

Investing in School Readiness

Building STEM Connections in Early Childhood

INTRODUCTION

Young children naturally and actively explore their surroundings; they are curious, eager to make discoveries and learn about the world around them. They are budding scientists who question, investigate, and develop possibilities about what they see and hear. Their exploration and active engagement build knowledge, create meaningful experiences, and help them develop the skills for life-long learning and problem-solving. As they continue to question, hypothesize and test, children build their skills in Science, Technology, Engineering, and Mathematics (STEM).

STEM not only refers to four individual disciplines, it also refers to how these fields connect. As a concept, STEM represents an active and engaging way of thinking and learning that promotes creativity and innovation. Central to STEM is the understanding that children reason, predict, hypothesize, and solve problems through their interactions with real things in their own lives. Immersing young children in STEM opportunities encourages children's natural curiosity, and introduces them to new ways of thinking and doing.

Interest in STEM continues to grow as educators, policy makers, scientists, and business leaders consider the skills our country requires for success in the years ahead.

Today:

- Education leaders are exploring possible gaps in math achievement and science innovation that may be due to a lack of experiences offered to young children in the United States;
- Policy makers and business leaders are focusing on the continued competitiveness of the United States workforce in the global economy;
- Communities increasingly recognize the importance of ensuring that all students, regardless of family education or income level, have the opportunity to actively engage in STEM enrichment to master skills essential to future career success; and
- Members of the Maker Movement, thousands of independent inventors and do-it-yourself tinkerers, are creating unique and sophisticated devices using internet resources and recycled materials.

In recent years, there has been considerable discussion about incorporating other disciplines, including the arts (STEAM) and reading (STREAM) under the STEM umbrella. It has been suggested that the integration of these additional disciplines inspire the use of more creative, hands-on methods and increase children's interest in STEM. Because engaging the whole child is a foundation of early learning, it is important that young children's experiences are integrated and aligned and that the arts and early literacy are incorporated into STEM activities. Creative engagement helps cement basic STEM concepts in developmentally appropriate ways best suited to young children – ways that will help them spark, connect, and retain a lifelong passion for learning and build a strong basis for future success in school and a career.

Approaching STEM subjects creatively and ensuring they are introduced in ways that have real world relevance is an essential strategy in early childhood education. It is, ideally, an equally powerful strategy to carry forward into K-12 and beyond, to captivate and retain a growing cadre of STEM-fluent professionals in the future workforce.





What are the benefits of STEM education for young children?

Early childhood is the perfect time to develop science skills. Young children are natural scientists and engineers who learn through play and use their innate curiosity to explore new things. When STEM education starts early, it taps into children's inclination to investigate.

The open exploration and experimentation of a child's first years help to develop muscle coordination, sensory observations, and early thinking skills. When toddlers sort things into groups of the same color, size, shape or use, they observe and analyze attributes as well as grasp objects. When

young children pour sand and water into containers of different sizes or pile blocks into tall structures and see them fall, they develop an understanding of spatial relationships and how objects can be manipulated.

STEM activities provide young children with opportunities to see math and science in everyday play and help children build basic understanding and interest in continued learning. When children play with blocks or when they participate in dramatic play, cooking or outdoor activities, they repeat processes of estimating, measuring,

predicting, testing and determining how the world works. They also learn to think critically and ask thoughtful questions.

As children explore and discover their world, they learn to process information more efficiently. STEM activities invite children to seek answers to questions and solve problems essential to development of 21st Century skills – critical thinking, collaboration and communication. These practices help to develop children's executive functions by encouraging their ability to focus, recall previous learning, and consider alternate perspectives.

Preparing a competent workforce for the 21st Century workplace requires STEM literacy. Key concepts and skills (identifying and solving problems, comparing and contrasting) as well as a variety of practices (observing, predicting, hypothesizing, and communicating) influence STEM learning. Together, these are the building blocks for a lifetime of learning and creativity.

HOW TO USE THIS BOOKLET

This booklet is designed for use by early childhood educators in family child care, center-based and preschool settings, and for use by families interested in supporting their young children's innate curiosity and inclination for exploration and discovery. Sample activities are built around everyday interactions with young children, at home, with friends, outdoors, or in an early childhood education setting.

■ **Share a sense of wonder** – As adults engage with children, it is especially helpful to share their sense of wonder. Efforts to follow their discoveries and have back-and-forth conversations about their exploration will help them develop their understanding of the world around them.

■ **Act as a play partner** – In this role, adults have an opportunity to join in (“I wonder why this block tower keeps falling down?”) and to offer gentle guidance during playtime conversation.

■ **Explore together** – Remember that STEM learning in early childhood is more about the process of “finding out” than it is about memorizing specific content or scientific facts; children will learn facts over time as they observe, predict and experiment with objects around them.



Special Note for Educators

Early childhood educators facilitate children's learning through their knowledge, encouragement and support as they help children to make connections and creatively interact with objects and ideas. To effectively engage young children, educators need a knowledge of STEM concepts and the ability to link that knowledge to best practices. Keeping children engaged in an activity as well as in meaningful conversations and reflections is important.

Educators also are encouraged to use STEM language to guide children's ability to build STEM concepts and ways of thinking. For example, we can encourage children to:

- notice and describe what they are doing with water, sand, shadows, blocks, or other materials;
- elaborate on their comments by asking them, "What else can you do with...?"
- predict what might happen next in an activity or experiment;
- respond to open-ended questions using statements such as, "I wonder if...?", "I wonder how...?", "I wonder why...?";
- explain their plan to complete a project.

In doing so, we are building children's confidence in exploring new concepts that lay the foundation for continued STEM discovery and learning.



SCIENCE

Children are naturally interested in the world around them. They observe, ask questions about what they see, investigate, and try to predict what might happen next. Through simple activities, adults can help children develop a passion for exploration and discovery.



INFANTS AND TODDLERS:

- Give children safe objects with various textures and smells to explore.
- Help infants reach things that are interesting to touch, such as leaves on a tree.
- Show children new plants, animals and people during walks indoors or outside.
- Invite children to play with toys that respond to their actions, such as those that make sounds when pushed or pulled.

Experiences like these help infants and toddlers:

- Use their senses to explore objects.
- Recognize and name animals they have seen on their outings.
- Anticipate effects of actions or the responses of toys.

TWO AND THREE YEAR OLDS:

- Show children how objects and events are related, such as how a drop of food coloring makes a glass of water look different.
- Share books or catalogues with pictures of flowers or plants.
- Partner with children to care for a pet and discuss its growth.
- Make fruit juice popsicles and discuss how the cold temperature turns liquid into a solid.

Experiences like these help two and three year olds:

- Learn to ask questions about why things happen.
- Develop an appreciation for living things like plants and animals.
- Talk about what children observe during everyday activities.

FOUR AND FIVE YEAR OLDS:

- Encourage children to collect objects and compare their size, shape and color.
- Read books with children that describe changes in seasons, plants, and insects.
- Plant seeds in glass jars or clear plastic bags so children can observe and describe what happens as the roots, stems and leaves grow. Take photographs or invite children to make drawings to record the changes.
- Talk about the weather and how it might influence clothing choices.

Experiences like these help four and five year olds:

- Begin to develop procedures for investigating the world.
- Try to figure out answers to simple problems.
- Notice and describe patterns and changes in nature and real-life events.
- Use documentation to reflect on and communicate about their observations.

TECHNOLOGY

Children learn best through meaningful interactions with caring adults and peers. When used appropriately, technology can enhance these interactions and open new, dynamic learning opportunities for young children. Using technology in a variety of ways helps children broaden their understanding of technology as an effective tool with multiple uses.



INFANTS AND TODDLERS:

- Use E-books and print books to read and sing to babies and toddlers.
- Describe actions when using technology; for example, “I am going to click the button in the middle of the smartphone to open the web site.”
- Limit interaction with technology several hours before bedtime.

Experiences like these help infants and toddlers:

- Begin to learn the language and vocabulary associated with technology as well as the basic functions associated with devices.
- Learn that there are times of the day when screen use is limited, such as before bedtime or when adults are not present.

TWO AND THREE YEAR OLDS:

- Ask children open-ended questions (“What happened when you pushed that button?”)
- Use video chatting services to talk to family and friends in other locations.
- Take pictures of different shapes around the house.

Experiences like these help two and three year olds:

- Think critically about cause and effect.
- Become curious about how and why things happen.
- Engage in conversations with family and friends regardless of geographical distance.
- Learn to identify objects by shape (triangles, circles, squares).

FOUR AND FIVE YEAR OLDS:

- Watch a video with children. Talk about how the characters in the program felt and behaved in response to specific events.
- Encourage children to take pictures of places they visit. Look at the pictures together and talk about what happened, who was there, etc. Take pictures at the school where children will begin kindergarten. Talk about what they might see and do at the school.
- Find collaborative storytelling applications that allow children to select characters and work with friends to create and tell stories.

Experiences like these help four and five year olds:

- Engage in the creative process.
- Create their own media.
- Build language and observation skills.

ENGINEERING

Engineering activities encourage brain development as children solve problems, use varied materials, and design, create, and build things that work. Infants and toddlers build neural connections as they observe the world around them.



INFANTS AND TODDLERS:

- Talk to children about being “over” and “under” things as they are carried safely throughout their homes or on the playground.
- Encourage children to stack brightly colored foam bricks and knock them down.

Experiences like these help infants and toddlers:

- Learn about cause and effect.
- Learn about repeatable actions.
- Develop language skills.

TWO AND THREE YEAR OLDS:

- Offer foam blocks, cardboard boxes and connecting blocks to create structures.
- Provide recycling materials, such as empty plastic milk jugs and small boxes for children to build tall towers.
- Ask questions that require predictions: “Is the building balanced?” “Do you think it will stay up by itself?”

Experiences like these can help two and three year olds:

- Develop math and science skills.
- Learn about balance and problem-solving.
- Begin to explore gravity.

FOUR AND FIVE YEAR OLDS:

- Read the story of “The Three Little Pigs” to children. Build houses using different materials and encourage children to act out the story. As the wolf, ask the children to “blow the house down” using their breath, a hairdryer or fan.
- Compare what happens when rolling toy cars down cardboard ramps. Which car went the farthest? What happens when the ramp is raised higher?

Experiences like these can help four and five year olds:

- Build language and spatial skills.
- Explore properties of force, motion and speed.
- Practice making predictions, plans, and comparisons.

MATHEMATICS

Children may begin to show an interest in mathematical concepts before they take their first steps. Through simple daily activities, young children can learn about numbers and counting, space and size, shapes and patterns.



INFANTS AND TODDLERS:

- Arrange things in order from smallest to largest.
- Count buttons when getting dressed or count the number of crackers served as a snack.
- Use toys that allow children to sort shapes.
- Arrange toys or food in groups of “same” or “different.”

Experiences like these can help infants and toddlers:

- Learn to recognize patterns.
- Understand the concepts of “same” or “different.”
- Observe similarities and differences in size, color and shape.

TWO AND THREE YEAR OLDS:

- Count steps as you walk with children; count pieces of food as you put them on the plate.
- Invite children to help sort socks by color and size.
- Create a pattern by alternating pieces of art clay of different color, shape and size.
- Encourage children to compare groups of “more” and “less.”

Experiences like these help two and three year olds:

- Enjoy grouping similar objects together.
- Use beginning counting skills and concepts of number.
- Use math language to communicate.

FOUR AND FIVE YEAR OLDS:

- Discuss measurements as children follow a simple recipe.
- Play a simple tune on the piano. Ask children to clap out the beat.
- Encourage children to guess how many raisins will fill a cup. Then fill the cup with raisins to determine the actual number. Choose a different size cup and try the activity again.
- Display “data” using simple charts and graphs and ask, “Does our weather chart show more sunny or cloudy days?”

Experiences like these can help four and five year olds:

- Look for patterns and symmetry.
- Learn to count.
- Understand how to compare sizes and amounts.
- Learn to collect and interpret printed data.

RESOURCES

Children's Books

Bring STEM to life with books like these:

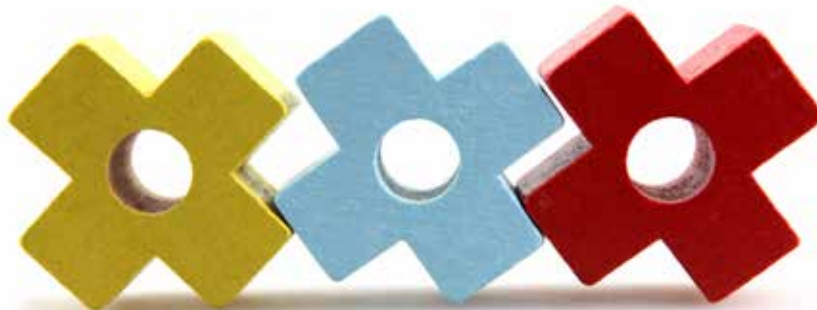
- Changes, Changes, by Pat Hutchins (Engineering)
- The Most Magnificent Thing by Ashley Spires (Engineering, Recycling)
- Dreaming Up: A Celebration of Building by Christy Hale (Engineering)
- Actual Size by Steve Jenkins (Life Science)
- If You Find a Rock by Peggy Christian (Earth Science)
- Green by Laura Vaccaro Seeger (Life Science)
- Shapes, Shapes, Shapes! by Tana Hoban (Geometry)
- Mrs. McTats and Her Houseful of Cats by Alyssa Satin Capucilli (Number Concepts)
- Sort It Out! by Barbara Mariconda (Early Math and Science)
- 10 Little Rubber Ducks by Eric Carle (Number Concepts)
- Blackout by John Rocco (Technology)
- Beautiful Oops! by Barney Saltzberg (Arts/Innovation)

Apps

Please visit Common Sense Media (<https://www.commonsensemedia.org/app-reviews>) for more information and reviews about the following apps:

- Tiny Hands Sorting (Engineering, Technology and Applications of Science)
Children sort familiar objects by size, shape and color. Ages 2+
- Toca Robot Lab (Engineering Science)
Children build a robot and send it through an interactive maze. Ages 2+
- Animals! Life Sciences Educational Games for Kids in Preschool and K (Life Science)
Learning facts about animals through a game of hide and seek. Ages 3+
- Build a Ship with Kate and Harry (Engineering, Technology and Applications of Science)
Mix and match boat parts to build a ship. Ages 3+

- Sid's Science Fair (Engineering, Technology and Applications of Science)
Teaches children how to analyze information with games that introduce sorting. Ages 3+
- Doodle Math: Shapes (Mathematics)
Children draw and experiment with shapes through activities and games. Ages 3+
- GazilliScience (Life Science, Living and Non-Living things)
Children explore various earth science concepts. Ages 3+
- Pettson's Inventions (Engineering Science)
Promotes critical thinking and problem-solving as children help characters complete their inventions. Ages 5+
- Presto Bingo Shapes (Geometry)
Based on the book, Shape Shift, children deconstruct animated puzzles, identifying shapes used to create each of the images.



For More Information:

- Fairfax County Office for Children
www.fairfaxcounty.gov/ofc
- Fairfax County Public Schools
www.fcps.edu
- Fairfax Futures
www.fairfax-futures.org



Investing in School Readiness

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