George and Sophia are playing in the block center when Ms. Smith asks the 4-year-olds, “How many blocks are you playing with?” After hearing the children’s response, she says, “Let’s sort the blocks by shape and size, and count again.”

Once the children have finished sorting, Ms. Smith invites them to the water table: “Which of these blocks will sink, and which ones will float?”

The vignette above illustrates one way in which early childhood teachers may promote children’s thinking about math and science by integrating the two subjects into other areas of the classroom. Too often, math and science are treated as separate areas. As a result, children—and teachers—often view the two subjects as something different and apart. In reality, math and science pervade every aspect of our everyday lives. We can help correct this misperception by applying math and science concepts throughout daily activities.

**Preschool math and science**

In the preschool curriculum, math covers a broad range of concepts, including numbers and shapes (geometry). It uses a vocabulary with phrases such as *more than*, *less than*, and *equal to* as well as *in front, behind, inside, outside, near, and far*. Math also involves adding, taking away, weighing, measuring, graphing, and other skills.

Similarly, science activities pervade the early childhood curriculum studies, including nature (plants, animals, geology), cooking (chemistry), weather (wind, rain), and the environment (air, water, recycling), to name a few. It uses skills such as observing, comparing, predicting, and documenting. Much of science requires measuring (temperature, speed, time), which involves math. To put it another way, scientists need math to talk about what they do.

In integrating math and science concepts in the classroom, we need to make sure our objectives are measurable and rooted in the skills we want to teach children. One objective, for example, might be: “By the end of the week, children will identify and sort items by shape and color.” This objective is measurable because we can assess whether or not children can perform this task.

Of course, children grasp concepts and develop skills at different rates. If Charlie can’t quite sort triangle blocks from the squares and rectangles, we might offer the same activity in the art center with paper or fabric shapes, for example.

In addition, children learn best through experience and hands-on activities (Piaget 1964). If an objective for the week is to teach counting or sorting, children need actual opportunities to count and sort. At lunch, for example, a teacher might ask, “How many
The integration of math and science concepts throughout early childhood classrooms promotes children’s development in all domains: cognitive, social, emotional, and physical.

**Cognitive development**

Children develop cognitive skills, such as language and thinking, in a variety of hands-on activities, including those that involve math and science. For instance, if two children are playing with Legos, they are learning not only about shape and size but also the number of bricks needed to build a structure. Moreover, they learn how to problem solve by predicting how many bricks they can use to gain the greatest amount of height without the structure falling over.

At the same time, they may learn the concept of cause and effect. Hence, if a tower of Legos falls over, they discover that adding additional bricks (cause) makes the tower fall (effect). They can begin applying this concept in other activities. Forgetting to water a bean plant, for example, causes the leaves to wilt.

When planning an activity, a teacher may recognize that Karen has more knowledge or experience about a math or science concept than Heather. By pairing them, the teacher has the opportunity to set up a scaffolding experience. That is, the teacher is providing a chance for Karen to help Heather advance her knowledge. The area between what Heather knows now and what she could learn is what Vygotsky (1978) called the *zone of proximal development* and is an excellent way to boost a child’s learning.

**Social development**

Interacting with other children during play promotes the acquisition of social skills and enhances the ability to communicate with other children. During games such as hopscotch, for example, children learn the skill of counting as well as number recognition (Piaget 1964). If an issue arises in which children are not sure who has the next turn, they can engage in abstract thought and negotiation while communicating about who goes next in the game.

Similarly, when painting a mural together, children may talk about the size and shape of objects they are painting as well as lines, angles, and other math concepts. In the process, they may discuss how to mix different paint colors to arrive at the color they desire, thereby gaining a basic understanding of the science of color (mixing red and blue produces purple).

**Emotional development**

Healthy emotional development entails learning what emotions are, how to respond to one’s own as well as other children’s emotions, and how to control emotions. For example, if four children are playing a board game with a pair of dice, they learn to share the dice while also learning about numbers. As a result, they may learn to delay gratification and practice patience while others take their turns.

Teachers can assist children in emotional development by first identifying their own feelings. For instance, a teacher may say, “I feel really happy that you enjoyed the squash we cooked for lunch.” Or, “I’m so disappointed that it’s raining today because we were all looking forward to going on a nature walk.” Labeling the emotion may assist children with associating it to an actual event.
Another way to guide children in identifying emotions is to have an emotions chart with either line drawings or photographs of faces. Children can learn to identify their emotions by finding a similar facial expression on the chart. In addition, children can compare expressions (straight line or an upside down semi-circle), thus learning concepts such as “similar” and “different.”

Physical development

Physical development consists of gross and fine motor skills. Gross motor skills include large movements, such as running or kicking a ball. Teachers can incorporate math concepts by asking questions such as “How far can you throw a ball?” or “How high can you jump?” In addition, teachers can name muscles (bicep, calf), thereby helping children learn body parts and health science.

In comparison, fine motor skills entail small movements, such as picking up a small toy with two fingers. Teachers can add measuring cups to the sand table, for example, and ask children to estimate how many cups of sand it would take to fill a pitcher. Not only would this activity assist children with developing fine motor skills, but it would also assist them with estimating, predicting, and measuring.

Tips for the classroom

Early childhood teachers play essential roles in children’s lives, especially when considering their cognitive, social, emotional, and physical development. Teachers can adapt many activities to integrate math and science concepts. Here are some suggestions:

- **Plan activities that capture children’s natural interests.** For instance, if children enjoy learning about dinosaurs, create activities that will give a sense of the huge size of an Apatosaurus (formerly called Brontosaurus), such as using a yardstick to measure 70 to 90 feet along a fence (almost the length of a football field). Using this type of emergent curriculum is important for developing children’s sense of autonomy or independence.

- **Create a warm and welcoming social environment that fosters a sense of community within the classroom.** For example, embrace each child’s background by creating a photo wall that displays children’s families. On show-and-tell days, invite children to talk about their families. This can promote the concept of diversity among people and in all living things.

- **Encourage problem solving and abstract thought.** For instance, if studying dinosaurs, for example, teachers could introduce the topic by reading a book and inviting children to create artwork about specific types of dinosaurs. Teachers could extend the activity by creating a fictional archeological dig site with plastic dinosaurs in a sand table. Children could pretend they were archeologists for the day and match the dinosaurs to their photos in a book or online.

- **Label your emotions so that children will learn what emotions mean.** Emotions can have a place in math and science activities—sadness when a plant dies, for example, and excitement when discovering a bright red maple leaf. In turn, children will learn to associate the name of an emotion with a facial expression and behavior.

- **Integrate hands-on activities that promote children’s fine and gross motor skills.** An art project in which children tear strips of paper and paste them to construction paper, for example, helps children develop fine motor skills as well as numerical concepts such as length and width. Kicking a ball during outdoor play helps develop gross motor skills as well as concepts such as distance and direction. Activities like these could also promote social skills such as cooperation and teamwork.

Integrating math and science concepts in everyday activities enhances cognitive, social, emotional, and physical development, and thus their overall growth.
Skills and concepts that children learn while they are young will expand as they gain experience and knowledge over time.

References

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