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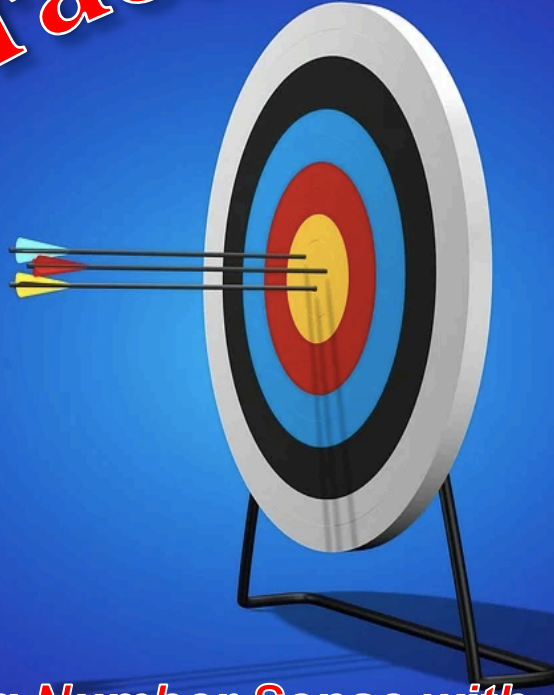
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Thanks.

*Brad*

# Target Practice



*Building Number Sense with  
Whole Numbers, Decimals, and More*

By Brad Fulton

Educator of the Year, 2005

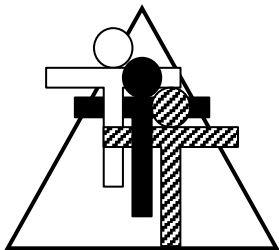
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# Brad Fulton

## Educator of the Year



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- ◆ Consultant
- ◆ Educator
- ◆ Author
- ◆ Keynote presenter
- ◆ Teacher trainer
- ◆ Conference speaker

Known throughout the country for motivating and engaging teachers and students, Brad has co-authored over a dozen books that provide easy-to-teach yet mathematically rich activities for busy teachers while teaching full time for over 30 years. In addition, he has co-authored over 40 teacher training manuals full of activities and ideas that help teachers who believe mathematics must be both meaningful and powerful.

### **Seminar leader and trainer of mathematics teachers**

- ◆ 2005 California League of Middle Schools Educator of the Year
- ◆ California Math Council and NCTM national featured presenter
- ◆ Lead trainer for summer teacher training institutes
- ◆ Trainer/consultant for district, county, regional, and national workshops

### **Author and co-author of mathematics curriculum**

- ◆ Simply Great Math Activities series: six books covering all major strands
- ◆ Angle On Geometry Program: over 400 pages of research-based geometry instruction
- ◆ Math Discoveries series: bringing math alive for students in middle schools
- ◆ Teacher training seminar materials handbooks for elementary, middle, and secondary school

### **Available for workshops, keynote addresses, and conferences**

All workshops provide participants with complete, ready-to-use activities that require minimal preparation and give clear and specific directions. Participants also receive journal prompts, homework suggestions, and ideas for extensions and assessment.

*Brad's math activities are the best I've seen in 38 years of teaching!*

Wayne Dequer, 7th grade math teacher, Arcadia, CA

*"I can't begin to tell you how much you have inspired me!"*

Sue Bonesteel, Math Dept. Chair, Phoenix, AZ

*"Your entire audience was fully involved in math!! When they chatted, they chatted math. Real thinking!"*

Brenda McGaffigan, principal, Santa Ana, CA

Like my activities? How about giving me a favorable rating on the Teachers Pay Teachers website? Four stars would be much appreciated and would help me sleep better at night.



Like me even more? Then please don't make copies for your colleagues. I know it's tempting when they say, "Wow! Groovy activity! Can I have a copy?" But this is how I make my money, and why are they still saying "groovy" anyway?



If we make copies for our friends, can we honestly tell our students not to copy or take things that don't belong to them? (Ouch!)



Discounted site licensed copies are available on the TPT website. Please encourage them to take advantage of this affordable option. Okay?

Thanks, and happy teaching,

Brad



## OVERVIEW

Materials:

- Access to projection of a webpage or an overhead four-function calculator and projector
- Pencils and paper (optional)

## PROCEDURE

Skills:

- Proportional reasoning
- Number magnitude
- Divisibility
- Factors
- Place value
- Decimal place value
- Positive and negative numbers
- Reciprocals



Use this qr code to go to the online calculator.

## Target Practice

Students will enjoy playing this game so much that they won't realize they are developing rich number sense. They'll build upon concepts of number magnitude, division, factors, place value, and decimal representations. You can play it once or every day, and your students' skills will grow and grow. A great filler, warmup, exit activity, or whole class lesson.

1. For this activity, you will need to be able to project a calculator. One option is using an overhead 4-function calculator and overhead projector. If you have a document camera, you can just focus it on a desktop calculator. If you have the ability to project a website, you can use an online calculator.

**It is important that you use the right type of calculator.** It must be programmed to use a specific constant function that is explained in steps 4 through 6 below. While many calculators have this function, many also do not. My iPhone calculator works fine. Here are two online calculators that have the right type of calculator:

<https://www.online-calculator.com/>

<https://www.online-calculator.com/online-maths-calculator/>

The first one is the standard four-function calculator. The second one has an option for use with negative numbers as addressed in step 26 below. However, if you use the second calculator it does show the math problem at the top of the screen, so be sure not to display that portion of the screen.



If you are using the web-based calculator, click the “Use the online calculator full screen” option below the image of the calculator.

2. Let the students watch as you type  $5 \div 5$ . Ask them what they expect to see when you press the equal key. They should know that the answer will be 1. Press the equal key and show that this is correct.
3. Now ask them what will happen if you type  $15 =$ . They will probably not know, but may suggest that you will just see the number 15 since you did not enter any operation key.
4. Type “ $15 =$ ” and let them see the result. The calculator displays the number 3. Ask them why this happened. They may realize that the calculator solved  $15 \div 5 = 3$ . That is, it remembered the  $\div 5$  from the previous problem. They can test this conjecture by asking you to type another number followed by an equal sign such as  $35 =$ . If you do this, the calculator shows a 7 verifying their conjecture.
5. Try this again. Type  $2 \div 2 =$ . The calculator displays 1. Now ask them to predict what they will see if you type  $12 =$ . The calculator displays a 6. It has taken the new number and applied the operation of dividing by 2 from the previous problem.
6. **This is an example of what is called a constant function.** When you typed  $2 \div \underline{2} =$ , it stored the underlined part of the problem in case you need it again. Thus, to the calculator, when you typed  $12 =$ , it solved  $12 \div \underline{2} = 6$ .
7. Now for the fun part. Turn off your display so that the students cannot see what number you type. This can be done by turning off the projector or document camera or by freezing your interactive board while you type.
8. Type  $8 \div 8 =$ . The calculator will display 1. Now reveal the calculator screen to the students. They will only see the answer. Explain that their job is to find out what you typed by guessing input numbers and seeing the result. If they guess 5,

you will type  $5 =$ . The calculator displays 0.625. What does this mean? It tells them that their guess was too small.

9. If they guess 10, you will type  $10 =$ . The calculator displays 1.25. Now their guess is too high.
10. Maybe they think you picked the lucky number 7. You then type  $7 =$ , and the calculator displays 0.875. What this actually tells them is that their guess is 87.5% accurate!
11. Eventually, they will guess 8. You will type  $8 =$ , and the calculator will show a 1. Ta-da!
12. Now, for round 2, turn off the display and type a much greater number like  $65 \div 65 =$ . The calculator will display a 1. Turn the display back on and ask them to try to guess your number.
13. Maybe they guess 10. You type  $10 =$ . The calculator now displays 0.15384615. Goodness sakes! What does that mean? It means that their guess was *way* too small.
14. Maybe they guess 100. You type  $100 =$ . Now the screen displays 1.53846154. This means that their guess is too big. Notice that the display simply shifted the decimal point. That is because this guess was exactly ten times greater.
15. For a third guess, let's assume that they choose 50. You type  $50 =$ , and the screen displays 0.76923077. This is too small. They now should realize that the correct number is between 50 and 100. They may also realize that 50 gave a closer result than 100 did.

The calculator cited in the website displays eight decimal places. If you are using a different calculator, some of your outputs may differ from what I have shown. This is a good time to talk to students about how to round numbers.

**In fact, it is proportional.** The display of 1.**53**846154 that resulted from the guess of 100 is off by a bit over 50% as shown by the bold-faced and underlined digits. The guess of 100 was about half again too much.

On the other hand, the guess of 50 resulted in a quotient of 0.**76**923077. As you can see, this is about 23% away from 100% accuracy. Hmm...what should they guess next?

16. Let's assume the guess 60. After you enter their guess, they see 0.92307692. They are about 92% accurate!
17. Maybe they try 70. The display shows 1.07692308. Now they are about 8% too high, so they shoot for the middle and guess 65.
18. You type 65 = and the calculator displays a 1. For the win!
19. For round 3, you can repeat a similar number until your students are demonstrating an increased sense for how to make good proportional guesses.
20. Once they are ready, try a larger number. You can make the number between 1 and 1,000, 1 and 10,000, or even 1 and 1,000,000. As you increase the size of the number, they learn more and more about place value. You can even require that they state the number correctly before you enter it. So, rather than say "Fourteen hundred and three," they must say, "One thousand, four hundred three."
21. Once students have developed a sense for the proportionality of the game, get creative. Tell them they are searching for a number between 1 and 100. With the display off, type something like  $14.48 \div 14.48 =$ . Once the calculator displays a 1, turn the screen back on.
22. Eventually, they will guess 14 and see the screen show 0.96685083. They will realize they are incredibly close and assume that the answer is 15, but when you type 15 =, the screen displays 1.0359116!
23. Now they realize that you have tricked them. They will probably try 14.5, which yields 1.00138122. But when they try 14.4, they get 0.99447514. They may try to convince you that these numbers round off to 1, so they should be given the trophy, but you insist that the display *must* say 1.
24. Eventually they will try 14.48 and give a sigh of relief and a cheer.



Guess	Display	
14	0.96685083	Low
15	1.0359116	High
14.5	1.00138122	High
14.4	0.99447514	Low

25. A great way to increase participation is to offer a reward for the student who hits the bullseye and gets the calculator to display 1. This will encourage students to record their guesses and the results. This can be done using a table like the one shown here.
26. Want to push the envelope even more? With the display off, type  $-3 \div -3 =$ . This is done on the web-based calculator by typing 3 +/- ÷ 3 +/- =. To do this on my phone, I must turn it sideways to access the  $\pm$  key.
27. Now turn on the screen on and tell that just to make it easier, you chose a number “less than 10”. Watch their surprise when they guess 5, and the calculator shows -1.66666667!



## Journal Prompts

When it was her turn, Andrea guessed 3.3. The screen showed 0.75. Two students discussed what they should choose as their next guess. Leslie suggested 2.5. Randall suggested 6.5. If you were on their team, what guess would you suggest? How would you explain it to them?

## Homework

Students can play this game at home using the online calculator. They can play with a parent, or play with a classmate via phone. The parent can sign a note that they played the game for 15 or 20 minutes. A student master with the URL and qr code is provided.

## Taking a Closer Look

As students work, they will realize that the display is showing them a representation of their guess ***proportional to*** the target

number. This is a key observation. Technically, they are seeing the result of this equation in which  $g$  is their guess,  $n$  is the target number, and  $d$  is the calculator's display.

$$g \div n = d$$

Expressing this division problem as a fraction yields this proportion:

$$\frac{g}{n} = \frac{d}{1}$$

Multiplying each side by  $n$  yields:

$$\frac{gn}{n} = \frac{dn}{1}$$

Simplifying yields:

$$g = dn$$

Dividing by  $d$  yields:

$$\frac{g}{d} = n$$

This means that taking their guess and dividing it by the calculator's display gives the target answer! Further, if they start by guessing one, the equation would read:

$$\frac{1}{d} = n$$

That is, the *reciprocal of the display* is the target number!

### Assessment



As if this engaging game wasn't good enough, it's self-assessing as well! You have no papers to collect or grade. What could be better?



Name \_\_\_\_\_

Date \_\_\_\_\_ Class \_\_\_\_\_



Play Target Practice with a family member or friend for \_\_\_\_\_ minutes. Use the url or qr code to go to the website. Then have a family member sign below to show that you have played the game. Good luck!

URL: <https://www.online-calculator.com/online-maths-calculator/>

How to play:

1. Hide the calculator from your partner.
2. Type any number.
3. Type the division key.
4. Type your number again.
5. Type the = key. The number 1 is displayed
6. Show the calculator to your partner, and ask them to make a guess.
7. Type their guess followed by the = key. The screen will divide their guess by your mystery number. They will be able to see if they guessed too low ( $<1$ ) or too high ( $>1$ ).
8. Don't clear the calculator. Let them keep guessing until they hit your target number and the screen displays 1.

Signature: \_\_\_\_\_

## Standards alignment:

### 4<sup>th</sup> grade:

CCSS.MATH.CONTENT.4.NBT.A.2

Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using  $>$ ,  $=$ , and  $<$  symbols to record the results of comparisons.

### 5<sup>th</sup> grade:

CCSS.MATH.CONTENT.5.NBT.A.3

Read, write, and compare decimals to thousandths.

CCSS.MATH.CONTENT.5.NBT.A.3.A

Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g.,  $347.392 = 3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$ .

CCSS.MATH.CONTENT.5.NBT.A.3.B

Compare two decimals to thousandths based on meanings of the digits in each place, using  $>$ ,  $=$ , and  $<$  symbols to record the results of comparisons.

CCSS.MATH.CONTENT.5.NBT.A.4

Use place value understanding to round decimals to any place.

### 6<sup>th</sup> grade:

CCSS.MATH.CONTENT.6.RP.A.1

Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

CCSS.MATH.CONTENT.6.RP.A.3

Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

### Grade 7:

CCSS.MATH.CONTENT.7.RP.A.1

Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.

### High school algebra:

CCSS.MATH.CONTENT.HSA.SSE.B.3

Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\*

CCSS.MATH.CONTENT.HSA.CED.A.1

Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

CCSS.MATH.CONTENT.HSA.CED.A.4

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

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Similar activities include:

- *Winning Ways with Number Sense*- Build rich number sense skills in your students easily with these five key strategies. You'll see how to engage students in rigorous mathematical thinking while minimizing your work.
- *Developing Proportional Reasoning* - This resource demonstrates eight ways to approach solving proportions from the most conceptual to the most abstract. A must for middle school math!
- *Take Your Places* - A great way to help students move from merely procedural mathematics to really thinking mathematically.

Feel free to contact me if you have questions or comments or would like to discuss a staff development training or keynote address at your site.

Happy teaching,  
*Brad*