

Math for Love

1st & 2nd Grade



Dan Finkel & Katherine Cook

A word about using this book

This book was designed to support a summer math program lasting sixteen 75 - 90-minute days. With minimal adjustment it can be used for longer programs, programs with shorter or longer class times, or other variations.

You can also use these activities to supplement a normal math class. There are enough activities to do something from this book 1-2 times a week for an entire school year. Most of the games can be played many times. Openers can be used in the first ten minutes of class. Games can be played for 5 - 30 minutes. Activities might be good for sparking your students' curiosity and digging in on a multi-day project. Use these materials in the way that works for you and your students.

The introduction in the following pages is worth reading, and can help get you started. We also have a video PD series to support this curriculum that should be helpful: mathforlove.com/video/math-for-love-video-pd.

Enjoy!

A word about the copyright

We want this book to be used by teachers to help students explore math in a positive way. Feel free to make photocopies, share ideas with parents and colleagues, and use this as a resource draw on. In general, we support this kind of fair use of our materials.

Please don't post elements from this book online without citing the source, share large chunks of the book electronically, or sell parts of the book to anyone.

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Introduction

Welcome to the Math for Love curriculum! We are thrilled to have you on board. We've seen this program make a meaningful difference in the lives of the students who have used it as a summer or supplemental curriculum. We hope it will do so for your students too.

Goals of the Math For Love Curriculum

We wrote this program to be both *play-based* and *rigorous*. The goals of the program are two-fold:

- Improve conceptual understanding of and fluency in mathematics
- Give everyone an opportunity to have fun and enjoy math

Many students haven't had enough time working with conceptual models of mathematics before being pushed into abstraction. To remedy this, the curriculum spends ample time exploring conceptual models, giving students opportunities to work concretely and pictorially while making connections to abstract reasoning.

Program Values

The goals 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 a 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, make meaning, and develop ownership of mathematical problems as they think through problems.
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 it if you tackle these responsibilities head on. Here are some concrete ideas on how to go about it.

★ **Be ready with questions**

Rather than simply telling students 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. This shows them that you value *their* thinking and contributions, not just the answer.

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

Students can sometimes get overly 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. You can also adjust many of the games to be collaborative rather than competitive.

★ **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 Opener in the daily plan). Use the Math Games and Station Breaks for transitions between Activities. 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. 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.

★ **Encourage conjectures and counterexamples**

Establish a habit of supporting students' conjectures, hypotheses and predictions, and students will learn more and commit to the thinking process. Help them use

counterexamples as a tool to break and improve conjectures (see the [Counterexamples](#) lesson plan on Day 10), and they'll begin behaving like true mathematicians. Making conjectures and counterexamples normalizes mistakes as part of the learning process, and gives students a practical way to learn from them. It also makes doing and thinking mathematics the central activity of your class.

★ **Give your students *time to think and explore***

Many students are not given enough time to establish solid conceptual models. Don't feel like you need to rush in order to get through the entire curriculum, if pausing and doing less in more depth would serve your students better. Make sure you don't push students to stop using blocks or pictures too quickly, either. Also note that a central place in the curriculum to practice fluency is in the games. 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 get started on problems with support when necessary. But 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 will be more familiar with the "stuck" part, so try to start them with successes, and then move them slowly 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

★ **Math Breaks and Physical Games**

Check out the math-based movement breaks in [Appendix 2](#). These are great to mix in as station breaks, if you run the activities in a station format. They're also excellent as breaks between activities.

★ **Folder for Worksheets**

Give each student a folder where they can keep their worksheets. If they finish an 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 both choose the activity that is right for them, and then stick with it for at least half of that station.

★ **Station Transitions**

If you use stations, provide 1-2 minute warnings before station transitions, to apply a gentle transition, cleanup, and—especially at Activity 1—a brief reflection or wrap-up. If you use an alarm, make it a gentle sound (i.e., a gong) rather than an abrasive one (i.e., a clock radio alarm).

★ **Letters home**

See [Appendix 1](#) for games to send home. These will help parents/guardians and students play math games at home. Note that there is no homework for this program otherwise.

★ **Build Dot Talk images with magnetic ten frames**

For Dot Talks, we recommend you create physical versions of them with magnetic ten frames or other manipulatives. Physical versions are often preferable, since students can manipulate the blocks directly.

Using this curriculum

If you use this curriculum to supplement math in a classroom, you'll find that you should have enough here to do one or two Math for Love activities a week, some relatively brief, like openers or games, and some activities taking longer. Many of the activities, and especially the games, can be returned to more than once. We recommend you move through the curriculum roughly in order. Use your best judgment, and adapt as necessary.

If you use this curriculum for a summer program, it can serve for a 27-day program of 75 - 90 minute days. If you need it for less, you can end sooner. If you need something longer, you should find some of the activities could use a second day. No matter how you use it, we encourage you not to feel like you have to “cover” all the material. Give students the time they need to explore the ideas and activities at a comfortable pace.

Day Plan

The Day Plan lets you know exactly what's happening on a given day. The components of a typical Day Plan are:

- *Goals*
- *Opener*
- *Activities*
- *Closer*
- *Differentiation*

Goals

These are the learning content goals that are the target of the lessons and activities for the day. These are meant to help the teacher know what to focus on throughout the day. The goals do not need to be shared with students.

Opener

The Opener is the first activity of math class. The goal of the Opener is to get students relaxed, focused, and thinking as quickly as possible. The teacher typically leads a Number Talk or other math game, built to transition the students into thinking and engagement. The Openers should be at a level of challenge that provides all students a positive, successful encounter with math first thing.

In general, the Opener should last about 5 - 10 minutes.

Activities

The bulk of class time is devoted to three activities. There are two recommended ways to approach this time.

1. Divide the class among stations, and have students rotate between stations. This is especially recommended when you have additional adults (instructional aides, parent volunteers, tutors) in the room aside from the teacher.
2. Take the whole class through the activities one by one. This is recommended when the teacher is the only adult in the classroom.

Either way you run your classroom, the activities are designed to give students the maximum opportunity to think & engage, practice skills, explore questions, and have fun.

- Activity 1 is typically a new game or exploration. If you run the classroom as stations, this is a good place for the teacher to be.
- Activity 2 will be a familiar game or a worksheet, possibly with a new twist. If you run stations, this is a good place for an instructional aide or other adult.
- Activity 3 is Choice Time.
Students choose which games or activities they want to do from a selection provided by the teacher. The collection of Choice Time options can grow naturally from the games and activities of the other two stations. Choice Time is an opportunity for students to take ownership of the work of class, and decide what they most like doing, and what they most need to do.

Closer

The Closer is a chance for students to reflect on what they learned or still have questions about in the day, and for the teacher to lead a closing discussion, or pose a final challenge on the new material from the day.

- Student Reflection: the teacher prompts the students to reflect on the day with two questions: *what did you notice?* and *what do you wonder?* After students have had a chance to reflect (and, if appropriate, write down some thoughts), the teacher invites the students to share some of their reflections. When students share what they noticed, it's a chance for their observations to come to the attention of the class; when students share what they wonder, it's a chance to see their questions, conjectures, and current state of understanding.
- Closing Discussion: the teacher uses what the students noticed and wondered to lead a closing discussion on the central ideas of the day. Details on ideas to emphasize and possible closing questions are provided in "The Wrap" section of the lesson plan.

Differentiation

The Differentiation section includes ideas for upleveling and downleveling the activities of the day to meet students' needs.

- Ideas for Downleveling, i.e., differentiating activities to make them more accessible.
- Ideas for Upleveling, i.e., differentiating activities to make them more challenging.

Day 1

Goals

1. Establish the class as a playful and engaging environment for the students.
 2. Get pre-assessment data and begin observing students' comfort and ability with math.
 3. Establish class protocols and conventions. Help students build a routine so they know what to expect and how to behave.
-

Opener

Introduce yourself, share expectations for the class, community-building exercises, etc. Play Mingle or another name game.

Activities

1) Pre-assessment

Explain that students aren't intended to know all the answers. This pre-assessment is designed to let the teacher know what students know, so they can make activities as fun and interesting as possible. They should try their best, but shouldn't worry if they don't know how to do some of the problems. Once a student individually completes the assessment, let them join in Exploration of Materials.

2) Exploration of Materials

Let students have free choice among the following materials:

- Pattern blocks
- Square tiles
- Tiny Polka Dot cards
- Dice
- Challenge Problems

Each material has a question to explore. Free play is also encouraged.

Closer

Today the class focused on playing games and exploring. Ask students what they think those things have to do with learning math? Let students share and discuss.

Some points to emphasize, or bring up if no one else does:

- Math includes learning about a lot of things! Numbers, shapes, and patterns are all part of math.
- You can play to learn math! In fact, it's one of the best ways to do it.

Mingle

The teacher calls out a number (e.g., 3), and the students get themselves into groups of that size 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 students are in groups, the teacher can 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.

This is also a good game to play as a name game: once students get in groups, they can learn each other’s names.

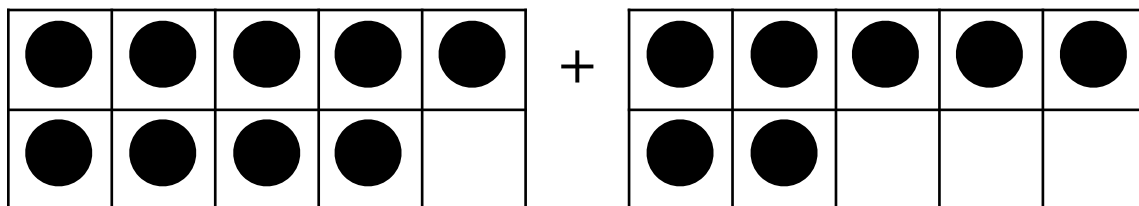
Tips for the Classroom

1. The teacher can get into or out of the groups in order to make sure no student is by themselves.

1st Grade Pre-assessment

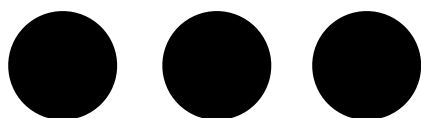
1) How many dots?

Show how you figured it out.



2) There are three dots below.

How many *more* dots do you need to make 10?



Name _____

Fill in the blank.

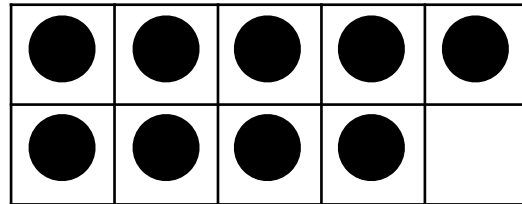
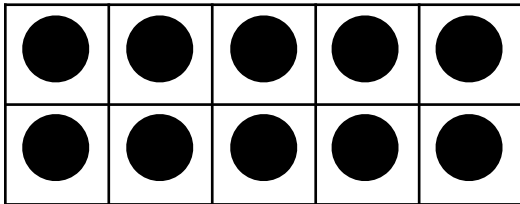
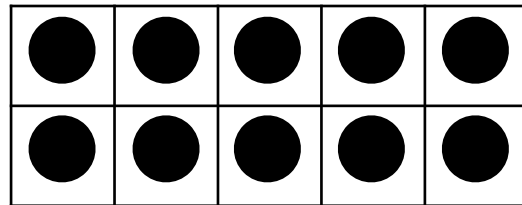
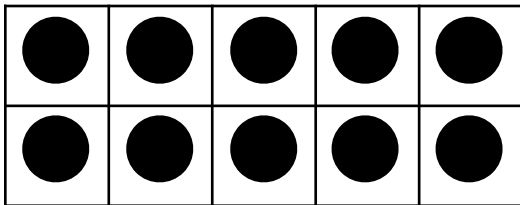
3) $6 + 13 =$ _____

5) $19 - 11 =$ _____

4) $17 + 8 =$ _____

6) $5 +$ _____ $= 23$

7) How many more dots do you need to have **50 dots**?



8) I have 15 books. Then I got 9 more books. How many books do I have?

9) Julie started with 19 dollars.
She got 5 dollars from her mom.
Later, she spent 8 dollars buying a present.

How much money does Julie have now?

10) I had \$60.

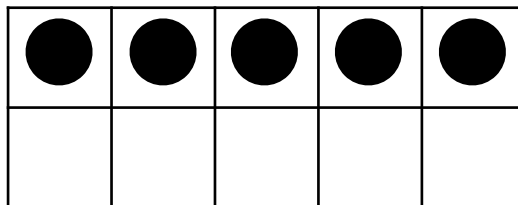
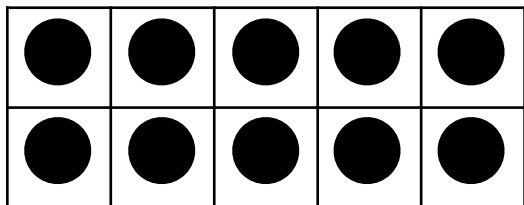
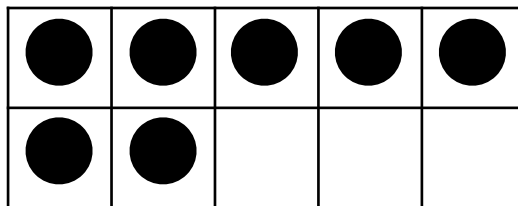
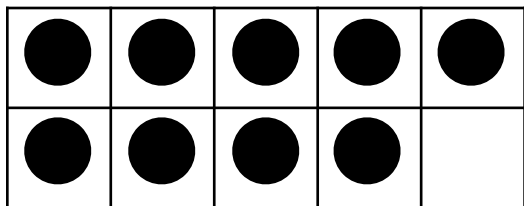
I bought a bike for \$45.

Then I sold it for \$50.

How much money do I have now?

2nd Grade Pre-assessment

- 1) How many dots are in the ten frames below?
Write an equation and solve.



Equation: _____

- 2) Fill in the blanks to make the equation true.

$$20 - \underline{\hspace{2cm}} = 10 + \underline{\hspace{2cm}}$$

Name _____

Fill in the blanks to make the equations true.

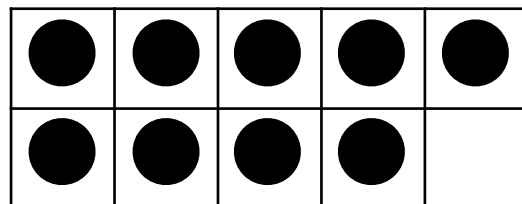
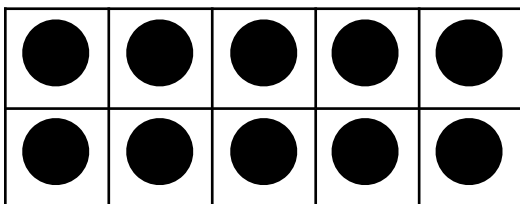
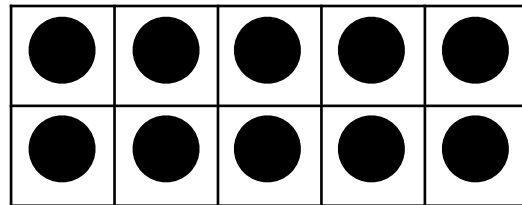
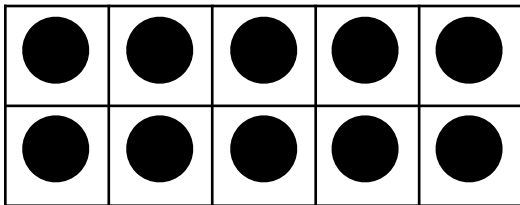
3) $31 - 12 =$ _____

5) _____ $= 16 + 23$

4) $17 + 68 =$ _____

6) $35 +$ _____ $= 63$

7) How many more dots to you need to have **100 dots**?



8) I had 45 books. Then I gave away 19 books.
How many books do I have?

9) Julie started with six \$20 bills.
Then she got \$25 from her mom.

How much money does Julie have now?

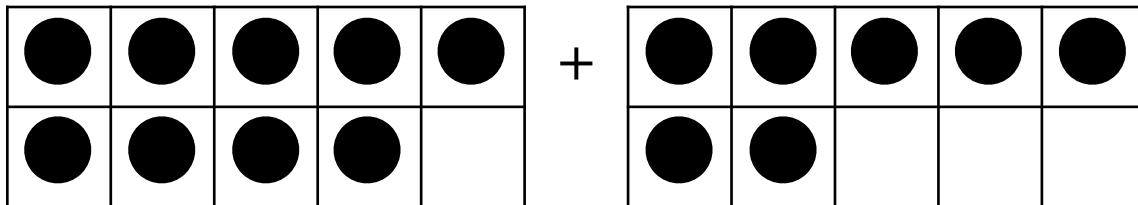
10) Mariah has 18 shells.
Aaliyah has 17 shells.
Martin has 14 shells.
Kwan has 20 shells.

Kwan says that he and Martin have more shells together than Mariah and Aaliyah. Is he right or not? Explain.

1st Grade Pre-assessment Solutions and Rubric

**Each question worth up to 10 points.
Some partial credit available.**

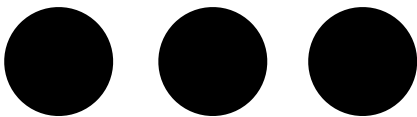
- 1) How many dots?
Show how you figured it out.



Answer: $9 + 7 = 16$

**5 points for correct equation/explanation,
5 points for correct answer**

- 2) There are three dots below.
How many *more* dots do you need to make 10?



Answer: 7 dots

10 points for correct answer

Name _____

Fill in the blank.

3) $6 + 13 = \underline{\mathbf{19}}$

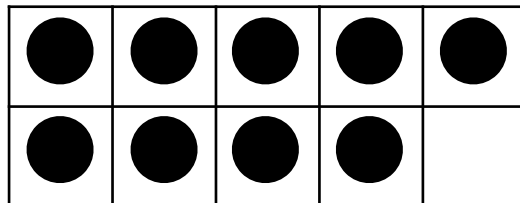
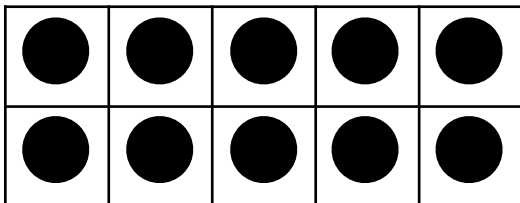
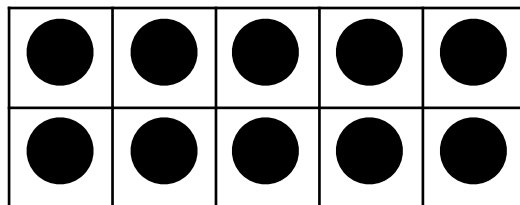
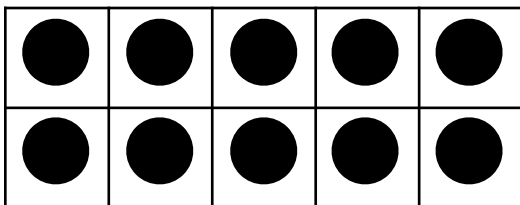
5) $19 - 11 = \underline{\mathbf{8}}$

4) $17 + 8 = \underline{\mathbf{25}}$

6) $5 + \underline{\mathbf{18}} = 23$

10 points for each correct answer

7) How many more dots to you need to have **50 dots**?



Answer: 11

Up to 5 points partial credit for a correct picture answer that students miscount (i.e., drawing in 1 ten frame and 1 extra dot)

8) I have 15 books. Then I got 9 more books. How many books do I have?

24 books

full 10 points for correct answer, including unit

-1 point for leaving off “books”

**up to 5 points partial credit for setting up
correct equation ($15 + 9 = \underline{\hspace{1cm}}$)**

9) Julie started with 19 dollars.
She got 5 dollars from her mom.
Later, she spent 8 dollars buying a present.

How much money does Julie have now?

\$16

Full 10 points for correct answer

-1 point for leaving off “\$” or “dollars”

**up to 5 points partial credit for setting up
correct equation or picture model,
i.e., $19 + 5 - 8 = \underline{\hspace{1cm}}$**

10) I had \$60.

I bought a bike for \$45.

Then I sold it for \$50.

How much money do I have now?

Answer: \$65

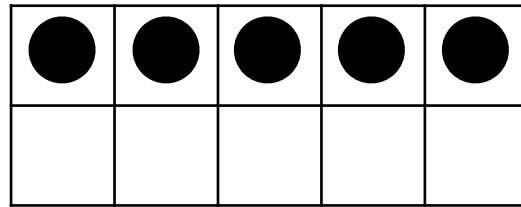
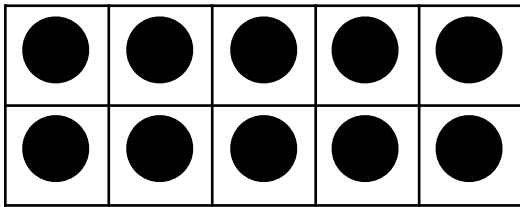
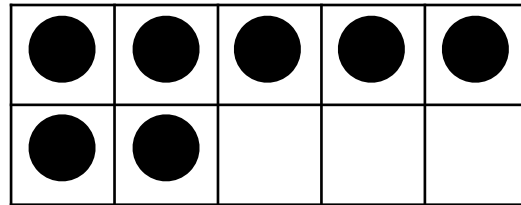
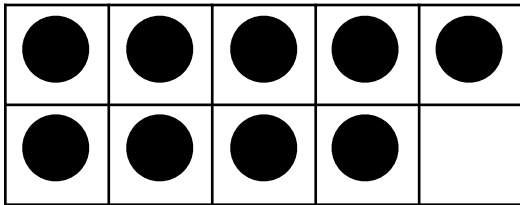
10 points for correct answer

Up to 5 points partial credit for setting up an equation or representation correctly, i.e., $60 - 45 + 50 = \underline{\hspace{2cm}}$

2nd Grade Pre-assessment Solutions and Rubric

**Each question worth up to 10 points.
Some partial credit available.**

- 1) How many dots are in the ten frames below?
Write an equation and solve.



Equation: 9+7+10+5 = 16 + 15 = 31

5 points for correct expression (i.e., 9+7+10+5)

5 points for correct answer

- 2) Fill in the blanks to make the equation true.

$$20 - \underline{\hspace{2cm}} = 10 + \underline{\hspace{2cm}}$$

10 points for any correct answer

i.e., $20 - \underline{6} = 10 + \underline{4}$

Name _____

Fill in the blanks to make the equations true.

3) $31 - 12 = \underline{\mathbf{19}}$

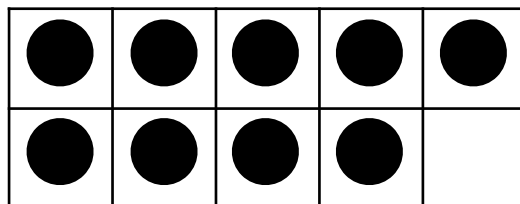
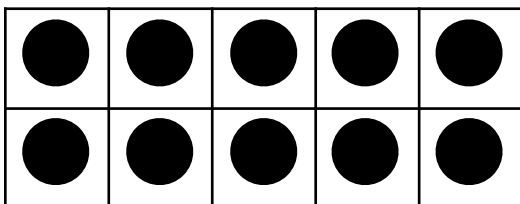
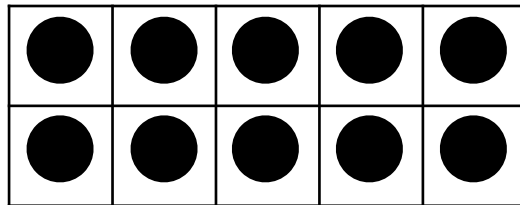
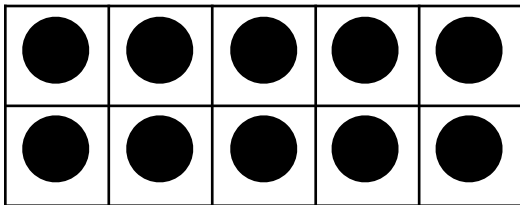
5) $\underline{\mathbf{39}} = 16 + 23$

4) $17 + 68 = \underline{\mathbf{85}}$

6) $35 + \underline{\mathbf{28}} = 63$

10 points for correct answers

7) How many more dots to you need to have **100 dots**?



10 points for correct answer: 61 dots

Up to 5 points partial credit for a correct picture answer that students miscount (i.e., drawing in 6 ten frames and 1 extra dot)

- 8) I had 45 books. Then I gave away 19 books.
How many books do I have?

26 books

full 10 points for correct answer, including unit

-1 point for leaving off “books”

**up to 5 points partial credit for setting up
correct equation ($45 - 19 = \underline{\hspace{1cm}}$)**

- 9) Julie started with six \$20 bills.
Then she got \$25 from her mom.

How much money does Julie have now?

\$145

Full 10 points for correct answer

-1 point for leaving off “\$” or “dollars”

**up to 5 points partial credit for setting up
correct equation, i.e.**

$20 + 20 + 20 + 20 + 20 + 20 + 25 = \underline{\hspace{1cm}}$ or

$6 \times 20 + 25 = \underline{\hspace{1cm}}$

10) Mariah has 38 shells.
Aaliyah has 37 shells.
Martin has 34 shells.
Kwan has 40 shells.

Kwan says that he and Martin have more shells together than Mariah and Aaliyah. Is he right or not?
Explain.

**Kwan is wrong, because he and Martin have
 $34 + 40 = 74$ shells, while Mariah and Aaliyah
have
 $38 + 37 = 75$ shells.**

**5 points for correct answer
5 points for showing work correctly
-1 points if units are never mentioned.**

Exploration of Materials

Students are encouraged to explore and play with the materials they'll be using in the class this summer. Free play is ideal, as long as the students stay relatively focused.

In addition, you can include these challenges to motivate students who need extra guidance.

Pattern Block Building Challenges

Pattern Blocks Building Challenges: first, students take option 1, and free build. For students who need additional challenges, look to the next two options.

- **Option 1:** Free build with pattern blocks.
- **Option 2:** Cut out the 12 cards on the following page, and separate into two piles. For a basic building challenge, a student picks a card at random, and then builds according to what is on the card.

Examples: Build a *Person*.
 Build something with *25 blocks*.

- **Option 3:** Advanced challenge: a student gets two cards, one which tells them what to build, and the other how many blocks to use.

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

Piles of Tiles with the color tiles and/or the snap cubes

Let students free play and build with the tiles and snap cubes. For students who need more direction, give them a pile of tiles, and challenge them to figure out which color occurs most.

Challenge Prompt: In this pile of tiles, which color is there more of? Write down your guess, and then find out.

Tiny Polka Dot Games and Challenges

with the Tiny Polka Dot decks

PowerDot. This is just like War or Top It: students break a deck into two piles of equal size (or roughly equal size), and turn over their top card. Whoever has the larger number gets to take both cards. You can play this with dominoes as well.

Challenge 1: Pick a suit (i.e., a color). Arrange the Tiny Polka Dot cards in that suit from smallest to biggest. What will it look like if you organize an entire deck?

Challenge 2: Pick a suit. Count all the Tiny Polka Dot cards of that color (in one deck).

Challenge 3: Pick a suit. Count all the dots in that suit!

Dice

Challenge Prompt: pick up six dice. If you roll them all, which number will get rolled the most? Make your prediction, then try and see.

Pattern Block Building Challenges

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

Piles of Tiles

Which color tile occurs the most in this pile?

Write your name under the color you think has the most.

Red	Green	Blue	Yellow

When you have voted, count how many of each color there are.

Day 2

Goals

1. Launch Counting Collections and Dots and Boxes, activities we'll be returning to in various forms throughout the program.
2. Run first Choice Time. Help students to plan what activity they'll do during Choice Time, and stick with it for at least most of the time.

Opener

Play Mingle again (optional).

Dot Talks - see Appendix 4 for images

Activities

Activity 1: Counting Collections

- Have students count different preset collections and record their work.
- These can be widely differentiated (i.e., 10 - 150).
- Wrap up by discussing counting strategies (i.e., grouping by tens).

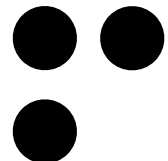
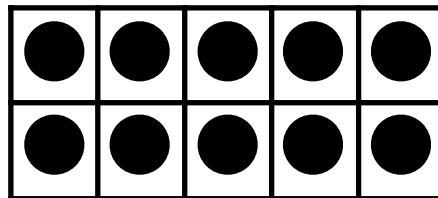
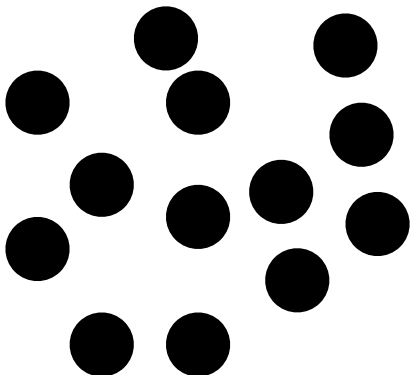
Activity 2: Dots and Boxes

If time permits, discuss student observations about Dots and Boxes gameplay or strategy. For example, are ties possible in Dots and Boxes?

Activity 3: Choice Time - Dots and Boxes, Block Free Play, Counting Collections

Closer

Ask students what kind of arrangements were easiest to count in Counting Collections, and which were hardest. If you have magnetic dot ten frames, place a jumble of 13 dots on the board, and ask students to count them. Then arrange the dots in a ten frame with three outside it. Is that easier to count? What strategies might students use next time they do Counting Collections? (You can draw these otherwise. Alternatively, you can use Tiny Polka Dot cards from the green, unordered suit, vs. the blue, ten frame suit)



Differentiation

- Downlevel: Guide students toward appropriate Counting Collections.
Make ten frames available to aid with Counting Collections.
Play enough demonstration games of Dots and Boxes so the rules are clear to everyone.
- Uplevel: Have more challenging Counting Collections available.
Use the larger Dots and Boxes board.

Dot Talks

Topics: Mental math, numerical fluency; argument & critique

Materials: White board & projector

Common Core: 1.OA.5, 1.OA.6, 1.OA.7, 1.NBT.1, 1.NBT.2, 1.NBT.4, 2.OA.1, MP3

This mental math routine creates powerful positive habits for students.

Why We Love Dot Talks

In just 5 - 10 minutes, these openers get all students involved, help strengthen fluency, intuition, and mental math strategies, improve students' ability to explain and critique solutions, and allow teachers a valuable window into their students' thinking.

The Launch

The talk starts very simply. The teacher projects the dot image on the board where all students can see it, and asks students to figure out how many dots there are.

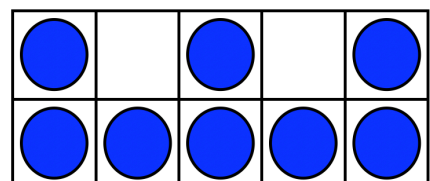
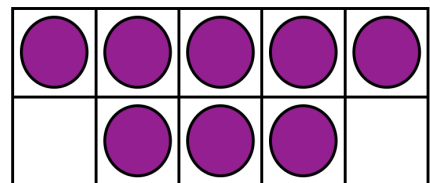
A common approach is to give students some time to think about the questions on their own first, and then share with a partner. Once students have had time to think the question through, lead a class discussion where students share their answers and approaches.

The key elements to these talks are a de-emphasis on speed and right answers and an added emphasis on process and communication. Expect some disagreements over the answers, and try to use those disagreements as a motivation for students to articulate their ideas to their classmates.

The Work

Students may have all kinds of approaches to count the dots, from counting by ones, twos, fives, or tens, to using the ten frames, to using the colors of the dots. Their conversations and arguments are the key, and the more you communicate that you're most interested in understanding what they're thinking (and writing it down so others can follow), the more they'll step up with more ideas to share.

In the image to the right, for example, one student might see "8 + 8," while another sees that if one dot is removed, the remaining make 3 rows of 5, meaning the total is one more than 15. Another students might imagine moving 2 dots from the bottom frame to the top to complete a set of ten, and thus see 16 total. Another might notice that the total is 4 less than 20.



Prompts and Questions

- Who would like to defend this answer?
- I don't quite follow. Do you mean I should count this group first?
- 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 how you counted.

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. A smart protocol is to have students put a thumb up at their chest rather than waving a hand in the in the air.
3. Give students constructive language to use in the discussion, like, "I respectfully disagree, because..." and "I agree with _____, because..."
4. Always keep the environment safe and positive.
5. Don't worry if you don't reach total consensus on every problem. Sometimes a student will need more time to process. You can move on when it feels like it is time.
6. Doing short (5 - 10 minute) Dot Talks regularly is more powerful than long ones infrequently. Do a maximum of two talks per day.

Counting Collections

Topics: Counting, skip counting, addition, multiplication (optional)

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

Common Core: 1.NBT.1, 1.NBT.2, 1.NBT.2.a, 1.NBT.2.b, 1.NBT.2.c, 2.OA.4, 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, and a foundational structure to return to again and again.

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., 11 - 30), 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. Demonstrate counting a small collection to show them how one might do it.

Students will work in pairs. Each pair will get to choose a collection and count it. For each collection, they will record what they counted, and how many objects were in that collection.

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?

The Wrap

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? 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. The recording forms for Counting Collections can get gradually more complicated. At first, the form might just contain a place for what and how many objects students counted. A more advanced form might contain an estimation (made before the count), space to record a drawing of how the students counted, or groupings of the number of tens and ones (or hundreds, tens, and ones) included in the final count.
2. You can differentiate Counting Collections most easily by including collections with many or fewer objects to count.
3. For a more advanced (but less hands-on) launch, you can try asking students what else they see in the room that they might count. They might list things like windows, chairs, tables, ceiling tiles, as well as blocks, markers, etc.
4. Don't take too long with the launch of Counting Collections. The students will catch on quickly, and too much instruction on how to do the counting may get in their way.

Name _____

Counting Collections

I am counting: _____

Picture of how I counted



Ten Frames

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?

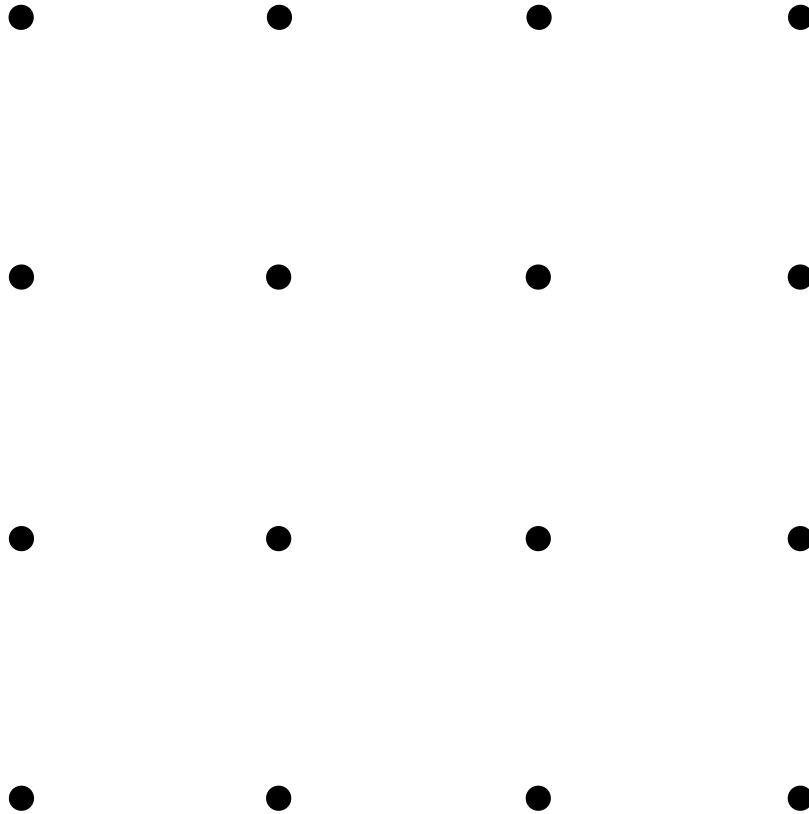
The Wrap

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

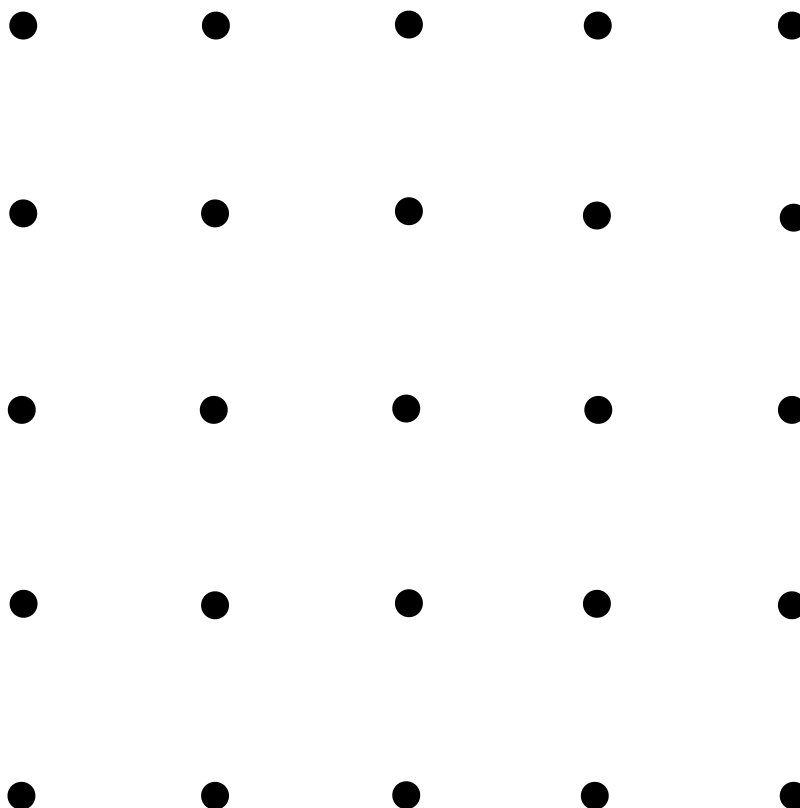


Dots and Boxes is a 2-player game.

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.

Day 3

Goals

1. Learn and play 1-2 Nim, a strategy and arithmetic game.
2. Consider all possible ways to sum two numbers to 5.

Opener

Guess My Number

Activities

- Activity 1: 1-2 Nim
Activity 2: Dot Five Memory
Activity 3: Choice Time
—Block Free Play
—1-2 Nim
—Dot Five Memory
—Dots and Boxes

Closer

Ask students to write down all the possible ways to make 5 by adding 2 numbers. (For example, $3+2$.) How many ways can it be done? Let them make lists alone, or with a partner or partners if they'd like. The final list should be:

$0 + 5$
 $1 + 4$
 $2 + 3$

$3 + 2$
 $4 + 1$
 $5 + 0$

Write the list down on the board and ask students what they notice about it. What might the observations lead them to guess about all the ways two numbers could add to 6?

Differentiation

- Downlevel: Play Dot Five Memory with the cards face up.
Play 1-2 Nim on a ten frame.
Uplevel: Challenge students to play 1-2 Nim with larger numbers, if they can consistently win with 10 and below.
Play Dot Five Memory with 3 or more suits.

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.

1-2 Nim

Topics: logic, patterns, addition, counting, subtraction, divisibility and remainders (optional)

Materials: Counters (tiles, beans, pennies, etc.) or paper and pencil

Common Core: 1.OA.B.4, 1.OA.C.5, 2.OA.B.2, MP1, MP2, MP3, MP5, MP7, MP8

You can take one or two counters from the pile. How do you get the last one?

Why We Love 1-2 Nim

Nim is fun, challenging, and rewarding for a wide range of kids. Done right, it can engage everyone from Kindergarten to upper elementary kids, and connect to basic counting and arithmetic up to division. Completely unlocking the game is an exciting and powerful achievement for a student.

The Launch

How to Play

Nim is a two-player game. You start with a pile of counters. On your turn, 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.

Example Game

We start with 8 counters in the pile.

Player 1 takes one counter, leaving 7.

Player 2 takes two counters, leaving 5.

Player 1 takes one counter, leaving 4.

Player 2 takes one counter, leaving 3.

Player 1 takes one counter, leaving 2.

Player 2 takes two counters, leaving 0 and winning the game.

Variations

1. Change the size of the pile.
2. 1-2-3 Nim: players may take one, two, or three counters per turn.
3. Poison: Whoever takes the last counter loses.

Prompts and Questions

The Central Question: how can you win 1-2 Nim? What would a perfect strategy look like?

Good questions for the teacher to ask students:

- What move should I (the teacher) make?
- How did you/they/I win that game?
- What do you think your/my opponent will do if you/I take two counters?

- Would you like to take back your move?
- What have you noticed about this game?

Possible student conjectures, true and false, that may arise:

- Whoever goes first wins.
- Whoever goes second wins.
- Odd vs. Even determines your strategy.
- It matters/doesn't matter what you do until there are less than six counters in the pile.
- Whoever can give their opponent four open spaces wins.

For students who have figured out the game, some challenge questions:

- How would you win 1-2 Nim if you start with a pile of 20? 30? 100? 217?
- These challenges can also apply to 1-2-3 Nim and Poison variations.

Tips for the Classroom

1. Demonstrate the game with volunteers for at least three games (or many more!), until you are certain everyone understands it and is excited to play.
2. When demonstrating 1-2 Nim, narrate the game out loud, using mathematical language, and leaving empty space for students to chime in: "My opponent just took 2 leaving... [wait for students] 5 in the pile. Who has advice for what I should do next?"
3. Remind students that they will lose many games as they play, and that every loss is an opportunity to learn. Can they steal the strategy of the person who just beat them? Point out how students are trying out new strategies as they play you in demonstration games.
4. As kids play each other, circulate to see what strategies they are developing. Challenge them to play you, and see if they can beat you.
5. Encourage student conjectures, but do not call them as true or false. Challenge students to break their own conjectures.
6. This game is great for station work once students already know how to play it.
7. We use the term "the 3 trap" to describe what happens when you give your opponent a pile of three counters. Understanding how to win boils down to understanding what pile sizes you want to leave your opponent with.
8. There are two incredibly powerful approaches to solving Nim. We'll discuss them here, BUT don't be in a rush to push the kids to find them. Help students only as far as they seem ready to go, and if for many weeks, or even the entire summer session, they never articulate a correct answer to the question of how to win at Nim, they'll still get lots of beneficial mathematical practice by simply playing the game. The first approach is to simplify. How could the game be easier? What if the pile had

only one counter? From this place of almost absurd simplicity, we slowly raise the difficulty. What about two counters? Three counters?

The second approach is to organize the data in a coherent way. A table does this very nicely.

Number of Counters	Winning Strategy
1	Go first. Take 1.
2	Go first. Take 2.
3	Go second.
4	?
5	?

9. We discourage a three-player game. Normally trying out different numbers of players is a great impulse. In Nim, it leads to spoilers, who can't win, but can choose who does win.

10. Optional Homework: teach 1-2 Nim to a friend or family member.

Dot Five Memory

Math concepts: Arithmetic, addition, greater than/less than

Equipment: Tiny Polka Dot cards

Common Core: 1.OA.6

Do you remember where the card is that makes it 5?

Why We Love Dot Five Memory

This memory-style game is easy to learn and fun to play. It is great practice for finding pairs that add to 5, and a perfect preliminary to Dot Ten Memory.

Launch

Take a volunteer for a demonstration game, and explain the rules while you demonstrate play. First, choose two suits, and take the cards (0 - 5) in those two colors. Mix them up and deal them out face down in a grid. Players take turns turning two cards face up. If these two cards add to 5, keep them, and take another turn. If not, turn them face down in place, and it is the next player's turn. Keep playing until all the cards are gone. Whoever has the most cards at the end is the winner.

If a group of four takes a single deck, they can split it into two piles of two suits and each pair can play a game. When they're all done, they can redivide the deck in a different way.

Questions and Prompts

- What number do you need to make five with the one you've already turned over? Think about it before turning over the next one.
- Do you know of any pairs that make five?
- Can you do anything with the card they just turned over?
- Show me how you know those two cards add up to 5.

Wrap Up

Let students share observations and questions they may have about the game. One nice closing question is whether certain pairs that sum to five feel easier or harder.

Tips for the classroom

1. For students who need a more challenging game, try Dot Six Memory, Dot Seven Memory, etc.
2. For students who need an easier game, play Dot Fives, where the cards are arranged face up instead of face down.
3. Students may, after repeated playing, come up with interesting variations, like being able to turn over three cards to make five. These may be worth exploring.

Day 4

Goals

1. Solve Flower Petal Puzzles, a logic and arithmetic puzzle.
2. Learn Dot Ten Memory, and practice sums to ten.

Opener

Dot Talks - see Appendix 4 for images

Activities

Activity 1: Flower Petal Puzzles

Activity 2: Dot Ten Memory

Activity 3: Choice Time

—Dots and Boxes

—Dot Ten Memory

—Challenge Problems - see Appendix 3, or use Flower Petal Puzzles

Note: students can use unfinished Flower Petal Puzzles as Challenge Problems today at Choice Time, and in the future

Closer

Play *High Tens*.

In this cooperative game, students meet in pairs. One student throws forward some number of fingers. The second student must throw forward however many fingers will make the sum 10. For example, if two students meet and one student puts forward two fingers, the other student should, as quickly as possible, look, think, and throw forward eight fingers. Then they part and each finds a new partner.

After everyone plays for a minute or two, discuss what pairs of numbers make ten. Write a complete list on the board with the students help. What do they notice about the list?

Differentiation

Downlevel: Students can play Dot Ten Memory with the cards face up.

Students can play Dot Five (or Six) Memory instead of Ten.

Uplevel: Students can make up their own Flower Petal Puzzles

Flower Petal Puzzles

Topics: addition, subtraction, logic

Materials: Worksheets, pencil and scratch paper

Common Core: 1.OA.A.2, 1.OA.C.6, 1.OA.D.8, 2.OA.B.2, MP1, MP7

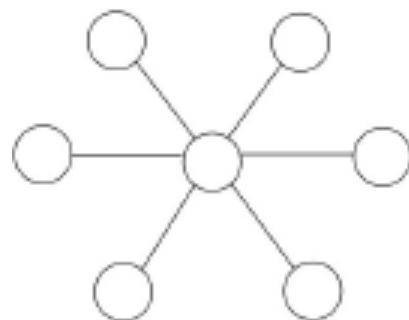
Put each number in a “petal” so each line of three numbers in a row has the same sum.

Why We Love Flower Petal Puzzles

This is a simple but thought-provoking puzzle. It’s a great way to encourage students to make mistakes and learn from them in order to arrive at a right answer in the end. A fun structure to explore and build on, this is skills practice embedded in a more rigorous and interesting puzzle.

The Launch

Draw the “flower” drawing and explain that it is possible to put the numbers 1 through 7 into each “petal,” using each number exactly once, so that each straight line adds up to 10. Take suggestions from students about which number could do where, making sure that a “1” does NOT go in the center.



1 2 3 4 5 6 7

With student input, get as far as you can until you are stuck. Then distribute the template and let students try on their own.

Example Launch

Teacher: I’ve heard that it is possible to put the numbers 1 to 7 into the petals of this flower to make every line of three petals add up to 10. How can we do it, I wonder? What number could we put in the middle?

Student: Three?

Teacher: Let’s try it. I’ll cross the “3” off my list of numbers, since I want to use each number only once.

Now what could I put in this next petal?

Student: I don’t know.

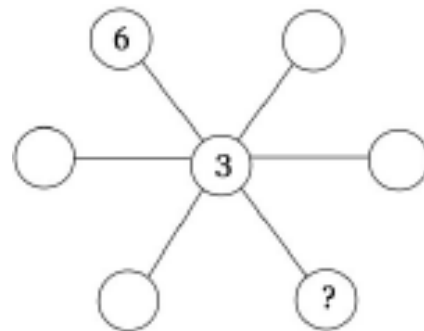
Teacher: I don’t either. But let’s try something and see if it will work. We can always erase later.

Student: What about six?

Teacher (writing in 6, and crossing it out from the list of numbers): Ok, now we have a 6 and a 3 in one row. What should we put in the last petal to make 10? In other words, if we add up 6 and 3, what more do we need to add to make 10?

Think about it, then pair and share.

[Kids think and discuss]



1 2 3 4 5 6 7

Student: It has to be 1.

Teacher: How do you know?

Student: Because $6 + 3$ is 9, and then we need one more to make 10.

Teacher: Aha! I'll put that in too, then. So what can go here?

[Teacher continues until it becomes clear that the flower petal puzzle CANNOT be solved.]

Teacher: Hmmmm... it looks like this isn't going to work. Maybe we should have put a different number in the middle. What number would you try? [Students give suggestions.] You know what, let's go ahead and try it out on our own. I've got empty flower petal pictures right here (passes out the empty template). Try out different numbers in the petals and see if you can get each row to add up to 10. When you can solve that, I've got some followup challenges for you too.

The Work

Let students work individually or in pairs to solve the Flower Petal Puzzle. When they solve it, they can come to you for the next challenge.

- Challenge 1: All lines add to 10.
- Challenge 2: All lines add to 12.
- Challenge 3: All lines add to 14.
- Challenge 4: Students make their own Flower Petal Puzzles.
- Challenge 5: Advanced Flower Petal Puzzles

Prompts and Questions

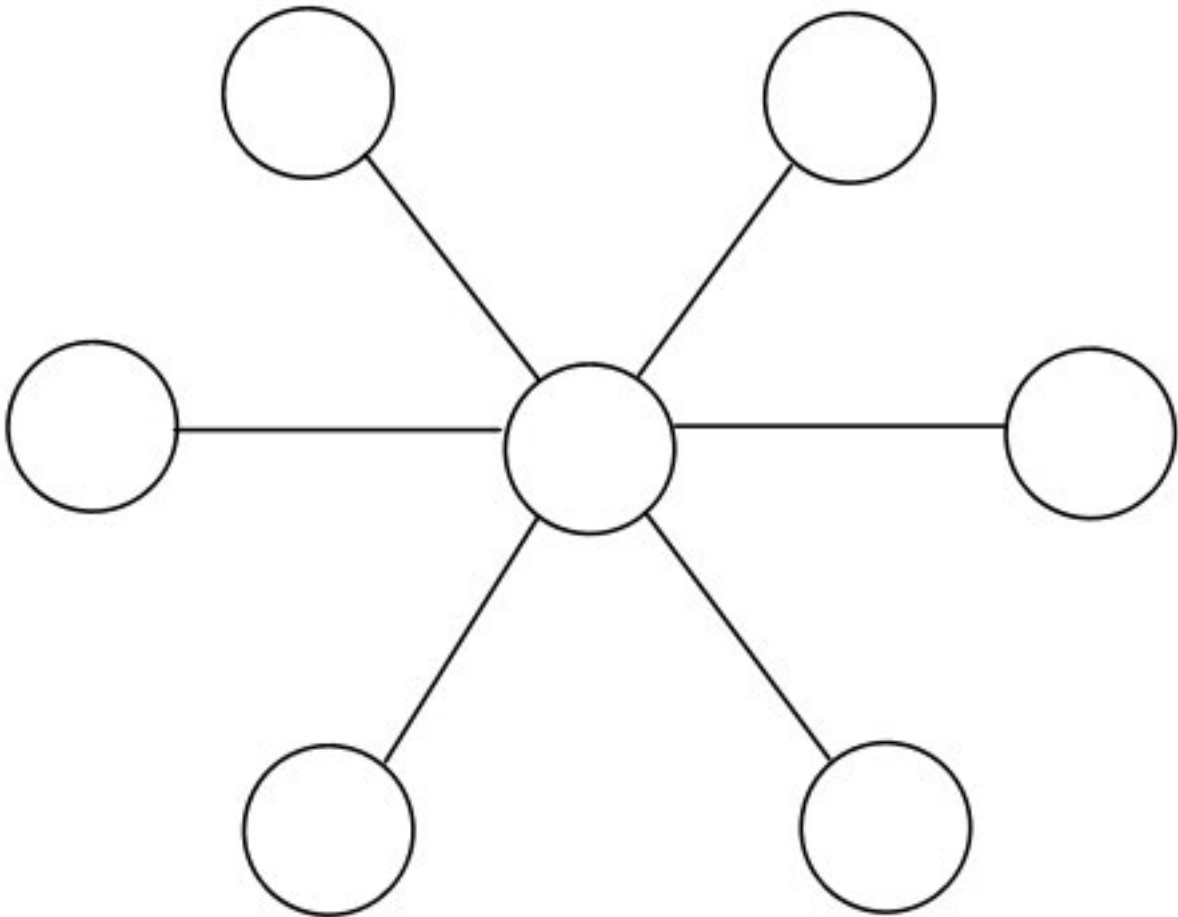
- What number could we try out in the middle?
- What needs to go in that spot for the three numbers to make 12?
- What do these two numbers in the row add up to now?

Tips for the Classroom

1. Hints: put a 1 in the middle to make each row add up to 10. To make 12s, put a 4 in the middle. To make 14s, put a 7 in the middle. Avoid accidentally getting the answer right when you demonstrate the puzzles.
2. Students can use counters to try moving numbers around if they need a more concrete look at the puzzle.
3. If students don't know what to try when they make up their own puzzles, encourage them to try drawing a flower with more petals, or give them the template with more petals and ask them what puzzle they can make from it.
4. If you can motivate students to create their own puzzles, this can be the start of an even richer exploration.

Flower Petal Puzzles

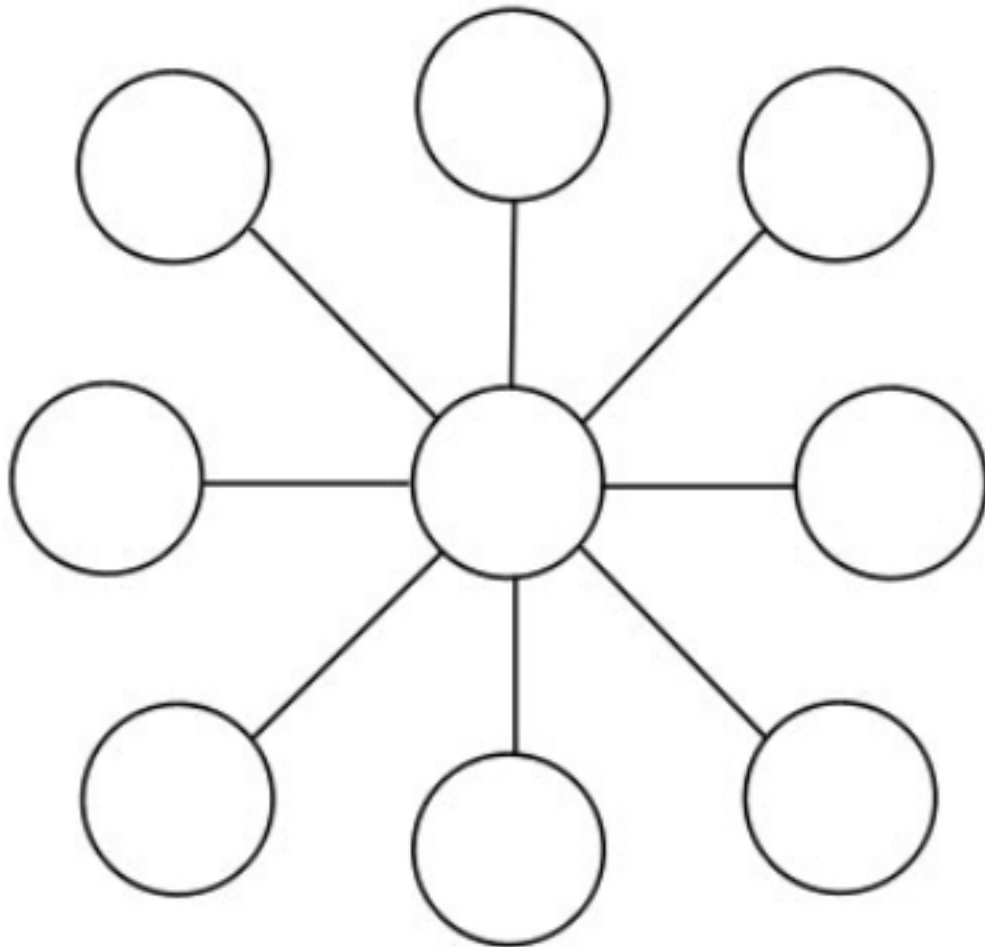
Write in the numbers 1 through 7 so that every group of three numbers in a line adds up to _____.



1 2 3 4 5 6 7

More Flower Petal Puzzles

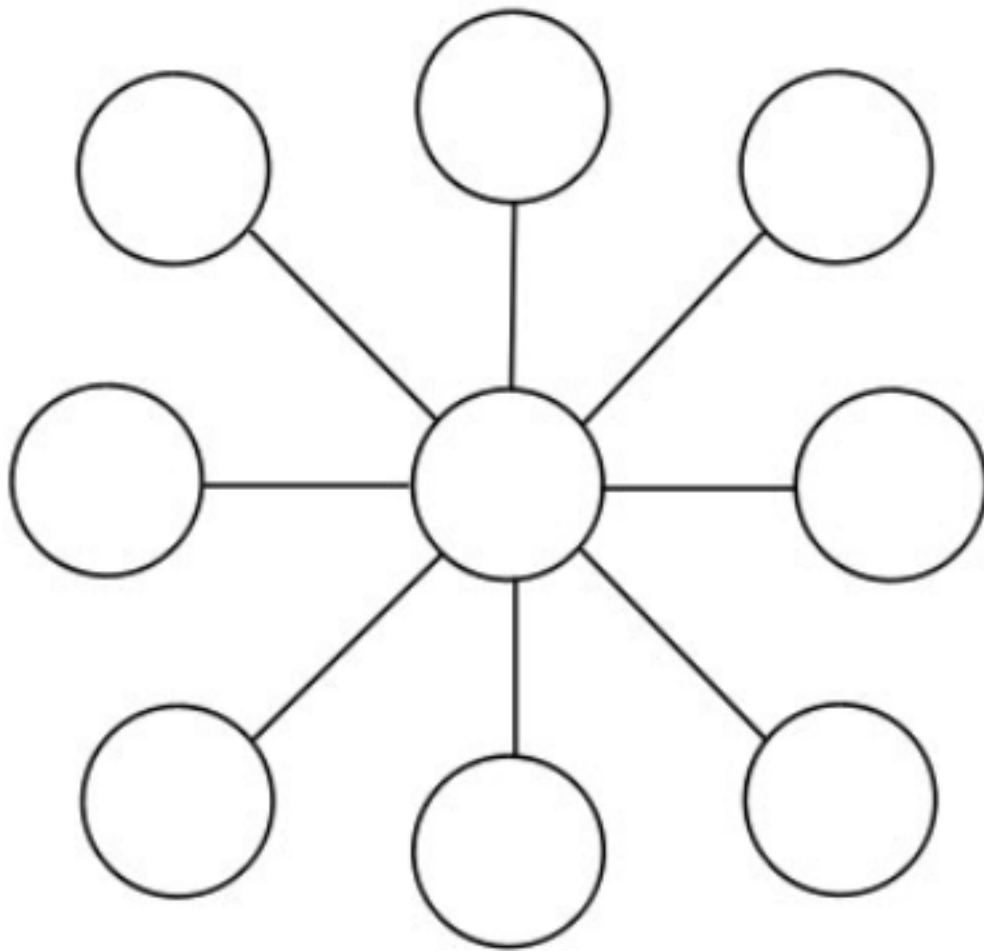
Write in the numbers 1 through 9 so that every group of three numbers in a line adds up to 15.



1 2 3 4 5 6 7 8 9

More Flower Petal Puzzles

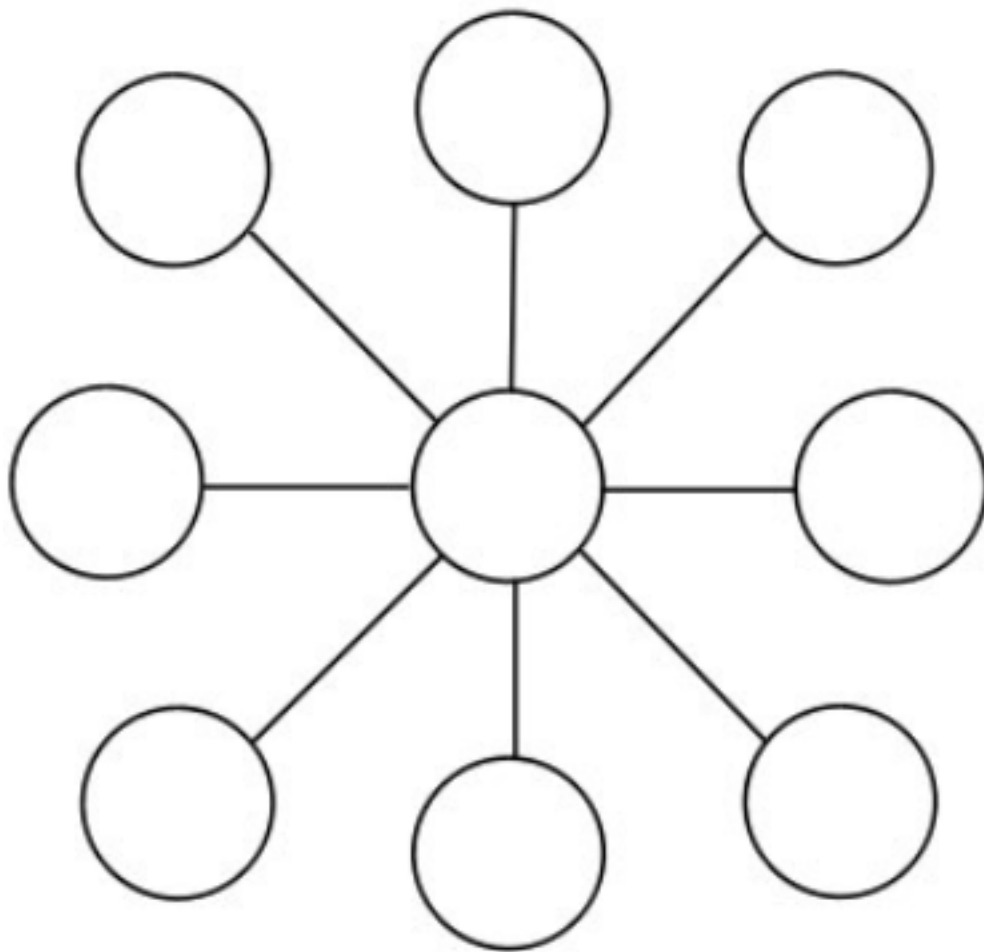
Write in the numbers 1 through 9 so that every group of three numbers in a line adds up to 18.



1 2 3 4 5 6 7 8 9

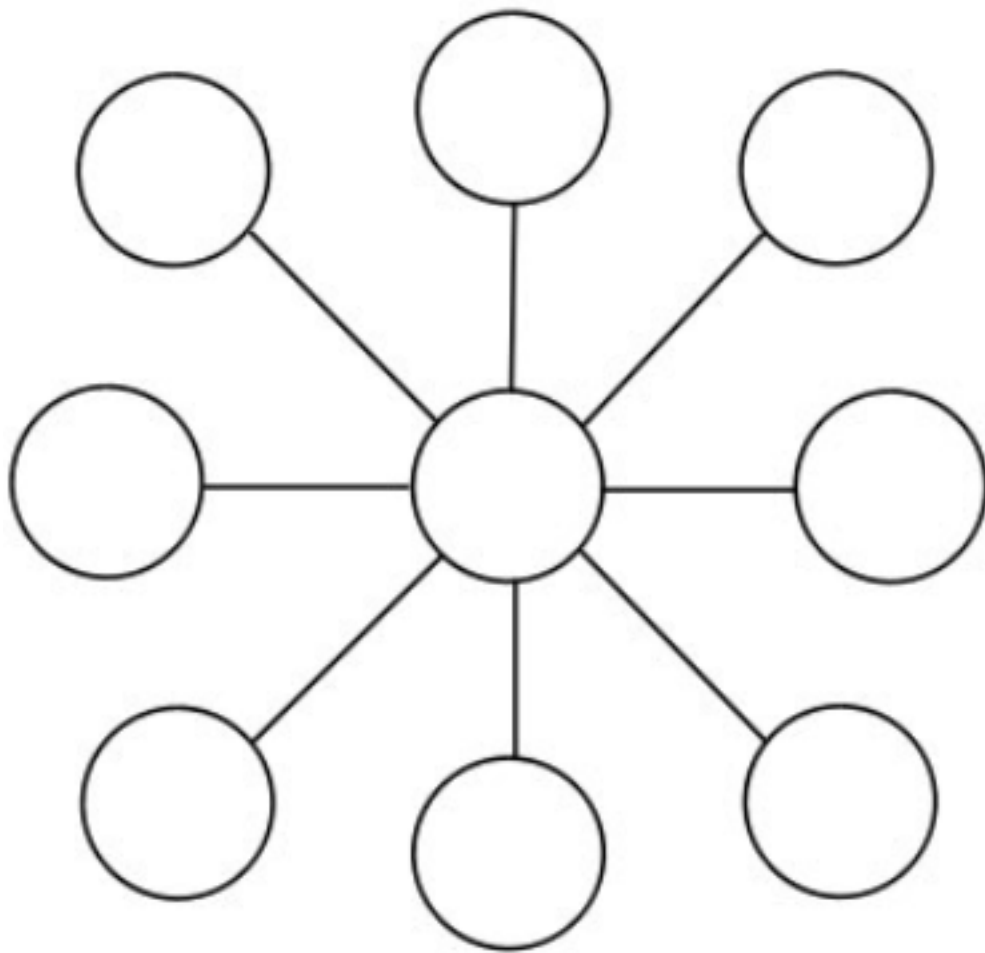
More Flower Petal Puzzles

Write in the numbers 10 through 18 so that every group of three numbers in a line adds up to 42.



10 11 12 13 14 15 16 17 18

Make your own Flower Petal Puzzle



Dot Ten Memory

Topics: Arithmetic, addition, greater than/less than

Equipment: Tiny Polka Dot cards

Common Core: 1.OA.5, 1.OA.6, 2.OA.2

Do you remember where the card is that makes it 10?

Why we love Dot Ten Memory

This memory-style game is easy to learn and fun to play, and is great practice for finding pairs that add to 10.

Launch

Take a volunteer for a demonstration game, and explain the rules while you demonstrate play. First, choose two suits, and take the cards (0 - 10) in those two colors. Mix them up and deal them out face down in a grid. Players take turns turning two cards face up. If these two cards add to 10, keep them, and take another turn. If not, turn them face down in place, and it is the next player's turn. Keep playing until all the cards are gone. Whoever has the most cards at the end is the winner.

If a group of four kids takes a single deck, they can split it into two piles of two suits and each pair can play a game. When they're all done, they can redivide the deck in a different way.

Prompts and Questions

- What number do you need to make ten with the one you've already turned over?
Think about it before turning over the next one.
- Do you know of any pairs that make ten?
- Can you do anything with the card they just turned over?
- Show me how you know those two cards add up to ten.

Closer

Let students share observations and questions they may have about the game. One nice closing question is whether certain pairs that sum to ten feel easier or harder.

Tips for the classroom

1. For students who need a simpler game, try Dot Five Memory, which starts with just the numbers 0 - 5, and pairs need to sum to 5 instead of 10.
2. 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.

Day 5

Goals

1. Connect counting and addition.
 2. Encourage/introduce use of the ten frame to see that counting with tens is an easier, more efficient option.
-

Opener

Target Number - use target number 5

Activities

Remind students that they can use ten frames (or just count by tens) to make counting easier and more efficient at Counting Collections.

Students can use a ten frame to play 1-2 Nim during Choice Time.

Challenge Problems are an option at Choice Time from now on, and can also be done if students finish with Counting Collections early.

Activity 1: Pattern Block Fill-Ins

Activity 2: Counting Collections

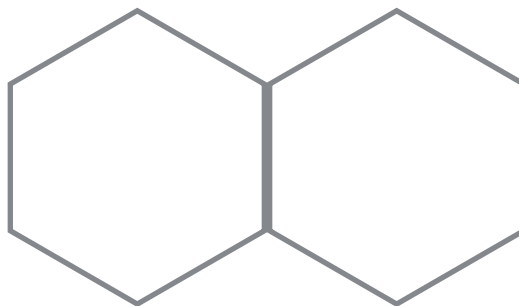
Activity 3: Choice Time

—1-2 Nim (on a ten frame)

—Challenge Problems - see Appendix 3

—Dots and Boxes

Closer



Build this shape using two hexagons, or draw it on the board, and ask:

- *Will it take more blocks to fill in a double hexagon in with trapezoids, or fill it in with triangles?*