Math for Love
Grade 2 Teacher's Guide

Introduction

Welcome to the Math For Love Supplemental Curriculum! We are thrilled that you will be using this curriculum with your students. Like the lesson plans, we'll make this introduction quick, easy to read, and useful.

We are [Math For Love](), an organization dedicated to transforming how math is taught and learned. Our passion is connecting students and teachers with opportunities to experience excellent mathematics, deepening everyone's skill and enjoyment in the process.

The Math For Love Supplemental Curriculum is built on our belief that *play* and *rigor* go hand in hand, and that the best of mathematics is accessible to students and teachers who are ready to work hard and have fun. You and your students will learn a lot of math over the next 80 lessons, and by the end we hope you'll see why we think math is one of the best parts of the day.

The Big Picture

We built this curriculum with a few key principles in mind.

Principle 1.
Every student can participate in rigorous mathematical thinking.
Rigorous mathematical thinkers want to understand *why*, not just get the answer. They make connections and seek underlying structure and coherence. They develop powerful tools to solve problems, including fact fluency and procedural efficiency. Rigorous mathematical thinkers ask questions, make conjectures and predictions, test out their ideas relentlessly, and expect to be surprised.

Principle 2.
Play is the engine of learning.
Mathematicians engage in play constantly: exploring, wondering, noticing, and being led by curiosity. Play can transform math class from tedious to joyful, from shallow to deep, from mundane into fascinating. Students at play are more likely to persist, to build tenacity, to remember, and to learn. Play is the secret sauce that helps students come to love and succeed in mathematics.

Principle 3.
Without rigor, mathematical play is formless.
Without play, mathematical rigor is unsustainable.
We need both, together, to get the most out of mathematics.

In this introduction, we'll discuss some specific teacher moves that can help encourage rigorous mathematical play.

But first, some details.

The Details

The Math For Love Supplemental Curriculum is built to provide eighty days of 1-hour (or longer) classes, intended to complement a standard curriculum. It can be used for small groups, enrichment, remediation, after school programs, and summer programs. Every lesson is written to accommodate a wide range of student skill level, making it easy and enjoyable to differentiate and support each individual's learning. Our belief is that beautiful and interesting math problems — when designed to be appropriately accessible — should be offered to everyone, no matter where they are in their math journey.

Materials included with curriculum:
- Teacher Guide
- Student Workbooks
- Manipulative Kit
- Math Games

The Lessons

Each lesson follows a standard format with four sections:
- Opener
- Main Activity
- Closer
- Choice Time

We sometimes provide a sketch of how a lesson might unfold, with prompts and questions to help you respond organically to what your students bring to the conversation. Any sample dialog is never meant to be a script, and precisely how the lesson goes will depend on you and your students.

We include guidelines for how long we expect each part of the day will take; however, times will vary depending on student engagement and your decisions.

When preparing for a lesson, review all sections of the lesson in advance. This will help you make decisions on how to group students, how to arrange materials, and what images to project. Even a little bit of preparation will help you be ready to emphasize what's important in the lesson and respond naturally to your students' ideas.

Choice Time Days

Occasionally a full lesson - after the Opener - is devoted to Choice Time. These Choice Time Days are intended to give students a chance to dig deeper into any lessons, or relax with some extra time to play the games they already know. As with normal Choice Time, you can use the suggestions we provide, or substitute in other options.

See the sample lesson templates on the next pages for more details about the lesson plans.

| **SAMPLE DAY** | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

This is where we highlight the main standards we're focusing on for the day, particularly in the main activity. We usually highlight one practice standard and one content standard.

Materials: This section will mention everything you need for the day. The main activity will also include a materials list.

Opener	**We'll say what the opener is here**	10 – 15 minutes
Main Activity	**We'll say what the main activity is here**	20 – 30 minutes
Closer	**We'll summarize what's happening in the Closer here**	5 – 10 minutes
Choice Time	• We'll provide a short list of good options for Choice Time here. • You're always welcome to choose different options!	5 – 25 minutes

Standards Connections

These are additional standards that are connected (or could connect) to today's lesson.

Opener

The lessons cycle through a short collection of our favorite opening routines. The first time you see a particular Opener, there will typically be more detail included. Later, these writeups will become shorter and more succinct. Don't be surprised to see the Opener instructions look almost identical on different days - once you're confident with a given opener, it should take very little time to prep for using it with class.

Here are the main Openers we use in this grade.

➔ **Number Talks**

Share an expression to evaluate.
Prompt: "How many ways can you find the answer?"

➔ **2-Color Dot Talks**

Project an image of dots, or build it with the magnetic ten frame. Students figure out how many dots there are of each color, and how many total, then discuss strategies.

➔ **Choral Counting**

Skip count with the class, then look for patterns.

➔ **Target Number**

Challenge students to create as many equations as they can that equal a given target number.

➔ **Teacher-led Games**

For example, Guess My Number, Bullseyes and Close Calls, Don't Break the Bank, Double Digit, and more.

Tips for the Classroom

1. Look here for some specific ideas for increasing student interaction, adjusting challenge, and more.

2. If there's an image to project for an opener, it's typically on the next page.

Prompts and Questions

- Look here for useful things to say to students to help them get started or push deeper in their thinking.

Main Activity

Materials and Prep

Here's where we describe what students will need for the main activity (doesn't include choice time materials). You'll need to read the lesson to make some decisions about how to arrange the materials for the day. In general, keep this simple – offer containers of manipulatives rather than exact amounts.

Motivating Question (OR How to Play)

To begin working or playing on their own, students should either have a question that frames the day's exploration— along with the knowledge and skill to begin thinking about it — or know the rules of the game they're about to play. We essentialize that question (or summarize those rules) here.

Launch

This is how to introduce the motivating question and get students excited and curious to think about it, or to teach the game in a way students will understand and find irresistible. In the case of games, demonstrating with a student volunteer is almost always the most powerful way to communicate how the game is played.

In general, the Launch should be as thorough as necessary *and* as short as possible. The goal should always be to have the students spending as much time as possible doing the thinking during math class. Whenever you are speaking to the whole class, pose questions and look for opportunities to ask for student ideas, questions, and contributions.

Work

As soon as they're ready, students go to work on their own or in pairs or small groups. This section will have some ideas of what to look for, the lesson flow, extensions, good hints, and (occasionally) solutions.

While students work, circulate in the room, offering help, prompts, hints, asking questions, making connections between ideas, and getting a sense of your students' strengths and where they could benefit from greater support.

Tips for the Classroom

1. Look here for additional ideas on how to implement this activity.

2. We'll often include extensions or simplifications to help with differentiation.

3. Student workbook pages will typically be included on the page right after the Tips for the Classroom.

Launch Key Points

- We try to include some key points for how to help the launch succeed in getting students excited to work.

- Points about the essential knowledge or skills might be here too.

Prompts and Questions

- This section gives ideas for what you might say to students during the "Work" section of the lesson, when they're working on their own or in small groups.

- Sometimes a prompt, hint, or nudge to talk to someone else is all students need.

Closer

Gather the students together for a whole-class discussion when the Main Activity is done. This is where students reflect, consolidate their learning, and potentially try an extension or variation of the Main Activity. To make sure the engaged thinking continues during this part of the day, rather than just summing up what everyone should have learned, take the opportunity to pose questions, invite student comments, and use partner sharing to give everyone a chance to participate.

Choice Time

Choice Time is when students get a chance to revisit games, puzzles, and other material they want to spend more time with. Getting to choose their activity helps with buy-in and self-regulation, and is a chance for students to reflect on what they want to think about more.

Choice Time works like this:
1. Present students with a short list of suggested activities.
2. Students choose the game, worksheet, challenge problem, block set, or other activity they'd like to pursue and commit to sticking with it for at least 5 - 10 minutes.
3. If time permits, students can try more than one activity.

The suggestions for Choice Time are only suggestions. If there is another activity from the curriculum that you think would be a better fit here, or if a student has a strong preference for something not on the suggested list, feel free to make a swap.

You may need to print some materials in advance to prepare for Choice Time. Since the final Choice options are up to you, we don't give a list of materials you'll need for them.

Here are some options that can be freely offered any Choice Time:
- Challenge Problems
- Free Block Play
- Addition by Heart (once students know how to play it)
- Tiny Polka Dot games (once students know how to play them)
- Work on problems from an earlier lesson

Prompts and Questions

- These prompts are for the Closer.

- They might be useful things to say to the class as a whole.

- They also might be helpful replies to anticipated student contributions to a closing discussion.

Teacher Moves

Here are some useful ways to support your students during these lessons.

- **Model enthusiasm and curiosity.** Ask questions. Statements like "I wonder if..." and "I notice that..." go a long way. If students see you enjoying the work, they'll be much more likely to enjoy it too.

- **Keep instructions and launches as brief as possible** (but as long as necessary) and look for places to invite student questions or ideas. As much and as often as possible, we want students to be spending classroom time doing mathematics and thinking mathematically.

- When launching games, **play a demo game with a volunteer** to help students learn the rules. When students play games against each other during work time, try these ways of grouping students:
    - Students play one against one and switch opponents often.
    - Students play in groups of three. Two play while one watches as a referee. When the game is over, the referee position rotates.
    - Students play two against two, and have to agree on moves with their teammate.
    - Students play collaboratively with a partner, and try to get the highest score they can, rather than beat an opponent.

- **Resist solving students' problems for them.** While working on hard problems, it's natural to feel stuck, or unsure of what to do next. Sometimes a key insight requires a lot of exploration first. Give students the time they need.

- **On the other hand, support students when they need it.** There's no use in leaving students feeling dispirited or unsuccessful, and the goal is for students to be productive, even if stuck. We provide ideas for questions, prompts, and hints to keep students motivated and engaged. Even when students are playing or exploring, understand your job as looking for opportunities to help students develop greater efficiency, organization, and power in their methods.

- **Have a plan for how to respond to wrong ideas and answers**. One of the strongest ways to handle these moments is to turn them back to the students by treating the idea seriously and asking for counterexamples or supporting arguments. A very good phrase to keep in your back pocket is: "Convince me."

- **Be willing to be the slowest person in the room**. This means asking for elaboration and clarification if you think there is even one student in the room who doesn't understand an argument yet.

- **Care and respect**. Show students you care about them, respect their thoughts, and that it matters to you that they learn, and enjoy, mathematics.

Materials

We provide just about everything you need to use this curriculum with a classroom of 25 (or more) students. The only extras you'll need are scratch paper, pencils, and crayons or colored pencils. You may occasionally need to make some additional photocopies for Choice Time, though students can often turn to earlier pages in their Student Workbook and find what they need. In addition to this Teacher's Guide and the student workbooks, manipulatives and games include:

Upscale Pattern Blocks. These blocks include the class 4 pattern block shapes in three different sizes, small, medium, and large. We'll use these for arithmetic and geometry.
They are also great for students to explore with during Choice Time.

Number Rods. Another excellent tool for understanding arithmetic operations, fractions, measurement, and more. Rods go from 1 cm to 10 cm long, in the colors named to the left.

Tiny Polka Dot. A math-enriched card deck with 6 suits, each with a different representation of number. Useful for a huge array of math games, puzzles, and explorations. Videos and more at mathforlove.com/dot.
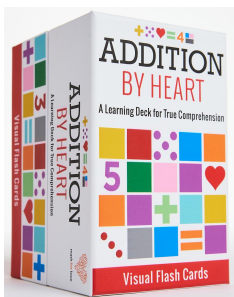
Addition by Heart. A visual flash card deck with three subdecks. Great in the classroom for small group fact practice and for simple fluency games. Ideas included in the lessons, and at mathforlove.com/add.

Challenge Problems Deck. These extra puzzles and problems are great options for Choice Time. These generally get harder the higher the number.
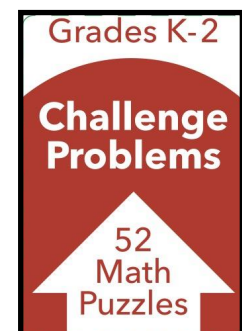
Also included: Square Tiles, 6-sided and 10-sided Dice, Connecting Cubes, Ten Frames, 2-Color Counters, and one Magnetic Ten Frame.

Note: the Magnetic Ten Frame is an excellent tool for Dot Talks and 2-Color Dot Talks.

Other Stuff

- Email errata@mathforlove.com if you notice an error that should be fixed.
- **Additional Material:** We'll gather corrections and additional material at mathforlove.com/curriculum/grade2.
  Password: M4LCurriculum
- Problem with access? Email info@mathforlove.com.

Thanks and Acknowledgements

These lesson plans were built from the lessons we developed over our years working with teachers and students of all ages. However, putting together this more ambitious curriculum required a team, and we were lucky to have an amazing one.

Our curriculum writers were Karen Gallagher, Mark Goldstein, Tara Hofmann, Becky Holden, and Chase Orton. Our editors were Hana Murray and Jen Moffett. We had help with images from Bella Christianne and Hana Murray.

This team of writers and editors worked with incredible focus and skill to build the teacher's edition you're holding now — big thanks to all of them for their dedication and contributions to this project.

Finally, thanks to all the teachers, coaches, students, and staff who have used versions of our materials over the years, and welcomed us into their classrooms.

Daniel Finkel | Founder | Math for Love

Katherine Cook | Creative Director | Math for Love

Table of Contents

Table of Contents

Table of Contents

Table of Contents

| DAY 1 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP1   Make sense of problems and persevere in solving them.

2.OA.1   Use addition and subtraction within 100 to solve problems.

Materials: Dots and Boxes 3 by 3 and 4 by 4 boards, crayons, pencils

Opener	**Mingle**	10 – 15 minutes
Main Activity	**Dots and Boxes**	20 – 30 minutes
Closer	**Dox and Boxes Ties**	5 – 10 minutes
Choice Time	● Dots and Boxes ● Number Rod Free Play ● Pattern Block Free Play ● Square Tile Free Play ● Connecting Cubes Free Play	5 – 25 minutes

Standards Connections

MP1 | MP2 | MP5 | MP6 | MP7 | MP8 | 2.OA.2 | 2.NBT.1

Mingle

Mingle is a great activity for the first day, since it provides students a chance to meet others in class.

Call out a number and have students get themselves into groups of that size as quickly as they can. It might be impossible for everyone to get in a group of the right size every time, which is fine. Students can just join any group. The goal is to be fast, light, and fun.

Once students are in groups, they share their names with each other. Lead an optional skip-count with the class by counting the students in the class by group size (i.e., 3, 6, 9, …).

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

Prompts and Questions

- How many are in your group?

- Will everyone be in a group of 4?

- What numbers can I call and leave no one leftover?

Tips for the Classroom

1. It's okay if not everyone finds a group before calling out the new number. Make sure students who don't find a group don't feel stigmatized. It's fine - they just join an existing group, or match with the teacher.

Dots and Boxes

Materials and Prep
Dots and Boxes pages, colored pencils or crayons

How to Play
This game is 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.

Launch
Draw or project the Dots and Boxes 3 by 3 page for all students to see. Invite a student volunteer to play against you. Describe the rules *as you play*.

Make sure you demonstrate how after you complete a box you move again - ideally, students will see how this can lead to a player taking many boxes on one turn.

Play the demon game to it's end so that students see the process of tallying the score. When students seem clear about the rules and excited to play on their own, release them to play against each other.

Example Game
The sidebar 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.

Work
Student play pairs. They should start with the 3 by 3 Dots and Boxes, but the 4 by 4 version is available for students who want a more complex game. Every 5 minutes or so have students find new opponents.

Tips for the Classroom
1. Use different colored crayons or pencils for each player.

2. The board with 16 dots forms an array with three boxes on each side – hence the name 3 by 3.
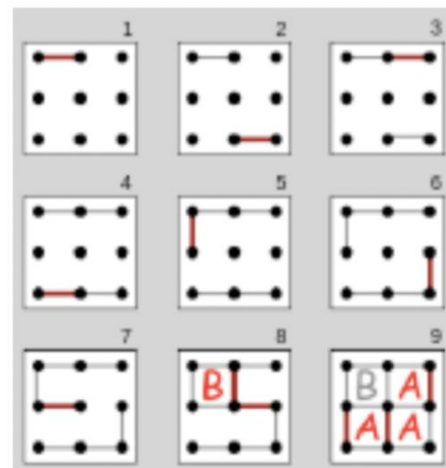
Image by of Wikipedia User Tiger66

Launch Key Points

- Keep the Demo game brief and narrate your thinking as you play.

- Invite the class to give advice about where to draw the next line on your turn.

- End the launch when it seems like most students understand the game.

Prompts and Questions

- If you go there, what do you think your opponent will do?

- Is it better to go first or second?

- Why did you win/lose your last game?

- Are ties possible?

Day 1

Dots and Boxes
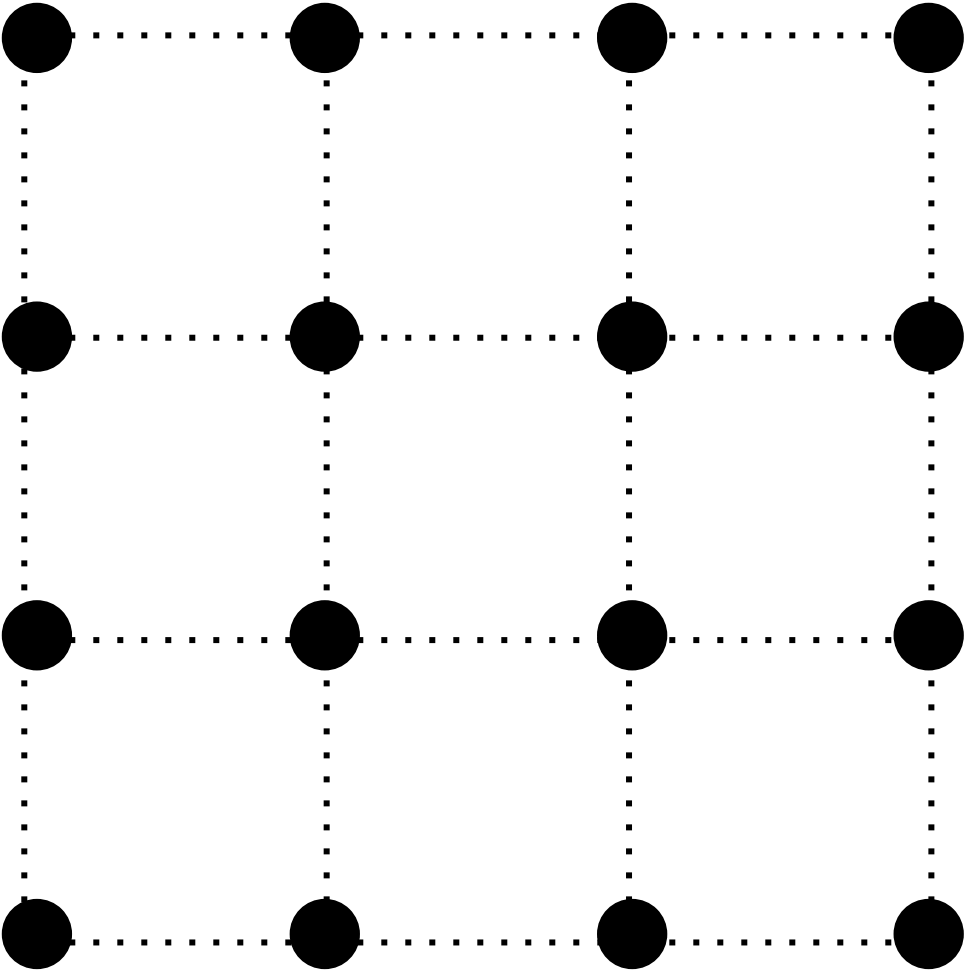
Day 1

Dots and Boxes
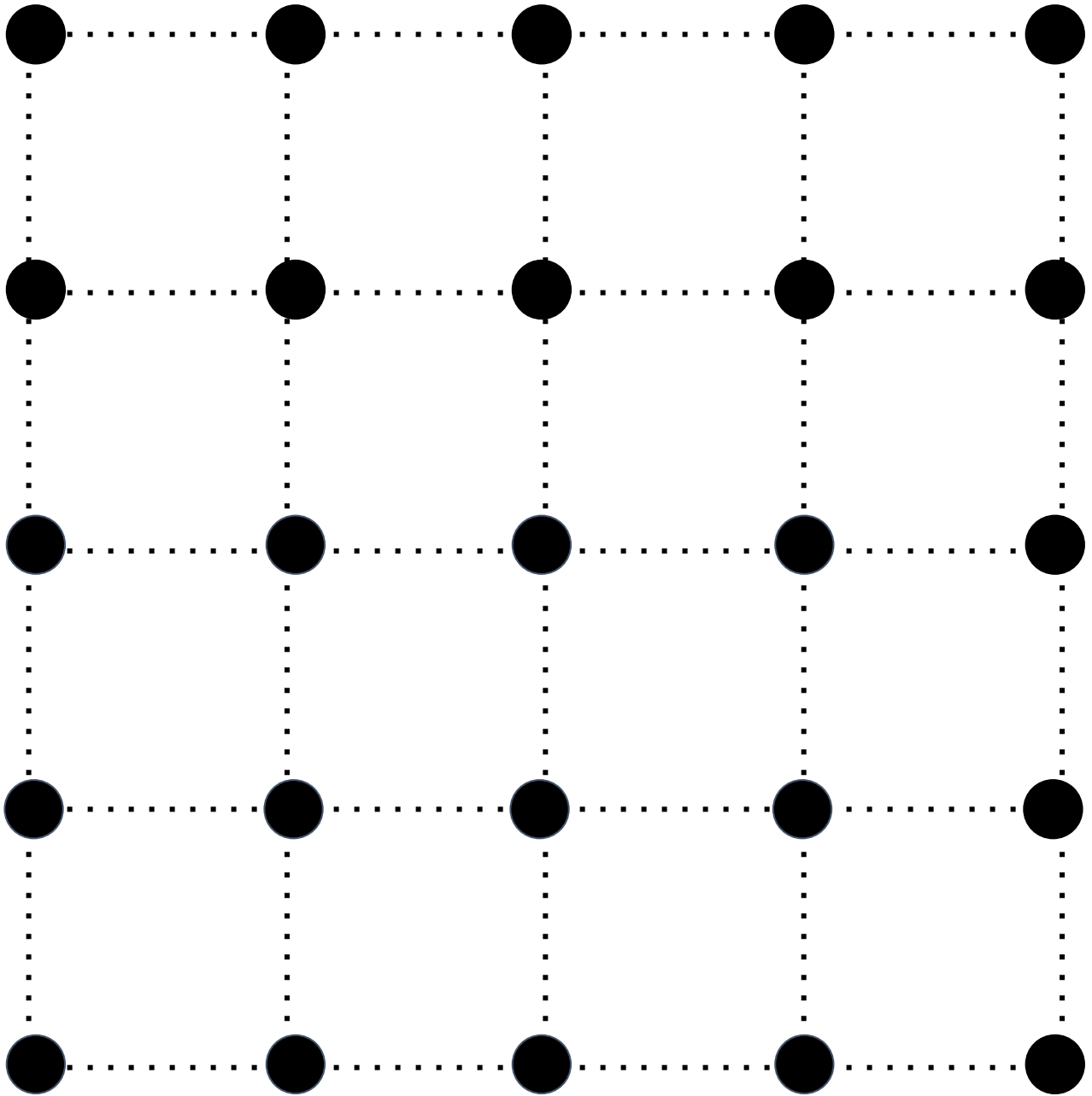
Closer

Ask students to share what they noticed about Dots and Boxes, and lead a brief class discussion to let them share their observations.

Mention that you have a question about the game: are ties possible? Go a step further and mention that you didn't see any ties in any of the 3 by 3 games, and tell students that you're going to make a *conjecture,* which is what we call an educated guess in mathematics.

Conjecture. It is impossible to have a tie game in Dots and Boxes.

Do students agree or disagree? Either way, ask them if they can find a *counterexample*, that is - could they play a game and try to tie on purpose? Let students try on both boards and then ask what they notice.

It turns out that ties are impossible on the 3 by 3 board, since you can't evenly divide 9 in half in this game (the condition required for a tie), but ties are possible on the 4 by 4 board, since each player could get 8 boxes. If students are able to follow all this, you can challenge them to figure out if ties are possible on a 3 by 4 board.

Choice Time

Today's Choice Time Options
- Dots and Boxes
- Number Rod Free Play
- Pattern Block Free Play
- Square Tile Free Play
- Connecting Cubes Free Play

Prepare students for Choice Time by explaining that they will choose from some pre-selected options. Tell students that once they choose an activity, they should spend at least 5 minutes on it before trying something else.

Show the Challenge Problem Deck and explain that it will always be among the Choice Time options. Students can simply take a challenge problem card and try to solve it, on their own or with a partner. Be sure to provide scratch paper and pencils to support student work.

Block free play is also an option. This is an opportunity for students to build with Pattern Blocks or other manipulatives. Students may also choose to play more Dots and Boxes.

Prompts and Questions

- Are ties possible?

- Can you play a game that ends in a tie? Let's see you do it!

- What if the board size were different? What if it were a 3 by 4 board?

| DAY 2 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP1   Make sense of problems and persevere in solving them.

2.OA.1   Use addition and subtraction within 100 to solve one- and two-step problems.

Materials: Upscale Pattern blocks, Triangle fill in page for launch, scratch paper, pencils

Opener	**Guess My Number**	10 – 15 minutes
Main Activity	**Pattern Block Triangles**	20 – 30 minutes
Closer	**Pattern Block Triangles**	5 – 10 minutes
Choice Time	● Dots and Boxes ● Block Free Play ● Challenge Problems	5 – 25 minutes

Standards Connections

MP6 | MP7 | MP8 | 2.OA.2

Guess My Number

Write the numbers from 1 to 20 on the board. Tell your students that you are going to think of a number from 1 to 20, 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.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Little do the students know that you haven't actually chosen a number! Instead, always make their guess turn out as poorly for them as possible, in order to prolong the game. If they guess 18, your number is less than 18. If they guess 2, your number is greater than 2.

After each guess and your response, ask students if they can identify which no numbers are no longer possible. Cross those numbers off the list and ask if that helps students with their next guess.

Plan to play 2 - 3 games. You can increase the range of numbers after each game, playing to 22, 25, 30, or more, instead of 20.

Tips for the Classroom

1. 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.

2. Don't play for too long at one time. Two to three games is usually enough to get the kids mentally alert and ready for whatever is coming next.

Prompts and Questions

- 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?

14

Pattern Block Triangles

Materials and Prep
Upscale Pattern Blocks, scratch paper, pencils

Motivating Question
Is it possible to build a triangle with whatever number of blocks you want?

Launch
Make sure every student has access to a set of Upscale Pattern Blocks.

Start with a (false) conjecture. If necessary, remind students that last lesson they learned a *conjecture* is an educated guess in mathematics. You can build toward the conjecture below by observing each individual block and noticing that the only triangles are green.

Conjecture. All pattern block triangles are green.

Invite the students to try to prove you wrong. They should start building right away. Ask them to raise a hand when they have found a counterexample.

Counterexamples. Students might include a red trapezoid with a green triangle on top or other shapes built from multiple blocks.
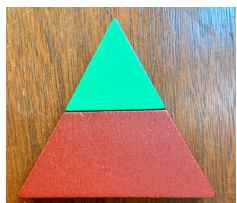
Count the number of blocks in each triangle that students have put forward as counterexamples. Then write the numbers from 1 to 20 on the board and ask students what number of blocks they think it's possible to build a triangle from. Maybe we know that 1, 2, and 4 are possible (given the examples above–your class may come up with different counterexamples). Is 3 possible? Is 9? Is 17?

Have students make their own list of numbers, 1-20, on their paper, with enough space to write an equation for each one. For the numbers you already have, demonstrate how to write in the equations for them: 2 = 1 G + 1 R and 4 = 3 G + 1 Y. 15
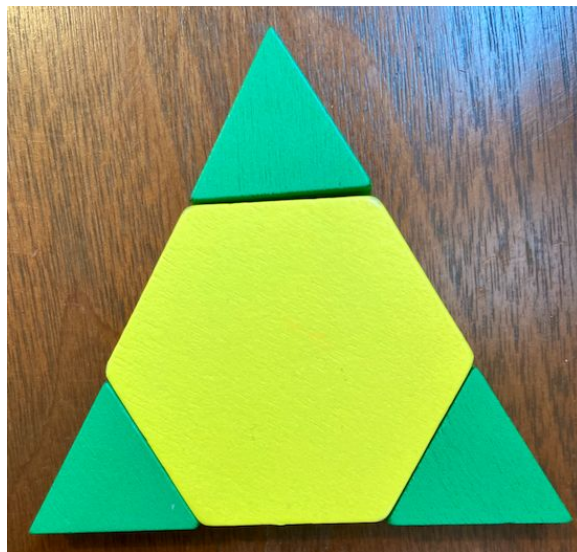
Launch Key Points

- Remind students about conjectures, and ask them to prove you wrong with counterexamples.

- Before sending students to work, ask the Motivating Question - challenge them to build a triangle with every possible number 1 to 20.

- Model how to write an equation for each number, where the summands are grouped by each type of block.

The big challenge for students is: can they build a triangle for each number from 1 to 20? Or is there any number that they won't be able to build?

Work

Students can work individually or with a partner to build different triangles.

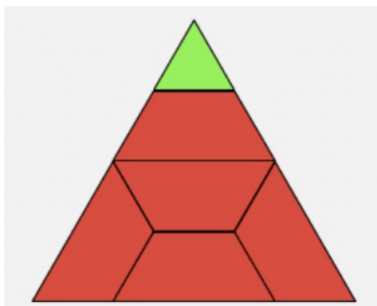If students can make a triangle using some number of blocks, they can write an equation for that number. For example, when they make a triangle using exactly 6 blocks, they can write an equation describing that triangle. For the triangle below for example, the equation might be 6 = 5 R + 1 G.

Prompts and Questions

- How many blocks did you use in that triangle?

- Did you record it yet? Show me the equation for that triangle.

- Have you built a triangle with 11 (or any other number) blocks yet? How did you do it?

Tips for the Classroom

1. The idea in using the list is that every triangle students build is a success, and then certain holes in the list become more challenging to make.

2. There are two excellent ways to challenge students who successfully make all the triangles from 1 to 20. First, ask them if they can make a larger number, say, 31. Second, challenge them to make a much larger triangle from the outside first (i.e. build the perimeter first), and show you how they can correctly add all the pieces inside it.

3. For today, "triangle" means triangles made out of Upscale Pattern Blocks with no empty spaces inside. Alternative definitions may pop up from students. Let them know that for today, we just mean triangles of this type (with no holes).

4. As a downlevel option, you can just go from 1 to 10 instead of 1 to 20, and not require writing equations for each triangle.

5. Additional challenges can make use of the larger and smaller Upscale pattern blocks explicitly. For example, can you make a triangle that uses all 3 sizes of triangle? (See image to the right for a way to do this with just 5 blocks.)

16

Closer

There is a powerful idea to underline as you wrap up this activity, which is that you can substitute smaller blocks—say, two trapezoids in the place of one hexagon—to raise the number of blocks you used in a triangle without changing anything else.

If you noticed any students that had figured out this strategy while working on their list of numbers, invite them to demonstrate on a specific triangle, and then ask students if they can predict how making this substitution will change the number of blocks. See the image below.

If no students had this idea, build the first shape below and ask for ideas on how to change it from 7 blocks to 8 blocks.

Can students use this idea to make triangles using any of the missing numbers from their list? Discuss with the class, and listen for arguments for why any number from 1 to 20 is possible.

Prompts and Questions

- What strategies did you use to build a triangle from a specific number of blocks?

- How could you make the hexagon with different blocks?

- Can you use this idea of substitution to make triangles using the missing numbers on your list?

2 hexagons + 4 trapezoids + 1 triangle = 7 blocks
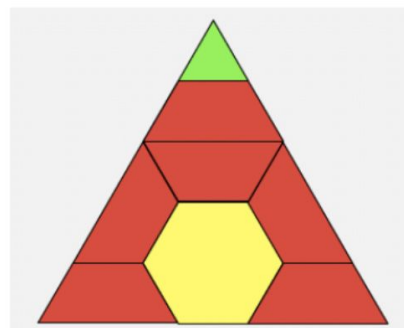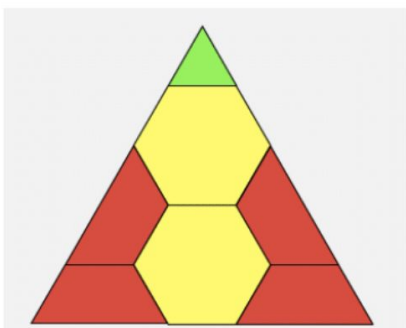
1 hexagon + **6** trapezoids + 1 triangle = **8** blocks

Choice Time
- Dots and Boxes
- Block Free Play
- Challenge Problems

| DAY 3 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP1　　　　　Make sense of problems and persevere in solving them.

2.NBT.A.2　　Count within 1,000; Skip count by 5s, 10s, 100s.

Materials:　　Objects to count, containers, ten frames, recording sheets, and pencils

Opener	**Choral Counting**	10 – 15 minutes
Main Activity	**Counting Collections**	20 – 30 minutes
Closer	**Counting using ten frames**	5 – 10 minutes
Choice Time	• Block Free Play • Dots and Boxes • Counting Collections • Challenge Problems	5 – 25 minutes

Standards Connections

MP6 | 2.OA.C.4 | 2.OA.A.1 | 2.NBT.A.3

18

Choral Counting

Choral counting is an incredibly powerful activity for building numeracy. Students practice counting forward, backward, skip counting, and — critically — looking for patterns.

For this first Choral Count, explain to students that you'll be counting together as a whole class. The goal is to go slow and stay together. If students aren't sure what the next number will be, you'll be going slow enough that they'll have some time to think about it.

Step 1. Tell students you'll **start at 0 and count by 2s until you reach 38**.

Step 2. The students' job is to predict to themselves what each next number will be as you write it, and to count along with you.

Step 3. Start writing out the numbers. Write 15 - 25 numbers. Do this slowly, so students have time to think of what might come next. Ask them to say each number with you as you write it. For today, write the numbers in **four rows of five.** Pause after writing 24 and ask students if they notice anything about the table.

Step 3. Once you've written out the whole sequence, recount the numbers together as a class.

Step 4. Ask students to share what they notice about the number sequence. Write down their observations.

0	2	4	6	8
10	12	14	16	18
20	22	24	26	28
30	32	34	36	38

Prompts and Questions

- What do you think I'll write next and why?

- Let's count all the numbers together.

- Take a moment to look at these numbers. What do you notice?

- What do you wonder about these numbers, that you might not know yet?

Tips for the Classroom

1. Changing the number of columns you use will create more or less emphasis on different kinds of patterns. You can experiment with this as you do more Choral Counts.

2. There may be some very interesting patterns that emerge. Some may be correct, some incorrect. Most important is to write students' comments down as clearly as you can, making notes/circles/arrows on the numbers if that helps.

3. Students might comment on first digits, last digits, digit sums, columns, rows, diagonals, or any other pattern. Prepare to be surprised!

Counting Collections

Materials and Prep

Objects to count (collections of the manipulatives, or beads, crayons, paper clips, beans, rocks, etc); containers to hold each collection (bowls, cups, or bags); worksheet, pencil, ten frames.

Organize objects into collections with varied quantities - smaller numbers of objects (i.e., 25 - 50), as well as larger numbers (50-200). Make a demo collection with a small number (less than 20) for the launch.

Set counting collections containers and ten frames around the room, so students have space to work.

Motivating Question

How many are in your collection?

Launch

Point out the collections around the room. Let students know they will count how many objects are in the collection they select today.

Use the demo collection and the counting collection worksheet to demonstrate. Keep this demo brief to get students quickly counting their own collections. Ask students how many objects they think are in this bag. Get guesses from students, then dump out the bag. (Do the guesses change once they see the contents out of the bag?)

Place objects in ten frames to organize your count. Then count the collection, then write down the number you counted, and demonstrate filling out the collection recording sheet. Explain that student pairs will choose a collection in the room, dump out the bag and find out how many there are with their partner.

Counting Collection

Guess: _____

Picture of how I counted

How many I counted: _____

Launch Key Points

• Demonstrate using the worksheet to record an estimate and the actual total.

• Make an observation about whether your estimate was high or low.

• Include putting the collection back in its container as part of your demo.

Day 3

Counting Collection

Guess: _____

Picture of how I counted

How many I counted: _____

Work

The students count and record their numbers. Observe how students are counting, and take notes on the strategies they're using, and where they are in their developing understanding of numbers or making equal groups to count.

Once students have filled out a recording sheet correctly, they can try counting another collection.

Tips for the Classroom

1. Offer tools to support students with counting and organization, such as ten frames, trays or cups.

2. Encourage students to think about grouping by 2s, 5s, or 10s, especially for counting larger collections.

Prompts and Questions

- What strategies are you using to count?

- What number do you find is easiest to count by?

- What can you do if you and your partner did not find the same amount?

- Can you tell how your partner counted by looking at their picture?

- Challenge: Invite students to recount their collection in a new way (by 2s, with 10 frames) if they finish quickly.

- Students can choose a larger collection for their second count if they successfully counted their first.

Closer

After students have finished counting for the day, ask for reports on counts. Discuss what strategies students used to count their collections.

Choose a student recording sheet to share that has a drawing using ten frames. If no students drew ten frames, you can invite a student who used ten frames to count to build their count in a place the whole class can view and discuss. (If there are no students who used ten frames, build the example below.)

Here is an example:
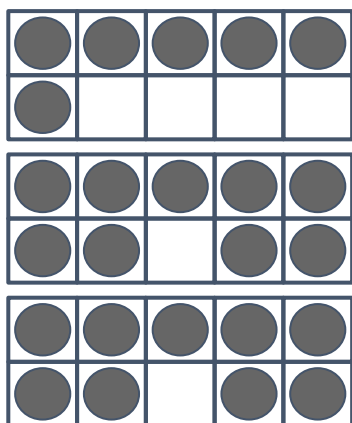
Ask students to share how many objects they can count in this arrangement. Discuss how students are counting to find how many, highlighting that a full ten frame can be recognized as a ten without needing to count them all. This is a good time to discuss the strategy of moving dots to make full ten frames. Using counters on empty ten frames can help with this.

> ## Prompts and Questions
>
> - How did you count your collection?
>
> - Which strategy for counting was most helpful?
>
> - What is a new counting strategy you saw or heard about from a classmate today that you might want to try next time?

Choice Time

- Block Free Play
- Dots and Boxes
- Counting Collections
- Challenge Problems

| DAY 4 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP1   Make sense of problems and persevere in solving them.

2.OA.2   Fluently add within 20 using strategies and mental math

Materials: Tiny Polka Dot cards

Opener	**Choral Count**	10 – 15 minutes
Main Activity	**Card sorting and PowerDot Pro**	20 – 30 minutes
Closer	**Gallery Walk**	5 – 10 minutes
Choice Time	● Dots and Boxes ● PowerDot Pro ● Challenge Problems	5 – 25 minutes

Standards Connections

MP2 | MP3 | MP6 | MP7

Choral Counting

Choral counting is an incredibly powerful activity for building numeracy. Students practice counting forward, backward, skip counting, and — critically — looking for patterns.

Here's how to lead a choral count.

1. **Step 1.** Tell students you'll **start at 20 and count by 2s until you reach 50**.
2. **Step 2.** The students job is to predict to themselves what each next number will be as you write it, and to count along with you.
3. **Step 3.** Start writing out the numbers. Write out the first two rows of numbers. Do this slowly, so students have time to think of what might come next. Ask them to say each number with you as you write it. For today, write the numbers in **four rows of five**, and pause after the first two rows to discuss observations.
4. **Step 3.** Once you've written out the whole sequence, recount the numbers together as a class.
   Step 4. Ask students to share what they notice about the number sequence. Write down their observations.

   Optional: Invite students to guess what number would be under 44, using what they notice about patterns.

20	22	24	26	28
30	32	34	36	38
40	42	44	46	48
50		??		

Prompts and Questions

- What do you think I'll write next and why?

- Let's count all the numbers together.

- Take a moment to look at these numbers. What do you notice?

- Can you predict what the number will be under 44 on the chart?

Tips for the Classroom

1. Changing the number of columns you use will create more or less emphasis on different kinds of patterns. You can experiment with this as you do more Choral Counts.

2. There may be some very interesting patterns that emerge. Some may be correct, some incorrect. Most important is to write students' comments down as clearly as you can, making notes/circles/arrows on the numbers if that helps.

3. Students might comment on first digits, last digits, digit nums, columns, rows, diagonals, or any other pattern. Prepare to be surprised!

25

Card Sorting and PowerDot Pro
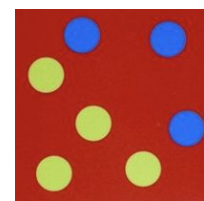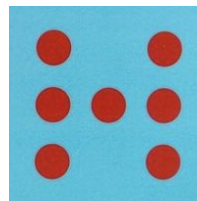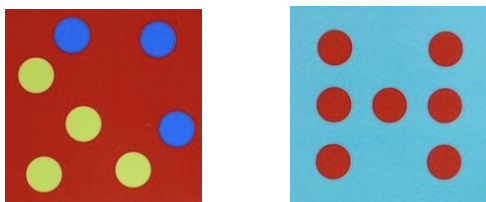
Materials and Prep
Tiny Polka Dot cards

Motivating Question
How can you sort the Tiny Polka Dot cards?

Launch
Show a few different Tiny Polka Dot cards to the class. Ask students what is the same and what is different between the cards.

Tell students you've gotten the Tiny Polka Dot decks all mixed up and you need some help sorting them. (Feel free to show a jumbled up hand of cards here to make your point.)

Students will work in pairs or trios and decide how they would like to sort the cards, then sort them. Some sorting schemas you might see are by suit (color), by number, or in sequential number order. The larger the deck students are working with, the more involved their sorting will be. Encourage students to sort the cards into grids rather than piles.

After every group has finished sorting, ask students to share some of the ways they decided to sort.

Once you've finished discussing the sorting strategies, tell students you'll be using the Tiny Polka Dot cards to play a game.

PowerDot Pro
Choose 2 student volunteers to demonstrate the game. Deal cards to each player. At the same time, each player turns over 2 cards. One player at at time finds the sum of their cards (verified by the other player). The player with the highest sum wins the round, taking all the cards and setting them aside.

Play until both players have used up their hand of the cards. The winner has collected the most cards by the end of the game.

Launch Key Points

- Ask what students notice about the different sets of Tiny Polka Dot cards?

- Students should understand that their group gets to decide how they will sort the cards. There are a lot of interesting possibilities here!

- After sorting the cards, make the intro to PowerDot Pro quick by giving the student volunteers enough cards for only a few turns by the end of the game.

26

Work
Students play PowerDot Pro in pairs or trios.

Tips for the Classroom
1. Vary the challenge of PowerDot Pro by adjusting suits of Tiny Polka Dot cards. Blue ten frame cards are more supportive, while Orange circle cards offer more challenge.

2. For greater challenge, students can turn over 3 cards per turn, instead of 2. To reduce the challenge, students can turn over just 1 card per turn.

Prompts and Questions

- How are you finding the sum of your cards?

- Which kind of Dot cards are easier for finding the sum?

- Which kind of Dot cards are more challenging for finding the sum?

Closer

Project the image below for a brief time before covering it up. Ask students to make an estimate of what their sum might be. Take guesses what they'll add up to (15? 30? 100?). Then uncover the image and ask students to add up all six cards.

Let students think on their own or with a partner, and then share their approaches.
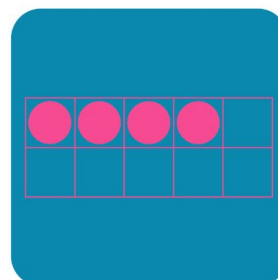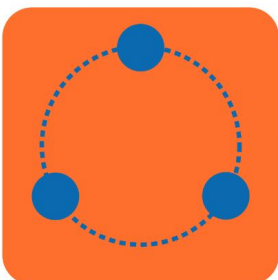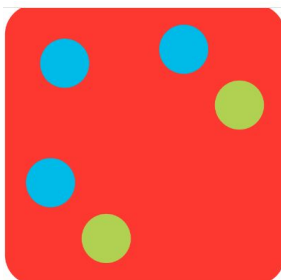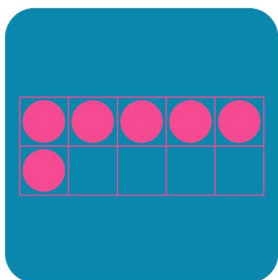
Discuss how far the actual sum was from their guess.

Choice Time

- Dots and Boxes
- PowerDot Pro
- Challenge Problems

Prompts and Questions

- How did you add? How did you begin?

- If you use a different strategy to add, will the sum be the same?

- Even if you didn't guess correctly (and why would you?), do you feel your guess was reasonable?

| DAY 5 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP2   Reason quantitatively.

2.OA.2   Fluently add within 20 using strategies and mental math.

Materials: Tiny Polka Dot cards

Opener	**2-Color Dot Talks**	10 – 15 minutes
Main Activity	**Dot Ten Memory**	20 – 30 minutes
Closer	**Adding up an entire suit**	5 – 10 minutes
Choice Time	• PowerDot • Dots and Boxes • Block Free Play • Challenge Problems	5 – 25 minutes

Standards Connections

MP1 | MP5 | MP6 | MP7 | 2.NBT.1

DAY 5 | **Opener** | Main Activity | Closer | Choice Time

2-Color Dot Talks

Project the image—with two colors of dots—on the board where all students can see it, and ask students to figure out:

1.   How many **dots of each color** there are
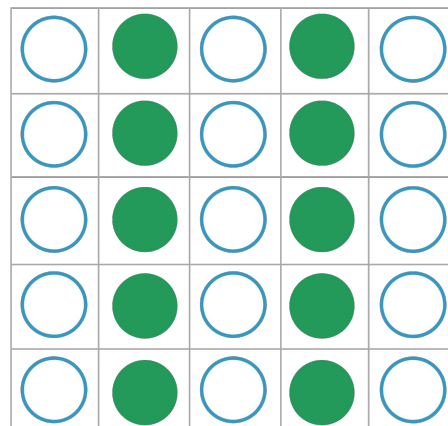2.   How many **total dots** there are

Students can think about the questions on their own first, and then share with a partner. Once students have had time to think the question through, lead a class discussion where students share their answers and approaches.

Your job is to restate and write down counting strategies, clarifying as necessary and making connections between ideas. If students come up with wrong answers or incorrect approaches, make sure these are addressed with clear arguments before moving on.

Discuss 3-5 strategies for the first image before moving on to the second.

Tips for the Classroom

1.   Students will be looking to see if you indicate what the right answer is. Don't favor right answers over wrong ones. Make sure that the explanations are what matters.

2.   Give students constructive language to use in the discussion, like, "I respectfully disagree, because..." and "I agree with _____, because..."

3.   Always keep the environment safe and positive.

Prompts and Questions

- Who would like to defend this answer?

- I don't quite follow. Do you mean I should count this color first?

- How did you do that/know that?

- Does anyone else think they can explain what Shawn is saying?

- It sounds like Anita noticed that there were ten dots in each row, and then counted by tens. Did anyone else use the same strategy?

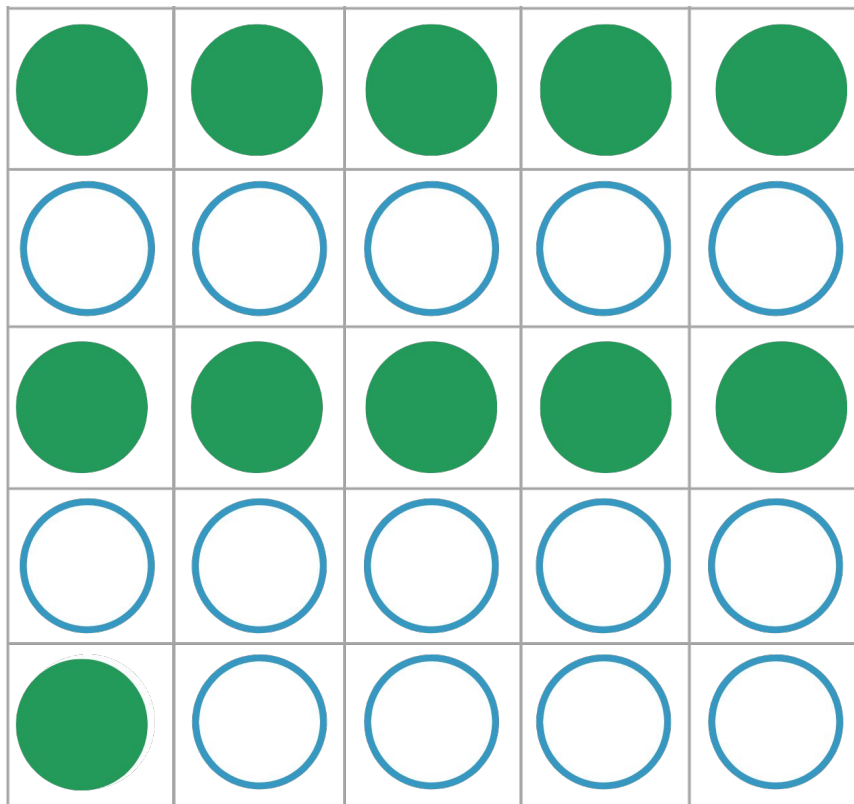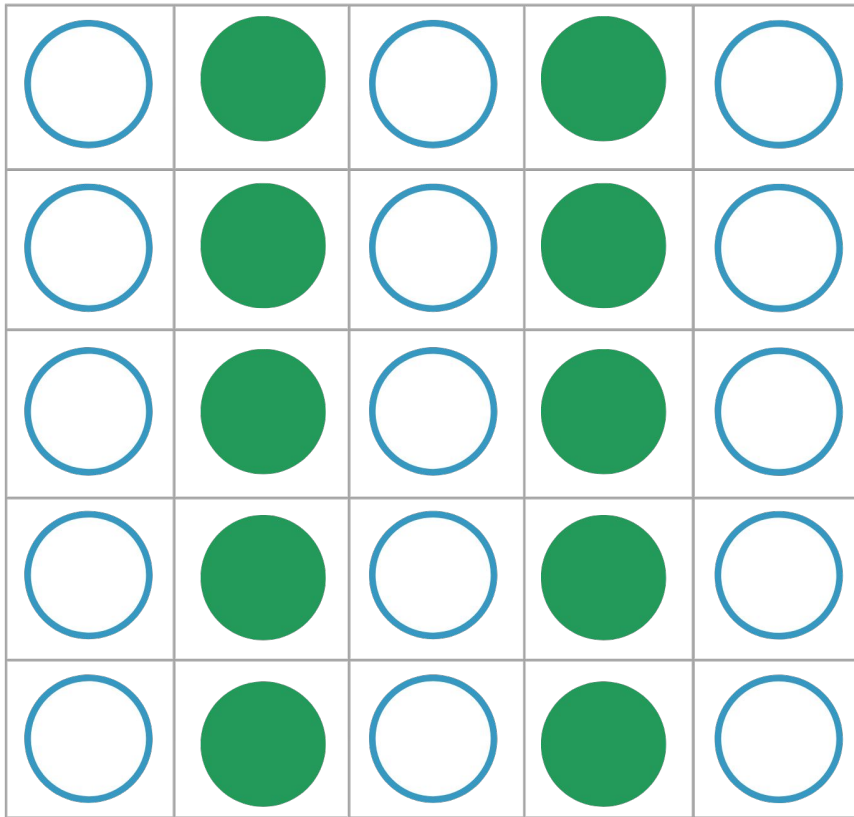- Turn to the person next to you and explain how you counted.

Dot Ten Memory

Materials and Prep
Tiny Polka Dot Cards

How To Play
Use 2 or more complete suits, from 0 to 10. Arrange cards face down in rows. Players take turns flipping up 2 cards at a time. If the cards sum to 10, keep them. If not, turn them back face down.

Keep playing until all the cards are gone. Whoever has the most cards at the end is the winner.

Launch
Take a volunteer for a demonstration game. Choose two suits, mix them up, and deal them out face down in a grid. Then begin playing, explaining the rules as you go.

Play the until everyone in the class is clear on the rules. Then let them play in pairs or trios.

Work
Circulate to support students as they play. If pairs finish, split them up and have them challenge students from another group.

Tips for the Classroom
1. Students may, after repeated playing, come up with interesting variations, like being able to turn over three cards to make ten. These may be worth exploring—use your judgement about whether their variations will be helpful or distracting.

2. Counting total scores is an opportunity to count by tens. Instead of just counting cards one by one, encourage students to count their pairs (each is worth ten).

3. Collaborative play is an option, where players work together to clear the board.
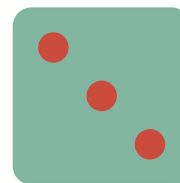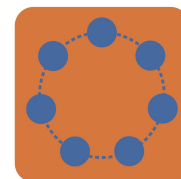
Launch Key Points

- Keep launch game very brief to get students playing quickly.

- During the demo, comment on different strategies to make ten depending on the arrangement of dots.

Prompts and Questions

- Do you know any pairs that make ten?

- What number do you need to make a ten with the one you've already turned over?

- What can you do with the card they just turned over?

Closer

Ask students to take a single suit of cards and figure out what they add up to altogether.

If students work in order, this might be hard. A helpful hint for those who start to struggle is to ask what if you find pairs that make 10?

Let students work independently or in pairs for a while. Then, discuss together as a whole class. Lay out all the cards in a suit.
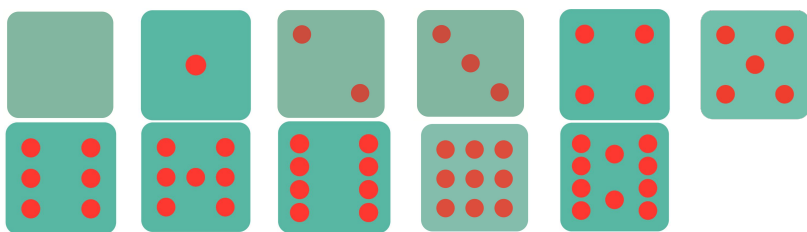
As students share pairs that make tens, move the cards around to provide a visual support for finding the total dots.
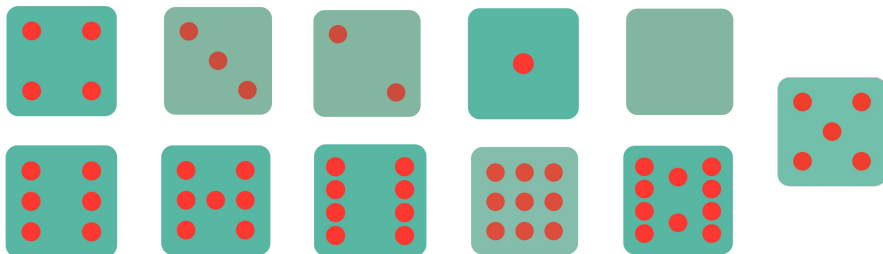
If they do find tens, they'll end up with 5 tens and 1 five, for a total of 55 dots.

If time allows, try it for 2 suits. (The total there is 110).

Choice Time

- PowerDot Pro
- Dots and Boxes
- Block Free Play
- Challenge Problems

> ## Prompts and Questions
>
> - Would finding pairs that make ten help?
>
> - Let's count these tens together.
>
> - Is there anything leftover?

DAY 6	Opener	Main Activity	Closer	Choice Time

Overview

Focus Standards

MP1   Make sense of problems and persevere in solving them.

2.OA.1   Solve problems involving addition and subtraction.

Materials: Counters, ten frames

Opener	**Number Talks**	10 – 15 minutes
Main Activity	**1-2 Nim**	20 – 30 minutes
Closer	**1-2 Nim Strategy**	5 – 10 minutes
Choice Time	• Dot Ten Memory • PowerDot Pro • Block Free Play • Challenge Problems	5 – 25 minutes

Standards Connections

MP2 | MP3 | MP5 | MP7 | MP8 | 2.OA.B.2

Number Talks

Write or project an arithmetic problem where everyone can see it.

The prompt is: find the answer *in as many different ways you can*.

Give students a couple minutes to solve the problem mentally, holding fingers up at their chests to indicate how many different approaches they have.

Once students have had enough think time, collect answers (without indicating which answer is correct) and write notes as students defend their answers and describe their approaches. Your job is to help clarify by restating or asking questions as necessary, and make connections where appropriate. In a Number Talk, the correct answer is not as important as how the problem was solved. If students share incorrect answers, make sure these are addressed and corrected with clear arguments before moving on.

After students have shared 3 - 5 approaches and you have reached a consensus as to which answers and approaches are correct, move to a second question. In a Number Talk, the second question is often an extension of the first, and it can be helpful to emphasize student strategies that make use what is known from the first problem.

For today's Number Talk, start with problem A.

Tips for the Classroom

1. Students will be looking to see if you indicate what the right answer is. Don't favor right answers over wrong ones. Make sure that the explanations are what matters—as the teacher, you can always be the last to be convinced if an explanation needs more.

2. Give students constructive language to use in the discussion, like, "I respectfully disagree, because..." and "I agree with _____, because..."

3. Having the class work together to correct a wrong answer or mistakes in an argument is an excellent opportunity for learning.

4. Always keep the environment safe and positive.

A. $7 + 5$

B. $17 + 5$

Prompts and Questions

- Who would like to defend this answer?

- How did you do that/know that?

- Does anyone else think they can explain what Shawn is saying?

- Turn to the person next to you and explain your approach.

1-2 Nim Day 1

Materials and Prep
10 counters (tiles, beans, etc) per student pair, or paper and pencil

How to Play
Start with a pile of 10 counters. Players alternate removing counters from the pile. On your turn, choose whether to remove one or two counters from the pile. You must take at least one counter on your turn, but you may not take more than two. Whoever takes the last counter is the winner.

Launch
Demonstrate playing 1-2 Nim with a student. Invite them to choose whether to go first or second. Narrate your choices and thinking as you play. If you happen to observe or know how to win this game, make sure not to reveal!

Work
Students play 1-2 Nim in pairs. As they begin developing strategies, change pairings so students can try out their ideas with new opponents. You can also groups partners so they can play 2 against 2, each team working together on their strategy.

As students play, a central question will begin to take shape: How can you win 1-2 Nim? What would a perfect strategy look like?

Tips for the Classroom
1. Think aloud during Demo games, using mathematical language.

2. Make space for students to share observations and ideas about the game during play.

3. Circulate and challenge students to beat you.

4. Variations for when students need more challenge:
   a. Change the size of the pile.
   b. 1-2-3- Nim: take one, two or three per turn.
   c. Poison: Whoever takes the last counter loses.

5. Don't reveal this to students, but leaving your opponent with a multiple of 3 will guarantee your victory. The first insight toward this, that leaving them 3 will lead you to win, we call "the three trap." Many games will lead students toward this revelation.

Launch Key Points

- Demonstrate and narrate the game until everyone understands and is excited to play.

- Every game played is an opportunity to learn. Students can expect to lose many times.

- Practice good sportsmanship in the demo games. For example, you could say, "Good game, I hope you win next time" after each game.

Prompts and Questions

- What move should you make next?

- What do you think your opponent will do if you take two counters?

- What have you noticed about this game?

- Would you like to take back your move?

Closer

Ask students what strategies they developed, or what theories they have about the game.

Take another volunteer who believes they can defeat you. Play as hard as you can against them. Can they beat you? If so, what's their strategy?

After a first game, ask students if they could beat you with a smaller number of counters. Take a challenger, and let them pick the size of the pile. Does anyone pick 1? 5? Whatever the size their choose, play them and try to win. What numbers give them control over the game?

If students have noticed that if they leave their opponent with three counters, they can win, you can bring this up for discussion. Ask someone to convince the class that this is actually true. We call leaving your opponent with three counters "the three trap."

Choice Time

- Dot Ten Memory
- PowerDot Pro
- Block Free Play
- Challenge Problems

Prompts and Questions

- Did you find any strategy that helped you win 1-2 Nim?

- If you change the size of the pile, is there a number that you're certain you could win with (if you get to choose whether to go first or second)?

| DAY 7 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP1   Make sense of problems and persevere in solving them.

2.OA.1   Solve problems involving addition and subtraction.

Materials: 20 counters, ten frames

Opener	**2-Color Dot Talks**	10 – 15 minutes
Main Activity	**1-2 Nim**	20 – 30 minutes
Closer	**Solving Nim**	5 – 10 minutes
Choice Time	• Dot Ten Memory • Dots and Boxes • Block Free Play • Challenge Problems	5 – 25 minutes

Standards Connections

MP2 | MP3 | MP5 | MP7 | MP8 | 2.OA.B.2
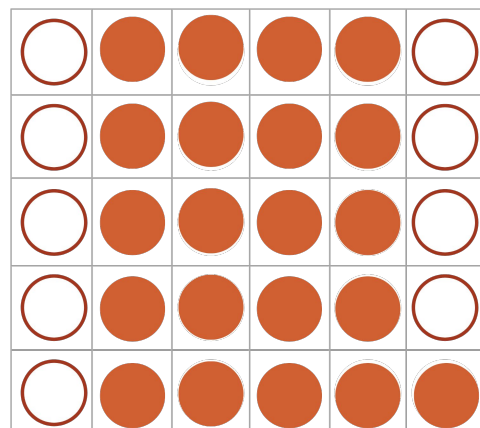
2-Color Dot Talks

Project the image—with two colors of dots—on the board where all students can see it, and ask students to figure out:

1.   How many **dots of each color**
2.   How many **total dots**

Students can think about the questions on their own first, and then share with a partner. Once students have had time to think the question through, lead a class discussion where students share their answers and approaches.

Tips for the Classroom

1.   Students will be looking to see if you indicate what the right answer is. Don't favor right answers over wrong ones. Make sure that the explanations are what matters.

2.   Give students constructive language to use in the discussion, like, "I respectfully disagree, because…" and "I agree with _____, because…"

3.   Always keep the environment safe and positive.

Prompts and Questions

- Who would like to defend this answer?

- I don't quite follow. Do you mean I should count this color first?

- How did you do that/know that?

- Does anyone else think they can explain what Shawn is saying?

- It sounds like Anita noticed that there were ten dots in each row, and then counted by tens. Did anyone else use the same strategy?

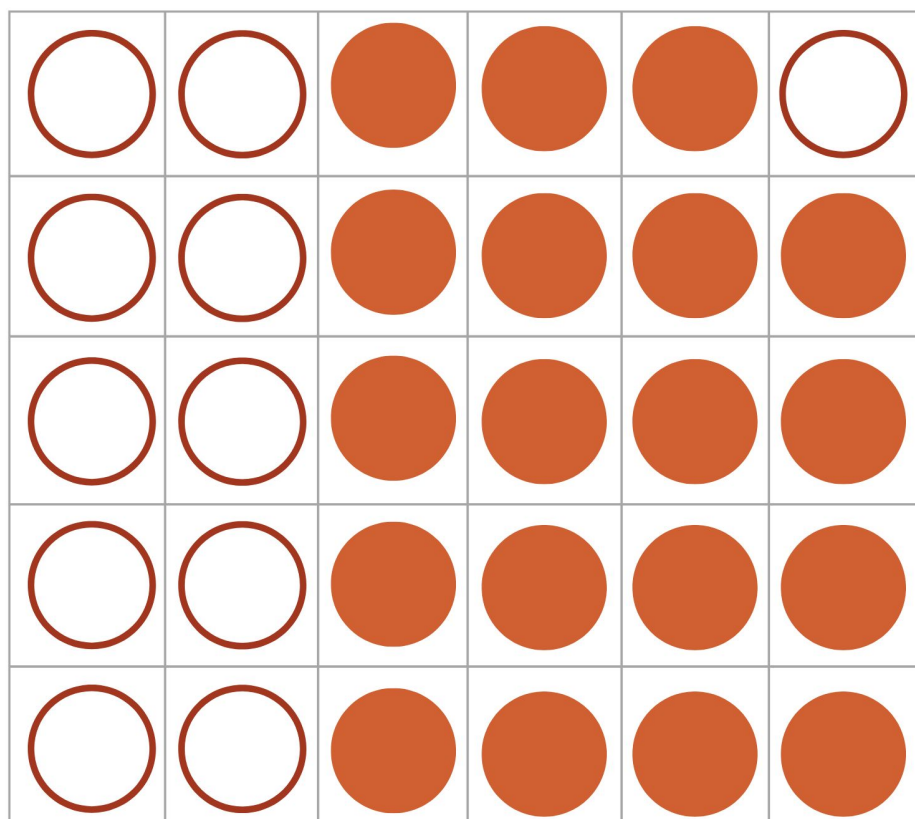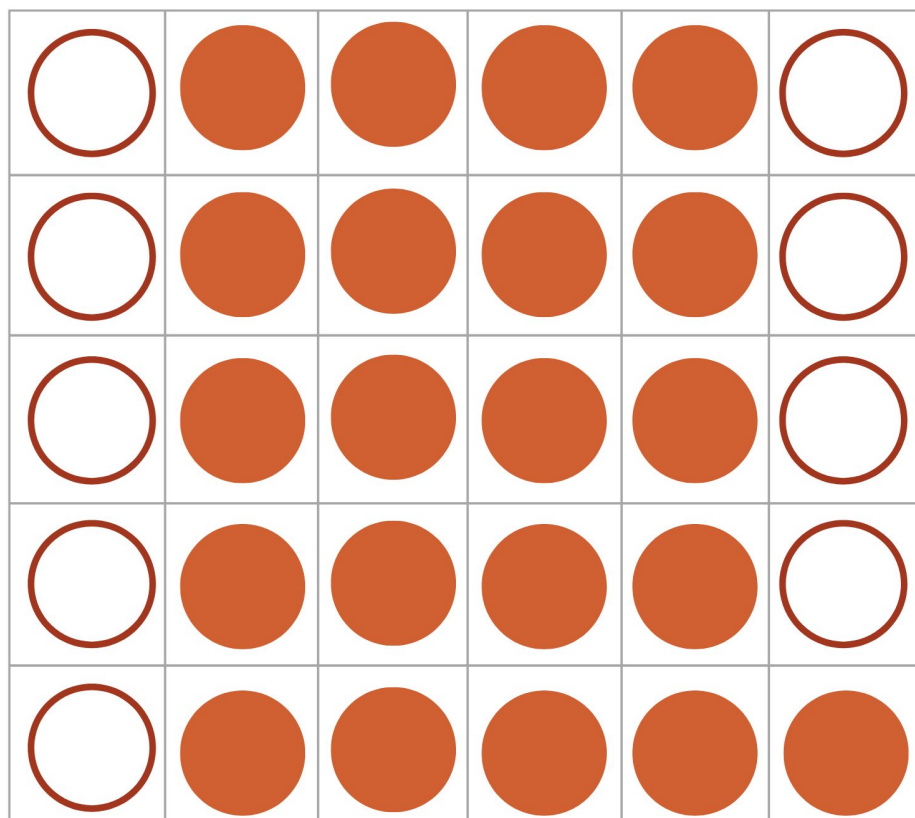- Turn to the person next to you and explain how you counted.

1-2 Nim Day 2

Materials and Prep
20 counters per student pair, paper & pencil

How to Play
Start with a pile of **20 counters**. Players alternate removing counters from the pile. On your turn, choose whether to remove one or two counters from the pile. You must take at least one counter on your turn, but you may not take more than two. Whoever takes the last counter is the winner.

Launch
Demonstrate playing 1-2 Nim with 20 counters with a student. Invite them to choose whether to go first or second. Narrate your choices and thinking as you play. If you happen to observe or know how to win this game, make sure not to reveal!

Work
How can you win 1-2 Nim with more counters than yesterday? Would a winning strategy look similar or different from playing with 10 counters yesterday?

Students play 1-2 Nim in pairs. As they begin developing strategies, feel free to change pairs around so students can try out their ideas with new opponents.

Tips for the Classroom
1. Go to the Closer early today - as soon as it feels like students need a good hint.

2. Variations for when students need more challenge
   a. 1-2-3- Nim: players may take one, two or three counters per turn.
   b. Poison: Whoever takes the last counter loses.

Launch Key Points

- The rules to the game are the same today as last time, but we are starting with a larger pile of counters.

- Remind students that they may have developed the beginnings of a strategy last time, and they can continue to explore that strategy today.

- The central question remains the same: how can you win at 1-2 Nim?

Prompts and Questions

- What move should you make next?

- What do you think your opponent will do if you take two counters?

- What have you noticed about this game?

- Would you like to take back your move?

41

Closer

Bring students together and ask them about their theories so far. Tell them that when mathematicians face tough problems, one tactic they use is simplifying the problem.

How could 1-2 Nim be simplified?

Students could play with a smaller pile. How small before they know for sure what's happening? Students may have ideas, but tell them that mathematicians happily start with the smallest possible number: 1. Take a challenger to play you with just one tile. Make sure to let them choose whether to go first or second. They should beat you handily.

What about 2 tiles?
What about 3 tiles?

Enter the data in a T-chart, and point out that we have some progress. If time permits, let students fill in as much of the chart as they can. How does the chart help them? Do they see any patterns in it? Do they have any conjectures? The chart below is filled out to a starting number of 6.

Number of tiles	Strategy
1	Go first, take 1
2	Go first, take 2
3	Go second
4	Go first, take 1
5	Go first, take 2
6	Go second
7	?

A full breakdown of this approach is available here:
mathforlove.com/video/rich-task-1-2-nim-lesson-plan-with-dan-finkel

> **Prompts and Questions**
>
> - What's your winning move with 4 tiles?
>
> - What about 5 tiles? 6?
>
> - Do you see any patterns in our chart so far?

Choice Time

- Dot Ten Memory
- Dots and Boxes
- Block Free Play
- Challenge Problems

42

| DAY 8 | Opener | Main Activity | Closer | Choice Time |

Overview

Focus Standards

MP1   Make sense of problems and persevere in solving them.

2.M.4   Measure to determine how much longer one object is than another.

Materials: Number rods, 1cm graph paper, colored pencils

Opener	**Target Number**	10 – 15 minutes
Main Activity	**Number Rods**	20 – 30 minutes
Closer	**Multiple representations of 6**	5 – 10 minutes
Choice Time	• 1-2 Nim • Tiny Polka Dot • Free Build with Number Rods • Challenge Problems	5 – 25 minutes

Standards Connections

MP2 | MP3 | MP5 | MP7 | 2.G.2 | 2.OA.2

Target Number

Write a "target" number on the board.

Tell students the class goal is to come up with as many ways to make the target number as possible, using equations. Demonstrate writing down an equation.

Give students a few minutes on their own to write down as many different equations as they can that have the target number as the answer. Then students share their favorite answers.

Today's target: 12

Example solutions:
$$12 = 6 + 6$$
$$12 = 10 + 1 + 1$$
$$12 = 5 + 5 + 1 + 1$$
$$12 = 20 - 8$$

Tips for the Classroom

1. Resist the temptation to praise answers with many steps as "smart." This activity gives everyone a chance to contribute and be valued. You can describe those answers as "long," or as having many parts.

2. If a student uses terms (like square root) that the class isn't ready for yet, you can write down their answer but move on to other solutions.

3. For Target Number, it helps to write the target number as the first part of the equation, e.g. $7 = 6 + 1$, $7 = 4 + 3$, etc. This emphasizes equivalences to 7 and encourages students to correctly understand the equals sign.

4. **THIS TIP IS ESPECIALLY USEFUL.**
   Let's say someone says that $7 = 5 + 3$. Rather than just saying "wrong," say that $5 + 3$ gets us close to 7, but we need to do something else to get all the way there, then challenge students to find what still needs to be done. If someone can explain that $5 + 3$ is 8, and so you need to take 1 away, you have the number equation $7 = 5 + 3 - 1$. This is both more sophisticated and accepts the original students wrong answer as a path toward a better, accurate answer, rather than a dead end.

Prompts and Questions

- If we only add 2 numbers, how many answers can we find?

- What if we add 3 numbers, or 4 numbers?

- What about any number of numbers?

- What if we only subtract?

- What's the longest number sequence you can find that hits the target number?

- Can you hit the target number if you only use a single number, such as the number 4, in your equation?

Number Rod Introduction

Materials and Prep
Number Rods - make sure everyone has access to multiple rods of every color; 1 cm graph paper, crayons or colored pencils

Motivating Questions
What do you notice about Number Rods? How do their lengths relate to one another?

Launch
Show students the set of Number Rods and give them some time to build whatever they want.

After about ten minutes of free play, take a few minutes to discuss what students have noticed as they built.

Next, students will figure out the value of all the rods. Set Turquoise to 1 (T = 1).

Ask students what Orange is, if T = 1. Discuss as a class, then demonstrate (or have a student demonstrate) how 2 Turquoise rods make 1 Orange rod: 1T + 1T = 1O. In other words, 2T = 1O. Record this argument in pictures on graph paper.

Let students know that after they have figured out the lengths of all the rods, their task is to **build and record a design worth 20**. Students can draw their design on graph paper and record a corresponding equation.

Work
Students find the values of all the Number Rods. Ask them to verify their values either with each other or with you before moving on to the building task.

Students build a design worth 20, and record their arguments using the graph paper. Help students with their recording as necessary. Once an individual is done, they can trade equations with a partner and try to build a design using that many blocks (it will look different!).

Tips for the Classroom
1. Number Rods are in cm increments, so should align closely (or exactly) with the cm graph paper.

T O Gn R B Pi Pu Y Lg Gy
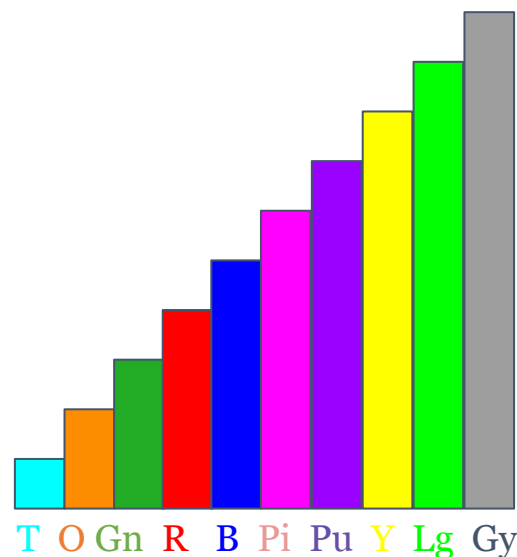
Launch Key Points

- Open this Launch with ~10 minutes of free play with Number Rods.

- Refrain from explicitly stating rod lengths at first.

- Make sure students understand how to record an equation for the rods.

Prompts and Questions

- What color is the longest? shortest?

- I see you showed that the Yellow equals two Reds. Does that tell you the value of the Yellow?

- Can you draw what you've just built on the graph paper?

Day 8

cm graph paper
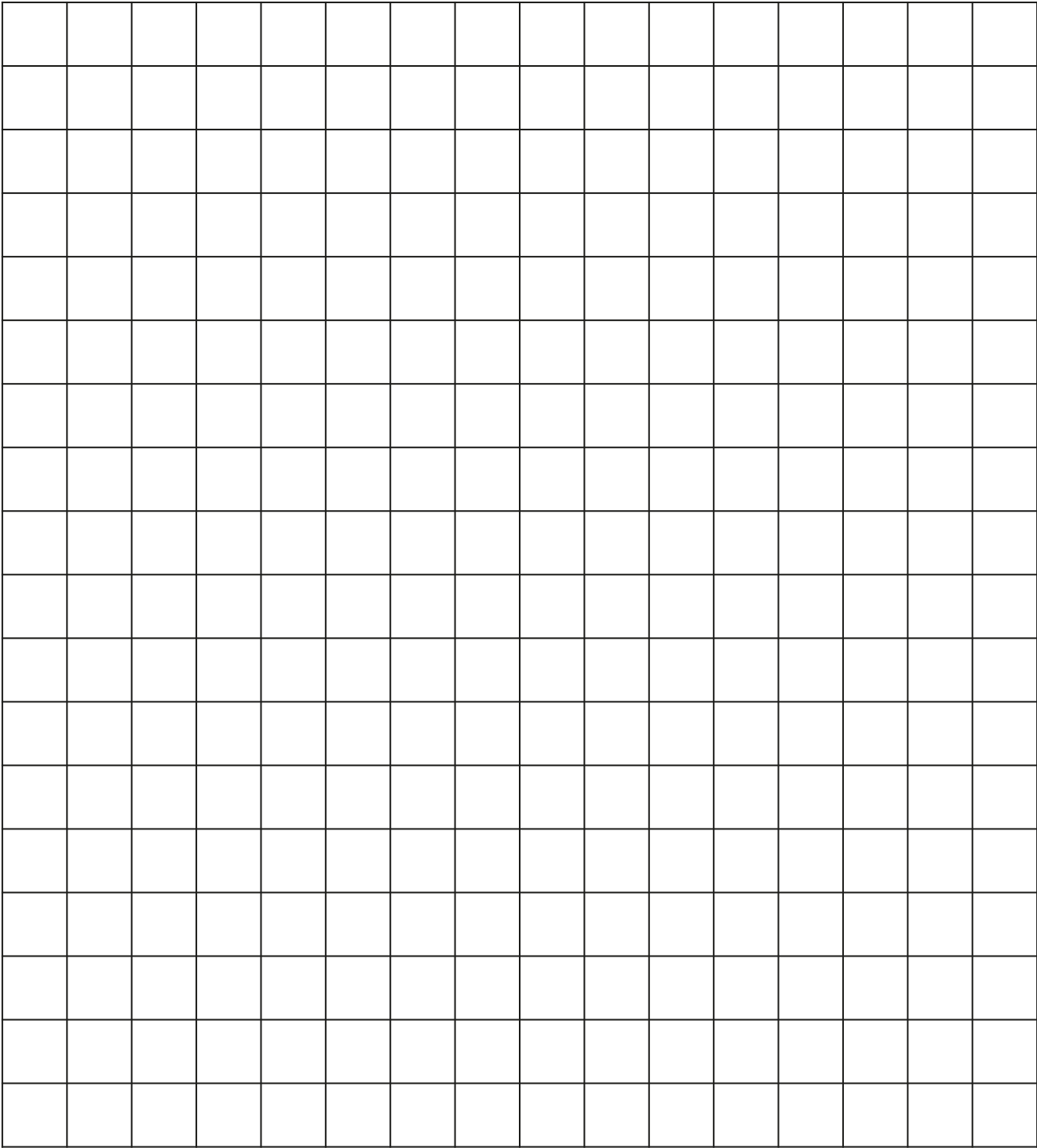
Closer

Show the students how the Pink rod is the same as 6 Turquoise. Ask students to work in pairs to find another way to show that the Pink rod equals 6. After a few minutes, students can share their arguments.

Arguments might include:
- Pink equals 2 Green, and each Green equals 3
- Pink is equal to 1 Turquoise less than Purple, which is 7.
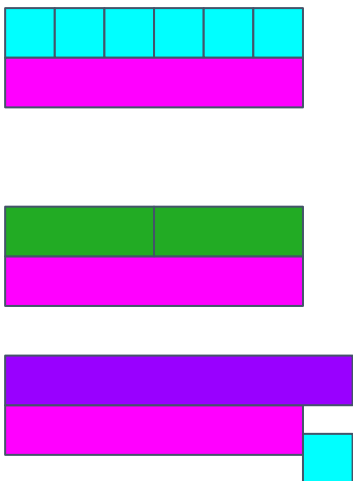
If time permits, ask students to find other ways to show the value of the other rods.

Choice Time
- 1-2 Nim
- Tiny Polka Dot
- Free build with Number Rods
- Challenge Problems

Prompts and Questions

- Can you build the Pink with two of another rod?

- Can you build a rod using three different smaller rods? What about three of the same smaller rods?

- Does their argument that pink equals 6 convince you? What would be another way to see it?