



Hands-On Science and Math



Fun, Fascinating
Activities for
Young
Children



Beth R. Davis, EdS, NBCT

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for Young Children**

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Dedication

This book is dedicated to the loving, compassionate, and hardworking staff of Kids For Kids Academy. Your dedication to finding the gifts and talents in every child and your sense of teamwork are to be admired. You truly make a difference every day with every child and family you touch.

Acknowledgments

A special thanks to Sandra Phillips, my volunteer lab assistant, whose commitment to inspiring young minds has made a difference for so many young children. Thanks for helping me to instill a love of science in our little scientists at Kids For Kids Academy!

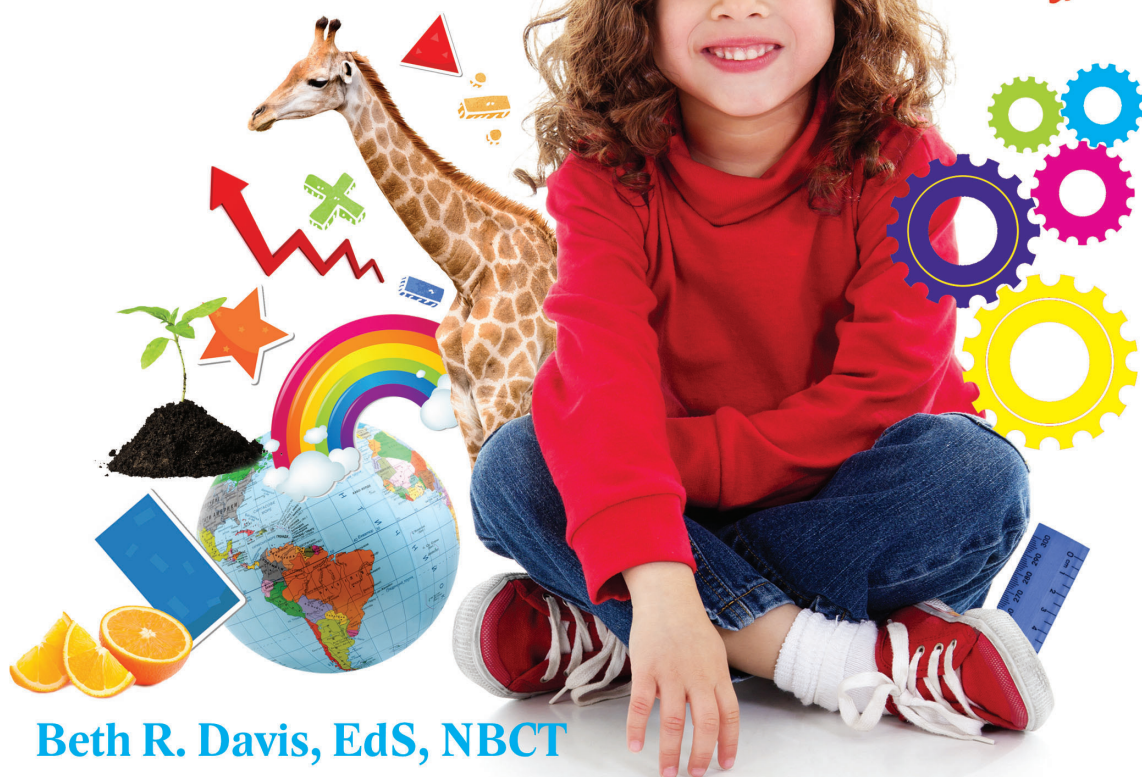
Finally, my love goes out to my parents, Reva, Marty, Richard, and Marcia; my children, Rebekah and Benjamin; and my dearest friends, Julie, Diana, Kim, and Alina, for always believing in me. Your love, encouragement, and support made it possible for me to turn my dream of publishing this book into a reality.



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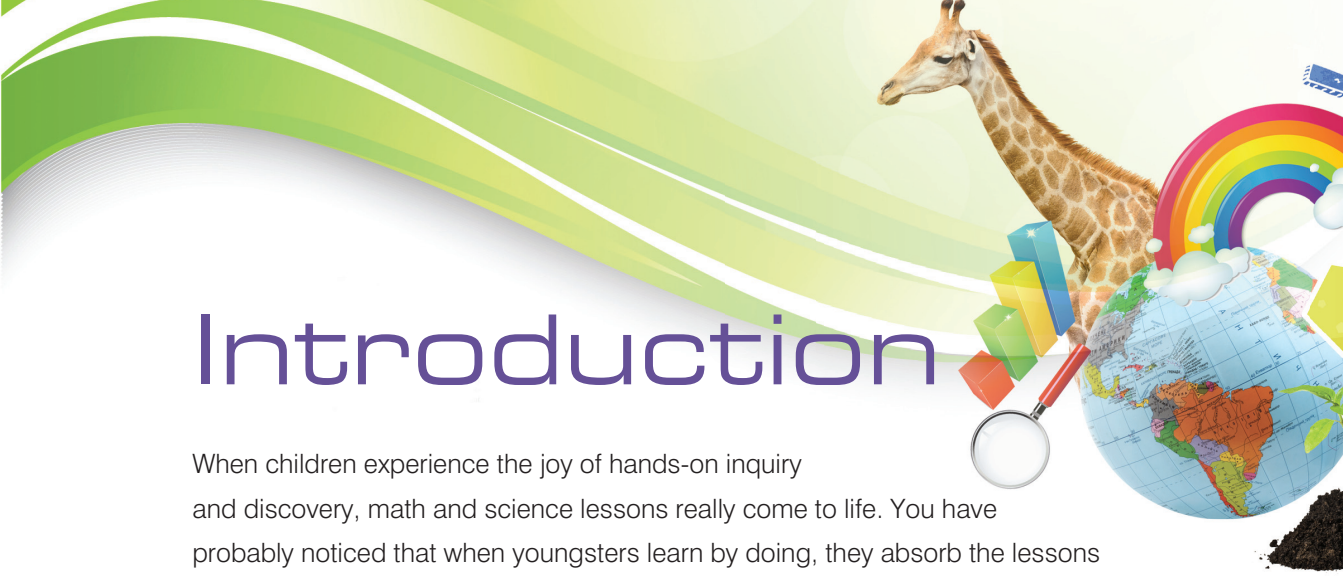
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Introduction

When children experience the joy of hands-on inquiry and discovery, math and science lessons really come to life. You have probably noticed that when youngsters learn by doing, they absorb the lessons in a lasting way. After a long day with the children, it is energizing when you see the lightbulb go off; you notice the excitement on their faces when they finally “get it” or make a new discovery.

The science and math activities contained in this book have been piloted and researched at Kids For Kids Academy in Miami, Florida, and have been successfully implemented in my school’s early childhood science lab using inexpensive and easy-to-find materials. The key concepts are based on my experience as a National Board certified teacher and are modeled after research I conducted in the science lab and in my classroom over a seventeen-year period. The focus of each activity is pre-K to grade two, but teachers can vary and extend the activities for older children.

In my research, published by Florida International University (in a book edited by Jill Farrell and Robert Vos), I found that children exposed to hands-on science instruction gain greater subject-matter understanding than students exposed to only book learning or traditional worksheets. When I doubled the amount of hands-on instruction given to the lowest-performing student population in an at-risk class at a Florida elementary school, these children showed the highest gains when compared with ten other classes made up of average and above-average students in the same elementary school.

The activities contained in this book have been used at Kids For Kids Academy preschool since 2006. Most of the voluntary pre-K students enrolled and exposed to these hands-on science activities have entered kindergarten prepared for success. Since its inception, Kids For Kids Academy students have achieved readiness ratings in the top 10 percent of preschool students in Miami–Dade County, Florida. These students are exposed to activities that foster critical thinking while they are participating in hands-on scientific inquiry not only in the school science lab, but also in other classes as teachers infuse science and math seamlessly throughout the school day.

On the pages that follow, you will find research-based methods, detailed explanations of science concepts and discussions, as well as step-by-step directions for hands-on science activities. On gryphonhouse.com, you can view videos of these activities done with preschoolers in my early childhood science lab. The videos show the instruction as well as how the children interact with the materials.

Mathematical thinking and scientific discovery are great opportunities to develop critical thinking skills in young children. To do this, children must be conscious of the world around them by exploring using their senses: touch, sound, sight, taste, and smell. Activities such as nature walks, visits to a school garden, and hands-on science explorations allow children to touch nature, see bugs, and listen to outdoor sounds.

Children can count the types of animals they see and make comparisons with regard to sizes, colors, shapes, and environments. Foster the children's inquiry skills by providing science and other materials that allow for exploration throughout the classroom, not solely in discovery areas. Include items such as

- books with various textures;
- instruments that make different sounds;
- music;
- water and sand play;
- playdough to form shapes and compare colors;
- floor mats with various textures to learn to take apart, touch, and put together;
- opportunities for painting with fingers and brushes;
- learning to paste objects; and
- touching and feeling different textures.

Observations and opportunities for discovery can also take place in school gardens, where children can plant seeds or seedlings, water their plants, and make observations about growth. When the plants are grown, children can pick and eat the foods. Using plants and animals as well as manipulatives, children can count, sort, and classify to reinforce mathematical thinking.

Scientific thinking enables children to gain an understanding of the world in which they live. Encourage them to ask questions and use simple tools as they make comparisons. As we respond to youngsters, answer their questions, and show examples, we can help develop their ability to draw conclusions from observations. The activities contained in this book provide opportunities for young children to experience science and math in a way that is meaningful and promotes critical thinking and problem solving.





Learning and Experimenting



Young children are filled with wonder and excitement. They are hungry for science and are easily amazed. Even when we challenge them to stretch and explore concepts that some might feel are too abstract, we give them opportunities to grasp bits and pieces of the ideas. By repeating the same activity from year to year, each time the children are exposed to the experience, they absorb greater levels of understanding of the same concept. In addition to exposing preschoolers and early learners to hands-on science, allow them to engage in free exploration. Through unstructured exploration, we foster the development of imagination and creativity.

Practical Tips for Science Explorations

In general, stick with concepts that are basic and not too abstract. Remember that these are preschoolers! While executing science experiments, it is best to work in small groups. It helps to give each child a tray to manage materials and define personal space. You can purchase plastic trays from a dollar store or ask a local grocery store to donate unused foam meat trays that you can reuse many times.

To be most effective, infuse your daily routines with science inquiry. Science can be easily integrated throughout your day. Provide opportunities for children to visit, play, and learn

SAFETY FIRST!

Safety is an important concept to introduce when teaching science. When you set these expectations, the children maintain better focus and concentration on the concepts being presented. Go over lab safety rules each time children participate in science experiments—for example:

- Leave all belongings outside the lab area.
- No running in the lab; always walk to avoid accidents.
- No shouting or playing around.
- When coming to the lab table, all hands should go under the table until the teacher gives instructions otherwise.
- Wear safety goggles to protect your eyes if you are working with chemicals or vinegar.
- Tie back long hair.
- No food or drink in the lab unless it is part of the experiment.
- Never smell or taste anything unless the teacher tells you to do so.
- Listen and follow all instructions carefully.
- Ask questions if you are uncertain about what to do during the experiment.
- Wash your hands with soap before and after touching animals.
- When you have completed an experiment, put waste materials in the correct containers.

in their science and discovery center, and stock the center with numerous activities and materials for children to observe and explore:

- Microscopes
- Hand lenses
- Rock and shell samples
- Sensory bottles and tables
- Magnets
- Real and plastic insects
- X-rays
- Variety of items to sort

Additional items can be rotated in and out of the center. When planning activities and stocking the classroom with exploration materials, provide a variety of options. Consider

using recycled items to cut down on cost while also teaching the children how to reuse and be kind to our planet. You might have animals in the classroom that the children can observe daily. Stock class libraries, discovery areas, and the school library with books based on various science themes. Create a garden with plants to water, observe, and harvest. You might want to schedule cooking activities regularly to practice science process skills, math, and following directions. You can align weekly science experiments with themes being taught each week and then provide opportunities for free exploration related to the themes.

Doing What Scientists Do

You can accomplish preschool science goals by practicing what scientists do:

- Observe objects, events, and people.
- Find words to describe observations and to communicate ideas.
- Ask questions.
- Explore and investigate to try to answer questions.
- Use science tools to observe and measure.
- Record observations using simple drawings and basic charts.

Use science process skills as a framework to guide scientific inquiry in the early childhood setting: observe, measure, classify, predict, experiment, and communicate.

By familiarizing younger children with the science process skills, you help prepare them for the transition to the scientific method, which is introduced in the early elementary grades.

SCIENCE PROCESS SKILLS

- Observe
- Measure
- Classify
- Predict
- Experiment
- Communicate

Math and Science Go Hand in Hand

Once the children have begun to develop their science process skills, they will be inclined to ask more questions that foster higher levels of critical thinking. Mathematical thinking and scientific discovery go hand in hand. Look for opportunities to link the two by having children follow step-by-step directions, count, measure, and interpret data during explorations. Involving children in meaningful experiences allows them to observe the world around them, think scientifically, and solve problems in a mathematical way.



A Closer Look with the Hand Lens

CONCEPTS

As you teach children the role of a scientist, be sure that they understand the proper use of the tools that scientists use. In this activity, children learn the use of a hand lens as a tool for making things appear bigger.

DISCUSSION

A scientist is someone who studies something to learn more about it. Scientists use special tools as they explore new things. Sometimes, scientists want to get a closer look at something to see all the little details. A hand lens, also called a magnifier, helps by making small things bigger and easier to see. To use a hand lens, the children should hold it in one hand and close one eye. Sometimes it is easier for a small child to cover one eye. The child should place the hand lens near one eye and look through it. He can place the item he is looking at in his other hand or on the table. Sometimes, it helps to put the item on top of an upside-down cup. That way, the child can get a closer look by using one hand to cover one eye and the other to hold the hand lens.

ACTIVITY

1. Place several small items on a plate or on a tray. Call out the name of each item one at a time, and have the children pick up the item and look at it using the magnifier. With older children, you can include some items with tiny print such as stamps or pennies. Discuss whether the magnifier made each item bigger or smaller.

MATERIALS

For each child:

- Small tray
- Unbreakable hand lens
- Variety of items to examine, such as pennies, stamps, flowers, rocks, shells, and tree-trunk pieces



2. After looking at several items, give each child rocks, shells, tree-trunk pieces, and other items found in nature, and instruct them to take a closer look at each one.
3. Encourage the children to get a closer look at their hands. Have them explain what looks different about their hands when viewing them with the hand lenses versus without the lenses.
4. Go on a scavenger hunt. Give each child a hand lens, and instruct the children to find tiny things in their environment and to use a hand lens to magnify those items.



MINDING THE MATH

Have the children draw an outline of one of the objects. Have them look at the object with the hand lens and then draw a larger outline around the original one to estimate how much bigger the object looks when magnified. This activity will visually reinforce for the concept of magnification and the degree of enlargement.

LITERACY EXTENSION

Have each child craft a language experience story about what happened when she drank magic shrinking juice and became so tiny that she could be seen only with a hand lens. Prewriters can dictate their stories to the teacher, and writers can write down their own stories.

Pouring and More: Funnels and Test Tubes

CONCEPTS

You will introduce the funnel as a tool scientists and other individuals use to prevent spills. Once children know how to use a funnel, you can add it to the sand-and-water table. You will also introduce test tubes as tools for holding liquids. The children will explore the proper use of test tubes and the use of funnels to make pouring easier.

DISCUSSION

Sometimes we want to pour something into a container with a small opening. A funnel makes it easier to pour liquids into small spaces without spilling. A scientist uses test tubes to study liquids and other small items. Test tubes are slender containers that hold liquid. To use a funnel, simply place the small end of the funnel into the test tube or container you wish to fill. Then, pour the water into the big opening of the funnel, and the water will flow into the container.

ACTIVITY

1. Give each child a test-tube rack. Instruct the children to place their test tubes inside the plastic containers to be used as catch basins. Each child will also need another container filled with water and a small cup. If you use colored water, the children will find the activity more interesting and easier to see.
2. Demonstrate by putting a funnel into the first test tube in a rack. Hold the test tube in the air, and show the children the top and bottom of the test tube or little water bottle. Using a cup, scoop some water from the

MATERIALS

- Food coloring (optional)
- Variety of containers
- Cups in a variety of sizes
- Small portion cups (available at dollar, party, and restaurant-supply stores)

For each child:

- Funnel
- Test-tube rack and plastic test tubes (Note: You can use 8-ounce water bottles as an alternative.)
- Plastic container large enough to hold a test-tube rack
- Plastic container filled with water
- Cup



plastic water-filled container. Ask the children to tell you when the water poured into the funnel reaches the top of the test tube or bottle. Slowly begin pouring, and stop when the children tell you to stop.

3. When the first test tube is filled, demonstrate moving the funnel from one test tube to the next. Practice filling the other test tubes and letting the children tell you when the water reaches the top of each one.
4. Give the children a chance to practice pouring the water into their own test tubes or water bottles. It will be easier for smaller children to do this standing up.
5. Once the children know how to use funnels, you can leave funnels in the sand-and-water or sensory tables along with various containers for practice and free exploration.

MINDING THE MATH

Give each child a small portion cup, and ask the children to predict how many tiny cups it will take to fill a test tube or other small container. The children can say their predictions out loud, write them on the board, or write them on sticky notes. If you use sticky notes, you can arrange the predictions from smallest to largest. You can vary the size of the cup, such as using tiny coffee-shot cups or small bathroom drinking cups, to vary the experience. Count how many cups it will take to fill various containers. Older children can create a graph showing their findings or a graph showing their predictions.

LITERACY EXTENSION

Write the word *funnel* on the board. Break the word down into syllables. Have the children clap their hands for each syllable. Count the number of letters in the word, and discuss the beginning sound. Ask if there are any letters repeated in the word. Point out that the letter *n* appears twice in the word, if they do not notice.

Tools for Drips and Drops

CONCEPTS

The children will become familiar with the proper way to use pipettes or droppers for experiments involving liquids. Teaching children to squeeze and release the dropper is great for improving small-motor muscles.

The pipette can also be used to discuss the concept of air: When the pipette is squeezed, the air is pushed out. When it is let go, the air outside the dropper pushes the water inside the dropper.

MATERIALS

For each child:

- Pipette
- Cup of water
- Container, such as an egg carton, water-bottle lid, film canister, or unused pill blister pack

DISCUSSION

Tell the children that pipettes, also called droppers, are used to measure and pick up small amounts of liquids. When you need to take a little bit of medicine, the person who takes care of you can use a dropper to measure and give you just the right amount. Air is all around us, including inside a pipette. The top of a pipette is called a bulb. When you squeeze the bulb, you push the air out of the pipette. When you place the dropper in the water and let go of the bulb, air pressure around you will push the water inside the pipette. By squeezing the bulb again, the water is pushed out.

ACTIVITY

1. Demonstrate the procedure by squeezing the bulb end of the pipette. This pushes the air out of the dropper. With the bulb squeezed, place the other end of the dropper in the water. With the end of the pipette in the water, let go of the bulb so that it is no longer squeezed. Air pressure will push the water into the dropper.

2. Remove the dropper from the water, and squeeze the bulb over the empty container to let the water out.
3. Give each child a dropper or pipette, a small container of water, and something to transfer the water into. For younger children, use bigger containers for catching the water; egg cartons work well. For older children, water-bottle lids or film canisters (available through science-supply stores) work well. You can also ask a pharmacy to donate unused pill blister packs, which have very small spaces for storing pills. Children with good motor control can easily squeeze water into these blister packs. They will also love transferring the water from one hole to another.
4. Have the children practice taking in the water and squeezing it out into the containers. This exercise helps improve fine-motor skills.



MINDING THE MATH

Have the children predict how many pipettes full of water they will need to fill a plastic lid. Count as each dropper is filled and emptied into the plastic lid. Compare their predictions with the actual experiment results.

Water Sense and Cents: Surface Tension

CONCEPTS

Water is made up of tiny molecules.

Each one is like a little magnet. At the edges of each drop of water, the molecules line up like little minimagnets, attaching to each other. They form a kind of skin on top of the drop, holding the rest of the water in. The “skin” is called *surface tension*. When there is too much water on the skin, the surface tension breaks and the water will overflow.

MATERIALS

For each child:

- Pipette
- Penny
- Paper towel
- Small container of water

- Nickels, dimes, and quarters to share
- Paper or whiteboard
- Marker

In this activity, the children will predict how many drops of water can fit on a penny. They will do the same for other coins and then graph the results.

ACTIVITY

1. Hold up a penny and wonder aloud, “How much water do you think a penny could hold on its surface?” With the children, determine the problem statement: How many drops of water will a penny hold?
2. Ask each child to make a hypothesis or guess: How many drops do you predict the penny will hold?
3. Create a data table on a piece of paper or on the whiteboard. In a T chart, list penny, nickel, dime, and quarter in the left-hand column. The right-hand column is where you will record the number of drops each type of coin can hold.
4. Place a penny with the head side up on a paper towel. (Using the same side of the penny eliminates the variable of the different crevices.)
5. Fill a dropper with water.
6. Drop the water one drop at time on the penny, and count how many drops the penny holds.

Encourage young investigators to feel, listen, smell, taste, and see their way to discovery by seamlessly infusing math and science throughout the school day! As you incorporate all five senses into learning experiences, you will give little innovators the opportunity to observe and explore the world around them.

The explorations in ***Hands-On Science and Math: Fun, Fascinating Activities for Young Children*** will help you plan engaging science, technology, engineering, and math (STEM) lessons that will excite children and foster their critical thinking. Children can experience the thrill of scientific inquiry through simple experiments:

- Launching Recycled Rockets
- Shake and Freeze: Homemade Ice Cream
- Look Out! Volcano Erupting
- The Mystery of Suspensions
- Go, Car, Go! Simple Machines and Inclined Planes

Designed to work with easy-to-find materials, the ***Hands-On Science and Math*** activities are inexpensive and uncomplicated, yet they lay the groundwork for understanding more complex STEM concepts later on.

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**Fun, Fascinating Activities for
Young Children**



Beth R. Davis, EdS, NBCT, holds a bachelor's degree in elementary education; a master's degree in teaching English to speakers of other languages, or TESOL; and an education

specialist degree in computer education. She is the director of Kids For Kids Academy preschool in Miami, Florida. She is a sought-after presenter and curriculum author and has served on Florida state panels in the areas of curriculum, standards, and testing.

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