Mathematics
Middle Primary

Level

F	1	2	3	4	5	6	B6

What chance do I have?

Strand:
Chance and data

Purpose:

Students explore the language and concepts of chance through the context of gambling opportunities that are readily visible within the community. They will investigate the general structure of at least one of these gambling opportunities and create a simplified model. They will analyse the data from the use of this model to evaluate the chance aspects and will study the advertisements associated with the original game. Following their discovery and assessment of the 'real chances of being lucky', students will create written and oral reports that describe a realistic picture about winning and losing. These reports will also identify the criteria students use when reasoning about chance events and making judgements about likelihood.

Overview of activities

The following table outlines the activities in this module about common gambling opportunities and the mathematics associated with them. It illustrates the way in which these are organised in phases and how they promote **thinking, reasoning and working mathematically**.

Thinking, reasoning and working mathematically

Phase 1

Identifying and describing

To focus on the investigation students:
- brainstorm about gambling opportunities within the community
- brainstorm about language associated with gambling (such as lucky/unlucky; fair/unfair; winners/losers)

Phase 2

Understanding and applying

Students:
- plan and conduct investigations that explore the mathematics associated with 'popular' gambling opportunities
- design a model that simulates (but also simplifies) a specific gambling opportunity (such as 'scratch casket tickets')
- discuss the design and provide feedback
- compare the chances of winning against the chances of losing

Phase 3

Communicating and justifying

Students:
- compare and contrast models of other gambling opportunities
- make evaluative comments about gambling opportunities
- develop a written report about the gambling opportunities within the study

Core Learning Outcome

This module focuses on thinking and reasoning about a range of gambling opportunities. The related Level 3 Chance core learning outcome is:

CD 3.1 Students identify all possible outcomes of familiar situations or actions and, for these sample spaces, order the likelihood of occurrence of the identified outcomes using experimental data

Because students will need to collect, organise and interpret data about each of the selected gambling opportunities, the module will also involve the Level 3 Data core learning outcome:

CD 3.2 Students design and trial a variety of data collection methods and use existing sources of data to investigate their own and others' questions, organise data and create suitable displays identifying and interpreting elements of the displays.

Core Content

Chance	Data
Likelihood • language of chance o more, less, equally likely o most likely, least likely o certain o multiple outcomes o relate everyday language or colloquialisms to likelihood (e.g. 'no chance') o experimental probability (e.g. one in four chance) o sample space (all possible outcomes) **Judgements** • subjective and numerical judgements o comparisons and predictions based on experimental data o fairness of rules o independence and dependence of subsequent outcomes (randomness)	**Collecting and handling data** • collection methods o surveys o observations o experiments • existing data sources o publications **Exploring and presenting data** • displays o tables o picture graphs (one to many representations) o bar graphs • main elements of displays o titles o axes o scales **Identifying and interpreting variation** • comparative and quantitative language • variety of displays to illustrate data features and variation

Teachers should note that the Level 3 Number concepts outcome (N 3.1) limits the size of whole numbers to be studied by students to 9,999. Consequently, as teachers plan learning experiences, they should adapt activities to match these limits.

Assessment

The assessment advice in the following table is based upon the *Elaborations* provided by the Queensland Studies Authority on its website (www.qsa.qld.edu.au).

The *Elaborations* are a resource that supports teachers to unpack each core learning outcome. They include statements about what students should know and what they should be able to do with that knowledge. The latter set of statements can be used as assessment criteria when determining the quality of students' learnings.

The assessment criteria related to demonstration of this outcome in blue type have some relevance to the context of this module. All of the other criteria appear in green type. Teachers can use the blue criteria as the basis of their assessment of students' understanding of the chance concepts included in this investigation.

CHANCE Topic

Core learning outcome	What students should know	Assessment criteria What students should be able to do
CD 3.1 Students identify all possible outcomes of familiar situations or actions and, for these sample spaces, order the likelihood of occurrence of the identified outcomes using experimental data	**3a** Familiar situations or actions may have more than one possible outcome	o relate everyday language or colloquialisms to likelihood such as no chance o identify the possible outcomes from a particular activity o identify and describe possible variations such as racing against different competitors, different age groups, in pairs, in different sports, over different distances, at different times of the day
	3b The likelihood of occurrence of outcomes of events within a sample space may be the same (equally likely) or different	o describe the set of outcomes as the sample space; o identify experiments where each outcome is independent of previous or future outcomes o identify situations where each possible outcome has an equal chance of occurring such as the tossing of a dice or coin o identify other situations or actions that have equally likely outcomes such as picking coloured counters that are the same shape, size and texture from a bag o identify situations where the likelihood of occurrence is affected by some attribute of condition o explain how the conditions of an experiment can be controlled to make the outcomes equally likely o explain how the conditions of the same experiment (as above) can be changed to ensure that the outcomes are not equally likely
	3c The order of likelihood of the occurrence of outcomes can be represented on a continuum	o estimate the order of likelihood o make judgements supported by reasoning about the likelihood of each outcome within a selected sample space o order the likelihood of the occurrence of that sample space based on experimental data
	3d Experiments provide samples of data that illustrate the likelihood of occurrence of possible outcomes	o conduct experiments to collect data about likelihood of events such as the dropping of a drawing pin o design and conduct experiments to collect data about the fairness of given rules o use experimental data to inform changes to rules to make them fairer o use data to describe the experimental probability such as a 1 in 4 chance of occurring o give reasons for judgements and relate these chance ideas to other situations

DATA Topic

Core learning outcome	What students should know	Assessment criteria What students should be able to do
CD 3.2 Students design and trial a variety of data collection methods and use existing sources of data to investigate their own and others' questions, organise data and create suitable displays identifying and interpreting elements of the displays	**3a** A variety of data collection method	o develop or interpret the question or issue to be investigated o select suitable data collection methods o trial data collection methods o evaluate data from the trial or from existing sources o modify data collection methods as required o conduct data collection with the targeted sample
	3b How to use existing sources of data to investigate a range of issues	o identify and select from existing sources of data o critically analyse existing data sources taking account of methods of collection, size and relevance of the sample o decide whether the data is applicable to the question/s posed
	3c Ways to organise data	o generate categories for the classification of data and justify the categories selected o select appropriate recording methods (such as tallying or checking expected responses) and give reasons for the selection o check accuracy of data gathered and data recorded o identify the range of results across and within categories
	3d Suitable displays for data interpretation	o determine a suitable data display to answer the question or address the issue and justify selection o evaluate the effectiveness of the display in terms of illustrating the data features and variations using the main elements of displays to assist interpretations o describe their own and others data displays using comparative and quantitative language
	3e Elements of displays	o select appropriate scales as required, titles and headings o explain why a particular scale has been selected over others

Contributions to the valued attributes of a lifelong learner

Through engagement with activities in this module, students develop the following attributes:

Knowledgeable person with deep understanding

- understands the purpose for collecting data
- makes judgements on data collected
- understands the concept of chance
- is able to make judgements about likely outcomes

Complex thinker

- analyses and organises information

Active investigator

- uses data collection to investigate questions
- accesses information from a variety of sources

Responsive creator

- uses a variety of displays to present data to a chosen audience

Effective communicator

- presents data collections to others using different data displays
- uses data displays as a means of communicating information

Participant in an interdependent world

- works independently and in groups, and acknowledges the ideas of others

Reflective and self directed learner

- looks for and recognises ways of "working mathematically" in everyday life

Background information

Gambling in Australia

Gambling is an integral part of Australian culture. It is an activity that has saturated the everyday and has impacted on the realities of children and young people.

Today's juveniles are the first generation to be raised in an environment where legalised gambling is so pervasive, readily accessible and socially acceptable. [1]

For many people, gambling is a recreational interest that provides important opportunities for social interaction, and is a harmless and enjoyable pastime. However, others may gamble excessively, resulting in high economic, social, family and personal costs. According to the *Queensland Household Gambling Survey (2001)* 0.83% of the Queensland adult population or about 22,000 people experience problems with their gambling [2].

It is difficult to define 'problem gambling' because behaviours and situations that harm some individuals may not cause problems for others. However, a problem gambler can be defined as 'a person whose gambling has caused unmanageability or problems in some areas of ...life, e.g. financial, marital, work, emotions, health, loss of identity, depression etc.'[2] For the purpose of this module, responsible gambling could be defined as participating in gambling practices that do not result in negative health outcomes.

To read more about gambling's impact on young people refer to the Introduction section of your *Responsible Gambling Teaching Resource Kit*.

Students and disclosure

If students make personal disclosures about gambling-related issues, professional support for the family or child is available through the Gambling Helpline (1800 222 050), local Gambling Help services and other community agencies such as Gam-Anon. Students may also access the Kids Help-line (1800 551 800).

Contact numbers for Gambling Help services are provided on a poster in the folder of your *Responsible Gambling Teaching Resource Kit*.

Details of help services can also be accessed via the Responsible Gambling website (http://www.responsiblegambling.qld.gov.au)

School authority policies

Be aware of and observe school authority policies that may be relevant to this module. Education Queensland policies can be found at (www.education.qld.gov.au/corporate/doem/sindex/m-ind.htm).

For policies and guidelines for the Catholic sector, refer to the Queensland Catholic Education Commission website (www.qcec.qld.catholic.edu.au/policies.htm).

Responsible Gambling Education Principles and Guidelines should be referred to. These can be found in section 2 of your Teaching Resource Kit or accessed via the Responsible Gambling website (www.responsiblegambling.qld.gov.au).

[1] Jacobs (2000) *Juvenile Gambling in North America: Analysis of long term trends and future*, Journal of Gambling Studies 16 (2/3) pp 119-152.

[2] Queensland Treasury (2001) Queensland Household Gambling Survey, *Queensland Government*, p.2.

[3] Symond, P. (1997) *A synopsis of problem/compulsive gambling*, in K. Healey (ed.), Gambling: Issues for the Nineties, The Spinney Press, Sydney.

Phase 1 Identifying and describing

What is gambling?

Students

- Have the students brainstorm about gambling and their perceptions of what constitutes gambling.
- Students should discuss their own observations about gambling in response to questions such as:
  - *Has anyone ever been given an 'instant scratch-it ticket' as a present or reward?*
  - *Has anyone ever bought or sold raffle tickets?*
  - *Who knows people who try their luck with Lotto?*
  - *Do you know people who visit the poker machines at clubs or hotels?*

Teaching considerations

- In your class discussion, refer to Resource Sheet 1 and OHTs 1 and 2. The orienting activities in Idea Sheet 1 will provide you with some discussion points around these resources.
- As students share their perceptions about gambling, teachers should be sensitive about privacy issues and stop students if they seem to be sharing information that is too personal about their family beliefs and practices.
- The students should be encouraged to access the Responsible Gambling website (http://www.responsiblegambling.qld.gov.au) and read the information provided in *School Stuff*.
- Write a list of all of the relevant ideas that students raise about gambling on the board. Try to organise the ideas into two main lists – those that seem to involve 'serious' gambling (such as casinos, poker machines, the TAB and the racetrack) and those that appear to be more 'social' events (such as instant scratch-it tickets, lotto, art unions, raffle tickets).
- Discuss the common features of all of these gambling opportunities – all involve risk, all involve large numbers of losers, all involve a small group of winners.
- Investigate some of the history of gambling using Resource Sheets 3 and 4 and OHT 4. The orienting activities in Idea Sheet 2 will provide you with some discussion points around these resources.
- Students should collect examples of newspaper advertisements for lotto or scratch tickets.
- Refer to the Level 4 module available in your Resource Kit: *In Control – Taking Responsible Risks* for ideas on deconstructing these media texts in particular Student Resource 2 (p 27).
- Students could also access the Golden Casket website to read the advertising and information available (http://www.goldencasket.com).

- **Teachers must be diligent in their monitoring of students' activities on the Golden Casket website and take care that they do not attempt to register on-line for any forms of gambling. Students should be made aware that it is against the law for people under 18 years of age (i.e. minors) to play the games or be sold tickets. Minors also cannot collect any winning prizes.**

- Students should discuss the variety of games available and when they can be played.
- They can also discuss how the advertising might attract people to play the games.
- Discuss the language used on the advertising examples collected inviting people to participate in the various games.

Discuss the language and concept of chance

Students

- ▶ Discuss the concepts of luck and risk with the students. What does it mean to say that someone is lucky?
- ▶ Read the Golden Casket brochure *HAVE FUN & PLAY RESPONSIBLY* – Resource Sheet 29.
- ▶ When someone pays money to buy an instant scratch-it ticket, are they taking a risk?
- ▶ Discuss the possible outcomes of buying an instant scratch-it ticket.
- ▶ Discuss whether it is worth the risk. Is it worth risking your money. What else could you use the money for?
- ▶ Discuss the concept of winning and losing. Do some people appear luckier than others?

Teaching considerations

- It is important that students begin to understand that any form of gambling involves taking risks. They need to understand the mathematics of any gambling opportunity to understand the risk.
- Discuss *luck* with the students. They should describe what they think it means to be lucky. Can people be *luckier* than others and why might people think this way? Does luck apply only to gambling? Can people be lucky in situations that do not involve winning or losing?
- Emphasise the chance aspects of situations where *luck* is involved. Stress also the risk aspects in these situations. Even if someone believes they are lucky, it does not reduce the risk.
- Have the students focus on 'instant scratch-it tickets'. Discuss what students understand about the risks involved in this type of gambling. They should make suggestions about what they need to know to work out if the risk is worthwhile (such as how many tickets there are in one 'game'; how many winners and losers are there?).

Phase 2 Understanding and applying

How are instant scratch-it games constructed?

Students

- ▶ Have the students read the information about the different 'instant scratch-it' games using Resource Sheet 29.
- ▶ They should identify the total number of tickets, and from this number, identify the number of winning tickets and the number of losing tickets.

Teaching considerations

- Have the students initially draw up tables in their groups to list the 'facts' associated with various instant scratch-it games. Some games have very large numbers of tickets – there are 3 million tickets in the $1 Instant Scratch-It game described in Resource Sheet 29.

  (NOTE: when the 'Odds of winning Top Prize' are listed as 1 in 3,000,000 then this should be interpreted as there being 1 first prize out of 3 million tickets).
- These facts should be discussed within the groups and the class using the information in Resource Sheet 29. Many students may need assistance to gain an appreciation of the size of the numbers involved.

  (NOTE: Students working through the Level 3 Number concepts outcome N 3.1 may be confident only with four digit whole numbers).
- Distribute copies of Resource Sheet 30 which shows the distribution of prizes in the $5 Instant Scratch-it game. Teachers should assist students to interpret the information in the sheet. For example, if there are 193,351 winning tickets, there will be more than 550,000 losing tickets.

- It is important that students appreciate the very large sample space (all of the tickets). Assemble a collection of 1,000 objects (such as MAB ones blocks) to assist students, and then discuss ways of visualising the larger numbers of tickets in the Instant Scratch-It games.
- They should also identify the relatively small set of winning tickets and the very large set of losing tickets. Using the 1 in 4 chance of winning any prize in the $5 game, have students separate out the blocks in this proportion.

Why does there need to be so many tickets in an Instant Scratch-It game?

Students

- ▶ Have the students read through the information about Instant Scratch-Its tickets using Resource Sheet 29.
- ▶ How many losing tickets do there need to be to pay for the larger prizes?
- ▶ How much of the money collected from the sale of tickets is paid out in prizes?

Teaching considerations

- Have the students use the tables they created in their groups to discuss all of the prizes paid out in a particular scratch casket game. Discuss the sizes of the prizes and how many of each size there are. Use Resource Sheet 30 to illustrate the distribution of prizes in that game.
- Students must see that there may be many prizes, but most of them are minor prizes – the one major prize is like a *needle in a haystack*. Discuss this saying with students and ensure that they can understand it in the context of Instant Scratch-It games.
- The top prize can be sold at any time. It may even be sold before most of the other tickets in the game are sold. There may be no major announcements about the prize being collected. The students might like to discuss why (i.e. no-one might buy any of the remaining tickets).
- Discuss the fact that the tickets in the various games are broken up into bundles and distributed to the many newsagents around the State. Discuss whether the 'local' newsagent might have a big prize in the bundle of tickets – but no one really knows until people scratch the tickets.
- Assist students to interpret the information in Resource Sheet 29 in relation to the numbers of losing tickets. For example, if there are 3 million tickets in a $1 Instant Scratch-It game, then according to the brochure:
  - o the odds of winning any prize at all are 1 in 5;
  - o there will be about 600,000 tickets that have a prize attached;
  - o it also means that there will be 2,400,000 tickets that are losers (four times as many)
- Have students identify this information for all of the games – calculators can be used if required.
- Discuss the importance of the security aspects associated with all of the Instant Scratch-It casket games and the covering of the scratch panels until they are purchased.

How would you make a model of an Instant Scratch-It game?

Students

- ▶ Have the students work in small groups to discuss ways to model an Instant Scratch-It game.

- ▶ Base the model on the collection of 1,000 objects (from before) and work out the number of winning tickets and losing tickets.
- ▶ Students should decide how their model relates to a real game and how they should manage the security of the 'tickets'.

Teaching considerations

- Before beginning the construction of this simulated Instant Scratch-It game, teachers must emphasise the purpose of the activity to students. The activity is designed to illustrate the chance concept – students' chances of picking a 'winning' ticket at random. This will allow a comparison to be made of the chances of winning with the chances of losing.
- The class should design a game based on the collection of 1,000 objects made earlier. These objects should be identical in shape, size and texture so that any selection will be a random one.
- If such a collection is not possible, the students can use a copy of Resource Sheet 31 which has 1,000 squares already drawn (40 rows of 25 squares). The sheet of paper can be glued onto cardboard before cutting them out to make the small shapes easier to handle.
- To simulate an Instant Scratch-It game, the students should use the odds of 1 in 5 winning tickets (the same as the $1 Scratch-It game). This will mean that 200 tickets (objects etc.) need to be identified, perhaps by colouring one face – and one of those might be coloured differently again to represent the top prize.
- Allow the students to observe the mixture of winning and losing 'tickets' as a group. They should observe that there are many more losers than winners.

Who will be winners and who will be losers?

Students

- ▶ Have each student in the class participate in the game and pick out five 'tickets'.
- ▶ Ensure that students observe rules and conditions that preserve fairness and randomness.

Teaching considerations

- Teachers should take steps to ensure that every draw is a random selection – that the draws are governed by chance. They might discuss the rules and conditions necessary to make each draw fair.
- The objects (or cut-outs from Resource Sheet 31) should be placed in an opaque jar or similar container that hides the contents. Discuss this fairness concept with students. *Would it be fair if some students 'knew' which blocks were coloured while other students did not? Would it be fair if these students always 'won' and other students did not?*
- Emphasise that no real money will be used when playing the game and therefore, there are no real money prizes to be won. However, if the class has 'class money' they can simulate decision making about whether to risk money they have earned to play the game.
  - o *The teacher could pay students a certain amount each week – such as $10 of class money – which the students can 'bank'. The students can also earn additional amounts of this class money by meeting specific standards or expectations.*
- Students can decide to spend some of their class money to purchase tickets. It is important that students understand the 'loss' of hard-earned money and the risks involved in gambling activities. Therefore, it is important to ensure that students are risking something that they value on the uncertain outcome of the activity.
- Students could use any money won from the game or in their bank to buy extra time on the computer or additional time to read their favourite book etc.
- **NOTE: If a student wins on the first attempt it is important to stress how many didn't win at the same time. The memory of past 'wins' can be extremely powerful for young people and it is important to balance the excitement of the win with an examination of the bigger picture.**

- Allow each student to make five draws – the order in which they make their draws could also be controlled by chance. The teacher might draw the students' names 'out of a hat'.
- Because the odds of having a winning ticket are 1 in 5, each student might expect to have one winner in the five selections. Have students make a prediction about their own result and then test out this expectation. They should inspect their selections and then examine the results as a class.
- Record the results on the board so that students can see how chance influences the results. Use a table such as that below and have students place a tally mark in the appropriate cell to record their results.

Result	0 in 5	1 in 5	2 in 5	3 in 5	4 in 5	5 in 5
No. of students						

Phase 3 Communicating and justifying

Who were winners? Who were losers?

Students

- ▶ The students should reflect upon the results recorded in the table. Did they expect this kind of outcome?
- ▶ Review the chance aspects of the activity. Students should make statements that use the data appropriately.

Teaching considerations

- The students should write a reflective summary of the experiment and the data that resulted. Ensure that they understand the conditions of the activity – that the chance of drawing winning tickets was 1 in 5.
- For this activity, the chance of drawing the top prize was 1 in 1000 (not 1 in 3 million or similar odds); the chance of drawing losing tickets was 4 in 5; the chance of not drawing the top prize was 999 in 1,000 (or 99.9%).
- Discuss the strategy of always providing the winning odds (such as 1 in 5) and not drawing too much attention to the losing odds (i.e. 4 in 5) in brochures and other advertisements.
- Students should include the themes used within advertisements designed to entice people to participate in the range of gambling opportunities – such as the naming of various games (e.g. *Set for Life*), television advertisements with parents paying off their children's housing mortgages, having holidays at exotic places, buying dream homes/cars etc.
- Refer to the Level 4 Arts module (*In Control – Taking Responsible Risks)* available in your Resource Kit for ideas on deconstructing these media texts, in particular Student Resource 2 (p 27).
- Allow each student to make another five draws each. They should record the results in a similar table to that used previously. The students should comment in their summary about whether the two sets of class results were similar – and whether they expected them to be similar or different and why.
- They should look at their own results as well – were they the same or different to the first time? What does this say about 'chance'?
- With the remaining tickets in the draw, the students should continue to make multiple drawings or purchases until they are all gone. They should make predictions each time about the overall results and their own five draws before beginning their selections.

Should I take the risk?

Students

- Do students understand the risks associated with these forms of gambling?
- Would they be prepared to risk their own money in the future?
- What does it mean to be responsible gamblers?

Teaching considerations

- Discuss the many and varied opportunities for gambling within the community. Discuss responsible gambling with the students and what it means when adults make decisions about whether they will take these kinds of risks. Refer to the Gamble Responsibly section of the Responsible Gambling website (http://www.responsiblegambling.qld.gov.au) for information on responsible gambling.
- Discuss whether students would risk money to participate in these kinds of gambling opportunities in the future. Students who offer opinions should support their ideas with reasons. Ensure that the students appreciate the 'responsible' aspect of the term responsible gambling.
- Have students explain their views and give examples of these views.

  It may assist some students to make short statements or give examples under headings such as that below:

Responsible gambling – it means:	**Responsible gambling – it does not mean:**

- Distribute copies of Resource Sheet 32 containing the True/False quiz. Allow students to work in pairs or small groups to discuss the answers to the quiz questions.
- When all questions have been answered, have students discuss each one in turn. Students should support their decisions with reasons.

Answers to the True/False Quiz.

a. **True** – each of these games is run by the Golden Casket in Queensland with the approval of the Queensland Government.

b. **True** – if the odds of winning any prize are 1 in 16 for the $2 Casket, then the chances of not winning must be 15 in 16.

c. **False** – just because the overall odds of winning a prize are calculated as 1 in 5, this does not mean that 1 out of every 5 tickets purchased is a winner.

d. **False** – the odds of winning the first prize in the Powerball (1 in 4,581,596) are much worse than the odds of winning the first prize in Saturday's Lotto (1 in 678,755).

e. **True** – the chances of winning any prize in Powerball (1 in 11) are better than Saturday's Lotto (1 in 18). However winning the top prize in Powerball is much harder than Gold Lotto. Powerball has seven divisions of prizes (offering a wider range of prizes) and Saturday Lotto has five divisions of prizes.

f. **True** – there are 1 million tickets sold in each game of the $5 Set for Life game and one top prize. Therefore the odds of buying that ticket are 1 in a million.

g. **False** – 1000 tickets is a very small number compared to the 3 million tickets in the whole game. Buying this number of tickets does give you a better chance (1 in 3,000) but not a great chance.

h. **True** – five of the seven games listed in the brochure have between 1 million and 3 million tickets and each has one top prize.