TEACHER WORKSHEET

CYCLE 4 • MATHEMATICS

DIMENSIONS AND STATISTICS IN BASKETBALL

OVERVIEW

EDUCATIONAL OBJECTIVES:

- Solve problems about proportions.
- Perform calculations for length, time, and speed.
- Work with compound units.
- Be familiar with and compare performance.

SPECIFIC SKILLS:

- Extract useful information from a document, reformulate it, organize it, and compare it with one's own prior knowledge.
- Check whether information is correct; read, interpret, and comment on tables.
- Solve problems involving various properties.
- Break a problem down into smaller problems.

INTERDISCIPLINARY SKILLS:

- PE:
  Understand performance in the context of human performance.
- Mathematics/numbers and calculations:
  Calculate with integers and decimals.

SCHEDULE FOR SESSIONS:

- Read texts aloud as a class.
- Solve problems.
- Share with class and review.

DURATION:

- 1 session (1 × 1 hour).

ORGANIZATION:

- Work alone or in pairs, then share as a class.

OLYMPIC GAMES KEYWORDS:

BASKETBALL • TEAM SPORT • RULES • SURPASSING ONESELF • RECORD

CONCEPTS ADDRESSED

A BRIEF OLYMPIC HISTORY OF BASKETBALL

Basketball was invented in 1891 by a Canadian physical education teacher who was looking for an indoor sport to keep students fit during the winter. Most of the 13 rules he came up with are still used today.

Basketball debuted at the 1904 Olympic Games in St. Louis, Missouri, in the United States, as a demonstration event, since only American teams competed.

Men's basketball became an official sport at the 1936 Games in Berlin, Germany, followed by women's basketball at the 1976 Games in Montreal, Canada.

RULES OF THE GAME

A basketball court is 28 meters long and 15 meters wide; the baskets are 3.05 meters above the ground.

A game is played in four 10-minute quarters between two five-player teams. The object of the game is to score more points than the opposing team in 40 minutes.

A successful shot is worth two points inside the three-point line (6.25 meters or 6.75 meters depending on the level) and three points outside the three-point line. A free throw (also known as a foul shot because it is taken after a foul) is worth 1 point.

The player with the ball must dribble it and can only take up to two steps without bouncing the ball off the ground.

No player whose team is in possession of the ball may stop for more than three seconds in the key. The key is the area between the free-throw line and the basket.

When a team takes control of the ball on the court, that team must take a shot within 24 seconds. The ball must hit the hoop to restart the 24-second shot clock.

MATH CONCEPTS

This worksheet will enable students to:

- Read raw data, tables, and graphs.
- Calculate and interpret central tendency and dispersion in a statistical series. Measures: mean, median, range.
- Perform calculations involving measurable quantities, using the same units.

FUN FACT!

Basketball was originally played using a peach basket... but without a hole in the bottom! The ball had to be retrieved after each point. In 1906, peach baskets were finally replaced by metal hoops and backboards, such as those used today.

FUN FACT!

In the late 1950s, one American player had the idea to make the basketball orange so that it could be more easily seen by players and spectators.

STUDENT WORKSHEET OVERVIEW

VOCABULARY:

Small forward, block, free throw, dribble basket, pass, pivot.

ACTIVITIES:

▶ **ACTIVITY 1: BASKETBALL COURT DIMENSIONS**

Calculate area, work with simple shapes and combined shapes, round numbers up or down.

12–13 yr | 13–14 yr | 14–15 yr

Materials: Court diagram with text-based questions.

FIND OUT MORE:

The three-point shot.

▶ **ACTIVITY 2: GAME STATISTICS**

Read documents, percentages.

12–13 yr | 13–14 yr | 14–15 yr

Materials: Text-based questions and table.

FIND OUT MORE:

Statistics and sports.

▶ **ACTIVITY 3: THE FRENCH BASKETBALL TEAM**

Statistics: mean, median, range.

12–13 yr | 13–14 yr | 14–15 yr

Materials: Text-based questions.

FIND OUT MORE:

The time out.

STUDENT WORKSHEET ANSWER KEY

▶ **ACTIVITY 1: BASKETBALL COURT DIMENSIONS**

Calculate area, work with simple shapes and combined shapes, round numbers up or down.

12–13 yr | 13–14 yr | 14–15 yr

1) There are 2 axes of symmetry: the midcourt line and the perpendicular bisector.
   Yes, the center of symmetry is the center of the center circle.
2) $5.8 \times 4.9 = 28.42$ m². 1 m² = 100 dm² = 10,000 cm², so 28.42 m² = 284,200 cm².
3) $3.6 \div 2 = 1.8$, so the center circle's radius is 1.8 m.
   Next, $\pi \times 1.8^2 = 3.24\pi$ (exact value) ≈ 10.18 m² (rounded to dm²)
4) To calculate the area of the semicircle: $\pi \times 6.75^2 = 45.5625\pi$ m².
   The two segments form a rectangle that is 1.58 meters wide and equal in length to the semicircle's diameter, i.e. $6.75 \times 2 = 13.5$ m.
   The area of the rectangle is therefore $13.5 \times 1.58 = 21.33$ m².
   The total area is $45.5625\pi + 21.33 \approx 164$ m².

▶ ACTIVITY 2: GAME STATISTICS

Read documents, percentages

12–13 yr 13–14 yr 14–15 yr

1) (2 × 5) + (3 × 5) + 5 = 10 + 15 + 5 = 30. Kevin Durant scored 30 points.
   (3 × 2) + 7 = 6 + 7 = 13. DeMarcus Cousins scored 13 points.
2) The two players scored a total 43 points. 43/96 × 100 ≈ 45%.
3) 5/6 × 100 ≈ 83% and 7/9 × 100 ≈ 78%. Kevin Durant has a better rate of success.
4) Kevin Durant missed three 2-point shots and six 3-point shots (for a total of 9) as well as a free throw. 30 + 3 + 4 + 2 + 1 – 9 – 1 – 2 = 28. His efficiency rating is 28.

▶ ACTIVITY 3: THE FRENCH BASKETBALL TEAM

Statistics: mean, median, range.

12–13 yr 13–14 yr 14–15 yr

1) For clarification, "at most two meters" includes players who are two meters tall. There are five players on the French team under two meters.
2) There are 12 players on the team. 5/12 × 100 ≈ 42%.
3) (2.15 + 2.10 + 1.88 + ...)/12 ≈ 2.00 m.
4) 110 – 81 = 29 kg.
5) There are 12 players on the team, so the median is the average age of the 6th and 7th players, when put in ascending order. That corresponds to the following: 28 and 29 years old, with an average age of 28.5 years. The median age is therefore 28 and a half years.
   This means that half of the players are over 28 and a half years old, while the other half are under 28 and a half.

FIND OUT MORE

EDUCATIONAL FILES

English: A passion for sports

English: The art of being a (s)wordsmith

Math: Performance in swimming

Geography: Tokyo: A global metropolis and host city of the 1964 and 2020 Olympic Games

French: Competing in the Olympics despite all opposition: ski jumping

Moral and civic education: The Olympic flame, torchbearers, and values

Information and media literacy: The 1936 Olympic Games in Berlin: propaganda and journalism

Interdisciplinary practical education: Sports and the fight against doping

Interdisciplinary practical education: Developing a symbolic view of the Olympic Games

EXHIBITIONS FOR STUDENTS

The Olympic Museum in Lausanne, Switzerland

DIGITAL RESOURCES

Éduscol:
https://cache.media.eduscol.education.fr/file/Grandeurs_et_mesures/52/7/RA16_MATH_C4_doc_maitre_grand_mesu_610527.pdf
https://cache.media.eduscol.education.fr/file/Traitement_des_donnees/03/6/RA16_C4_MATH_doc_maitre_564036.pdf

Les Clefs de l'École:
http://www.lesclefsdelecole.com/College/4eme/Mathematiques/Aires-Perimetres-definition-et-unites-en-4eme
http://www.lesclefsdelecole.com/College/4eme/Mathematiques/Aires-Perimetres-de-figures-usuelles-en-4eme
http://www.lesclefsdelecole.com/College/4eme/Mathematiques/Les-statistiques-en-4eme

ACTIVITIES FOR STUDENTS

End of unit: "It's your turn! Dimensions and statistics in basketball" (and answer key).

STUDENT WORKSHEET

CYCLE 4 • MATHEMATICS

DIMENSIONS AND STATISTICS IN BASKETBALL

VOCABULARY

SMALL FORWARD: The player whose position is at the front of a team's offensive line.

BLOCK: A tactic when a player deflects an attempt from an offensive player.

FREE THROW: An unopposed attempt awarded to the shooter after a foul by the opposing team.

DRIBBLE: To continuously bounce the ball with small hand strokes (for basketball) past opponents.

FIELD GOAL: A successful shot.

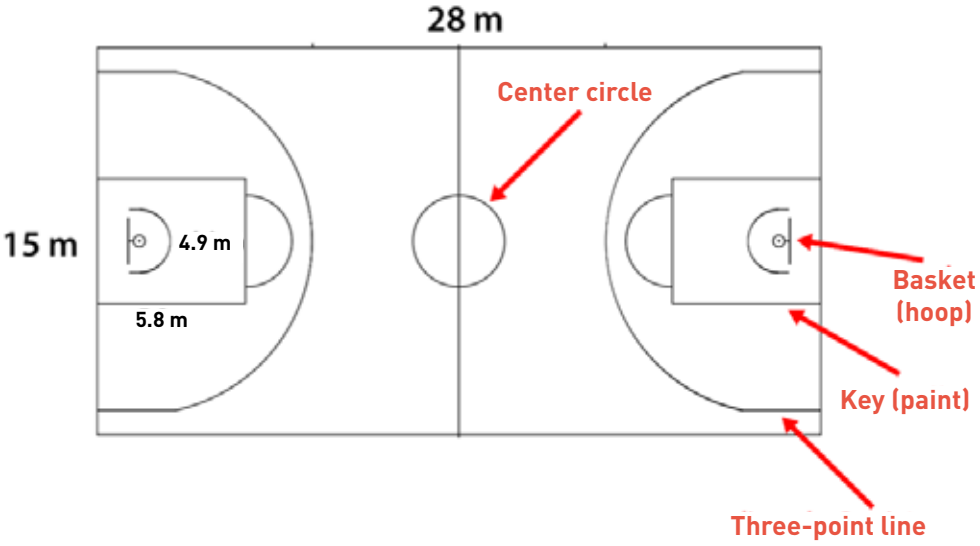
PASS: The act of passing the ball to a teammate.

PIVOT: The player located closest to the baseline or basket; also known as a center.

ACTIVITIES

▶ ACTIVITY 1: BASKETBALL COURT DIMENSIONS

Here are the standard dimensions of a basketball court.



TIPS & TRICKS

While watching a basketball game on TV, you might have already seen a coach give players pointers using a dry-erase board for clarity. You too can use scrap paper to organize your ideas. That should help you see more clearly and turn in a clean assignment.

1) How many axes of symmetry are there on a basketball court? Is there a center of symmetry?

2) The key is an area where an offensive player cannot stay more than three seconds at a time. Since 2010, the key has been shaped like a rectangle that is 5.8 meters long and 4.9 meters wide. What is its area? Write your answer in square centimeters (cm^2).

3) The center circle is used to put the ball in play through a jump ball. The circle has a diameter of 3.6 meters. What is its area? Give the exact value, then round off to the nearest square decimeter (dm^2).

4) The three-point line is used to determine whether a shot is worth 2 or 3 points. Think of it as a semi-circle with a radius of 6.75 meters, extended on each side by two segments 1.58 meters long. What would be the area of the zone marked off by the three-point line? Round your answer to the nearest square meter (m^2).

FIND OUT MORE

The distance from the three-point line to the basket used to be 6.25 meters, but was increased to 6.75 meters in 2010 to make three-point shots harder.

But since the court is only 15 meters wide, that doesn't leave much space on the sides (i.e. players only have 75 centimeters to move and shoot). That's why the three-point line's arc actually stops about three meters from the baseline and leaves 90 centimeters of space on each side. And since players continue to score three-point shots, some observers think the line should be moved further back!

Like in other sports, the rules of basketball are constantly changing to keep the game well rounded.

▶ ACTIVITY 2: GAME STATISTICS

At the 2016 Olympic Games in Rio de Janeiro, Brazil, the United States defeated Serbia 96 to 66, thanks in part to small forward Kevin Durant and center DeMarcus Cousins, whose statistics in the final were as follows:

	Points scored	Field goals (2 pts)	Field goals (3 pts)	Free throws (1 pt)	Rebounds	Assists	Fouls	Turnovers	Blocks	Steals
Kevin Durant		5/8	5/11	5/6	3	4	2	2	1	2
DeMarcus Cousins		3/5	-	7/9	15	2	3	0	0	1

Note: "5/8" in the "Field goals (2 pts)" column means that the player attempted eight two-point shots and scored five.

1) How many points did Kevin Durant and DeMarcus Cousins score?

2) The U.S. team scored 96 points. What percentage of those points was scored by Kevin Durant and DeMarcus Cousins? Round to the nearest whole number.

3) Calculate the success rate of both players in free throws as a percentage, rounding to the nearest whole number. Which of player had the better success rate?

4) In basketball, an efficiency rating is used to determine a player's contributions during a game. The following formula is used to calculate efficiency:
Efficiency = Points + Rebounds + Assists + Steals + Blocks – Missed Field Goals – Missed Free Throws – Turnovers
Calculate Kevin Durant's efficiency rating during the game.

FIND OUT MORE:

A number of statistics can be calculated after a basketball game. In the United States, besides efficiency, the offensive production rating is calculated by dividing the number of points scored by the number of possessions, as well as the true shooting percentage, with the formula "points scored / (field goal attempts + 0.44 × free throw attempts)".

Those statistics help to identify a team's playing style. There are also a number of different records, such as "most defensive rebounds in a game" and "most missed free throw attempts in a game".

▶ ACTIVITY 3: THE FRENCH BASKETBALL TEAM AT THE RIO 2016 OLYMPIC GAMES

There are 12 players on a team, but only five players from each team are on the court at a given time.

Here's the list of players for the French basketball team at the Olympic Games in Rio de Janeiro, Brazil, in 2016.

	NAME	AGE	HEIGHT	WEIGHT
	Rudy Gobert	24	2.15 m	108 kg
	Kim Tillie	28	2.10 m	93 kg
	Tony Parker	34	1.88 m	81 kg
	Joffrey Lauvergne	25	2.08 m	109 kg
	Florent Piétrus	36	2.02 m	107 kg

	**Nando de Colo**	**29**	**1.95 m**	**85 kg**
	**Antoine Diot**	**28**	**1.92 m**	**87 kg**
	**Thomas Heurtel**	**27**	**1.89 m**	**81 kg**
	**Nicolas Batum**	**28**	**2.03 m**	**91 kg**
	**Boris Diaw**	**34**	**2.03 m**	**110 kg**
	**Mickaël Gelabale**	**33**	**2.01 m**	**98 kg**
	**Charles Kahudi**	**30**	**1.96 m**	**100 kg**

1) How many players on the team are at most two meters tall?

2) What percentage does that represent? Round to the nearest whole number.

3) What is the average height? Round to the nearest centimeter.

4) Calculate the team's weight range.

5) What is the median age? Explain your answer.

FIND OUT MORE:

A timeout is a temporary pause in the game that ranges from 30 seconds to a few minutes.

Halts in play and timeouts are an opportunity for each team to replace one or more players.
The coach can only call two timeouts in the first half of the game, and three in the second half.

REVIEW

- The formula for the area of a circle is $\pi \times r^2$. The answer is never a whole number, so it should be rounded up or down. Don't confuse that formula with the perimeter of a circle ($2 \times \pi \times r$), and make sure that you're working with the circle's radius and not the diameter before using the formula.
- The answer can be divided by 2 to find the area of a semi-circle, or added or subtracted to find the area of more complex shapes.
- Some documents contain a lot of information, and not all of it is useful. To solve a math problem involving those kinds of documents, try to read the question while highlighting any relevant information. Problems with a lot of information often involve fairly simple mathematical concepts.
- The median is used to divide a series into two groups that are the same size. Specifically, at least half of the values in a series are less than or equal to its median, and at least half of the values are greater than or equal to the median. Don't confuse median and mean, since they don't mean the same thing in a statistical series.

NOW, TAKE ACTION!

- **Watch a game and take notes.** Choose a team and write the players' numbers on a sheet of paper, then decide which actions to watch for during the game (number of passes, field goals, missed shots, changes, etc.) and write them in columns. Then make a note in the right box every time a player does one of those things. That's how you get the game stats for a team.
- **Apply what you've learned to other sports.** Use the formulas you've learned to calculate surface areas in football, handball, volleyball, etc. For example, you can calculate the area of the center circle or penalty area in football.
- **Try to improve your own stats.** Run laps (or a set distance) and make a note of the time it takes you to do each lap. Do that over several days and see if you improve, and if you're better at the beginning, middle, or end of the session. Apply that statistical data to the other sports you play, to try to improve your performance.

CYCLE PROGRESS WORKSHEET

CYCLE 4 • MATHEMATICS

DIMENSIONS AND STATISTICS IN BASKETBALL

The concept of central tendency in a statistical series is introduced at the start of the cycle. Students study the concept of dispersion around age 13.
Work on measurable quantities and units of measurement, introduced in Cycle 3, is developed throughout Cycle 4, drawing on other disciplines and from everyday life.

AREAS FOR DEVELOPMENT:

– Activity 1 (area) by calculating other areas using addition and subtraction.

– Activity 2 (statistics) by having students calculate and interpret other player or team statistics. The purpose of those statistics (are they all relevant?) could also serve as a topic for discussion.

– Activity 3 (statistics) by expanding work on a given series in a table or bar chart, using cumulative frequency to determine the median.

IT'S YOUR TURN!

CYCLE 4 • MATHEMATICS

DIMENSIONS AND STATISTICS IN BASKETBALL

PUT YOUR KNOWLEDGE TO THE TEST

1 WHAT IS THE AREA IN WHICH AN OFFENSIVE PLAYER CANNOT STAY FOR MORE THAN THREE SECONDS?

☐ The bar ☐ The key ☐ The handle

2 WHICH OF THE FOLLOWING CRITERIA ARE TAKEN INTO ACCOUNT IN A BASKETBALL PLAYER'S EFFICIENCY RATING?

☐ Points ☐ Blocks ☐ Speed

☐ Three-pointers ☐ Assists

3 HOW TALL WAS THE TALLEST PLAYER ON THE FRENCH TEAM AT THE RIO OLYMPIC GAMES?

☐ 2.15 m ☐ 2.20 m ☐ 2.25 m

4 WHAT IS THE FORMULA FOR THE AREA OF A CIRCLE?

☐ $\pi \times r^2$ ☐ $\pi \times r$ ☐ $\pi^2 \times r$

TEST YOUR KNOWLEDGE FURTHER

1 HOW LONG IS AN OLYMPIC BASKETBALL GAME?

☐ 40 minutes ☐ 45 minutes ☐ 60 minutes

2 HOW MUCH TIME DOES A TEAM HAVE TO TAKE A SHOT AFTER TAKING POSSESSION OF THE BALL?

☐ 20 seconds ☐ 24 seconds ☐ 28 seconds

3 THE KEY'S SHAPE HAS ONLY BEEN RECTANGULAR SINCE 2010. YOU CAN STILL FIND COURTS WITH THE OLD KEY. WHAT WAS THE KEY'S SHAPE BEFORE 2010?

☐ Square ☐ Arc ☐ Trapezoid

4 HOW MANY MEDALS HAS FRANCE WON IN BASKETBALL IN THE HISTORY OF THE OLYMPIC GAMES?

☐ 1 ☐ 2 ☐ 3

5 WHY ARE BASKETBALLS ORANGE?

.....

KICK OFF THE DISCUSSION... GIVE YOUR OPINION!

Amateur athletes vs. professional athletes.

For a long time, only amateur athletes could compete in the modern Olympic Games, which is what Pierre de Coubertin wanted. The International Olympic Committee changed that rule for the 1984 Games in Los Angeles, California, when professional athletes were also allowed to compete.

At the 1992 Games in Barcelona, Spain, famous players with the National Basketball Association (NBA) were allowed to represent the United States for the first time. The international media dubbed them the Dream Team.

WHAT DO YOU THINK ABOUT PROFESSIONALIZATION IN THE SPORT?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

IT'S YOUR TURN!

CYCLE 4 • MATHEMATICS

DIMENSIONS AND STATISTICS IN BASKETBALL

PUT YOUR KNOWLEDGE TO THE TEST

1 WHAT IS THE AREA IN WHICH AN OFFENSIVE PLAYER CANNOT STAY FOR MORE THAN THREE SECONDS?

- ☐ The bar
- ☑ The key
- ☐ The handle

2 WHICH OF THE FOLLOWING CRITERIA ARE TAKEN INTO ACCOUNT IN A BASKETBALL PLAYER'S EFFICIENCY RATING?

- ☑ Points
- ☑ Blocks
- ☐ Speed
- ☐ Three-pointers
- ☑ Assists

3 HOW TALL WAS THE TALLEST PLAYER ON THE FRENCH TEAM AT THE RIO OLYMPIC GAMES?

- ☑ 2.15 m
- ☐ 2.20 m
- ☐ 2.25 m

4 WHAT IS THE FORMULA FOR THE AREA OF A CIRCLE?

- ☑ $\pi \times r^2$
- ☐ $\pi \times r$
- ☐ $\pi^2 \times r$

TEST YOUR KNOWLEDGE FURTHER

1 HOW LONG IS AN OLYMPIC BASKETBALL GAME?

- ☑ 40 minutes
- ☐ 45 minutes
- ☐ 60 minutes

2 HOW MUCH TIME DOES A TEAM HAVE TO TAKE A SHOT AFTER TAKING POSSESSION OF THE BALL?

- ☐ 20 seconds
- ☑ 24 seconds
- ☐ 28 seconds

3 THE KEY'S SHAPE HAS ONLY BEEN RECTANGULAR SINCE 2010. YOU CAN STILL FIND COURTS WITH THE OLD KEY. WHAT WAS THE KEY'S SHAPE BEFORE 2010?

- ☐ Square
- ☐ Arc
- ☑ Trapezoid

4 HOW MANY MEDALS HAS FRANCE WON IN BASKETBALL IN THE HISTORY OF THE OLYMPIC GAMES?

☐ 1 ☐ 2 ☑ 3

5 WHY ARE BASKETBALLS ORANGE?

To be clearly visible to players and spectators.

KICK OFF THE DISCUSSION... GIVE YOUR OPINION!

Amateur athletes vs. professional athletes.

For a long time, only amateur athletes could compete in the modern Olympic Games, which is what Pierre de Coubertin wanted. The International Olympic Committee changed that rule for the 1984 Games in Los Angeles, California, when professional athletes were also allowed to compete.

At the 1992 Games in Barcelona, Spain, famous players with the National Basketball Association (NBA) were allowed to represent the United States for the first time. The international media dubbed them the Dream Team.

WHAT DO YOU THINK ABOUT PROFESSIONALIZATION IN THE SPORT?