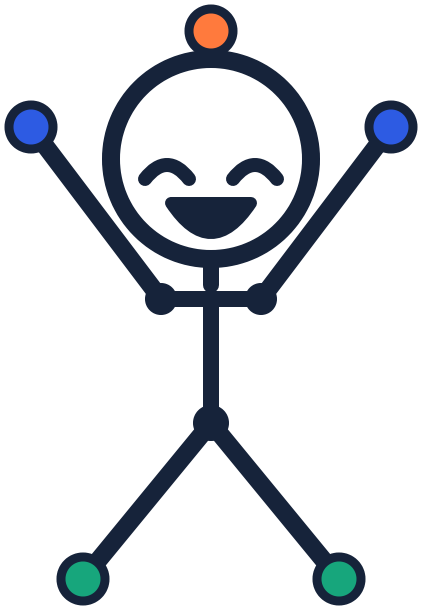
Young Innovators
FOR CHANGE
innovateyouth.org

A FULL-YEAR ENRICHMENT PROGRAM · GRADE 2

Things Worth Noticing

36 weekly assignments, maps, robots, secret codes, and the math of *how things connect*



This book belongs to

_____

Teacher _____ School year _____

One assignment a week · two pages, front and back · about 30 to 40 minutes
Built to sit alongside the California Grade 2 math curriculum, not to replace it.

How This Book Works

Read this page with a grown-up before Week 1.



Hi. I am Pip.

I am made of **dots** and **lines**, which is exactly what a lot of this book is about. Five of my lines end in a colored dot: two arms, two legs, and my antenna. Count them. By Week 26 you will know why that number matters.

One assignment a week, two pages

Page 1 starts with a note about what you are doing in class this week, then a two-minute **Number Warm-Up**, then the main adventure.

Page 2 has more to try, a **Talk About It** question to answer out loud, a hint if you get stuck, and a ★ **Challenge Zone**.

About the Challenge Zone

It is genuinely harder, and nobody is expected to get every one. It is there for the weeks when you finish early and want more. Skipping it is fine. Trying it and not getting it is also fine, that is what it is for.

Three rules for this book

1. Guessing and checking is allowed. It is a real strategy that real mathematicians use.
2. If you are stuck, explain the problem out loud to somebody. Say every step.
3. Some puzzles have **more than one right answer**. A few have **none**, and figuring out *why* is the best part of the whole book.

For the grown-up helping

The best question you can ask is not “is that right?” but **“how do you know?”** Most pages here have short answers and long reasons, and the reasons are the whole point. When a child is stuck, resist solving it, ask them to say the problem back to you in their own words. That step alone can be enough.

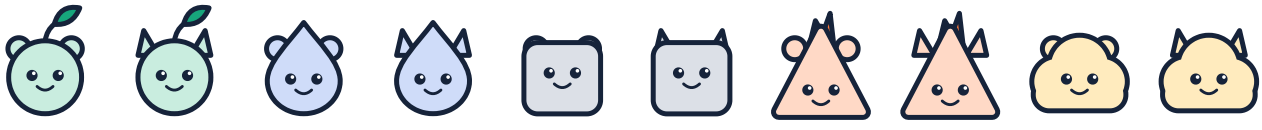
The Year at a Glance

Weeks 1–18. The last column is what the class is usually doing that week.

WK	ASSIGNMENT	STRAND	IN CLASS THIS WEEK
TRIMESTER 1 · WEEKS 1–13			
1	**What's My Rule?**	Sorting & Logic	Adding & subtracting within 20
2	**Two Circles, One Middle**	Sorting & Logic	Sorting; even and odd
3	**Pair Them Up**	Number Structure	Odd and even numbers (2.OA.3)
4	**Always, Sometimes, Never**	Sorting & Logic	Fluency within 20
5	**How Computers Count**	Number Structure	Place value to 1000 (2.NBT.1)
6	**Number Machines**	Number Structure	Skip counting by 5s, 10s, 100s (2.NBT.2)
7	**Put Them in Order**	Number Structure	Comparing numbers (2.NBT.4)
8	**Twenty Questions**	Sorting & Logic	Greater than / less than (2.NBT.4)
9	**The Shortest Way to the Gold**	Paths & Routes	Adding within 100 (2.NBT.5)
10	**Magic Squares**	Number Structure	Missing addends (2.OA.1)
11	**Balance Puzzles**	Number Structure	Equations and unknowns (2.OA.1)
12	**The Handshake Problem**	Counting Carefully	Adding within 100 (2.NBT.5)
13	**Detective Week**	Sorting & Logic	Review & reasoning
TRIMESTER 2 · WEEKS 14–25			
14	**Sorting by Length**	Measuring & Comparing	Measuring length (2.MD.1, 2.MD.4)
15	**Covering a Strip**	Counting Carefully	Length as repeated units (2.MD.1)
16	**Two Ways Across the Park**	Measuring & Comparing	Adding lengths; number line (2.MD.5, 2.MD.6)
17	**Color the Kingdom**	Maps & Colors	Shapes and attributes (2.G.1)
18	**When Three Colors Is Not Enough**	Maps & Colors	Attributes; impossibility (2.G.1)

Meet the InnovaCritters

One of them is at the top of every week. In weeks 12 and 23 five of them are the friends, and in week 24 eight of them play a tournament.



Pod **Burr** **Plink** **Wade** **Cobble** **Grit** **Flick** **Zing** **Wisp** **Gust**

The Year at a Glance

Weeks 19–36. The last column is what the class is usually doing that week.

WK	ASSIGNMENT	STRAND	IN CLASS THIS WEEK
19	**How Many Ways to Make 15¢?**	Money & Time	Money (2.MD.8)
20	**The Fewest Coins**	Money & Time	Money word problems (2.MD.8)
21	**Clock Arithmetic**	Money & Time	Telling time to 5 minutes (2.MD.7)
22	**Getting Ready for the Party**	Money & Time	Time; order of events (2.MD.7)
23	**Dots and Lines**	Data & Graphs	Bar graphs (2.MD.10)
24	**Who Wins the Tournament?**	Data & Graphs	Reading data (2.MD.10)
25	**Puzzle Fair**	Sorting & Logic	Review & reasoning
TRIMESTER 3 · WEEKS 26–36			
26	**Trace It Without Lifting**	Paths & Routes	Odd and even as a tool (2.OA.3)
27	**The Bridges of the Old City**	Paths & Routes	Adding within 1000 (2.NBT.7)
28	**Connecting the Towns**	Paths & Routes	Adding within 1000 (2.NBT.7)
29	**Counting Routes**	Counting Carefully	Addition patterns (2.NBT.7)
30	**Guess My Shape**	Shapes & Parts	Shape attributes (2.G.1)
31	**Cutting Fair Shares**	Shapes & Parts	Halves, thirds, fourths (2.G.3)
32	**Filling a Rectangle**	Shapes & Parts	Rows and columns (2.G.2)
33	**The Ice Cream Shop**	Counting Carefully	Arrays and repeated addition (2.OA.4)
34	**Choice Trees**	Counting Carefully	Arrays and repeated addition (2.OA.4)
35	**Program the Robot**	Algorithms & Codes	Rows, columns, repeated addition (2.OA.4)
36	**Secret Codes**	Algorithms & Codes	Place value review (2.NBT.1)

WEEK 1 SORTING & LOGIC

What's My Rule?

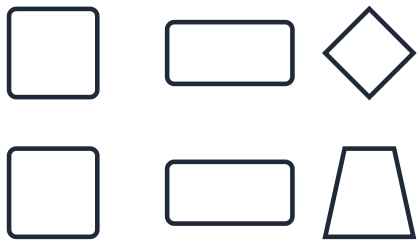
Every group has a rule. Your job is to find it.

IN CLASS THIS WEEK
Adding and subtracting within 20 · even and odd numbers

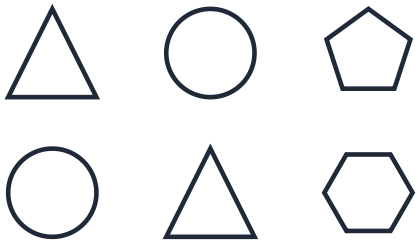
NUMBER WARM-UP · 2 MINUTES
Count by 2s out loud to 20. Then count by 5s to 50.

I sorted these shapes into two boxes using a **secret rule**. Look at *both* boxes before you guess, the "do not" box is just as useful.

THESE FOLLOW MY RULE



THESE DO NOT



1 What is my secret rule?

_____

2 Draw two more shapes that follow my rule.

3 Now try it with numbers.

A. Follow: 2 6 10 14 Do not: 3 7 9 15

Rule:

B. Follow: 5 15 25 50 Do not: 4 12 33 41

Rule:

C. Follow: 11 22 33 44 Do not: 12 21 34 43

Rule:

TALK ABOUT IT

Pick rule A. Say out loud why 20 follows it and why 21 does not.

How does the **do not** box help you? Could you have found rule C without it?



STUCK? TRY THIS

Ask yourself: what do **all** the yes ones share? Then check that your answer rules out **every single** no.

★ CHALLENGE ZONE

Here is a trickier one. Follow: 3, 13, 23, 30, 31. Do not: 4, 12, 25, 40, 52. What is the rule?

Invent your own secret rule. Sort six things into two boxes and see if someone can guess it.

WEEK 2 SORTING & LOGIC

Two Circles, One Middle

Where two groups overlap.

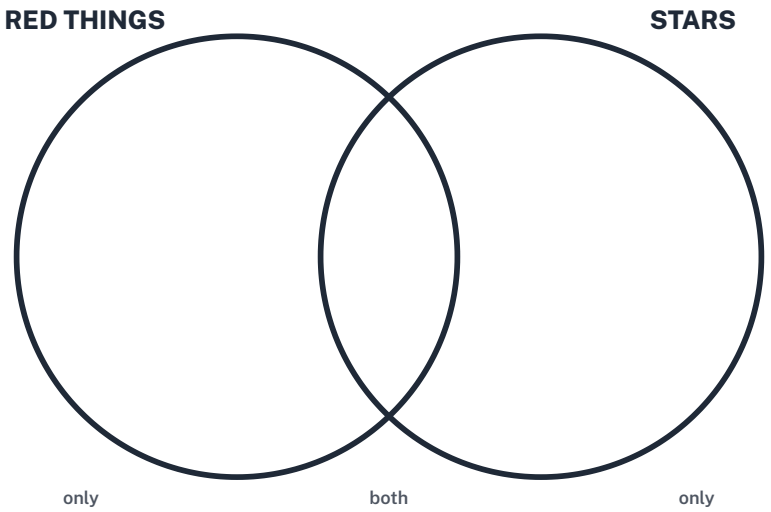
IN CLASS THIS WEEK
Sorting and comparing · even and odd numbers

NUMBER WARM-UP · 2 MINUTES
What is 7 + 8? Now what is 8 + 7? Why are they the same?

The left circle holds **RED THINGS**. The right circle holds **STARS**. The middle is for things that are **both**. Write each letter where it belongs.

A, red square | **B, blue star** | **C, red star** | **D, green circle** | **E, red triangle**

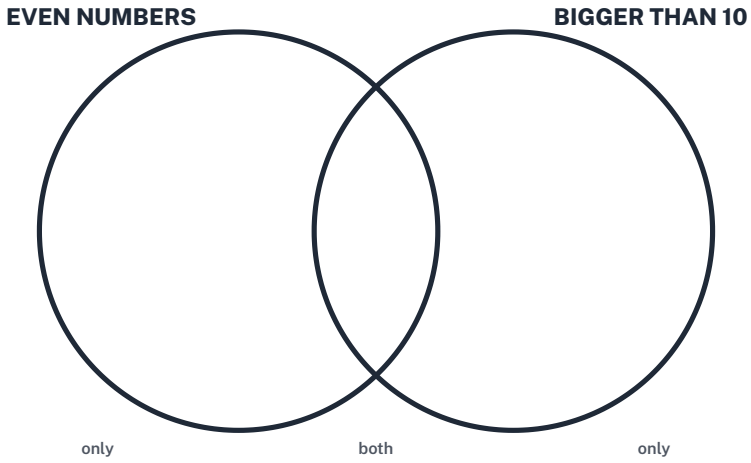
F, yellow star | **G, red star (big)** | **H, blue square**



1. How many letters went in the middle? _____
2. How many stars in all? _____ (do not forget the middle)
3. **Two** letters belong outside both circles. Which? _____ _____ Write them outside.

Same two circles, now with numbers. Left: **EVEN NUMBERS**. Right: **BIGGER THAN 10**. Some go in the middle. Some go outside both.

4	7	12	15	20	3	18	11



1. In the middle: _____
2. Outside both: _____
3. What do the outside numbers have in common?

_____

TALK ABOUT IT

The middle is not a third group. Explain what it really means to be in the middle.

Name a number that would go outside both circles. Now name three more.



STUCK? TRY THIS

Test each thing against the left label and the right label **separately**. Two yeses means the middle. Two nos means outside.

★ CHALLENGE ZONE

Could anything go in the middle of a Venn diagram for **SQUARES** and **CIRCLES**? Explain.

Could a number land outside both circles *and* be bigger than 100? Think hard about what "outside both" really means.

Pair Them Up

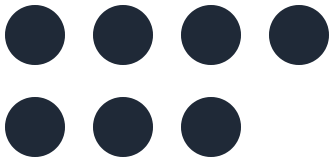
Even and odd, by pairing, not by memorizing.

IN CLASS THIS WEEK
Odd and even numbers; writing an even number as two equal parts (2.OA.3)

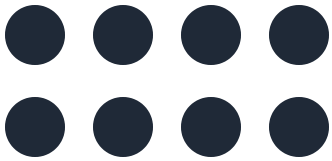
NUMBER WARM-UP · 2 MINUTES
Count by 2s starting at 1: 1, 3, 5, 7... What are these called?

Circle the acorns in **pairs of 2**. If every acorn gets a partner, the number is **EVEN**. If one is left alone with no partner, it is **ODD**.

7 acorns



8 acorns



7 is _____ 8 is _____

Predict first. Think about pairs, do not add.

If you add...	Example	Even or odd?
even + even	6 + 4 =	
even + odd	6 + 5 =	
odd + odd	5 + 7 =	

The surprise is **odd + odd**. Draw two odd groups of dots and show what the two lonely dots do.

Every even number is two equal parts. Fill these in.

8 = _____ + _____ 12 = _____ + _____

16 = _____ + _____ 20 = _____ + _____

Now try an odd number. Can you split 9 into two equal parts?

9 = _____ + _____ What goes wrong?

_____

Circle every even number.

13 24 31 46 55 68 70 99

TALK ABOUT IT

Use the lonely dots to explain why odd + odd is always even.

How can you tell if 138 is even without pairing up 138 things?



STUCK? TRY THIS

Draw the dots. Two rows that line up means even. One dot sticking out means odd.

★ CHALLENGE ZONE

Can 15 cookies be shared fairly between 2 people? Between 3? Between 5? What is it about each number that decides?

Is 7 + 7 + 7 even or odd? Answer **before** you add, then check.

WEEK 4 SORTING & LOGIC

Always, Sometimes, Never

Mathematicians do not just answer. They prove.

IN CLASS THIS WEEK
Fluency within 20 · properties of numbers and shapes

NUMBER WARM-UP · 2 MINUTES
Is 9 + 9 even or odd? Is 9 + 8? Say how you know without adding.

Read each sentence. Put a ✓ in one column. Being right is not enough, you have to be able to say **why**.

Statement	Always	Sometimes	Never
1. A square has 4 sides.			
2. A triangle is red.			
3. An even number ends in 5.			
4. A number that ends in 0 is even.			
5. Even + even is even.			
6. A rectangle is a square.			

Pick one you marked SOMETIMES.

Give one example where it is true and one where it is false.

TRUE when...

FALSE when...

Four more. This time also write **one example** that shows you are right.

Statement	Always	Sometimes	Never
1. Odd + odd is odd.			
2. A shape with 4 sides is a square.			
3. If you add 0 to a number, it stays the same.			
4. A number bigger than 10 has two digits.			

Your example for number 1:

_____

_____

💬 **TALK ABOUT IT**

One example is enough to prove a **sometimes**. Why is one example never enough to prove an **always**?

What would you have to find to prove a statement is **not** always true?



STUCK? TRY THIS

For every **always** you mark, try hard to break it. If you honestly cannot, that is when you start to believe it.

★ **CHALLENGE ZONE**

To prove something is **never** true you cannot just test a few. Give a reason: why can an even number never end in 5?

Write one always, one sometimes, and one never sentence of your own. Trade with a partner.

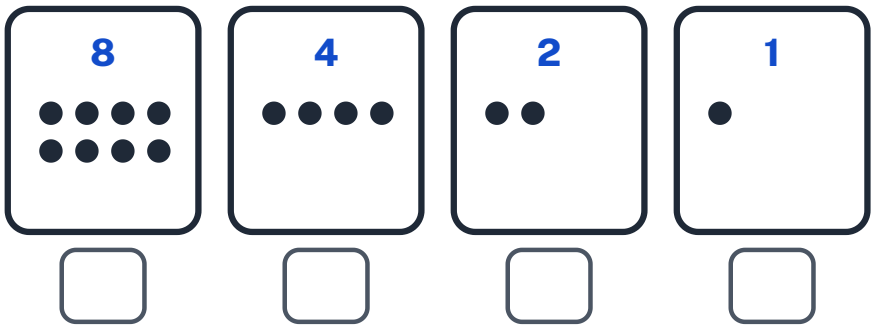
How Computers Count

Two symbols, 0 and 1, are enough for every number.

IN CLASS THIS WEEK
Place value: hundreds, tens, and ones (2.NBT.1)

NUMBER WARM-UP · 2 MINUTES
What does the 3 in 35 mean? What does the 5 mean? Why is 35 not 53?

A computer has cards worth **8, 4, 2,** and **1**. Each card is either **ON (1)** or **OFF (0)**. To make a number, turn on the cards that add up to it.



Write **1** for ON and **0** for OFF.

Example

To make **5**: turn on the 4 card and the 1 card. 4 + 1 = 5. So 5 is written **0 1 0 1**.

Make these numbers.

Number	8	4	2	1
5	0	1	0	1
9				
12				
15				

More numbers. The last row is yours to choose.

Number	8	4	2	1
3				
6				
10				
13				
14				
your own				

1. What is the **biggest** number you can make with these four cards? _____

2. What number is **0 0 0 0**? _____

3. In our normal numbers each place is worth 1, 10, 100. Here the cards are worth 1, 2, 4, 8. What are you multiplying by each time?
Normal: _____ Computer: _____

💬 **TALK ABOUT IT**

In 35 the 3 means three tens. In the computer number 1 0 1 1, what does the first 1 mean?

Why can a computer not just have a 2 card, a 3 card, and a 5 card instead?



STUCK? TRY THIS

Start with the **biggest** card that still fits, turn it on, then see what is left over. Keep going with the smaller cards.

★ **CHALLENGE ZONE**

Write every number from 0 to 15. Look down the **last** column. What do you notice? What is always in that last spot for an even number?

Add a fifth card worth **16**. What is the biggest number now? What would the next card be worth?

Number Machines

Feed a number in. A rule changes it. What comes out?

IN CLASS THIS WEEK
Skip counting by 5s, 10s, and 100s (2.NBT.2)

NUMBER WARM-UP · 2 MINUTES
Skip count by 10s from 7: 17, 27, 37... keep going past 100.

This machine follows one rule. Put a number in the left box, and the machine writes the answer in the right box.



5	15
12	
40	
	38

Now a machine with a secret rule.

Look at what it did to these numbers:

3 → 6 5 → 10 8 → 16

The rule is: _____

So 10 → _____ and 20 → _____

Find each secret rule, then fill in the missing numbers.

Machine C: 20 → 15 · 35 → 30 · 60 → _____

Rule: _____

Machine D: 1 → 5 · 2 → 10 · 3 → 15 · 6 → _____

Rule: _____

Machine E: 4 → 4 · 17 → 17 · 99 → _____

Rule: _____

Machine D counts by 5s. Write the first eight numbers it makes.

5, _____, _____, _____, _____, _____, _____, _____

💬 **TALK ABOUT IT**

Two different machines can give the same answer for one number. Find a number where **+ 10** and **double** both give the same result.

How many examples do you need before you trust a secret rule? Is two enough?



STUCK? TRY THIS

Try the easiest rules first: *add something*, *subtract something*, *double*. Then check your guess against **every** example, not just one.

★ **CHALLENGE ZONE**

Send a number through **+ 10** and then through **double**. Start with 3. What comes out?

Now do it in the other order: double first, then + 10. Start with 3 again. Do you get the same answer? What does that tell you about order?

Put Them in Order

Two ways to sort, and one is less work.

IN CLASS THIS WEEK
Comparing two-and three-digit numbers (2.NBT.4)

NUMBER WARM-UP · 2 MINUTES
Which is bigger, 27 or 34? How do you know? Which digit did you look at first?

Here are five number cards, all mixed up.

34	12	50	27	8

Method 1: Find the Smallest

Look at all five cards. Find the smallest and write it in box 1. Cross it off. Now find the smallest of what is left. Keep going.

1	2	3	4	5

Sorted list: _____

Method 2: Fix the Neighbors

Start over with the mixed-up cards: **34, 12, 50, 27, 8**. Compare the first two, if the left one is bigger, swap them. Then cards 2 and 3. Then 3 and 4. Then 4 and 5. That is **one pass**.

After pass 1: _____

After pass 2: _____

After pass 3: _____

After pass 4: _____ Sorted? _____

Now sort these three-digit cards with whichever method you like.

418	204	481	240

Smallest to biggest: _____

TALK ABOUT IT

Both methods gave the same answer. Which one felt like less work, and why?

In Method 2, watch the **biggest** card. Where does it end up after just one pass?



STUCK? TRY THIS

For Method 1, cross each card off as you use it. For Method 2, only ever compare **two neighbors at a time**, never the whole row at once.

★ CHALLENGE ZONE

How many passes could you possibly need to sort 5 cards? What about 10 cards?

Sort the same five cards by a new rule: **add the digits** (34 → 3 + 4 = 7). Does the order change?

WEEK 8 SORTING & LOGIC

Twenty Questions

The fastest way to find a hidden number.

IN CLASS THIS WEEK
Comparing numbers; greater than and less than (2.NBT.4)

NUMBER WARM-UP · 2 MINUTES
Say a number between 8 and 12. Now one between 40 and 50.

I am thinking of a number from **1 to 16**. You may only ask questions I can answer **yes** or **no**, like “Is it more than 8?”

The bad plan: ask “Is it 1?” then “Is it 2?” then “Is it 3?” … That could take 16 questions.

The good plan: cut the list **in half** every time. Cross off the half that is gone.



My number is 11. Follow along and cross numbers off the line above.

Question	Answer	Numbers still possible
Is it more than 8?	YES	9 to 16
Is it more than 12?	NO	
Is it more than 10?		
Is it more than 11?		

Now you try. Your partner picks a number from 1 to 16 and only says yes or no.

Question	Answer	Numbers still possible

You found it in _____ questions.

1. Playing the good way, what is the **most** questions you would ever need for 1 to 16? _____
2. Each question cuts the list in half. 16 → 8 → _____ → _____ → _____

💬 **TALK ABOUT IT**

Why is “Is it 1?” a weak question, even though it might get lucky?

What makes a question a **good** question in this game?



STUCK? TRY THIS

A good question splits the numbers that are left into two piles that are as close to **equal size** as you can make them.

★ **CHALLENGE ZONE**

How many questions would you need for 1 to 32? For 1 to 64? What happens to the number of questions each time the list doubles?

You saw this in Week 5. The cards 8, 4, 2, 1 and this halving game are the same idea. Can you say why?

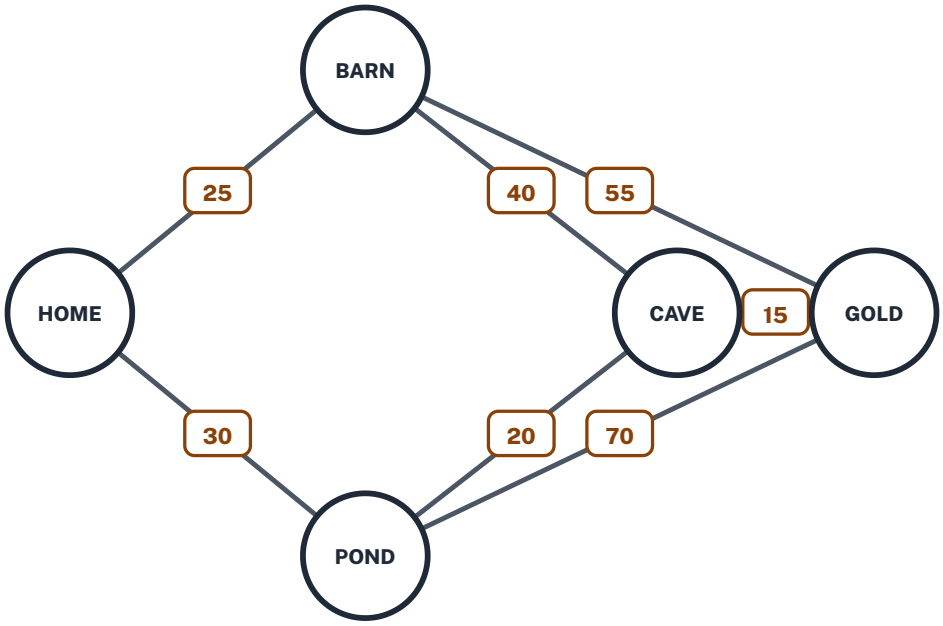
The Shortest Way to the Gold

The route that looks shortest is not always the shortest.

IN CLASS THIS WEEK
Adding and subtracting within 100 (2.NBT.5)

NUMBER WARM-UP · 2 MINUTES
25 + 40 = ? 30 + 20 = ? 50 + 15 = ?

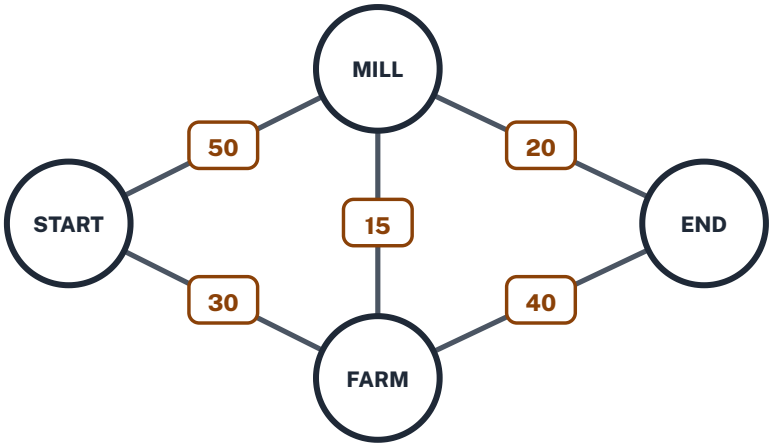
Start at **HOME** and reach the **GOLD**. The number on each path is how many steps it takes. Find the route with the **smallest total**.



Route	Add up the steps	Total
HOME → BARN → GOLD	25 + 55	
HOME → BARN → CAVE → GOLD		
HOME → POND → CAVE → GOLD		
HOME → POND → GOLD		

Circle the shortest route. It takes _____ steps.

A second map. Find the shortest way from START to END.



Route	Total
START → MILL → END	
START → FARM → END	
START → FARM → MILL → END	

Shortest: _____

TALK ABOUT IT

Was the shortest route the one with the **fewest stops**? What does that tell you?

If you were the map maker and could shorten one path, which one would help a traveler most?



STUCK? TRY THIS

Write each route out as an addition problem first, then add. Do not try to guess the shortest by looking, the picture will fool you.

★ CHALLENGE ZONE

It rains and the POND → CAVE path floods away. What is the shortest route now? Something surprising happens, look closely at the totals.

Of the four routes in your table, which is the **longest**? How much longer is it than the shortest?

Magic Squares

Every row, every column, every diagonal, the same total.

IN CLASS THIS WEEK
Adding within 100 · finding a missing addend (2.OA.1)

NUMBER WARM-UP · 2 MINUTES
What plus 6 makes 15? What plus 9 makes 15? What plus 4 makes 15?

In a **magic square**, the three numbers in every row add to the same total. So do the columns. So do the two diagonals. This one uses the numbers **1 to 9**, each once, and every line adds to **15**.

8		6
	5	
4		2

1. Start with the top row: 8 + _____ + 6 = 15.
2. Now the first column: 8 + _____ + 4 = 15.
3. Fill in the rest. Then **check the middle row** and both diagonals. Do they all make 15?

_____

This one uses the numbers 2 to 10. Every line adds to 18.

9		7
	6	
5		3

This time nobody told you the total. Find it first.

	9	2
3	5	7
8	1	

The magic total is _____

TALK ABOUT IT

Look at the middle number in each square. Compare it to the magic total. What do you notice?

Why is a row that already has two numbers easier to fill than a row with only one?



STUCK? TRY THIS

Find a row, column, or diagonal that is **missing only one number**. Fill that one first. It will open up the next one.

★ CHALLENGE ZONE

The numbers 1 to 9 add up to 45. The square has three rows. Use that to explain why the magic total **has** to be 15, no other total is possible.

Take the first magic square and add 10 to every number. Is it still magic? What is the new total?

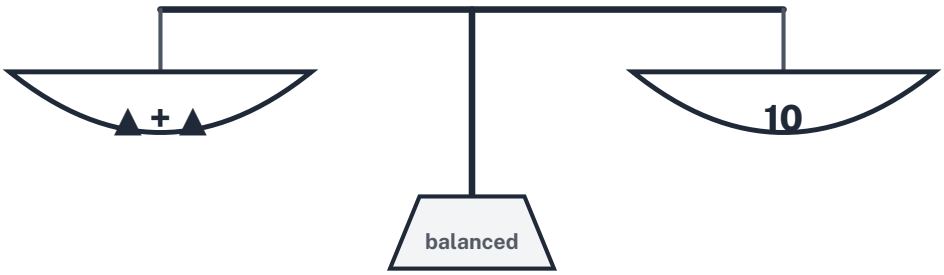
Balance Puzzles

Whatever one side weighs, the other side weighs too.

IN CLASS THIS WEEK
Missing addends and equations (2.OA.1, 2.OA.2)

NUMBER WARM-UP · 2 MINUTES
5 + □ = 12. What is □? □ + 8 = 14. What is □?

The scale balances, so the two sides weigh exactly the same. Every shape of the same kind weighs the same amount.



Work down the list. Each answer helps you with the next one.

▲ + ▲ = 10 → ▲ = _____

▲ + ■ = 12 → ■ = _____

■ + ● = 15 → ● = _____

▲ + ■ + ● = _____

A new set of shapes. Same idea.

★ + ★ + ★ = 12 → ★ = _____

★ + ♥ = 11 → ♥ = _____

♥ + ◆ = 16 → ◆ = _____

★ + ♥ + ◆ = _____

Which scales balance? Write YES or NO.

★ + ★ = 8 _____ ♥ + ★ = ◆ + 3 _____

◆ + ◆ = 20 _____ ♥ + ♥ = ★ + 10 _____

💬 TALK ABOUT IT

If ▲ + ▲ = 10, how do you know one ▲ is 5 without guessing?

If you take one shape off the left side, what must you do to the right side to keep it balanced?



STUCK? TRY THIS

Always start with the line that has only **one kind of shape** on it. That one you can solve on its own. Then carry the answer into the next line.

★ CHALLENGE ZONE

Try this one: ▲ + ▲ + ■ = 16, and ■ is 4 more than ▲. Find ▲ and ■. (Guess a value for ▲ and check, that is a real strategy.)

Write a two-shape balance puzzle of your own and give it to a partner. Make sure it has exactly one answer.

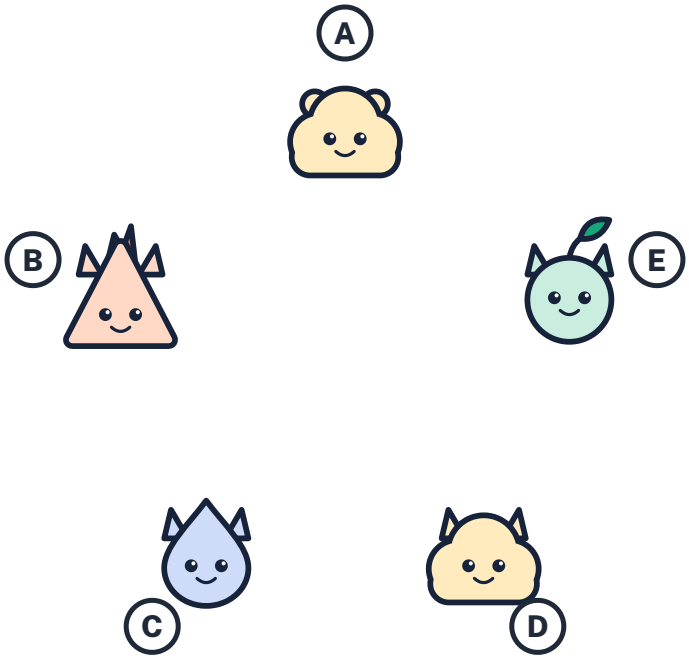
The Handshake Problem

Everyone shakes hands once. How many handshakes?

IN CLASS THIS WEEK
Adding within 100 · counting strategies (2.OA.1, 2.NBT.5)

NUMBER WARM-UP · 2 MINUTES
4 + 3 + 2 + 1 = ? 5 + 4 + 3 + 2 + 1 = ?

Five friends meet. Every friend shakes hands with every other friend **exactly once**. Draw a line for each handshake, then count the lines.



1. How many handshakes in all? _____

2. How many hands does **A** shake? _____ And **B**? _____

3. There are 5 people and each shakes 4 hands. That is 4 + 4 + 4 + 4 + 4 = 20, one 4 for each person. But you counted fewer lines than 20. Why?

_____

Fill in the table. Draw the small ones if it helps.

How many friends?	2	3	4	5	6	7
How many handshakes?	1	3				

What do you add each time you invite one more friend? _____

The pattern of handshakes.

With 5 friends: 4 + 3 + 2 + 1 = _____

With 6 friends: 5 + 4 + 3 + 2 + 1 = _____

With 7 friends: _____ = _____

💬 **TALK ABOUT IT**

Why does the first person shake 4 hands but the last person shake none that are new?

Where else have you seen the numbers 1, 3, 6, 10, 15? What do they have to do with triangles?



STUCK? TRY THIS

Go around the circle in order. Person A shakes everyone. Then person B shakes everyone **except A**, because that handshake already happened. Keep going.

★ **CHALLENGE ZONE**

A class of 10 students all shake hands. How many handshakes? You can build it from your table instead of drawing 45 lines.

Now suppose every person waves at every other person, and a wave only goes one way. Would there be more waves than handshakes? How many more?

Detective Week

Everything from the first twelve weeks, in one case file.

IN CLASS THIS WEEK
Review · reasoning and explaining (Mathematical Practices)

NUMBER WARM-UP · 2 MINUTES
Name an even number bigger than 40. Now an odd one smaller than 10.

Ana, Ben, Cruz, and Dee each have **one** pet, and no two have the same pet. Use the clues. Write ✗ when you know it is *not* that pet, and ✓ when you are sure.

Clues

1. Ana has neither the dog nor the rabbit.
2. Cruz has a pet that lives in water.
3. Dee has a pet that hops.

	Cat	Dog	Fish	Rabbit
Ana				
Ben				
Cruz				
Dee				

Ana: _____ Ben: _____ Cruz: _____ Dee: _____

Four quick cases. Each one is from a week you have already done.

Case 1 (Week 1). Follow the rule: 20, 30, 60, 90. Do not: 21, 34, 65, 99. The rule is _____

Case 2 (Week 3). Is 23 + 23 even or odd? _____ Say why *before* you add.

_____

Case 3 (Week 6). A machine turns 6 into 3, 10 into 5, and 18 into 9. The rule is _____ So 40 becomes _____

Case 4 (Week 8). Your partner picks a number from 1 to 16. What is your **first** question?

_____

💬 **TALK ABOUT IT**

Which clue in the pet puzzle did you use first, and why did that one help most?

Which kind of puzzle from the last twelve weeks did you like best? What made it good?



STUCK? TRY THIS

In a logic grid, one ✓ lets you fill a whole row and a whole column with ✗ marks. Do that every time before looking for your next clue.

★ **CHALLENGE ZONE**

Take one clue away from the pet puzzle. Can it still be solved? Try removing each one and see.

Write your own logic puzzle with three people and three pets. Give it to a partner, then check that it has exactly one answer.

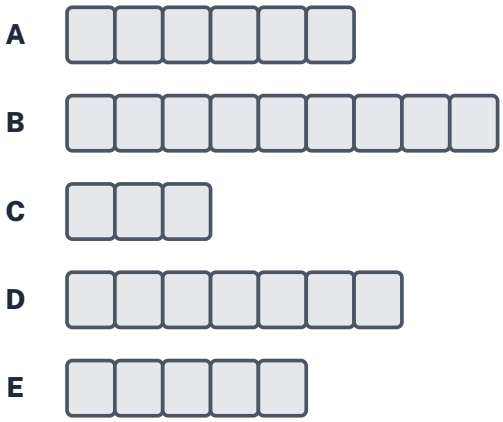
Sorting by Length

The same method as Week 7, on something that is not a number.

IN CLASS THIS WEEK
Measuring length in units; comparing lengths (2.MD.1, 2.MD.4)

NUMBER WARM-UP · 2 MINUTES
Which is longer, 8 units or 5 units? How much longer?

Each strip is built from equal-size units. Count the units in each strip and write the number at the end of the bar.



Now sort them, shortest to longest, using Method 1 from Week 7.

Find the shortest strip. Write its letter in box 1. Cross it off. Find the shortest of what is left. Keep going.

1	2	3	4	5

Compare the strips.

1. How much longer is **B** than **C**? _____ units
2. How much longer is **D** than **E**? _____ units
3. If you laid **C** and **E** end to end, how long would they be? _____ units
4. Which two strips together are exactly as long as **B** plus **C**? _____

Sorting without measuring.

Imagine you have no ruler. You can only hold two strips side by side and see which is longer. Could you still put all five in order? _____ How many times would you have to compare?

_____

💬 **TALK ABOUT IT**

You used the same method as Week 7, but on lengths instead of numbers. What stayed exactly the same? What changed?

Does it matter whether you start from the shortest or the longest? Try it the other way.



STUCK? TRY THIS

Count the units carefully, do not judge by eye. Then treat the counts exactly like the number cards from Week 7.

★ **CHALLENGE ZONE**

Put the strips in order by length **without writing any numbers down**, only by comparing two at a time. Keep a tally of how many comparisons you needed.

Could two different strips ever be the same length and still be different strips? What would that do to your sorted list?

Covering a Strip

Two tile shapes. Surprisingly many ways.

IN CLASS THIS WEEK
Measuring with same-size units; length as repeated units (2.MD.1)

NUMBER WARM-UP · 2 MINUTES
How many 2s make 6? How many 2s make 10?

You have **short tiles** (1 unit) and **long tiles** (2 units). You want to cover a strip completely, with no gaps and no overlaps. How many different ways are there?

A strip 1 unit long



only 1 way: one short tile

1 way

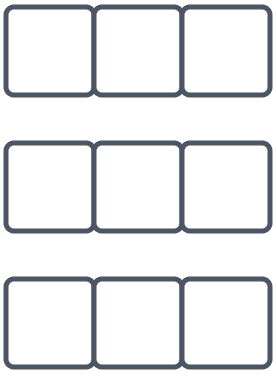
A strip 2 units long



short + short or one long tile

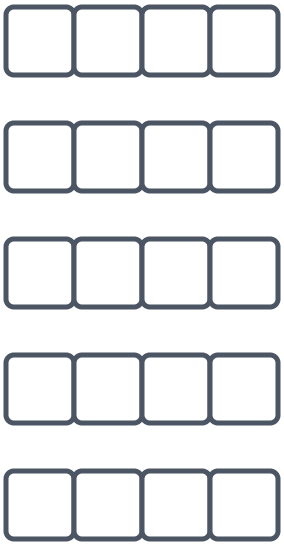
2 ways

A strip 3 units long. Draw every way you can find.



You found _____ ways.

A strip 4 units long. Draw every way.



You found _____ ways.

Now look at your answers so far.

Strip length	1	2	3	4	5	6
How many ways?	1	2				

Can you fill in 5 and 6 **without drawing them**?

_____

TALK ABOUT IT

Look at 1, 2, 3, 5. How do you get the next number from the two before it?

A strip of length 5 either starts with a short tile or a long tile. How does that explain the adding pattern?



STUCK? TRY THIS

Be organized. First draw every way that **starts with a short tile**, then every way that **starts with a long tile**. That way you cannot miss one or repeat one.

★ CHALLENGE ZONE

How many ways for a strip 7 units long? Use the pattern, not drawing.

What if you also had a 3-unit tile? Redo strips of length 1, 2, 3, and 4. Does the pattern still add the two before?

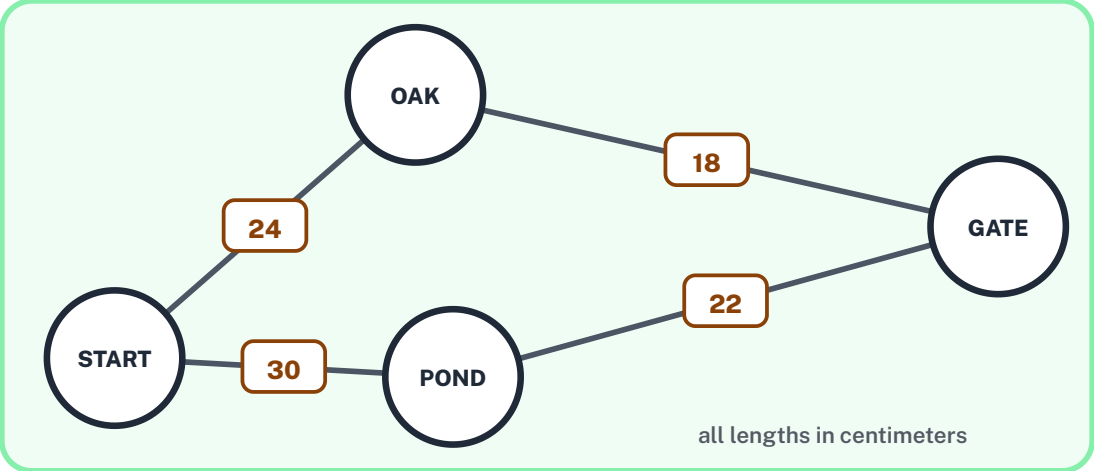
Two Ways Across the Park

Adding lengths to compare whole routes.

IN CLASS THIS WEEK
Adding lengths; using a number line (2.MD.5, 2.MD.6)

NUMBER WARM-UP · 2 MINUTES
24 + 18 = ? 30 + 22 = ? Which answer is bigger?

Two paths lead from the **START** to the **GATE**. Each part is marked with its length in centimeters. Which whole path is shorter?



Path 1 (through OAK): _____ + _____ = _____ cm

Path 2 (through POND): _____ + _____ = _____ cm

The shorter path is _____ and it is _____ cm shorter.

Show Path 1 on the number line. Start at 0 and make one jump for each part.



Now show Path 2 with a different colored pencil. Which one lands farther to the right?

_____

More lengths to compare.

1. A red ribbon is 45 cm. A blue ribbon is 28 cm. How much longer is the red one? _____ cm
2. Two sticks, 34 cm and 29 cm, laid end to end. How long? _____ cm
3. A path is 80 cm. You have walked 55 cm. How much is left? _____ cm

💬 **TALK ABOUT IT**

How is this the same as the treasure map in Week 9? How is it different?

Why does a path with more turns in it not have to be longer?



STUCK? TRY THIS

Write each path as an addition problem **before** you add anything. Then you are just comparing two totals.

★ **CHALLENGE ZONE**

Using only the four lengths on the map (24, 18, 30, 22), can you pick some that add to exactly **72**? Which ones?

If the park builders could shorten **one** part of the map, which one should they pick to help walkers most? Explain your choice.

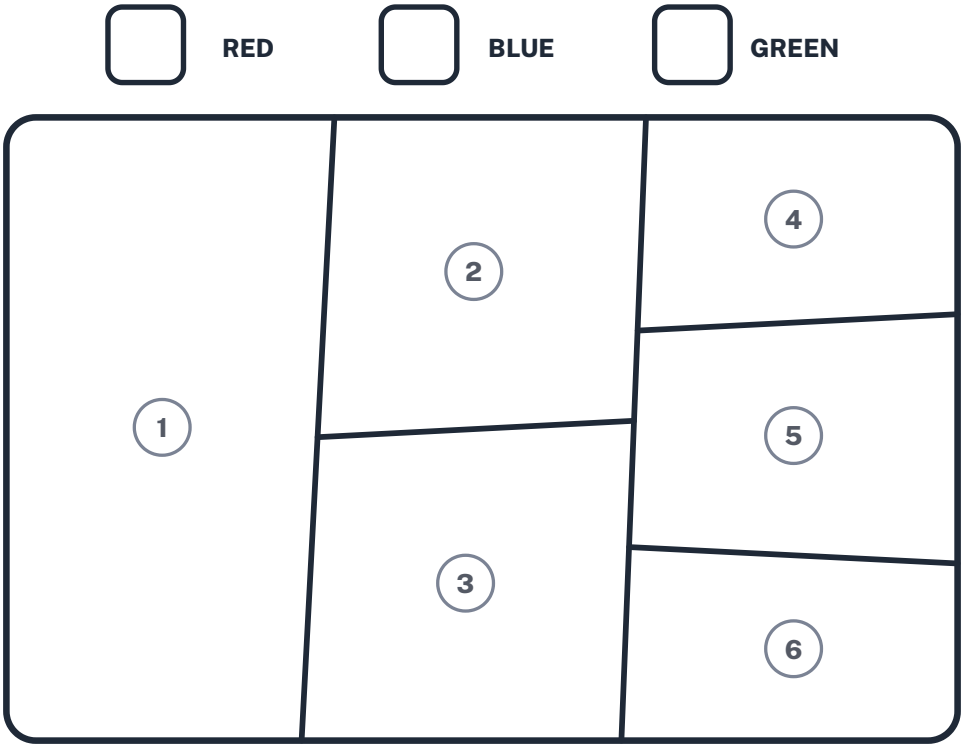
Color the Kingdom

Neighbors must never match.

IN CLASS THIS WEEK
Shapes and their attributes; sides and corners (2.G.1)

NUMBER WARM-UP · 2 MINUTES
Name three numbers between 30 and 40. Which of them are even?

Color every region of the map. **The rule:** two regions that share a border (a whole edge, not just a single corner) may **not** be the same color. Try to use only **3 colors**.



1. How many colors did you use? _____

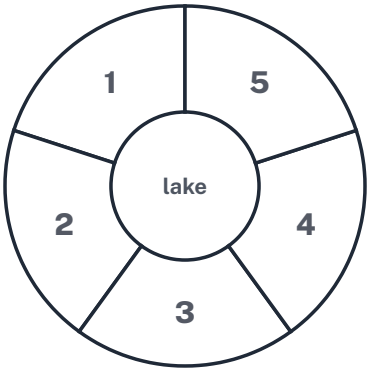
2. Now try with only **2** colors. What goes wrong?

_____

3. Find three regions that **all touch each other**. Write their numbers: _____

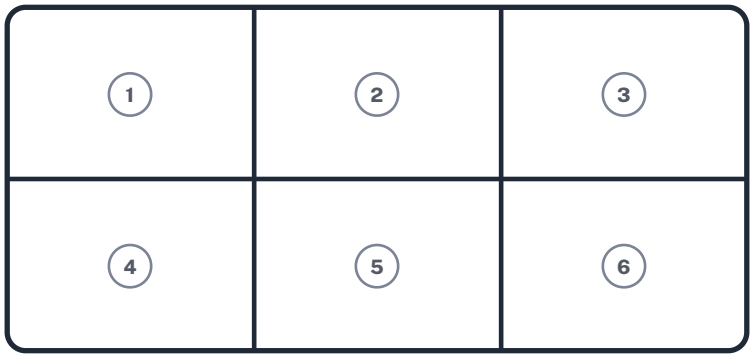
Two more maps. Color each one with as few colors as you can.

Map B, five regions in a ring around a lake (leave the lake uncolored)



Fewest colors: _____

Map C



Fewest colors: _____

TALK ABOUT IT

Map B has five regions and Map C has six. Why does Map B need more colors, even though it has fewer regions?

What has to be true about a map for two colors to be enough?



STUCK? TRY THIS

Start with the region that touches the **most** neighbors. Give it a color, then work outward. If you get stuck, back up and change one color rather than starting over.

★ CHALLENGE ZONE

On the first map, regions 1 and 4 do not touch. Could they be the same color? Try a coloring where they are and one where they are not. Do both work?

Change Map B to a ring of **six** regions. Now how many colors do you need? What is it about the number of regions in the ring that matters?

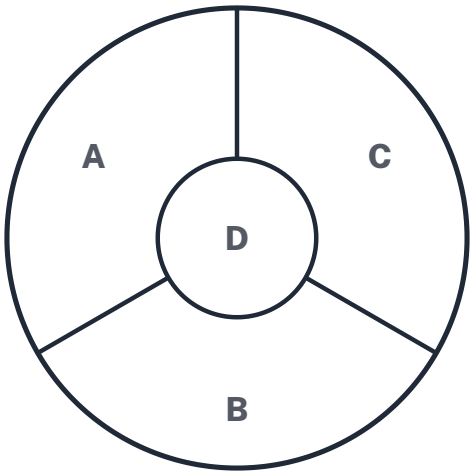
When Three Colors Is Not Enough

A puzzle that took mathematicians 124 years.

IN CLASS THIS WEEK
Shape attributes; reasoning about why something is impossible (2.G.1)

NUMBER WARM-UP · 2 MINUTES
4 + 4 = ? 40 + 40 = ? 44 + 44 = ?

This map has four regions: three big wedges and a small circle in the middle. First try to color it with only **3** colors. Then try again with 4.



1. Does 3 colors work? _____ Which region gets stuck? _____

2. Why is this map harder than last week's?

_____

3. What is the fewest number of colors that works? _____

A true story

In **1852** a young man coloring a map asked a simple question: is **4 colors always enough** for any flat map, no matter how wiggly? Grown-up mathematicians could not prove it for **124 years**. In **1976** two mathematicians finally proved yes, and they needed a computer to check more than a thousand special cases. It was the first famous proof a computer helped with.

Draw your own map that needs exactly 4 colors.

Hint: you need four regions where **every** region touches all three of the others. Test it by trying 3 colors first and getting stuck.

💬 **TALK ABOUT IT**

Three regions that all touch each other need 3 colors. What do you need for 4?

Why is being **stuck** different from just not having found the answer yet?



STUCK? TRY THIS

Color the three wedges first. Once all three colors are used up, look at the middle circle and ask what is left for it.

★ **CHALLENGE ZONE**

Can you draw a flat map that needs **5** colors? Go ahead and try hard. You will not manage it, and that is exactly what the 1976 proof says.

What if the map were drawn on a doughnut instead of a flat page? Mathematicians know the answer there is 7. Why might a doughnut be harder?

How Many Ways to Make 15¢?

Counting every answer without missing one.

IN CLASS THIS WEEK
Money: pennies, nickels, dimes, and quarters (2.MD.8)

NUMBER WARM-UP · 2 MINUTES
How many pennies in a nickel? In a dime? How many nickels in a dime?

You have pennies (1¢), nickels (5¢), and dimes (10¢), as many as you want. How many **different** ways can you make exactly **15¢**?



Be organized: start with the most dimes, then work down.

Dimes	Nickels	Pennies	Adds up to
1	1	0	10 + 5 = 15¢
1	0		
0	3		
0			
0			
0			

There are _____ ways in all.

Now make 20¢. Same three coins. Fill in every way.

Dimes	Nickels	Pennies
2		

There are _____ ways in all.

💬 **TALK ABOUT IT**

Why does starting with the most dimes and working down make sure you miss nothing?

Which amount had more ways, 15¢ or 20¢? Why does a bigger amount usually have more ways?



STUCK? TRY THIS

Once you choose how many dimes and how many nickels, the pennies are **forced**, they just fill in the rest. So you only really have two choices to make.

★ **CHALLENGE ZONE**

How many ways to make **25¢** with pennies, nickels, and dimes? Use the same organized table. (There are more than ten.)

Now allow a quarter too. How many ways to make 25¢ now? What is the only new way a quarter gives you?

WEEK 20 MONEY & TIME

The Fewest Coins

A rule so simple a machine could follow it. Usually.

IN CLASS THIS WEEK
Money: solving word problems with coins (2.MD.8)

NUMBER WARM-UP · 2 MINUTES
25 + 25 = ? 25 + 25 + 10 = ? 60 + 10 + 5 = ?

A vending machine gives change using the **fewest coins possible**. Its rule is simple: **always take the biggest coin that still fits**, then repeat.



Follow the machine's rule for 68¢.

Biggest coin that fits in 68¢: a quarter. 68 − 25 = _____

Biggest that fits now: _____. Left over: _____

Keep going until nothing is left.

68¢ needs _____ coins in all.

Make each amount with the fewest coins. Write how many of each.

	25¢	10¢	5¢	1¢
47¢				
93¢				
36¢				
80¢				

1. Which amount needed the **most** coins? _____

2. Could you make 36¢ a different way? _____ Would it use more coins or fewer?

_____

💬 **TALK ABOUT IT**

Why does taking the biggest coin first give the fewest coins with our money?

The machine never has to think ahead or go back. Why does that make it a good rule for a machine?



STUCK? TRY THIS

After each coin, work out what is **left over** and write it down. Then start again with the leftover amount as if it were a brand new problem.

★ **CHALLENGE ZONE**

Imagine a country with only **1¢, 7¢, and 10¢** coins. Follow the machine's rule to make 14¢. How many coins does it use?

Now find the **real** best way to make 14¢ in that country. The simple rule failed! Why does it work with our coins but not with theirs?

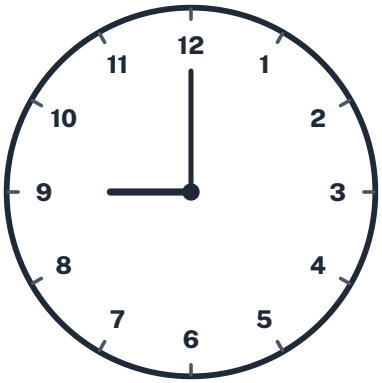
Clock Arithmetic

On a clock, numbers wrap around.

IN CLASS THIS WEEK
Telling and writing time to the nearest five minutes (2.MD.7)

NUMBER WARM-UP · 2 MINUTES
Count by 5s around a clock: 5, 10, 15… all the way to 60.

A clock only has the numbers 1 to 12. When you count past 12, you do not get 13, you wrap back around to 1.



It is 9 o'clock now. Draw the new hour hand for each answer.

5 hours later it will be _____ o'clock

8 hours later it will be _____ o'clock

12 hours later it will be _____ o'clock

3 hours **earlier** it was _____ o'clock

Fill in the table.

Start	Hours later	New time
11 o'clock	4	
7 o'clock	8	
10 o'clock	5	
6 o'clock	12	
2 o'clock	11	

Minutes wrap too. There are 60 minutes in an hour.

1. It is 10:40. In 25 minutes it will be _____
2. It is 3:50. In 15 minutes it will be _____
3. It is 8:05. It was _____ ten minutes ago.

💬 **TALK ABOUT IT**

On a clock, 12 + 3 gives 3. In normal arithmetic that would be wrong. Why is it right here?

Adding 12 hours always lands you back where you started. Why?



STUCK? TRY THIS

Put your finger on the starting hour and **walk it around the clock**, counting out loud. When you pass 12, keep going at 1.

★ **CHALLENGE ZONE**

What hour will it be **100 hours** after 3 o'clock? Hint: every 12 hours brings you back to 3, so count by 12s first and see what is left over.

Days of the week wrap too, with 7 instead of 12. If today is Tuesday, what day is it in 30 days?

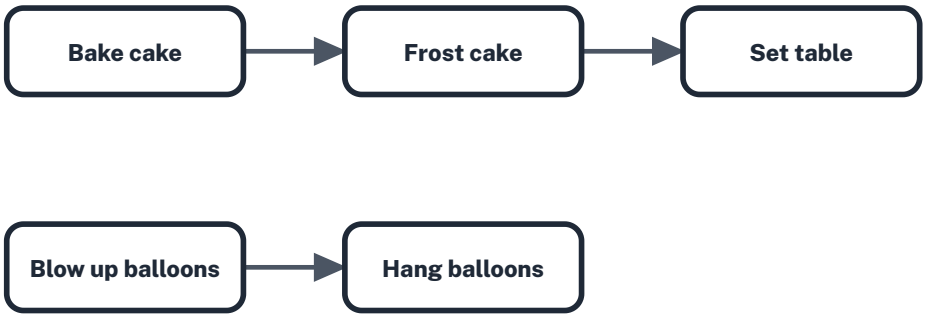
Getting Ready for the Party

Some jobs have to wait for others.

IN CLASS THIS WEEK
Telling time and the order of events (2.MD.7)

NUMBER WARM-UP · 2 MINUTES
If something takes 15 minutes and something else takes 20, how long are both together?

Five jobs must be done before the party. An arrow means **this job must be finished before that one can start**. Jobs with no arrow between them can be done in any order.



1. Which job could you do **first**? There is more than one right answer. _____

2. Write one order that works, all five jobs:

_____ _____ _____ _____ _____

Now with a helper.

You and a friend work at the same time. Which two jobs could be happening **at the same moment**?

_____ and _____

Which two jobs could **never** happen at the same moment, no matter how many helpers you have? _____

Each job takes 10 minutes.

1. Working alone, how long to do all five? _____ minutes

2. With one helper, what is the fastest you could possibly finish? _____ minutes. Explain why you cannot go any faster.

_____

💬 **TALK ABOUT IT**

What is the difference between a job that **must** come before another and one that just **happens** to come first?

Find the longest chain of arrows. Why does that chain decide how fast you can possibly finish?



STUCK? TRY THIS

Cover up the arrows and ask about one job at a time: *what has to be done before I can start this?* If the answer is nothing, it can go first.

★ **CHALLENGE ZONE**

How many different orders work for all five jobs? Try to list them in an organized way. (There are more than five.)

Add a new job: **Buy candles**, which must be done before **Frost cake**. Does the fastest finishing time change?

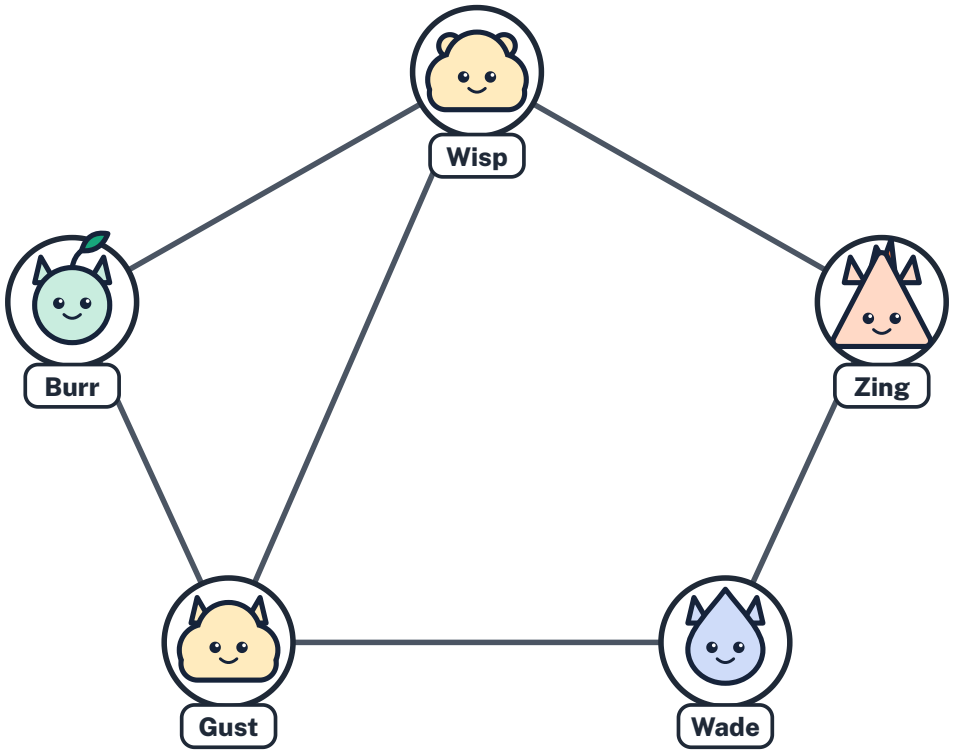
Dots and Lines

A picture of who is connected to whom.

IN CLASS THIS WEEK
Drawing and reading picture graphs and bar graphs (2.MD.10)

NUMBER WARM-UP · 2 MINUTES
Count on from 4 up to 12. How many numbers did you say?

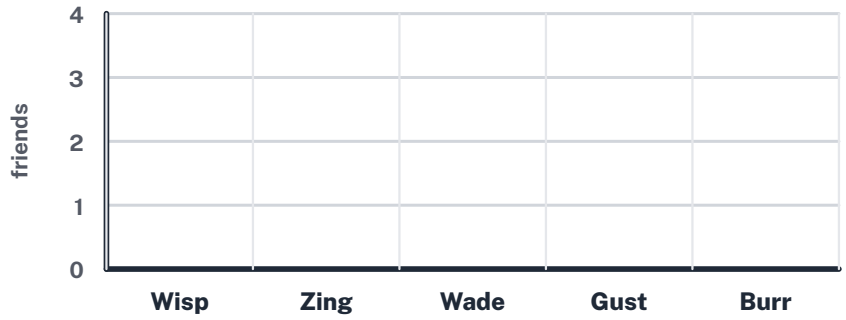
Each critter is a dot. Each line means those two critters are friends. In mathematics a dot like this is called a **vertex** and a line is called an **edge**.



Critter	Friends
Wisp	
Zing	
Wade	
Gust	
Burr	

1. Most friends? _____
2. Fewest friends? _____
3. How many **lines** in all? _____
4. Add up your whole Friends column. _____

Turn your table into a bar graph. Shade one square for each friend.



1. Which bars are the same height? _____

2. How many more friends does Wisp have than Zing? _____

3. Look back at questions 3 and 4 on page 1. One answer is exactly double the other. Why?

_____

TALK ABOUT IT

Every line touches exactly two dots. Use that to explain the doubling you found.

Wisp wants to pass a note to Wade, but notes only pass between friends. What is the fewest hand-offs? Trace it with your finger.



STUCK? TRY THIS

Count carefully by putting your pencil **on** a dot and following each line out of it one at a time. Make a tally mark for each line before you write the number.

★ CHALLENGE ZONE

Draw your own graph with 5 dots where **every** dot has exactly 2 lines.

Now try to draw one where every dot has exactly **3** lines. It is impossible. Use your doubling rule to explain why. (What would the column total have to be?)

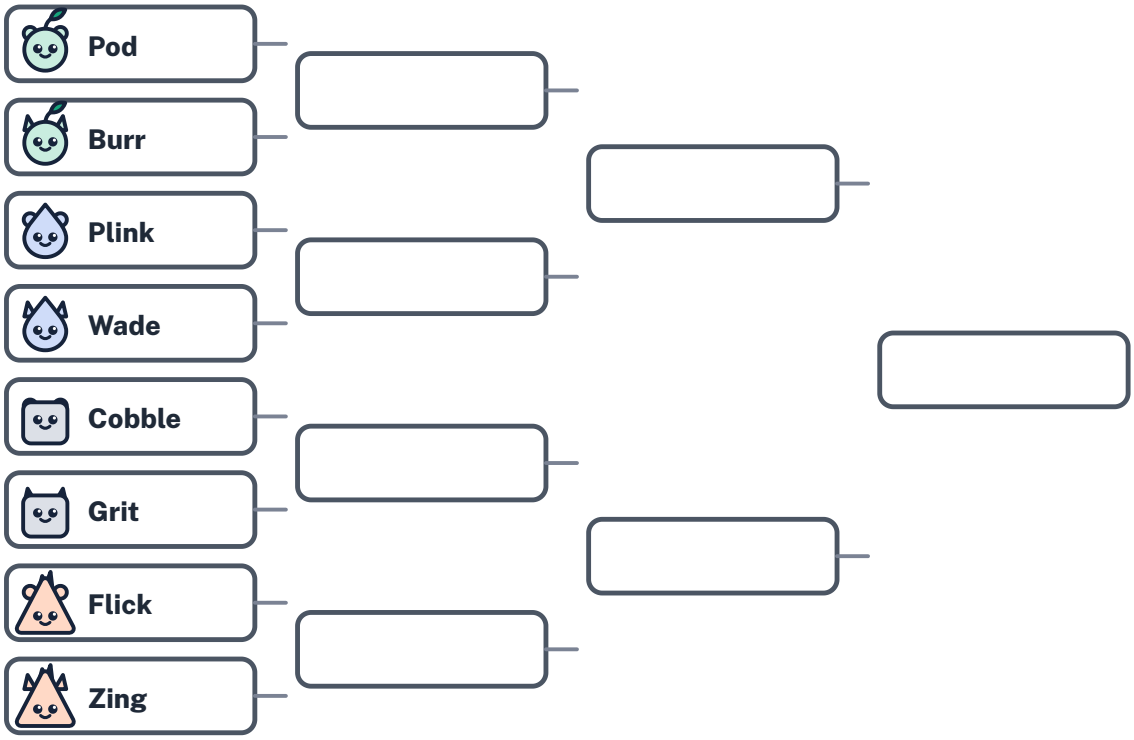
Who Wins the Tournament?

Counting games without drawing every one.

IN CLASS THIS WEEK
Reading and comparing data; adding and subtracting (2.MD.10, 2.NBT.5)

NUMBER WARM-UP · 2 MINUTES
8 − 1 = ? 16 − 1 = ? 100 − 1 = ?

Eight critters play a knockout tournament. Lose one matchup and you are out. Fill in the bracket with any winners you like, all the way to the champion.



1. Games in round 1: _____ Round 2: _____ Round 3: _____

2. Games in all: _____

Try other tournament sizes.

Teams	2	4	8	16	32
Games to find a winner	1				
Rounds	1		3		

The quick way to count.

Every game knocks out exactly **one** team. To find a single champion out of 8 teams, how many teams have to be knocked out? _____

So the number of games is always _____

💬 **TALK ABOUT IT**

Why is the number of games always one less than the number of teams?

The number of **rounds** grows much more slowly than the number of teams. Where did you see that same slow growth before? (Look back at Week 8.)



STUCK? TRY THIS

You do not have to fill in the whole bracket to count. Just count the little boxes in each column, each box is one game.

★ **CHALLENGE ZONE**

A tournament has **100** teams (some get a bye and skip round 1). How many games are played in all? You can answer without drawing anything.

How many rounds would 64 teams need? What about 128? Each time the teams double, what happens to the rounds?

WEEK 25 SORTING & LOGIC

Puzzle Fair

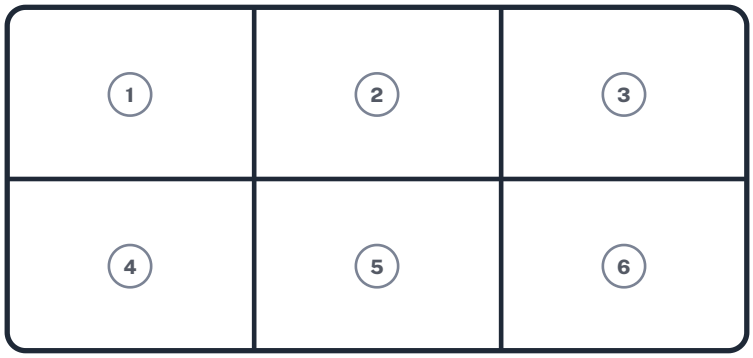
A little of everything from Weeks 14 to 24.

IN CLASS THIS WEEK
Review · explaining your reasoning (Mathematical Practices)

NUMBER WARM-UP · 2 MINUTES
25 + 25 + 10 = ? What time is 4 hours after 10 o'clock?

Five stations. Do them in any order, but write down **why**, not just what.

① Station 1, Color the map with as few colors as you can.



Colors used: _____

② Station 2, Fewest coins

Make **57¢** with the fewest coins. Quarters: _____ Dimes: _____ Nickels: _____
Pennies: _____ Total coins: _____

③ Station 3, Clock wrap

It is 8 o'clock. What time is it 7 hours later? _____

What time was it 10 hours **earlier**? _____

④ Station 4, Tournament

A tournament has 16 teams. Games played: _____ Rounds: _____

How do you know without drawing the bracket?

_____

⑤ Station 5, Your turn

Write a puzzle of your own, from any week so far. Then write the answer upside down at the bottom so a partner can check.

TALK ABOUT IT

Which of these five stations was hardest? What made it hard, the numbers, or the thinking?

Pick one station and explain your answer to a partner without showing them your paper.



STUCK? TRY THIS

If a station stumps you, go back to the week it came from and reread the first page. Everything you need is there.

★ CHALLENGE ZONE

Make Station 1 harder: redraw the map so that it **needs** three colors. What did you have to add?

In Station 2, is there any amount under a dollar that needs **more** than 9 coins? Hunt for the worst one.

Trace It Without Lifting

An old puzzle with a beautiful rule hiding inside.

IN CLASS THIS WEEK
Odd and even numbers, used as a tool (2.OA.3)

NUMBER WARM-UP · 2 MINUTES
Circle the odd ones: 1 2 3 4 5 6 7 8. How did you decide?

The challenge: trace each figure with one pencil stroke. You may not lift your pencil, and you may not go over the same line twice. (Crossing at a dot is fine.)

Before you try: count the lines meeting at each dot and write the number right there. Then circle every dot with an **odd** number.

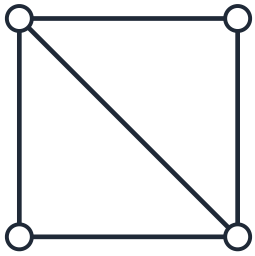


Figure A

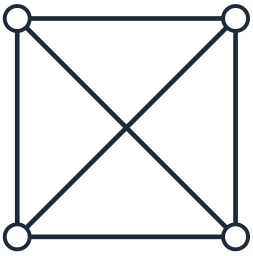


Figure B

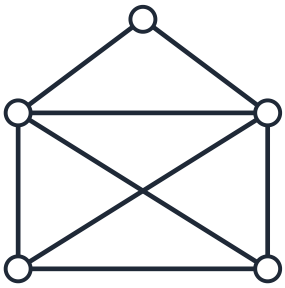


Figure C

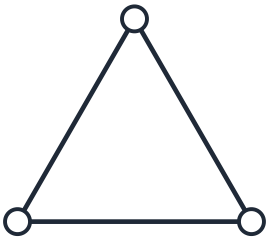


Figure D

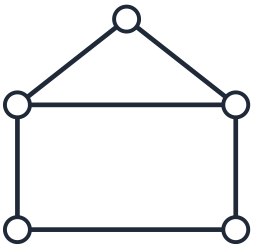


Figure E

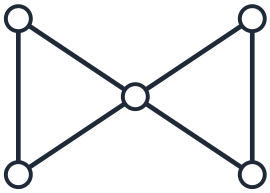


Figure F

Figure	A	B	C	D	E	F
How many odd dots?						
Can you trace it?						

The rule you just discovered

A figure can be traced when it has _____ or _____ odd dots. Any other number and it is impossible.

When there are exactly 2 odd dots, where do you have to **start**? _____

Why the rule works

Every time you pass **through** a dot you use up two lines, one to come in, one to go out. So a dot in the middle of your journey always uses lines in pairs. Which means an odd dot can only be the _____ or the _____ of your trip.

Test the rule on a new figure. Draw a shape, count its odd dots, predict, then try.

TALK ABOUT IT

Why can a figure never have exactly **one** odd dot? Try to draw one and see what happens.

Figure D has zero odd dots. What is special about where you finish?



STUCK? TRY THIS

Write the number right next to each dot before you try tracing anything. The counting is the actual mathematics; the tracing just checks it.

★ CHALLENGE ZONE

In an old city there were 4 pieces of land joined by 7 bridges, and every piece of land had an **odd** number of bridges. People wanted a walk crossing every bridge exactly once. Use your rule: possible or impossible?

Take Figure B, the one that fails. **Erase one line** so that it becomes traceable. Which line, and what happened to the odd dots?

WEEK 27 PATHS & ROUTES

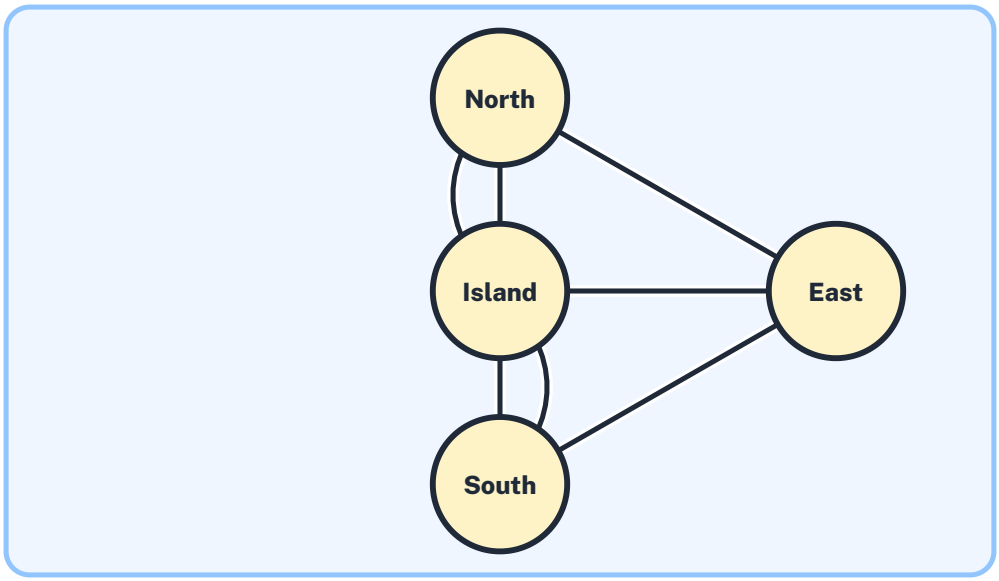
The Bridges of the Old City

A walk that was never possible, and the proof.

IN CLASS THIS WEEK
Adding within 1000 (2.NBT.7) · odd and even as a tool

NUMBER WARM-UP · 2 MINUTES
3 + 3 + 5 + 3 = ? Is your answer odd or even?

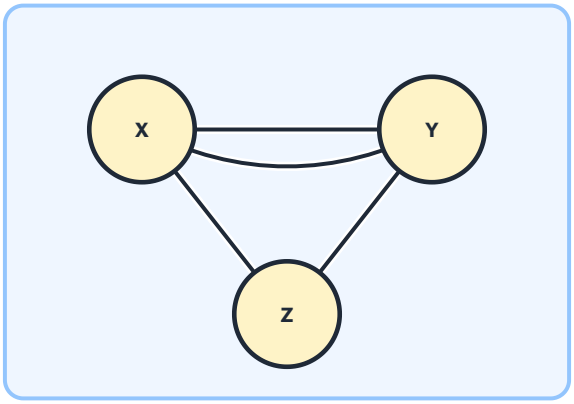
This is a real place. Four pieces of land, seven bridges. For years people tried to find a walk that crossed **every bridge exactly once**. Nobody ever managed it.



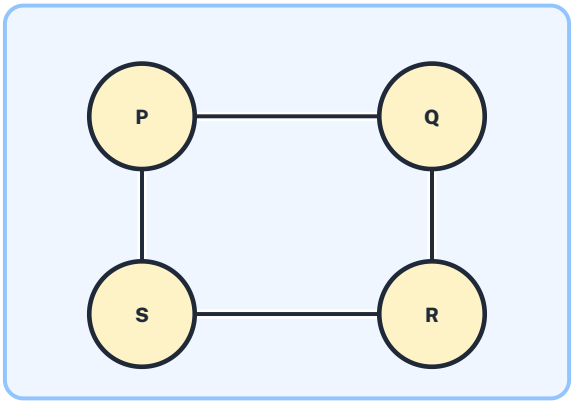
1. Count the bridges at each piece of land. North _____ South _____ Island _____ East _____
2. How many of those are **odd**? _____
3. Use last week's rule. Is the walk possible? _____ How do you know?

_____

Two more island maps. Count bridges, then predict.



Odd islands: _____ Walk possible? _____



Odd islands: _____ Walk possible? _____ Do you end where you started? _____

TALK ABOUT IT

In 1736 a mathematician named Euler proved the old city walk was impossible. Why is proving something impossible more useful than just failing to find it?

Adding one more bridge could make the walk possible. Where would you build it, and why there?



STUCK? TRY THIS

Count the bridges touching each island out loud, pointing at each one. Double bridges are easy to miss, they count as two.

★ CHALLENGE ZONE

Design your own island map where a bridge walk **is** possible and you finish back where you started. What has to be true about every island?

Design one where the walk is possible but you must finish somewhere **else**. How many odd islands does yours have?

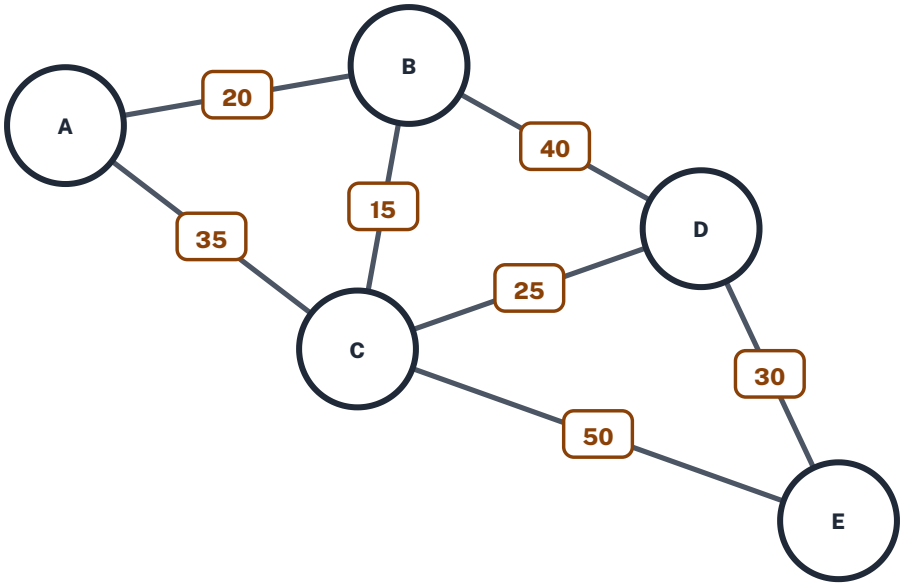
Connecting the Towns

Every town joined, for the smallest possible cost.

IN CLASS THIS WEEK
Adding and subtracting within 1000 (2.NBT.7)

NUMBER WARM-UP · 2 MINUTES
15 + 20 = ? 35 + 25 = ? 60 + 30 = ?

Five towns want to be connected by roads. The number on each line is what that road would **cost**. You do not need every road, you only need to be able to get from any town to any other, even if you pass through a town on the way.



Build the cheapest set of roads.

Go one at a time. Each turn, pick the **cheapest road left**, but skip it if both of its towns are already connected to each other some other way.

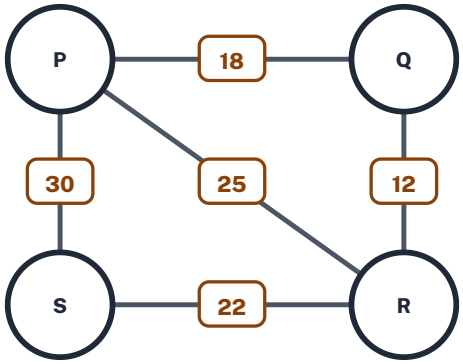
Roads I built: _____ _____ _____ _____

Total cost: _____

Check your work.

1. How many roads did you build? _____
2. Can you get from **A** to **E** using only your roads? Trace it. _____
3. Is there any road you could remove and still connect every town? _____

A smaller version. Four towns, five possible roads.



Cheapest total: _____ Roads used: _____

💬 **TALK ABOUT IT**

You needed exactly 4 roads for 5 towns. Why not 3? Why not 5?

What would go wrong if you built a road that made a **loop**? Is the loop useful?



STUCK? TRY THIS

List all the roads in order from cheapest to most expensive first. Then work down the list, asking each time: *are these two towns already joined?*

★ **CHALLENGE ZONE**

The road you paid the most for gets washed out. What is the cheapest way to reconnect everything now?

Would picking the **most expensive** road each time and skipping loops also connect every town? Try it. Does it cost more?

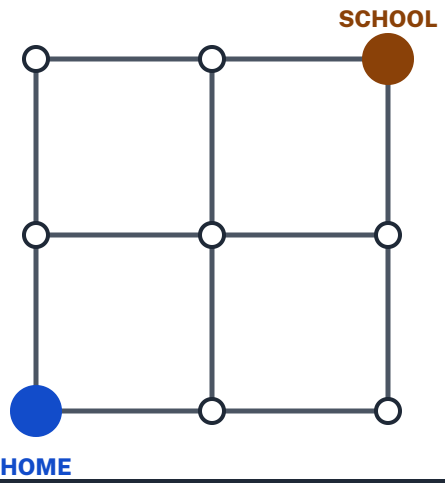
Counting Routes

How many ways to walk to school?

IN CLASS THIS WEEK
Adding within 1000; addition patterns (2.NBT.7, 2.OA.4)

NUMBER WARM-UP · 2 MINUTES
1 + 1 = ? 1 + 2 = ? 2 + 3 = ? 3 + 3 = ?

You start at **HOME** and walk to **SCHOOL**. You may only walk **right** or **up**, never back down or left. How many different routes are there?

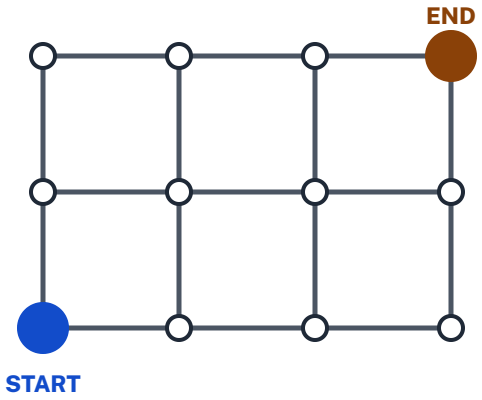


The counting trick

Write a number at every corner: **how many ways can you reach that corner?** Every corner on the bottom row and the left side has only **1** way. For every other corner, add the number below it and the number to its left.

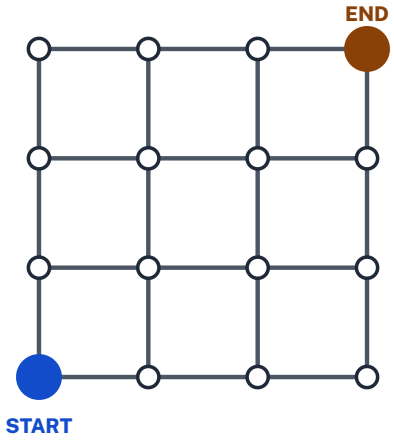
Write your numbers on the dots above. The number at SCHOOL is the answer: _____

A bigger grid: 3 blocks across, 2 up.



Routes: _____

And a square grid: 3 across, 3 up.



Routes: _____

💬 TALK ABOUT IT

Why does adding the two numbers give the number of ways to reach the next corner?

Every route from HOME to SCHOOL on the first grid uses exactly 4 steps. Why is that always true?



STUCK? TRY THIS

Do the corners in order: finish the whole bottom row first, then the row above it, then the row above that. Never skip ahead.

★ CHALLENGE ZONE

On a 4-across, 4-up grid, how many routes? Fill in the corners, you never have to draw a single route.

Go back to the first grid and **block off** the middle corner (a puddle). How many routes are left? Which numbers change?

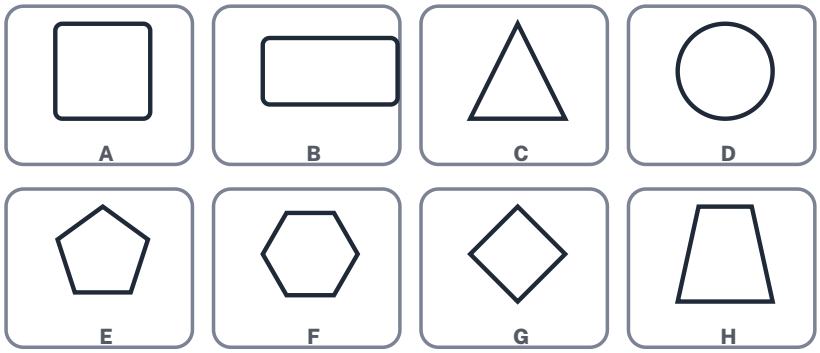
Guess My Shape

The Week 8 game, played with shapes.

IN CLASS THIS WEEK
Recognizing shapes by their attributes: sides and corners (2.G.1)

NUMBER WARM-UP · 2 MINUTES
How many sides does a triangle have? A hexagon? A circle?

I am thinking of one of these eight shapes. You may only ask questions I can answer **yes** or **no**, and they must be about the shape, not its name. Cross off the shapes your answer rules out.



A first question that works well: *Does it have exactly 4 sides?*

If the answer is **YES**, which shapes are left? _____

If the answer is **NO**, which are left? _____

Play it. Your partner picks a shape and only says yes or no.

Your question	Answer	Shapes still possible

1. How many questions did you need? _____

2. Why is *"Is it the circle?"* usually a weak first question?

_____

3. Write a question of your own. How many shapes does a YES leave, and how many does a NO leave? _____

TALK ABOUT IT

A good question splits the shapes as evenly as it can. Why does that finish the game faster?

Some questions are about **sides**, some about **corners**, some about **size**. Which kind was most useful?



STUCK? TRY THIS

After every answer, actually cross the ruled-out shapes off with your pencil. Seeing the group shrink is what tells you what to ask next.

★ CHALLENGE ZONE

Playing the best way, what is the **most** questions you would ever need for 8 shapes? How does that compare to your answer in Week 8 for 16 numbers?

If I drew 16 shapes instead of 8, how many questions would you need? What if I drew 32?

WEEK 31 SHAPES & PARTS

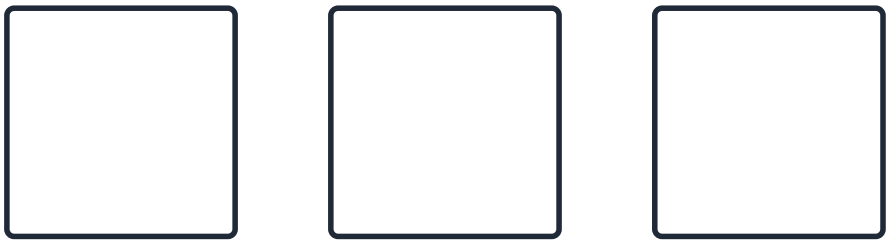
Cutting Fair Shares

Equal parts do not have to look the same.

IN CLASS THIS WEEK
Partitioning shapes into halves, thirds, and fourths (2.G.3)

NUMBER WARM-UP · 2 MINUTES
If you cut a sandwich into 4 equal pieces, what is each piece called?

Cut each square into **4 equal parts**, and make each square different from the others. Every part must be exactly the same size as the other parts in its square.



1. Did all three of your ways make parts of the same size? _____

2. Two of your fourths might be different **shapes**. Can they still be the same amount? _____ Explain.

_____

Now cut these. Label one part in each with its fraction name.



Left circle: **halves** · Rectangle: **thirds** · Right circle: **fourths**

Fair or not fair?

1. A pizza is cut into 4 pieces, but one is much bigger. Are those fourths? _____ Why?

_____

2. Which is bigger, one half of a sandwich or one fourth of the **same** sandwich?

_____

💬 **TALK ABOUT IT**

Two fourths of the same square can look completely different and still be equal. How?

The more parts you cut something into, the smaller each part gets. Why does that feel backwards when the number is getting bigger?



STUCK? TRY THIS

Fold, do not just draw. If you fold a paper square in half and in half again, the creases show you fourths that must be equal.

★ **CHALLENGE ZONE**

Cut a square into 4 equal parts where **none** of the parts is a square or a rectangle. (Try lines from the center to the corners.)

Cut a square into 4 equal parts where all four parts are the same shape as each other, and each one is a tiny copy of the whole square.

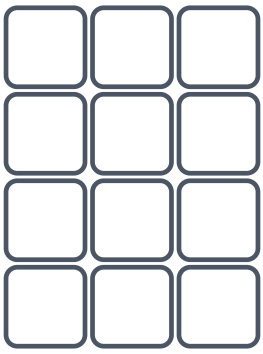
Filling a Rectangle

Rows and columns give the same total.

IN CLASS THIS WEEK
Partitioning a rectangle into rows and columns of same-size squares (2.G.2)

NUMBER WARM-UP · 2 MINUTES
3 + 3 + 3 + 3 = ? 4 + 4 + 4 + 4 = ? Why are they the same?

This rectangle is filled with same-size squares. Count them two different ways: once by rows, once by columns.



1. Rows: _____ Squares in each row: _____
2. Counting by rows: _____ + _____ + _____ + _____ = _____
3. Counting by columns: _____ + _____ + _____ = _____ Same answer? _____

Two more rectangles. Write both addition sentences for each.



Rows: _____
Columns: _____



Rows: _____
Columns: _____

Draw a rectangle with exactly 8 squares.

Is there more than one way? Draw two different ones.

TALK ABOUT IT

Why do rows and columns always give the same total, no matter which rectangle you pick?

Which is easier for you, counting by rows or by columns? Does it change with the shape?



STUCK? TRY THIS

Count one full row, then count how many rows there are. That is all you need, you never have to count the squares one at a time.

★ CHALLENGE ZONE

Which rectangles can you make with exactly **12** squares? Find all of them. (There are more than two.)

Which number of squares between 1 and 20 gives you the **most** different rectangles? Which numbers give you only one?

WEEK 33 COUNTING CAREFULLY

The Ice Cream Shop

Counting every choice, without missing one.

IN CLASS THIS WEEK
Using addition to find the total in a rectangular array (2.OA.4)

NUMBER WARM-UP · 2 MINUTES
2 groups of 3 is how many? 3 groups of 2 is how many? Are they the same?

You have **2 flavors**, Vanilla and Chocolate, and **3 toppings**, Sprinkles, Fudge, and Cherry. Every bowl gets one flavor and one topping. List **every** bowl you could make.

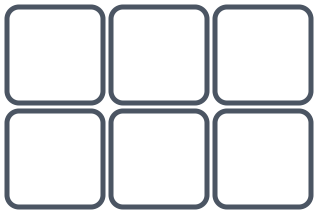
Flavor	Topping	Is this bowl new?
Vanilla	Sprinkles	yes, the first one

1. How many different bowls? _____

2. How did you make sure you missed none?

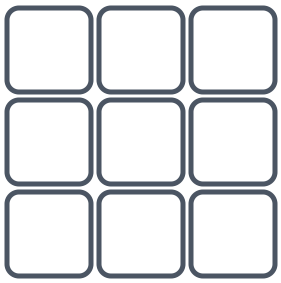
_____

The same answer as a picture. Each row is a flavor, each column is a topping.



By rows: 3 + 3 = _____ By columns: 2 + 2 + 2 = _____

The ice cream shop adds Strawberry. Now 3 flavors and 3 toppings.



Bowls now: _____ As addition: _____

TALK ABOUT IT

Why does the rectangle picture answer the same question as the list?

If the ice cream shop added a fourth topping, would you have to start the list over? What would you do instead?



STUCK? TRY THIS

Hold one flavor still and go through **every** topping before you switch flavors. That is how you know you have them all.

★ CHALLENGE ZONE

Now every bowl also comes in a **cone** or a **cup**. With 2 flavors and 3 toppings, how many choices? What happened to your old answer?

With 3 flavors, 3 toppings, and cone-or-cup, how many? Explain how you got there without listing all of them.

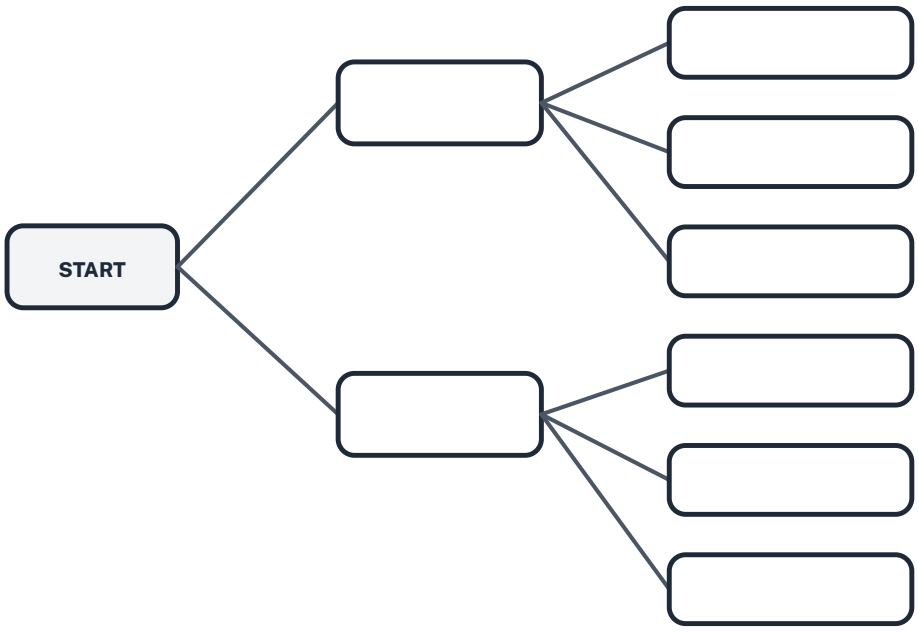
Choice Trees

The same counting, drawn as branches.

IN CLASS THIS WEEK
Arrays and repeated addition (2.OA.4)

NUMBER WARM-UP · 2 MINUTES
Double 4. Double 8. Double 16. What is happening?

You are getting dressed. You have **2 shirts** (striped, plain) and **3 pairs of pants** (red, blue, green). Fill in the boxes, shirts first, then pants. Each path from START to the end is one outfit.



1. How many paths from START to the end? _____

2. You got this same number last week at the ice cream shop. Why do two different stories give the same answer?

_____

Flip a coin twice. Draw the tree with H and T.

Endings: _____ List them: _____

Now three flips.

Without drawing the whole tree, how many endings? _____

Fill in: 1 flip → _____ 2 flips → _____ 3 flips → _____ 4 flips → _____

💬 **TALK ABOUT IT**

Each extra coin flip **doubles** the number of endings. Why doubling, and not adding 2?

Where else this year have you seen numbers doubling like 2, 4, 8, 16? (Look back at Weeks 5, 8, and 24.)



STUCK? TRY THIS

Follow one path all the way from START to the end with your finger, and say the outfit out loud. Then go back and take the next branch.

★ **CHALLENGE ZONE**

Draw the ice cream problem from Week 33 as a tree. Does it look like the outfit tree?

You flip a coin 5 times. How many endings? How many of them are all heads?

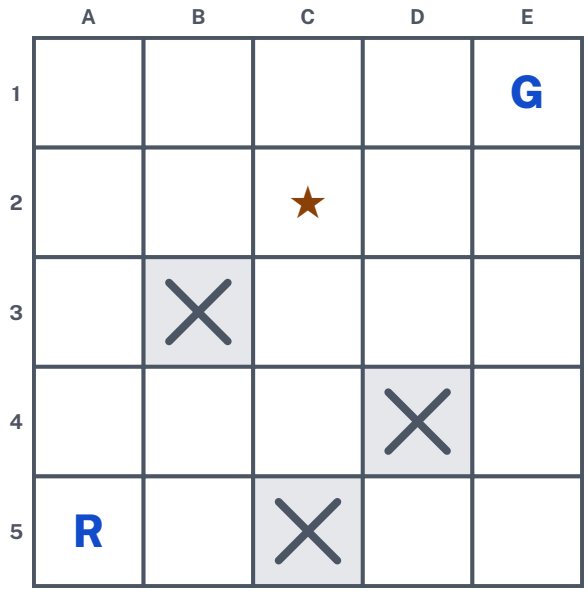
Program the Robot

Instructions precise enough for a machine to follow.

IN CLASS THIS WEEK
Rows and columns; repeated addition (2.G.2, 2.OA.4)

NUMBER WARM-UP · 2 MINUTES
Start at 20 and count back by 1 to 12. How many numbers did you say?

Get the robot **R** to the goal **G**. Squares with ✗ are walls: the robot cannot enter them. It moves one square at a time: ↑ ↓ ← →, never diagonally.



Write your program. One arrow per box. You may not need every box.

1	2	3	4	5	6	7	8	9	10

1. How many moves did your program take? _____
2. What is the **fewest** moves possible? _____ How do you know you cannot do better?

Loops save writing.

Instead of → → → → → →, a programmer writes **REPEAT 6 TIMES [→]**.

REPEAT 4 TIMES [↑] = _____

REPEAT 3 TIMES [→ ↑] = _____

↓ ↓ ↓ ↓ ↓ = REPEAT _____ TIMES [_____]

Loops are repeated addition.

REPEAT **4** TIMES [**3** moves] gives 3 + 3 + 3 + 3 = _____ moves.

Draw a rectangle with 4 rows of 3 squares and count them. Same number? _____

💬 TALK ABOUT IT

Why is a loop better than writing every arrow out, even though they do the same thing?

Your friend goes **right first**, all the way. What happens? Why?



STUCK? TRY THIS

Count how many squares the robot has to move **across** and how many **up**. Add those two numbers, that is the fewest moves possible, before you worry about walls.

★ CHALLENGE ZONE

There is a ★ on the grid. Can you reach the goal in the **same fewest number of moves** *and* pass over the star? Write that program.

The robot also knows FORWARD 3 and TURN RIGHT. Write a loop that draws a **square**. How many repeats, and what goes in the brackets?

Secret Codes

The last week. Everything you learned, put to work.

IN CLASS THIS WEEK
Place value review (2.NBT.1) · reasoning with symbols

NUMBER WARM-UP · 2 MINUTES
Say the alphabet. What letter comes after M? After R?

In the **slide code**, every letter was slid **one step forward** in the alphabet, so a real **A** was written as **B**. To read it, slide each letter **back** one.

A	B	C	D	E	F	G	H	I	J	K	L	M

N	O	P	Q	R	S	T	U	V	W	X	Y	Z

top row = the coded letter | bottom row = write the real letter

Decode this message.

N B U I J T G V O

_____ _____ _____

The computer code. Remember your cards from Week 5: 8, 4, 2, 1.

Turn each group of four into a number. Then use A = 1, B = 2, C = 3, and so on.

0 1 0 0 0 0 0 1 0 1 0 0

Numbers: _____ _____ _____ Word: _____

Write your own secret message.

Pick either code. Write a short message for a classmate. Do not tell them which code, write a **clue** instead.

_____

_____

💬 **TALK ABOUT IT**

What makes a code hard to break? Which of these two would take longer to crack?

A code is really just a rule, like the machines in Week 6. What is the rule for the slide code?



STUCK? TRY THIS

For the slide code, write the alphabet out along the top of your page first. Then you can just point one letter to the left for every letter you decode.

★ **CHALLENGE ZONE**

This message slid **two** steps forward. Decode it: **QWT EQFG**

With four cards (8, 4, 2, 1) you can only write 1 to 15, which is A through O. What fifth card would you add so you can reach **Z**, which is 26?

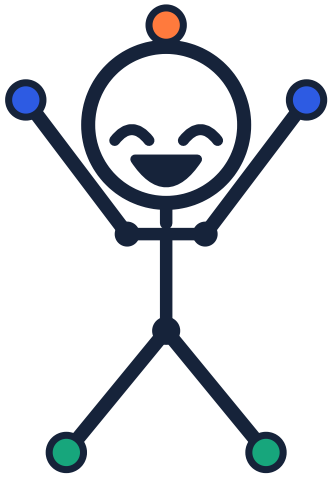
Now add that fifth card and write MATH with all five: M = 13, A = 1, T = 20, H = 8.

CERTIFICATE OF COMPLETION

Chief Noticer

awarded to

for a whole year of coloring maps, sorting cards, balancing scales, crossing bridges, programming robots, breaking codes, and, hardest of all, explaining *why*.



a Young Innovator for Change

Teacher

Date

Young Innovators
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