MATH /SCIENCE

Class-room clues

Confused by your child's math homework? Worried that it's too hard—or too easy? How about science (or is science an afterthought in her school)? Remember, there's more to these subjects than what appears in a textbook. You might be surprised by how much you can pick up from clues in your kids' classrooms.

This guide will help you find out whether your children are getting the math and science instruction they need in pre-kindergarten through fifth grade—and will help you do something about it if they aren't. It will explain what the new Common Core State Standards mean for your child.

No school is perfect, but if you understand the strengths and weaknesses of your child's school you can help fill in the gaps—even if you don't know much math and science yourself. You can learn a great deal by looking around your child's classroom.

For all grade levels

Whatever your child's grade level, look for fun-to-read books about math and science, as well as fish tanks, animals such as gerbils, live plants and tools including magnifying glasses, magnets, or electrical circuits.

Real science investigations can spark curiosity and make kids want to do more.

Check the daily schedule, which is usually posted in the classroom. Children should be working on math at least 1 hour a day. Science lessons should be part of a regular school day, not only a special class once a

week. If you see an egg incubator (so children can watch chicks hatch and grow) or caterpillars (which will grow into butterflies), that's a good clue that science lessons are part of the daily routine.

The best schools find ways to weave science together with math, reading, social studies, and even art. Children may work for long periods on units about birds, or bridges, or Central Park. Look for evidence of these explorations in the classroom. At PS 321 in Park Slope, Brooklyn, for example, kindergartners study trees. They post tree graphs, leaf rubbings, and diagrams based on their frequent trips to the park to observe changes over the course of the year.

Of course you want to see children's artwork and essays on the walls, but you should see examples of math and science as well. At PS 221 in Douglaston, Queens, a bulletin board had fourth-graders' own questions about science: "How do snails breathe?" and "How does dust form?" and "What started the Black Death?" Science exploration that starts with children's own questions is more likely to prompt them to ask more.

Most of the science experts we interviewed said it's more important to spark children's curiosity than to develop a particular body of knowledge in the elementary school years. Whether your child is studying the solar system or rocks and minerals, it's important that he is excited and engaged in his work. Learning lots of facts can wait.

"Too much rote learning may well kill interest," said Richard Seager, a climate scientist at Columbia University and parent of two children who attended PS 75 on the Upper West Side. "I would think that the best that can be done is to instill a sense of wonder and interest in the natural world in the kids, that they may be motivated to pursue it more in the future."

Math is a little different. It's important for math to be exciting and fun, but children also need specific skills. A look around the classroom will also help you tell if these skills are being taught.

Pre-kindergarten and kindergarten

Look for blocks and puzzles. Research shows that developing good spatial skills by learning how to put together different shapes is as important as learning to count.

Look for small objects (such as buttons, plastic animals, or Legos) that children can touch, count, and sort. Even before children learn to write numerals, they need to get a sense of what numbers are. Counting objects builds an intuitive feel for math that teachers call "number sense." Young children with good number sense quickly figure out amounts— who has more strawberries, for instance, or which pile of M&Ms is larger. This is an important foundation for advanced math skills later on.

In pre-kindergarten, children should learn to count to 20; identify shapes such as circles and triangles; and know relative words including "big," "small," "tall," and "short." By the end of kindergarten they should be able to count to 100; write numbers from 1-20; and know words such as "above," "below," "flat" and "solid," according to the Common Core State Standards.

A textbook alone isn't enough. Look for plants and animals in the classroom.

Cooking ingredients and other kitchenware are evidence of science exploration.

First and second grades

In first and second grades, children should be learning to add and subtract. They need to understand the value of coins, learn how to tell time, and know how to measure distances.

Look for a math area with things such as dice, play money, dominoes, and number lines. Also look for counting frames, clocks, pattern blocks, and rulers. Well-equipped classrooms also have "manipulatives"— little plastic cubes kids can snap together to learn to add and subtract.

Look for bundles of sticks used to represent "tens" and little cubes

used to represent “ones” to help young students learn place value. Such tools help children understand the concepts underlying arithmetic, not just the rules for addition and subtraction. Classrooms often have a shelf with puzzles and games such as Sorry or Connect Four, which are fun ways for children to reinforce arithmetic skills, especially when they are indoors a lot during a long winter.

Small counters, puzzles, and blocks help kids make sense of how math works.

Look for a variety of science tools on classroom shelves, not hidden away in boxes.

Children are learning to talk about math and read word problems at this age, so look for lists of math words posted on the wall to help them remember words such as “sum” and “difference.”

According to the Common Core State Standards, by the end of first grade, children should be able to add and subtract numbers up to 20; by the end of second grade, they should be able to add and subtract large numbers.

Third grade

In third grade, children learn multiplication and division. They need quick recall of math facts, so some drill is necessary. Look for worksheets, flashcards, and workbooks so children can practice basic math facts until they become automatic.

Children also need to understand what multiplication and division really mean. For that, teachers may ask children to color rows of squares on graph paper, or to cut strips of paper a certain width and length.

Third-graders should learn how to calculate the area and perimeter of a rectangle. Sometimes classrooms have square plastic tiles that children can assemble into rectangles so they can see concretely what “area” and “perimeter” mean.

By the end of third grade, children should have memorized the times

tables up to 10 x 10 as well as division facts, according to the Common Core.

Fourth and fifth grades

Fourth-graders need to be able to multiply and divide large numbers, and by fifth grade children should be able to multiply and divide fractions. You might see posters with drawings of problems such as: How can 8 children share 5 hero sandwiches fairly?

You may see charts showing the work kids have done to solve big word problems that require them to use all of their math skills—addition, subtraction, multiplication, division, and fractions. If children solve problems in different ways, that's a good sign that they understand what they are doing and have not merely mastered a formula.

Research shows children need both a deep understanding of math and the ability to solve arithmetic problems quickly, so look for evidence of both teaching approaches in the classroom. Numbers lined up in neat rows—the way most of today's parents learned arithmetic—show a quick and efficient way to solve problems. Conversely, children's written explanation of their work—part of most lessons today—is designed to demonstrate that they get the concepts.

Math textbooks are fine, but good teachers draw on several different math programs or resources (think instructional YouTube videos or sites such as EngageNY.com, which offers an array of activities as well as games for helping students practice key skills of the Common Core State Standards) because not all kids learn in the same way. Some kids look at numerals on paper and understand them right away; others need pictures and objects to make sense of arithmetic. Some prefer worksheets and workbooks. Others need to count, use number lines, or use a computer. It's helpful if there is variety. No one set of math books works for all kids; many of the best schools use elements from a variety of math books.

One of the best things we can do as parents is to be aware, interested, and open. Learning math and science is a process. Keep an eye on these classroom clues and grade-level milestones, and take note of how your child learns best.

★ **See a slideshow of what to look for in math and science education in grades K-5—plus find a list of 15 NYC elementary schools with exemplary math and science instruction—at Insideschools.org.**

★ **Learn about the year-round programming at the New York Hall of Science at nymetroparents.com/nysci.**

★ **Discover what a visit to Manhattan's Museum of Mathematics looks like at nymetroparents.com/momath.**

the Right Questions

Whether you're mystified by math and stymied by science or you're a renowned physicist, determining the strength of your kid's education in these subjects can seem impossible. But asking the right questions—of the teacher and your child—will yield revealing answers.

Students at Brooklyn Brownstone in Bedford-Stuyvesant, Brooklyn harvest crops from schoolyard planters.

What to ask the teacher

Obviously, you want to ask questions as part of friendly curiosity, not grilling the teacher. Remember, you both have your children's best interest at heart. Here are some ideas for questions:

How do you challenge the best students and help struggling learners?

Reaching children of different abilities is one of a teacher's most difficult tasks, particularly when it comes to math. Most teachers know how to find books to match a child's reading level, but they often pitch math lessons to the whole group in order to cover a certain amount of material.

The best schools ensure the brightest children can move ahead of their peers, either by working on more complex problems or by working independently on math websites such as Khan Academy (khanacademy.org). They also ensure struggling kids get the help they need, often in small groups inside or outside the classroom.

Faster learners shouldn't be told to read a book while other children finish their work. They should be working on math during math time. It's okay if a teacher occasionally asks them to double-check their work or to help their peers, but faster learners need a chance to do more advanced work.

At PS 172 in Sunset Park, Brooklyn,

In a fifth-grade math class the teacher managed to adapt the same complex problem for different children: If two teachers, shopping together, each buy a pair of shoes at a "buy one, get one for half-price" sale, what's the fairest way to divide the cost? Some children worked on the problem independently or in pairs, others got little hints from the teacher, and still others got step-by-step instructions from the second teacher in the class, who is trained in special education. At the end of the period, all children sat on a rug and discussed how they arrived at the answer.

Does the school do anything to encourage girls in math?

Girls often get discouraged by math early in their school careers. Good schools work to bolster girls' confidence and break down stereotypes about girls not liking math. These schools encourage girls to build with blocks and Legos, join the math or robotics club, and hang out in the computer lab with the technology teacher during lunch. Mentors count: Girls often model their behavior after their female teachers. It's particularly important for female teachers not to say, "I wasn't good at math." Research shows female teachers often unwittingly pass on their own insecurity about math to their female pupils.

At the Museum of Mathematics in Murray Hill, executive director Glen Whitney tests out the Coaster Rollers exhibit, where visitors can propel themselves along a track filled with oddly shaped objects.

Do you have any math and science partnerships?

Some schools hire consultants to train teachers in challenging math curricula such as Math in Focus, based on math programs in Singapore. Many schools have partnerships with colleges or museums.

Children in second through fourth grades learn about preservation of bird habitats as part of an Audubon Society program called "For the Birds!" (learn more at ny.audubon.org/birds-1). Similarly, the Cornell Lab of Ornithology distributes grants to teachers and assists youngsters in high-quality data collection about birds in urban areas (read about its programs at birds.cornell.edu).

In a project called Tomatosphere, children at PS 205 in Queens grow tomato seeds in conditions designed to simulate those on a trip to Mars. They contribute data to the Canadian Space Agency's project studying the feasibility of growing edible plants on long journeys in space.

The Center for Architecture Foundation helps children build models such as a long house, a tenement building, and a skyscraper to show New York City's history through 200 years of architecture.

Are there ways for students to get involved with math and science outside the regular school day?

Schools that have a strong math and science focus often have robotics, math or chess clubs during lunch or after school. Children involved in some of these programs may even take part in national competitions.

What does your child say?

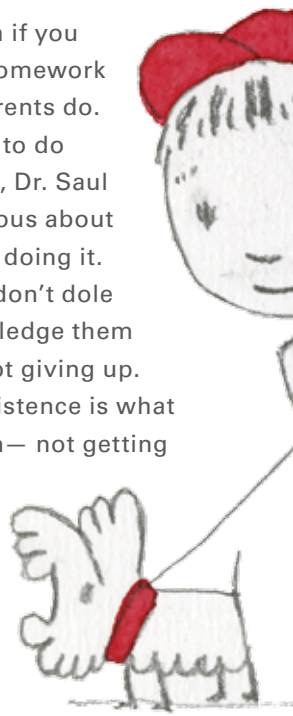
Another telling clue: Is your child talking about math and science? Does she bring her enthusiasm home?

One mother we spoke to said that her son was thrilled to tell her what he learned about migration when he tallied the number of pigeons in his neighborhood as part of a project at the Brooklyn New School. First-graders at Midtown West in Manhattan ask their parents to help them find simple machines at home—a flip-top lid (a.k.a., a lever) and a doorstop (for scientific purposes, a wedge).

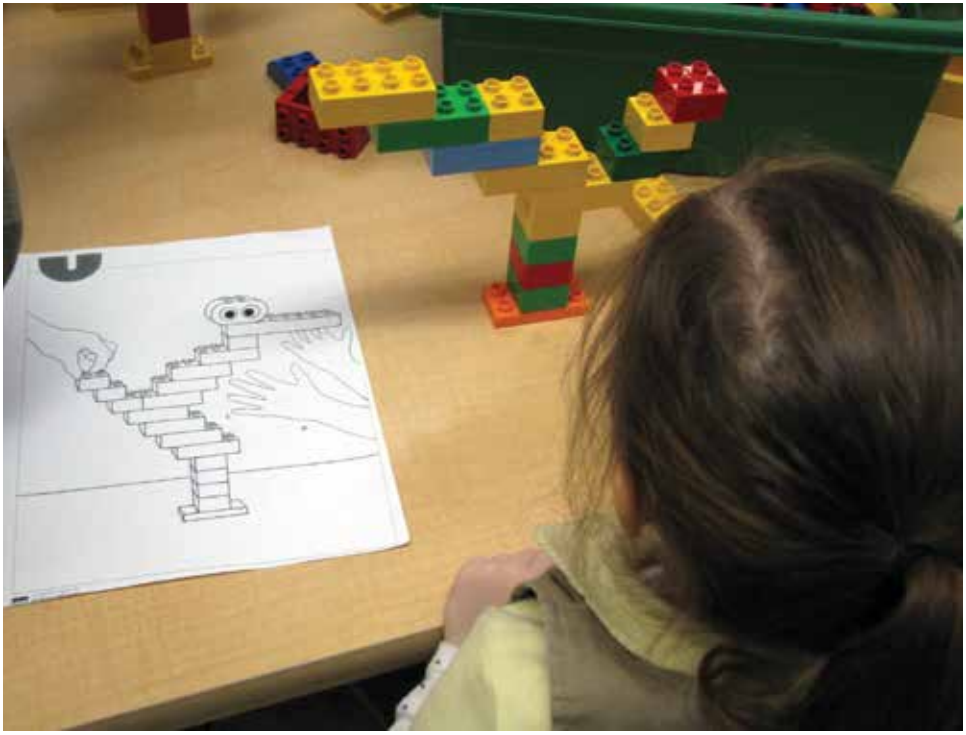
Does your child use words such as "carnivore," "porous," "sediment," "volcanic ash" or "metamorphosis"? Good science instruction builds a child's vocabulary.

It's a good sign if kids are thinking about math and not just doing it, according to Mark Saul, Ph.D., director of the Center for Mathematical Talent at New York University. Can your child use a measuring cup to double a recipe while cooking with you? Or figure out how long it will take for Grandma and Grandpa to arrive by looking at the clock and doing the math? How about determine approximate mileage for a family trip by looking at a map? Those are all good signs.

Don't worry too much if you find your children's homework confusing— many parents do. And don't force them to do math the way you did, Dr. Saul says. Instead, be curious about the way your kids are doing it. Ask them questions; don't dole out answers. Acknowledge them for trying hard and not giving up. Research shows persistence is what counts in the long run— not getting everything right the first time.



If your children are engaged and show curiosity themselves, things



A girl at PS 185 The Early Childhood Discovery and Design Magnet in Central Harlem South looks at plans to help her build a Lego design. Girls often need to be encouraged to work through the tricky parts of a science challenge—and that support is tantamount in today's world; minority women comprise fewer than 1 in 10 employed scientists and engineers.

are probably okay. If they avoid homework or race through it—if they are bored, anxious, or confused—there may be a problem.

Some schools send home different homework packets depending on a child's ability. Teachers at PS 59 in Manhattan send home a customized plan for each child including reading levels and math strengths, with games kids and parents may play together to support math concepts and skills they've studied in school. They send home pictures of math strategy charts used in class so parents can also reference them at home, and post ideas on a web page.

The specifics of what your child talks about will vary based on his classroom experiences, but rest assured, if he's engaged and truly learning math and science, he'll likely be enthusiastic about what he shares.

what parents can do... if a school falls short

If your child falls short in math and science, there is much you can do to help. .

Volunteer at the school

- Start a chess or robotics club after school or during lunch. Shewonia Bowman, an engineer and the mother of two girls, started an early morning math club with interactive games at PS 199 in Manhattan.
- Help children plant a school vegetable garden to teach them about nutrition and the environment.
- Chaperone or extend other help on a relevant field trip; excursions to area museums are good ways to bolster science.

Repeat after me

- If your child's school is good at teaching the concepts of math but doesn't teach quick recall of facts, you may want to supplement at home with a computer program or flash cards.
- If your child doesn't respond to old-fashioned memorization drills, look for songs to memorize facts. For example, you can teach your child to "skip count" by the dreaded 7s by setting the numbers to the tune of "Happy Birthday": 7, 14, 21 / 28, 35 / 42, 49 / 56, 63...
- Visit **mathabc.com**, a free website loaded with drills, to help with memorization of multiplication tables.

Get creative

- Introduce games such as Yahtzee or Scrabble at home and let the kids keep score.
- Engage kids in studies when they're actively doing something else they love. One parent got her son a mini-trampoline, and he was much more open to practicing facts when paired with jumping up and down.
- Help your children conduct real research: Citizen Science enlists ordinary citizens to count pigeons in cooperation with Cornell University; scientists use the data in their published work. In Project Bud Burst kids find a bush and watch it during the season when the bush opens a bud; it's a sensitive measure for global climate.
- If the teaching leans too much in the direction of "drill and kill," give your kids the opportunity to try tangrams, mazes, 2-D puzzles, shapes, origami and visual puzzles.
- Take a free workshop offered by NYU's Courant Institute, where you can pick up ideas such as making shapes out of toothpicks and gumdrops to talk about vertices, faces and edges. Courant will suggest you Google "DAT = Dental Admissions Test" to find puzzles that help kids 'see' math concepts.

Go on educational family outings

- Check out the World Science Festival each May with activities across the city. Gaze through a telescope at the night stars, or listen to scientists explain "What is sleep?" See: **worldsciencefestival.com**

- Visit the Museum of Mathematics in Manhattan. This dynamic and interactive museum, which focuses on enhancing public understanding and perception of math in daily life, is the first of its kind in the country. Learn more about its unique programming at **nymetroparents.com/momath**.

- Take your kids to the annual Maker Faire, a technology and science extravaganza with lots of free hands-on activities, held every September at the New York Hall of Science in Queens. Stop by NYSCI any time of year for the wide array of programs. Read more at **nymetroparents.com/nysci**.

- Make a wish-list of places to see: American Museum of Natural History in Manhattan; the Bronx Zoo; Liberty Science Center across the Hudson in nearby New Jersey; the Greenburgh Nature Center, a short train ride away in Scarsdale; the New York Aquarium in Brooklyn's Coney Island; the Town of Ramapo Challenger Center in Rockland County, where kids can be astronauts for a day; the Science Museum of Long Island in Manhasset; the Maritime Aquarium in Norwalk, CT; and the Wolf Conservation Center in South Salem. Find details on these and many more at **nymetroparents. com/nature** and **nymetroparents.com/outings**.

Find the beauty

- We want our children to think of math and science as beautiful, not merely useful. Pamela Liebeck, author of *How Children Learn Mathematics*, says math appeals to kids in much the same way art and music do—based on their intellectual or aesthetic response. Math and science should be appealing—because if it is, kids will want to do more of it.

Sources & Recommended Reading

1. Female teachers unwittingly passed their own math anxiety onto their female students in an article based on the work of Sian L. Beilock, et.al., called: "Female Teachers' Math Anxiety Affects Girls' Math Achievement."
2. When science and literacy lessons are integrated, students demonstrate greater skill in all of these areas, writes Gina N. Cervetti, et. al., in a paper titled, "A Model of Science-Literacy Integration."
3. Many girls believe math ability is fixed-—it's a gift you have or do not have. Girls who believe math is an acquired set of skills do better, according to Carol S. Dweck, in her book: Mindset.
4. The early years are important: Number sense in first grade predicts math ability in middle school, say Geary, Hoard, Bailey & Nugent in "Adolescents' Functional Numeracy Is Predicted by their School Entry Number System Knowledge."
5. Stereotype threat can impact student academic performance, according to author Claude Steele in his book: Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do.
6. Blocks and puzzles can help school readiness; using words such as "between," "under," "shorter," and "longer" can help kids better understand spatial problem-solving tasks, says lead author Brian N. Verdine in "Finding the Missing Piece: Blocks, Puzzles, and Shapes Fuel School Readiness."
7. National Girls Collaborative Project presents research focused on what works to engage and support girls in Science, Technology, Math and Engineering at ngcproject.org.
8. Games for Math: Playful Ways to Help Your Child Learn Math, From Kindergarten to Third Grade by Peggy Kaye is a user-friendly book filled with math games to play at home.
9. Build number sense as you browse and discuss this picture book with your child ages 4-8: Anno's Counting Book, by Mitsumasa Anno.
10. In addition to games and puzzles, Family Math by Jean K. Stenmark, et.al., includes a step-by-step description of how to organize a "family math" class at your child's school.