TEACHER WORKSHEET

CYCLE 4 • MATHEMATICS: DIMENSIONS AND MEASUREMENTS

PERFORMANCE IN SWIMMING

OVERVIEW

EDUCATIONAL OBJECTIVES:

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

SPECIFIC SKILLS:

- Extract useful information from a document, reformulate it, organize it, and compare it with one's own prior knowledge.
- Recognize situations involving proportions and solve corresponding problems.
- Solve problems involving various geometric properties, physical quantities, and economic indicators.

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:

SWIMMING • SPORT • SPEED • OLYMPIC POOL • SURPASSING ONESELF • RECORD

CONCEPTS ADDRESSED

SWIMMING AND HUMANKIND

People in Prehistoric times already knew how to swim, as some cave paintings depict, and in Greek mythology there are several references to swimming. In early 19th century Britain, competitive swimming first became popular, mainly with the breaststroke.

The earliest version of the crawl, which included a flutter kick, was inspired by a stroke used by indigenous people in South America. In the late 1880s, an Englishman named Frederick Cavill learned about the stroke while traveling the South Seas. He settled in Australia and went on to teach the stroke, which came to be known as the "Australian crawl".

A BRIEF OLYMPIC HISTORY OF SWIMMING

Swimming was included in the first modern Games in 1896, with events in freestyle (crawl) and breaststroke. The backstroke was added in 1904. The butterfly stroke officially debuted at the 1956 Olympic Games in Melbourne, Australia.

Women's swimming became an Olympic discipline in 1912 at the Olympic Games in Stockholm, Sweden, and has been included in every edition ever since.

The men's and women's programs are nearly identical and feature the same number of events, with one difference—the freestyle distance is 800 meters for women and 1,500 meters for men.

Since 2008, at the Olympic Games in Beijing, China, the 10-kilometer open-water marathon has been part of the official men's and women's programs. At the 2016 Olympic Games in Rio de Janeiro, Brazil, French swimmer Marc-Antoine Olivier won bronze in the event, while another French swimmer, Aurélie Muller, could have taken home silver but was disqualified for obstructing an Italian swimmer at the finish line.

The other Olympic swimming disciplines are synchronized swimming (a women-only event), water polo, and diving.

MATH CONCEPTS

- Solve problems to find the fourth value in proportional relationships.
- Perform calculations involving measurable quantities, notably compound units, using the same units.
- Check answers for consistency in terms of units.
- Understand basic quotients of physical quantities.

FUN FACT!

The swimming stroke known as the crawl is so called because the swimmer's motion in the water resembles crawling.

FUN FACT!

Swimming is one of the most watched Olympic sports in the world, along with athletics. Swimming also has the most events—with 16 men's events and 16 women's events, combining four strokes over various distances. Some events are freestyle (crawl, breaststroke, backstroke, or butterfly) and others require a specific stroke, such as the butterfly, backstroke, and breaststroke events over 100 and 200 meters.

FUN FACT!

American swimmer Michael Phelps holds the record for most medals ever won at the Olympic Games, with a total of 28 medals, including 23 gold!

FUN FACT!

At the 1900 Olympic Games in Paris, swimming events took place in the Seine river!

STUDENT WORKSHEET OVERVIEW

VOCABULARY:

Breaststroke, crawl, butterfly, Olympic swimming pool.

ACTIVITIES:

▶ **ACTIVITY 1: THE 1,500 METERS: AN ENDURANCE EVENT**

Calculate and compare times and speeds 12–13 yr | 13–14 yr | 14–15 yr

Materials: Text-based questions

FIND OUT MORE:

History of the crawl

▶ **ACTIVITY 2: THE BUTTERFLY: A SPECTACULAR STROKE**

Convert units, percentages 12–13 yr | 13–14 yr | 14–15 yr

Materials: Text-based questions and tables

▶ **ACTIVITY 3: THE OLYMPIC POOL: A VERY SPECIAL VENUE**

Calculate length, area, and volume 12–13 yr | 13–14 yr | 14–15 yr

Materials:Text-based questions

FIND OUT MORE:

The first swimming events at the modern Olympic Games

STUDENT WORKSHEET ANSWER KEY

▶ **ACTIVITY 1: THE 1,500 METERS: AN ENDURANCE EVENT**

12–13 yr | 13–14 yr | 14–15 yr

1) Convert Gabriele Detti's swimming time in the 1,500-meter freestyle into seconds.
Gabriele Detti swam the 1,500-meter freestyle in 880.86 seconds.

2) Convert Gregorio Paltrinieri's swimming time into seconds.
Gregorio Paltrinieri swam it in 874.54 seconds.

3) On average, how long did it take Gregorio Paltrinieri to swim one lap?
Write your answer in seconds, rounded to the nearest tenth of a second.
1,500 ÷ 50 = 30. Gregorio Paltrinieri swam 30 laps, and 874.54 ÷ 30 ≈ 29.2 seconds.
So it took him an average of 29.2 seconds to swim one lap.

4) Convert Gabriele Detti's swimming time in the 400-meter freestyle into seconds.
Gabriele Detti swam the 400-meter freestyle in 223.49 seconds.

5) If Gabriele Detti had been able to swim the 1,500-meter freestyle at the same pace as the 400-meter freestyle, what would his time have been?
First write your answer in seconds rounded to the nearest hundredth, then write it in minutes and seconds.
Applying the rule of three: 223.49 × 1,500 ÷ 400 ≈ 838.09 sec. ≈ 13 min. 58.09 sec.
If Gabriele Detti had been able to swim the 1,500-meter freestyle at the same pace, he would have taken about 838.09 seconds, or 13 minutes 58 seconds and 9/100.

6) Why is there a difference between the time calculated in question 5 and the time achieved by Gabriele Detti in the 1,500-meter freestyle?
Swimmers' endurance keeps them from swimming at the same pace over longer distances.

▶ ACTIVITY 2: THE BUTTERFLY: A SPECTACULAR STROKE

12–13 yr | 13–14 yr | 14–15 yr

1) Convert Michael Phelps's time to seconds in the 200-meter butterfly.
Michael Phelps swam the 200-meter butterfly in 113 seconds.

2) Calculate Michael Phelps's speed. Write your answer in $m \cdot s^{-1}$, rounded to the nearest hundredth.
$200 \div 113 \approx 1.77$ $m \cdot s^{-1}$. Michael Phelps's speed is about 1.77 meters per second.

3) Convert that speed to $km \cdot h^{-1}$. Round to the nearest hundredth.
$1.77 \times 3{,}600 \div 1{,}000 \approx 6.37$ $km \cdot h^{-1}$ which is about 6.37 $km \cdot h^{-1}$.

4) Convert that time to seconds.
139 seconds.

5) How much did the best time drop between 1956 and 2016? Write your answer as a percentage, rounding to the nearest whole number.
139 – 113 = 26 s. The best time dropped 26 seconds between 1956 and 2016. $26 \div 139 \times 100 \approx 19$. That represents a drop of about 19%.

▶ ACTIVITY 3: THE OLYMPIC POOL: A VERY SPECIAL VENUE

12–13 yr | 13–14 yr | 14–15 yr

1) What is the surface area of a swimming pool? Write your answer in square meters (m^2).
$50 \times 25 = 1{,}250$. The area is 1,250 m^2.

2) How much water can such a pool hold? First write your answer in cubic meters (m^3), then in liters.
$50 \times 25 \times 3 = 3{,}750$. The volume of water is 3,750 m^3. Given that 1 m^3 = 1,000 l, that represents 3,750,000 liters of water.

3) Calculate the water bottle's volume:
The water bottle's diameter is 7 cm, so its radius is 3.5 cm.
– The volume of the cylinder is equal to $3.5^2 \times \pi \times 12 = 147\pi \approx 462$ cm^3.
– The volume of the semi-sphere is equal to $1/2 \times 4/3 \times 3.5^3 \times \pi = 85.75/3\pi \approx 90$ cm^3.
The water bottle's total volume is therefore approximately $462 + 90 = 552$ cm^3 , i.e. 552 ml, so about 0.552 l.
$3{,}750{,}000 \div 0.552 \approx 6{,}793{,}478$, which would fill about 6,793,478 water bottles.

4) How wide is the space that swimmers have in each lane?
$25 \div 10 = 2.5$. A lane is 2.50 meters wide. Furthermore, 10 cm = 0.10 m, and 2.50 – 0.10 = 2.40, so swimmers have 2.40 meters to swim.

5) Some swimming pools are only 25 meters long, but swimming times are not comparable with those in an Olympic swimming pool. Why is that?
Over the same distance, swimmers make more turns and can push off at each end of the pool to swim faster.

FIND OUT MORE

EDUCATIONAL FILES

English: A passion for sports

English: The art of being a (s)wordsmith

Math: Dimensions and statistics in basketball

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

DIGITAL RESOURCES

Éduscol:
http://cache.media.eduscol.education.fr/file/Proportionnalite_/09/2/RA16_C4_MATH_RESOU_PROPO_555092.pdf

Les Clefs de l'École:
http://www.lesclefsdelecole.com/College/4eme/Mathematiques/Proportionnalite-produits-en-croix-et-regle-de-trois-en-4eme
http://www.lesclefsdelecole.com/College/4eme/Mathematiques/Les-grandeurs-composees-en-4eme

EXHIBITIONS FOR STUDENTS

The Olympic Museum in Lausanne, Switzerland. https://www.olympic.org/museum (virtual tour available online)

ACTIVITIES FOR STUDENTS

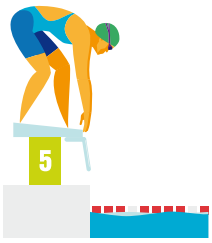
End of unit: "It's your turn! Performance in swimming" (and answer key).

STUDENT WORKSHEET

CYCLE 4 • DIMENSIONS AND MEASUREMENTS

PERFORMANCE IN SWIMMING

VOCABULARY



BREASTSTROKE: A stroke in which a swimmer moves forward face down, raising the head above the water, and using the arms and legs in a corresponding movement.

CRAWL: A stroke in which a swimmer propels the body forward face down using the arms and legs in an alternating movement.

BUTTERFLY: A stroke derived from the breaststroke in which both arms are raised above the water moving forwards in an undulating movement, like a dolphin. The butterfly has been standardized since 1953.

OLYMPIC SWIMMING POOL: A type of swimming pool with dimensions defined by the International Swimming Federation (FINA) = 50 meters long and 25 meters wide, filled with fresh water.

ACTIVITIES

▶ ACTIVITY 1: THE 1,500 METERS: AN ENDURANCE EVENT

In addition to the 10-kilometer open-water marathon, the 1,500-meter freestyle is the longest swimming event and is held in an Olympic-size swimming pool. Swimmers must swim for about fifteen minutes in the 50-meter-long pool.

At the 2016 Olympic Games in Rio de Janeiro, Brazil, Italian swimmer Gregorio Paltrinieri won the gold medal in the 1,500-meter freestyle.

With a time of 14:34.57, the 21-year-old beat American swimmer Connor Jaeger (in second place with 14:39.48), and another Italian swimmer, Gabriele Detti (in third place with 14:40.86).

1) Convert Gabriele Detti's swimming time in the 1,500-meter freestyle into seconds.

2) Convert Gregorio Paltrinieri's swimming time into seconds.

3) On average, how long did it take Gregorio Paltrinieri to swim one lap? Write your answer in seconds, rounded to the nearest tenth of a second.

TIPS & TRICKS

Whether playing sports or video games, try to learn from your mistakes to improve. And don't get discouraged! In class, apply the same behavior—see your mistakes in a positive light.

On the first day of the 2016 Games in Rio de Janeiro, Brazil, 20-year-old Australian swimmer Mack Horton won the gold medal in the 400-meter freestyle, beating the defending champion, Chinese swimmer Sun Yang.

Behind Horton, who finished with a time of 3:41.55, and Sun, second with 3:41.68, Italian swimmer Gabriele Detti took the bronze medal with 3:43.49. In London in 2012, Australia—a country where swimming is a major event—failed to win a single individual Olympic title.

4) Convert Gabriele Detti's swimming time in the 400-meter freestyle into seconds.

5) If Gabriele Detti had been able to swim the 1,500-meter freestyle at the same pace as the 400-meter freestyle, what would his time have been?
First write your answer in seconds rounded to the nearest hundredth, then write it in minutes and seconds.

6) Why is there a difference between the time calculated in question 5 and the time achieved by Gabriele Detti in the 1,500-meter freestyle?

FIND OUT MORE:

In swimming, the stroke used in freestyle events is almost always the crawl.

The stroke has been around since ancient times, but was first used in the West in 1844 at a competition in London, where it was swum by Native Americans. The breaststroke was a favorite among English swimmers, but two Anishinaabe, Flying Gull and Tobacco, easily beat their competitors. The crawl then underwent several improvements thanks to swimmers in Australia, the United States, and Japan, until the 1930s, when it became the most efficient stroke.

In 2012, French swimmers won 7 medals, including 4 gold, in swimming events—including Camille Muffat (400-meter freestyle), Yannick Agnel (200-meter freestyle), and Florent Manaudou (50-meter freestyle).

Mehdy Metella, Fabien Gilot, Florent Manaudou, and Jérémy Stravius, silver medalists in the 4 × 100-meter freestyle relay at Rio 2016.

▶ ACTIVITY 2: THE BUTTERFLY: A SPECTACULAR STROKE

The butterfly is one of the most spectacular strokes, but it also requires the most coordination. When done well, the butterfly is the second fastest stroke after the crawl.

The butterfly stroke emerged in the 1930s as a variant of the breaststroke. The first butterfly event at the Olympic Games was held in 1956.

At the 2016 Olympic Games in Rio, American swimmer Michael Phelps won the gold medal in the 200-meter butterfly with a time of 1:53.

1) Convert Michael Phelps's time to seconds in the 200-meter butterfly.

2) Calculate Michael Phelps's speed. Write your answer in $m \cdot s^{-1}$, rounded to the nearest hundredth.

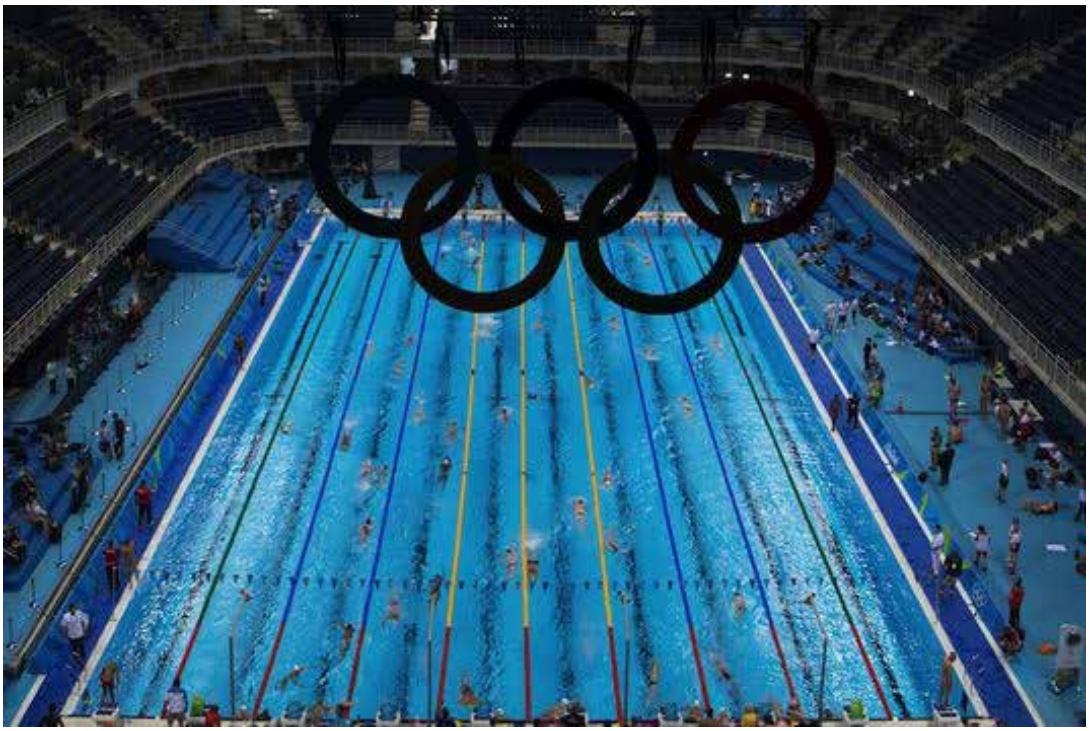
3) Convert that speed to $km \cdot h^{-1}$. Round to the nearest hundredth.

At the 1956 Olympic Games in Melbourne, Australia, the best time in the 200-meter butterfly was set by American swimmer William Yorzyk, with a time of 2:19.

4) Convert that time to seconds.

5) How much did the best time drop between 1956 and 2016? Write your answer as a percentage, rounding to the nearest whole number.

Over the course of his career, Michael Phelps won 28 medals, including 23 gold!



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▶ ACTIVITY 3: THE OLYMPIC POOL: A VERY SPECIAL VENUE

Swimming events at the Olympic Games take place in an Olympic swimming pool. Most Olympic-size swimming pools have the following characteristics:

– Length: 50 meters

– Width: 25 meters

– Number of lanes: 10

– Depth: 3 meters

To give you an idea, that's twice the length of a standard public swimming pool (25 m).

1) What is the surface area of a swimming pool? Write your answer in square meters (m^2).

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2) How much water can such a pool hold? First write your answer in cubic meters (m^3), then in liters.

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3) Imagine a cylindrical water bottle 12 cm high with a diameter of 7 cm, and rounded at the top like a semi-sphere with a diameter of 7 cm. How many of those water bottles could an Olympic-size swimming pool fill?

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Swimming pools have floating lines to mark out the lanes.
The diameter of each floating device is about 10 cm.

4) How wide is the space that swimmers have in each lane?

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5) Some swimming pools are only 25 meters long, but swimming times are not comparable with those in an Olympic swimming pool. Why is that?

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FIND OUT MORE:

Swimming was not part of the ancient Games, but it was included in the program for the 1896 Olympic Games in Athens, Greece. The event was held in open water.

The first Olympic competitions to take place in a swimming pool were in London, England, in 1908, where a pool 100 meters long and 17 meters wide was built for the occasion. That was also the year the International Swimming Federation (FINA), which sets the rules for authorized strokes, was founded.

Today, swimming has one of the highest number of events, at 37.

REVIEW

- Problems of proportionality can be quickly solved using the rule of three. But if the problem involves lengths of time, be sure to convert them into a single unit (e.g. convert minutes and seconds into just seconds).
- For calculations involving speed, distance, and time, the formula d = v/t is a must! You can then apply the rule of three to find the missing value.

NOW, TAKE ACTION!

- **Use your head.** A lot of math problems can be solved without a formula, just by using your head. Math formulas are often very logical. What matters is to always follow the same logic.
- **You use math without even realizing it.** Whether you do crafts or play sports, knowing how to measure length is a key skill. For example, if you want to cover a shoebox with wrapping paper, you have to cut a strip of paper the same length as... the box's perimeter! If you want to know how many kilometers you rode on your bike, you should add up the meters, which you can convert into kilometers... Math is hiding everywhere!
- **Jump right in!** Put on your swimsuit and swim cap and try to swim the length of the pool (25 m) using the stroke of your choice. Time your performance and calculate your speed in $km \cdot h^{-1}$.

CYCLE PROGRESS WORKSHEET

CYCLE 4 • DIMENSIONS AND MEASUREMENTS

PERFORMANCE IN SWIMMING

PRODUCTS AND QUOTIENTS

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.
Products and quotients are introduced to students 13–14 years old.

AREAS FOR DEVELOPMENT:

Math problems become more complex in Cycle 3 as the unit progresses:

- Activities 1 and 2 in the worksheet; have students perform other calculations and conversions for speed or time, using track and field events as an example.

- Activity 3; have students calculate the area of other venues (e.g. a stadium) or the volume of other containers (e.g. a bottle or tank) to compare them with the surface area or volume of an Olympic swimming pool.

IT'S YOUR TURN!

CYCLE 4 • MATHEMATICS: DIMENSIONS AND MEASUREMENTS

PERFORMANCE IN SWIMMING

PUT YOUR KNOWLEDGE TO THE TEST

1 HOW LONG IS AN OLYMPIC-SIZE SWIMMING POOL?

- ☐ 25 meters
- ☐ 50 meters
- ☐ 100 meters

2 WHAT IS THE DISTANCE OF THE LONGEST SWIMMING EVENT AT THE OLYMPIC GAMES?

- ☐ 400 meters
- ☐ 1.5 kilometers
- ☐ 10 kilometers

3 FROM WHICH STROKE DID THE BUTTERFLY ORIGINATE?

- ☐ The crawl
- ☐ The backstroke
- ☐ The breaststroke

4 WHICH OF THE FOLLOWING FRENCH SWIMMERS HAVE WON A GOLD MEDAL?

- ☐ Florent Manaudou
- ☐ Laure Manaudou
- ☐ Yannick Agnel
- ☐ Damien Joly
- ☐ Mehdy Metella
- ☐ Alain Bernard
- ☐ Jordan Pothain

TEST YOUR KNOWLEDGE FURTHER

1 WHERE DID SWIMMING EVENTS AT THE 1900 OLYMPIC GAMES TAKE PLACE?

- ☐ In a river
- ☐ In the ocean
- ☐ In a swimming pool

2 THE FOLLOWING TWO DETAILS ARE FOUND IN AN OLYMPIC SWIMMING POOL. WHAT ARE THEY USED FOR?

a) Two rows of flags hanging above the water's surface, five meters from each end wall.

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b) Two lane markings in black tile, at the end of each lane, two meters from the end wall.

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KICK OFF THE DISCUSSION... GIVE YOUR OPINION!

WHAT MAKES A GREAT CHAMPION?

IT'S YOUR TURN!

CYCLE 4 • MATHEMATICS: DIMENSIONS AND MEASUREMENTS

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a) Two rows of flags hanging above the water's surface, five meters from each end wall.

The flags tell backstroke swimmers when they are close to the edge, and to get ready to turn.

b) Two lane markings in black tile, at the end of each lane, two meters from the end wall.

The markings are used by crawl, breaststroke, and butterfly swimmers to turn around without having to look ahead.