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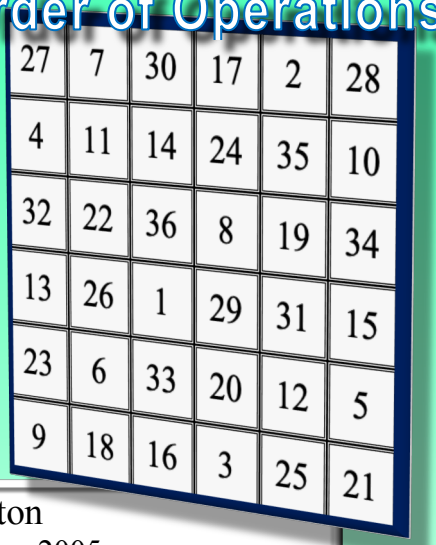
2 GREAT GAMES • SWEEP • NEIGHBORS

The Fun and Effective Approach to Teaching Numbers Sense, and Order of Operations



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4	11	14	24	35	10
32	22	36	8	19	34
13	26	1	29	31	15
23	6	33	20	12	5
9	18	16	3	25	21

By Brad Fulton
Educator of the Year, 2005
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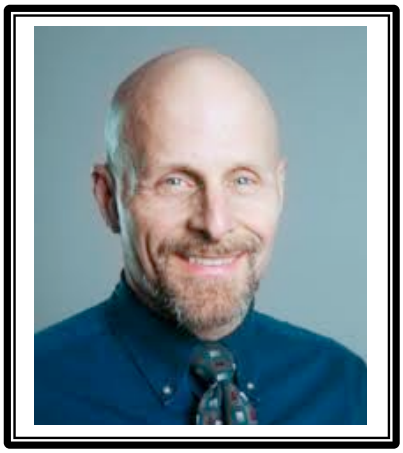

Brad Fulton

Educator of the Year

- ♦ Consultant
- ♦ Educator
- ♦ Author
- ♦ Keynote presenter
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- ♦ Conference speaker

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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

"Absolutely engaging. I can teach algebra to second graders!"
Lisa Fellers, teacher

References available upon request

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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

I want...

- ☐ a) <u>Effective</u> staff development
- ☐ b) <u>Affordable</u> staff development
- ☐ c) <u>Ongoing</u> staff development
- ☐ d) ***ALL OF THE ABOVE!***

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- **Effective because** they are classroom-tested and classroom-proven. These popular DVDs of Brad's trainings have been utilized by teachers throughout the country for years.
- **Affordable because** they are site-licensed. Buy only one copy for your whole school, print as many copies of the handouts as you need.
- **Ongoing because** when you hire new staff, simply hit "play" and the training begins. There's no need to bring back the consultant.

Sweep

The Fun Way to Foster Fluency with Order of Operations

Overview:

Students will score points for creating complex problems. This activity will work with students of all ability levels while it encourages them to improve the sophistication of their math skills. This game can be played with the whole class, or pairs of students can play independently.

Required Materials:

- ☒ Display of activity master
- ☒ One or two dice or a spinner

Optional Materials:

- ☐ Student copies of the activity master

Procedure:

1. Display a copy of the activity master. You will also need to generate random digits. It is best to use two dice if you have them. If not, use the 1 through 6 spinner provided in the back of this book and spin it twice. Students multiply the two numbers. This product is the answer they must get to a math problem they will generate. Using spinners with more sectors will allow students to practice multiplication facts with numbers greater than six.

2. Students then use any of the six numbers in the *bottom* row of the Activity Master to write a math problem that has the product for the answer. Students may use some of all of the available numbers. For example, if a team rolls a 3 and a 6, they must create a math problem with an answer of 18 using the numbers available on the bottom row: 5, 4, 3, 2, 2, and 5. The team gets one point for each number used. Here are some possible ways to get 18 and the respective scores:

Problem:	Score:
$(5 + 4) \times 2 = 18$	3 points
$3^2 \times 2 = 18$	3 points
$4! - 3! = 18$	2 points
$5 + 5 + 4 + 2 + 2 = 18$	5 points

$4^2 + (3 - 2) + {}^5/_5 = 18$ 7 points

This last problem is a sweep because it uses all six numbers. A sweep always gets a one-point bonus making it worth 7 points.

0	7	4	2	1	1
4	4	5	8	8	8
4	0	5	4	1	3
7	7	1	8	6	4
2	1	8	4	2	5
6	4	3	8	2	0
2	5	8	0	6	6
8	0	2	8	5	7
5	***6***	0	***2***	1	8
~~5~~	~~4~~	***3***	~~2~~	***2***	***5***

3. Let's assume the team uses the first example. After making their problem, they cross out the numbers they used.

4. Play alternates to the other team or student. The player rolls both dice or spins the spinner twice to get two new factors. After finding the product, they may use any of the numbers available at the *bottom* of the column. In this case, the numbers 5, 6, 3, 2, 2, and 5 are now available. After creating their problem, this team scores a point for each number they used and crosses those numbers off the bottom of the column.

5. Students should record their problems for each round. A recording sheet is provided for this purpose, or they can simply use their own paper. The game ends after a specified number of rounds or when the top row has been reached.

Journal Prompts:

Sometimes a number appears twice in a row as shown. If your math problem uses that number only once, does it matter which one you cross off? Why?

Are there numbers you would rather not leave available to the other team? Which ones? Why?

0	7	4	2	1	1
4	4	5	8	8	8
4	0	5	4	1	3
7	7	1	8	6	4
2	1	8	4	2	5
6	4	3	8	2	0
2	5	8	0	6	6
8	0	2	8	5	7
5	6	0	2	1	8
5	4	3	***2***	***2***	5

Homework:

Students can play this game at home with a parent or sibling.

Another alternative is to assign them a row from the chart and a target answer. Ask them to find problems using those numbers to hit that target. The recording sheet can be used for this purpose. Who can get the best score?

Taking a Closer Look:

Show students operations that will allow them more flexibility with their problems. They can use square roots to turn 4's into 2's and 9's into 3's. Factorials and exponents will cause numbers to grow quickly.

3! is called "three factorial" and means 3 x 2 x 1 = 6.
4! = 4 x 3 x 2 x 1 = 24
5! = 5 x 4 x 3 x 2 x 1 = 120

Show students how you can always use a one or a zero in any problem:

8 + (3 x 2) = 14

[8 + (3 x 2)] x 1 = 14

[8 + (3 x 2)] + 0 = 14

Students can also utilize double numbers by making a one or a zero with them.

[8 + (3 x 2)] x 5/5 = 14

[8 + (3 x 2)] + (5 – 5) = 14

Assessment:

Students will generally assess themselves and their opponents during the process of this game making further correcting unnecessary.

Fellow students can check homework by typing the math problems into a calculator that performs order of operations correctly.

Good Tip!

To make a much more challenging version of the game, *divide* the number on the first die by the number on the second. For example if a 6 is rolled first, and a five is rolled second, the target answer is 6 ÷ 5 = 1.2.

Sweep

0	7	4	2	1	1
4	4	5	8	8	8
4	0	5	4	1	3
7	7	1	8	6	4
2	1	8	4	2	5
6	4	3	8	2	0
2	5	8	0	6	6
8	0	2	8	5	7
5	6	0	2	1	8
5	4	3	2	2	5

Name_____

Recording Sheet

Sweep

Use this page to record your math problems from your game. Be sure to check that you have written the problem correctly.

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

10 _____

11 _____

12 _____

13 _____

14 _____

15 _____

16 _____

17 _____

18 _____

19 _____

20 _____

Neighbors

A Strategic Game Exploring Order of Operations

Overview:

Students will enjoy competing against each other or against the teacher in this activity that richly develops number sense and operations. They will learn to apply order of operations and put square roots, exponents, and factorials to use. Once they learn the game, they will enjoy playing it in pairs or teams.

Required Materials:

- ☒ Display of activity master
- ☒ One or two dice or a spinner

Optional Materials:

- ☐ Student copies of the activity master

Procedure:

1. Display a copy of the activity master. You may wish to provide copies to students also. If they are to play against one another in teams, they will need these copies. You could laminate these and let students use dry erase markers on them so that you can reuse them each year.

2. Select three numbers at random using a spinner or die. Tell the students they must use all three numbers to create a problem that has one of the game board numbers as its answer. Their goal is to get the highest score possible. After creating a problem, they mark the answer on the game board with an "X". Their goal is to cover the largest possible answer. For example, if the numbers 1, 2, and 3 are selected, some problems are:

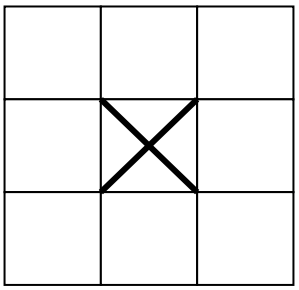
$1 + 2 + 3 = 6$	$(1 + 2) \times 3 = 9$
$(2 + 1)^3 = 27$	$3!\,(2 + 1)! = 36$

3. Allow the second team to take their turn. They may use the same three numbers, or they may choose to replace one of them with a new selection. They may choose for example to cancel the 1. Then a replacement is selected randomly. Team two uses their three numbers to create a new math problem. They mark their answer with an "O" to distinguish it from the other team.

4. Play alternates between the two teams. Each time one new number may be chosen to replace an existing one, or the previous three numbers may be used. If a team cannot mark a number, their score for that round is zero.

5. Each time a team creates a new answer, it *must* be a "neighbor" of a previous one. The new answer may be a neighbor vertically, horizontally, or diagonally as shown.

All eight of these empty squares are neighbors and can be used for legal moves for team X.



6. Students should keep track of the problems they write and the answers on a separate piece of paper. This paper can be used to verify the students' work and for the bluffing option explained in the following step.

7. Bluffing:
An effective alternative is to allow students to bluff. In this case, students do not show their problem to the other team. They simply announce the answer they got. The opposing team then decides to "accept" or "reject" the answer. If they believe the answer is legitimate, they say, "Accept", and play resumes with their turn. If they doubt that the team really found a problem with that answer, they say, "Reject". In this case, the first team must show their problem. If they did bluff, they score zero for that round, and play goes to the opposing team. If, however, they did find a way to get that answer, they receive a bonus of a double score. If they said they got a 32, and they did, by surviving the bluff they would get 64 points. Bluffing serves a very useful purpose. It engages the non-playing team. They can't relax and wait for their turn; they must consider all the options possible with the other team's numbers. However, the double-point bonus discourages them from challenging relentlessly.

8. You have three options for ending the game.
   a. Play continues for a specified number of rounds or for a specified time limit.
   b. Play continues until one team reaches a specified score such as 1,000.
   c. Play continues until one team has recorded six neighbors. The other team then gets a 50 point bonus and the highest score wins. This option helps keep a low-scoring team in the game. Their opponent will not want to get their sixth neighbor if it means the other team will win. In this case, they are allowed to create a problem that has an answer that is not a neighbor and add it to their score. They will not want to end the game until they can establish at least a 51-point lead.

Good Tip!

To increase the difficulty of the game for older students, you may require that the numbers selected must be used in the order in which they were selected.
Another option is to allow numbers to be grouped into multi-digit numbers. If 1, 2, and 3 are selected, students could then create these problems:
12 x 3 = 36
31 x 2 = 62
3! + 21 = 27

9. Be creative in adapting the rules to fit your class. You can increase or decrease the complexity of the game using options described below in "Taking a Closer Look." You can also adjust penalties or bonus points as needed or enforce time limits for moves.

10. Two game boards are provided. The simpler one will result in games that are easier and will take less time.

Journal Prompts:

If the numbers 3, 5, and 6 are selected, what is the largest score possible? What is the smallest score? Show how you get these scores.

What numbers on the game board are difficult to hit? Why is that true?

What operations tend to give you bigger answers? Is this always true?

Homework:

Give the students randomly chosen numbers and a blank game board. Have them create math problems to cover as many answers as possible. A homework master is provided for this.

Taking a Closer Look:

Use only two numbers at a time to simplify the operations. In that case, use the smaller 6 x 6 game board. To make the game more challenging, select four numbers that must be used.

To make the game more challenging for older students, put negative signs in front of some of some of the numbers in the grid. Students then add the absolute value of their answer to their score. This will give them practice in working with integers, while the absolute value will ensure that they can still aim for a higher score.

Assessment:

Higher scores will tend to indicate that a student is more proficient at using operations although some luck is also involved in the drawing of the numbers. Students who are better at using the operations and applying order of operations correctly will tend to play longer games because they think more about their moves.

Errors will usually be noticed and corrected by the opposing team. If the bluffing option is being used, this will also help to check students who are giving incorrect problems.

Activity Master

Neighbors

14	39	9	55	22	64	2	75
85	96	108	27	132	35	92	33
36	1	12	70	6	140	16	50
80	65	48	120	45	28	128	7
5	44	20	24	18	135	42	32
54	4	90	52	105	11	8	110
66	115	10	88	3	72	84	21
25	30	100	15	60	40	144	63

Activity Master

Neighbors

27	7	30	17	2	28
4	11	14	24	35	10
32	22	36	8	19	34
13	26	1	29	31	15
23	6	33	20	12	5
9	18	16	3	25	21

Homework Master

Neighbors

Name_____

Use the digits _____, _____, and _____ to create math problems that have the answers shown in the game board. Record your problems and their answers in the blanks provided below.

14	39	9	55	22	64	2	75
85	96	108	27	132	35	92	33
36	1	12	70	6	140	16	50
80	65	48	120	45	28	128	7
5	44	20	24	18	135	42	32
54	4	90	52	105	11	8	110
66	115	10	88	3	72	84	21
25	30	100	15	60	40	144	63

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

10 _____

11 _____

12 _____

13 _____

14 _____

15 _____

16 _____

17 _____

18 _____

19 _____

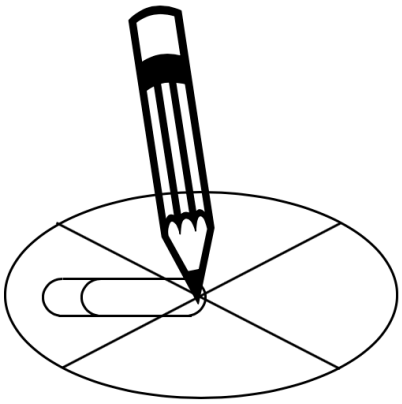
20 _____

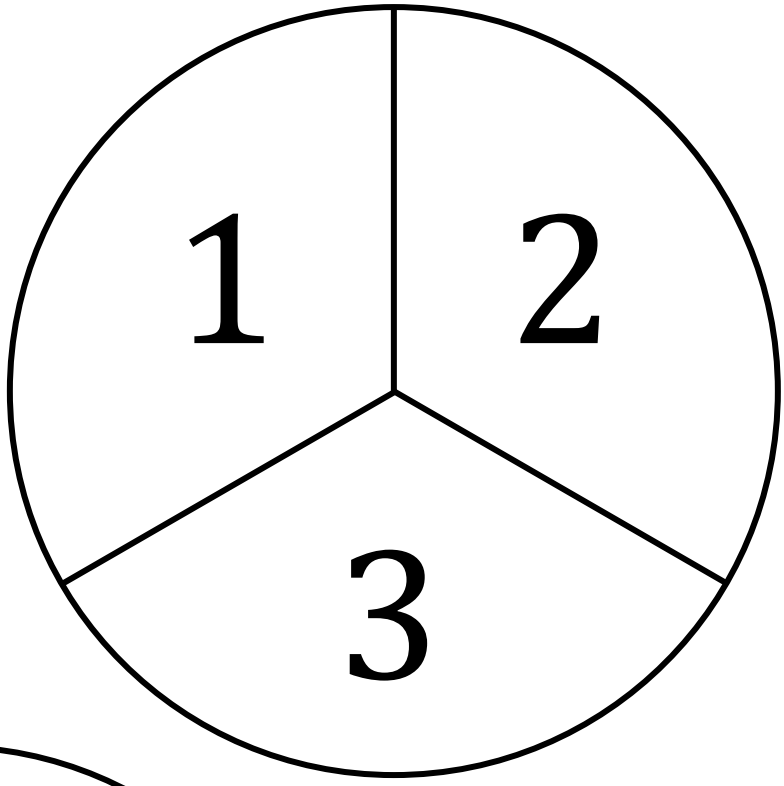
21 _____

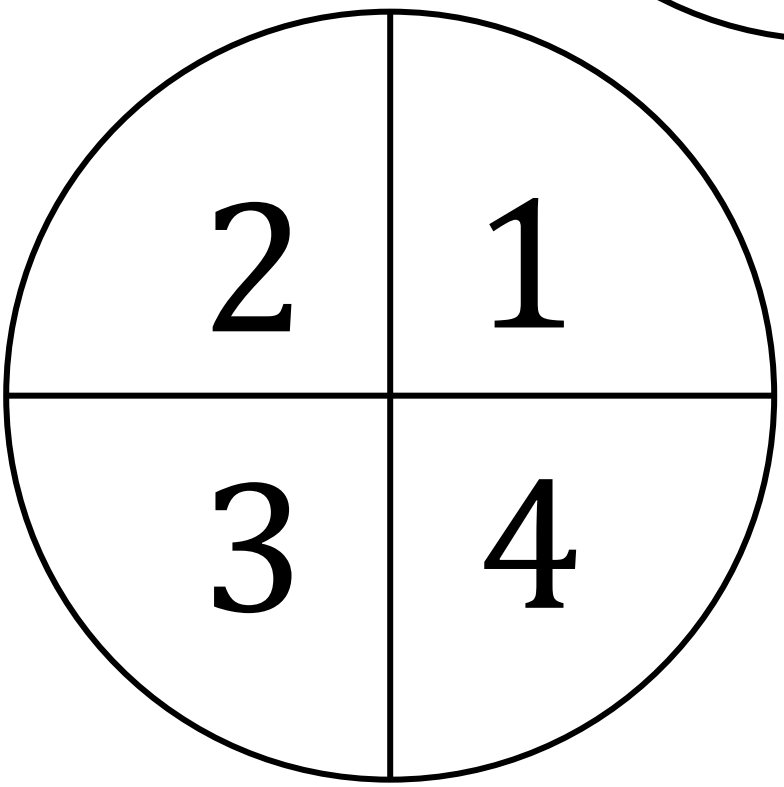
22 _____

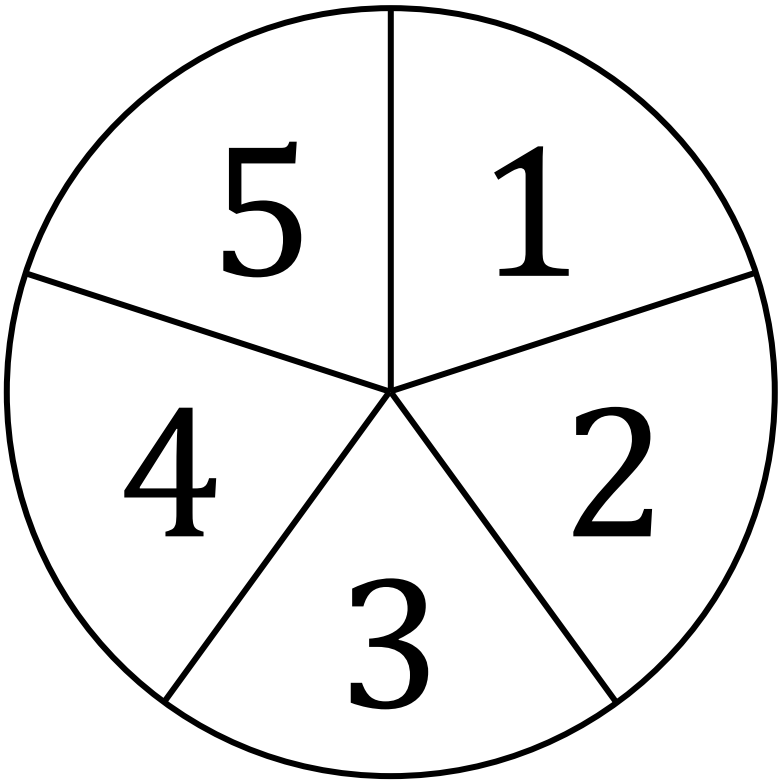
23 _____

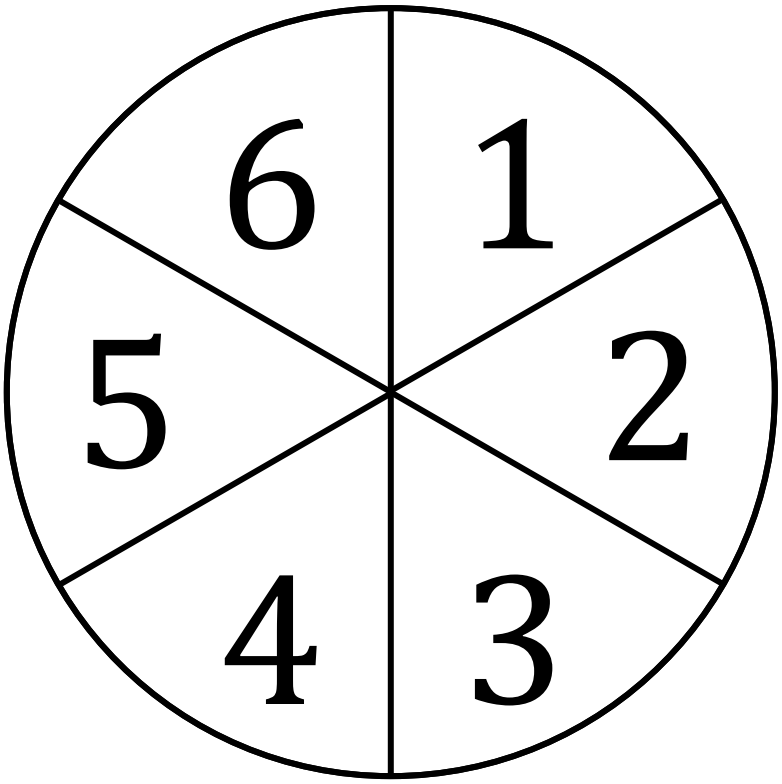
24 _____

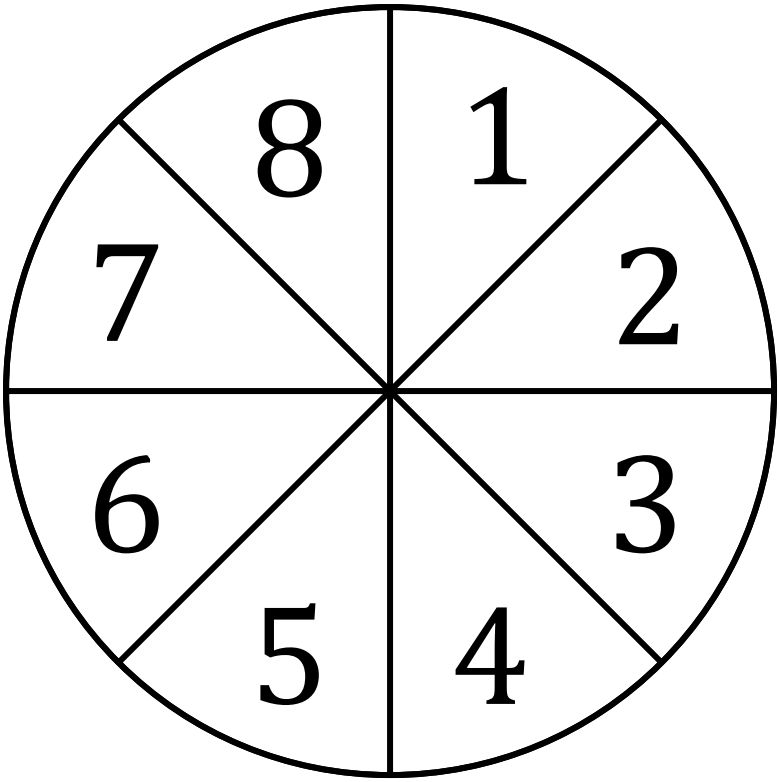


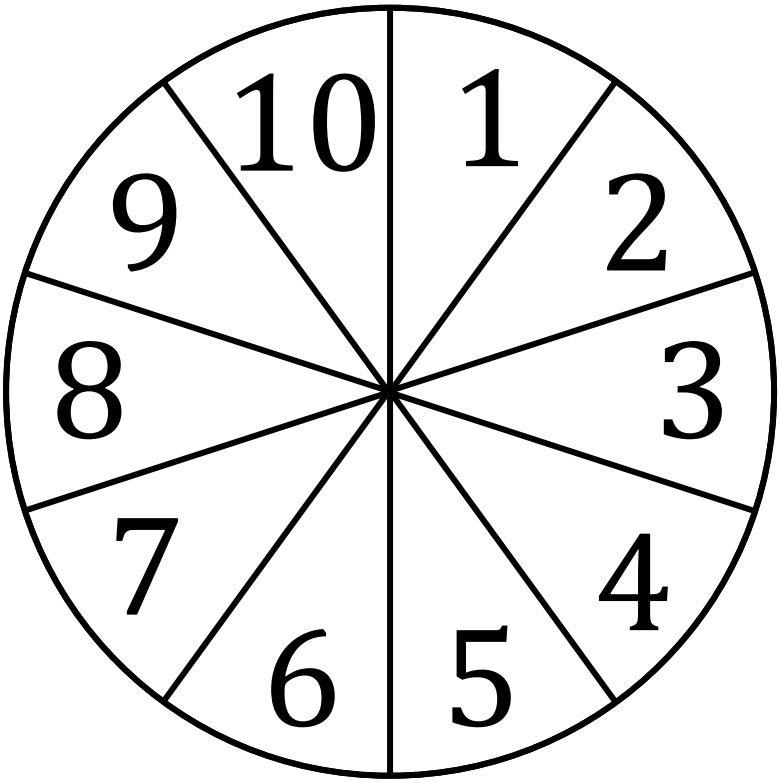


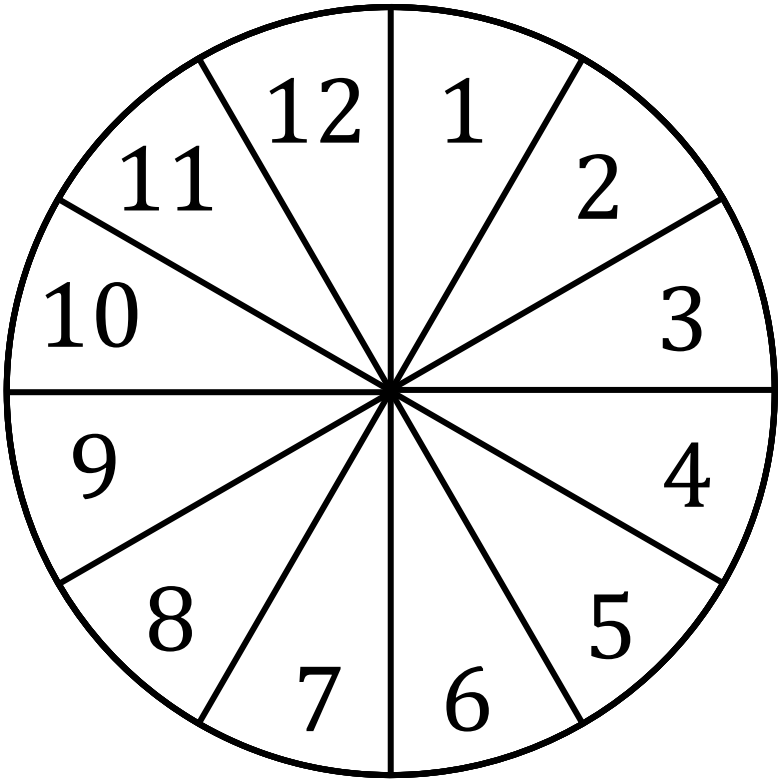


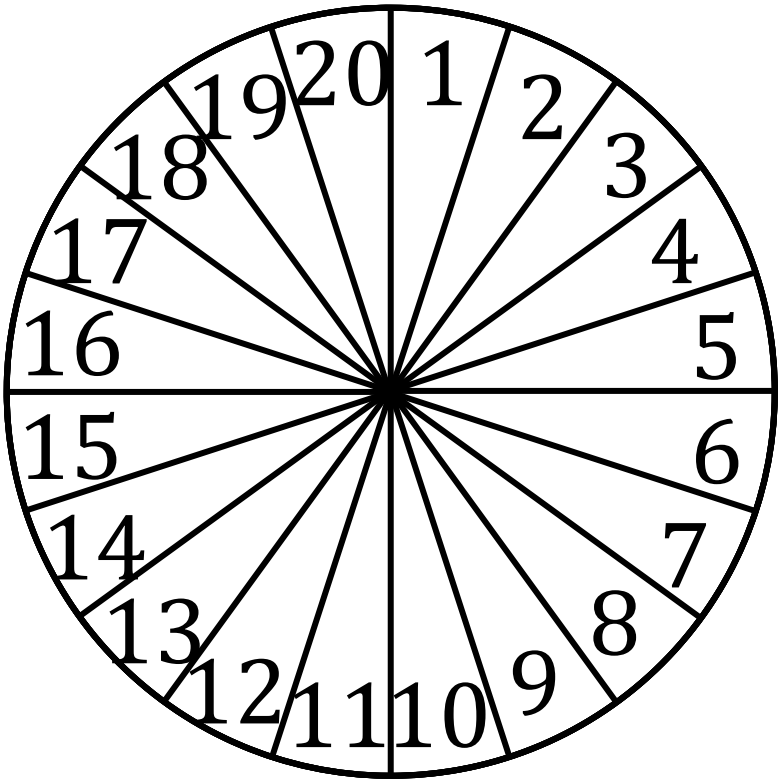












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- *Managing the Math Class, volumes 1 & 2* – Stop the paper chase. Here are two proven approaches to minimizing your paperwork so that you can focus on what matters most: your students, your lessons, and coffee!

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