## REAL WORLD MATH: SPORTS

## SOCCER



Skills Library

## REAL WORLD MATH: SPORTS SOCCER



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## CHAPTER ONE

## Go for the Goal!



Soccer is one of the most exciting sports in the world.

T ou race with your team
down the field. You move
quickly to reach the ball and
kick it to your teammate.

Your teammate moves
the ball down toward the
opponents' goal. The goalie
braces for the kick. At the last second, the ball is passed back to you. With your final kick, the ball speeds past the goalie and into the net. Score!

Soccer is the most popular sport in the world today. It was adapted from an ancient Chinese game called tsu chu (SUU-CHEW). The word $t s u$
means "to kick the ball with your feet." The word chu means "a ball made
of leather." The object of the game was to kick the ball through a hole in a
net to score. Like soccer today, players were not allowed to use their hands.

It was a very difficult game, and players who were skilled at scoring were
celebrated as heroes.

The game of soccer as we know it today began in Great Britain in the

1800s. The name soccer has an interesting history. In the early 1800 s, there

## Real World MAth challenge

Soccer balls come in different sizes. Mary's U6 team (for players 6 years old and younger) uses a size 3 soccer ball. The circumference of their ball is 23 inches ( 58 centimeters), and it weighs 11 ounces ( 0.31 kilograms). Joe's U10 team uses a size 4 soccer ball. The circumference of their ball is 26 inches ( 66 cm ), and it weighs 13 ounces ( 0.37 kg ). How much larger is the circumference of the ball used by Joe's team compared to the ball used by Mary's team? How much heavier is the ball used by Joe's team than the ball used by Mary's team? Give your answers in percentages.
(Turn to page 29 for the answers)

Many people from Europe immigrated to the United States in the late 1800s, bringing along their love of the game. Immigrants helped form teams in the towns where they lived. People started forming organized leagues. This led to the formation of the American Soccer League (ASL) in 1921. Today, many Americans enjoy Major League Soccer (MLS), which was formed in 1993.

How do you think the formation of organized teams and leagues helped make the game of soccer more popular?
but never won, the World Cup. The
U.S. women's team, however, has
won the World Cup twice! They
won in 1991 and again in 1999.

Today, the U.S. men's and women's
teams are ranked in the top 20
teams in the world.

Soccer is a competitive sport,
with very precise rules. Soccer


Playing soccer takes more than quick feet and coordination. Players also need good math skills.
fields must be a specific size. The
soccer ball can only weigh a certain number of ounces. A limited number
of players are allowed on the field at any single moment. Maybe the most
important numbers are the ones that add up to the winning score!

## CHAPTER TVO

## A Few Soccer Basics



Goalkeepers are the only players on the field allowed to use their hands.

Soccer is pretty easy to understand. Two teams play against each other.

Each team has a goal. The object of the game is to get the ball into the opponent's goal. Each team must defend its goal against the opponents.

The team with the highest number of goals at the end of the game wins.

There are 11 players on a soccer team. Ten are field players, and one is the goalkeeper, or goalie.

Field players play one of the following positions:
defender, midfielder, or forward. Defenders prevent the ball from going into the goal. Midfielders help pass the ball down the field to position it for a goal. Forwards shoot the ball into the goal. The goalkeeper guards the goal from the opposing team.

Soccer is one of the purest team sports in the world today. Ask any one of soccer's greats, from Pelé to David Beckham, and they will tell you that a single player cannot win a game for their team. Collaborating with your teammates and creating a game plan result in the best chance for victory.

Field players can't use the area from their shoulders
to their fingertips to touch the ball while it is in
play. This means they may not use their hands. Only
the goalkeeper is allowed to use his hands to stop
the ball.


The dimensions of a soccer field will vary depending on the age of the players.

Soccer is a game in which
the conditions vary with the age
of the players. U8 players have a
shorter playing time. They play
two 20-minute halves. U17-Adult
players have games with two 45-
minute halves.

A soccer field must always be
longer than it is wide. You can't
play soccer on a square field!

The lines running along the long
sides of the field are called the sidelines. The ball cannot go beyond these lines during a game. The lines running across the short ends of the field
are called the end lines. The center circle is in the middle of the field. The centerline runs through the center circle.

## Real WORLD MATH Challenge

The field size for an international soccer match is 110 to 120 yards ( 101 to 110 $\mathrm{m}) \times 70$ to 80 yards ( 64 to 73 m ). How many square yards are in a $\mathbf{1 1 0}$ yard $\mathbf{x} \mathbf{7 0}$ yard field? How many square yards are in a field that measures $\mathbf{1 2 0}$ yards $\mathbf{x} \mathbf{8 0}$ yards? What is the difference between the two?
(Turn to page 29 for the answers)

The goals are at either end of the field. They are located in the center of the end lines. For adults, the official size of the goal is 8 feet $(2.4 \mathrm{~m})$ by 24 feet ( 7.3 m ). For the youngest players, the goal size is 4 feet ( 1.2 m ) by 6 feet ( 1.8 m ).

To begin the game, the ball is placed in the center of the center circle for the kickoff. The two teams are each on their own sides of the field.


Players from both teams work to keep possession of the ball.

The defending team cannot be in the center circle. The referee blows the
whistle, and the ball is kicked. The player who first kicked the ball cannot
touch the ball again until another player touches the ball. Each team is
trying to get possession of the ball and score. The teams are also trying
to keep the other team from scoring. Soccer is a fast-moving game with
players racing up and down the field.

There are only four reasons to stop play: a goal is scored, the ball goes out of bounds, a player is injured, or the referee calls a foul. A foul is an illegal play. Referees can give either yellow or red cards, depending on the intensity of the foul. A yellow card is a warning. A red card means the player is out of the game. Players foul by kicking, pushing, or tripping another player. They can also get a foul for handling or holding the ball.

There are other fouls, but these are the basics. When a player fouls, the other team gets a free kick.

How is math important to soccer? Field size, soccer ball size, rules, and different methods of scoring are all examples. Another example is how professional players use numbers to rack up impressive records. Let's meet two players who have helped make soccer a popular sport.

## CHAPTER THREE

## Do the Math: IMPRESSIVE PROS

There are great soccer players all over the world. The United States recognizes outstanding players at the National Soccer Hall of Fame, located in Oneonta, New York. Since 1950, many gifted soccer players have been inducted. One Hall of Famer is Mia Hamm.


Mia Hamm speaks at her National Soccer
Hall of Fame induction in 2007.

Hamm began her amazing career at age 15 when she joined the U.S.

Women's National Soccer Team. She was the youngest person ever to join
the team. Her first game was against China in 1987. She played her last
professional game against Mexico in 2004. During her 17-year career, she racked up some impressive stats.

Hamm graduated from the University of North Carolina (UNC) in 1994. She led her team to four National Collegiate Athletic Association (NCAA) championships. When she graduated, she held the all-time record for most conference goals—103! Hamm continued to play with the U.S.

Women's National Soccer Team. She was a key player in the World Cup victories in 1991 and 1999. She also helped her team win Olympic gold medals in 1996 and 2004. Between 1987 and 2004, Hamm played an impressive 275 international games.

FIFA honored Hamm with the Women's World Player of the Year
award in both 2001 and 2002. In 2004, FIFA created a list of the 125
greatest living soccer players. They named only two women: Hamm and

Michelle Akers. They were also the only Americans listed. For five years in
a row (1994-1998), Hamm was the U.S. Soccer Federation Female Athlete of the Year. She was elected to the Soccer Hall of Fame in 2007.

## Real World MAth challenge

Hamm played soccer at UNC for four years. During that time, she made 103 conference goals. What was the average number of goals she scored each year?
(Turn to page 29 for the answer)

Perhaps the most famous soccer player of all time was inducted into
the Hall of Fame in 1993. Edson Arantes do Nascimento was born in 1940
in Brazil. Most people know him as Pelé (PAY-lay). As a child, Pelé was
very poor. He shined shoes
to help support his family.

His father, a former soccer
player, taught him how to
play the game. A famous
soccer player from Brazil,

Waldemar de Brito (wal-

DAY-mar DAY BREE-toh),
saw Pelé play. He was very
impressed. He told people


Michelle Akers shoots the ball during a match against China in 1999.
that Pelé would be "the
greatest soccer player in the world." Pelé began playing with a team from
the town of Santos. He scored a goal in his very first game.


Pelé holds the Olympic
torch in 2004.

In 1958, Pelé scored six
goals to help Brazil's National
team win its first World Cup.

He was only 17 years old. In

1970, he helped Brazil win
another World Cup. It was
a 4-1 win over Italy. Pelé
was proud because he made

Brazil's 100th World Cup
goal. During his career, he played 1,360 games and made 1,280 goals.

## Real World Math challenge

During his career, Pelé scored 1,280 goals. Another player from Brazil is reported to have scored 1,329 goals. How many more goals did he score than Pelé? (Turn to page 29 for the answer)

In 1974, he left the Santos team. Two years
later, Pelé came out of retirement to join the

Cosmos of the North American Soccer League. He
played with them for two years. Many credit Pelé
with making soccer a popular sport in the United

States. Soon other international players began
playing for U.S. teams.

Pelé and Hamm both used numbers to rack
up amazing scores and career victories. Many
other players and teams also hold impressive
records. Let's read about how they use math to
create winning numbers.

## Content

The National Soccer Medal of Honor is given to "extraordinary individuals whose positive contributions to soccer at the national level have been so great as to have changed the course of soccer history in the United States." In 1991, it was given to an entire team! The U.S. Women's National Soccer Team received this honor for their skill and determination at the World Cup games. This team is also responsible for bringing women's soccer to the 1996 Olympics, where they won the gold medal. The U.S. women's team is still one of the best teams in the world. The team continues to represent women - and the United States - as a strong force in world soccer.

## Do the Math: Remarkable Soccer Records



Ronaldo dribbles the ball during a World Cup match against Chile in 1998.

Delé referred to
fellow Brazilian

Ronaldo Luis Nazário
de Lima as "one of
the greatest." Ronaldo
and his team won the

World Cup in 1994
and in 2002. He was
named FIFA Player of
the Year three times
(1996, 1997, and
2002). He is the all-time World Cup goal scorer, with 15 goals in 19 games in three World Cups.

Hall of Famer Mia Hamm wasn't the first woman to be elected to the National Soccer Hall of Fame. April Heinrichs was elected in 1998. She was a captain of the 1991 World Cup championship team. In 1986 and 1989,

Heinrichs was named U.S. Soccer Female Athlete of the Year. She went from player to head coach of the U.S. Women's National Soccer Team from 2000 to 2005 .

Landon Donovan is another player with an impressive record. He is a member of the LA Galaxy professional soccer team. He is also a member of the U.S. Men's National Soccer Team. He scored a goal in his very first international game in October 2000. Only six other people have done that! Donovan was named U.S. Soccer Athlete of the Year in 2003 and 2004.

He led the national team in points for three years in a row. During the 2006 World Cup, he played in 16 of the 18 matches and scored 6 goals.

A young woman player to watch is Marta Vieira da Silva. She is considered to be one of the best women soccer players today. At 5 feet 4 inches ( 1.6 m ) tall, she is a force on the field. Marta was a member of Brazil's team at the 2004 Olympics. They won the silver medal. She was named the FIFA Woman's World Player of the Year in 2006 and 2007.

## Real World MAth challenge

Ronaldo Luis Nazário de Lima scored 15 goals in 19 games during 3 World Cup competitions. What was the average number of goals he scored per game during those competitions? What was the average number of goals he scored in the 3 World Cup competitions?
(Turn to page 29 for the answers)


Marta Vieira da Silva plays in a match against Japan in 2007.

Brazilian soccer player Ronaldo Luis Nazário de Lima worked hard to achieve success as a professional soccer player. It would be easy for him to just sit back and enjoy the fame that comes with being one of the best soccer players in the world. But he remembers how soccer brought him from the poverty of his childhood to where he is today. He gives back to the world community by volunteering for the United Nations Development Programme (UNDP). As a UNDP goodwill ambassador, he works to help bring education and sports to refugee children around the world. He once said in an interview, "All children deserve the same opportunity to play and a chance for a better future."

Players could not set records without the
help of their entire team. Teams can hold
records, too. Brazil holds the record as the only
country to play in every World Cup. Italy has
won four World Cups, and Germany has
won three.

You don't have to play in the World Cup to
be competitive. Each week, there are thousands
of soccer games being played all over the globe.

Each game is important to both players and
fans. All of those players need numbers to keep
track of just how well they—and their teams-
are doing!

## CHAPTER FIVE

## Get Your Game Going!



Many young soccer players compete in local leagues and on school teams.

There are many ways to get your own soccer game going. Many kids play soccer at their school during recess. There are also organized leagues.

The American Youth Soccer Organization (AYSO) was formed in 1964 in

California. Players' ages are between 4 and 18. There are AYSO programs


Cleats, shin guards, and a ball are the basic equipment you need to play soccer.
in the United States, the U.S.

Virgin Islands, and Trinidad
and Tobago. You can find
other teams with the Boys and

Girls Clubs of America, the

YMCA, and city leagues. Many
parents support their kids'
teams by attending games.

It is also fun to get a game
going with your friends. All
you need is a soccer ball, but some other things will help keep you safe and comfortable. Soccer players generally wear shorts and a loose-fitting shortsleeved shirt. This keeps them cool and doesn't restrict their movements.

Shin guards are required during organized competitions. Shin guards are sturdy plastic shields
that strap to the lower part of your legs. You pull your
soccer socks over the shin guards to help hold them in
place. Shin guards help keep your legs from getting
bruised. Soccer players also wear cleats. Cleats have
hard knobs on the bottom to give players traction to
avoid sliding on the grass and into other players.

## Real World MAth challenge

There are some 650,000 players in AYSO. Girls make up 40 percent of these players. What percentage of the players are boys? Based on the total number of players $(650,000)$, how many girls play in the AYSO? How many boys play in the AYSO?
(Turn to page 29 for the answers)

## Century ontent

Having fun while playing soccer also means playing it safe. Make sure you keep your health and safety in mind when you get a game going with your friends. Drink plenty of water, especially if it is very warm outside, to stay hydrated. If a ball bounces into the street, make sure you and your friends look before crossing to retrieve the ball. And be sure to have extra Band-Aids for cuts and injuries. Can you think of some other health and safety tips for soccer players?

You've seen basketball players dribble the ball down the center court.

Soccer players also dribble the ball, but they use their feet. Short taps
on the ball make it possible for players to run with the ball and still have control. You need hours of practice to become good at dribbling. Eventually, you will become skilled at using your feet, thighs, and even
your head to keep the ball moving.

Soccer is a team sport. One person may kick the ball into the goal, but it takes all the other players to help get the ball to the scoring position. Playing
with friends is the best way to practice passing the ball back and forth.

An official adult soccer game lasts 90 minutes. The average adult soccer
player runs about 7 miles ( 11.3 kilometers) during that time! You won't need to travel quite that far, but soccer will keep you moving-you can count on it!

## Real World Math Challenge Answers

## Chapter One

## Page 5

The difference in circumferences between the 2 balls is 3 inches.
26 inches - 23 inches $=3$ inches
This means that the soccer ball used by Joe's team is 13 percent larger than the ball used by Mary's team.
3 inches $\div 23$ inches $=0.13=13 \%$
The difference in weights between the 2 balls is 2 ounces. 13 ounces -11 ounces $=2$ ounces
This means that the soccer ball used by Joe's team is 18 percent heavier than the ball used by Mary's team.
2 ounces $\div 11$ ounces $=0.18=18 \%$

## Chapter Two

## Page 11

There are 7,700 square yards $(7,041 \mathrm{~m})$ in a 110 yard $x$ 70 yard field.
110 yards $\times 70$ yards $=7,700$ square yards
There are 9,600 square yards $(8,778 \mathrm{~m})$ in a 120 yard $x$ 80 yard field.
120 yards $\times 80$ yards $=9,600$ square yards
The difference between the two fields is 1,900 square yards $(1,737 \mathrm{~m})$.
9,600 square yards $-7,700$ square yards $=1,900$ square yards $=1,900$ square yards

## Chapter Three

## Page 16

Hamm averaged 25.75 conference goals each year at UNC.
103 goals $\div 4$ years $=25.75$ goals

## Page 18

The other player scored 49 more goals than Pelé.
1,329 goals $-1,280$ goals $=49$ goals

## Chapter Four

## Page 22

Ronaldo Luis Nazário de Lima scored an average of 0.79 goals per game.
15 goals $\div 19$ games $=0.79$ goals per game
He scored an average of 5 goals per World Cup competition.
15 goals $\div 3$ World Cups $=5$ goals per World Cup

## Chapter Five

## Page 27

Boys make up 60 percent of the players in the AYSO.
100 percent -40 percent $=60$ percent
There are 260,000 girls in the AYSO.
650,000 players $\times 0.40=260,000$ girls
There are 390,000 boys in the AYSO.
650,000 players $\times 0.60=390,000$ boys

## Glossary

circumference (sur-KUHM-fur-uhnss) the distance around an object such as a soccer ball
competitive (kuhm-PET-uh-tiv) the efforts of two or more parties to win a sporting event
defender (di-FEND-ur) a field player who protects the goal
forward (FOR-wurd) a player who makes many shots on goal during a soccer game
hydrated (HY-dray-tid) has the right amount of fluid
immigrated (IM-uh-grayt-id) moved from one country to another
inducted (in-DUHK-tid) admitted as a new member
international (in-tur-NASH-uh-nuhl) worldwide, or global
midfielder (MID-feeld-ur) a player who links the offense and defense
opponents (uh-POH-nuhnts) players on the other side or opposite team
referee (ref-uh-REE) a game official
refugee (REF-yuh-jee) a person forced to leave home because of a war, natural disaster, or some other event

# For More Information 

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## About the Authors



Cecilia Minden, PhD, is a former classroom teacher and university professor. She now enjoys being a literacy consultant and author of children's books. She lives with her family near Chapel Hill, North Carolina. She would like to thank all her soccer-playing nieces and nephews for helping her to enjoy "the beautiful game."

Katie Marsico worked as a managing editor in children's publishing before becoming a freelance writer. She lives near Chicago, Illinois, with her husband and two children. She dedicates this book to her daughter and future soccer champion, Maria A. Marsico.

## た 21 1s Century <br> Skills Library

To play soccer you need a soccer ball, a field, a net, and teammates. Did you know you also need math skills? From tallying the score to estimating the distance to the goal, look inside to discover the connections between math and soccer.

The Real World Math: Sports series shows readers how math skills can improve their game in the increasingly complex world of the 21 st century. Other titles in the series include:

- Baseball - Speed Skating
- Basketball
- Football
- Swimming
- Running
- Tennis

To guide your reading, look for these notes that will help build the understanding and skills you'll need in the $21^{\text {" }}$ century. Look for the following margin notes:

## Learning \& Innovation Skills

You need to learn about lots of things, but you also need to learn how to learn. These notes give you hints about how to use what you know in better and more creative ways.

## $21^{14}$ Century Content

You study reading, math, science, and social studies. You also need to learn about the world of work and your community. These notes tell you about business and money. They also give you ideas about how you can help yourself, your community, and the world.

## Life \& Career Skills

These notes tell you about skills you will use throughout your life. They give you ideas about how to work well with others, make good decisions, and achieve your goals in life.

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