Batter Up!
Thematic Unit of Study

I. Introduction – rationale, goals, target audience

It's the final day of the 1941 season and Ted Williams' batting average is .39955. What will he do? Sit this one out and guarantee an historic .400 season or take a chance and aim for mathematic immortality? Find the answer to this and other exciting stories in a dugout full of whole numbers, fractions and decimals, percentages, proportions and problem solving. Fun for fifth-graders and above, this thematic unit teaches fundamental concepts that connect the calculator and the clubhouse while learning, using and interpreting the statistics of famous ballplayers. Computation is the key in determining batting averages and slugging percentages. Will it be a single, double, triple or home run? It all depends on the hitter's math skills in this interactive game where long division and the long ball are one and the same. Batter up!

II. Objectives – in completing this lesson, students will:

A. **Examine** how everyday mathematical concepts, such as addition, subtraction, fractions, decimals, etc., apply to baseball and the real world.

B. **Analyze** baseball statistics and interpret data in terms of fundamental mathematic operations.

C. **Understand** the application of baseball statistics and how they are calculated using basic mathematical principles.

III. Preparing the Students

A. Background

Baseball fans love the numbers of the game. True enthusiasts, especially those who have studied the history of our National Pastime, are able to tell you the significance of numbers, such as Joe DiMaggio's 56 game hitting streak in 1941, Ted Williams' .406 batting average in 1941, Barry Bonds' 73 home runs in 2001, and Ty Cobb's .367 lifetime batting average. Some could even tell you why and how numbers such as: Babe Ruth's 60 home runs, Ty Cobb's 4,191 lifetime hits, and Lou Gehrig's 2,130 consecutive games played have been surpassed by larger numbers. Through studying baseball statistics and daily boxscores, students not only learn about the game, but also about math – especially fractions and decimals. Knowing that one hit in four at bats represents the fraction ¼, which in turn computes to a batting average of .250,

can provide an early introduction to whole numbers, fractions and decimal conversion, percentages, proportions and problem solving.

B. Vocabulary

At bat
Average*
Batter
Batting average
Boxscore
Decimal*
Double
Doubleheader
Earned Run Average (ERA)
Fraction*
Grand slam
Hit
Home run
Inning
Lineup
Percentage*
Pinch hitter
Proportion*
Ratio*
Single
Slugging percentage
Statistics*
Total bases
Triple

*Mathematical definitions

C. Suggested Pre-Program Activities

1) Ask students to brainstorm everything they know about baseball and any related math concepts that come to mind (e.g. batting average, on-base percentage, etc.). Discuss their ideas; list all words and concepts on a "word wall" so they can see their responses. Categorize the words if necessary.

2) Using baseball cards, put the players in order according to their respective batting averages beginning with the highest batting average descending to the lowest batting average. Use statistics from the most recent year listed on the back of the baseball card.

3) Pass out note cards with simple fractions to each student in the class. Ask the students to convert the fraction into a batting average. Students should put themselves in order from the highest batting average to the lowest. Add the fractions to compute a collective batting average for the entire class.

4) Collect statistics from actual softball, baseball or physical education games in which the students are involved; after the unit is complete, ask students to calculate individual and class batting averages or slugging percentages using these statistics.

5) Teach the students to score an actual baseball game and convert the players' performances into individual and team batting averages.

IV. Presentation

A. Opening

1) Tell the story of Ted Williams. Show a picture of Williams and tell of his heroic exploits in World War II and the Korean War. Explain that on the final day of the 1941 season, his average was .39955 – rounded to the nearest hundredth as .400. Did he sit out the last two games of the year and protect his .400 average? Or, did he try for an even higher average and risk his record-setting season? What would you do if you were Ted Williams? We'll find out what happened at the end of this lesson.

2) Ask what Derek Jeter's batting average would be if he has one hit in three at bats. Explain that a decimal representation of that fraction, .333, also represents his batting average. Next, ask what his average would be if he went two for four in the following day's game. Add his numbers from the two games (three hits in seven at bats) to compute a combined batting average (.429) using fractions and decimals. Now, what would his cumulative batting average be if he goes hitless in three at bats the following day? The answer: three hits in 10 at bats equal an average of .300. *INSTRUCTOR NOTE: The player's name and numbers can be changed to reflect a local team or favorite athlete.*

B. Lesson

1) Using the Batter Up! *game guidelines*, play two innings of a simulated game where batters (students) complete *math problems* of varying difficulty. Students should be organized into teams with lineups. Correct answers result in singles, doubles, triples or home runs depending on their degree of challenge. Incorrect answers result in outs. Play two to three innings of a game, giving each student at least one at bat.

2) After the final inning of the game, return to the story of Ted Williams. Ask students to again guess what Ted Williams did on the final day of the season. Suggest different scenarios that might have resulted if Williams had gone hitless. What if Williams had gotten two hits in eight at bats? What if Williams had gotten three hits in eight at bats? What if Williams had gotten four hits in eight at bats? What would have happened to his .400 average in each of these cases? Would his average have gone up or down?

3) Reveal Williams' career statistics. Ask students to locate his final average for 1941. Explain that, in the final doubleheader of the season, he chose to play and went to bat eight times. With six hits in those eight plate appearances, his batting average rose to .406. No player since then has reached the .400 plateau.

4) Using an analysis of Ted Williams' career statistics as the model, distribute baseball cards to the students and ask them to answer various questions related to the data on those cards (e.g. Does anyone have a player with more than 300 home runs? Does anyone have a player who was born in the 1960s? Does anyone have a shortstop, a pitcher, an outfielder?).

C. Conclusion

1) Review with students what has been learned today, including the various mathematical concepts that were used in the game.

2) Ask students what they have learned about baseball history while playing this game.

V. Enrichment and Assessment Activities

A. Research the statistics for two baseball players of choice. Compare their performances and determine which of the two had a better year statistically. Write an analysis that justifies your position.

B. Write a skit or produce a video simulating a sportscast, incorporating statistics from a real or fictional baseball game. The announcer should use vocabulary terms that describe the game's action and its statistical highlights.

C. Pretend to be a newspaper sportswriter and create an article about a recent game, either real or fictional. Use vocabulary terms that describe the game's action and its statistical highlights.

D. Have students design and create baseball cards for themselves. The cards should list their position and include statistics, such as games, at bats, hits, doubles, triples, home runs, batting average and runs batted in. Use a computer and scanner to incorporate a photo of the student.

E. Design a baseball stadium using scale, proportion and angles. The ballpark can be based on an actual stadium or it can be fictional.

F. Ask students to hypothesize how changing distances in ballpark dimensions and baseball rules would affect statistics and player performance. These changes might encompass the distance to the outfield fence, distances between bases or the distance between the pitcher's mound and home plate.

G. Given a group of players and their individual statistics, order them according to their batting averages and slugging percentages. Compare and contrast the two lists, reasoning why some players might be higher on one list and lower on the other.

H. Using the principles learned in this lesson, encourage those students interested in other baseball statistics to learn how a pitcher's earned run average (ERA) is calculated (earned runs x 9 ÷ innings pitched = earned run average. EXAMPLE: 4 earned runs x 9 ÷ 5 innings pitched = 7.20 earned run average). Apply this equation to the computation of a collective ERA for an entire team.

VI. Additional Resources

A. Literature

Bench, Johnny. *The Complete Idiot's Guide to Baseball.* Alpha Books, 1999.

Buckley Jr., James. *The Visual Dictionary of Baseball.* Dorling Kindersley, 2001.

Dickson, Paul. *The Joy of Keeping Score.* Harvest Book, Harcourt Brace & Company, 1996.

Jennison, Christopher. *Baseball Math: Grandslam Activities and Projects for Grades 4-8*. GoodYearBooks, 1995.

Lorimer, Lawrence. *The National Baseball Hall of Fame and Museum Desk Reference.* Dorling Kindersley, 2002.

National Baseball Hall of Fame and Museum. *Baseball As America.* National Geographic Books, 2002.

Scheidt, Tim. *Fantasy Baseball: An Integrated Mathematics Unit.* Giant Step Press, 1999.

Smith, Robert. *Thematic Unit: Baseball.* Teacher Created Materials, Inc., 2001.

Thorn, John. *Treasures of the Baseball Hall of Fame.* Villard, 1998.

B. Web Links

baseballhalloffame.org
Official site of the National Baseball Hall of Fame and Museum

baseball-almanac.com/bstatmen.shtml
The Baseball Almanac (statistics)

mlb.com
Official site of Major League Baseball

http://teacher.scholastic.com/products/instructor/baseballmath.htm
Scholastic.com Math Baseball site

sportsillustrated.cnn.com/
CNN and Sports Illustrated

D. Multi-Media Gallery

Photograph of Ted Williams
Photograph of Joe DiMaggio

Photograph of Barry Bonds
Photograph of Babe Ruth
Photograph of Ty Cobb
Photograph of Lou Gehrig
Photograph of Derek Jeter
Baseball card of Ted Williams

VII. Relevant National Learning Standards

A. Math

1) Work flexibly with fractions, decimals and percents to solve problems.

2) Compare and order fractions, decimals and percents efficiently and find their approximate locations on a number line.

3) Understand and use ratios and proportions to represent quantitative relationships.

4) Understand the meanings and effects of arithmetic operations with fractions, decimals and integers.

5) Use the associative and commutative properties of addition and multiplication and the distributive property of multiplication over addition to simplify computations with integers, fractions and decimals.

6) Select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers and paper and pencil, depending on the situation, and apply the selected methods.

7) Develop and analyze algorithms for computing with fractions, decimals and integers and develop fluency in their use.

8) Develop and use strategies to estimate the results of rational-number computations and judge the reasonableness of the results.

9) Develop, analyze and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios.

10) Represent, analyze and generalize a variety of patterns with tables, graphs, words and, when possible, symbolic rules.

11) Relate and compare different forms of representation for a relationship.

12) Use graphs to analyze the nature of changes in quantities in linear relationships.

13) Precisely describe, classify and understand relationships among two- and three- dimensional objects using their defining properties.

14) Understand relationships among the angles, side lengths, perimeters, areas and volumes of similar objects.

15) Create and critique inductive and deductive arguments concerning geometric ideas and relationships, such as congruence, similarity and the Pythagorean relationship.

16) Draw geometric objects with specified properties, such as side lengths or angle measurements.

17) Use geometric models to represent and explain numerical and algebraic relationships.

18) Recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science and everyday life.

19) Understand, select and use units of appropriate size and type to measure angles, perimeter, area, surface area and volume.

20) Select and apply techniques and tools to accurately find length, area, volume and angle measures to appropriate levels of precision.

21) Develop and use formulas to determine the circumference of circles and the areas of triangles, parallelograms, trapezoids and circles and develop strategies to find the area of more complex shapes.

22) Solve problems involving scale factors, using ratio and proportion.

23) Formulate questions, design studies and collect data about a characteristic shared by two populations or different characteristics within one population.

24) Select, create and use appropriate graphical representations of data, histograms, box plots and scatterplots.

25) Discuss and understand the correspondence between data sets and their graphical representations, especially histograms, stem-and-leaf plots, and scatterplots.

26) Build new mathematical knowledge through problem solving.

27) Solve problems that arise in mathematics and in other contexts.

28) Apply and adapt a variety of appropriate strategies to solve problems

29) Monitor and reflect on the process of mathematical problem solving.

30) Make and investigate mathematical conjectures.

31) Develop and evaluate mathematical arguments and proofs.

32) Select and use various types of reasoning and methods of proof.

33) Organize and consolidate their mathematical thinking through communication.

34) Communicate their mathematical thinking coherently and clearly to peers, teachers and others.

35) Analyze and evaluate the mathematical thinking and strategies of others

36) Use the language of mathematics to express mathematical ideas precisely.

37) Recognize and use connections among mathematical ideas.

38) Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.

39) Recognize and apply mathematics in contexts outside of mathematics.

40) Create and use representations to organize, record and communicate mathematical ideas.

41) Select, apply and translate among mathematical representations to solve problems.

B. Technology

1) Students demonstrate a sound understanding of the nature and operation of technological systems.

2) Students are proficient in the use of technology.

3) Students practice responsible use of technology systems, information and software.

4) Students use technology tools to advance learning, increase productivity and promote creativity.

5) Students use productivity tools in constructing technology-enhanced models, prepare publications and produce other creative works.

6) Students use telecommunications to collaborate, publish and interact with peers, experts and other audiences.

7) Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

8) Students use technology to locate, evaluate and collect information from a variety of sources.

9) Students use technology tools to process data and reports results.

10) Students use technology resources to solving problems and making informed decisions.

11) Students employ technology in the development of strategies for solving problems in the real world.

C. Language Arts

1) Students read a wide range of print and non-print texts to build an understanding of texts, of themselves and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.

2) Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audience and for different purposes.

3) Students conduct research on issues and interests by generating ideas and questions and by posing problems. They gather, evaluate and synthesize data from a variety of sources (e.g. print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

4) Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

5) Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information).

D. Theater Arts

1) Students individually and in groups, create characters, environments and actions that create tension and suspense.

2) Students in an ensemble, interact as the invented characters.

3) Students apply research from print and non-print sources to script writing, acting, design and directing choices.

E. Visual Arts

1) Students integrate visual, spatial and temporal concepts with content to communicate intended meaning in their artworks.

2) Students use subjects, themes and symbols that demonstrate knowledge of contexts, values and aesthetics that communicate intended meaning in artworks.