

NATIONAL
SPORTS
MUSEUM

MATHS IN SPORT

LEVELS 6

YEARS 9

HOW DO SPORTS USE MATHEMATICS?



Key concept

Mathematics is involved in sport in many ways.

Focusing questions

1. How do sports use mathematics?
2. How is mathematics used in my chosen sport?

National Sports Museum exhibition focus

All areas

VELS dimensions addressed

Discipline-based Learning: Mathematics

Interdisciplinary Learning: Communication; ICT; Thinking Processes

Overview

These activities aim to give students some insight into the many ways that sport uses mathematics. Since its general purpose is motivation, the challenge of the mathematical content is not high.

Part of the reason that many students lose interest in mathematical studies is the seeming irrelevance of school (textbook) mathematics to areas of life in which they are particularly interested. Many of them are highly motivated by sports, and many have no idea of how mathematics is integral to the participation and record keeping of the sport.

The National Sports Museum does not go out of its way to expose the mathematics involved in the many sports encountered there. But there is sufficient opportunity to use the amazing displays and wealth of information to motivate students to explore the mathematics in sport. So the emphasis in this excursion-followed-by-a-project is motivation.

The purpose of the introductory activities is to begin this process of motivation. For many this can be achieved by merely exploring some sports web sites looking for mathematics – numbers, statistics, shapes, times and time lines, relationships and so on. This may orient students to look for some of this kind of information at the National Sports Museum itself, and also start them thinking about how they will tackle the challenge of finding the mathematics in a sport of their own choosing, for the post-visit project.

Pre-visit activities

Introduce the key concept: Mathematics is involved in sport in many ways.

Focus skills, knowledge and understandings: Mathematics

- 1 Outline the purpose of the visit to the National Sports Museum. Explain that there will be a set of sheets to be completed during the visit and later at home using internet research.
- 2 Explain that the follow-up activity will be a project. Each student will choose a sport and will prepare a report (probably electronically) demonstrating some of the ways that mathematics contributes to the sport.
- 3 Hold a discussion about how they think mathematics contributes to a sport with which they are familiar, such as Australian football or netball.
- 4 Students will benefit from looking at some of the following websites before their visit.
 - National Sports Museum www.nsm.org.au
 - Melbourne Cricket Ground www.mcg.org.au. Take the Virtual Tour.
 - Olympic records www.olympic.org/uk/sports/index_uk.asp
 - AFL www.afl.com.au
 - Sport Australia Hall of Fame www.sahof.org.au/
 - Australian Netball: www.netball.asn.au/extra.asp,
 - Soccer: www.soccerstas.com, www.playerhistory.com/
 - Tennis: www.tennis.com.au,
 - Volleyball: www.avf.org.au/
 - Athletics: www.athletics.com.au/
 - Swimming: www.swimming.org.au

During the visit to the National Sports Museum

All students will receive the Maths in Sport Gizmo.



This 'gizmo' has questions for each gallery and the students need only select the correct answer and mark it on the back. There are 12 focus questions for their visit to the National Sports Museum. It is designed to be fun, slightly challenging and not onerous. We want the students to enjoy the whole experience.

If you consider your students capable of greater output and museum investigation, we then suggest you print off pages Worksheet Pages 1 – 4. Read the next section.

Materials

Worksheet 1 (3 sides)

Ask students to look for mathematical information related to many parts of the exhibit. To assist in this a worksheet 1 is prepared – you could copy one for each student in advance. Post-visit, students will be required to undertake an inquiry-based research project on a sport of their choosing in which they will explore the related mathematics.

Tour of the MCG

During your visit to the National Sports Museum at the Melbourne Cricket Ground, we also suggest that you take an MCG Tour. Our bookings staff will help schedule this. It is an excellent opportunity to make special use of the reduced price combination package.

Post-visit activities

Focusing question 1: How do sports use mathematics?

Focus skills, knowledge and understandings: Mathematics

Materials

- 1 Worksheet 2
- 2 Internet access for research.

Worksheet 2 has a set of headings and short descriptions that suggest some of the ways that mathematics is involved in a sport. Copy these and use them as the basis of a discussion of the ways mathematics contributes to sports in general.

Focusing question 2: How is mathematics used in my chosen sport?

Focus skills, knowledge and understandings: Mathematics; Thinking Processes; Communication; ICT.

Materials

Internet access for research

Students work alone (or in pairs if advisable) to complete a report within a timeline of your choosing. Hand out the assessment guide (rubric – Worksheet 3) to let students know what is expected.

Indicators of student achievement and assessment strategies

The activities in these materials address the following dimensions of VELs and are reflected in the design of the rubric on page 12:

Mathematics

Number; Space: Measurement; Chance & Data

Students demonstrate a thorough understanding of the relevant mathematical concepts as appropriate to the student's level.

Students use accurate mathematics and systematic reasoning to make decisions and reach conclusions.

Thinking Processes: Reasoning, processing and inquiry

Students develop their own questions for investigation, collect relevant information from a range of sources and make judgments about its worth

Communication: Presenting

Students develop their skills in organising ideas and information logically and clearly to suit their purpose and needs of their audience.

ICT

Students use ICT tools and a range of data types to create information, analyse of concepts, solve problems and to describe and test hypotheses.

Interpersonal Development: Working in teams

Students work effectively in different teams and take on a variety of roles to complete tasks of varying length and complexity

Source: Adapted from Victorian Essential Learning Standards, VCAA 2005

Answers

The factual questions on Worksheet 2 have these answers. Use them to check the students' work.

- 1 L = 174 m, W = 149 m.
Volume: 1.7 million m³, or 1700 000 m³, or about 1/588 th of a cubic km.
- 2 The model has L = 87 cm and W = 74.5 cm. Scale of model: 1 m shows 200 m, or 1 cm shows 2 m. Light towers are 74 m high.
- 3 130 000 in 1959 for the Billy Graham Crusade.
- 4 2007 Grand Final (42 253 L of beer, 17 433 buckets of chips, 14 212 pies)
2006 Boxing Day Test (79 648 L of beer, 22 967 buckets of chips, 24 278 pies)

Cricket has more: beer = 189%, buckets of chips = 131%, pies = 170%. The cricket day lasts 7 hours (11 am to 6 pm), while AFL finals last 22.5 hours (from 2.30 to 5 pm).
- 5 Edwin Flack won the 800 m in 1896 in 130 seconds. His speed was $800 \div 130 = 6.1 \text{ m/s} = 6.1 \times 3.6 = 22 \text{ km/h}$. The record is decreasing at 27 seconds in 100 years, or 0.27 seconds per year.

Flack later won the 1500 m in 273 seconds, at a speed of $5.5 \text{ m/s} = 20 \text{ km/h}$. This record is decreasing at 61 seconds in 104 years, or 0.59 seconds per year. These rates of increase are most unlikely continue to increase for a century, since most of the improvement happened before the first 50 years were up. The rate of increase is slowing considerably.
- 6 Betty Cuthbert won gold in 1956, in Melbourne. Her time was 11.45 seconds, so her speed was $8.73 \text{ m/s} = 31.4 \text{ km/h}$.
- 7 Colin Coates speed-skated in 18 events at six Games, more than any other Australian: in 1968, 72, 76, 80, 84 and 88.
- 8 Youngest: Sandra Morgan (aged 14) swimming
- 9 Oldest: Bill Northam (aged 59) yachting
- 10 Two draws, but 1948 and 1977. Probability estimate 2 in 111 or 0.018.
- 11 Heights and weights are increasing. Height (in cm) is generally 100 more than mass (in kg),
- 12 The 1998 average height fits the trend, as shown by a graph or rough calculation. (1998 is about three quarters of the time from 1968 to 2008, and 186 cm is about three quarters of the height difference.)
- 13 The player in the 1920s is at the expected average height, but is about 4 kg overweight!
- 14 Rod Laver won two complete Grand Slams in two consecutive years.
- 15 Lesley Bowrey won 13 Grand Slam titles in one season.
- 16 John Newcombe won 25 titles in his career.
- 17 Margaret Court won 62 (or 24) Grand Slam titles in her career.
- 18 In the longest match she played 42 games (42-12 and 11-9) over 2.5 hours.
- 19 Swimming (64).
- 20 Bradman scored 6996 runs, in 700 test matches (average 99.94). His final score was 0 (a 'duck') but his highest score was 452 not out.

Answers continued

- 21 John Landy was Victoria's Governor from 2001 to 2006. He broke the world mile record in 1953 and was the second person in the world to run under 4 minutes for this event. Taking 4 minutes for a mile means a speed of 15 miles per hour, or 24 km/h.

The mile is longer than 1500 m, being about 1580 m. (Multiply 1728 yards by 0.9144.)

In 1956 in the National titles, Landy won the mile after stopping during the last of four laps when Ron Clarke fell in the middle of the pack. Landy lost 5 seconds, but still won the race.

- 22 Coventry scored 1299 goals in 18 seasons (average 72 goals per season). He played 306 games for an average of 4.25 goals per game.

- 23 See image

- 24 The cricket pitch is 1 chain (or 22 yards) long, and 8 foot 8 inches wide. The crease line is 4 feet from the end of the pitch. The stumps are 28 inches high. The cricket pitch: 20.12 m long and 2.64 m wide. The crease line is 1.22 m. Stumps 71 cm

Worksheet Page 1

Hunting for maths

As you walk around the National Sports Museum you will find many examples of mathematics. See if you can locate and correctly record all of these. Some answers you will need to complete at home.

The Melbourne Cricket Ground (MCG)

Take the MCG tour. While you do, answer question 1.

- 1 a Estimate the length and width of the grassed area.
b Estimate the height of the light towers.
c Estimate the volume of the MCG. in m^3
- 2 Model of 'The G' inside the museum.
a Estimate the length and width of the grassed area in the model.
b Use the answers 3b and 4a to estimate the scale of the model.
c Discover the actual height of the light towers from the information on the model.
- 3 There is a time line. When was the greatest ever crowd? How big was it?
- 4 Crowds need food.
a How many pies were sold to the AFL's 2007 Grand final crowd?
b How many pies were sold to the 2006 Boxing Day test cricket crowd?

Olympic Games

- 5 a Edwin Flack won Australia's first medal? In which event? _____
b What was his time? _____
c Estimate his speed. _____
d The current Olympic record holder for this event is Rodal (102.58 s in 1996). Estimate his speed.
e At what rate (per year) has the record time for this event changed over the last century?
- 6 Watch the video of Betty Cuthbert running 100 m in the 1956 Melbourne Olympics.
a Note the time for the 100 m.
e Use this to calculate her average speed in m/s.
- 7 Why is Colin Coates famous as an Olympian?
- 8 Who was Australia's youngest Olympic gold medal winner?
- 9 Who was Australia's oldest Olympic gold medal winner?

Worksheet Page 2

Australian football

- 10 Has there ever been a draw in a Grand Final? Estimate the chance of a drawn final.
- 11 There is a display showing average height and weight of footballers since the 1900s. Is there any relationship between height and weight? If so, describe it.
- 12 The mean height of players in 1998 was 186.6 cm. Does this fit the trend you observed? Explain how you know.
- 13 We are not told that the player depicted for the 1920s is 'average'. Is he, and if not, how is he different from the average?

Other sports

- 14 For what is Rod Laver especially famous?
- 15 Lesley Bowrey won more Grand Slam titles in one season than any other Australian player. How many?
- 16 John Newcombe won more Grand Slam titles than any other Australian man. How many?
- 17 Margaret Court won more Grand Slam titles than any other Australian woman. How many?
- 18 Margaret Court won the longest ever final in history. How many games were there, and how long did it take? (Hint: estimate 3.5 minutes per game)

Sport Australia Hall of Fame

- 19 Which sport has the greatest number of inductees in the Hall of Fame?
- 20 The first member of the Hall of Fame and the first legend is Sir Donald Bradman.
 - a How many runs did he make in test cricket?
 - b How many matches did he play?
 - c What was his average in test matches?
 - d His average before his last test innings was 101.39. What was his last score?
 - e What was his highest score?
- 21a John Landy was Governor of Victoria in which years?
 - b When did he break the world mile record?
 - c What was his time?
 - d What was his average speed over the mile in miles per hour?
 - e Multiply answer d by 1.6 to estimate his speed in km/h.
 - f Which is longer: a mile or 1500 m? By how many metres?

Worksheet Page 3

g View the movie of the National titles in 1956. How many seconds did Landy lose before winning the race?

22a Gordon Coventry kicked the great number of goals in his lifetime. How many goals did he score?

b How many seasons did he play? _____

c What was his average goals-per-season? _____

d How many games did he play? _____

e What was his average goals-per-game? _____

Cricket

23 The picture shows the scoreboards for the highest scoring match of all time.

BATSMEN OUT.		FALL OF WKTS.	BATSMEN.	RUNS.	BOWLERS.	WKTS	RUNS
WOODFULL	C	2133	1	FOR 375	ELLIS	63	
HENDRY	C	3100	2	" 594	BLACKIE	27	
PONSFORD	B	6352	3	" 614	EXTRAS	27	1
LOVE	S	316	4	" 631	OUT	1107	2
KING	S	317	5	" 657	VICTORIA	3	MAILEY 4
HARTKOPF	C	361	6	" 634	1 ST INNINGS	4	CAMPBELL 89
LIDDICUT	B	236	7	" 915	2 ND INNINGS	5	PHILLIPS 64
RYDER	C	7295	8	" 1043	N. S. W.	6	MORGAN 1137
MORTON	R	0	9	" 1046	1 ST INNINGS	22	1
			10	"	2 ND INNINGS	8	ANDREWS 2148
							KIPPAX 26

(Courtesy of MCC Collection)

a Who was the highest scoring player?

b What was the average batter score?

c What was the worst bowling average?

d Which two players played for the highest scoring partnership, before one was dismissed?

24 Complete:

The cricket pitch is 1 chain (or ____ yards) long, and ____ foot ____ inches wide.

The crease line is ____ feet from the end of the pitch. The stumps are ____ inches high.

Worksheet # 2: Maths in a sport: skeleton plan

Introduction (possibly some history)

Origins of the sport, and some history of the sport in Victoria or Australia.

Equipment

The major components of the equipment, what the players wear and what it all costs. (Give dimensions, and types where they differ.) Photos would be helpful. If you play the sport, include yourself!

Club or association membership

The numbers of clubs or associations that cater for the sport, what it costs to join and other costs.

Where the sport is held

Dimensions of the playing field, with variations if they exist. If you play the sport, where do you play?

Rules of the game

The procedures involving measurement of times, distances, areas, weights (masses), heights etc.

How a competition is put together

The 'draw' for a season, if it exists, for example the use of "Round robin" or elimination rounds.

Scoring

How the scoring system works, and what is done in the case of a tied competition.

Statistics

Typical and outstanding scores from competitions. Average scores, winning margins,

History of finals series, if they are held. If clubs are involved, possibly a timeline showing some history of at least one club – you could choose your own club, if you play!

Interesting statistics such as comparisons of averages and relationships that might suggest what leads to 'winning' performances.

Olympic results

If the sport has been in the Olympic Games (Summer or winter), give some of the interesting results, including close events, outstanding performers, trends in records, etc.

Records, close events, trends

Look at world records for the sport and suggest trends over time. Can you predict the future with a graph?

Sports Australia Hall of Fame

Are there any players of this sport in the Sport Australia Hall of Fame? Name them and explain why they are there, indicating their achievements mathematically.

Rubric (assessment guide) for the project

Mathematics (Number, Space, Measurement, Chance & Data, Structure)

Demonstrates a thorough understanding of the relevant mathematical concepts as appropriate to the student's level.

Uses accurate mathematics and systematic reasoning to make decisions and reach conclusions.

4 Consistently

3 Often

2 Sometimes

1 Never

Working mathematically

Students make relevant mathematical connections with everyday experiences.

4 Consistently

3 Often

2 Sometimes

1 Never

Thinking Processes: Reasoning, processing and inquiry

Students develop their own questions for investigation, collect relevant information from a range of sources and make judgments about its worth

4 Consistently

3 Often

2 Sometimes

1 Never

Communication: Presenting

Students develop their skills in organising ideas and information logically and clearly to suit their purpose and needs of their audience.

4 Consistently

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2 Sometimes

1 Never

ICT: for visualising thinking

Students use ICT tools and a range of data types to create information, analyse of concepts, solve problems and to describe and test hypotheses.

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Interpersonal Development: Working in teams

Students work effectively in different teams and take on a variety of roles to complete tasks of varying length and complexity.

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