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Parents can play a crucial role in their children's math learning (e.g., Apeiman & King, 1993; Peressini, 1998). Teachers, educators, and parenting professionals agree that it is just as important for parents to do math with their children as it is to read to them. While many parents have ideas on how to support their children's literacy learning, they are much less sure of how to encourage their math learning (Hartog et al., 1998).

Although there are growing numbers of materials and programs intended to support parental involvement in math learning, many do not fully serve the needs of parents. Today's busy parents need ways to do math with their children that mesh with the realities of their time constraints, commitments, and experience with math teaching and learning.

The new Math Out of School group at TERC has been established to develop materials and methods for supporting children and their parents and caregivers in learning mathematics outside the school environment. Our work with

families centers on developing activities that enable parents to build math into the things they already do with their children, such as housework, shopping, meal preparation, and playing games. We are distributing the materials through workplace benefits programs, community centers, libraries, and museums, thereby leveraging existing mechanisms for reaching a broad range of families.

An image of math in family life: What is and what could be

Most parents who do math activities with their children use workbooks or flashcards, probably because these materials provide the only available models for "doing math." If parents are to support their children's mathematical thinking, they need new images of what it means to do math with their children.

Fortunately, there are many opportunities to do math as part of everyday family life. These moments, however, are often not obvious to parents because they don't include doing calculations with a pencil and paper. The situations involve everyday mental computation, such as figuring out how to triple a recipe, determine the amount of material you'll need for a sewing project, or decide if you have enough money to

buy the groceries in your cart or enough time to get to the library before it closes. In everyday life, adults are less likely to use memorized algorithms and procedures; instead they tend to rely on their knowledge of number relationships, estimation, and other approaches emphasized in standards-based math (Lave 1988; NCTM, 1989). One of our goals is to help parents become more aware of the math embedded in everyday situations and to support them in drawing it out for their children.

An opportunity to do math

Consider the following situation: It's 5:18 and the parent (P) is in the kitchen making dinner, which he hopes to have ready at 6:00. The eight-year-old child (C) comes in and announces, "I'm starving. How long until we eat?"

Scenario 1. Child does no math.

One approach is for the adult to simply do the math needed to find the answer, without involving the child:

P glances at the clock, notes that it's close to 5:15, reasons that 6:00 is 45 minutes away, and responds, "about 45 minutes." Or perhaps P computes the exact time, "42 minutes."

Scenario 2. Mathematical interaction that focuses on the answer.

Another approach is to ask the child to find how long until dinner, and to emphasize the correct answer, in the spirit of a traditional textbook story problem.

P: It's 5:18. Dinner is at 6:00. Can you figure it out?

C: (after thinking a bit) Um, 48.

P: Try it again.

C: It's 42! Definitely 42.

P: That's right. Great work! While I'm chopping onions, why don't you sit down at the table and get started on your homework.

P engages C in finding how long until dinner, and he verifies her answer.

Once C arrives at the correct answer, the mathematical interaction ends.

Scenario 3. Mathematical interaction that focuses on how the child solved the problem.

A third approach is to engage the child in explaining her thinking and reasoning as she solves the problem.

P: It's 5:18. Dinner is at 6:00. How could you figure it out?

C: (after thinking a bit) Um, 48.

P: How did you do that?

C: Well, it's 45 minutes until 6:00. Then there's the 3 other minutes because it's 5:18. So, I added them together.

P: So you started with something you knew—it's 45 minutes from 5:15 to 6:00.

C: Yup, and I added the extra 3.

P: So it's more than 45 minutes?

C: (after a brief pause) Wait! It has to be less because 5:18 is after 5:15.

P: Sometimes it's hard to figure out if it's more or less. Hope it's not too much less, because these potatoes are hard as rocks. So, how much less?

C: It's gotta be 3 less than 45, so 42!

P: Okay, I think we can make it. I'm gonna be pretty busy, so what could you get done in the time you have left? Is there enough time to finish reading that chapter on snakes?

As in Scenario 2, P engages C in finding the answer herself. However, instead of verifying C's answer, P encourages her to explain her thinking, and helps her to clarify her ideas. As C talks through her approach, she recognizes that her answer was incorrect, and she revises her thinking. Math continues to contribute to the flow of conversation between P and C as they consider what they can get done in the remaining time until dinner, thereby furthering C's understanding of what "42 minutes" represents.

A fundamental component of our work is the development of materials that help families have interactions like those in Scenario 3. Although there

are many compilations of mathematical activities for families (e.g., Alexander, 1998; Kanter, 1993; Mokros, 1996; Stenmark et al., 1986; www.ed.gov/pubs/parents/math), these typically do not go far enough to support parents in engaging children in important mathematical content.

Parents need more than just lists of activities to carry out. They need ideas for questions they can ask to stimulate children's mathematical thinking and ways to encourage children to go beyond finding a correct answer, so that discussions are rich in mathematical reasoning. Parents also need to understand the significance of the mathematics in the activities—how does it relate to what children need for school, everyday life, and later work life.

A sample activity *How Much Do We Save?* (pages 12–13) was developed as part of the Math Packs for Families project, which is creating materials that support parents doing math at home with their children. The materials are appropriate for elementary-grade students and are distributed through parents' workplaces.

The activity is based on the math involved in using grocery store coupons. Included are the steps parents need to take to set up and carry out the activity, and a range of related information: suggestions for adjusting the activity to meet children's needs; ideas on supporting children's learning as they do the activity; and ways to vary the activity both to offer children increased challenge over time and to keep their interest. Some of our activities also include actual parent-child dialogs that model realistic and effective interactions and give parents a sense of what to expect when doing math with children.

In addition to activities based on everyday situations, our Math Out of School efforts include developing mathematical games for families to play at home and at settings such as museums and community centers, creating kits with design and construction

materials, and identifying ways to draw the math out of popular toys, games, and recreations. What is common about all our materials is that they offer solid, feasible suggestions for supporting children's mathematical thinking and learning. They are designed with the realities of parents' math background, time, and circumstances in mind.

The need for feasible approaches to parent involvement

Parents not only need access to high-quality materials, they also need to learn to use them effectively, and they need a place to turn for guidance and support. Many parents, no matter how interested in their children's educational well-being, have little extra time to learn about and carry out new ways to support their children's math learning. Parents today face increasingly demanding work schedules, requiring many hours away from their children and homes (Hewlett & West, 1998). Family life has changed significantly within the last 30 years. Parents have far less time to spend with their children. Mothers are spending an average of 85 hours per week on the combination of paid work and household work (Hochschild, 1989). A full 20% of parents work two jobs, and the average worker in this country is working 163 more hours per year now than twenty years ago (Schor, 1992).

For school-based programs, a further impediment to parental participation is a sense of alienation from schools and from educational jargon. Some parents (such as those who had limited or negative school experiences or who are learning English) avoid school events or are hesitant to seek help from schools. Although programs have been developed to address the needs of parents unlikely to attend school events, access to these programs is far from universal. Parents who want to participate may have no local school-based or other programs available.

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Everyone wants to save money. With coupons, children can learn about math and about saving. Try this activity just before your next grocery shopping trip. As children figure out how much your family will save with coupons, they practice adding, multiplying, and estimating with dollars and cents. Since many grocery coupon amounts are multiples of 5 and 10, like 20¢, 25¢, and 75¢, children get in a lot of work with these important numbers.

SAVE 60¢ OFF
peanut butter

JUICE BARS
SAVE \$1.00

Look—here's a coupon for \$1.00 off on juice bars! And here's one for 60¢ off my favorite brand of chunky peanut butter!

There's a bunch of others, too. I bet we'll save at least \$10 next time we go to the grocery store.

before you begin

Age Range 7–11

Materials

- grocery advertisements with coupons
- scissors
- pencil and paper

Alone or with your child, go through grocery advertisements and cut out the coupons you think your family will use. Sort them into piles for immediate use and future use. Gather a set that you intend to use during your next trip to the grocery store.



Talk About Grocery Coupons and Store Savings

If your children are unfamiliar with coupons, explain how people use them. Point out the important information on several coupons—the product, how many you have to buy, the amount of savings, and when the offer expires. You might ask for a quick prediction of how much your family generally spends at the grocery store each week, and how much you might save with coupons. Some children will have no idea of these amounts; as you repeat this activity, they'll develop a better understanding.

Find Out How Much You'll Save

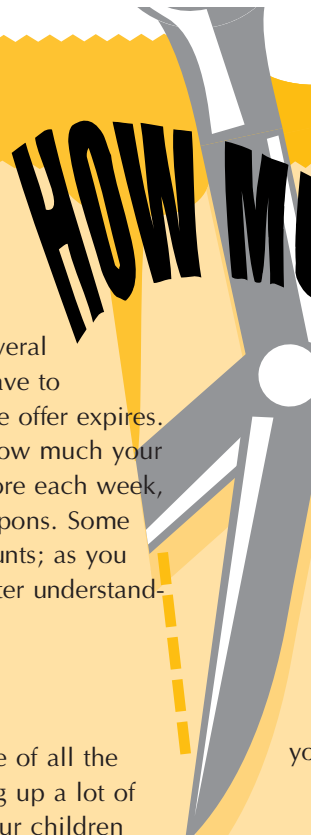
Ask your children to find the total value of all the coupons in the set. If the task of adding up a lot of coupons seems overwhelming, or if your children aren't sure how to begin, suggest they start by sorting the coupons into piles worth the same amount—a pile of 25¢ coupons, a pile of 50¢ coupons, and so on. Here are some more ways to break the task into easier steps:

Combine coupons to make "dollars." Find and group coupons that add to \$1.00, such as 25¢ + 75¢, or 20¢ + 20¢ + 60¢. You can also make groups that total \$2.00 or other whole-dollar amounts, being careful not to mix these with the one-dollar groups.

Combine coupons to make 50, 80, or other multiples of 10. Because multiples of 10 are easier to add up than numbers like 35, put together coupons to make multiples of 10. For example, two 35¢ coupons are worth 70¢. A 75¢ and 55¢ coupon are worth \$1.30.

Add by counting up. Try this if you have groups of coupons worth the same amount. For example, you would count a group of 20¢ coupons this way: 20¢...40¢...60¢... Some children may need help after the first few coupons or when the total reaches \$1.00. When this happens,

TIP If you are adding up a lot of coupons, it's easy to miss a few. Find a way to keep track of the coupons already added and those that are left to add. For example, make a special place to set aside coupons after figuring them into the total.



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v a r i a t i o n s

Use a Calculator (ages 7–11) Many adults use calculators when figuring out how much they spend and save. Children need a chance to learn what calculators can do. After doing this activity with a calculator, ask your children to check their results with a mental estimate. For example, they can round coupon values to the nearest 25¢ (round 20¢ to 25¢, or 90¢ to \$1.00) and then figure the approximate total. If your coupon set is mostly amounts your children can easily add in their heads (for example, half- or whole-dollar amounts such as 50¢, \$1.00, or \$3.00), talk about times when it makes sense to use a calculator and times when it's just as easy to find the total using common sense.



Double or Triple Coupons (ages 9–11) If your market doubles or triples the value of any coupons, explain how this works. Ask your child to find the total value of this week's grocery coupons with this information in mind.



How Can You Sort the Coupons? (ages 5–7) Here's a fun activity that can help young children work on sorting, logical thinking, and numbers. Provide 20 or more coupons for your children to sort into groups. They can decide what the groups will be. They might form categories like junk food, healthy food, things you can eat, or things only pets can eat. When they have finished sorting, ask number questions about their coupon groups. Which group has the most coupons? Which group has the fewest? Which coupon lets us save the most? the least?



Do We Have Enough to Save \$5.00? (ages 5–9) Provide ten coupons worth different amounts. For ages 5–7, choose coupons worth 25¢, 50¢, or whole-dollar amounts. For slightly older children, choose a wider variety of coupon amounts. This is the challenge: Find out if there are enough coupons to save your family at least \$5.00. (If you have a lot of coupons worth whole-dollar amounts, choose a larger total.) Ask children to explain how they found their answer—that way you can see how they are thinking mathematically.



If you are doing this activity with more than one child, they can share the coupons, or can sort them into piles worth same amount, distribute the piles, each find the total of their own. They then combine their individual totals.

TIP If your children think it's too hard to find the total value of all the coupons, talk through how you would do it yourself. Don't expect your children to follow every step. As their math knowledge grows, they'll be able to do more of the calculations themselves.

You can make this activity a regular part of your grocery shopping routine; you can also try it when you're using coupons for the hardware store or pharmacy. Encourage children to make a habit of checking the total coupon value by adding the coupons in a different way; for example, by regrouping them into different "dollar" combinations, or adding them up in a different order. Ask your children to explain some of the calculations they are doing as they find the total. As children talk through their ideas about addition and subtraction, they develop a better understanding of the processes. They also learn about the role math plays in solving everyday problems.

Bringing Math to Families

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Given the situation, how and where can we get parents involved in doing math with their children? A key starting point is to reach families in places where they are already spending their time: at playgrounds, at home, in laundromats, and commuting from place to place. We also need to reach parents where they are spending most of their time: the workplace. We are pioneering an approach that reaches out to parents where they work. For many parents, work is a place where they can informally share parenting experiences and issues with colleagues. At some workplaces, more structured parent supports are built in through on-site day care, summer and vacation child care programs, and child care resource and referral programs.

In the Math Packs for Families project, we are collaborating with Ceridian Performance Partners, a work-family resource provider that reaches several million employees nationwide. One of Ceridian's services involves distribution of free materials to parents at their workplaces—materials dealing with issues such as child safety, planning for college, and finding good day care. Through our project, parents working at Ceridian's partner companies will have access to free Math Packs that they can use with their children. They will also be able to attend workplace seminars on doing math with kids. Parents, grandparents, and other caregivers at a given workplace receive an announcement about a lunchtime program on "doing math with your kids." Workers from all levels of the company are encouraged to attend and are provided with a free set of materials to

bring home and use with their children. Parents learn to use the materials and have a chance to eat lunch with other parents while at the same time sharing ideas about doing math at home.

The materials and lunchtime sessions we are developing consist of a low-key, engaging series of activities focusing on a particular topic, such as "math games," "shopping math," or "Fair Share math" (a way to inject math into dealing with common childhood complaints of "It's not fair—she has more than I do!"). Parents do a little math themselves while learning how to do math with their children. They pull out the math that already exists in their everyday lives to share with their children. We are finding that many workplaces are eager to support parents and to allay parents' concerns about their children's education. Workplaces are a natural place to introduce parents to ways that they can do meaningful and engaging math with their children. 🏠

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