Math for Love

Kindergarten



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Introduction

Welcome to the Math for Love Curriculum! This draft was adapted from a summer program we designed in 2017. The materials are ideal for use in a summer program, or as a supplemental curriculum to provide remediation or enrichment to students.

Goals of the Curriculum

The goals of the program are two-fold:

- Improve student conceptual understanding of mathematics, while exercising skills and fluency
- Give everyone an opportunity to have fun and enjoy math

This curriculum spends ample time exploring conceptual models, giving students opportunities to work concretely and pictorial while making connections to abstract reasoning.

Program Values

The goals of this curriculum are to strengthen student understanding and deepen their enjoyment of math. The values of the program help work toward those goals:

- Students should play, with both games and ideas
- Students should have hands-on experiences, exploring math with manipulatives
- Students should experience math as a meaningful, compelling activity, with multiple ways to approach solving a problem, representing a situation, and developing a strategy.
- Students should have time to think deeply about mathematics.

In short, this curriculum is designed to help you build a classroom where students are *doing math* and *thinking math*.

Teacher's Responsibility

As a teacher in the program, you are tasked with establishing a healthy and dynamic classroom environment where these values are expressed. Your responsibilities are:

- 1. **Engagement**. Create an classroom where your students spend the bulk of their class time actively engaged in mathematical play and problem-solving.
- 2. **Differentiation**. Help students encounter problems, games, and activities of the right level of difficulty to create engagement.
- 3. **Thinking**. Get students thinking as soon as possible every day, and help keep them *productively stuck*, actively working to understand and make meaning in a situation they don't yet fully understand.

4. **Positive Environment**. Help the classroom be a place where students trust themselves, their teacher, and each other, and can make mistakes, ask questions, and grow.

The curriculum is designed to help you in these tasks, and your students and you will get the most out of the summer if you tackle these responsibilities head on. Here are some concrete ideas on how to go about it.

★ Ask students questions rather than telling them answers

Rather than telling them whether their answers are correct or not, ask them what they did to solve the problem. Ask them what they think the answer is and why. Invite them to share their thinking with you and their classmates.

★ Model how to play games, and teach how to win and lose

Students can sometimes get really attached to winning, and take their wins and losses as deeper signs about themselves. It's best to get ahead of this right away. Talk about how the players of a game are working together to learn about the game, and every loss is a chance to get more information about how to win. Rather than thinking about the other player as your rival, think of them as your collaborator, there to help you learn.

★ Avoid what doesn't involve math; get students into actual, active thinking situations about mathematics as fast as you can

Our goal is to make the most of classroom time, and avoid things that use up too much time without much gain in mathematical understanding. Start class right away with a Number Talk or opening game (see the Warm Up in the daily plan). Use the Math Games and Movement Breaks from Appendix 1 for transitions between stations. Establish the classroom as a place where we all are committed to working on improving our understanding of math.

★ Have a growth mindset classroom

Some of your students will believe that they are just bad at math. They will think this is an unchangeable personality trait. These students have what is known as 'fixed mindset' about math. The truth is that every student can succeed in mathematics, regardless of how they've done in the past. Convey to your students, early and often, that math is something you learn to be good at, not something you just know; how making and learning from mistakes is the key to improving; and how everyone can be good at math if they put in the time and the energy.

★ Embrace mistakes

One important way to encourage growth mindset is to embrace mistakes. They are a natural part of learning, and even more than that, they actually help us learn more and help us remember what we've already learned. Model for your students how to make mistakes, and how to use mistakes productively.

★ Give your students *time* to think and explore

Remember that many of the students in the program are here because they weren't given enough time to establish solid conceptual models. We are going to protect their time to develop those models in the summer. Make sure you don't push them too fast to drop the blocks or pictures. If you need to take more time on some lessons and don't make it through everything that's fine; this curriculum is built to give you more than you might need. Also note that a central place in the curriculum where the students practice fluency is in the games, and the goal is for the practice and experience of growing mastery to be tied to the experience of playing.

★ Give your students the right amount of struggle

We want the students to be 'productively stuck', i.e. we want them to be working on material they haven't mastered yet but not material that is so hard they can't get started. Most of the lessons in the curriculum start easy, so make sure everyone is able to begin, and help students break down problems if necessary. However, don't offer so much help that you take away their opportunity to learn. Learning happens when we are trying to do something we know how to begin and don't know how to finish. Keep in mind that many students in this program will be more familiar with the "stuck" part, so try to start them with successes, and then slowly move them toward greater problem-solving stamina.

★ Value play

It's easy to feel like students have to suffer to learn math. In fact, the opposite is true. Approach math in a playful way, and you'll see students more willing to struggle and persevere, more willing to take risks and learn from mistakes, and more able to absorb new ideas and put them into practice.

Other Notes and Best Practices

If you use this curriculum as a standalone for a summer program or other intervention, here are some ideas to help get the most out of it.

★ Math Games and Movement Breaks

Check out the math-based movement breaks in Appendix 1. These are great to mix in as breaks between activities.

★ Folder for Worksheets

Give each student a folder where they can keep their worksheets. If they finish another activity early, they can turn back to their unfinished worksheets and finish them.

★ Choice Time

Provide a structure for Choice Time like putting up the choices on a white board and having students put their names at the games or activities they want to try that day. Ideally, they should choose an activity that is right for them, and then stick with it for at least half of Choice Time.

★ Number Talk Images and other warm ups

For the Number Talks that require images, see Appendix 2. You can project these images to your class, or, where possible, create physical versions of them with magnetic ten frames or other blocks. Physical versions are sometimes preferable, since students can manipulate the blocks directly.

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Day 1

Goals

- 1. Establish class norms and community.
- 2. Introduce games and activities.
- 3. Assess student comfort with counting, cardinality, and basic numeracy.

Part 1

Opener

Block Free Play Class introductions, Mingle or other name games, class agreements

Warm Up Guess My Number

Exploration

Exploration of the Materials - set up spots in the room for free play, so students can explore and build with the materials of the class. We also include some optional challenges to pose to students who need more guidance or more challenge. These challenges can be options for Choice Time in future classes.

Pattern Block Building ChallengesPiles of tilesSnap Cube Trains

Hungry NumbersRoll and Separate

Game Match The Dots or Dot Memory

Part 2

Warm Up Guess My Number

Activity Counting Collections

Game Dots and Boxes

Choice Time Block Free Play

Mingle Opening Game or Station Break

Mingle is a quick name game you can play on the first day of class. You can also return to its more mathematical versions later in the course as a station break.

How to play

The teacher calls out a number (i.e., 3), and the students get themselves into groups of that size (or as near as possible to that size as possible) as quickly as they can. It might be impossible for everyone to get in a group every time, but each new number gives everyone another chance.

Once they are in groups, students can each learn each other's names. Then the teacher calls out a new number.

In the basic game, just call out single numbers. Once students get the idea, you can call out addition or subtraction problems (i.e., "get into groups of 7-4").

Tips for the classroom

- 1. Call the adults in or out of the game depending on the number of students you have and what numbers you call, in order to give everyone at least one other person to have in their group.
- 2. Keep the game moving quickly to keep the energy up.
- 3. Don't forget to call out a group of 1 and a group of however many students are in the entire class at some point in the game.
- 4. For future games, once everyone knows each other's names, you can can lead an optional skip-count with the class by counting the students in the class by group size (i.e., 3, 6, 9, ...).

Guess My Number

Topics: Greater than/less than, logic **Materials**: Whiteboard or paper and pencil **Common Core**: MP1, MP3, K.CC.C7, 1.NBT.B.3

Guess My Number is a quick, fun, and easy opening game to lead with a small group or the entire class. Students try to guess the number you're thinking of in the fewest number of guesses possible.

Why We Love Guess My Number

It's hard to think of a game more natural than Guess My Number. Kids can immediately start playing, and have a great time doing it. The game is also a perfect way to introduce the basics of logical thought and strategy, and let the game do the teaching with only minimal extra observations from the teacher. Surprisingly replayable and enjoyable, this is a great game to play early and often.

The Launch

As you write the numbers from 1 to 10 down on the board, tell your students that you are going to think of a number from 1 to 10, and they will try to guess it in the fewest number of guesses possible. After every guess, you will tell them whether your number is greater or less than their guess.

Example

Teacher: Who would like to make the first guess? [Students raise hands. The teacher calls on different students for each guess.]

Student: 3.

Teacher: My number is not 3. But my number is greater than 3. [Optional: write "My number >3".] Are there any numbers I can cross off my list?

Student: It's not 3. [Teacher crosses off the 3]

Student: It's not 2 or 1 either.

Teacher: Right. Because my number is greater than 3, but those numbers are less than 3 [Teacher crosses off 1 and 2.] Who has another guess?

Student: 9.

Teacher: My number is not 9, but my number is less than 9. [optional: write "My number <9".] Can I cross any more numbers off the list?

Student: The 9 and the 10.

Teacher: Because my number is less than 9, so it can't be 9 or 10. [Crosses them off. Looks at the board.] So the only options left are 4, 5, 6, 7, or 8. Take a minute to think about what would be a good next number to guess. Then tell someone sitting next to you what you would guess next, and why. [Students pair and share.] Who has another guess?

Student: Is it 7?

Teacher: My number is not 7, but my number is less than 7 [optional: write "My number

<7]. What numbers can I cross off?

Student: 7 and 8.

Teacher: Right. Because my number is less than 7, so it can't be 7 or 8. [Crosses them off.] So the only options are 4, 5, or 6. Who has another guess?

Student: Is it 5?

Teacher: My number is not 5, but it is... greater than 5. [Students' hands shoot up.] Whoever thinks they know my number, say it together.

Students: 6!

Teacher: You got it! Now that took you [counts] 1, 2, 3, 4, 5 guesses. Who thinks they could do it in fewer? [Optional: play again.]

Prompts and Questions

- How can you guess my number in the fastest, most efficient way possible?
- Talk to a neighbor about what you think the next guess should be, and why.
- How many numbers do you think that guess will cross out?

Tips for the Classroom

1. **Cheat**! By which I mean, don't actually choose your number ahead of time. If students guess 1, tell them your number is more than 1. Always make each guess give them the least amount of information possible, and deny them the lucky guess. Make them work for it, and they'll be more invested in working smarter.

AVOID: Student: Is it 8? Teacher: It is! Lucky guess! You got it on the first try.

BETTER: Student: Is it 8? Teacher: My number is not 8, but my number is less than 8.

- 2. You can slowly expand up to larger ranges of numbers as students are ready for them. I'll usually go up to 12 after a few games, and soon to 20. Kids love to see the game get harder, as long as it doesn't get too hard too fast. And because you write all the numbers up on the board at the start, they can always see what needs to happen.
- 3. If kids make a bad guess, don't try to steer them toward a good guess right away. But you can ask the students after you write the guesses down which guesses were most helpful, or whether they would make a different guess if they could take it back.
- 4. Don't play for too long at one time. One or two games is usually enough to get the kids mentally alert and ready for whatever is coming next.

Pattern Block Building Challenges

With the pattern blocks

Cut out the 12 cards on the following page, and separate into two piles. One pile should contain the numbers, and the other pile should contain the objects.

Challenge Question: a student picks a card at random, and then builds according to what is on the card.

Advanced Challenge Question: a student gets two cards, one which tells them what to build, and the other how many blocks to use.

Example: Build a *House* using *15 blocks*.

Note: if students can't count to the larger numbers, give them smaller numbers (5 or 10) for their building challenges.

Hungry Numbers

with the Tiny Polka Dot decks

Line up the numeral cards from 1 - 5. These are the hungry numbers. Spread out a pile of dot cards from 1 to 5 dots. The students take turns choosing dot cards and feeding them to each numeral card, which "eats" the dot card when it goes above the dot card. (Enhance the game by making eating sound effects: "Nom nom nom.") The game is over when all the dot cards have been "eaten."

In subsequent games, add in the next biggest numeral. For example, play with 1 - 6, then 1 - 7, and so on, until you have all the numbers 1 - 10.

Piles of Tiles

Let students free play and build with the tiles. For students who need more direction, give them a pile of tiles, and challenge them to figure out which color would build the longest line of tiles, if you put them all in a row. This will involve separating the tiles by color and lining them up in rows.

Roll and Separate

Students roll a group of dice, then separate out the ones, the twos, the threes, etc., into different groups. Which number comes up the most? Once students understand the game, they can guess first, then roll. Play with more or fewer dice, as appropriate for the students.

Challenge question: which number will come up most?

Snap Cube Trains

with the snap cubes

Free play and building with the snap cubes.

Challenge question: Build a train with 1 red, then 2 blues, then 3 greens, and keep going, so that each color block is one longer than the last. How far can you go?

Pattern Block Building Challenges

Flower	Bird	Person
Pattern	Shape	House
5 blocks	10 blocks	15 blocks
20 blocks	25 blocks	30 blocks

Match the Dots

Topics: Counting and cardinality, subitizing, recognizing numbers **Materials**: Tiny Polka Dot cards **Common Core**: K.CC.4, K.CC.5, MP6, MP7

The numbers look different. Which ones are the same?

Why we love Match the Dots

This simple game of counting and matching helps students see how different-looking collections of dots may actually represent the same number.

The Launch

Choose a student volunteer to demonstrate the game, or put the cards where everyone can see them (center of a circle, document camera) and play with the entire class, where you find a match, and then the students raise their hands if they see a match.

The rules are simple: deal a collection of cards face up. On your turn, simply find two cards of the same number, and remove that pair from the board. There aren't really winners or losers in this game—you just play taking turns until all the cards are gone. For early games, pick just two suits at a time, and start with numbers the students know. For a first game, you might pick Teal 0-4 and Blue 0-4. In subsequent games, students can play with larger numbers and additional suits.

Prompts and Questions

- How do you know those two cards have the same number of dots?
- I'm going to pick this card. It has two dots. Do you see a card that matches it?
- Are you sure those to are the same? Let's count them together.

The Wrap

Ask students which cards were easiest and hardest to count.

Tips for the classroom

- 1. Start students with very easy numbers, and slowly let them increase the difficulty. Every step up should feel like a fun new challenge. "Do you think you're ready to add in some sixes?"
- 2. The game is more fun if you're using an even number of suits, so every card gets taken in the end.
- 3. This game evolves into Dot Memory and Dot Fives. If students are ready for a greater challenge, you can show them those games.
- 4. If students aren't ready for Match the Dot, you can let them play Hungry Numbers, or just play with the cards, or organize them into color piles.

Counting Collections

Topics: Counting, skip counting, addition

Materials: Paper, pencil, objects of many types (button, beans, stones, pencils, markers, blocks, etc.), ten frames

Common Core: K.CC.A.1, K.CC.A.2, K.CC.A.3, K.CC.B.4, K.CC.B.5, K.MD.B.3, 1.NBT.A.1, 1.NBT.B.2, 1.NBT.B.2.a, 1.NBT.B.2.b, 1.NBT.B.2.c, MP1, MP6

Kids love to count things. This is a simple exercise, but a great way to get kids excited about arithmetic. Counting Collections also seeds ideas about how the place value system helps make counting work.

Why We Love Counting Collections

So much of the work of teaching math in elementary school is about sharing arguments that make counting faster and more efficient. But why should the students care if they don't need to count anything? By making counting explicit, hands-on, and fun, this activity actually provides a motivation for the mathematics of place value (counting by ones, tens, and hundreds), addition (counting two or more smaller groups and adding them together), and multiplication (skip counting, arranging objects in arrays). Not only that, each new method and algorithm can be immediately tested in a concrete setting. Counting Collections are an indispensable tool for young children.

The Launch

Set collections of objects in different places in the room. Examples might include cups of legos, straws, blocks, pencils, buttons, markers, etc. Make sure that there are enough collections with a small numbers of objects (i.e., 6 - 20), as well as some with larger numbers.

Point out the collections around the room. Let students know that their job will be to take an inventory of the objects in the room—that is, to count how many objects are in each collection. In addition to recording how many objects are in a collection, they can make a sketch to remember how they got the answer.

Students will work in pairs. Each pair will get to choose a collection and count it. For each collection, they will record how many they counted on a sheet of paper next to the collection. Multiple groups will write the number they think is in the collection. There may be different numbers! If so, this is worth revisiting in the wrap up.

Main Activity

The students count and record their numbers.

The teacher can use this time in many ways. She can observe how students are counting, and take notes on the strategies they're using and where they are in their developing

understanding of numbers. She might distribute ten frames, rubber bands, cups, or other devices to help kids count or bundle objects.

Prompts and Questions

- What strategies are you using to count?
- What number do you find is easiest to count by?
- Can you tell how your partner is counting by looking at their picture?

Wrap Up

You don't have to wrap up this activity after the first day; Counting Collections can be something to return to, to let students test their methods on larger and more difficult groupings of objects.

However, it can be nice to discuss different strategies along the way. After students have done their counting for the day, ask for reports on counts, and discuss strategies kids used for counting. Was it easier to count by 2s? By 10s? Was it helpful to arrange the objects in some neater organization, like a grid, or on top of a ten frame? What other strategies did people have? Did all the groups who counted the same thing get the same answer? Which counting methods are most accurate? Which are easiest?

Tips for the Classroom

- 1. You can differentiate Counting Collections most easily by including collections with many or fewer objects to count.
- 2. On the first day of Counting Collections, make sure you have many small collections (5 20 objects) for students to count.
- 3. Make ten frames available as a counting aid.

Dots and Boxes

Topics: Logic, counting, shape recognition, strategy **Materials**: Dot Paper, pencils or crayons **Common Core:** K.CC.B.5, K.CC.C.6, K.G.B.5, 1.G.A.1, MP1, MP6, MP7

A game of squares and strategy that is easy to learn and hard to master.

Why We Love Dots and Boxes

This is a classic you may remember from childhood. The game is like a more sophisticated tic-tac-toe: fun and challenging for young kids, with simple counting and shape recognition practice built in, and connections to deeper mathematical strategy at play in the background. It's a perfect game for stations or ten extra minutes.

How to Play

Dots and Boxes is a game for two players, played on a small grid of dots. On your turn, add a vertical or horizontal edge between neighboring dots. If you complete a square, get one point and go again. Keep track of the score by coloring

in your square, or writing your initial inside it.

Whoever has the most squares at the end wins.

Example Game

This graphic is of a small game of Dots and Boxes from Wikipedia. Players A and B play a game in nine turns. Notice that A's last turn consists of several moves, since every box completed gives A an extra move.

Prompts and Questions

- Is it better to go first or second?
- Why did you win/lose your last game?
- Are draws possible?



Image by of Wikipedia User Tiger66

The Wrap

Ask students how many boxes there are altogether in a finished board. What are the possible scores? For example: 9 to 0, 8 to 1, etc. Can they come up with all the possible scores?

Tips for the Classroom

- 1. Small games are better, especially to start.
- 2. Play enough demonstration games with students so that the rules are clear.
- 3. Use different colored crayons or pencils while playing for a clearer game.
- 4. Placing square tiles on completed squares may help keep track of the score.

Dots and Boxes 3 by 3

Dots and Boxes is a 2-player game.

On your turn, add a vertical or horizontal edge between dots. If you complete a square, get one point and go again. Keep track of the score by coloring in your square, or writing your initial inside it.

Whoever has the most squares at the end wins.

Dots and Boxes 4 by 4



Dots and Boxes is a 2-player game.

On your turn, add a vertical or horizontal edge between dots. If you complete a square, get one point and go again. Keep track of the score by coloring in your square, or writing your initial inside it.

Whoever has the most squares at the end wins.