

Hundred chart challenge



NCTM's *Principles to Actions: Ensuring Mathematical Success for All* (2014) outlines eight teaching practices for effective teaching and learning of mathematics. One of them, *Use and connect mathematical representations*, involves engaging students in “making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving” (p. 10).

In this month's problem scenario, students will use a mathematical representation—namely, a hundred chart—to solve problems focused on developing their understanding of place value, magnitude, and addition and subtraction structures.

Problem scenario

1. With your partner, draw two number cards from the stack. Record your numbers.
2. Draw a Challenge card. Rewrite the problem with your numbers inserted (if necessary).
3. Use the hundred chart to determine the solution to the problem as written in question 2. Using the hundred chart, explain and justify how you found your answer.

Refer to **figures 1 and 2** for the Challenge cards and hundred chart, respectively, and see the **activity sheet** (p. 70). (Full-size items are appended to the online version of this article.)

FIGURE 1

Using Challenge cards like those below, students can have fun developing a better understanding of place value, magnitude, and addition and subtraction.

Challenge Card 1 How far apart are your two numbers?	Challenge Card 2 How much more is the [larger number] than the [smaller number]?
Challenge Card 3 What number is [smaller number] less than [larger number]?	Challenge Card 4 I started with a number. When I counted on [smaller number] from my number, I ended up at [larger number]. What number did I start with?
Challenge Card 5 I started with the [larger number]. When I counted back, I ended up at the [smaller number]. How far did I count back?	Challenge Card 6 I started with the [smaller number]. When I counted on, I ended up at [larger number]. How far did I count on?

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FIGURE 2

Each student draws and records a number card. In pairs or small groups, they draw a Challenge card and use a standard hundred chart to solve and justify their answers.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Classroom setup

Before using the problem with your students, solve each of the Challenge cards for several pairs of Number cards on your own, including an explanation for your answer using the hundred chart. In addition, anticipate the multitude of strategies, appropriate and inappropriate, that your students might use to represent and solve the problem.

Before presenting the problem to your students, gather some materials:

- Multiple copies of the **activity sheet** (p. 70) for each pair or group of students
- Copies of the hundred chart (see **more4u** at the end of this article) and partial hundred charts (see **figs. 3** and **4**; full-size pages for duplication are in the **online appendix**) for each pair or group of students
- One set of Number cards (1–100) for each group, which you can make from copies of the hundred chart
- Two game pieces or “chips” for each student pair or group to mark the numbers from their Number cards on the hundred chart
- One set of Challenge cards (see **fig. 1** and **more4u**) for each group
- A digital camera or a smartphone or tablet with a camera

Launch the task by having two or three students model the activity for the whole class as you explain the rules. If using two students, have each draw a number and take turns drawing a Challenge card. If using three students, then two students will each draw a Number card, and the other student will draw the Challenge card.

Organize students in pairs or groups of three. Distribute the activity sheet (for students to record their strategies and solutions) as well as the hundred chart, Number cards, and Challenge cards. Allow enough time for students to complete several Challenge cards with their partner or group.

As students are working on the activity, monitor *how* they are (a) locating numbers on the hundred chart, (b) determining the answer to their Challenge card, and (c) how their

FIGURE 3

Challenge students to use a partially empty hundred chart to apply what they have learned.

			4		6		8	9	
11	12				16			19	
				25			28		
		33			36				40
	42		44	45				49	
						57	58		
		63						69	
	72			75			78		
						87			90
91					96				

29

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strategies change as they engage in the activity. For example, do students—

- use the structure of the hundred chart to locate their numbers and/or find their solution to the Challenge card?
- recognize that the number of rows they move up in the hundred chart represents adding ten and that moving down represents subtracting ten?
- recognize that each column they move to the right in the hundred chart represents adding one and that each column they move to the left represents subtracting one?
- use such strategies as counting on, counting back, counting using the base-ten structure of the hundred chart, or counting by ones when joining or separating?

You may want to take some pictures with a digital camera, smartphone, or tablet to help gather evidence of student thinking during the solution process. To maintain the task's high level of cognitive demand, try not to tell students how to find the solution for the Challenge card. Instead, ask questions that build on the ways that students are thinking about the problem:

- How are you finding your number(s) on the hundred chart?
- What is a strategy you could use to find the solution to this Challenge card?
- How did you find the solution to this Challenge card?
- Is there another way to find your solution? Why or why not?
- What are some patterns in the hundred chart that can help you find the solution to this Challenge card?

As you monitor students at work, select particular strategies for pairs or groups to share with the class and carefully consider the order in which the strategies will be presented. The counting strategies could be ordered from less sophisticated to more sophisticated. For example, one pair or group may count on from the smaller number. In contrast, another pair

Where's the math?

Throughout K–grade 12 mathematics instruction, opportunities to learn should be focused on developing students' understanding of important mathematics concepts (NCTM 2000). The Hundred Chart Challenge is situated in what appears to be a simple task using a representation commonly found in elementary school classrooms. However, because there are multiple approaches to using the hundred chart to solve the problems on the Challenge cards, students have the opportunity to develop their number and operation sense in conjunction with place-value concepts. The Challenge cards include various structures for addition and subtraction (Hankes 1996; Hoosain and Chance 2004; Van de Walle and Lovin 2006):

- **Challenge card 1:** How far apart are your two numbers? (Compare Difference Unknown)
- **Challenge card 2:** How much more is 47 than 32? (Compare Difference Unknown)
- **Challenge card 3:** What number is 32 less than 47? (Separate Result Unknown)
- **Challenge card 4:** I start with a number. When I count on 32 from my number, I end up at 47. What was the number I started with? (Join Initial Unknown)
- **Challenge card 5:** I started with 47. When I counted back, I ended up at 32. How far did I count back? (Separate Change Unknown)
- **Challenge card 6:** I started with 32. When I counted on, I ended up at 47. How far did I count on? (Join Change Unknown)

Through exposure to structures beyond Join Result Unknown and Separate Result Unknown, students can strengthen their understanding of the relationship between addition and subtraction and avoid common misconceptions related to number and operation (Switzer, Buchheister, and Dougherty 2014).

In the Hundred Chart Challenge, students have the opportunity to demonstrate several of the Common Core's Standards of Mathematical Practices (SMP) (CCSSI 2010). For example, students will *use appropriate tools strategically* by considering how to use the hundred chart to approach the problems on the Challenge cards. The structure of the hundred chart allows for multiple strategies varying in levels of sophistication with respect to students' number sense (e.g., counting on, counting back, skip counting, and applying base-ten structures).

or group could have used a more sophisticated strategy of counting by tens and ones. The strategies could also be sequenced from more concrete to more abstract representations. For instance, pairs or groups may rely on the hundred charts for their counting strategies, whereas other groups may recognize the connection between the hundred chart and place value to determine their solutions. As pairs or groups share their strategies, ask questions that help students make connections between the

various strategies and build the mathematical understandings underlying the task:

- Are some strategies more efficient than others? Why?
- How are the various strategies similar and different?
- How are the various Challenge cards similar and different?
- How could you use your strategy for [one Challenge card] to help you find the solution for [a different Challenge card]?
- How can you represent your strategy without using the hundred chart?

To enable students to make connections among strategies, representations, and mathematical

ideas, maintain a running record on the board or chart paper of pair or group contributions.

Extensions and modifications

As presented, this task is designed for students in the middle elementary grades (2–4). However, the task may be modified for students in the lower elementary grades by limiting the Number cards (e.g., 1–20) and/or Challenge cards from which they can select. Further, opportunities for differentiation are incorporated into the nature of the task. Some students may find their solutions to the Challenge cards using a single strategy. As indicated in the sample prompts, encourage students who finish early to consider other approaches or representations as well as the relationships between various Challenge cards. Providing students with an empty or partially empty hundred chart (see fig. 3) or a partial hundred chart (see figs. 4a and b) serves as an additional opportunity to further students' thinking about the mathematics by applying what they learned using the complete hundred chart to alternative representations that make the structure of the hundred chart less explicit.

Share your students' work

Try this problem in your classroom. We are interested in how your students responded to the problem, which problem-solving strategies they used, and how they explained or justified their reasoning. Send your thoughts and reflections—including information about how you posed the problem, samples of students' work, and photographs showing your problem solvers in action—by **November 1, 2015**—to Problem Solvers department editor **Sarah Quebec Fuentes**, Texas Christian University, TCU Box 297920, Fort Worth, TX 76129; or email her at s.quebec.fuentes@tcu.edu. Selected submissions will be published in a subsequent issue of *TCM* and acknowledged by name, grade level, and school name unless you indicate otherwise.

REFERENCES

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FIGURE 4

Like the partially empty hundred chart in figure 3, partial hundred charts can differentiate this game and prompt students to apply their recently acquired knowledge and make connections between strategies and representations.

(a)

21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80

(b)

32	33	34	35	36	37	38	39
42	43	44	45	46	47	48	49
52	53	54	55	56	57	58	59
62	63	64	65	66	67	68	69
72	73	74	75	76	77	78	79
82	83	84	85	86	87	88	89

/wp-content/uploads/Math_Standards.pdf

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J. Matt Switzer, j.switzer@tcu.edu, is an assistant professor of mathematics education at Texas Christian University (TCU). His research interests include pre-service teacher education, early algebra, learning theory, learning trajectories, and identification of and interventions for students struggling in mathematics. Edited by Sarah Quebec Fuentes, who is also an assistant professor of mathematics education at TCU. Each month, this section of the Problem Solvers department features a new challenge for students. Readers are encouraged to submit problems to be considered for future columns.

more4U

Access <http://www.nctm.org> to find a full-size hundred chart and partial hundred charts and Challenge cards appended to the online version of this article. This is a members-only benefit.

A VITAL NEW RESOURCE: Help Parents Effectively Participate in Their Children's Math Education

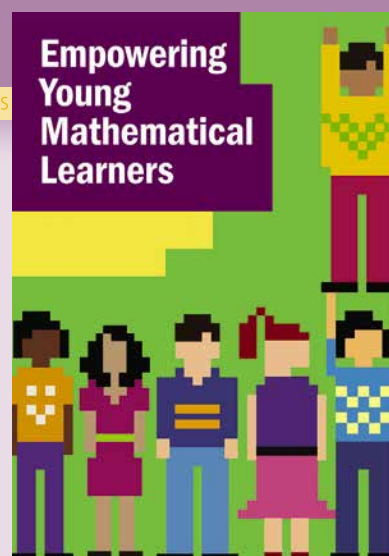
MATH IS ALL AROUND US | MATH IS ALL AROUND US | MATH IS ALL AROUND US | MATH IS ALL AROUND US

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Name _____

The Hundred Chart Challenge

1. With your partner, draw two number cards from the stack. Record your numbers below.

Smaller number: _____

Larger number: _____

2. Draw a Challenge card. Rewrite the problem with your numbers inserted (if necessary).

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3. Use the hundred chart to determine the solution to the problem as written in question 2. Using the hundred chart, explain and justify how you found your answer.