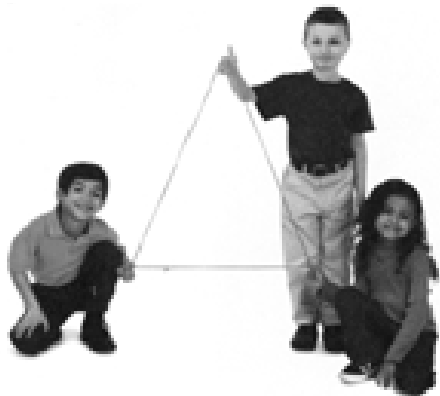


# Kindergarten: A Vital Component of Elementary Mathematics



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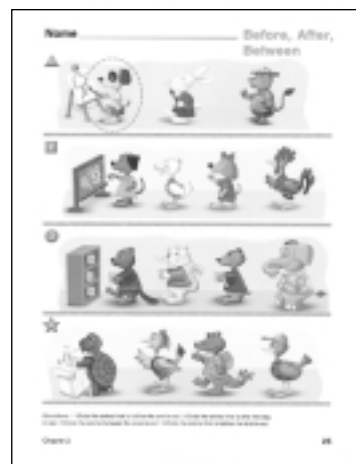
**D**ue to more rigorous national, state, and district standards, it has become imperative that mathematics educators begin laying a formative groundwork in kindergarten for concepts that will be more fully developed in subsequent grades. Additionally, international competition has also raised the stakes for improved educational standards in the U.S. It



has become increasingly important to get children thinking about, talking about, and using mathematics as part of the kindergarten curriculum.

## EARLY FOUNDATIONS HELP CHILDREN UNDERSTAND THE NATURE OF MATHEMATICS

Apart from these pressures, the argument for setting an early foundation for mathematical achievement before first grade is a sound one. Mathematics is a



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natural activity for children: kids demonstrate a great capacity for learning mathematics long before they enter school. Children entering kindergarten already have some basic understanding of mathematics, and teachers can build

upon that experience and encourage them to talk about it. As the authors of NCTM's *Principles and Standards for School Mathematics* point out, "Classifying and ordering are natural and interesting to children" (National Council of Teachers of Mathematics, 2000). Exploring mathematics can help kindergarten children satisfy and deepen their natural curiosity about the sizes, shapes, numbers, and relationships they encounter in the world.



**SHAPES IN NATURE: INTRODUCING YOUNG LEARNERS TO GEOMETRY**

Geometry provides young learners with a natural springboard for learning other mathematics concepts. Children begin forming spatial concepts early in their development. As children learn to navigate the three-dimensional world, they become aware of and curious about shapes, dimensions, and patterns, as well as paths and relationships between objects. Symmetrical shapes—present in nature and in manufactured objects and designs—provide a natural introduction to a discussion of equal parts. From symmetry, children can progress easily to the concept of halves, connecting shape with number. And working with halves in the classroom can help children learn the concept of sharing.

As children learn to recognize and describe geometric characteristics and relationships, teachers can reinforce these concepts through conversations, demonstrations, and stories. Using an example



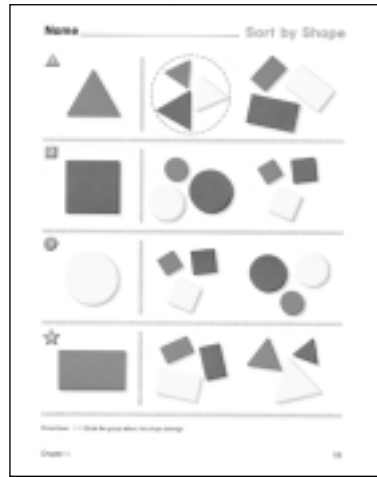
from NCTM’s *Standards*, “When students act out the story of the three billy goats and illustrate *over* and *under*, *near* and *far*, and *between*,

they are learning about location, space, and shape” (NCTM, 2000). In addition to shape, size, and proportion, exercises that teach position—who is first in line, last in line, and in the middle—start kindergartners thinking about ordinal numbers.

**THE BEGINNINGS OF ALGEBRA**

Children’s understanding of mathematical relationships develops gradually, so it is important to set the foundation early in kindergarten and

pre-kindergarten. As the authors of NCTM’s *Standards* suggest, “We need to view algebra as a strand in the curriculum from pre-K on to help students build a solid foundation of understanding and experience as a preparation for more sophisticated work” (NCTM, 2000).



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Sorting and classifying objects not only teaches children about attributes and relationships, but also promotes thinking logically and applying rules. Children can practice sorting by moving objects into different

groups based on observable characteristics such as size, shape, color, or number. Sorting and classifying exercises can also provide children with models for organizing things in the real world, such as putting blocks away or setting the table for dinner.

Similarly, paths and mazes, which are fun and interesting for children, are a good platform for teachers to extend young learners’ understanding of relative position in space. Concepts of distance and measurement become attainable for kindergartners once they begin to distinguish navigational directions such as *left* and *right*, *up* and *down*, and *forward* and *back*. Using visual exercises and three-dimensional models to reinforce these concepts in the kindergarten classroom lays the groundwork for using coordinates and graphing functions that will be formalized in later elementary grades and used later in algebra courses.

## START KINDERGARTNERS TALKING MATHEMATICS

When teachers present young learners with interesting mathematical problems and materials, including calculators and computers, children are encouraged to converse and learn. Kindergarten instructors can create and structure dynamic classroom environments that get young learners involved in mathematical dialogues. To do this effectively, teachers should try to

- Encourage children to explain their thinking
- Provide opportunities for children to discuss and share ideas
- Model and reinforce appropriate conventional vocabulary.

## ENCOURAGE CHILDREN TO EXPLAIN THEIR THINKING

Reasoning is an important part of kindergarten mathematics. To increase children's comfort level with talking about mathematics and to know what they are thinking, instructors need to listen carefully and encourage children to extend their responses, whether or not the logic is correct. When children are asked to explain their thinking to others through words, gestures, using models, or drawings, it can help them to organize their thoughts and correct their own errors. And teachers can clarify concepts



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by prompting kindergartners to complete and extend their thoughts, paraphrasing answers, and praising efforts.

Developing reasoning about mathematics helps children transition from imitation (i.e. doing something

because the teacher tells you to) to problem solving (i.e. doing something because it makes sense). "Teachers should help students recognize that all math can and should be understood" (NCTM, 2000). And such understanding promotes confidence. Young learners should be asked to explain their answers, and how they arrived at them. When children answer correctly, it is important that they understand why their answers are correct and that even correct answers need explanation. By explaining themselves, children learn how to apply reason and logic and build confidence in their ability to solve problems.

## PROVIDE OPPORTUNITIES FOR CHILDREN TO DISCUSS AND SHARE IDEAS



To make children comfortable with talking about mathematics, teachers can employ visual aids to clarify and develop the concepts. Graphs,

materials, and sets of objects should be used to visually represent a problem and get children to ask each other questions about it. To encourage children to participate, teachers should pose open-ended questions. They can provide model answers, then invite children to respond to similar questions. To involve children personally, it is helpful to talk about experiences to which they can relate, such as events that have happened in the classroom. Recording children's responses by name, on the board or in a chart, allows them to recognize their contributions. Reviewing their responses in this fashion helps children understand that their contributions to the classroom discussion matter, and provides teachers with an opportunity to discuss answers. When this is done regularly in small and large groups, children also learn to talk with and listen to their peers.

When helping kindergartners discuss and share their ideas, teachers need to accept and reinforce different representations of the same idea. In soliciting answers to open-ended questions, teachers can listen for a variety of answers and even different versions of the same answer. Problem-solving skills are developed along with reasoning and communication when children are prompted with questions like, “How do you know?,” “Why do you think so?,” “What’s another way to do this?,” “What more can we say about this?” In giving their explanations, young learners should not only be allowed to express themselves verbally but also act out, draw, use models, and write responses. Teachers themselves should model multiple forms of communication as well. For example, creative movement can help kindergartners illustrate a variety of concept words such as *above* and *below* and *higher* and *lower* using body language.

### MODEL AND REINFORCE APPROPRIATE CONVENTIONAL VOCABULARY

Language is as vital to building a mathematics foundation as it is to learning how to read. As children begin to talk about math, they will use their own vocabulary to describe objects and relationships. But while young learners should be encouraged to explain mathematical ideas in their own words, kindergarten teachers should also teach children the conventional math vocabulary they need to express and share ideas precisely. Learning and using correct terminology gives young learners a basis for acquiring and sharing knowledge and process. The ideas and the language of geometry, for example, are important to helping children form cognitive connections between concrete objects and abstract concepts. And adults need children to understand some special vocabulary so they can follow directions and engage in conversation.

Children should begin learning and using appropriate vocabulary from an early age so that they can express and clarify their ideas during classroom

discussions. When instructors model mathematically correct vocabulary consistently from kindergarten, young learners are better prepared to learn new concepts when that same vocabulary is reviewed and extended in subsequent grades.



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To further children’s communication skills, educators should encourage good school communication in the home. The more places children can gain exposure to good math language and understanding, the better. Educators can encourage parents and caretakers to support the child’s mathematical growth at home by

- Communicating to parents about classroom lessons and activities
- Asking family members to review and discuss math work sent home
- Sharing mathematical vocabulary that parents can reinforce with their children
- Suggesting exercises that parents can do with their children
- Offering recommendations for math-related children’s literature.

Kindergarten lays a vital foundation for children’s mathematics learning. Sound concepts, strong and useful skills, abilities to communicate mathematically, and positive attitudes can all be built through challenging curriculum, caring and knowledgeable teachers, and supportive families. Children are our future, and good mathematics education for all is a crucial part of a bright future!

### REFERENCES

- Kirkpatrick et al (2001). *Adding It Up: Helping Children Learn Mathematics*. Washington, D.C.: National Academies Press.
- NCTM (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.