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Math

The focus of these lessons is the mathematics of basketball. Students develop important math skills while reading and completing box scores, adding and subtracting scores, computing shooting percentages, creating and interpreting double bar graphs, estimating, investigating tournament brackets and studying measurements. Numerous historical anecdotes as well as some surprising sports trivia add to your students' enjoyment.

LESSON

1

Basketball Box Scores

Students practice addition, subtraction and multiplication as they complete and verify the totals for a past Division I men's basketball championship box score.

National Standards: NM.K-4.1, NM. 5-8.1, NM. K-4.8, NM. 5-8.7
Skills: Adding, subtracting and multiplying whole numbers, reading box scores, verifying answers
Estimated Lesson Time: 40 minutes

Teacher Preparation

- Duplicate the Basketball Box Scores worksheet on pages 171-172 for each student.
- Use a photocopier to enlarge the box score found on the worksheet on page 171 and make a transparency of the enlargement.
- Collect the items listed under Materials.
- (Optional) Collect copies of box scores from local newspapers.

Materials

- 1 copy of the Basketball Box Scores worksheet on pages 171-172 for each student
- 1 pencil for each student
- The transparency of the enlarged box score

Background Information

Throughout a basketball game, the team statistician as well as statisticians from the newspapers record all the important game details. They compare notes, both at halftime and at the end of the game, so their facts will be correct when they prepare the box score. The next day, fans, coaches and players can study the data in the box score. The box score contains the following information: the location and dates of the game; the names of the teams, players and officials; the halftime and final scores; and the important data for each player and for the team as a whole. The data are listed using a number of standard abbreviations, explained here:

min—Minutes played

FG-FGA or FGM-FGA—Field goals made and field goals attempted. (The number includes both two-point and three-point baskets.)

3P-3PA or 3PM-3PA—Three-point field goals made and three-point field goals attempted.

FTM-FTA—Free throws made and free throws attempted.

RB—Rebound. (A rebound is the capture of a ball in the air after a missed shot. This number is often broken down as **o-t**, meaning offensive and total.)

A—Assists. (An assist is a pass to a player who then makes a basket.)

PF—Personal fouls.

TP—Total points. (This means the sum of the points earned from three-point field goals, two-point field goals and free throws.)

Introduce the Lesson

Show students some newspaper sports pages containing box scores from local NCAA® college basketball games. Briefly discuss how this information is important to coaches, players and fans because it helps them gauge how well players are performing. Show the transparency of the partially completed box score and tell the students that they will practice the math they need to read and verify box scores.

Follow These Steps

1. To familiarize students with box scores, ask questions about the information on the transparency. Who won the game? What were the halftime and final scores?
2. Discuss and explain the abbreviations. Ask questions such as, “How many field goals did Player B2 make? How many did he attempt? How many were three-point field goals? How many were two-point field goals?” (*8, 17, 5, 8 – 5 = 3.*)
3. Tell students they are going to finish the box scores by computing the total points and the totals. Begin with Player A1.

    Total field goals made = 7

    Total 3-point field goals made = 1 ← Subtract 1 from 7.

    Total 2-point field goals made = 6

    Total free throws = 3

    Player A1’s total points = (3 × 1) + (2 × 6) + 3 = 3 + 12 + 3 = 18
4. Do another example if necessary. Then have the students work in pairs to find the total points for Team B’s players. Circulate around the classroom as they work and spot-check answers.
5. Direct students to fill out the *Totals* row by adding the columns. Warn them to be careful with the *FG-FGA* column as the numbers are not properly lined up.
6. Write in the correct answers to the *Totals* column and discuss any errors. Help students to verify their work by recomputing the team’s total points using the same method they used to compute the individual totals.

$$(3 \times \text{total 3-point field goals}) + (2 \times \text{total 2-point field goals}) + \text{total free throws} =$$

$$(3 \times 9) + (2 \times 21) + 13 = 27 + 42 + 13 = 82$$

If this total agrees with the total of the *TP* column, the work is correct.

7. For homework, assign students to complete Team B’s portion of the box score in the same manner.

Extend and Vary the Lesson

- Invite a local college or university Sports Information Director (SID) or newspaper or college basketball team statistician to visit the class and explain what the job entails as well as his or her method for verifying box scores.

- Find some box scores in which the rebounds are broken down into offensive and total (o-t). See the current *Basketball Statisticians Manual* to see how the rebounds can be used to check box scores. You can find this manual at the NCAA® Web site, **www.ncaa.org**. Once at this site, select Site Index; then under the topic basketball select Statistics; then select Men's Basketball; then select Statisticians' Manual; then select View Online; Balancing a Box Score is located on page 22.
- Read to students from sections of *The World of Sports Statistics* by Arthur Friedman with Joel H. Cohen. The book gives an entertaining look at sports, players and fans as seen through the eyes of a sports statistician.
- See lesson 4 in this section, "Math in the Sports Pages," to figure various percentages, which also sometimes appear in box scores.

References

Benson, M., ed. 2001. *2002 Men's NCAA Basketball Records*. Indianapolis: National Collegiate Athletic Association.

Suggested Readings

Friedman, A., J.H. Cohen. 1993. *The World of Sports Statistics*. Encore Editions.

Basketball Box Scores

Name______________________________________ Date___________________

Ever wonder how to read and check the box score that appears in the newspaper the day after a basketball game? Sports statisticians are responsible for making box scores. Complete this box score for a past Division I men's championship basketball game.

Directions

1. Fill out the total points (TP) column. Follow the example here.
   - Begin with Team B's Player 1. Find the number of 2-point field goals he made.

     Total field goals made: 7

     Total 3-point field goals made: 1 ←Subtract 1 from 7.

     Total 2-point field goals made: 6

     Total free throws: 3
   - Compute how many points Player B made.

     TP = (3 × 3-point field goals) + (2 × 2-point field goals) + FT

     = (3 × 1) + (2 × 6) + 3

     = 3 + 12 + 3

     = 18
2. Find the totals for each column. Add carefully since the numbers are not lined up perfectly.
3. To verify the totals, compute the team's total points using the same method you just used to compute the individual totals.

Team A	**FG-FGA**	**FTM-FTA**	**RB**	**PF**	**TP**
Player 1	7-13	1-3	8	2	______
Player 2	5-9	0-1	11	4	______
Player 3	8-15	6-8	11	4	______
Player 4	2-11	3-4	3	2	______
Player 5	4-17	2-3	4	1	______
Player 6	2-6	0-0	3	3	______
Player 7	0-0	0-0	1	4	______
Player 8	0-0	0-0	8	0	______
Team					
Totals	______	______	______	______	______

Team B	**FG-FGA**	**FTM-FTA**	**RB**	**PF**	**TP**
Player 1	7-14	3-6	11	1	______
Player 2	8-17	0-1	3	3	______
Player 3	0-1	0-0	2	1	______
Player 4	3-5	2-3	4	2	______
Player 5	5-15	4-6	3	4	______
Player 6	2-3	2-3	3	3	______
Player 7	5-9	2-3	12	3	______
Team			4		
Totals	______	______	______	______	______

Halftime: Team B: 35, Team A: 33. Three-point field goals: Team A: 4-22 (Player 1: 4-8, Player 3: 0-1, Player 4: 0-8, Player 5: 0-4, Player 6: 0-1); Team B: 9-27 (Player 1: 1-5, Player 2: 5-9, Player 4: 1-1, Player 5: 2-11, Player 6: 0-1). Officials: Scott Thormley, Frankie Boudreaux, Ed Corbett. Attendance: 45,994

LESSON 2

The Net in Sports and in Math

Students will score in visualizing three-dimensional objects when they practice with nets of polyhedrons.

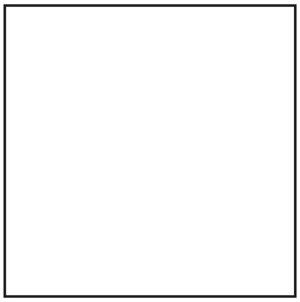
National Standard: NM.K-4.1, NM.K-4.2, NM.K-4.3, NM.K-4.9, NM.5-8.12.
Skills: Solving problems, using models to verify and defend answers, visualizing the solid given the net
Estimated Lesson Time: 40 minutes

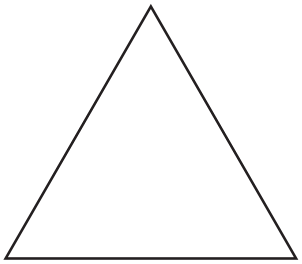
Teacher Preparation

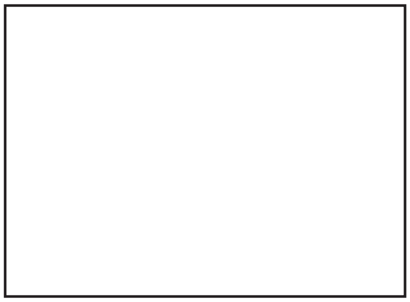
- Duplicate the Net: A Word With Many Meanings worksheet on pages 176-177 for each student.
- Collect the items listed under Materials.
- Using card stock, draw and cut out models of nets 1, 2, 4 and 6 as shown in the lesson plan. (Trace around the poster board shapes to make the nets.)
- Fold net 1 to make a tetrahedron. Tape the edges.
- Create student groups, with 3 to 4 students per group.

Materials

- 1 copy of the Net: A Word With Many Meanings worksheet on pages 176-177 for each student
- 1 roll of tape for each group
- 1 sheet of card stock for each student
- 1 pencil for each student
- 1 triangle, 1 rectangle and 1 square for each student (precut from lightweight poster board using the models below) for use as templates in making nets







Background Information

Basketball, tennis, volleyball and soccer all use different types of nets. We also use nets in mathematics. In math, a *net* is a pattern made by the edges of a hollow three-dimensional figure that has been opened along its edges and then flattened. A *polyhedron* is a three-dimensional figure with sides that are polygons. *Polygons* are closed two-dimensional shapes whose sides are straight lines (e.g., triangles, rectangles, squares and so on). The flat sides of a polyhedron are called *faces;* the sides of the polygons are *edges;* and the points where three or more edges meet are called *vertices.* This pattern made by all the flattened edges looks like a piece of fishing net.

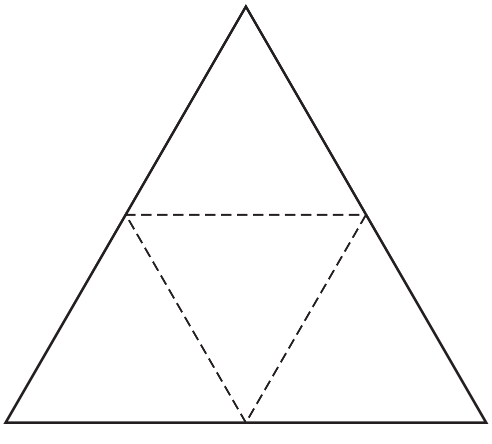
We will look at some nets and decide if they will fold to form a tetrahedron, a cube or a triangular prism. A *tetrahedron* is a polyhedron with four triangular faces. The faces of the tetrahedrons in this lesson are all equilateral triangles. A *cube* is a polyhedron with six square faces. A *triangular prism* is a polyhedron with two identical triangular faces that are parallel and three more rectangular faces. The worksheet contains pictures of a tetrahedron, a cube and a triangular prism.

Introduce the Lesson

Point out that a word can have many different meanings and that frequently these meanings are related. Brainstorm different meanings of the word *net.* Tell students that our goal is to understand the mathematical meaning of the word *net.*

Follow These Steps

1. Hold up three polyhedrons: a tetrahedron, a prism and a cube. Point out the edges, faces and vertices. Hold up the tetrahedron and say you will reveal the net. Slit the tape holding the sides together; open the tetrahedron; and, using a marker, trace the edges and creases to show the net. Copy the net onto the chalkboard. Ask students to imagine the three outer triangles folding up to make the tetrahedron. Then fold the tetrahedron back together again as they watch.



2. Say that each polyhedron has many nets. Draw the following nets on the chalkboard and ask the students to decide which are actually the nets of a tetrahedron. Demonstrate how tracing around the poster board triangle makes it easy to produce good nets that can later be cut out and folded.

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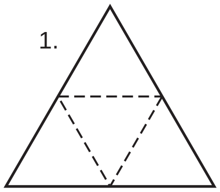

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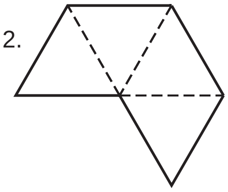

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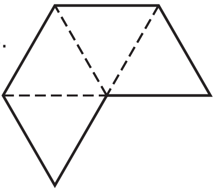

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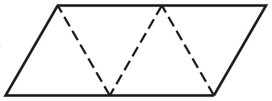

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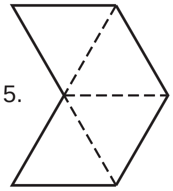

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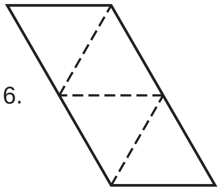

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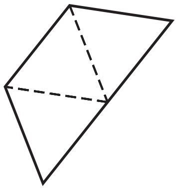


3. Discuss the answers. (*These points should be made: Net 7 does not have enough triangles, so it will not work; nets 2, 3 and 5 are really the same net; and nets 4 and 6 are the same net.*) Some students will be puzzled, so show them net 2, flip it over so it looks like net 3 and then rotate it so it looks like net 5. Advise the class to make their work easier by first identifying nets that are the same but look different because they have been rotated or flipped.
4. Inform students that some people solve these problems by imagining the faces are folding up and curling into a polyhedron. Encourage your students to employ this method. If, however, a group is still unsure or disagrees, have them draw a model on card stock using poster board templates, cut it out and fold it.
5. Distribute the worksheet and other materials. Circulate. When everyone is finished, have the groups report their answers. Settle disagreements by actually folding the nets.

Extend and Vary the Lesson

- Leonard Euler (pronounced *Oil-er*) discovered this relationship between the edges, vertices and faces of a polyhedron: number of faces + number of vertices – number of edges = 2. Using a variety of polyhedrons, verify that the equation is true by counting the faces, vertices and edges.
- Use the models to discuss parallel, intersecting, skew and perpendicular lines. Using a cube, have students color each set of parallel edges the same color. (They will need three colors.) Because the tetrahedron has no parallel edges, color each set of skew edges the same color. (Three colors will be needed.)
- Make a paper sculpture that moves. Make eight tetrahedrons of very sturdy paper taped with masking tape and connect them to form a ring. First, tape the tetrahedrons together in four pairs by joining each pair at an edge. Next, join pairs so that the new connection is skew to the original connection. The new sculpture will have very fluid movement.

References

Hansen-Smith, B. 1999. *The Geometry of Wholemovement.* New York: W.H. Freeman.
Stewart, M. 1988. *Basketball: A History of Hoops.* New York: Franklin Watts.

Net: A Word With Many Meanings

Name____ Date____________________

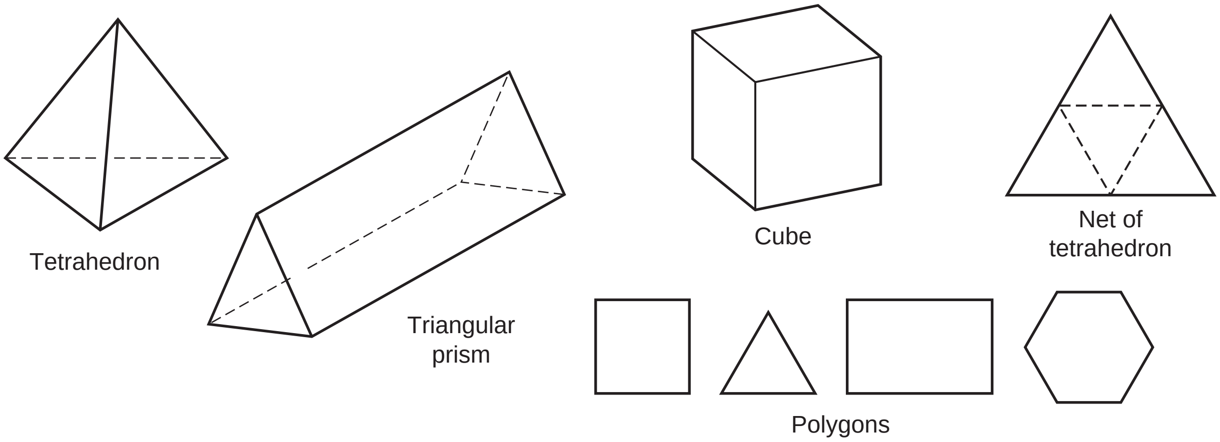
In basketball:

1891—The net is a peach basket. Every time a player makes a basket, someone has to climb a ladder to retrieve the ball.

1896—The net is a drawstring bag attached to a ring. The referee pulls a cord to release the ball after every basket.

1913—The modern net is in use. No one has to work to get the ball after a basket.

In mathematics, a **net** is a pattern made by the edges of a hollow three-dimensional polyhedron that has been opened along its edges and then flattened. A **polyhedron** is a three-dimensional figure whose sides are polygons. **Polygons** are flat shapes like triangles, rectangles, squares and so on. Their sides are always straight and there are no openings and no extra segments sticking out.



Instructions

As you solve the problems, visualize the nets folding up into polyhedrons. Try to imagine where each part goes. If your group members cannot agree on an answer, trace around the poster board shapes to make the net, then cut out the net and fold it to see if it makes the desired polyhedron. Show work by identifying nets that are really the same but are laid out in different positions.

Cross out nets that do not work.

1. Decide which examples are nets of a prism. How many different nets that fold to a prism are pictured?

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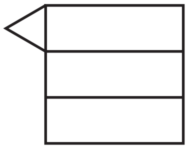

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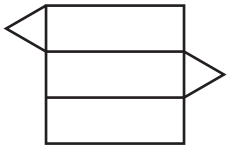

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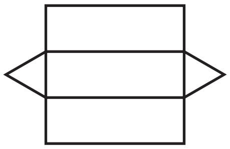

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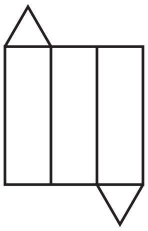

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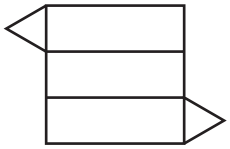

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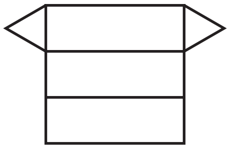

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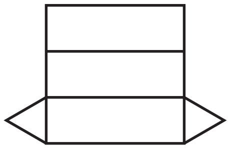

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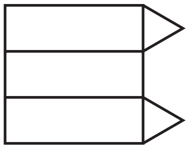

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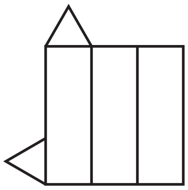

2. Which nets fold into a cube? How many different nets did you find?

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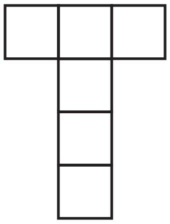

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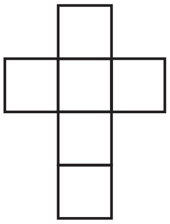

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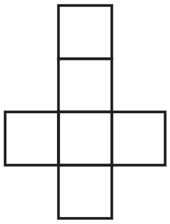

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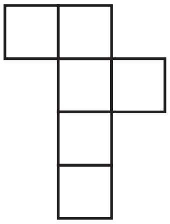

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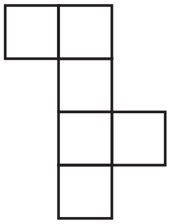

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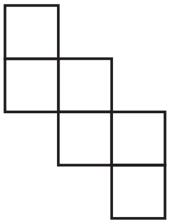

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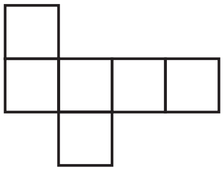

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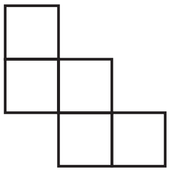

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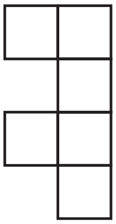

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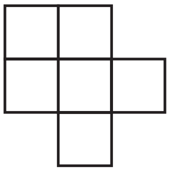

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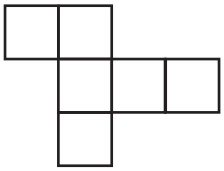

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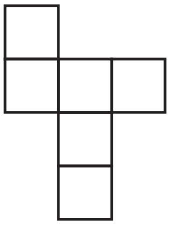


3. How is the meaning of the word **net** as it is used in basketball different from the meaning used in mathematics? How are the meanings alike? ______________________________

____

____

4. Describe the main method you used to solve problems 1 and 2. ____________________

____

____

LESSON 3

Score!

Students seek victory over story problems as they add and subtract scores from a past Division I women's basketball championship tournament.

National Standards: NM.K-4.8, NM.5-8.7

Skills: Identifying words that indicate addition or subtraction, solving addition or subtraction story problems, reading a tournament schedule

Estimated Lesson Time: 30 minutes

Teacher Preparation:

- Duplicate the Score! 3 worksheet on pages 180-181 for each student.
- Copy the tournament schedule onto the board or transparency.

Materials

- 1 copy of the Score! 3 worksheet on pages 180-181 for each student
- 1 pencil for each student

Background Information

Tournament schedules work best when the number of participants is a power of two, such as 64, 32, 16, 8 or 4. In NCAA® women's basketball, the Division I college teams are organized into four regions: the East, the West, the Mideast and the Midwest. At selection time 64 teams, 16 from each region, are invited to participate. In the first round of the tournament, eight games are played in each region. The eight winners play four more games and those four winners play two more games. Then the two victors play to decide the regional winner. The number of games played within each region is 15 (8 + 4 + 2 + 1 = 15) which is one fewer than the number of teams in each region. To view or print the 2002 NCAA Division I Women's Basketball Championship bracket, visit **www.finalfour.net/local/bkw_2002_bracket.gif**.

During the NCAA Division I Women's Basketball Championship, the winners of the four regions play in the two semifinals and those two winners play for the championship. The total number of games played in the championship is 63 (15 + 15 + 15 + 15 + 2 + 1 = 63), which is one fewer than the number of teams in the championship.

In this lesson, students solve word problems by identifying key words that indicate addition or subtraction, searching the Division I women's basketball schedule for the specific scores and solving the problems by adding or subtracting the scores.

Introduce the Lesson

Tell students that together you will examine word problems for clues—special words that tell us to add or subtract. Then you will gather information from the 2001 Division I women's basketball tournament schedule to help you solve the problems.

Follow These Steps

1. Go over the tournament schedule, pointing out the regional games, the semifinals and the championship game. To familiarize all students with the schedule, ask such questions as, "What was Purdue's score in the Purdue versus Xavier game?" or "How many games did Connecticut play?"
2. Brainstorm a list of words that indicate addition. (*Add, plus, total, sum, in all, altogether.*) Write those terms on the board. Label them "Clues to Addition."
3. Brainstorm a list of words that indicate subtraction. (*Subtract, minus, difference, how many more, how much plus a word ending in -er, such as "how much wider."*) Write those terms on the board. Label them "Clues to Subtraction."
4. Distribute the worksheet, read the directions aloud, ask if there are any questions and then help the students as needed.

Extend and Vary the Lesson

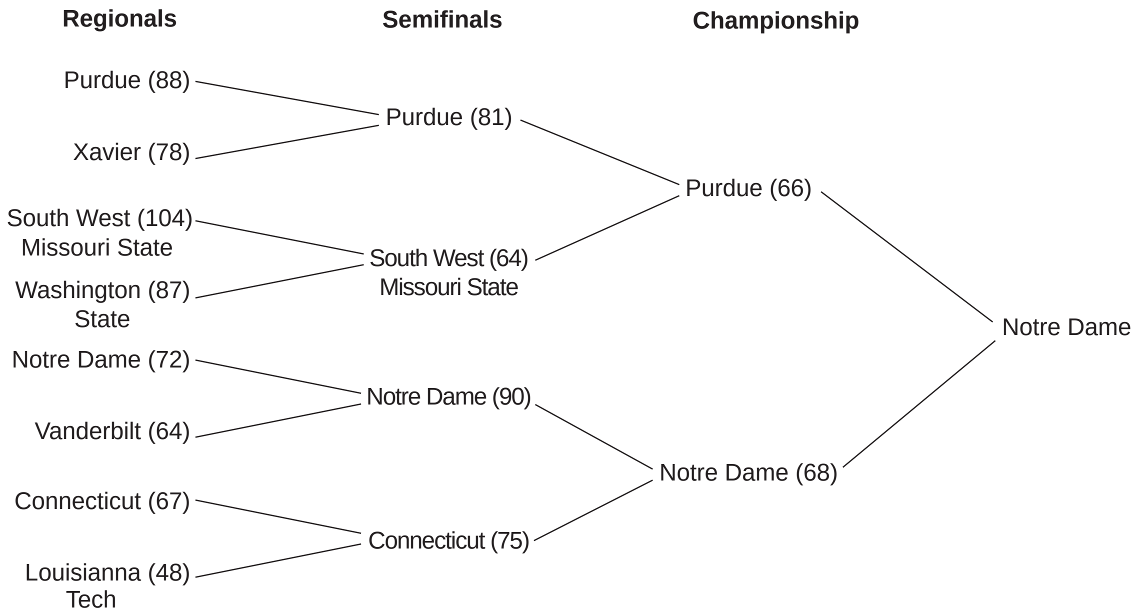
- Use **www.ncaabasketball.net** to find other basketball information. Have the students use the information to write story problems using the words in the "Clues to Addition" and "Clues to Subtraction" lists.
- Design riddles about Roman numerals using the words in the "Clues to Addition" and "Clues to Subtraction" lists. Examples: Subtract one letter from a three-letter word to get 9 (SIX – S = IX = 9), or add one letter to a famous candy to get 2005 (MM + V = MMV = 2005).
- Make a schedule for a class chess, checkers or other game tournament. Look at **www.finalfour.net** to see how to organize a tournament.

Score! 3

Name____ Date____________________

This Division I women's basketball tournament was exciting down to the last second! Fans held their breath as 6-foot, 5-inch Ruth Riley tied the score at 66 points with 1 minute remaining in the championship game.

To find out how Ruth won the game in the last 30 seconds, work each problem. The answers should be one of the choices in the box. Record the scrambled letters corresponding to the answers under the correct problem number. Unscramble the letters under the answer blanks and write the unscrambled word in the space matching the problem number in the following message. Use this figure to solve the problems.



1. Circle the addition or subtraction words in each question.
2. Find the numbers in the chart.
3. Solve each question.

Questions

1. What is the sum of the scores in the Purdue versus Xavier game? __________
2. How many more points did Notre Dame score than Purdue in the championship game? __________
3. What was the difference in the scores in the South West Missouri State versus Washington State? __________
4. Altogether, how many points did Connecticut score in its two games? __________
5. In the semifinals, what was the highest score? __________ What was the lowest

score? _________ Subtract the lowest score from the highest score. _________

6. Find the total number of points scored in the championship game. _________
7. In the Notre Dame versus Connecticut game, how much bigger was the winner's score than the loser's score? _________
8. Add the points scored in the Connecticut versus Louisiana Tech game. _________
9. In all, how many points did Purdue score during the games it played? _________

166	2	115	26	134	148	17	235	15	142
tog	het	reef	lefudo	dame	logas	lalb	trowhs	wot	saw

Problem numbers: 1 2 3 4 5 6 7 8 9

Scrambled words: _____ _____ _____, _____ _____ and ____ _____ ____ ______.

Message: Ruth Riley _____ _____ _____, _____ _____ and ____ _____ ____ ______.

LESSON 4

Math in the Sports Pages: Sports Percentages

Students practice solving percentage problems as they compute sports page statistics.

National Standards: NM.K-4.12, NM.5-5.8, NM.K-4.8, NM.5-8.7, NM.K-4.4, NM.5-8.4

Skills: Changing a percent to a decimal, changing a fraction or a decimal to a percent, finding the percentage of a number

Estimated Lesson Time: 30 minutes

Teacher Preparation

- Duplicate the Math in the Sports Pages: Sports Percentages worksheet on pages 185-186 for each student.
- Collect the items listed under Materials.
- Collect sports pages from the newspaper for a week.
- Review the meanings of the various abbreviations used in basketball by reading the background information in lesson 1, “Basketball Box Scores,” on page 168.
- Add extra interest by substituting statistics about local NCAA® college basketball teams for the statistics in the lesson.

Materials

- Sports pages collected from local newspapers
- 1 copy of the Math in the Sports Pages: Sports Percentages worksheet on pages 185-186 for each student
- 1 calculator for each student
- 1 pencil for each student

Background Information

How can we compare two players if they have played on different teams and in a different number of games? One way is to compute percentages. Percentages alone can be misleading, however. For example, two basketball players with identical field goal percentages of .667 can have very different backgrounds. One could have made 44 field goals out of 66 attempts while the other has made 8 out of 12 attempts. Since the first player has made a fairly large number of field goal attempts, his or her percentage is likely to be very stable; however, the second player has made relatively few attempts so his or her percentage might fluctuate more despite equivalent play over the next few games. For example, if both players make 2 of the next 5 field goal

attempts, their averages would be .648 and .588 respectively. This is why box scores usually list both the FG-FGA ratio and the percentage after each players' names. This practice gives a more accurate statistical picture of the athletes' performances.

Accurate sports statistics are important to newspapers and colleges. Newspapers regularly request sports statistics so they can identify the leaders in various categories such as rebounding and scoring; coaches are interested in a potential student-athlete's statistics. This lesson involves solving word problems about sports by finding percentages and finding the percentage of a number. Students are encouraged to verify their answers.

Introduce the Lesson

Show the class the sports pages from several editions of the local newspaper and tell them that they will be working on problems related to sports statistics. Explain the need for accuracy.

Follow These Steps

1. Review how to change a fraction to a decimal by dividing the numerator by the denominator.
2. Copy the following information to the chalkboard and discuss the basketball abbreviations from lesson 1, "Basketball Box Scores," on page 168:

	FGM-FGA	3P-3PA	FTM-FTA
Player 1	58-123	4-11	23-34

3. Compute Player 1's percentages, explaining each step as you do so. Remind students that the bar in a fraction indicates division and that ≈ means *approximately equal to.*

$$\frac{\text{field goals}}{\text{field goals attempted}} = \frac{\text{FG}}{\text{FGA}} = \frac{58}{123} = .4715447... \approx 47.2\%$$

4. Have the class find Player 1's other two percentages. Spot-check the answers.

$$\text{(Answers: } \frac{\text{3P}}{\text{3PA}} = \frac{4}{11} = .363636... \approx 36.4\ \% \quad \frac{\text{FT}}{\text{FTA}} = \frac{23}{34} = .676470... \approx 67.6\%\text{)}$$

5. Inform students that because statistics must be correct, they must be double-checked. To check Player 1's field goal percentage, multiply that percentage by the number of field goals Player 1 attempted. The answer should equal the number field goals made.

$$\text{PCT} \times \text{FGA} = \text{FG}$$

$$47.2\% \times 123 = \text{FG}$$

$$.472 \times 123 = \text{FG}$$

$$58.056 = \text{FG}$$

Compare the answer to the actual number of field goals Player 1 made. The numbers should be approximately the same. Because the percentage used in the check had been rounded, the answer produced is slightly off.

6. Distribute the Math in the Sports Pages: Sports Percentages worksheet and tell students that the problems contain information found in the newspaper or on Web sites. Circulate and help students as needed.

Extend and Vary the Lesson

- At the beginning of the season devote a bulletin board to keeping the statistics of a local NCAA basketball team. List the players' names and statistics. Have the class update the statistics after every game. To hold the students' interest you might have the girls track a girls' team and the boys track a boys' team. Discuss periodically which team seems to be doing better.
- Invite a local NCAA basketball coach to discuss how he or she uses statistics to improve the team and how the statistics are usually different for players with different roles on the team. Before the visit, have the class write down a list of questions they want answered and assign different students the responsibility for asking each of the questions.
- See the sixth grade-eighth grade math lesson 6 page 329 for some special equations involving statistics.

Math in the Sports Pages: Sports Percentages

Name____ Date____________________

1. Statistics help coaches and players judge how their performances are improving. Newspapers often list the area leaders in different categories. Complete this chart.

Area Girls' Basketball Statistical Leaders: Free-Throw Percentages

Player/School	FTA	FT	FT%
Pettifor, Champaign	22	19	_______
Davis, Danville	20	12	_______
McGinty, Urbana	25	21	_______
Klein, Collinsville	50	41	_______

2. The coach has just prepared some statistics on his players' field goal percentages. He wants them to be accurate, so he checks them.

Field Goal Percentages: Eliot High School

Name	FGA	FG	PCT
Johnson, D.	119	_______	66.4
Klein, G.	35	_______	65.7
Alvero, J.	103	_______	66.0
Davis, J.	34	_______	58.8

To check Johnson's percentage he finds 66.4% of 119 ($.664 \times 119 = 79.016$), or about 79. (The difference results because 66.4 was a rounded answer.) If this answer agrees with the number of field goals Johnson made, the coach knows his work is correct. Figure the FG for each player so Coach can check his work. Remember, PCT × FGA ≈ FG.

Newspaper sportswriters might compute problems like these:

3. During the game between the Illini and the Wildcats, the Illini made 26 field goals with 66 attempts. The Wildcats made 21 field goals with 60 attempts. What percentage of its field goals did the Illini make? Find the Wildcats' field goal percentage.

4. By December 31, 2001, the Illini women's team had won 9 of the 12 games it had played. What was the percentage of games they won? The percentage they lost?

5. In Top 25 men's action, Bret Nelson scored 19 points for Florida as they won 107 to 55 against visiting Belmont. What percentage of Florida's points were made by Nelson?

6. Coach was reading the box scores for her team. It listed the number of free throws attempted as 20, the number completed as 15 and the percentage as 70.0%. Is the percentage correct? Show your work.

LESSON 5

Sports Graphs

Students interpret double bar graphs that document how Title IX has benefited women and girls in providing them greater opportunities for sport participation.

National Standards: NM.K-4.11, NM.5-8.5, NM.K-4.8, NM.5-8.7
Skill: Reading a double bar graph
Estimated Lesson Time: 30 minutes

Teacher Preparation

- Duplicate the Title IX Sports Graphs worksheet on page 189 for each student.
- Use a photocopier to enlarge the graph on the worksheet and then make a transparency of the enlargement, or copy the graph onto the board.
- Collect the materials listed.

Materials

- 1 copy of the Title IX Sports Graphs worksheet on page 189 for each student
- 1 ruler for each student
- 1 pencil for each student

Background Information

In this lesson students read double bar graphs comparing female to male participation in sports. The nature of women's participation in athletics changed in a major way in 1972 when Congress enacted Title IX. Title IX states, "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any educational program or activity receiving Federal financial assistance" (20 U.S.C. § 1681).

Public and private institutions of learning that receive federal assistance must practice Title IX. Title IX does not apply to private colleges and universities that do not receive any federal assistance. Since 1972, many new opportunities have become available for female athletes to participate in sports. New teams were formed and new organizations established. By 1976, the number of females participating in high school athletics had risen to 1,645,039. In the 2000-01 school year, the number of females participating in high school athletics was 2,784,154. (These statistics are according to the National High School Federation [NFHS].) Title IX had far-reaching effects, producing new opportunities for women in such areas as coaching, sports reporting, scholarships and equipment.

Introduce the Lesson

Read Title IX to the students. Tell them that today you are going to use double bar graphs to see how the law has changed the lives of females.

Follow These Steps

1. Using either a transparency or a chalkboard drawing, show students the double bar graph.
2. Tell students that a double bar graph is used to compare two groups. Point out the necessary features of such a graph: the title, the numbers along the vertical and horizontal axes and the key that tells which bar represents males and which represents females. The graph should also list the source of the data.
3. Ask questions similar to the ones on the worksheet. Tell students they might wish to insert four marks, equally spaced, within each subdivision of the vertical axis to indicate 10,000, 20,000, 30,000 and so on, up to 240,000.
4. Pass out the worksheets. Circulate. Help students as needed.
5. Go over the answers.

Extend and Vary the Lesson

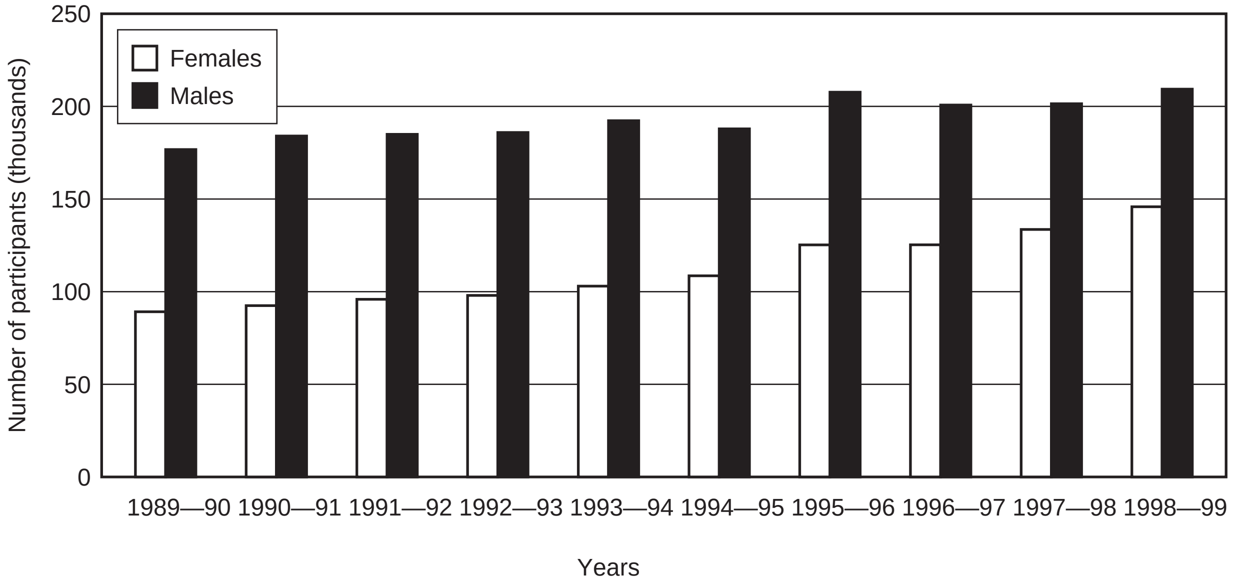
- Research the win-loss percentage of home versus away games for an NCAA® school over five years. Make a double bar graph of the data. Answer this question: Did the team win more games at home or away?
- Poll the class. Ask students their usual bedtime; the number of hours they use the TV in a week, including video games; the number of hours they exercise in a week, including PE and walking to and from school; the number of movies they watch in a week; and the number of books they read in the past year. Tally the data and make double bar graphs to show how the males and females in the class compare.
- Go to **www.nfhs.org/Participation/SportsPart01.htm** to see high school athletics participation totals and to find other data about school populations to compare different groups. Make a double or a multiple bar graph to display the data by gender or race.
- Make frequency polygons for the data in the bar graphs. To make a frequency polygon, find the midpoint of horizontal lines at the top of each bar. Connect all the midpoints for females with line segments. Make a second frequency polygon for males. Sometimes only the polygons, not the bars themselves, are used to present data.

Title IX Sports Graphs

Name____ Date____________________

Pat Summitt, coach of the first U.S. women's basketball team to win an Olympic gold medal, claims this is the reason she beat her opponents: She _______________ them.

To discover her secret, solve each problem by reading the double bar graph. The answer to each problem corresponds to a letter in the list at the bottom of this page. Write those letters in the spaces provided below the list. Then rearrange the letters to find the missing word.



1. About how many women participated in sports during the 1992–93 school year?
2. About how many women participated during the 1997–98 school year?
3. In which year was the number of female players almost half the number of male players?
4. In which year was the number of female players about 110,000?
5. In which year was the number of female players about 125,000?
6. About how many men played in the 1996–97 school year?
7. Which group appears to be growing more rapidly?
8. From the 1989–90 season to the 1998–99 season the number of females increased by almost ______.
9. On the back of this page, write a sentence about what you learned from this data.

Women = W   1995–96 = R   200,000 = U   100,000 = O   Men = M
1989–90 = S   1994–95 = O   133,000 = T   58,000 = K   80,000 = G

Rearrange the letters ___ ___ ___ ___ ___ ___ ___ ___ to make one word.
1 2 3 4 5 6 7 8

LESSON 6

Year by Year

Students estimate subtraction answers as they learn about the effects of Title IX on women in sports.

National Standards: NM.K-4.1, NM.5-8.1, NM.K-4.4, NM.5-8.4, NM.K-4.8, NM.K-4.5, NM.5-8.7
Skill: Estimating subtraction with front-end subtraction
Estimated Lesson Time: 30–40 minutes

Teacher Preparation

Duplicate the Year by Year: Estimation in Subtraction worksheet on pages 193-194 for each student.

Materials

- 1 copy of the Year by Year: Estimation in Subtraction worksheet on pages 193-194 for each student
- 1 pencil for each student

Background Information

How old is women's basketball? Many people are surprised to discover that the sport began just weeks after Dr. James Naismith invented the game in 1891 for young men in Springfield, Massachusetts. A group of elementary teachers, one of whom he later married, asked Naismith to teach them the game. In 1893 Senda Berenson, the director of physical education at Smith College, modified the game for women. Later, Clara Baer wrote a set of rules for basketball for women, which she called "Basquette."

Through the years there were exceptional female players. The year 1972 was a turning point for women's athletics. In March the Association of Intercollegiate Athletics for Women (AIAW) organized the first women's collegiate basketball championship and on June 23, 1972 President Richard Nixon signed Title IX into law. This decade saw the development of superstar players.

In 1982 the NCAA® began holding championships for women's collegiate athletics, giving women's sports a further boost. In the '90s, the popularity of women's basketball skyrocketed. The first NCAA Division I women's basketball championship was televised by CBS in 1982 (Lousiana Tech University versus Cheyney University of Pennsylvania). The 2002 NCAA Division I Women's Basketball Championship (University of Oklahoma versus University of Connecticut) was viewed by 2,497,000 households (approximately 2.5 viewers per household) or 8,926,720 viewers.

Introduce the Lesson

Inform students that they are going to explore sports data to investigate some of the effects of Title IX on women's lives. Tell students that because the numbers tend

to be large, they will use front-end estimating techniques to help them see the big picture quickly.

Follow These Steps

1. Ask students whether they think an error in the front end (or left-hand side) of a number is worse or better than an error in the back end (or right-hand side) of a number. Discuss their answers. Point out that front-end estimating techniques capitalize on the fact that we are more interested in the front end of the number than the back end. In a number like $72,356, if the 7 is really supposed to be a 6, it is a $10,000 mistake; if the 5 is supposed to be a 4, it is merely a $10 error. Front-end errors cause more damage than back-end or middle errors.
2. Work a few examples that do not require borrowing—for example, 5,370 – 2,154.

Step 1: Subtract the front numbers (those farthest to the left).	Step 2: Improve your estimate by subtracting the next column of numbers.	Step 3: Fill in the remaining places with zeros.
5,370	5,370	5,370
–2,154	–2,154	–2,154
3	3 2	3,200 estimated answer

3. Work some examples that require borrowing, for example, 5,137 – 2,943. If you look ahead and notice that borrowing will be required, just subtract the front columns, ignoring the columns to the right and record zeros as before in the unsubtracted columns.

5,137	← Subtract 29 from 51 to get 22. Put the 22 under the 29. Put zeros in the empty spaces.
–2,943	
2,200	← Estimated answer

4. Distribute the worksheets.
5. Circulate and help students as necessary.

Extend and Vary the Lesson

- Go to **www.ncaasports.com** and have students write four word problems based on their research of women's sports. Discuss when it is appropriate to estimate subtraction answers.
- Research the lives of well-known women in sports. What personal traits made these athletes successful?
- Investigate the accuracy of your estimates finding the actual answers to the worksheet problems. Compare the results to your estimates.
- Use addition and multiplication to estimate measures on the basketball court. See lesson 7, "Figuring the Metric Dimensions for a Model Court," for exact measurements (on page 195). Estimate the perimeter and area of the court and other marked regions painted on the court. Use $\pi = 3$ to quickly estimate the circumferences and areas of circles and semicircles.

References

Rutledge, R. 1998. *The Best of the Best in Basketball.* Brookfield, CT: Millbrook Press.

Stewart, M. 1988. *Basketball: A History of Hoops.* New York: Franklin Watts.

Yost, H., ed. 2001. *2002 Women's NCAA Basketball Records.* Indianapolis: National Collegiate Athletic Association.

Year by Year:
Estimation in Subtraction

Name____ Date____________________

On June 23, 1972, President Richard Nixon signed Title IX into law. Title IX forbids discrimination on the basis of gender in both high school and college sports. How did Title IX change women's sports? Solve the problems and see.

Year	**Number of girls playing high school sports**
1972	817,073
1973	1,300,169
1984	1,779,972
1992	1,997,489
1996	2,367,936

Use front-end estimation to see how many more girls played in high school sports.

1. _____________ in 1973 than in 1972.

2. _____________ in 1984 than in 1972.

3. _____________ in 1992 than in 1972.

4. _____________ in 1996 than in 1972.

5. _____________ in 1996 than in 1992.

The first NCAA® women's basketball national championship tournament took place in Norfolk, Virginia, in 1982. Use the data in the table to make estimates.

Year	Teams	Game attendance	Total attendance
1982	Louisiana Tech vs. Cheyney	9,531	56,320
1987	Tennessee vs. Louisiana Tech	15,615	104,412
1992	Stanford vs. Western Kentucky	12,072	187,417
1997	Tennessee vs. Old Dominion	16,714	225,933

6. Estimate how many years have passed since the first NCAA women's basketball tournament.

7. Estimate how many more people attended the 1997 championship game than the 1982 championship game.

8. Estimate the difference between the total attendance in 1982 and 1997.

9. Another student estimated that the increase in championship game attendance from 1982 to 1992 was 3,000. Is this estimate a little high or a little low? Explain.

10. Is an estimate of 120,000 for the increase in total attendance from 1987 to 1997 a little high or a little low? Explain.

11. Use estimation to find the five-year period with the greatest increase in championship game attendance.

LESSON
7

Figuring the Metric Dimensions for a Model Court

Students get a metric measurement workout when they compute the measurements for a scale model of the NCAA® basketball court.

National Standards: NM.K-4.1, NM.5-8.1, NM 5.8-4, NM.5-8.5, NM.5-8.7, NM.K-4.10, NM.5-8.13, NM.K-4.12, NM.5-8.12, NM.5-8.13

Skills: Solving conversion problems using ratios, computing the measures of a model given the measure of the actual object

Estimated Lesson Time: 30 minutes

Teacher Preparation

- Duplicate the Figuring the Metric Dimensions for a Model Court worksheet on pages 199-200 for each student.
- Collect the items listed under Materials.
- Make a transparency of the diagram of the NCAA basketball court on page 196, or copy the diagram onto the chalkboard.

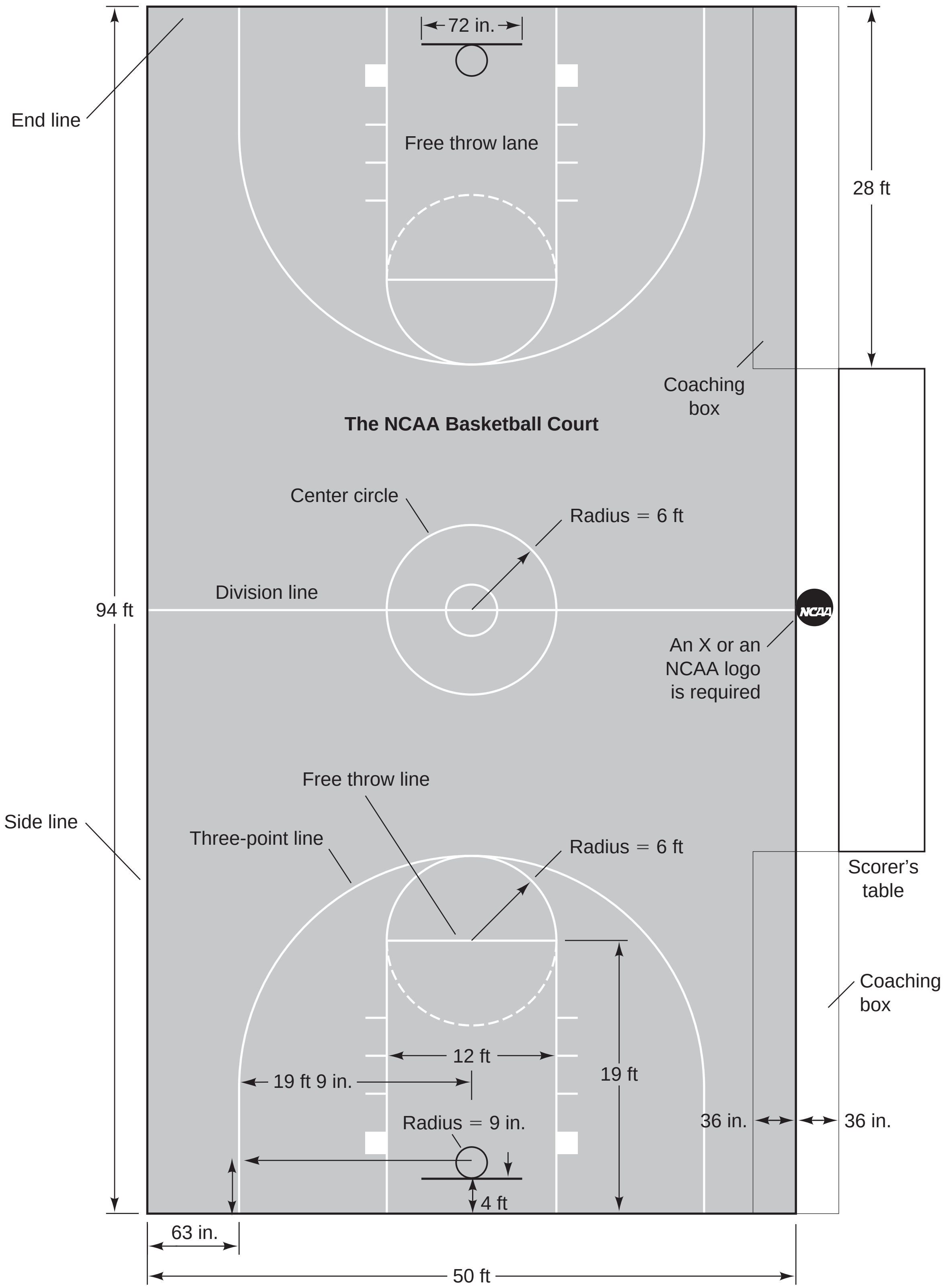
Materials

- 1 copy of the Figuring the Metric Dimensions for a Model Court worksheet on pages 199-200 for student
- 1 pencil for each student
- Extra paper for students to show their work
- 1 copy of page 196 for each student
- (Optional) 1 transparency showing the basketball court with its various parts labeled

Background Information

The students will use the actual dimensions of the regulation NCAA basketball court to compute the dimensions for a model using a scale of 1 cm to 4 ft. Because we are moving from feet to centimeters, we will multiply by 1 cm/4 ft so the feet will cancel out. If we were going from centimeters to feet, we would multiply by 4 ft/1 cm so the centimeters would cancel out. This scale was chosen because the diagram fits nicely on an 8 1/2- by 11-inch sheet of paper.

Details about the court or the rules can change from year to year. Visit the NCAA Web site, **www.ncaa.org**, to see an up-to-date rulebook. (Go to site index; under the word Rules select Playing [rules books]; then select men's and women's basketball rules and interpretations.) There may be slight differences between the different divisions of college play and also between different levels of basketball. For example, high school basketball courts vary in length from 90 ft to 94 ft.



From *NCAA Basketball Fast Break: Lessons Across the Curriculum With the NCAA,* ©2003, NCAA.

The lesson begins with a vocabulary review to help familiarize the students with the names of the various regions of the diagram. The different parts of the court such as the three-point line, the endlines, the sidelines and the division line are labeled on the diagram of the court that appears on page 196.

Introduce the Lesson

Tell the students that they are going to compute the measurements for a scale model of an NCAA basketball court. In the model, 1 cm will represent 4 ft. (Inform the students if you plan to have them actually draw a diagram of the basketball court.

Follow These Steps

1. Distribute the diagram of the basketball court on page 196. Use a transparency or a chalkboard sketch to review the basketball terms labeled on the diagram. Point out that the three-point line starts out as a pair of parallel segments 63 inches long and then turns into a semicircle with a center directly under the basket. Mention that the length of the free throw lanes is the longer measure of 19 ft.
2. Tell students to find the measures for the model by multiplying each actual foot measure by the scale factor, 1 cm/4 ft. Go over the details of these three examples for changing feet or inches to the centimeters needed for the model.
   a. Find the length of the coaching boxes.
      1. Find the coaching boxes. One box is at each end of the lower sideline. Each box is 28 ft.
      2. Change 28 ft to centimeters.

$$\frac{28\text{ ft}}{1} \times \underset{\substack{\uparrow\\ \text{The ratio of the model}\\ \text{to the actual court}}}{\frac{1\text{ cm}}{4\text{ ft}}} = \frac{28}{1} \times \underset{\substack{\uparrow\\ \text{Cancel ft and}\\ \text{multiply}}}{\frac{1\text{ cm}}{4}} = \frac{28\text{ cm}}{4} = 7\text{ cm}$$

   b. The line at the end of the coaching boxes extends 36 inches on each side of the side line. We can change inches to feet and convert to the model size in one step:

$$\frac{36\text{ in.}}{1} \times \underset{\substack{\uparrow\\ \text{Changes}\\ \text{in. to ft.}}}{\frac{1\text{ ft}}{12\text{ in.}}} \times \underset{\substack{\uparrow\\ \text{Changes from}\\ \text{actual to model size}}}{\frac{1\text{ cm}}{4\text{ ft}}} = \frac{36\text{ cm}}{4} = 0.75 \approx 0.8\text{ cm}$$

   c. Change 4 ft 3 in. (Requires two steps.)

Step 1: 3 in. = ___ ft

$$\frac{3\text{ in.}}{1} \times \frac{1\text{ ft}}{12\text{ in.}} = \frac{3\text{ ft}}{12} = 0.25\text{ ft}$$

So 4 ft 3 in. = 4.25 ft. Remind students not to round until the final step.

Step 2: Convert 4.25 ft to the dimension for the model.

$$\frac{4.25\text{ ft}}{1} \times \frac{1\text{ cm}}{4\text{ ft}} = 1.0625\text{ cm} \approx 1.1\text{ cm}$$

3. Distribute the worksheet, circulate and answer questions.

Extend and Vary the Lesson

- Make an actual diagram of the NCAA basketball court.
- Make a model of another NCAA sports court using standard English measures. Have students recommend different scale factors they might use and then discuss which of these might be the best choice. Visit **www.ncaa.org** to locate various NCAA playing surfaces.
- Invite an architect, a blueprint maker or a surveyor to the class to talk about their careers and tell students about the math they use in their work.
- Compute the areas and perimeters of different sections of the court using actual measures of the court.
- Compute the distance of the court from the surrounding walls and make a three-dimensional model of the court.

References

Benson, M., ed. 2001. *Men's and Women's Illustrated Basketball Rules and Interpretations.* Indianapolis: National Collegiate Athletic Association.

Figuring the Metric Dimensions for a Model Court

Name____ Date____________________

How is a basketball player different from a romantic actor?

Find the answer to the riddle as you check your work.

To make a scale model of a basketball court, first convert each measurement of the actual court to the measurement that will be used for the model. Using a scale of 1 cm to 4 ft will produce a diagram that fits nicely on an 8 1/2- by 11-inch sheet of paper.

Find the Measures

1. Look at the diagram of the basketball court and find the actual measurements for each part of the court. Record your answers under the Actual measurement column on the chart on page 200.
2. Convert the actual measurement to the measurement needed for the model. Since the scale is 1 cm to 4 ft, multiply each foot measure by 1 cm/4 ft. Change measures given in inches to feet by multiplying by 1 ft/12 in. Round the final answer to the nearest tenth of a centimeter. Record your answers in the Measurement of model column on the chart on page 200.
3. Show your work on a separate piece of paper.

After you have solved all of the measurements, find your answer to each question in the following list. In the box below the list, write the letter that corresponds to the question number. Doing this will solve the riddle!

Part of court	**Actual measurement**	**Measurement of model**
Length of side line	1.	11.
Length of end line	2.	12.
Radius of center circle	3.	13.
Parallel part of 3-point line	4.	14.
Radius of 3-point line	5.	15.
Radius of basket	6.	16.
Distance of backboard from end line	7.	17.
Length of backboard	8.	18.
Length of free throw line	9.	19.
Length of free throw lane	10.	20.

16	6	14	9	5	18	4	2	8	19	18	1	8	17	10	12	18	19	11	12
15	14	16	12	15	14	10	1	8	17	7	12	2	3	6	13	20	5	18	4

4 ft = R
6 ft = I
12 ft = P
19 ft = R
19 ft 9 in = L
50 ft = S
94 ft = C
9 in = N
63 in = Y
72 in = O

.2 cm = O
.4 cm = M
1 cm = U
1.3 cm = E
1.5 cm = A
3 cm = N
4.75 cm = P
4.9 cm = H
12.5 cm = T
23.5 cm = D