Finding Your Batting Order

for 3rd- 5th Grade

Math Learning Goals:

- Apply the practice of changing fractions to percentages.
- Analyze data.
- Select data based on questions and guidelines.
- Classify events as likely or not likely using percentages.
- Use multiple trials to generate experimental probability data.
- Use mathematical and statistical modeling to strategically select a batting lineup and simulate a baseball game.

Materials Needed:

For Each Student or Group:

- 1 Player Statistics Activity Sheet
- 1 Batting Order Worksheet
- 1 Game Day Batting Order Worksheet
- 1 Baseball Diamond Activity Sheet
- 9 Percent Circle Sheets
- Set of small paper squares numbered 1-9
- Paper clips
- Sharp Pencils
- Scissors
- Calculators

For the Class:

- Answer Key – Batting Order
- Batting Order Overhead
- Sample Overhead for Marty McSingle

Intro:

First, ask if any of the students are familiar with baseball and its rules. Make sure there is at least one student that is comfortable explaining baseball in each group. Then, pass out the activity sheets for each group. These will help you as you explain this activity. You only need one copy of the overheads.

Provide each group with a sharp pencil and a paper clip with one end straightened, to serve as a spinner. The percent circle sheets will be given to each student.

Start with a discussion about baseball and softball. Ask students if they play either sport. Guide the discussion toward scoring runs. Explain that runs are scored when a player circles the bases and reaches home plate. Ask, "How do you determine which team wins?" [The team that has scored more runs when the game is over wins.] Ask students to explain how a batter can get on base, and how runners advance on the bases. As you are doing this, write the ways players can get on base on the board, along with the common abbreviations: walk W, single 1B, double 2B, triple 3B, home run HR. Be sure to address how a batter gets an out. There are three common ways that an out is made:

1. A ground out: when a batter hits the ball on the ground in fair territory (between the first base line and the third base line) and the team on the field gets the ball to first base before the runner reaches first base.
2. A fly out: when a batter hits a ball in the air, and it is caught by the team on the field before it touches the ground.
3. A strikeout: when a batter gets three strikes. A strike occurs when the batter swings and misses, the batter does not swing at a "good" pitch in the "strike zone," or the batter hits a foul ball that is not caught. The third strike must be a swing and miss, or a foul tip that the catcher catches, or when the batter is "caught looking" at a pitch that is in the strike zone.

Next, ask questions about which type of batter usually bats first, second, third, etc. Guide the discussion toward the following guidelines using the Batting Order Overhead:

- The first batter is usually someone who gets on base a lot.
- Players who get on base a lot usually bat 1st through 5th.
- The 3rd, 4th , and 5th batters usually have a lot of doubles and home runs.
- The 4th batter usually has the most home runs on the team.
- You want to avoid having consecutive batters who do not get on base a lot.

The Activity:

Separate the class into "teams" of 2 or 3 and distribute the Player Statistics Activity Sheet and Batting Order Activity Sheet. Have students name their teams.

Explain to students that they will be using the provided statistics to select 9 players for their team and determine their team's batting order. Refer to the overhead to remind students of the criteria for building a batting order. Ask questions such as, "How do you determine who gets on base a lot?" to help guide students in making their decisions. As students analyze the statistics and choose their players, make sure they are filling out their batting orders in the "Player" column.

Next, all groups should have their batting orders filled out. Begin a class discussion about each group's batting order, and which players they chose for 1st batter and 4th batter. Guide the discussion toward the terms "chance" and "likely" in order to introduce the concept of probability. Ask questions such as, "Which of your players is the most likely to get on base?"

Begin the next period by summarizing the activities from the previous period. Place the Batting Order Overhead on your projector during the discussion. Ask:

- "Which of your players is most likely to hit a home run?"[Answers will vary but the higher the number in the HR column, the more likely the player will hit a home run. In the Player Statistics Activity Sheet, this would be Chang.]
- "Will the player hit a home run every time he is up to bat?" [No.]
- "Which of your players is most likely to get on base?" [Answers will vary depending on players on a team, but the player with the lowest number in the "Outs" column is most likely to get on base. For example, Martinez is more likely than Lin to get on base.]
- "How do you think knowing the players' statistics and the guidelines on the overhead help a team score runs?" [By using each player's statistics as a measure of likelihood of getting hits, a manager can plan a batting order in which the team has the best chances of scoring the most runs. The manager would be using what is called mathematical and statistical modeling, and we can do it too!]

Tell students they will start by preparing a visual display for each player's statistics. Display the Sample Overhead for Marty McSingle. Explain that there are two steps in this process:

- Determining a percent for each type of event (single, out, walk, etc.)
- Using the percent to determine the size of each section on the disc.

Explain that in the next period students will use a percent circle sheet to measure the size of each section on the disk. First, they need to calculate the percents.

Using the overhead, demonstrate that you first add all of the values to find the total number of events, which is 50. Then you divide each statistic by the total to get a decimal, which is converted to a percent by multiplying the decimal by 100 (or moving the decimal 2 places to the right). Briefly discuss the concept of percents: if a result is 9%, it means "9 per hundred."

Using Marty McSingle's statistics, the section representing home runs (HR) is calculated by: 2/50 = 0.04 = 4%. Explain that this means you would expect Marty to hit 4 home runs for every 100 times that he is the batter. Have students take turns calculating the percents for Marty, and fill in the rest of the bottom row on the overhead with the calculated percents.

Tell students to determine all of the percentages for their batters, recording their data on the Batting Order Activity Sheet. Students will need guidance as they perform the calculations. Circulate among the groups to gauge progress. After students have worked on several players, provide a shortcut - tell them that the total number of events (walks, hits, and outs) is always 50 for these data, so they can use 50 as the denominator every time. Ask, "Can anyone tell me a time-saving rule for finding the percent when the denominator is 50?" [Just double the numerator to find the percent.] Stress that this rule works because doubling the numerator and denominator creates an equivalent fraction with the denominator being 100.

End this period with a discussion about the relationship between the percents and the combined part of the whole that walks, hits, and outs represent. Make a connection between greater percents and greater likelihood.

Begin the next period by reviewing the information discussed in the previous class. Display the sample player overhead, and tell the students they will use the converted percentages to make a visual display such as the one in the overhead. Use simple examples to show how 50% represents half of a circle, 25% represents one-fourth of a circle, etc. Tell students that they will be creating a disc for each player.

Then, using the statistics for Kelley, demonstrate the use of a percent circle to determine the angle for each category.

(Using Kelley will match data given in the Baseball Probability Activity Sheet 2 Answer Key.) These are the steps:

- Draw a radius in the circle.
- Explain that it's important to begin with the smallest value (2%). Beginning with the smallest category will ensure that all categories will be represented on the disk, because these are approximate measures.
- Mark the 2% mark, which corresponds with the calculated size of Kelley's section for home runs. Draw a radius to this mark, and label the section as "HR."
- Continue through all types of hits, walks, and outs, using the lowest percentages first. Make the sections adjacent, and label each section.
- Finally, you will be left with one last section, for example "singles." Check the measure of this section to be sure it is close to the calculated percent value for singles.

Teacher will develop a disk for Kelley.

Have the student groups complete a disk for every player the group selected, and label the disks with the players' names. End the class by having students share some of their disks. Based on the sizes of certain sections, ask questions such as, "What is the likelihood of this player making an out? A home run?" and "On a scale of 0 to 10, where 0 is never happens and 10 is certain to happen, how likely is each event to occur for each player?"

Begin the next period by asking students if they have any questions from the previous period. Tell students that today they will be playing a baseball game using the player disks they created. Using the player disks, the small paper squares numbered 1 - 9, the Game Day Batting Order Activity Sheet, and the Baseball Diamond Activity Sheet, students are ready to "play ball!" They first need to fill out the names of their players on the Game Day Batting Order Activity Sheet, which will be used to tally the number of runs scored. The names should be in the same order as on the Batting Order Activity Sheet.

Pass out the spinner parts (the pencil and paper clip) to each group. Demonstrate an "at bat" using the Sample Overhead for Marty McSingle. The paper clip should be unbent at one end. Use the pencil point to hold the paper clip in place at the center of the circle. Spin the paper clip with a flick of a finger, making sure the spinner spins at least a few times before stopping. If the spinner stops on the "out" section, it would be recorded with a tally mark as the first out in Inning 1. If the spinner

lands on, for example, a single (1B), the square labeled "1" would be placed on first base on the Baseball Diamond Activity Sheet. This sheet will be used to track the progress of the batters around the bases. During the demonstration for the class, you might draw a representation of the baseball diamond on the board and draw where the player's square would go.

Explain that the spinner is then spun for Player 2. If a hit occurs, place the square labeled "2" accordingly. Be sure to use the correct numbered squares to represent each player's position in the batting order.

Explain to students that to avoid arguments in this simulation, runners on the bases always move ahead exactly the same number of bases as the number that corresponds to the hit:

- On an out, all runners stay where they are.
- On a single or a walk, all runners advance 1 base;
- On a double, all runners advance 2 bases;
- On a triple, all runners on base score (because they advance 3 bases).
- On a home run, all runners score, including the batter.

For example, suppose Player 1 is on 2nd base, and Player 2 then hits a double. As a result, Player 1 will advance 2 bases to reach home plate. At that point, you could tally 1 run for Player 1 using the "RUNS SCORED" column of the Game Day Batting Order Activity Sheet. You would also tally 1 run in the first inning on the Baseball Diamond Activity Sheet. Proceed until three outs are registered, at which point the inning is over. Then add up the tallies for runs scored for that inning, and record it in the table.

There are two options for the game. You can have each group play a game of 6 or 9 innings to see how many runs they score. Or, you can have one group play another group for 6 or 9 innings (in each inning both teams get a turn to bat until they make three outs). Although there is the possibility that two groups may have some of the same batters, tell them they are testing their selections and the order of their batters. Tell the students that they just did some mathematical modeling.

The students then will begin a discussion using the questions below:

How did you decide on the batting order for your team?
[Answers will vary. Students can share problems they had, such as having 4 players in a row at the end of the batting order who make a lot of outs. They also may have had problems with a player like Chang, who gets lots of hits (suggesting he should be Player 1), but also hits a lot of home runs (suggesting he should be Player 4).]

1. How did you make use of the percent circle?
   [Answers may vary. Sample answer: I'm not sure how I would have made the sections of the circle the right size without it. I could have made sections that were easy, like 50% or 25%. Maybe I could have divided sections further to make other more difficult sections. For example I could divide a quarter circle in half to make a section that is about 12%.]
2. Compared to what you expected, were there players you felt were "lucky" because they got more hits or more home runs than you expected? Be specific in your answer by using numbers or percents.
   [Answers will vary. Sample answer: Kelley got 1 home run in 7 at bats. You would expect

Kelley to get 1 home run in 50 at-bats. I think Kelley was lucky because she got a home run about 7 times more often than expected.]

3. Did you feel your strategy for making the batting order succeeded? Why or why not? If you were to play another game, are there any changes you would make to your batting order? Give reasons based on player performance for your change.
   [Answers will vary. Students may realize that many trials would be needed to decide whether one strategy was usually better than another.]
4. Do you think this outcome is likely to happen in real-life? What are some of the factors we did not use that could happen in real – life?

[Answers will vary. Students will probably answer with weather and the players attitudes or who is having a bad night.]

TN Math Standards:

3rd Grade:

Operations and Algebraic Thinking:

3.)Use multiplication and division within 100 to solve word problems in situations involving equal arrays, groups, and measurement quantities.

7.) Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division or properties of operations.

4th Grade:

Number and Operations:

3b.) Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions by using a visual fraction model.

3c.) Add and subtract mixed numbers with like denominators by replacing each mixed number with an equivalent fraction and/or by using properties of operations and the relationship between addition and subtraction.

3d.) Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators by using visual fraction models and equations to represent the problem.

5th Grade:

Numbers and Operations in Base Ten:

7.) Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

Number and Operations:

6.) Solve real world problems involving multiplication of fractions and mixed numbers by using fractions models or equations to represent the problem.

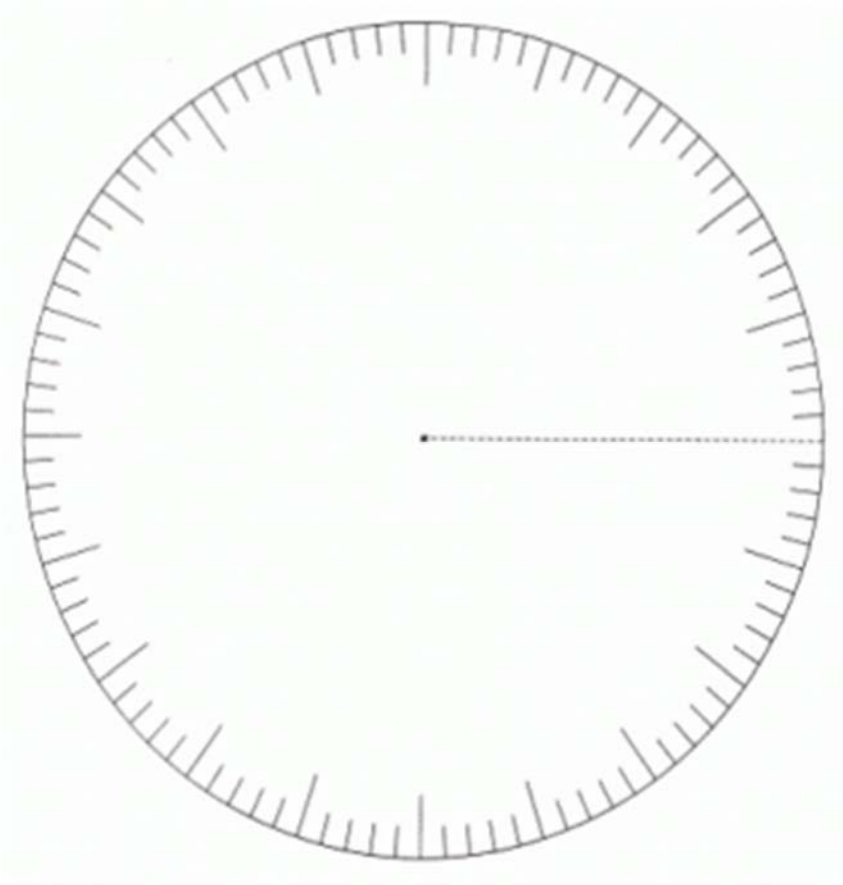
Source:

Mathematics, N. C. (2015, April). *Making a Baseball Lineup: Using Baseball Statistics to Create a Baseball Game Simulation*. Retrieved April 2015, from National Council of Teachers of Mathematics: http://www.nctm.org/classroom-resources/lessons/Making-a-Baseball-Lineup_-Using-Baseball-Statistics-to-Create-a-Baseball-Game-Simulation/

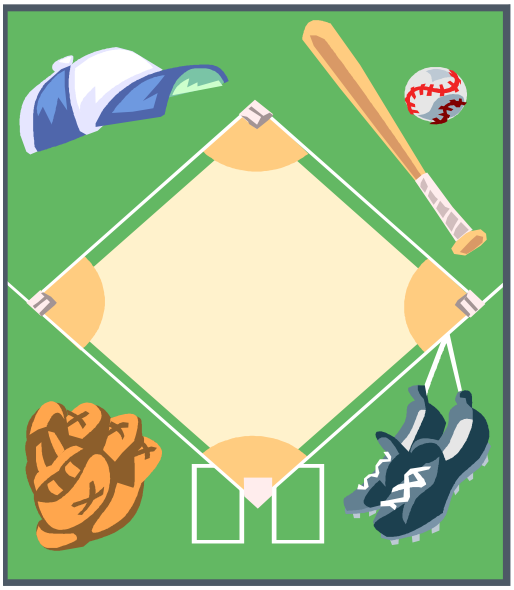
Edited by: Virginia Parkman, Kelly Sturner, and Suzanne Lenhart

Team Name: _____

Player Name: _____

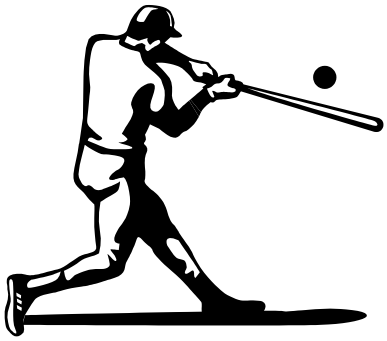


Batting Order



- The first batter is usually someone who gets on base a lot.
- Players who get on base a lot usually bat 1st through 5^{th}.
- The 3rd, 4th, and 5th batters usually have a lot of doubles and home runs.
- The 4th batter usually has the most home runs on the team.
- You want to avoid having consecutive batters who do not get on base a lot.

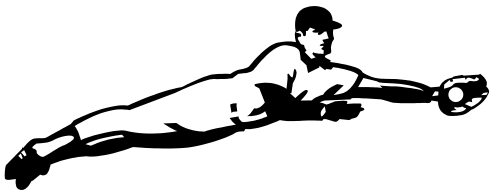
Player Statistics



The following table shows the statistics of several baseball players. Select 9 players for your batting order.

PLAYER	WALKS	1B	2B	3B	HR	OUTS
Davis	2	9	3	1	5	30
O'Brien	10	15	5	2	0	18
Dasari	4	7	1	3	1	34
Lin	5	10	0	2	2	31
Martinez	9	13	4	3	0	21
McGhee	11	14	4	3	1	17
Chang	3	10	1	1	8	27
Jones	9	11	6	3	0	21
Lloyd	2	7	0	2	1	38
Graham	3	7	1	1	6	32
Stewart	8	12	5	3	0	22
Kelley	9	17	4	3	1	16
Robinson	8	16	5	1	1	19
Abrahm	4	8	0	2	1	35
Yoder	9	15	4	3	0	19

Batting Order



Team Name_____

Determine the percent of each type of hit, walks, and outs.

PLAYER	W %	1B %	2B %	3B %	HR %	OUTS %

Game Day Batting Order

Fill in the names of your players. Record the number of runs each player scores.

Batting Order Number	Player	Runs Scored
1		
2		
3		
4		
5		
6		
7		
8		
9		

Inning	1	2	3	4	5	6	7	8	9
Outs									
Runs Scored									

Baseball Diamond

NAME_____

Answer Key – Batting Order

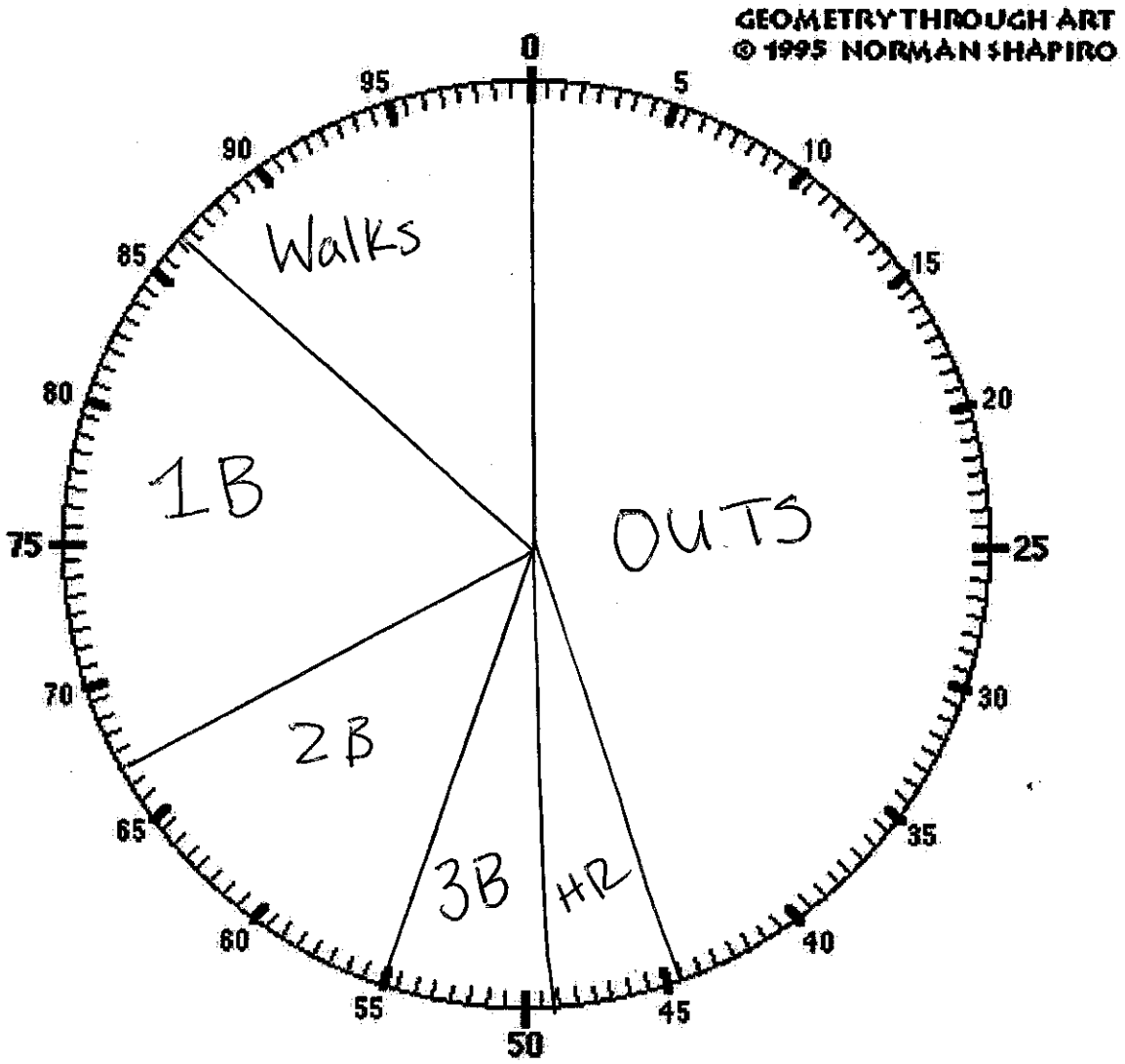
Determine the percent of each type of hit, walks, and outs.

Player	W %	1B %	2B %	3B %	HR %	Outs %
Kelley	**9 18%**	**17 34%**	**4 8%**	**3 6%**	**1 2%**	**16 32%**
Yoder	**9 18%**	**15 30%**	**4 8%**	**3 6%**	**0 0%**	**19 38%**
Jones	**9 18%**	**11 22%**	**6 12%**	**3 6%**	**0 0%**	**21 42%**
Chang	**3 6%**	**10 20%**	**1 2%**	**1 2%**	**8 16%**	**27 54%**
Robinson	**8 16%**	**16 32%**	**5 10%**	**1 2%**	**1 2%**	**19 38%**
Martinez	**9 18%**	**13 26%**	**4 8%**	**3 6%**	**0 0%**	**21 42%**
O'Brien	**10 20%**	**15 30%**	**5 10%**	**2 4%**	**0 0%**	**18 36%**
McGhee	**11 22%**	**14 28%**	**4 8%**	**3 6%**	**1 2%**	**17 34%**
Stewart	**8 16%**	**12 24%**	**5 10%**	**3 6%**	**0 0%**	**22 44%**

Answers will vary. Sample answers shown.

Team Name: Rangers

Player Name: Marty McSingle



	Walks	1B	2B	3B	HR	OUTS	Total
Walks/ Hits/ Outs	7	10	6	3	2	22	50
Percent of Total	14%	20%	12%	6%	4%	44%	100%