MATH IN AFTERSCHOOL

A Guide to Using the
AFTERSCHOOL TRAINING TOOLKIT
for Professional Development

A Supplement to the
Online Afterschool
Training Toolkit
for 21st Century
Community Learning Centers
www.sedl.org/afterschool

Produced for the U.S. Department of Education by the National Partnership for Quality Afterschool Learning.

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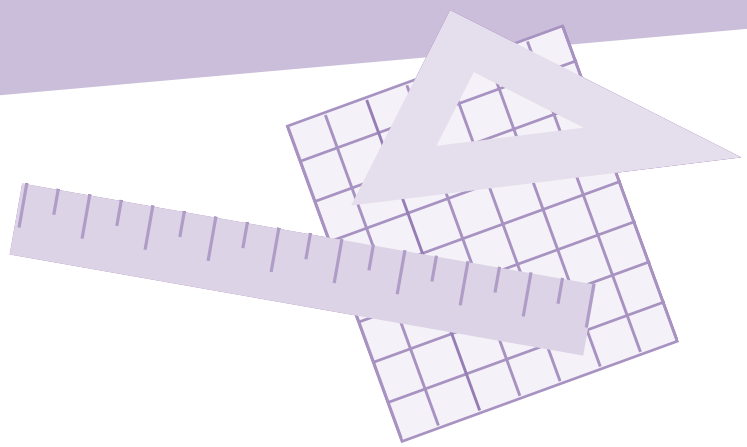
11
10
9
8
7
6
5
4
3
2
1



Introduction

From simple addition and subtraction to algebra and geometry, math knowledge and skills are central to students' success, both in school and in the world beyond the classroom. How can afterschool programs bring these math concepts to life? The structures of many afterschool programs, including small-group and hands-on activities, lend themselves to the teaching and learning of math concepts. Not only can afterschool programs supplement their curriculum with mathematics lessons, but they can also look for math in already popular activities. For example, cooking activities can build students' skills in measurement and treasure hunts using mapping can extend understanding of geometry.

The National Partnership for Quality Afterschool Learning developed the online Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits) to give afterschool program directors and instructors the resources needed to plan fun, innovative, and academically enriching activities for students. The math section of the toolkit comprises seven promising practices, which are recommended methods of instruction that have been observed to increase student achievement. The promising practices are the following:

- *Finding Math*
- *Math Centers*
- *Math Games*
- *Math Projects*
- *Math Tools*
- *Math Tutoring*
- *Family Connections*

By "promising" practices, we mean recommended methods that have been observed to increase student achievement. Each practice is built on youth development principles and research on effective mathematics instruction. At their core, the Afterschool Training Toolkit materials are designed to illustrate techniques and activities that leverage student curiosity to make mathematics in afterschool both enjoyable and relevant. This guide provides professional development ideas for each practice.

In addition, three key ideas ensure that each practice results in the learning of important mathematics content, processes, and concepts: 1) problem solving, 2) math talk, and 3) working together. These key ideas are woven throughout each of the practices. It is important when providing professional development that each of these three key ideas are addressed and instructors are aware of how the ideas can be utilized within each of the practices. For more detail regarding the three key ideas for supporting mathematics learning, visit www.sedl.org/afterschool/toolkits/math.

How to Use This Guide

This guide has been developed to complement the mathematics section of the National Partnership for Quality Afterschool Learning's Afterschool Training Toolkit. It provides afterschool program leaders with practical suggestions for engaging staff members in professional development using each of the mathematics practices in the online Afterschool Training Toolkit. While this document provides sufficient information and direction to provide professional development for your afterschool staff using the math practices, the authors encourage you to visit the toolkit (www.sedl.org/afterschool/toolkits/math) for more details and additional recourses.

Separate professional development experiences are provided for each practice. The practices have either one or two different professional development ideas with each ranging in length from 30 to 60 minutes. Included are hands-on activities, videos from the Afterschool Training Toolkit, and reading and discussion activities. You may need to modify the ideas to meet the specific needs of your site; however, they provide a nice place to begin planning. In addition, do not hesitate to expand on the ideas presented here to capitalize on the interests of your staff.

This guide also includes tips for working with English Language Learners (ELLs). With the growing number of students from diverse backgrounds attending afterschool programs, it is important that practitioners increase their skills in working with this unique population. Afterschool often provides a safe place for ELLs to develop language skills, and this guide provides tips on how to simultaneously develop mathematics abilities.

Every afterschool program has areas for growth. Often, it can be overwhelming to decide where to focus improvement efforts. In this guide, we provide a rubric to assess your program's ability to provide high-quality mathematics enrichment. It is suggested that program staff come to consensus on the ratings and then choose one area on which to concentrate. After a strategy has been identified, give it time to be put into practice and then evaluate the impact it is having on student achievement.

Suggestions for Supporting English Language Learners

All students, both native English speakers and non-native English speakers, come to afterschool with different skills and attitudes based on their mathematical abilities and experiences. Some students may have strong basic skills but lack experience in problem solving, while others might have had more experience in problem solving but lack basic skills. However, as an additional level of complexity, English Language Learners (ELLs) also differ in their exposure to and proficiency in the English language. Thus, instructors need to take into account where ELLs fall on the continuum of math conceptual understanding and on the continuum of language ability.

The following overarching guidelines are helpful to take into consideration when planning math enrichment activities involving ELLs.

- **Allow nonverbal demonstration of understanding with manipulatives or pictures.** Some beginning ELLs may be in what is called the "silent receptive stage." That is, they may understand the mathematical concepts involved but may not have the linguistic competence to orally share an answer or explanation with the group or instructor. In these cases, it may be better to provide opportunities for students to write or draw their answers on the board or demonstrate their solutions with math tools.
- **Communicate information, vocabulary, or instructions nonverbally to ELLs through illustrations, examples, models, and demonstrations.** Math games, for instance, can be fun and lead to valuable learning if one understands the rules and math concepts that apply. Before playing, demonstrate the game to be sure that everyone knows how to participate.
- **Be intentional about how you group students.** Although you may want to group several beginning ELLs together to explain a problem or demonstrate an activity, be sure to experiment with different groupings, allowing ELLs to practice English with a variety of native speakers. Bilingual students who are fluent in two or more languages can serve as excellent partners, but it is important not to rely too much on them for translation.

- **Consult with the day-school and the English as a Second Language (ESL) teachers to establish a language policy specifically for the afterschool program.** Some schools have bilingual programs in which students may study certain subjects in their native language in addition to learning English. In other schools, particularly those where there is no predominant second language group, students communicate with each other and with teachers in English. Regardless of the school's program, it is ideal if afterschool can provide a time for ELLs to use their native language during times not specifically devoted to English language instruction.
- **Identify a linguistic goal for each math activity.** Determine both the mathematical language and the English vocabulary that is inherently involved in the math activity and choose a goal that is appropriate for the language levels of the ELL students. By considering the language involved in each activity, instructors can give students the words and language structures they need to be active and successful participants in each activity. *ELL teaching tips* and examples of *language goals* are included for each sample lesson in the online Afterschool Training Toolkit.

If your program serves ELL students, consider including professional development on this topic when learning about each of the math practices. You can accomplish this by including the following questions to help instructors think intentionally about how they can meet the needs of ELL students:

- What language will the students need to understand in order to fully participate in the activity?
  - Create a list of key vocabulary words to provide to students.
  - Develop sentence starters that will give students a place to start (e.g., "When I went to the store, I bought . . .").
- What parts of the procedure of the activity could you model to increase ELLs' comprehension?
- What visual guidance could you provide to improve understanding?

Practice 1

Finding Math

What Is It?

The key goals of *Finding Math* are to a) engage students in math through everyday activities they already enjoy; b) increase students' desire to learn; and c) ultimately extend their understanding of math. By noting the activities that students already like to do and then explicitly making mathematics connections to them, afterschool programs can maximize opportunities for math learning. From cooking to exercise, *Finding Math* encourages students to engage in fun activities while making meaningful discoveries, enhancing their understanding of math, and building their enthusiasm for learning. Programs that successfully implement the *Finding Math* practice tie the learning to what students are doing in school and to standards.

Why Do It in Afterschool?

We know that combining social enrichment with academics has a positive effect on mathematics achievement (Lauer, Akiba, Wilkerson, Apthorp, Snow, & Martin-Glenn, 2004), so it makes sense for afterschool programs to utilize their strengths to increase student achievement. The afterschool setting provides a great opportunity to integrate math learning with existing activities that students enjoy. Popular activities can be redesigned to naturally make connections between foundational mathematical concepts and their applications (Caine & Caine, 1994; Nunley, n.d.; Policy Studies Associates for the US DOE, 1995). *Finding Math* extends opportunities for learning mathematics in afterschool by capitalizing on popular afterschool activities.

What Does It Look Like?

Surprisingly, math can be found in a variety of fun afterschool activities. For example, utilizing an existing afterschool cooking club provides opportunities for students to engage in meaningful, relevant opportunities to use mathematics. They might measure ingredients, compare measurements of liquids and solids, convert between standard and metric systems, and reduce or enlarge amounts. In addition, many popular activities have physical components that might provide a different learning context for students struggling with mathematics (Caine & Caine, 1994; Nunley, n.d.; NCTM, 2000). Sports like basketball can become learning experiences about statistics, fractions, or percentages.

Professional Development Ideas

There are multiple ways to help staff understand and apply the *Finding Math* practice. On the following pages are plans for two professional development sessions. The first idea, which requires 1 hour, utilizes a hands-on activity and a vignette to demonstrate the practice in action. The second idea, which takes 30 minutes, demonstrates how a video clip from the online Afterschool Training Toolkit can be used to help staff understand *Finding Math.*

For sample lessons, an additional video clip, and links to additional resources to support the *Finding Math* practice, please visit the Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_find.html).

Professional Development Idea 1: Using a Vignette

The purpose of this professional development idea is to help participants visualize what a practice might look like in real life. Vignettes are short, narrative scenes that provide a sketch of an event. By examining vignettes, participants can consider how they might apply the practice to their professional situation. Before reading the vignette, it is important to engage the participant and create a context. Thus it is helpful to involve participants in a short hands-on activity. Following the vignette, participants discuss the mathematics that students learned during the scene and what the facilitator did or did not do to support the math learning. Finally, participants read a brief overview of the practice to help solidify and formalize their learning. Here participants are asked to consider the strengths they have in relationship to the practice and any areas they see for growth. By the end of this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ 2 cups of small marshmallows
- ❒ 1 1-cup measuring cup
- ❒ 1 highlighter for each participant
- ❒ Handout A: A Frog in a Pond Vignette (1 copy for each participant)
- ❒ Handout B: *Finding Math* Overview (1 copy for each participant)

Opening Activity

15 MINUTES

Ask participants to estimate how many marshmallows will fit into their measuring cup. Have each instructor write his or her estimate on the board. Ask questions about the strategies used for estimating such as the following:

- What strategies did you use to make your estimate?
- What factors did you consider when making your estimate?
- Did you count a section of the marshmallows before making your estimate?
- Did you select your estimate based on round numbers (fives, tens, etc.)?
- Did you picture in your mind how many would fill a certain space and then estimate based on that?

Allow for multiple strategies. This will reinforce the idea that there is not one right way to estimate.

Next, have one participant fill one measuring cup with marshmallows, count the total number it took to fill the cup, and write this number on the board. This is a good opportunity to talk about good estimates in relative terms by asking the following questions:

- How close or reasonable was your estimate?
- How reasonable does an estimate have to be to be "good?"
- Is 10% off of the actual measurement good enough? When might it not be good enough?

A Frog in a Pond Vignette

25 MINUTES

During this activity, participants read and discuss Handout A: A Frog in a Pond Vignette to "find" mathematical concepts and analyze an instructor's approach to intentionally extending students' learning of those concepts in a cooking exercise.

Ask participants to read Handout A. As they read, ask them to highlight in the text mathematical ideas the students are learning during the activity.

After the participants have finished reading, ask them to discuss the following question in small groups of two or three:

- For each mathematical idea you identified, what did the afterschool instructor, Beth, do or not do to facilitate the children's learning? Identify specific evidence from the vignette to support your claim.

Ask small groups to share their ideas with the whole group.

Finding Math Overview

20 MINUTES

Provide participants with Handout B: *Finding Math* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss how the vignette illustrated the practice of *Finding Math.*

Finally, ask participants to reflect in writing on their own practice. Ask the following questions:

- What are the implications of *Finding Math* for your own work in afterschool?
- What big ideas are you taking away with you?

Give participants time to privately think and journal about these questions.

Professional Development Idea 2: Using a Video

The purpose of this professional development idea is to show participants what has been done in other afterschool programs to implement the practice. Participants are asked to begin by reading and discussing an overview of the practice. This will provide them with the background knowledge necessary to make meaning of the video clip. In other words, they will have a deeper understanding of why they are viewing the clip and what they should look for while watching. After this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

30 minutes

Materials:

- ❒ Handout B: *Finding Math* Overview (1 copy for each participant)
- ❒ Video Clip: Rhythm and Beats
- ❒ 1 highlighter for each participant

Finding Math Overview — 15 MINUTES

Provide participants with the Handout B: *Finding Math* Overview. Ask them to read it and mark the text in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss what this might mean for their practice.

Rhythm and Beats

15 MINUTES

Before playing the video for the participants, ask them to consider the following questions while they watch:

- What mathematical ideas are the students learning about during the activity?
- How engaged are the students during the activity, and why do you think that is so?

Play the video for the participants. The video can either be found on the accompanying DVD or online at www.sedl.org/afterschool/toolkits/math/pr_math_find.html.

After watching the video, ask participants to discuss the following questions in small groups of two or three:

- For each mathematical idea you identified, what did the afterschool instructor do or not do to facilitate the children's learning? Identify specific evidence from the video to support your claim.
- How does this real-life video compare to the math learning that is happening in your program? What are you doing well? What could you improve?

Handout A: A Frog in a Pond Vignette

Beth, the afterschool instructor of nine children in grades K–2, is beginning the week's cooking class. The children are arranged around two tables—four at one and five at the other. Supply bags containing sets of measuring cups and ingredients are in front of each student. The children are about to create a "frog in a pond" constructed of orange juice, frozen yogurt, and marshmallows.

BETH: *Can you please hold up the biggest measuring cup?*

Beth pours orange juice into each child's 1-cup measuring cup. Then Beth asks the students to carefully pour the orange juice from their measuring cup into their own plastic cup.

BETH: *Pay attention to how the orange looks in the measuring cup and how it looks in the plastic cup. Do you notice anything in particular?*

THOMAS: *It looks like there is more orange juice in the clear cup.*

BETH: *Do the rest of you agree with Thomas?*

JULIE: *Well, I think the plastic cup has more orange juice in it because the orange juice is taller in the plastic cup than in the measuring cup.*

PETER: *But I think they have the same amount because we didn't add any orange juice to the plastic cup. They are the same.*

BETH: *Can you show us what you mean, Peter?*

Peter pours the orange juice from the plastic cup back into the measuring cup.

PETER: *See. It's the same amount. It doesn't matter which cup it's in.*

After providing more time for the students to discuss their ideas, Beth moves on.

BETH: *Find the 1/4-cup measuring cup. How many marshmallows do you think will fit into the 1/4-cup measuring cup? Do you think it will be closest to 5, 10, 15, or 20? Make a guess and write it down.*

How did you make your guess?

MICHELLE: *I tried to picture how many marshmallows would fill the bottom of the measuring cup. I thought there would be about 6—1 in the middle and 5 around the sides. Then I thought that the measuring cup would hold two rows, so that would be 12 marshmallows. That's closest to 10, so I picked 10.*

BETH: *Thanks for sharing, Michelle. Did anyone else have another way?*

KEVIN: *I did almost the same thing, but I thought that the bottom of the cup was like a square that would hold nine marshmallows, like this (Kevin arranges a 3 x 3 square of marshmallows on his desk). I also thought I could fit two rows of marshmallows in the cup. That makes 18 marshmallows, and that's almost 20. So I said 20.*

BETH: *Are there any other ways that you used to make a guess?*

MIGUEL: *I think it's 10. I think I could stuff 20 marshmallows into my mouth, and I also think I could fit two cups into my mouth. So that's 10 in each cup.*

BETH: *Go ahead and fill your measuring cup with marshmallows and then count them. Once you have counted, please go to the board and write your number down.*

The children count and create a list of numbers on the board.

BETH: *What do you notice about the numbers?*

Several observations from the children emerge, like:

"Almost all of the numbers are different."

"The biggest number is 21."

"The smallest number is 9."

BETH: *Why do you think most of the numbers are different?*

The children talk about how the measuring cups might all be different sizes. They wonder if Phillip squished his marshmallows because he wanted to eat more, and they wonder if they counted wrong.

BETH: *How could we measure again so that we all have about the same number of marshmallows in each measuring cup?*

Someone says, "Don't squish them!" Another says, "Don't heap them; even them out so it's flat across the top."

BETH: *Let's try measuring again without squishing or heaping the marshmallows.*

The children measure, count their marshmallows, and list their numbers on the board. This time the numbers are much closer.

BETH: *What do you see about the numbers this time?*

The children say that the numbers are closer, ranging from 5 to 13, and that the biggest number is 13.

Having talked about estimation with the children, Beth continues the cooking portion of the activity. She scoops frozen yogurt into each child's plastic cup of orange juice and asks them to put their marshmallows into the orange juice.

BETH: *Now you have made a frog in a pond. What is the orange juice?*

CHILDREN: *The pond.*

BETH: *What is the frozen yogurt?*

CHILDREN: *The frog!*

BETH: *What are the marshmallows?*

CHILDREN: *The bugs in the pond.*

BETH: *Enjoy your frog in a pond!*

After the activity, the children discuss what they know about frogs and read several books about frogs.

Handout B: *Finding Math* Overview

What Is It?

The key goals of *Finding Math* are to a) engage students in math through everyday activities they already enjoy; b) increase students' desire to learn; and c) ultimately extend their understanding of math. By noting the activities that students already like to do and then explicitly making mathematics connections to them, afterschool programs can maximize opportunities for math learning. From cooking to exercise, *Finding Math* encourages students to engage in fun activities while making meaningful discoveries, enhancing their understanding of math, and building their enthusiasm for learning. Programs that successfully implement the *Finding Math* practice tie the learning to what students are doing in school and to standards.

Why Do It in Afterschool?

We know that combining social enrichment with academics has a positive effect on mathematics achievement (Lauer, Akiba, Wilkerson, Apthorp, Snow, & Martin-Glenn, 2004), so it makes sense for afterschool programs to utilize their strengths to increase student achievement. The afterschool setting provides a great opportunity to integrate math learning with existing activities that students enjoy. Popular activities can be redesigned to naturally make connections between foundational mathematical concepts and their applications (Caine & Caine, 1994; Nunley, n.d.; Policy Studies Associates for the US DOE, 1995). *Finding Math* extends opportunities for learning mathematics in afterschool by capitalizing on popular afterschool activities.

What Does It Look Like?

Surprisingly, math can be found in a variety of fun afterschool activities. For example, utilizing an existing afterschool cooking club provides opportunities for students to engage in meaningful, relevant opportunities to use mathematics. They might measure ingredients, compare measurements of liquids and solids, convert between standard and metric systems, and reduce or enlarge amounts. In addition, many popular activities have physical components that might provide a different learning context for students struggling with mathematics (Caine & Caine, 1994; Nunley, n.d.; NCTM, 2000). Sports like basketball can become learning experiences about statistics, fractions, or percentages.

Practice 2

Math Centers

What Is It?

Math centers are individual or small-group stations that are designed to be used by children independent of any formal instruction. Math centers let students work on fun math activities such as puzzles, problems using manipulatives, and brainteasers. Children can choose to work with others or alone; they are allowed to pick the center(s) they work at; and they can individually determine how much time to spend at each center. The key goals of math centers are to a) engage students in math-related activities that build their problem-solving skills; b) increase students' desire to learn; and c) ultimately extend students' understanding of math.

Why Do It in Afterschool?

The use of centers in afterschool blends several research-based approaches for improving student achievement and learning in mathematics. Centers encourage student autonomy and independence and increase enthusiasm for learning by giving students opportunities to exercise choice (Van de Walle, 2004). Stephens and Jairrels (2003) see learning centers as educational environments that allow students to deepen their content understanding through self-directed learning. Students are able to choose which centers to work at and how to approach a problem-solving situation based on their strengths, abilities, and interests. Learning centers also enhance socialization skills by providing authentic opportunities for students to work together on a problem (Welsh, Russell, Williams, Reisner, & White, 2002).

What Does It Look Like?

Center activities typically include engaging, worthwhile mathematical problems that require reasoning and thinking. Math centers work best when students have some choice in their activity, when they can approach an activity or problem from different angles, and when students can work independently or with their peers to solve a problem. When using math centers, instructors act as facilitators; they circulate among the students, ask questions to guide them toward deeper thinking, and provide feedback that encourages students' desire to learn. When deciding on center activities, talk to the day-school teacher to find out what concepts students are learning, consider activities that your students enjoy, and think about how appropriate math concepts and skills can be incorporated into those activities.

Professional Development Ideas

There are multiple ways to help staff understand and apply the *Math Centers* practice. On the following pages are plans for two professional development sessions. The first idea, which requires 1 hour, utilizes a hands-on activity and a vignette to demonstrate the practice in action. The second idea, which takes 30 minutes, demonstrates how a video clip from the Afterschool Training Toolkit can be used to help staff understand *Math Centers.*

For sample lessons and links to additional resources to support the *Math Centers* practice, please visit the Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_centers.html).

Professional Development Idea 1: Using a Vignette

The purpose of this professional development idea is to help participants visualize what a practice might look like in real life. Vignettes are short, narrative scenes that provide a sketch of an event. By examining vignettes, participants can consider how they might apply the practice to their professional situation. Before reading the vignette, it is important to engage the participant and create a context. Thus it is helpful to involve participants in a short hands-on activity. Following the vignette, participants discuss the mathematics that students learned during the scene and what the facilitator did or did not do to support the math learning. Finally, participants read a brief overview of the practice to help solidify and formalize their learning. Here participants are asked to consider the strengths they have in relationship to the practice and any areas they see for growth. By the end of this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ Unlined and/or graph paper
- ❒ Calculators
- ❒ Pencils with erasers
- ❒ Base-10 blocks (a math manipulative to aid in the development of operations and place value) (optional)
- ❒ Play money (optional)
- ❒ Handout C: Using Gift Certificates (1 copy for each participant)
- ❒ Handout D: Restaurant Gift Certificate Vignette (1 copy for each participant)
- ❒ Handout E: *Math Centers* Overview (1 copy for each participant)
- ❒ 1 highlighter for each participant

Opening Activity

20 MINUTES

Divide participants into groups of three or four. The members of the group may work independently or together as a group. Provide them with Handout C: Using Gift Certificates and the accompanying materials. Give them 10 minutes to work on solving the problem with the expectation that they may not come to a final solution in that time. The purpose of the activity is to examine the multiple ways in which people approach a given math problem.

Spend the remaining 10 minutes allowing each small group (or individual) to present their solution to the whole group as well as the steps and mathematical reasoning involved. If participants are having a difficult time expressing their problem-solving strategies, use guiding questions to help them explain their thinking. Sample guiding questions include the following:

- What strategies or reasoning did you use to solve the problem?
- What steps did you take to solve this problem? What did you do first?
- Why did you choose the process that you did?

Allow for other groups to ask questions of the presenters as necessary. Reinforce the idea that there is not one right way to solve the problem.

Restaurant Gift Certificate

20 MINUTES

During this activity, participants read a vignette that illustrates what math centers might look like in an afterschool program.

Ask participants to read Handout D: Restaurant Gift Certificate Vignette. As they begin reading, ask them to highlight in the text mathematical ideas the students are learning during the activity.

After the participants have finished reading, ask them to break into small groups of three or four to discuss the following:

- For each mathematical idea you identified, what did the afterschool instructor do or not do to facilitate the children's learning? Identify specific evidence from the text to support your claim.

Ask everyone to share their ideas with the whole group.

Math Centers Overview

20 MINUTES

Provide participants with Handout E: *Math Centers* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss how the vignette illustrated the practice of *Math Centers.*

Finally, ask participants to reflect in writing on their own practice. Ask the following questions:

- What are the implications of *Math Centers* for your own work in afterschool?
- What big ideas are you taking away with you?

Give participants time to privately think and journal about these questions.

Professional Development Idea 2: Using a Video

The purpose of this professional development idea is to show participants what has been done in other afterschool programs to implement the practice. Participants are asked to begin by reading and discussing an overview of the practice. This will provide them with the background knowledge necessary to make meaning of the video clip. In other words, they will have a deeper understanding of why they are viewing the clip and what they should look for while watching. After this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

30 minutes

Materials:

- ❒ Handout E: *Math Centers* Overview (1 copy for each participant)
- ❒ Video Clip: Center-based Math Games
- ❒ 1 highlighter for each participant

Math Centers Overview — 15 MINUTES

Provide participants with Handout E: *Math Centers* Overview. Ask them to read it and mark the text in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss what this might mean for their practice.

Center-based Math Games

15 MINUTES

Before playing the video for the participants, ask them to consider the following questions while they watch:

- What mathematical ideas are the students learning about during the activity?
- How engaged are the students during the activity, and why do you think that is so?

Play the video for the participants. The video can either be found on the accompanying DVD or online at www.sedl.org/afterschool/toolkits/math/pr_math_centers.html.

After they have watched the video, ask participants to discuss the following questions in small groups of two or three:

- For each mathematical idea you identified, what did the afterschool instructor do or not do to facilitate the children's learning? Identify specific evidence from the video to support your claim.
- How does this real-life video compare to the math learning that is happening in your program? What are you doing well? What could you improve?

Handout C: Using Gift Certificates

Mission Description

You received a gift certificate to your favorite restaurant worth $65. You invite four of your closest friends to dinner. All five of you must order at least one entree and at least one drink; you may not spend more than $65. Make a list of what each member of the group would order and find the total cost. Good luck!

Menu

ENTREES

Spaghetti $8.00
Hamburger and fries $7.25
Fish fillet $8.50
Soup and sandwich $6.50
Soup and salad $6.00

SIDES

Salad $2.99
French fries $1.99
Baked potato $.99
Steamed vegetables $1.50
Applesauce $.75

DESSERTS

Brownie sundae $3.50
Ice cream sundae $2.50
Chocolate layer cake $2.50
Cherry pie $3.00
Lemon square $2.75

DRINKS

Milk $1.25
Juice $1.50
Soda $1.00
Lemonade $1.00
Iced tea $.75

Handout D: Restaurant Gift Certificate Vignette

Mr. José has his room set up with four different math centers for the kids. He spoke with the day-school teachers and discovered that many of his students are having difficulty with adding decimals.

It is 3:00 p.m., and students start to trickle in. They have just finished snack time in the cafeteria. Mr. José greets every student as they enter. This daily routine gives him a chance to briefly connect with each student. He begins, "Place your backpacks against the wall, choose any center to start at, and have a seat so that you can begin your mathematics adventure!"

One math center is set up like a restaurant table with a checkerboard tablecloth, napkins, plastic utensils, and menus. At the center of the table are supplies (unlined paper, graph paper, calculators, pencils, base ten blocks, erasers). The table also has a table tent made out of construction paper that reads "PROBLEM SOLVERS ONLY: Make the Most of a Gift Certificate to Your Favorite Restaurant!" Soon, four students find their seat at the center and begin to assess what is in front of them.

"SWEET! Maybe we'll get something to eat!" announces Vincent, a fifth grader.

"Silly, we just had snack!" replies Felicia, also a fifth grader, rolling her eyes.

"Can't you guys read?" questions Manuel, a fourth grader, pointing to the center of the table.

"We are going to figure out the best way to spend money!" Tanya, the final member of the group, also a fourth grader, encourages the group.

"Well, let's get started!" exclaims Manuel.

Tantalized by the menu and the impending task, the foursome works together to pass out supplies and "mission descriptions."

Mr. José has worked since the beginning of the year to instill a sense of mystery, curiosity, and problem solving in the center activities. Over time, he has seen his students become both more inquisitive and better at working on challenges.

The mission description reads:

You received a gift certificate to your favorite restaurant worth $65. You invite four of your closest friends to dinner. All five of you must order at least one entree and at least one drink; you may not spend more than $65. Make a list of what each member of the group would order and find the total cost. Good luck!

"I know who I will invite! Carlos, Becky, Victor, and Dominic," announces Vincent.

"I knew you liked Becky!" teases Felicia.

Handout D, continued

"Let's start thinking about how you are going to tackle this problem," says Mr. José. "I'll be back in a few minutes to see where each of you is with your thinking."

Mr. José walks away. The children's minds are racing.

Manuel and Felicia begin to scratch away on their paper while Vincent grabs a calculator and begins to run through some scenarios in his head. Tanya sits quietly, absorbing the problem before acting. After a minute, Tanya starts to manipulate the base ten blocks and divides her paper in five sections.

Felicia and Vincent begin to compare ideas. Shaking their heads at each other, they laugh and continue working independently. The friendly competition fuels their engines.

Manuel looks over at Tanya's segmented paper and asks her why she has divided it the way she has.

Tanya replies, "Because it is easier for me to keep track of what I've done so far. There are five girls eating, so each person has her own section. I am going to map out each person's meal."

"That's a good idea, I think I'll try it . . . if you don't mind," says Manuel.

"Sure, go for it," Tanya replies.

Mr. José returns and asks, "So what are you four thinking?"

"Mr. J., I had some ideas and am trying to test them out on a calculator," responds Vincent.

"I see. Good. How are you keeping track of your thinking and the tests you have run?"

"I'll start doing that because I think I'm getting pretty close." Vincent grabs a piece of paper and begins to record.

"I'm anxious to see your results, Vincent. Keep at it. What about the rest of you?"

Felicia shows Mr. José her paper and how she has made predictions by estimating totals. Mr. José notices that Felicia has rounded down in order to estimate and asks her why she has chosen to do so.

"I wasn't sure if rounding up or down really made a difference because either way you're rounding and not getting an exact answer. I plan to test out my estimates."

"Good, Felicia. It will be interesting to see how close your estimates are and for you to then determine whether or not rounding down versus up was a helpful process."

Manuel begins to show Mr. José the organization of what he has recorded and reveals that he got the idea from Tanya.

"Good. I am glad that you are sharing ideas," reinforces Mr. José. "Tanya, how are you solving this problem?"

Tanya responds, "I figured since there are five people and $65, each person can spend $13. I'm then thinking about each person's favorite food and trying to see if they have enough money to order it."

"Keep at it, each of you. I'll be back after a bit to see how things are going," states Mr. José.

Students at other centers are focused and working on different missions. Mr. José continues to circulate among them to assess student progress and offer support when needed.

Vincent, Manuel, Felicia, and Tanya continue to work and share their information with each other and Mr. José. By the end of the time allotted for centers, each student has reached a conclusion that he or she is satisfied with. Vincent couldn't be prouder that he has created a scenario that will cost $64.75. The centers are straightened up by the students prior to leaving, and Mr. José stands at the door shaking each of their hands as they leave for recreation. "Mission accomplished!" he tells them.

Mr. José heads back to his folder to quickly jot down some notes so he won't forget the details of what he will share with the day-school math teachers the next time he sees them.

Handout E: *Math Centers* Overview

What Is It?

Math centers are individual or small-group stations that are designed to be used by children independent of any formal instruction. Math centers let students work on fun math activities such as puzzles, problems using manipulatives, and brainteasers. Children can choose to work with others or alone; they are allowed to pick the center(s) they work at; and they can individually determine how much time to spend at each center. The key goals of math centers are to a) engage students in math-related activities that build their problem-solving skills; b) increase students' desire to learn; and c) ultimately extend students' understanding of math.

Why Do It in Afterschool?

The use of centers in afterschool blends several research-based approaches for improving student achievement and learning in mathematics. Centers encourage student autonomy and independence and increase enthusiasm for learning by giving students opportunities to exercise choice (Van de Walle, 2004). Stephens and Jairrels (2003) see learning centers as educational environments that allow students to deepen their content understanding through self-directed learning. Students are able to choose which centers to work at and how to approach a problem-solving situation based on their strengths, abilities, and interests. Learning centers also enhance socialization skills by providing authentic opportunities for students to work together on a problem (Welsh, Russell, Williams, Reisner, & White, 2002).

What Does It Look Like?

Center activities typically include engaging, worthwhile mathematical problems that require reasoning and thinking. Math centers work best when students have some choice in their activity, when they can approach an activity or problem from different angles, and when students can work independently or with their peers to solve a problem. When using math centers, instructors act as facilitators; they circulate among the students, ask questions to guide them toward deeper thinking, and provide feedback that encourages students' desire to learn. When deciding on center activities, talk to the day-school teacher to find out what concepts students are learning, consider activities that your students enjoy, and day-school think about how appropriate math concepts and skills can be incorporated into those activities.

Practice 3

Math Games

What Is It?

Math games are fun activities that develop targeted math strategies and skills by leveraging students' natural inclination to play. The purpose of *Math Games* is to engage students in learning math in an unconventional way. The best games are those that encourage involvement, call for both skill and chance, require students to think deeply, and allow for students to use multiple problem-solving strategies (Hildebrandt, 1998). The games should build students' math knowledge and skills while increasing their desire to learn.

Why Do It in Afterschool?

In the afterschool environment, games provide a rich context for social and mathematical development (Hildebrandt, 1998). By interacting together to solve a math problem during a game, students not only increase their math knowledge, but they also improve their ability to work with others. Math games also provide students with the opportunity to explore new strategies for problem solving, and repeated play gives children opportunities to practice these strategies (Hildebrandt, 1998). Perhaps most important, games can be highly motivating to students.

What Does It Look Like?

Math games should be selected to engage students' interests but should also target the mathematical concepts and skills students need to learn. The games might be competitive, cooperative, whole group, small group, or solitary. Mathematical games appear to be most effective in enhancing students' development when a caring adult is present to support and extend students' learning (Peters, 1998). As a facilitator, your role is to ask questions that encourage students to use what they know about math, to highlight important mathematical concepts through modeling, and to promote conversations with and among students.

Professional Development Ideas

There are multiple ways to help staff understand and apply the *Math Games* practice. On the following pages are plans for two professional development sessions. The first idea, which requires 1 hour, utilizes a hands-on activity and a vignette to demonstrate the practice in action. The second idea, which takes 30 minutes, demonstrates how a video clip from the Afterschool Training Toolkit can be used to help staff understand *Math Games.*

For sample lessons, an additional video clip, and links to additional resources to support the *Math Games* practice, please visit the Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_games.html).

Professional Development Idea 1: Using a Vignette

The purpose of this professional development idea is to help participants visualize what a practice might look like in real life. Vignettes are short, narrative scenes that provide a sketch of an event. By examining vignettes, participants can consider how they might apply the practice to their professional situation. Before reading the vignette, it is important to engage the participant and create a context. Thus it is helpful to involve participants in a short hands-on activity. Following the vignette, participants discuss the mathematics that students learned during the scene and what the facilitator did or did not do to support the math learning. Finally, participants read a brief overview of the practice to help solidify and formalize their learning. Here participants are asked to consider the strengths they have in relationship to the practice and any areas they see for growth. By the end of this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ 10-sided numbered die or a spinner labeled 0–9 (1 die for every 3 participants)
- ❒ Handout F: Number Wizards Directions and Game Board (1 copy for every 3 participants)
- ❒ Handout G: Number Wizards Relay Vignette (1 copy for each participant)
- ❒ Handout H: *Math Games* Overview (1 copy for each participant)
- ❒ 1 highlighter for each participant

Opening Activity

15 MINUTES

Invite participants to play the game Number Wizards. Distribute the directions (Handout F), and clarify how the game is played. Divide participants into groups of three players. Distribute dice or spinners. Provide about 10 minutes for the participants to play.

Afterward, ask questions about the strategies used for playing such as the following:

- How did you decide where to place each number?
- Which strategy seemed to work the best given who won?

When debriefing this activity, make sure to allow for multiple strategies. This will reinforce the idea that there is not one right way to play the game, though there may be more or less effective strategies.

Number Wizards Relay Vignette

25 MINUTES

Ask participants to read Handout G: Number Wizards Relay Vignette. As they read, ask them to think about the ways in which the instructor integrated math concepts into a physical education activity.

After the participants have finished reading, ask them to talk in small groups of 3 or 4 about the following:

- What did you notice about the way in which the instructor integrated math concepts into a physical education activity?
- How might you change the Number Wizards game to keep it interesting over time (e.g., try to make the smallest number possible)?

Ask everyone to share their ideas with the whole group.

Math Games Overview

20 MINUTES

Provide participants with Handout H: *Math Games* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss how the vignette illustrated the practice of *Math Games.*

Finally, ask participants to reflect in writing on their own practice. Ask the following questions:

- What are the implications of *Math Games* for your own work in afterschool?
- What big ideas are you taking away with you?

Give participants time to privately think and journal about these questions.

Professional Development Idea 2: Using a Video

The purpose of this professional development idea is to show participants what has been done in other afterschool programs to implement the practice. Participants are asked to begin by reading and discussing an overview of the practice. This will provide them with the background knowledge necessary to make meaning of the video clip. In other words, they will have a deeper understanding of why they are viewing the clip and what they should look for while watching. After this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

30 minutes

Materials:

- ❒ Handout H: *Math Games* Overview (1 copy for each participant)
- ❒ Video Clip: Bacon and Eggs
- ❒ 1 highlighter for each participant

Math Games Overview — 15 MINUTES

Provide participants with Handout H: *Math Games* Overview. Ask them to read it and mark the text in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss what this might mean for their practice.

Bacon and Eggs

15 MINUTES

Before playing the video for the participants, ask them to consider the following questions while they watch:

- What mathematical ideas are the students learning about during the activity?
- How engaged are the students during the activity, and why do you think that is so?

Play the video for the participants. The video can either be found on the accompanying DVD or online at www.sedl.org/afterschool/toolkits/math/pr_math_games.html.

After watching the video, ask participants to discuss the following questions in small groups of two or three:

- For each mathematical idea you identified, what did the afterschool instructor do or not do to facilitate the children's learning? Identify specific evidence from the video to support your claim.
- How does this real-life video compare to the math learning that is happening in your program? What are you doing well? What could you improve?

Handout F: Number Wizards Directions and Game Board

Objective:

Play a game in which you try to build the greatest number possible with a given set of digits.

Materials:

- 10-sided numbered die or a spinner labeled 0–9 (1 for every 3 participants)
- Handout F: Wizards Directions and Game Board (1 copy for every 3 participants)

Directions:

1. Divide into groups of three.
2. Players take turns rolling a 10-sided die or twirling a spinner labeled 0–9.
3. Each player writes the number that comes up on his or her roll (or spin) in one space on his or her place on the game board.
4. Once the digit is written, it cannot be moved. The person who builds the greatest number after 10 rolls is the winner.

Player #1 _____

_____, _____ _____ _____, _____ _____ _____, _____ _____ _____

Player #2 _____

_____, _____ _____ _____, _____ _____ _____, _____ _____ _____

Player #3 _____

_____, _____ _____ _____, _____ _____ _____, _____ _____ _____

Handout G: Number Wizards Relay Vignette

Ms. Chen is working in the gym today with her group of 19 fourth graders. It has been raining heavily all day, and her students are fidgety. Ms. Chen is hoping to capture their attention by engaging them in a fun game, but she also knows her students need help on mathematical number sense. She's been planning some games and activities that involve mathematics; now will be a great time to try out one of them.

MS. CHEN: *Okay, what would you guys like to do today?*

MARIA: *Can we jump rope?*

DARIUS: *I wish we could play basketball. I need to practice for tomorrow's game.*

Another student suggests that the group could do both by running a relay race.

Thinking on her feet, Ms. Chen considers how she can combine a new math game she discovered called Number Wizards with a relay race. Ms. Chen has students number off to form four teams.

MS. CHEN: *Now let's count off, starting with Karin: one, two, three, four, one . . . .*

After the students have counted off, Ms. Chen directs the students to form four lines, one for each team.

MS. CHEN: *The people in your line are your teammates. Are you ready to face off against the other teams in a relay race challenge that requires jumping rope, shooting baskets, math, and speed?*

The students respond with cheers.

MS. CHEN: *For this relay race, you first jump rope 10 times in a row, next complete a basket, and then run back to your team. Each team will have a piece of paper that looks like this.*

She holds up one piece of paper for each team that has lines representing a place holder for 10 digits and commas separating the thousands place, the millions place, and the billions place.

_____, _____ _____ _____, _____ _____ _____, _____ _____ _____

MS. CHEN: *When you get back to your team, you will roll a 10-sided die. You then write your number on one of the lines. Once you write your number down, you cannot change it. Your team's goal is to make the largest number possible. The team with the largest number receives a point, and the team who finishes the relay first will also receive a point. We will play this more than once, so the team with the most points at the end of our time will win. Does anyone have questions?*

Handout G: continued

After answering a few questions, each team is given a 10-sided die and a Number Wizards game board. Ms. Chen asks if everyone is ready; the students are eager to begin.

MS. CHEN: *Ready, set, go!*

Sam returns from jumping rope and making a basket and rolls a 7. He quickly writes 7 in the 10 millions place.

____, ____ ___7___ ____, ____ ____ ____, ____ ____ ____

After completing the relay, José rolls a 1 and a small groan comes from his team. He writes it in the tens place.

AMIR: *Why didn't you write it in the ones place?*

JOSÉ: *Someone could roll a 0. We want that to go in the ones place.*

Brianna completes both tasks quickly and runs back to roll her number.

BRIANNA: *I rolled a 9!! I'm putting it in the first spot.*

Ms. Chen overhears Brianna and asks her to correctly name the "first spot."

BRIANNA: *Oh, that's easy. It's the billions place.*

Play continues until all the lines are filled in. Ms. Chen writes each team's numbers on the white board.

MS. CHEN: *Who has the biggest number?*

JUAN: *We do! Our number starts with 9, and all of the other numbers start with a smaller number.*

MS. CHEN: *OK. So that's one point for Team #2 for having the largest number and one point for Team #1 for finishing the relay first. Are you ready to play again?*

Handout H: *Math Games* Overview

What Is It?

Math games are fun activities that develop targeted math strategies and skills by leveraging students' natural inclination to play. The purpose of *Math Games* is to engage students in learning math in an unconventional way. The best games are those that encourage involvement, call for both skill and chance, require students to think deeply, and allow for students to use multiple problem-solving strategies (Hildebrandt, 1998). The games should build students' math knowledge and skills while increasing their desire to learn.

Why Do It in Afterschool?

In the afterschool environment, games provide a rich context for social and mathematical development (Hildebrandt, 1998). By interacting together to solve a math problem during a game, students not only increase their math knowledge, but they also improve their ability to work with others. Math games also provide students with the opportunity to explore new strategies for problem solving, and repeated play gives children opportunities to practice these strategies (Hildebrandt, 1998). Perhaps most important, games can be highly motivating to students.

What Does It Look Like?

Math games should be selected to engage students' interests but should also target the mathematical concepts and skills students need to learn. The games might be competitive, cooperative, whole group, small group, or solitary. Mathematical games appear to be most effective in enhancing students' development when a caring adult is present to support and extend students' learning (Peters, 1998). As a facilitator, your role is to ask questions that encourage students to use what they know about math, to highlight important mathematical concepts through modeling, and to promote conversations with and among students.

Practice 4

Math Projects

What Is It?

Math projects are experiences that connect mathematical concepts and procedures to engaging real-world activities that extend for more than one lesson. Key to the concept is that mathematics, content and processes, emerge from the students' own investigation of an authentic situation rather than from a classroom exercise. This helps students see ties between mathematics and real-life experiences.

Why Do It in Afterschool?

Afterschool project-based learning in math works because students are directly involved in their own learning. They develop problem-solving skills, learn new math content, and apply what they learn in genuine situations. Through project work students develop a need to learn new mathematical content and applications in order to complete their projects. They also grapple with the connections between the math they have learned in school and real-world experiences. In doing so, they gain skill in transferring and applying this knowledge.

What Does It Look Like?

Begin by talking with the day-school teacher, who can identify the math concepts, skills, and standards students are studying. Work with students to choose an idea or project that interests them. Then identify what students will do, make a project plan and time line, identify resources you will need, and conduct the project. Projects work best when students can work on them in a regular, ongoing way, as some projects can take several days. You will also want to determine how your students will present their projects and how you will evaluate them. A culminating activity, such as a final product or presentation, is a typical way to wrap up a math project.

Professional Development Idea

There are multiple ways to help staff understand and apply the *Math Projects* practice. On the following pages is a sample plan for a professional development session. This option, which requires 1 hour, utilizes small- and large-group discussion along with a video clip from the Afterschool Training Toolkit to help staff understand how math projects can be incorporated into an afterschool program.

For sample lessons and links to additional resources to support the *Math Projects* practice, please visit the Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_projects.html).

Professional Development Idea: Using a Video

The purpose of this professional development idea is to show participants what has been done in other afterschool programs to implement the practice. Participants are asked to begin by learning the difference between project-based learning and thematic learning. This will provide them with the background knowledge necessary to make meaning of the video clip. In other words, they will have a deeper understanding of why they are viewing the clip and what they should look for while watching. After this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ Video clip: Small Fry
- ❒ Handout I: Thematic Versus Project-based Learning Venn Diagram (1 copy for each small group)
- ❒ Handout J: *Math Projects* Overview (1 copy for each participant)
- ❒ Handout K: *Math Projects* Video Reflection Sheet (1 copy for each participant)
- ❒ 1 highlighter for each participant

Opening Activity

20 MINUTES

Key to understanding *Math Projects* is to understand the difference between project-based learning and thematic learning. These terms can be misleading if not examined closely. To make sure that your whole staff has the same background knowledge and understanding of *Math Projects,* it is important to distinguish between these two types of learning.

To start this conversation, begin by sharing the following definitions with your staff.

The Center for Summer Learning at Johns Hopkins University defines thematic learning as "an approach that uses one idea to frame and connect activities from multiple subject areas or disciplines. Thematic learning is sometimes referred to as interdisciplinary, multi-disciplinary, webbed, integrated, or cross-disciplinary learning. Thematic learning often includes elements of experiential learning, or learning presented in meaningful contexts that incorporate aspects from life outside the classroom" (Fairchild, McLaughlin, & Eden, 2006, p. 49).

The Buck Institute for Education (2003) defines project-based learning as "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks" (p. 4).

Once participants have read the quotes, ask participants to pair up and complete Handout I: Thematic Versus Project-based Learning Venn Diagram. Where the two circles overlap, participants should write the features that thematic learning and project-based learning share. In the

left side of the diagram, they should place concepts that are unique to thematic learning, and on the right side, they should place concepts that are unique to project-based learning.

Once all groups have had an opportunity to complete their diagrams, allow for each pair to share with the larger group. It is important that you build a common understanding of the two terms.

Math Projects Overview

20 MINUTES

Provide participants with Handout J: *Math Projects* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and to reflect on their own current use of math projects. Ask the following questions:

- What are the implications of *Math Projects* for your own work in afterschool?
- What big ideas are you taking away with you?

Give participants time to privately think and journal about these questions.

Small Fry

20 MINUTES

In the real world, we are unlikely to find a project that solely involves mathematics knowledge and skills. The same is the case when we look at projects in the afterschool setting. This practice, therefore, was designed to help practitioners think about how to integrate multiple content areas into one project. When thinking about *Math Projects,* we often see science integrated. In order to gain a better understanding of how projects work in afterschool, view the Small Fry video in the science section of the Afterschool Training Toolkit.

Before playing the video for the participants, ask them to consider the following questions while they watch (distribute Handout K: *Math Projects* Video Reflection Sheet so participants can record their ideas):

- What about the video did you find most intriguing?
- How engaged are the students during the activity, and why do you think that is so?
- What mathematical ideas are the students learning about during the activity?
- Aside from mathematics and science, were there other academic components to this project?

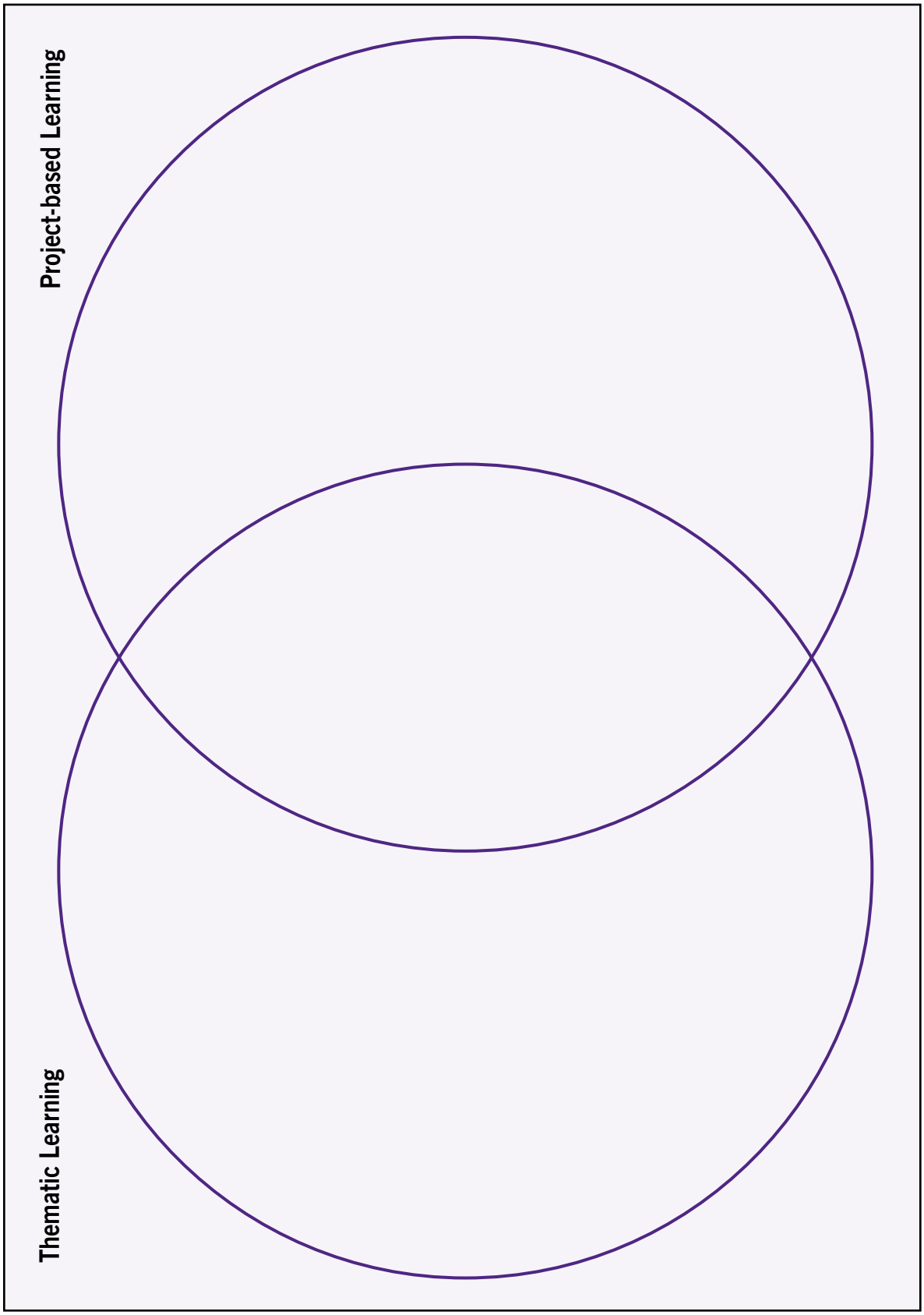
Play the video for the participants. The video can either be found on the accompanying DVD or online at www.sedl.org/afterschool/toolkits/science/pr_exploring.html.

After watching the video, ask participants to discuss their responses to the video reflection questions.

To conclude the session, ask participants to reflect on the following questions either through discussion or journaling:

- How does this real-life video compare to the math learning that is happening in your program? What are you doing well? What could you improve?

Handout I: Thematic Versus Project-based Learning Venn Diagram



Handout J: *Math Projects* Overview

What Is It?

Math projects are experiences that connect mathematical concepts and procedures to engaging real-world activities that extend for more than one lesson. Key to the concept is that mathematics, content and processes, emerge from the students' own investigation of an authentic situation rather than from a classroom exercise. This helps students see ties between mathematics and real-life experiences.

Why Do It in Afterschool?

Afterschool project-based learning in math works because students are directly involved in their own learning. They develop problem-solving skills, learn new math content, and apply what they learn in genuine situations. Through project work students develop a need to learn new mathematical content and applications in order to complete their projects. They also grapple with the connections between the math they have learned in school and real-world experiences. In doing so, they gain skill in transferring and applying this knowledge.

What Does It Look Like?

Begin by talking with the day-school teacher, who can identify the math concepts, skills, and standards students are studying. Work with students to choose an idea or project that interests them. Then identify what students will do, make a project plan and time line, identify resources you will need, and conduct the project. Projects work best when students can work on them in a regular, ongoing way, as some projects can take several days. You will also want to determine how your students will present their projects and how you will evaluate them. A culminating activity, such as a final product or presentation, is a typical way to wrap up a math project.

Handout K: *Math Projects* Video Reflection Sheet

- What about the video did you find most intriguing?

- How engaged are the students during the activity, and why do you think that is so?

- What mathematical ideas are the students learning about during the activity?

- Aside from mathematics and science, were there other academic components to this project?

Practice 5

Math Tools

What Is It?

Math tools are any concrete materials used to measure, count, sort, or evaluate a mathematical problem. They may include manipulatives such as beans, counters, blocks, rulers, pictures, symbols, and technology (Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, et al., 1997; National Research Council, 2001; Van de Walle, 1998). Using math tools has shown to have a positive impact on student achievement and to improve student attitudes toward learning (Sowell, 1989). Additionally, math tools 1) help students think flexibly about mathematics, 2) allow for more creative approaches to new problems (Hiebert et al., 1997), and 3) enable students to explore math with less anxiety (English & Halford, 1995; Hiebert et al., 1997).

Why Do It in Afterschool?

Afterschool programs offer unique opportunities to provide students with extended practice using various math tools, and using these tools has been demonstrated to have a positive impact on student achievement (Policy Studies Associates for the US DOE, 1995). The *Math Tools* practice is powerful because students can use the tools to explore concepts and build mathematical understanding (Van de Walle, 1998). Because the nature of afterschool is active and social, afterschool settings are ideal for allowing students to explore, test, build, think, talk, connect, and reason with math tools. When tools are used productively, students will not only become better mathematical thinkers, but they will also enjoy mathematics more (Sowell, 1989).

What Does It Look Like?

It is tempting to show students how to use the manipulatives, but math tools work best when students figure out for themselves how the tools can help them solve a problem. Provide an assortment of tools to tap students' interest and to help them see the variety of approaches to solving a problem. Help students make connections between the tools and the corresponding mathematical ideas. Finally, encourage students to discuss how specific tools contributed to their thinking about mathematics.

Professional Development Idea

There are multiple ways to help staff understand and apply the *Math Tools* practice. On the following pages is a sample plan for a professional development session. This idea, which requires 1 hour, utilizes a hands-on activity and a vignette to demonstrate the practice in action.

For sample lessons and links to additional resources to support the *Math Tools* practice, please visit the Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_tools.html).

Professional Development Idea: Using a Vignette

The purpose of this professional development idea is to help participants visualize what a practice might look like in real life. Vignettes are short, narrative scenes that provide a sketch of an event. By examining vignettes, participants can consider how they might apply the practice to their professional situation. Before reading the vignette, it is important to engage the participant and create a context. Thus it is helpful to involve participants in a short hands-on activity. Following the vignette, participants discuss the mathematics that students learned during the scene and what the facilitator did or did not do to support the math learning. Finally, participants read a brief overview of the practice to help solidify and formalize their learning. Here participants are asked to consider the strengths they have in relationship to the practice and any areas they see for growth. By the end of this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ Pencils
- ❒ Paper
- ❒ 1 small bag of M&Ms for each group of 2–3 students
- ❒ 1 computer with Microsoft Excel for each group
- ❒ Handout L: Investigating the Colors of M&Ms (1 copy for each participant)
- ❒ Handout M: Investigating the Colors of M&Ms Vignette (1 copy for each participant)
- ❒ Handout N: *Math Tools* Overview (1 copy for each participant)
- ❒ 1 highlighter for each participant

Opening Activity

30 MINUTES

The purpose of this activity is to engage the participants in a portion of the activity from the vignette.

Divide participants into groups of two or three. Provide each group with a small bag of M&Ms.

Before participants open their bag, ask them to estimate the number of M&Ms in the bag and predict how many of each color will be in each bag (note that there is the potential to find red, green, brown, blue, orange, and yellow). Everyone should write down his or her prediction.

Ask participants to open their bag and sort, classify, count, and record 1) the total number of M&Ms and 2) the number of each color in their bag.

Ask participants the following questions:

- What strategies did you use to make your estimate? What factors did you consider?
- How did you collect your data?
- How accurate was your prediction? Why do you think that was so?

Distribute a copy of Handout L: Investigating the Colors of M&Ms to each participant and have them complete the activity using Excel.

When participants have completed the activity, ask them to use the information to create a picture of the M&Ms in their bag. Spend the remaining minutes providing the opportunity for each group (or individual) to present their results, as well as their steps and mathematical thinking involved, to the group. Allow for other groups to ask questions of the presenters as necessary. Reinforce the idea that there is not one right way to solve the problem.

Investigating the Colors of M&Ms Vignette

15 MINUTES

Ask participants to read Handout M: Investigating the Colors of M&Ms Vignette. As they read, ask them to highlight any mathematical ideas the students are learning. After the participants have finished reading, ask them to talk in small groups of three or four about the following:

- For each mathematical idea you identified, what did the afterschool instructor do or not do to facilitate the children's learning? Identify specific evidence from the text to support your claim.

Ask everyone to share their ideas with the whole group.

Math Tools Overview

15 MINUTES

Provide participants with Handout N: *Math Tools* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss how the vignette illustrated the practice of *Math Tools.*

Finally, ask participants to reflect in writing on their own practice. Ask the following questions:

- What are the implications of *Math Tools* for your own work in afterschool?
- What big ideas are you taking away with you?

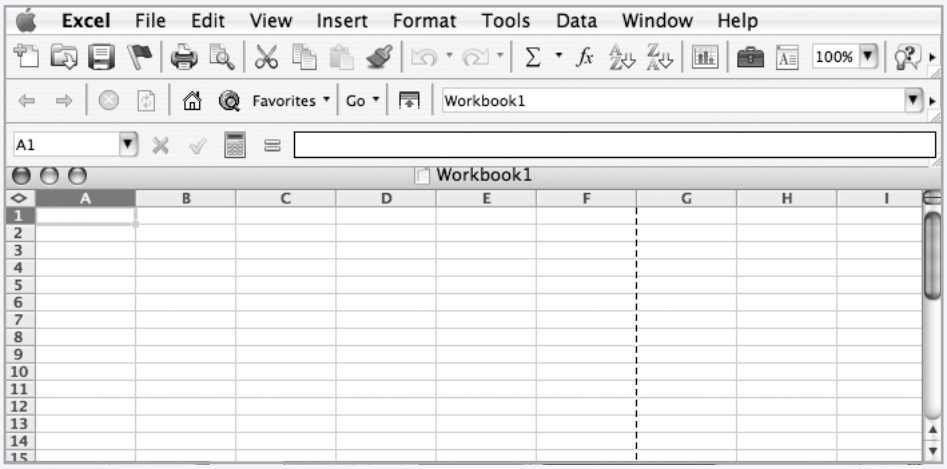
Give participants time to privately think and journal about these questions.

Handout L: Investigating the Colors of M&Ms

The M&M candy makers claim there is a certain percentage of each color in each bag. Let's see if they are right. Make a spreadsheet to calculate the number of each color that should be in each bag, based on the percentages that the candy maker tells us. Then open a bag of M&Ms, count them, and make a comparison to see if the M&M candy makers are right.

First open up Microsoft Excel.

A blank spreadsheet will appear like the one below. If it does not automatically appear, you can click on "File," then "New," and then "New Workbook" to start a new spreadsheet file.



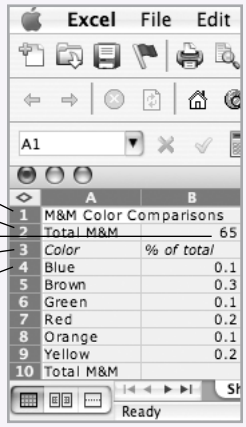
The M&M candy makers say that a bag contains the following distribution of colors:

10% blue	30% brown	10% green	20% red
10% orange	20% yellow		

Let's create a spreadsheet to do some calculating and comparing.

Setting Up Your Table

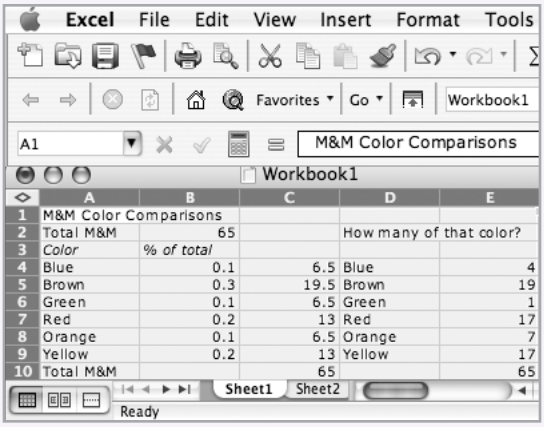
- Create a title in cell A1 (M&M Color Comparisons).
- Create a label for cell A2 (Total M&Ms).
- Enter the total number of M&Ms in *your* bag in cell B2.
- Create and label columns A3 (color) and B3 (% of total).
- Enter the colors and the company percentage in the columns and rows as shown.



Calculating and Comparing

Let's first figure how many of each color should be in your bag based on the company's formula (Column C). For example, to determine the number of blue, multiply the total number (65 in this example) by the percentage of blues (.10 or 10%).

To do this using Excel, begin by typing 65 into C10. Place your cursor in cell C4 and type this formula: =sum(C10*B4). Press the Return key. This tells the computer to multiply the total number (C10) by the percentage (B4). The correct answer will appear in C4. Use the same procedure to determine the amount of other colors (e.g., in cell C5, type =sum(C10*B5)). Be sure to use the correct cell numbers in your calculations.



	A	B	C	D	E
1	M&M Color Comparisons				
2	Total M&M	65		How many of that color?	
3	*Color*	*% of total*			
4	Blue	0.1	6.5	Blue	4
5	Brown	0.3	19.5	Brown	19
6	Green	0.1	6.5	Green	1
7	Red	0.2	13	Red	17
8	Orange	0.1	6.5	Orange	7
9	Yellow	0.2	13	Yellow	17
10	Total M&M		65		65

Determining the Actual Percentage of Each Color in Your Bag of M&Ms

First, label cell D2 "How many of that color?" Next, in Column D enter the names of the colors as you did in Column A.

Now, count the actual number of each color in your bag and enter those numbers in Column E. Compare this with what the candy maker said should be in the bag (Column C).

To determine the actual percentage of each color, use this formula in Column F: =SUM(E4/E10). It will divide the number of an individual M&M color by the total number of M&Ms. Use the same formula for every other color, but be sure to use the correct cell numbers in your formula.

Questions to Consider

- Were the percentages the same? Create another column to calculate the difference.
- What formula did you use to do this? How did you determine that formula?
- What might explain the difference?
- How could you make your results more precise?

Explore on Your Own

Create a chart from your data. To do this go to "Insert" and then "Chart" and follow the instructions that appear.

Change the look of your spreadsheet with Word Art, borders, or clip art.

Remember to save your work.

Handout M: Investigating the Colors of M&Ms Vignette

"How many total M&Ms do you estimate are in your bag, and how many of each color do you think there will be?" asks Miss North. "Each of you should record your predictions."

Students in grades 5–8 are paired at desks. Smiling, they begin to discuss and record their predictions. The room is buzzing with early confidence.

"I bet that there will be more orange ones than green ones but more reds than any other color," boasts Kyle.

"I'm not so sure about that. I got a lot of blues the last time I had M&Ms," ponders Anna.

Miss North is circulating through the room listening to conversations and noting predictions.

"What are you basing your predictions on, you two?" inquires Miss North.

"Experience, for sure . . . ." blurts Anna.

"Okay. That makes sense. What else might you base your prediction on?"

"Oh, maybe this is like what we've been doing in math class. What if we look at our totals and then think about the probability that a certain color shows up more than once? But I'm not sure if that will work," responds Kyle. "What do you think, Anna?"

"Let's see if we can come up with anything that would make sense and, if not, just stick to our predictions based on experience."

"Sounds good. Let me know when you are ready to move on," encourages Miss North.

Miss North continues to circulate and ask students questions. It is important for her to hear students' thinking so that she knows some effort is going into this stage of the activity. Her experience tells her that kids want to open the bags immediately but that questioning them carefully encourages them to slow down and be purposeful. The articulation of their mathematical thinking (orally and through writing) is also very important to what Miss North knows that Mr. Shaw and Mrs. Gomez, the day-school teachers, are hoping the students will practice during afterschool.

"Now that you have made your predictions and have communicated your reasoning, go ahead and open your bags and record your actual data. DO NOT eat your data yet!" charges Miss North.

Students sort, classify, count, and record the total number of M&Ms and the number of each color.

"I was way off," admits Dana.

"My total was wrong, but I was right about having more browns than any other color," celebrates Enrique.

Miss North is listening to the pair's conversation and asks Enrique to address the entire group. "What was your prediction based on, Enrique?"

"I decided that the company probably spends less money on making the M&Ms brown than making them other colors, so they include more browns to save money," explains Enrique.

"I like that level of thinking, and thank you for sharing it with us. Who has written their data in the form of ratios?" Miss North continues.

Anna raises her hand to share, and Miss North calls on her.

"I wrote 3/12 to show how many yellows I had in my bag. Isn't that a ratio?"

Miss North looks to the group to answer Anna's question.

"It's a fraction, which is kind of like a ratio. To write it as a ratio you would write 3:12," explains Robert.

Simone suggests, "You can also write 3/12 as 1/4 or 1:4."

"How did you get 1:4?" probes Miss North. "Please show us on the overhead."

Simone addresses the group and walks through her steps on the overhead for all to see. "3/12 simplifies to 1/4 because 3 goes into 12 four times. And 1/4 can be written as a ratio, or 1:4."

"But there aren't 4 total M&Ms in the bag, Simone. There are 12," argues Dana. "Shouldn't we use the total number to write the ratio, Miss North?"

Miss North decides to pose the question to the group instead of answering it herself. She also wants to re-direct the conversations to smaller concentrated groups to ensure participation by all.

"Does anyone else have a ratio that is equivalent to 1:4? Consider this in your small group conversations. Also consider the information that Anna, Simone, and Dana presented—we don't want to lose any of that thinking. As we move forward, we will have an opportunity to compare all of this thinking using pictures and maybe come to some conclusions," she says.

The pairs continue to discuss their thinking and look for evidence of ratios equivalent to 1:4 from their data.

Handout M: continued

"When do we get to eat our data?!" exclaims Kyle with a smile.

"I'm sorry! Go ahead and eat your M&Ms if you have your data recorded," Miss North answers. "As you finish your conversations and snack, move forward with the computer portion of the activity. It may help deepen your thinking about fractions and ratios."

The students then pick up their data sheets and move to the computer stations where they use Excel, an electronic spreadsheet, to create a circle graph from their data.

As a next step, and as they are ready, students are prompted to compile the data from the class set of data, which Miss North collected and recorded at the front of the room, to create an additional pie graph.

"What do you notice about ratios in comparison to fractions, as posed earlier by both Simone and Dana?" asks Miss North of the whole group.

"3/12 or 3:12 seems to be 1/4 of the circle!" exclaims Anna. "Simone was right!"

To conclude the activity, Miss North asks students to make a conjecture about the number of each color of M&Ms in a mystery bag of candy, using any pie graph they created. The student with the estimate closest to the actual numbers wins the candy.

Students easily navigate through their data now recorded in Excel to make their predictions. The competition is on!

"So that everyone is clear, and to make this competition fair, I want everyone to write down your prediction and hand it in as you leave. The winner will be announced tomorrow," concludes Miss North.

Handout N: *Math Tools* Overview

What Is It?

Math tools are any concrete materials used to measure, count, sort, or evaluate a mathematical problem. They may include manipulatives such as beans, counters, blocks, rulers, pictures, symbols, and technology (Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray, et al., 1997; National Research Council, 2001; Van de Walle, 1998). Using math tools has shown to have a positive impact on student achievement and to improve student attitudes toward learning (Sowell, 1989). Additionally, math tools 1) help students think flexibly about mathematics, 2) allow for more creative approaches to new problems (Hiebert et al., 1997), and 3) enable students to explore math with less anxiety (English & Halford, 1995; Hiebert et al., 1997).

Why Do It in Afterschool?

Afterschool programs offer unique opportunities to provide students with extended practice using various math tools, and using these tools has been demonstrated to have a positive impact on student achievement (Policy Studies Associates for the US DOE, 1995). The *Math Tools* practice is powerful because students can use the tools to explore concepts and build mathematical understanding (Van de Walle, 1998). Because the nature of afterschool is active and social, afterschool settings are ideal for allowing students to explore, test, build, think, talk, connect, and reason with math tools. When tools are used productively, students will not only become better mathematical thinkers, but they will also enjoy mathematics more (Sowell, 1989).

What Does It Look Like?

It is tempting to show students how to use the manipulatives, but math tools work best when students figure out for themselves how the tools can help them solve a problem. Provide an assortment of tools to tap students' interest and to help them see the variety of approaches to solving a problem. Help students make connections between the tools and the corresponding mathematical ideas. Finally, encourage students to discuss how specific tools contributed to their thinking about mathematics.

Practice 6

Math Tutoring

What Is It?

Math Tutoring involves working with students on specific math skills. The key goal is to provide experiences that build students' understanding of specific math concepts and skills. The content of *Math Tutoring* draws from school-day learning and the specific needs identified for each student. This work can take place in ongoing one-on-one or small-group sessions.

Why Do It in Afterschool?

Research indicates that regular, high-quality one-on-one tutoring may be the most effective afterschool activity for improving academic achievement (Fashola, 1998; Lauer et al., 2004). Math tutoring from well-trained staff allows afterschool programs to target students' individual strengths, weaknesses, and interests by providing direct, diagnostic mathematics instruction and mentoring. This type of tutoring is most effective when tied to the school day, allowing children to practice and reinforce what they are learning in the classroom (Elbaum et al., 2000; Fashola, 1998).

What Does It Look Like?

With the day-school teacher, identify for each student the specific math concepts or skills that are difficult, examples of problems that the student struggles with, and activities that could help clarify a concept and build understanding. Talk to the individual student as well, and ask him or her what math skills are difficult, what his or her strengths are, and what kinds of activities he or she enjoys. These are the kinds of activities that will engage students and increase their desire to learn. Once specific skills areas have been identified, determine short- and long-term goals. For example, if a younger student is struggling to add two-digit numbers, a short-term goal would be to master equations using base-10 blocks or other manipulatives. A long-term goal would be for the student to be able to add without using manipulatives. Provide regular, positive feedback to encourage students to succeed. At the end of each tutoring session, allow time to discuss what was learned and what skills and activities require more practice.

Professional Development Idea

There are multiple ways to help staff understand and apply the *Math Tutoring* practice. On the following pages is a sample plan for a professional development session. This idea, which requires 1 hour, utilizes a hands-on activity and a vignette to demonstrate the practice in action.

For sample lessons and links to additional resources to support the *Math Tutoring* practice, please visit the National Partnership for Quality Afterschool Learning's online Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_tutoring.html).

Professional Development Idea: Using a Vignette

The purpose of this professional development idea is to help participants visualize what a practice might look like in real life. Vignettes are short, narrative scenes that provide a sketch of an event. By examining vignettes, participants can consider how they might apply the practice to their professional situation. Before reading the vignette, it is important to engage the participant and create a context. Thus it is helpful to involve participants in a short hands-on activity. Following the vignette, participants discuss the mathematics that students learned during the scene and what the facilitator did or did not do to support the math learning. Finally, participants read a brief overview of the practice to help solidify and formalize their learning. Here participants are asked to consider the strengths they have in relationship to the practice and any areas they see for growth. By the end of this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ Tangrams (cards with pictures to be made with a plastic set of seven shapes)
- ❒ Handout O: Art in Math Vignette (1 copy for each participant)
- ❒ Handout P: *Math Tutoring* Overview (1 copy for each participant)
- ❒ 1 highlighter for each participant

Opening Activity

15 MINUTES

Read the story below of how tangrams came into existence to the group.

> According to legend, tangrams were invented when a Chinese boy named Tan accidentally dropped a bright red square tile his father had given him for his birthday. The tile broke into seven pieces. When Tan tried to put the pieces back together, he discovered that he could create many different pictures with the shapes.

Provide the participants with the tangram pieces and cards. Ask them the following question:

- Can you use this set of seven shapes to create the solid picture on one of the cards?

Allow participants time to work and talk with one another. After they have had the chance to make two or three tangram pictures, ask them the following questions to elicit their thinking:

- What strategies did you use to decide where to place the pieces?
- What made putting the pictures together easy?
- What made putting the pictures together difficult?
- Why might this activity be a good thing for students to do?

Art in Math Vignette

25 MINUTES

During this activity, participants read and discuss Handout O: Art in Math Vignette to help them imagine what quality math tutoring might look like.

Ask participants to read the handout. As they read, ask them to highlight in the text mathematical ideas the student is learning during the activity.

After the participants have finished reading, ask them to discuss the following question in small groups of two or three:

- For each mathematical idea you identified, what did the afterschool instructor do or not do to facilitate the child's learning? Identify specific evidence from the vignette to support your claim.

Ask small groups to share their ideas with the whole group.

Math Tutoring Overview

20 MINUTES

Provide participants with Handout P: *Math Tutoring* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss how the vignette illustrated the practice of *Math Tutoring*.

Finally, ask participants to reflect in writing on their own practice. Ask the following questions:

- What are the implications of *Math Tutoring* for your own work in afterschool?
- What big ideas are you taking away with you?

Give participants time to privately think and journal about these questions.

Handout O: Art in Math Vignette

"Art is the only class where I don't get in trouble," says Martin, a fifth-grade student at McPherson Elementary School.

Mrs. Garcia, a tutor with the afterschool program, is sitting across a small table. She has been asking Martin questions about his favorite subjects, his hobbies, what he's good at, and other things he likes to do. She is trying to gather information that will help link Martin's interests and strengths with the mathematics he needs to learn.

"Why don't you get in trouble in art?" Mrs. Garcia asks. Martin thinks for a moment and replies, "Because I get to do what I like there. Nobody is teaching me stuff I don't like."

Martin was identified for the afterschool math tutoring program because he is bright and inquisitive but struggles with math. He has very little motivation or interest in math and is receiving poor grades. "I hate math!" he tells Mrs. Garcia.

After talking with Martin, Mrs. Garcia talks with his day-school teacher, Mr. Donaldson. He's not surprised that Martin would rather be creating art than doing mathematics. He chuckles, "Martin is usually doodling instead of doing his work."

Mr. Donaldson agrees that a different approach during the tutoring session, one that integrates art activities with math, might help Martin. They decide to try a focus on geometry concepts to engage Martin's interests and strengths and perhaps increase his motivation to learn math.

Mrs. Garcia works with Martin to explore the symmetry and congruence (similarity) of shapes in art. Building these skills will support Martin's understanding of topics later in the year including the concepts of area, fractions, and multiplication. Mr. Donaldson provides some math manipulatives including geoboards, pattern blocks, tangrams, and coloring sheets with tessellations. Mrs. Garcia searches the Internet and finds some interactive Web sites about symmetry and congruence (see below).

In the following month, Mrs. Garcia and Martin work together twice a week. During the first session, Mrs. Garcia shows Martin the work of Wassily Kandinsky and M. C. Escher, which she downloaded from the Internet. Martin's fascination with the art leads easily into lessons focused on the use of specific geometric shapes, symmetry, and even fractions. After several months, Mr. Donaldson is able to document an improvement in both Martin's attitude toward math and his mathematics performance.

Suggested Sites

- http://illuminations.nctm.org/LessonDetail.aspx?id=U154
- www.gieson.com/Library/projects/games/matter/
- www.mcescher.com/
- http://ejad.best.vwh.net/java/patterns/patterns_j.shtml
- http://nlvm.usu.edu/en/nav/topic_t_3.html
- www.glyphs.com/art/kandinsky/

Handout P: *Math Tutoring* Overview

What Is It?

Math Tutoring involves working with students on specific math skills. The key goal is to provide experiences that build students' understanding of specific math concepts and skills. The content of *Math Tutoring* draws from school-day learning and the specific needs identified for each student. This work can take place in ongoing one-on-one or small-group sessions.

Why Do It in Afterschool?

Research indicates that regular, high-quality one-on-one tutoring may be the most effective afterschool activity for improving academic achievement (Fashola, 1998; Lauer et al., 2004). Math tutoring from well-trained staff allows afterschool programs to target students' individual strengths, weaknesses, and interests by providing direct, diagnostic mathematics instruction and mentoring. This type of tutoring is most effective when tied to the school day, allowing children to practice and reinforce what they are learning in the classroom (Elbaum et al., 2000; Fashola, 1998).

What Does It Look Like?

With the day-school teacher, identify for each student the specific math concepts or skills that are difficult, examples of problems that the student struggles with, and activities that could help clarify a concept and build understanding. Talk to the individual student as well, and ask him or her what math skills are difficult, what his or her strengths are, and what kinds of activities he or she enjoys. These are the kinds of activities that will engage students and increase their desire to learn. Once specific skills areas have been identified, determine short- and long-term goals. For example, if a younger student is struggling to add two-digit numbers, a short-term goal would be to master equations using base-10 blocks or other manipulatives. A long-term goal would be for the student to be able to add without using manipulatives. Provide regular, positive feedback to encourage students to succeed. At the end of each tutoring session, allow time to discuss what was learned and what skills and activities require more practice.

Practice 7

Family Connections

What Is It?

Family Connections involves fostering family involvement in and enthusiasm for math. The goal of this practice is to capitalize on families to support academic learning. By engaging parents and students in meaningful mathematics learning experiences, students can benefit both afterschool and during the school day. A popular choice for many afterschool programs is family math nights, which give parents and students a chance to enjoy mathematics together; foster positive attitudes toward mathematics in both parents and children; and encourage the development of positive relationships between schools and families. For example, during one of these events, families might read a book and talk about the mathematics it contains or play games that explore or use math skills and concepts (Griffith & Clyne, 1994).

Why Do It in Afterschool?

Research on afterschool programs and general education strongly supports the importance of family connections to student learning. In fact, parental interest and support is a primary factor for a student's educational success (Henderson & Mapp, 2002). *Family Connections* helps build an environment where parents can feel knowledgeable and comfortable with helping their children succeed in math. There are many reasons why families do not become involved, but afterschool provides an ideal environment to overcome those apprehensions and build family connections.

What Does It Look Like?

There are multiple ways to involve families. For example, a workshop could help parents learn strategies for helping students with homework, or a family math fair with game booths might teach parents fun activities they could recreate at home. To help maximize participation at events, gather information from your families to get a sense of their interests, needs, and preferences. Then involve day-school teachers, afterschool staff, and parents in the planning of any events. Each group brings a unique perspective and will contribute to the success of the event.

Professional Development Idea

There are multiple ways to help staff understand and apply the *Family Connections* practice. On the following pages is a sample plan for a professional development session. This idea, which requires 1 hour, utilizes a hands-on activity and a vignette to demonstrate the practice in action.

For sample lessons and links to additional resources to support the *Family Connections* practice, please visit the Afterschool Training Toolkit (www.sedl.org/afterschool/toolkits/math/pr_math_events.html).

Professional Development Idea: Using a Vignette

The purpose of this professional development idea is to help participants visualize what a practice might look like in real life. Vignettes are short, narrative scenes that provide a sketch of an event. By examining vignettes, participants can consider how they might apply the practice to their professional situation. Before reading the vignette, it is important to engage the participant and create a context. Thus it is helpful to involve participants in a short hands-on activity. Following the vignette, participants discuss the mathematics that students learned during the scene and what the facilitator did or did not do to support the math learning. Finally, participants read a brief overview of the practice to help solidify and formalize their learning. Here participants are asked to consider the strengths they have in relationship to the practice and any areas they see for growth. By the end of this experience, participants should understand the purpose of the practice, how it is used, and how they might improve their instruction to include the practice.

Time:

1 hour

Materials:

- ❒ *Sir Cumference and the First Round Table: A Math Adventure* by Cindy Neuschwander (Waterton, MA: Charlesbridge Pubishing, 1997)
- ❒ Handout Q: Sir Cumference Vignette (1 copy for each participant)
- ❒ Handout R: *Family Connections* Overview
- ❒ 1 highlighter for each participant

Opening Activity — 15 MINUTES

Explain to the participants that one way to engage people of all ages, including adults, is to use picture books.

Read *Sir Cumference and the First Round Table: A Math Adventure* by Cindy Neuschwander to the group.

Ask participants to talk with a partner about the following questions:

- What did you like or not like about being read to?
- How might reading a storybook help connect parents and their children to each other?
- What math was in the book?
- How might reading a storybook help connect parents and their children to math?

Sir Cumference Vignette

25 MINUTES

During this activity, participants read and discuss Handout Q: Sir Cumference Vignette to help them imagine what quality family connections might look like.

Ask participants to read the handout. As they read, ask them to highlight in the text the strategies that were used by the group to make family connections.

After the participants have finished reading, ask them to discuss the following questions in small groups of two or three:

- What family connections did you notice?
- What else struck you?

Ask small groups to share their ideas with the whole group.

Family Connections Overview

20 MINUTES

Provide participants with Handout R: *Family Connections* Overview. Ask them to read it and mark the following items in the following ways:

- Underline key ideas.
- Put a star next to things you already do well.
- Put an arrow next to any new ideas.

Ask participants to discuss how they marked the text with a partner and discuss how the vignette illustrated the practice of *Family Connections.*

Finally, ask participants to reflect in writing on their own practice. Ask the following questions:

- What are the implications of *Family Connections* for your own work in afterschool?
- What big ideas are you taking away with you?

Give participants time to privately think and journal about these questions.

Handout Q: Sir Cumference Vignette

With confidence in her voice, LaShawn begins the planning meeting for the monthly family math night. "Alright, let's get started. Based on our parent survey, we discovered a few things. Laura, as our parent representative, would you like to talk about what our parents need?"

"Sure," Laura says. "Parents told us that they're worried about helping their kids with math they don't know how to do, especially middle schoolers. They also are concerned that their kids don't like math, and they want to figure out how to change that."

Toshiko, a student at the local community college, responds excitedly, "Well, in my teaching literacy class we are talking about how children's books can help kids get interested in math. Maybe we could do something with a children's book that talks about math. We just talked about a great one called *Sir Cumference and the First Round Table: A Math Adventure.*"

"I really like that idea," responds Greg, a math teacher at George Washington Middle School. "I'd love to do more of that in my classroom, but with testing, I just can't seem to find the time. I'd be happy to help create an activity the kids could do with their parents after reading the book. Plus, this book is perfect because we study circumference throughout middle school."

"I love how working together makes this so much easier than doing this alone! I think reading a children's book is a great way to connect with parents who feel intimidated by difficult math," says LaShawn. "But how are we going to get the parents to come? Laura, do you have any ideas? We didn't have a very good turn out for the last math night."

"That's true. What if we try calling people?" suggests Laura. "I know with my daughter, fliers get lost in her backpack and never see the light of day. Plus, I think calling people makes it more personable. I think I could get a few parents to help me make the phone calls."

"Are you sure that isn't too much work for you?"

Laura thinks for a moment. "Yeah, it is a lot of work, but if it helps get parents to come, then I think it's worth it."

"I know that food always gets people to come, and I think providing baby-sitting for the younger kids would really help some parents out," suggests Thomas. "Do you think we can find money in the budget for some pizza, LaShawn?"

"I think I can make it work. It would be great, too, if we could find some high school students to volunteer. I'll see if the principal can help out with that," LaShawn answers. "Well, it sounds like we've got a plan. Thanks for your help, everyone. Let's meet again next week to see where we are with all of our tasks. When is everyone free?"

Handout R: *Family Connections* Overview

What Is It?

Family Connections involves fostering family involvement in and enthusiasm for math. The goal of this practice is to capitalize on families to support academic learning. By engaging parents and students in meaningful mathematics learning experiences, students can benefit both afterschool and during the school day. A popular choice for many afterschool programs is family math nights, which give parents and students a chance to enjoy mathematics together; foster positive attitudes toward mathematics in both parents and children; and encourage the development of positive relationships between schools and families. For example, during one of these events, families might read a book and talk about the mathematics it contains or play games that explore or use math skills and concepts (Griffith & Clyne, 1994).

Why Do It in Afterschool?

Research on afterschool programs and general education strongly supports the importance of family connections to student learning. In fact, parental interest and support is a primary factor for a student's educational success (Henderson & Mapp, 2002). *Family Connections* helps build an environment where parents can feel knowledgeable and comfortable with helping their children succeed in math. There are many reasons why families do not become involved, but afterschool provides an ideal environment to overcome those apprehensions and build family connections.

What Does It Look Like?

There are multiple ways to involve families. For example, a workshop could help parents learn strategies for helping students with homework, or a family math fair with game booths might teach parents fun activities they could recreate at home. To help maximize participation at events, gather information from your families to get a sense of their interests, needs, and preferences. Then involve day-school teachers, afterschool staff, and parents in the planning of any events. Each group brings a unique perspective and will contribute to the success of the event.

Enrichment Rubric

The following document provides afterschool staff with a means of assessing the quality of their mathematics enrichment program. The rubric provides expectations for quality in 11 areas: alignment, student engagement, integration, student choice, feedback/assessment, environment conducive to learning, equal access, mathematics content, opportunities to "do " mathematics, productive disequilibrium, and professional development.

The first step to using this rubric is to engage in a self-assessment. Ideally, multiple people use the rubric to individually assess the program and then discuss their scores to reach consensus. This process engages multiple perspectives and ensures a more accurate understanding of the current status of the program. Do not be discouraged if you are not in the "strong evidence" column for any or all of the 11 categories. This just means you have opportunities to grow.

Next, ask the group to examine the 11 areas and determine in which area you would like to change. Develop an action plan to help reach your new goal. Distribute responsibilities, create a time line, and decide how you will assess if you are, in fact, making progress. Remember that changes will not occur overnight. The most important thing is to be sure that everyone is onboard with the change and willing to make it.

As you improve in one area, reconvene the group and decide on the next area for improvement. Continue this cycle until you can demonstrate strong evidence that you provide high-quality mathematics enrichment in all 11 categories on the rubric.

Essential Features of High-Quality Mathematics Enrichment

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Alignment	Staff are unaware of *standards* and/or how they can be articulated in terms of the activities used in their program. There is no expectation that staff should be aware of *standards* when attempting to integrate content into the afterschool program. Mathematics content is not appropriately challenging to all students.	Staff are aware of *standards* and how they could connect to afterschool activities. There is no expectation that staff align activities to *standards* on a regular basis; however, staff are encouraged to choose *standards*-based activities. Staff are not able to articulate a process for aligning content-based activities to *standards.* Mathematics content is appropriately challenging to some students.	Staff select and communicate mathematics activities in terms of *standards.* Staff are able to determine student outcomes in terms of *standards.* *Professional development* is provided for staff to learn how to choose or develop and lead afterschool activities that are connected to *standards.* Staff review student day-school program data to inform mathematics content selection. Mathematics content is appropriately challenging to all students.	Afterschool curriculum has been aligned to state *standards.* Staff plan with and teach to these standards. Staff clearly articulate student outcomes on a regular basis in terms of *standards.* *Professional development* provides afterschool staff opportunities to discuss instructional practices that support the learning of mathematics *standards* and *benchmarks.* Staff plan academically rigorous afterschool activities based on data from the day-school mathematics classrooms. Communication and planning with day-school teachers is carried forth on a regular basis to ensure all academic content is aligned with day-school *standards.* Support is in place to ensure the above processes happen.

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Student Engagement	Students are off task and disruptive on a regular basis. Instructor does not address student questions or confusion in any way. When provided with mathematical tasks, students exhibit a non-productive disposition toward tasks and the instructor makes no attempt to encourage the sensibility and usefulness of mathematics. Students do not see mathematics as relevant, useful, or doable. Very little mathematical thinking is taking place. Students are not asked to think deeply about the mathematics in the task.	Students exhibit compliance when directed. Students remain off task when not directed. Instructor steps in when students get frustrated or are off task in an attempt to maintain engagement with work. These efforts are limited to techniques such as providing the methods for doing the problem, telling students they are correct or incorrect, or giving partial answers. The instructor promotes productive disposition toward mathematics by identifying real-life connections. Students see mathematics as a discipline to be mastered only by particular students. Minimal higher-level mathematical thinking is taking place on the part of students. The teacher may answer his or her own questions in an effort to keep the pace moving.	A balance of both instructor and student-directed learning is evident. Instructor encourages persistence when students experience frustration. Instructor is aware of the importance of scaffolding and *disequilibrium* in learning but occasionally defaults to asking leading questions to assist struggling students. When provided with mathematical tasks, students apply themselves willingly. Active engagement in learning is evident. There is evidence that students see mathematics as useful and doable. Students are encouraged to justify, explore, investigate, estimate, question, predict, and test their ideas.	Students are primarily self-directed and address appropriate mathematics content knowledge with perseverance, attention to detail, and focus. Instructor manages student frustration by coaching students to challenge themselves on a continual basis. To assist struggling students, the instructor responds to student questions with new questions such as, "What do you think?" and "Try it and see if it works." The instructor listens carefully and designs follow-up questions based on student thinking and understanding to encourage maximum student benefit. Students exhibit ownership for, enthusiasm about, and enjoyment of mathematics learning. Students see mathematics as enjoyable, useful, and doable. Students are encouraged to justify, explore, investigate, estimate, question, predict, and test their ideas.

Essential Features of High-Quality Mathematics Enrichment, continued

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Integration (with other content areas, non-academic components, and real-life applications)	Mathematics is seen and practiced in isolation. Mathematics activities and discussions hold no evidence of supporting other content, non-academic components, or real-life situations in the application or understanding of concepts.	Mathematics is typically seen and practiced in isolation, but occasional surface-level connections are made. Students struggle to find connections between mathematics and other disciplines and/or the world around them.	Evidence of meaningful mathematics learning being integrated with other content areas, non-academic components, and/or real-life application is observed frequently. Students are frequently provided with opportunities to connect mathematics with other disciplines and/or to the world.	Evidence of mathematics learning being integrated with many content areas, non-academic components, and real-life application is consistently observed; integration is authentic and helps students deepen their understanding of the math content. Students independently connect mathematics learning to other disciplines and to the world around them on a consistent basis.

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Student Choice	Assignment for all student mathematics work is given by Instructors. Students have no say in what mathematics activities they will be involved in or the methods they will use to engage in mathematics learning.	Activities are not intentionally planned to allow for student interest or choice (any alignment with student interest and/or choice happens by chance). Students have little say in what methods they will use to engage in mathematics learning and/or showcase their learning.	Activities are planned to meet a variety of student interests. Grouping strategies may include student choice. Instructor occasionally provides opportunities for students to show what they learn (e.g., poster, written paper, song). Students have some say in what methods (e.g., procedures, tools) they will use to engage in activities. Students are encouraged to do mathematics in a way that makes sense to them.	Students choose the mathematics they wish to do as well as the method, often creating the real-world problems they wish to solve. Instructor is intentional about grouping strategies, which may include student choice at appropriate times. Students are held accountable for their choices. Instructor frequently provides students with opportunities to show what they learn using a method of their choice (e.g., poster, written paper, song). Students are encouraged to choose their own method for tackling activities; their methods are shared and discussed by staff and peers.

Essential Features of High-Quality Mathematics Enrichment, continued

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Feedback/ Assessment	Students receive little or no *feedback* from instructors in terms of mathematics learning. Instructor does not use *assessment* of any kind to structure mathematics learning in afterschool. Instructor does not use questioning as a strategy for soliciting student understanding or for providing *feedback.*	Students receive *feedback* in terms of mathematics learning on an inconsistent basis. Afterschool staff assess student progress made in afterschool on an annual or infrequent basis. Little attempt is made to make connections between day-school data, decisions made in structuring afterschool activities, and data gathered in afterschool. Data about student academic progress is infrequently shared between day-school and afterschool staff. Instructor responds to student questions with answers, which tends to stop student thinking.	Instructor provides *feedback* to students that contributes to student understanding of their mathematics learning and *metacognition* on a regular basis. Instructor daily questioning practices provide both instructor and student with information about ongoing mathematics progress. Instructor communicates with day-school teachers on a regular basis about student academic progress (in mathematics). Instructor honors student questions by expressing genuine interest in student thinking. He or she might present them to other students to answer or consider.	Students play a key (active) role in seeking and providing *feedback* from instructors (day-school program also) as well as peers. Instructor questions students in a way that encourages students to connect and explain their thinking such that student thinking is drawn out rather than led to a certain way of thinking. Wait time is used appropriately to elicit more thinking than rapid-fire questioning.

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Environment Conducive to Learning	The mathematics environment is neither respectful of individual student ideas nor rigorous in terms of individual student learning. There is no evidence of *productive disequilibrium.* Activities are often not developmentally appropriate or relative to students.	Rules for respect are provided by the instructor and posted for students to see. Expectations for student performance are stated by the instructor at the start of the year, and reminders surface when needed on a per-student basis. Student ideas are shared and responded to from time to time when students raise their hands or bring questions to the instructor (on a per-need basis). Activities are not necessarily chosen based on whether they are developmentally appropriate or relative to students.	The mathematics environment is respectful of students' ideas. Respect is discussed as a whole group on a regular basis. The mathematics environment is rigorous. Students are challenged at their *zone of proximal development.* The mathematics environment effectively develops and fosters critical thinking, creative thinking, and self-regulated thinking. Instructor works to maintain high expectations for all students to create *productive disequilibrium* when appropriate.	The mathematics environment is respectful of students' ideas and this respect is fostered by students as well as instructors. Students play a key role in the process of determining parameters for both respect and high expectations.

Essential Features of High-Quality Mathematics Enrichment, continued

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Equal Access	Mathematics activities are slanted, biased, or culturally inaccessible. Some students do not have access to the learning. Students are compared openly to one another by instructors. All students are expected to approach mathematics learning and mathematics activities the same way. Prior knowledge is not actively taken into account. All students are expected to work at the same pace. Instructor expectations for students are neither clear nor equitable.	Instructor makes some attempts to offer students different types of activities based on individual needs and cultural relevance. Instructor may compare students to one another when doing so is seen as motivational. Minimal effort is made to honor different approaches to learning mathematics. Some effort is made to allow particular students to work at their own pace. The instructor's efforts to communicate expectations are inconsistent.	Mathematics activities offer multiple entry points to students. High-level mathematics is generally accessible to all. Student needs are managed equitably; they are not compared to each other. Students are encouraged to work at their own pace and to choose their own method for approaching mathematical situations. Instructor communicates clear and high expectations for all.	High levels of access are ensured through the examination of student performance data, the acknowledgement of specific learning needs and unique talents, and the integration of culturally relevant material. Student performance is compared to individual progress toward specific learning goals. Students are encouraged to (and do) work with peers to expand their thinking about ways to learn and do mathematics. Students play an active role in ensuring instructor expectations are clear and appropriate.

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Mathematics Content	Mathematics content is chosen with little evidence of appropriateness—usually grade-based. Students rarely interact with significant, worthwhile mathematics content. Content is limited to simple recall and procedural tasks that require little conceptual understanding.	Mathematics content is chosen based on evidence of appropriateness and encourages developing mathematical proficiency. Student contact with worthwhile content is inconsistent. Most content is limited to simple recall and tasks that require little conceptual understanding. Some effort is made to expose students to cognitively complex, significant mathematics tasks that require multiple problem-solving strategies.	Mathematics content is in-depth, appropriately challenging, and develops mathematical proficiency for all students. Students are encouraged to interact purposefully with significant, worthwhile content on a regular basis.	Students interact purposefully with significant, worthwhile content on a daily basis.

Essential Features of High-Quality Mathematics Enrichment, continued

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Opportunities to Do Mathematics	Students are provided little or no opportunity to engage in mathematics that supports conceptual understanding through exploration and rigorous problem solving. Mathematics is seen as drill and practice, commonly worksheet-based.	Learning is active at times; this time is limited to being special—not the norm.	Learning is predominantly active. Students are encouraged to do mathematics (what mathematicians do): justify, explore, investigate, estimate, question, predict, and test their ideas through structured processes. Students are encouraged to make meaning of problems and bring mathematics thinking to life through consistent interactive opportunities.	Students are able to independently do mathematics (what mathematicians do): justify, explore, investigate, estimate, question, predict, and test their ideas. Students are able to talk about important mathematic concepts and why they matter.

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Productive Disequilibrium	Instructor describes exact procedures for solving problems (i.e., students are told how to solve problems). Student struggling is viewed as negative, and instructors try to minimize it. Instructor feels the need to and does rescue students on a consistent basis. The instructor questioning is rapid fire and leads to pre-determined answers.	Scaffolding is limited to the instructor providing hints or new ways of looking at problems. Instructor understands the concept of *disequilibrium* but does not know how to support it. Instructor periodically uses questioning to uncover student thinking.	Students experience new phenomena that contradict their current conceptions in a productive way. Students are provided with experiences that allow them to recognize contradictions, feel dissatisfied with old concepts, recognize the plausibility of new ideas, and accept new thinking (cognitive conflict). Instructor routinely asks questions that attempt to uncover student thinking. Instructor feels *disequilibrium* at times and is comfortable with that feeling (especially when attempting to uncover student thinking).	Students are comfortable in *disequilibrium;* they view it as an opportunity to stretch their thinking and learn new things (students have learned to embrace the opportunity *productive disequilibrium* offers). Instructor is aware of the balance between support and the disequilibrium essential for students to advance forward in their thinking and learning.

Essential Features of High-Quality Mathematics Enrichment, continued

	No Evidence	Some Evidence (Beginning to Use)	Evidence (Routine Use)	Strong Evidence (Refined Use)
Professional Development	Little or no mathematics *professional development* is provided. There is no evidence of the use of data (i.e., student achievement, staff learning needs) to inform *professional development.*	Mathematics *professional development* is limited. Professional development is not necessarily aligned with program goals and contexts. There is limited evidence of the use of student achievement data to inform *professional development.*	High-quality mathematics *professional development* is focused on program mission and goals. Data are used to target *professional development* needs.	High-quality mathematics *professional development* is focused on program mission and goals. Based on student achievement data, specific efforts are made to address topics such as: • Effective instructional strategies • Connecting mathematics to the real world • Techniques for working with special-needs populations, including language minority students • Assessing student progress

Glossary

Assessment: Methods for determining the extent of student learning. Assessments in afterschool can involve projects, observations of performance in an activity, informal and formal tests, and/or the completion of creative assignments.

Benchmark: Criterion that illustrates developmental progress toward the mastery of knowledge and skills defined by a standard (see *Standard*).

Disequilibrium: The loss of a sense of competency or efficacy that occurs when new phenomena contradict current conceptions. Teachers can intentionally and temporarily induce this state of mind within students to highlight knowledge gaps. In such cases, disequilibrium is seen as a state necessary before new, meaningful learning can take place.

Enrichment Activities: Activities that extend the learning beyond what is offered in other learning environments. Enrichment activities are those that provide support, add value, or provide additional relevancy to the learning of the afterschool student.

Feedback: Consistent, specific, supportive, and timely information given to the student to inform his or her progress toward learning goals.

Manipulatives: Any object or tool that a student can hold or use to physically represent mathematical concepts. For example, blocks can be used as a manipulative to help young children learn the concept of addition and subtraction.

Metacognition: The practice of reflecting on the quality of one's own thinking and learning relative to specific content. Metacognition involves reflecting on what has been learned, how it has been learned, and what skill or concept remains to be learned.

Practice: A set of routine actions and behaviors embedded in the planning, implementation, and execution of afterschool mathematics programming.

Productive Disequilibrium: Refers to a state in which the student feels both temporarily ineffective and mildly confused, yet supported and safe. It is in this stage where learning can occur.

Rubric: A scoring guide that uses criteria to establish the level of student learning relative to a content standard.

Standards: Definitions of knowledge, skills, and procedures identified by local, state, and national entities to represent targeted learning for all students.

Vignettes: Short narratives describing an example of the practice. These will include a description of the environment as well as the activity. They will be linked to detailed lesson plans that include intended outcomes, materials (including resources as appropriate), procedures, and guidance for the instructor (e.g., assessment ideas, common misconceptions). Video clips will be incorporated as appropriate.

Zone of Proximal Development: Defines the level of challenge an activity poses for a particular child. The zone of proximal development is a level of activity that is neither too easy nor too hard for that child. The task is hard enough to challenge and engage but not so hard as to frustrate.

Online Resources

National Council of Teachers of Mathematics (NCTM)
www.nctm.org

NCTM's Online Journal of School Mathematics
http://my.nctm.org/eresources/journal_home.asp?journal_ID=6

Thinkfinity
www.mped.org

PBS TeacherSource
www.pbs.org/teachers/math

Finding Math

Mathematical Fiction
http://math.cofc.edu/faculty/kasman/MATHFICT/default.html

At Home With Math
http://athomewithmath.terc.edu/math_kits.html

Math Centers NCTM Illuminations
http://illuminations.nctm.org

Untangling the Mathematics of Knots
www.c3.lanl.gov/mega-math/workbk/knot/knot.html

A Collection of Activities to Help Enrich Mathematical Learning
www.cyffredin.co.uk

Math Games

The Game 24
www.24game.com

Cool Math 4 Kids
www.coolmath-games.com/0-animationpuzzle/index.html

Gamequarium
www.gamequarium.com/math.htm

Math Projects

Global School Net
www.gsn.org

KIDPROJ
www.kidlink.org/KIDPROJ

I*Earn (International Education and Resource Network)
www.iearn.org

Buck Institute for Education
www.bie.org/pbl/resources/resources.php?category_id=2

Math Tools

National Library of Virtual Manipulatives for Interactive Mathematics
http://matti.usu.edu/nlvm/nav/vlibrary.html

eThemes
www.emints.org/ethemes/resources/S00000592.shtml

Mathematics Tutoring

National Tutoring Association
www.ntatutor.org

Family Connections

Figure This! Math Challenges for Families
www.figurethis.org

At Home With Math
http://athomewithmath.terc.edu/math_kits.html

U.S. Department of Education's Helping Your Child Learn Mathematics
www.ed.gov/parents/academic/help/math/index.html

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The developers believe that these practices and materials will help afterschool leaders and educators create high-quality programs that will motivate, engage, and inspire students' learning and participation.

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This guide to the Afterschool Training Toolkit was created with the support of the U.S. Department of Education for the use of 21st Century Community Learning Centers. Used with the online Afterschool Training Toolkit, this guide will give you the resources you need to lead professional development activities that will teach your staff to build fun, innovative, and academically enriching activities that not only engage students but also extend their knowledge in new ways and increase academic achievement.

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