
<i>ELA/Literacy – Mathematics-</i>	

# Life Science

PreK-LS1 From Molecules to Organisms: Structures and Processes	
<b>PreK-LS1-1.</b>	<b>Compare, using descriptions and drawings, the external body parts of animals (including humans) and plants and explain functions of some of the observable body parts.</b> [Clarification Statement: Examples can include comparison of humans having two legs and horses four, but both use legs to move.]
<b>PreK-LS1-2.</b>	<b>Recognize that all plants and animals grow and change over time</b>
<b>PreK-LS1-3.</b>	<b>Explain that most animals have 5 senses they use to gather information about the world around them.</b>
<b>PreK-LS1-4.</b>	<b>Use their five senses in their exploration and play to gather information.</b>
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>
<b>Developing and Using Models</b> <ul style="list-style-type: none"> <li>Represent (e.g., draw, use blocks, use clay, make a collage) findings. (PreK-LS1-1)</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Look for and describe patterns and relationships (PreK-LS1-2, PreK-LS1-3,)</li> </ul> <b>Obtaining, Evaluating, and Talking about Information</b> <ul style="list-style-type: none"> <li>Document experiences and thinking to communicate with others. (PreK-LS1-4)</li> </ul> <b>Planning and Carrying Out Investigations</b> <ul style="list-style-type: none"> <li>Use their senses and simple tools to observe, gather, and record data (e.g., dictate, draw, photograph, write). (PreK-LS1-4)</li> </ul>	<b>LS1.A: Structure and Function</b> <ul style="list-style-type: none"> <li>All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive, grow, and produce more plants. (PreK-LS1-1)</li> </ul> <b>LS1.B: Growth and Development of Organisms</b> <ul style="list-style-type: none"> <li>Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. (PreK-LS1-2, PreK-LS1-3)</li> </ul> <b>LS1.D: Information Processing</b> <ul style="list-style-type: none"> <li>Animals have body parts that capture and convey different kinds of information needed for growth and survival-for example, eyes for light, ears for sounds, and skin for temperature or touch. (PreK-LS1-4) (PreK-LS1-5)</li> </ul>
<i>Connections to other DCIs in Pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i> ELA/Literacy – Mathematics - sequencing	

PreK-LS2 Ecosystems: Interactions, Energy, and Dynamics	
<b>PreK-LS2-1.</b>	<b>Use evidence from animals and plants to define several characteristics of living things that distinguish them from non-living things.</b>
<b>PreK-LS2-2.</b>	<b>Using evidence from the local environment explain how familiar plants and animals meet their needs where they live.</b> [Clarification statement: <b>Basic needs include water, food, air, shelter, and, for most plants, light. Examples of evidence can include squirrels gathering nuts for the winter and plants growing in the presence of sun and water. The local environment includes the area around the student’s school, home, or adjacent community.</b> ]
<b>PreK-LS2-3</b>	<b>Give examples from the local environment of how animals and plants are dependent on one another to meet their basic needs.</b>
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>
<b>Engaging in Discussion/Argument from Evidence</b> <ul style="list-style-type: none"> <li>Support thinking with evidence. (PreK-LS2-1)</li> <li>Engage in discussion before, during, and after investigations</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Construct theories based in experience about what might be going on. (PreK-LS2-2)</li> <li>Look for and describe patterns and relationships (PreK-LS2-3)</li> </ul>	<b>LS2.A: Interdependent Relationships in Ecosystems</b> <ul style="list-style-type: none"> <li>Animals depend on their surroundings to get what they need, including food, water, shelter, and a favorable temperature. Animals depend on plants or other animals for food. Plants depend on air, water, minerals (in the soil), and light to grow. Animals can move around, but plants cannot, and they often depend on animals for pollination or to move their seeds around. Different plants survive better in different settings because they have varied needs for water, minerals, and sunlight. (Pre-K LS2-1, PreK-LS2-2, PreK-LS2-3)</li> </ul> <b>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</b> <ul style="list-style-type: none"> <li>Organisms obtain the materials they need to grow and survive from the environment. (PreK-LS2-2, PreK-LS2-3)</li> </ul>
<i>Connections to other DCIs in Pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i> ELA/Literacy – Mathematics	

<b>PreK-LS3 Variation of Traits</b>	
<b>PreK-LS3-1. Use observations to explain that young plants and animals are like but not exactly like their parents. [Clarification statement: Examples of observations include puppies that look similar but not exactly the same as their parents.]</b>	
<b>PreK-LS3-2. Use observation to recognize differences and similarities among themselves and their friends.</b>	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> .	
<b>Science and Engineering Practices</b> <b>Engaging in Discussion/Argument from Evidence</b> <ul style="list-style-type: none"> <li>Support thinking with evidence. (PreK-LS3-1)</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Look for and describe patterns and relationships (PreK-LS3-1, PreK-LS3-2)</li> </ul>	<b>Disciplinary Core Ideas</b> <b>LS3.A: Inheritance of Traits</b> <ul style="list-style-type: none"> <li>Young animals are very much, but not exactly, like their parents and also resemble other animals of the same kind. (PreK-LS3-1)</li> </ul>
<i>Connections to other DCIs in Pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i> ELA/Literacy – ELA - Mathematics	

## Physical Sciences

<b>PreK-PS1. Matter and Its Interactions</b>	
<b>PreK-PS1-1. Raise questions and investigate the differences between liquids and solids and develop awareness that a liquid can become a solid and vice versa.</b>	
<b>PreK-PS1-2. Investigate the natural and human-made natural and human-made objects, describe, compare, sort and classify objects based on observable physical characteristics, uses, and whether something is manufactured or occurs in nature.</b>	
<b>PreK-PS1-3. Differentiate between the properties of an object and those of the material of which it is made.</b>	
<b>PreK-PS1-4. Recognize through investigation that physical objects and materials can change under different circumstances. (Clarification statement: Changes include building up or breaking apart, mixing, dissolving, or changing state.)</b>	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> .	
<b>Science and Engineering Practices</b> <b>Asking Questions and Solving Problems/Designing Things (Engineering)</b> <ul style="list-style-type: none"> <li>Observe and ask questions about observable phenomena (objects, materials, organisms or events). (PreK-PS1-1)</li> </ul> <b>Planning and Carrying Out Investigations</b> <ul style="list-style-type: none"> <li>Use their senses and simple tools to observe, gather, and record data. (PreK-PS1-2, PreK-PS1-3)</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions</b> <ul style="list-style-type: none"> <li>Construct theories based in experience about what might be going on. (PreK-PS1-1, PreK-PS1-4)</li> <li>Use evidence to support a theory or solution (PreK-PS1-1, PreK-PS1-4)</li> </ul>	<b>Disciplinary Core Ideas</b> <b>PS1.A: Structure and Properties of Matter</b> <ul style="list-style-type: none"> <li>Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. (PreK-PS1-1)</li> <li>Objects and materials can be described and classified by their observable properties (e.g., visual, aural, textural), by their uses, and by whether they occur naturally or are manufactured. Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces (e.g., blocks, construction sets). Objects or samples of a substance can be weighed, and their size can be described and measured. (Boundary: volume is introduced only for liquid measure.) (PreK-PS1-2), (PreK-PS1-3)</li> </ul> <b>PS1.B: Chemical Reactions</b> <ul style="list-style-type: none"> <li>Materials and objects can change under different circumstances. Sometimes these changes are reversible (e.g., melting and freezing, taking something apart and putting it back together), and sometimes they are not (e.g., baking a cake, burning fuel, mixing certain substances.) (PreK-PS1-4)</li> </ul>
<i>Connections to other DCIs in Pre-K:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i> ELA/Literacy – Mathematics -	

<b>PreK-PS2. Motion and Stability: Forces and Interactions</b>	
<b>PreK-PS2-1. Using evidence, discuss ideas about what is making something move the way it does and how some movements can be controlled.</b>	
<b>PreK-PS2-2. Through experience, develop awareness of factors that influence whether things stand or fall.</b> (Clarification statement: Examples of factors in children’s construction play include using a broad foundation when building,, considering the strength of materials, and using balanced weight distribution in a block building.)	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	
<b>Science and Engineering Practices</b> <b>Engaging in Discussion/Argument from Evidence</b> <ul style="list-style-type: none"> <li>Engage in discussion before, during and after investigations (PreK- PS4-1)</li> <li>Support thinking with evidence. (PreK-PS2-1)</li> </ul> <b>Planning and Carrying Out Investigations</b> <ul style="list-style-type: none"> <li>Plan and implement investigations using simple equipment; designing/building a solution to a problem. (PreK-PS2-1, PreK-PS2-2),</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Look for and describe patterns and relationships (PreK-PS2-2)</li> </ul>	<b>Disciplinary Core Ideas</b> <b>PS2.A: Forces and Motion</b> <ul style="list-style-type: none"> <li>Objects pull or push each other when they collide or are connected. Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (PreK-PS2-1), (PreK-PS2-2)</li> </ul> <b>PS2.B: Types of Interactions</b> <ul style="list-style-type: none"> <li>When objects touch or collide, they push on one another and can change motion or shape. (PreK-PS2-2)</li> </ul>
<i>Connections to other DCIs in PreK:</i>	
<i>Articulation of DCIs across grade-bands:</i>	

<b>PreK-PS4. Waves and Their Applications in Technologies for Information Transfer</b>	
<b>PreK-PS4-1. Investigate different sounds made by different objects and different materials and reason discuss explanations about what is causing the sounds. Through play and investigations, identify ways to manipulate different objects and materials that make sound to change volume and pitch.</b>	
<b>PreK-PS4-2. Connect daily experience and investigations to demonstrate the relationships between the size and shape of shadows, the objects creating the shadow, and the light source.</b>	
The performance expectations above were developed using the following elements from the NRC document <i>A Framework for K-12 Science Education</i> :	
<b>Science and Engineering Practices</b> <b>Planning and Carrying Out Investigations</b> <ul style="list-style-type: none"> <li>Plan and implement investigations using simple equipment; designing/building a solution to a problem. (PreK-PS4-1)</li> <li>Using their senses and simple tools to observe, gather and record data. (PreK-PS4-1, PreK-PS4-2)</li> </ul> <b>Engaging in Discussion/Argument from Evidence</b> <ul style="list-style-type: none"> <li>Engaging in discussion before, during, and after investigations PreK-PS4-1)</li> </ul> <b>Constructing Explanations/Theories and Evaluating Solutions (Engineering)</b> <ul style="list-style-type: none"> <li>Construct theories based in experience about what might be going on. (PreK-PS4-2)</li> </ul>	<b>Disciplinary Core Ideas</b> <b>PS4.A: Wave Properties</b> <ul style="list-style-type: none"> <li>Sound can make matter vibrate, and vibrating matter can make sound. Different objects and materials make different sounds. The pitch and volume of sound can be changed. (PreK-PS4-1), (PreK-PS4-2)</li> </ul> <b>PS2.B: Electromagnetic Radiation</b> <ul style="list-style-type: none"> <li>Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them (i.e., on the other side from the light source), where the light cannot reach. The size and shape of a shadow depend on several factors(i.e. the orientation of the object, the location of the light source, and the distances between light source, object, and shadow. (PreK-PS4-3), (PreK-PS4-4)</li> </ul>
<i>Connections to other DCIs in first grade:</i>	
<i>Articulation of DCIs across grade-bands:</i>	
<i>Common Core State Standards Connections:</i> <i>ELA/Literacy –</i> <i>Mathematics –</i>	

# Crosswalk between the 2013 Prekindergarten Standards in Science, Technology and Engineering and the

## *Guidelines for Preschool Learning Experiences*

**Instructions:** On the left side of the page (Column 1) are the new pre-kindergarten Science, Technology, and Engineering Standards. The guideline(s) for curriculum and instruction from the Guidelines for Preschool Learning Experiences (Guidelines, 2003) are listed on the right (Column 2).

To use this crosswalk, refer to the activities listed under that guideline in the Guidelines. Some activities will be more appropriate to the new pre-k standard than some others. In particular, some activities do not reflect the use of inquiry practices as indicated in the new standards. Teachers are encouraged to design learning experiences that support children’s use of the practices in the standards and to embed these activities in larger curriculum themes and projects that are meaningful and interesting to the children in a particular class.

<b>MA PRE-K SCIENCE, TECHNOLOGY AND ENGINEERING STANDARDS</b>	<b>LEARNING GUIDELINES FOR PRESCHOOL LEARNING EXPERIENCES (THE “GREEN BOOK”)</b>
<b>Earth and Space Sciences</b>	<b>Earth and Space Sciences</b>
ESS1-1. Demonstrate awareness that the moon can be seen in the daytime and at night, and of the different apparent shapes of the moon over a month.	9. Observe and describe or represent scientific phenomena meaningful to children’s lives that have a repeating pattern (e.g., day and night).
ESS1-2. Observe and use evidence to describe that the sun is in different places in the sky during the day.	8. Explore sunlight and shadows and describe the effects of the sun or sunlight. 9. Observe and describe or represent scientific phenomena meaningful to children’s lives that have a repeating pattern (e.g., day and night).
ESS2-1. Raise questions and engage in discussions about how different types of local environments (including water) provide homes for different kinds of living things.	1. Ask and seek out answers to questions about objects and events with the assistance of interested adults. 17. Observe and describe how natural habitats provide for the basic needs of plants and animals with respect to shelter, food, water, air, and light.
ESS2-2. Observe and classify non-living materials, natural and human made, in their local environment.	5. Compare and contrast natural materials such as water, rocks, soil, and living organisms using descriptive language.
ESS2-3. Explore and describe different places water is found in the local environment.	5. Compare and contrast natural materials such as water, rocks, soil, and living organisms using descriptive language.
ESS2-4. Use simple instruments to collect and record data on elements of daily weather, including sun or clouds, wind, snow or rain, and higher or lower temperature.	3. Identify and use simple tools appropriately to extend observations. 4. Record observations and share ideas through simple forms of representation such as drawings. 7. Identify the characteristics of local weather based on first-hand observations. 24. Demonstrate and explain the safe and proper use of tools and materials.
ESS2-5. Describe how local weather changes from day to day and over the seasons and recognize patterns in those changes.	7. Identify the characteristics of local weather based on first-hand observations.
ESS2-6. Understand the impact of weather on living things.	16. Observe and describe seasonal changes in plants, animals and their personal lives.
ESS3-1. Engage in discussion and raise questions using examples about local resources, (including soil and water) humans use to meet their needs.	23. Explore and describe a wide variety of natural and man-made materials through sensory experiences.
ESS3-2. Observe and discuss the impact of people’s activities on the local environment.	

Life Sciences	Life Sciences and Living Things in Their Environment
LS1-1. Compare, using descriptions and drawings, the external body parts of animals (including humans) and plants and explain functions of some of the observable body parts.	10. Observe and identify the characteristics and needs of living things: humans, animals and plants. 26. Observe and describe ways that animals, birds, and insects use various parts of their bodies to accomplish certain tasks and compare them to ways people would accomplish a similar task.
LS1-2. Recognize that all plants and animals grow and change over time.	12. Observe and describe plants, insects, and animals (sic) as they go through predictable life cycles.
LS1-3. Explain that most animals have 5 senses they use to gather information about the world around them.	
LS1-4. Use their five senses in their exploration and play to gather information.	15. Use their senses of sight, hearing, touch, smell and taste to explore their environment using sensory vocabulary.
LS2-1. Use evidence from animals and plants to define several characteristics of living things that distinguish them from non-living things.	11. Investigate, describe, and compare the characteristics that differentiate living from non-living things.
LS2-2. Using evidence from the local environment explain how familiar plants and animals meet their needs where they live.	17. Observe and describe how natural habitats provide for the basic needs of plants and animals with respect to shelter, food, water, air, and light.
LS2-3. Give examples from the local environment of how animals and plants are dependent on one another to meet their basic needs.	17. Observe and describe how natural habitats provide for the basic needs of plants and animals with respect to shelter, food, water, air, and light.
LS3-1. Use observations to explain that young plants and animals are like but not exactly like their parents.	13. Observe and describe ways in which many plants and animals closely resemble their parents in observed appearance.
LS3-2. Use observation to recognize differences and similarities among themselves and their friends.	

Physical Science	Physical Science
PS1-1. Raise questions and investigate the differences between liquids and solids and develop awareness that a liquid can become a solid and vice versa.	19. Explore, describe, and compare the properties of liquids and solids found in children's daily environment. 1. Ask and seek out answers to questions about objects and events with the assistance of interested adults.
PS1-2. Investigate natural and human-made objects; describe, compare, sort and classify objects based on observable physical characteristics, uses, and whether something is manufactured or occurs in nature.	18. Manipulate a wide variety of familiar and unfamiliar objects to observe, describe, and compare their properties using appropriate language
PS1-3. Differentiate between the properties of an object and those of the material of which it is made.	
PS1-4. Recognize through investigation that physical objects and materials can change under different circumstances.	2. Make predictions about changes in materials or objects based on past experience.
PS2-1. Using evidence, discuss ideas about what is making something move the way it does and how some movements can be controlled.	20. Investigate and describe or demonstrate various ways that objects can move. 21. Explore and describe various actions that can change an object's motion such as pulling, pushing, twisting, rolling, and throwing.
PS2-2. Through experience, develop awareness of factors that influence whether things stand or fall.	22. Experiment with a variety of objects to determine when the objects can stand and ways that objects can be balanced.
PS4-1. Investigate different sounds made by different objects and different materials and reasonably discuss explanations about what is causing the sounds. Through play and investigations, identify ways to manipulate different objects and materials that make sound to change volume and pitch.	
PS4-2. Connect daily experience and investigations to demonstrate the relationships between the size and shape of shadows, the objects creating the shadow, and the light source.	

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## WEBSITES

Boston Children's Museum

[www.bostonchildrensmuseum.org/learning-resources/race-to-the-top](http://www.bostonchildrensmuseum.org/learning-resources/race-to-the-top)

Brain Building in Progress public service campaign (United Way of Massachusetts Bay and Merrimack Valley <http://brainbuildinginprogress.org>)

Department of Early Education and Care

[www.mass.gov/edu/government/departments-and-boards/departments-of-early-education-and-care](http://www.mass.gov/edu/government/departments-and-boards/departments-of-early-education-and-care)

WGBH

[www.pbs.org/parents/child-development](http://www.pbs.org/parents/child-development)

[www.pbs.org/parents/education/science](http://www.pbs.org/parents/education/science)

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[www.resourcesforearlylearning.org](http://www.resourcesforearlylearning.org)

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