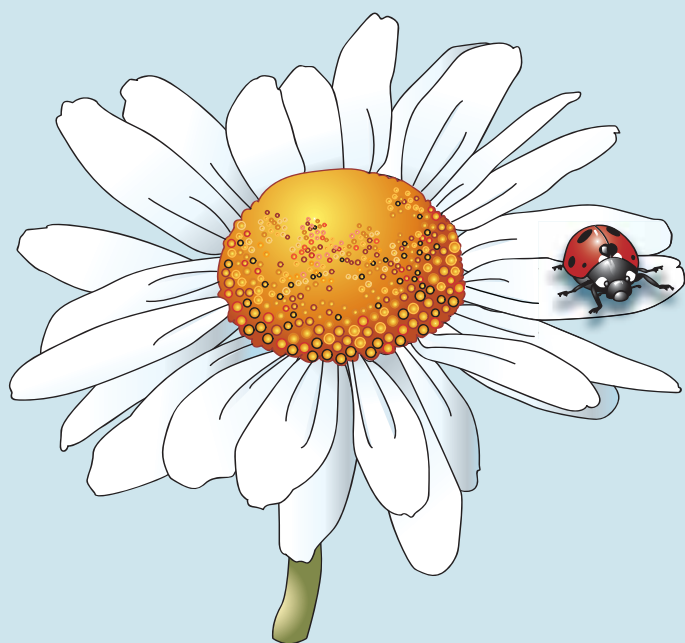


Playing to win

Teacher guidelines



6

Mathematics

Queensland Comparable
Assessment Tasks (QCATs)
2010

Contact information

Direct questions about the implementation of QCATs or receipt of materials to:

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The 2010 QCATs

What are QCATs?

Queensland Comparable Assessment Tasks (QCATs) are designed to provide evidence of what students know, understand and can do in relation to a selection of [Essential Learnings](#) for English, mathematics and science in Years 4, 6 and 9, and to the [Standards](#).

QCATs are authentic, performance-based assessments that:

- engage students in solving meaningful problems
- emphasise critical thinking and reasoning
- provide teachers, students and parents/carers with information about student progress and a focus for future teaching and learning.

Consistency of teacher judgments

QCATs support teachers in making consistent judgments about the quality of student work. Improved consistency of teacher judgments is achieved when teachers:

- engage in professional conversations about the quality of evidence in student responses
- reach consensus about the quality of student work
- adopt a consistent approach when using the [Guide to making judgments](#) (page 32).

Information gathered may be used by teachers to promote, assist and improve key learning area programs and help students achieve the highest standards they can.

Additional resources [QCATs Information Statement](#)

www.qsa.qld.edu.au > Prep–Year 9 > QCATs (Years 4, 6 & 9)

[Essential Learnings](#) and [Standards](#)

www.qsa.qld.edu.au > Prep–Year 9 > Essential Learnings & Standards (Years 1–9)

Important dates

Friday 25 June	QCATs packages have arrived in schools
Tuesday 13 July ↓ Friday 17 September	Schools: <ul style="list-style-type: none">• administer QCATs at any time during the school weeks of this period• grade QCATs• select five student samples that are representative of grades awarded
Monday 4 October	Schools are notified if selected to submit student samples for QSA's random sampling process
Monday 1 November	Final day for schools to submit student data to QSA
Friday 10 December*	Schools must retain all Student booklets until the end of the school year

*This date may vary from school to school

Getting ready

Student preparation

Students should have the opportunity to do their best work. For this to occur, student preparation should include:

- opportunities to engage with the [Selected Essential Learnings](#) (page 21) well in advance of participating in QCATs. If students have not engaged with the [Selected Essential Learnings](#) recently, review and consolidation may be necessary. Preparation activities should not involve rehearsal of the actual or a similar assessment
- experience with the types of questions used within the QCAT.

The quality of information provided by the QCATs will depend on the level of interaction teachers have with their students before, during and after implementation.

Additional resources [Centrally-devised design brief](#)
www.qsa.qld.edu.au > Prep–Year 9 > QCATs (Years 4, 6 & 9)

Catering for diversity — special provisions

All students should have the opportunity to participate in school-based assessment. Schools are responsible for determining which students require special provisions.

The QCATs are designed to be part of a classroom assessment program, and principles of participation and equity apply. The QSA offers this general advice:

- Students who have been identified as having specific educational requirements may be assisted using those adjustments and supports usually available in the classroom. To make participation possible in all or part of the assessment task, such help may be in the form of inclusive learning technologies, reading support or the use of support personnel.
- Students for whom English is not their first language, and who are assessed as not achieving a reading level appropriate to complete the task, may be assisted by an interpreter or educational devices (e.g. pictures, electronic whiteboards, interactive devices) to allow participation in all or part of the task.
- In exceptional circumstances, where a student's learning difficulties have precluded them from engaging with the [Selected Essential Learnings](#), the principal (in consultation with specialist and support staff and parents/carers) may make a decision about the participation of that student in the task. Some students may be given an opportunity to complete some aspects of the assessment.

Additional resources [Inclusive strategies for implementing QCATs](#)
www.qsa.qld.edu.au > Prep–Year 9 > QCATs (Years 4, 6 & 9)
[Equity](#)
www.qsa.qld.edu.au > P–12 approach > Equity

Teacher preparation

Check contents of QCAT packages as soon as they arrive at your school

- Check that you have the appropriate number of [Student booklets](#) and [Stimulus sheets](#) (one per student) and [Teacher guidelines](#) (one per implementing teacher).
- Check for any defective [Student booklets](#) and [Stimulus sheets](#).
- Contact the QSA if any additional copies are required.

Familiarise yourself with the assessment

- Read all the documents provided.
- Review the [Selected Essential Learnings](#) (page 21).
- Complete a [Student booklet](#) yourself, and then refer to the [Model response](#) (page 24) so that you understand what students are required to do.
- Download and view [Sample responses](#) from the [QSA Assessment Bank](#) (see Additional resources below).

Plan implementation

- Discuss the assessment with your colleagues, and plan any teaching or revision that may be required.
- Set the times and dates for the implementation:
 - teachers have flexibility to implement the QCATs at any time during the designated period
 - the QCATs may be completed in one, two or more sessions over one or more days
 - implementation times may differ for verified students, students with specific educational requirements or students who have English as a second language.
- Plan:
 - any support required to enable students to do their best work (e.g. teacher aides or other support personnel)
 - any materials or equipment needed to implement the assessment.
- Decide:
 - how you will implement this task for all classes at this year level
 - the processes you will use to achieve consistency of teacher judgment
 - how you will select student samples for the QSA's random sampling process
 - when, how and who will submit your school's data.

Additional resources [Sample responses](#)

QSA Assessment Bank <<https://qcar.qsa.qld.edu.au/assessmentbank>>

[Using Queensland Comparable Assessment Tasks \(QCATs\) to support learning](#)
www.qsa.qld.edu.au > Prep–Year 9 > QCATs (Years 4, 6 & 9)

Implementation

Setting up

Read through [Tips for game play](#) on page 23.

Working with the Student booklet

Use the [Annotated Student booklet](#) (page 8) to set the conditions that ensure all students have the opportunity to do their best work.

Students should be encouraged to interact with teachers to seek clarification when required, and with other students if appropriate to the task.

Suggested implementation timeline

Preparation

Setting the scene: Group discussion	30 minutes
-------------------------------------	------------

The assessment task

Exploring outcomes and likelihood	20 minutes
Making and justifying a strategy	15 minutes
Evaluating your strategy	40 minutes
Applying your learning	15 minutes



Suggested time: 30 minutes (Group discussion: 15 minutes, Activity: 15 minutes)

Read through **Setting the scene: Group discussion** with the whole class.

Engage students in a discussion about:

- the meaning of the bold words
- the board games students have played and how dice have been used in the game
- games that rely purely on chance (e.g. *Snakes and ladders*, *Beetle*)
- games that involve chance and choice (e.g. *Monopoly*, *Risk*, *Trouble*)
- how some people are better at playing strategy games because they understand that chance can inform decision making.

Setting the scene: Group discussion

Many games use a pair of six-sided dice.

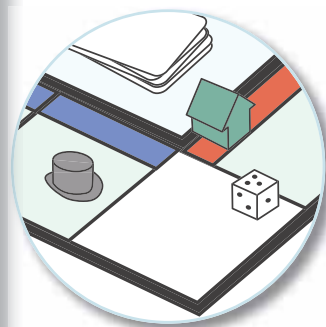
The **sum** of the two dice can determine:

- how far a playing piece moves around a board
- the total of the dice contributing to a score
- how much of something is gained or lost.

What other ways are dice used in games?

Some games that you may have played rely only on **chance** — dice give a **random** result and you do not need to make any decisions.

What are some examples of games that rely only on chance?



Many board games also have an element of **choice**, where you make decisions as a part of playing the game. These decisions might be to choose:

- a path to take
- whether or not to buy something
- where to place something on the board
- who to give or take something from.

What are some examples of games that rely on choice and chance?

What other decisions can be made in games?

Games that involve both choice and chance are won more often by people who have a clearly thought-out plan — a **strategy** — about the choices that they are going to make.



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Introduce the game “Fly away home” and explain the rules (see [Tips for game play](#) on page 23). Supervise the organisation of students into pairs or threes to play the game. Ensure each group of students has two six-sided dice.

Students will need about 15 minutes to play several games. Allow students to continue to play if enthusiastic discussion is occurring.

Activity

In the game “Fly away home”, players:

- draw ladybirds on flower petals
- take turns at rolling two dice and crossing out ladybirds on the petal that matches the total
- attempt to be the first player to cross out all their ladybirds.

Your teacher will now read through the rules to the game “Fly away home”, and will organise you into groups to play the game.



Students work on their own [Stimulus sheet](#) when playing.

Read through each question.

Ask students to share their thoughts.

Discuss their responses to these questions.

More group discussion

Your teacher will lead a discussion about the game “Fly away home”. Think about these questions:

- What parts of this game rely on chance?
- What choices are made in this game?

In this assessment, you will:

- conduct a mathematics investigation to explore the question:

“What are the best number/s to place my five ladybirds on in order to cross them out the fastest?”

- consider what outcomes occur when rolling a pair of six-sided dice
- determine the likelihood of rolling the different outcomes
- plan and justify a strategy you think will increase your chances at winning the game “Fly away home”
- evaluate the strategy by collecting and analysing data
- use your findings to evaluate four different game strategies.

Read through the assessment task with the whole class.



Stop here: Wait for your teacher's directions.

Instruct students that they must stop and wait for your directions where indicated.

Work through the [Guide to making judgments](#) (page 32) with students to highlight the assessable elements for this QCAT. Explain, in student-friendly terms, the task-specific assessable elements. These identify what is being valued in the student responses.







Suggested time: 20 minutes

Engage students in a discussion about the layout of the grid in Question 1, including:

- the meaning of possible outcomes
- the use of two different colours of dice, for example:

“Using two different colours of dice makes it easier to understand what outcomes occur when rolling two six-sided dice.

When you roll two dice, two separate rolls are happening. The number appearing on the blue die does not affect the number appearing on the white die. This means that   is actually different to  , even though both make the sum of 10.”





































- the example shown to the right of the grid.

This question gathers evidence of students’ understanding of:

- the concept of sample spaces
- representing data graphically.

Exploring outcomes and likelihood

This grid shows all possible outcomes when rolling two six-sided dice. Use the grid to answer the questions below.

 2	 3	 4	 5	 6	 7
 3	 4	 5	 6	 7	 8
 4	 5	 6	 7	 8	 9
 5	 6	 7	 8	 9	 10
 6	 7	 8	 9	 10	 11
 7	 8	 9	 10	 11	 12

The sum of 10 has

3 possible outcomes:



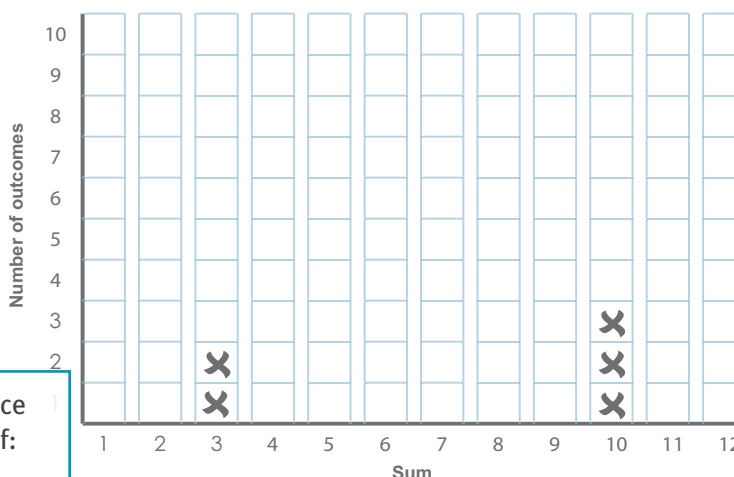
which can be written as:

$4 + 6$ $5 + 5$ $6 + 4$

Students should use this format to write responses for Question 1b.

- a) How many possible outcomes make a sum of 8?
 - b) Write all the possible outcomes that make a sum of 6.
.....
 - c) Complete Graph 1 by using a cross (X) to indicate the number of outcomes for each sum. The possible outcomes for the sums of 3 and 10 have been completed for you.

Graph 1: Number of outcomes for each sum



Explain that students will use the grid to complete Graph 1. Suggest to students that they cross out the sums in the grid as they count them. Use the sum of 10 as an example.

Use Graph 1 on page 4 to complete the following questions.

2. a) What sum/s will never be rolled?
 b) Another sum has the same number of outcomes as the sum of 9.

Which sum is it?

- c) Name two other sums that have an equal number of outcomes.

..... and

- d) Complete the Number of outcomes column in Table 1 below.

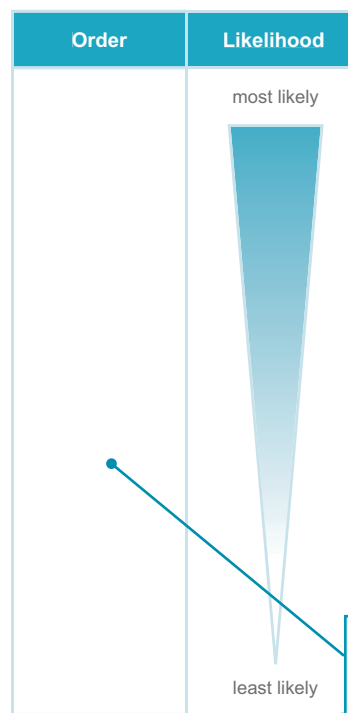
- e) In the Likelihood column, express the likelihood of rolling each sum as a common fraction. You do not need to simplify the likelihood by cancelling down.

- f) Order the sums from most likely to least likely in Diagram 1.

Table 1: Likelihood of rolling each sum

Sum	Number of outcomes	Likelihood
1	.....	.....
2	.....	.....
3	2	$\frac{2}{36}$
4	.....	.....
5	.....	.....
6	.....	.....
7	.....	.....
8	.....	.....
9	.....	.....
10	3	$\frac{3}{36}$
11	.....	.....
12	.....	.....
Total	36	

Diagram 1: Order of likelihood



Explain that students will use Graph 1 to complete Question 2.

Provide students with the formula for probability, as you have taught it in class.

Explain that students will need to write the likelihood of each sum as a fraction.

Students do not need to simplify the fractions.

Explain that the fraction $\frac{2}{36}$ means 2 possible outcomes in every 36 rolls.

Students should not be penalised if they do not include the sum of 1 in ordering the likelihood in Diagram 1.



Stop here: Wait for your teacher's directions.

This question gathers evidence of students' understanding of:

- the concepts of impossible events and equal likelihood
- expressing theoretical probability as a common fraction, using suitable mental computation
- comparing and ordering estimates of probability from most likely to least likely.



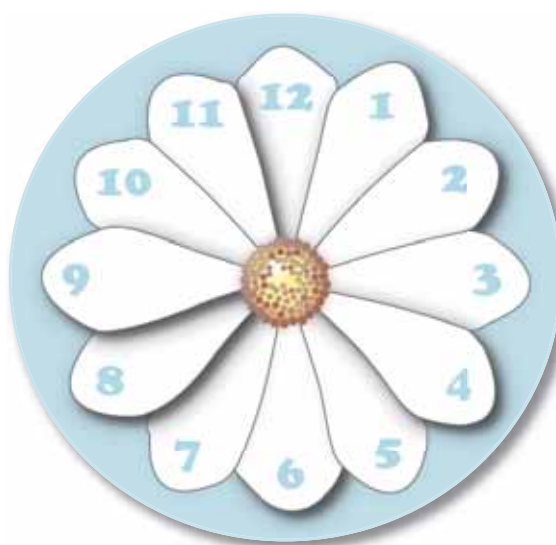
Suggested time: 15 minutes

Making and justifying a strategy

On page 3 we posed the question:

“What are the best number/s to place my five ladybirds on in order to cross them out the fastest?”

3. a) **Predict which numbers will give you the best chance of winning this game.**
Draw your five ladybirds on the number/s you selected.



- b) **Justify the choices you made.**

.....

.....

.....

.....

.....

.....

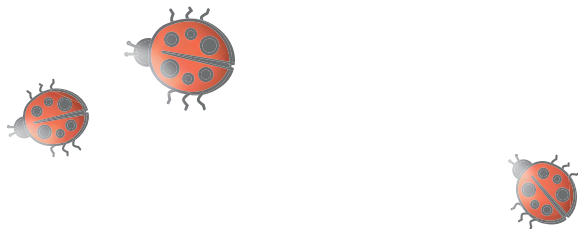
.....

This question gathers evidence of students' understanding of:

- planning a strategy to solve a mathematical question
- developing an argument to justify a prediction
- using mathematical language to communicate reasoning.



Stop here: Wait for your teacher's directions.





Suggested time: 40 minutes

Remind students to use their strategy from page 6 while playing the game.

Explain what students are required to do.

Emphasise that students are not to colour the squares. They should use a cross to mark each sum rolled (as on page 4).

Explain that students will need to look back at Graph 1 on page 4.

Emphasise that you are looking for mathematical explanations.

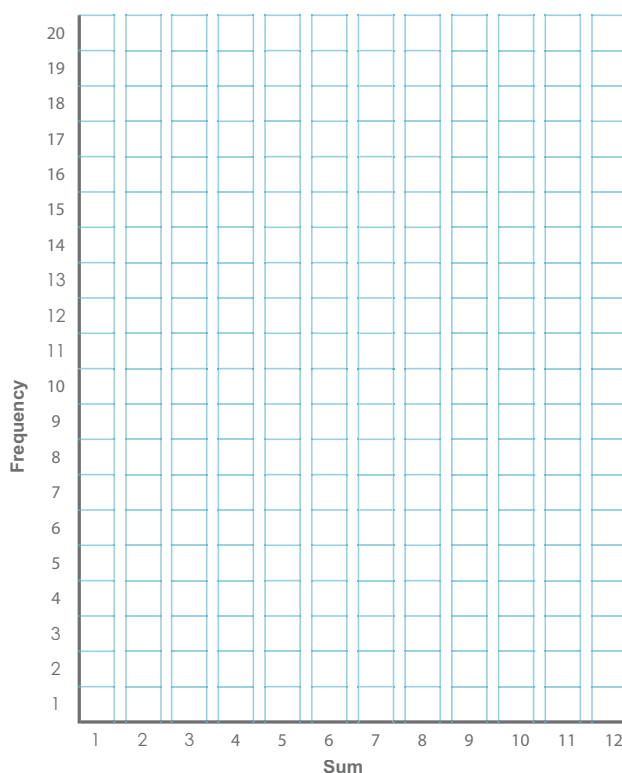
Evaluating your strategy

Your teacher will organise you into your groups to play the game again for fifteen minutes. Use your strategy from page 6.

- Use a cross (X) to record each of the sums rolled by you and your partner while you play the game. Stop recording all rolls if one of the sums reaches a frequency of 20.



Graph 2: Frequency of each sum



Look at the shape of Graphs 1 and 2 on pages 4 and 8, and complete the sentence below.

- The two graphs may not be the same shape because:
-
-
-
-

These questions gather evidence of students' understanding of:

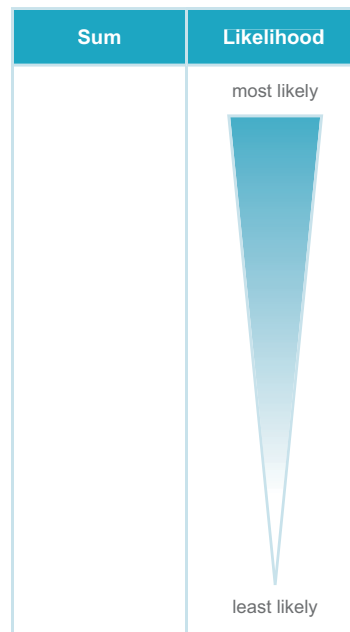
- representing data graphically
- comparing theoretical and experimental probability
- identifying causes of variation in data collections
- using mathematical language to communicate reasoning.

6. a) Use Graph 2 on page 8 to help you complete the table below. You do not need to simplify the likelihood by cancelling down.
- b) Complete Diagram 2 by ordering the sums in Table 2.

Table 2: Likelihood of rolling each sum

Sum	Frequency	Likelihood
1
2
3
4
5
6
7
8
9
10
11
12
Total

Diagram 2: Order of likelihood



Remind students of the formula for probability before they attempt Question 6.

Explain that students will use Graph 2 when answering this question.

- c) What are the best numbers to put the five ladybirds on according to the data?

.....

- d) Would these numbers always be the best numbers to pick? **Yes / No**
(circle one)

Explain:

.....

.....

- e) Was the strategy you developed on page 6 an effective strategy? Explain your answer.

.....

.....

.....

.....



Stop here: Wait for your teacher's direction

This question gathers evidence of students' understanding of:

- expressing experimental data for chance as a common fraction, using suitable mental computation
- comparing and ordering experimental data for chance from most likely to least likely
- developing an argument to justify a generalisation
- reflecting upon games played and learning to evaluate the effectiveness of a strategy
- using mathematical language to communicate reasoning.

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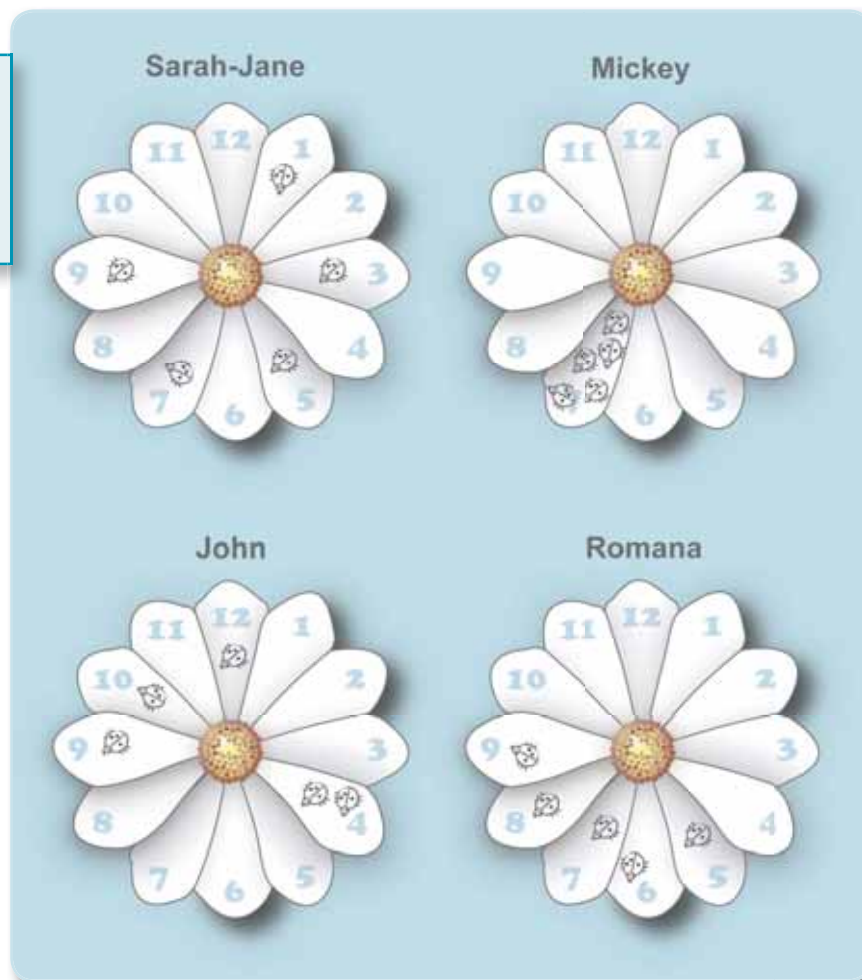


Suggested time: 15 minutes

Applying your learning

Sarah-Jane, Mickey, John and Romana played “Fly away home”. Each player has a different strategy, which is shown below. They use the same strategy for every game they play.

Explain that students will need to use everything they have learned so far to complete the Question 7.



7. Examine the strategies that the students developed for playing the game. Decide on what chance they have of winning, and justify your thinking.

a) Sarah-Jane has **a good**
a poor
no chance of winning because:
(circle one)

.....

.....

.....

b) Mickey has **a good**
a poor
no chance of winning because:
(circle one)

.....

.....

.....

c) John has **a good**
a poor
no chance of winning because:
(circle one)

.....

.....

.....

d) Romana has **a good**
a poor
no chance of winning because:
(circle one)

.....

.....

.....

Remind students that there may be more than one person who has a good, a poor, or no chance of winning.

Going further

Teachers could follow up this QCAT by:

- collecting class data from the information collected on page 8, and discussing small versus large data sets
- comparing a range of strategies by determining the average number of rolls required to cross out the ladybirds (e.g. out of 50 games). Students do not necessarily have to play the game to do this.

This question gathers evidence of students' understanding of:

- reflecting upon learning within the QCAT to apply to a new scenario
- evaluating multiple strategies in order to compare their effectiveness
- using mathematical language to communicate reasoning.

Making judgments

Use the [Guide to making judgments \(GTMJ\)](#) on page 32 to grade student responses.

The [Model response](#) (page 24) and [Sample responses](#) are provided for reference purposes only. They each demonstrate possible responses and should be used to support the GTMJ.

Making judgments is not about determining whether one student's work is better than that of another. Rather, you should make standards-based judgments by matching evidence in student responses to descriptors in the GTMJ.

Read and consider all of the evidence in the student's responses before making and recording a judgment about the quality of the performance for each assessable element.

Additional resources [Sample responses](#)

QSA Assessment Bank <<https://qcar.qsa.qld.edu.au/assessmentbank>>

Using the GTMJ

This QCAT uses a continua-style GTMJ, where descriptors are placed along a continuum within each column. The diagrams below show the different parts of the GTMJ continua model, and how to use the GTMJ when grading student responses.

Record a nil award of "N" only when there is insufficient evidence to make a judgment for an overall grade.

In the following diagrams:

- [Diagram 1: Understanding the GTMJ](#) points out the different parts of the GTMJ
- [Diagram 2: Using the GTMJ — the judgment process](#) gives steps to follow when grading student responses.

Diagram 1: Understanding the GTMJ

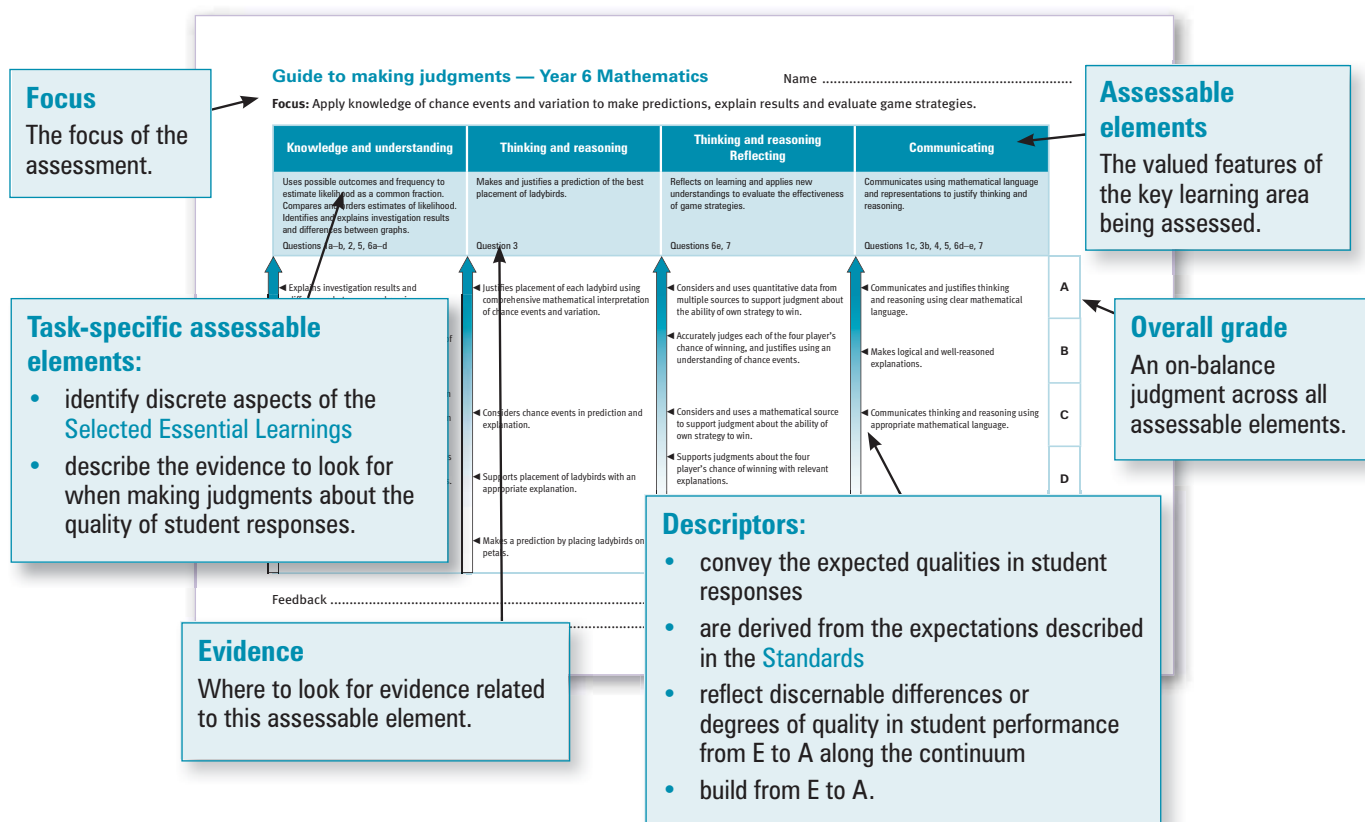
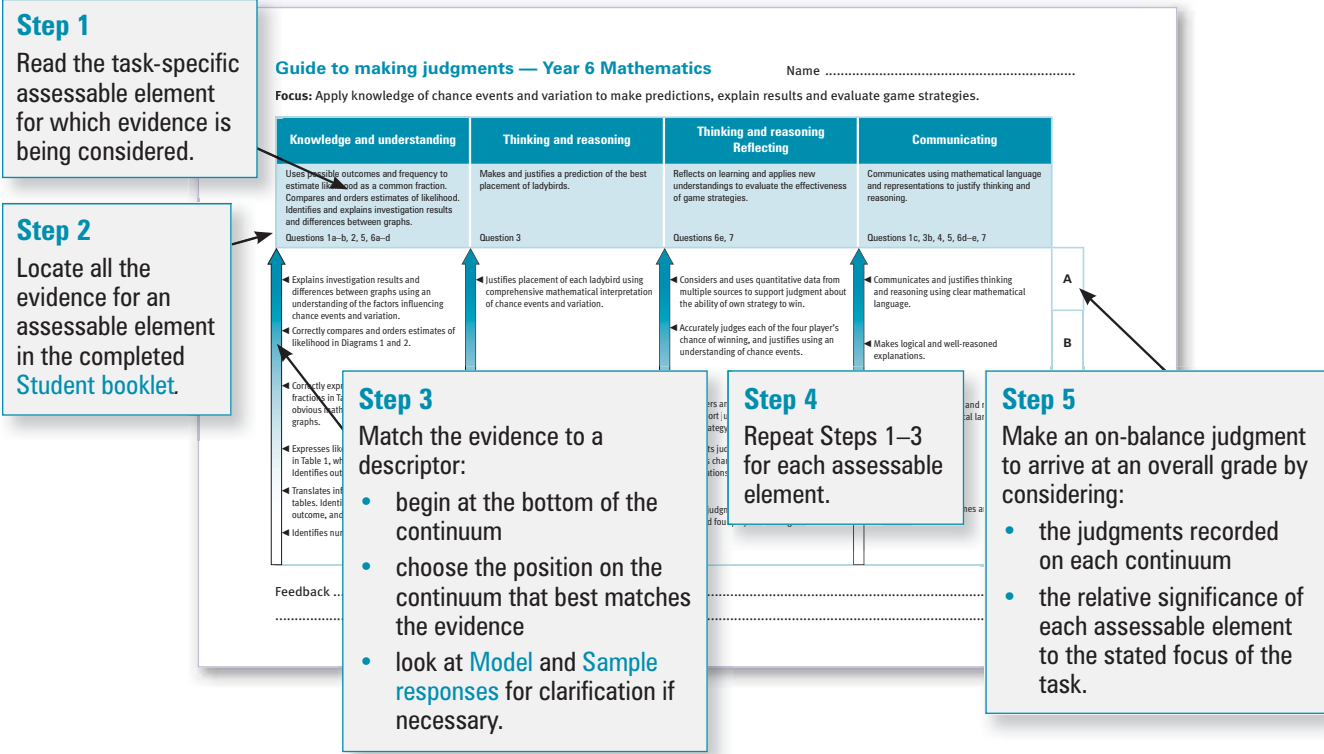


Diagram 2: Using the GTMJ – the judgment process



Using feedback

Assessment alone will not contribute significantly to improved learning — it is what teachers and students do with the information gathered that makes the difference. Providing quality and useful feedback is a crucial step in using assessment information to support future learning.

Assessment feedback goes beyond a simple mark or grade. Comments on the strengths of students' achievements, and on areas for improvement, provide quality feedback that can be used to inform future teaching and learning. Assessment feedback is most helpful if the specific elements of the knowledge and skills are identified and specific suggestions are provided.

The information gathered from the implementation, marking and moderation of QCATs should feed back into future planning of teaching and learning.

Feedback to help students learn

Quality feedback to a student:

- focuses on their achievement in relation to either the assessable elements with their task-specific descriptors or the [Selected Essential Learnings](#) (page 21) and their associated questions
- includes strengths of achievements
- identifies areas for improvement and strategies for future learning
- is communicated in student-friendly language
- is appropriate (e.g. in quantity and detail) to the student's age and their capacity to respond
- includes the use of [Sample responses](#) to provide examples of the quality of work corresponding to each standard.

Feedback to help teacher planning

Individual and collective student performance on QCATs, along with other school-based assessment, can be used to inform teaching and learning.

Additional resources [Using feedback to inform teaching and learning](#)

www.qsa.qld.edu.au > Prep–Year 9 > QCATs (Years 4, 6 & 9)

[Sample responses](#)

QSA Assessment Bank <<https://qcar.qsa.qld.edu.au/assessmentbank>>

Resources

Selected Essential Learnings

The 2010 QCATs will assess what students know, understand and can do in relation to the following selection of [Essential Learnings](#).

Mathematics Essential Learnings by the end of Year 7	
Assessable elements The valued features of the key learning area about which evidence of learning is collected and assessed.	Ways of working The processes students use to develop and demonstrate their knowledge and understanding . Students are able to:
Thinking and reasoning	<ul style="list-style-type: none"> plan activities and investigations to explore concepts through selected pathways, and plan strategies to solve mathematical questions, problems and issues select and use suitable mental and written computations, estimations, representations and technologies to generate solutions and to check for reasonableness develop arguments to justify predictions, inferences, decisions and generalisations from solutions evaluate thinking and reasoning to determine whether mathematical ideas, strategies and procedures have been applied effectively
Communicating	<ul style="list-style-type: none"> communicate thinking and justify reasoning and generalisations, using mathematical language, representations and technologies
Reflecting	<ul style="list-style-type: none"> reflect on learning, apply new understandings and identify future applications.
	Knowledge and understanding The essential concepts, facts and procedures.
Knowledge and understanding	<p>Number Numbers, key percentages, common and decimal fractions and a range of strategies are used to generate and solve problems.</p> <ul style="list-style-type: none"> Whole numbers, including positive and negative numbers, and common and decimal fractions can be ordered and compared using a number line. <p>Chance and data Probability of events can be calculated from experimental data. Data can be summarised and represented to support inferences and conclusions.</p> <ul style="list-style-type: none"> Events have different likelihoods of occurrence and estimates of probability can be expressed as percentages, common fractions or decimal fractions between 0 and 1. Experimental data for chance events can be compared with theoretical probability. Sample data drawn from a given population can be summarised, compared and represented in a variety of ways. Measures of location such as mean, median and mode, and frequency and relative frequency, can be used to explore distributions of sample data. Variation and possible causes of bias can be identified in data collections.

Source: www.qsa.qld.edu.au > Prep–Year 9 > Essential Learnings & Standards (Years 1–9)

Literacy and Numeracy Indicators


The [Literacy and Numeracy Indicators](#) are a resource that can be used when planning for teaching, learning, assessment and monitoring in all key learning areas.

This QCAT may provide opportunities to monitor and assess student progress in a selection of the [Literacy and Numeracy Indicators](#), and may provide further focus for feedback for teachers and students to support improved learning.

Additional resources [Literacy and Numeracy Indicators Information Statement](#)
www.qsa.qld.edu.au › Prep–Year 9 › Literacy & Numeracy Indicators (P–Year 9)

Tips for game play

Fly away home



Number of players: 2 or 3

Object of game: To be the first player to cross out all their ladybirds.

Equipment: Two six-sided dice, pencil, "Fly away home" sheet.

Rules for play:

Getting ready

- Choose one flower each and draw five ladybirds on the petals of your flower. You can have more than one ladybird on a petal.

Rolling the dice


- Roll the dice to see who goes first. The player who rolls the highest sum goes first.

Taking a turn

- Roll the dice and add them together to get the sum.
- If you have a ladybird on the petal that matches the sum, cross that ladybird out.
- Pass the dice to the next player.


Winning

- Keep playing until one player has crossed out all their ladybirds.




6

Mathematics



QCATS 2010 Stimulus sheet Year 6 Mathematics



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- For quickest game play, split students into pairs. Use groups of three only if you have an odd number of students, or a shortage of dice.
- Make sure you have a pair of six-sided dice for each group of players.
- Students play the game twice: once in [Setting the scene: Group discussion](#), and again in Question 4. Explain that students will use their own [Stimulus sheet](#) each time they play the game.
- Read through the instructions on the [Stimulus sheet](#) with the class.
- Model a game, encouraging students to assist with placing ladybirds.
- When modelling game play to your class, you could:
 - use a data projector
 - copy a [Stimulus sheet](#) onto an overhead transparency and use an overhead projector.
- Discuss dice-rolling etiquette, e.g.
 - use manners when playing dice
 - roll dice in a set area, and towards the next player
 - how to use a dice cup
 - what to do when a die lands unevenly.

Possible discussion question

- Discuss whether the way the dice are thrown will affect the outcome, e.g.
 - blowing on the dice
 - shaking the dice.

Model response

This Model response gives one example of a very high quality response for each question. The Sample responses, available for download from the QSA Assessment Bank, demonstrate the quality of student responses for each standard, A to E.

Setting the scene: Group discussion

Many games use a pair of six-sided dice.

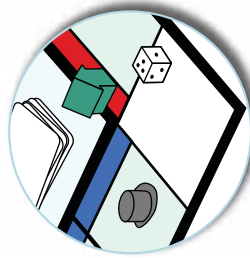
The sum of the two dice can determine:

- how far a playing piece moves around a board
- the total of the dice contributing to a score
- how much of something is gained or lost.

What other ways are dice used in games?

Some games that you may have played rely only on **chance** — dice give a **random** result and you do not need to make any decisions.

What are some examples of games that rely only on chance?



Many board games also have an element of **choice**, where you make decisions as a part of playing the game. These decisions might be to choose:

- a path to take
- whether or not to buy something
- where to place something on the board
- who to give or take something from.

What are some examples of games that rely on choice and chance?

What other decisions can be made in games?

Games that involve both choice and chance are won more often by people who have a clearly thought-out plan — a **strategy** — about the choices that they are going to make.

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Activity

In the game "Fly away home", players:

- draw ladybirds on flower petals
- take turns at rolling two dice and crossing out ladybirds on the petal that matches the total
- attempt to be the first player to cross out all their ladybirds.

Your teacher will now read through the rules to the game "Fly away home", and will organise you into groups to play the game.



More group discussion

Your teacher will lead a discussion about the game "Fly away home". Think about these questions:

- What parts of this game rely on chance?
- What choices are made in this game?

In this assessment, you will:

- conduct a mathematics investigation to explore the question:

"What are the best number/s to place my five ladybirds on in order to cross them out the fastest?"

- consider what outcomes occur when rolling a pair of six-sided dice
- determine the likelihood of rolling the different outcomes
- plan and justify a strategy you think will increase your chances at winning the game "Fly away home"
- evaluate the strategy by collecting and analysing data
- use your findings to evaluate four different game strategies.



Stop here. Wait for your teacher's directions.

Model response

Exploring outcomes and likelihood

This grid shows all possible outcomes when rolling two six-sided dice. Use the grid to answer the questions below.

2	3	4	5	6	7
3	4	5	6	7	8
4	5	6	7	8	9
5	6	7	8	9	10
6	7	8	9	10	11
7	8	9	10	11	12

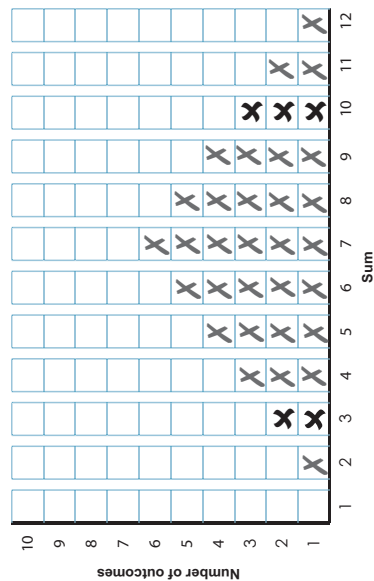
The sum of 10 has 3 possible outcomes:

which can be written as:

4 + 6 5 + 5 6 + 4

- How many possible outcomes make a sum of 8? 5
 - Write all the possible outcomes that make a sum of 6.
5 + 1, 4 + 2, 3 + 3, 2 + 4, 1 + 5
 - Complete Graph 1 by using a cross (X) to indicate the number of outcomes for each sum. The possible outcomes for the sums of 3 and 10 have been completed for you.

Graph 1: Number of outcomes for each sum



Use Graph 1 on page 4 to complete the following questions.

- What sum/s will never be rolled? 1
 - Another sum has the same number of outcomes as the sum of 9.
Which sum is it? 5

- Name two other sums that have an equal number of outcomes.
..... 2 12

- Complete the Number of outcomes column in Table 1 below.

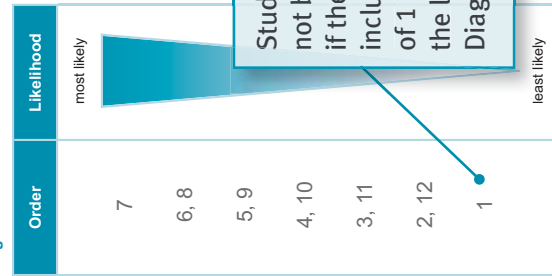
- In the Likelihood column, express the likelihood of rolling each sum as a common fraction. You do not need to simplify the likelihood by cancelling down.

- Order the sums from most likely to least likely in Diagram 1.

Table 1: Likelihood of rolling each sum

Sum	Number of outcomes	Likelihood
1	0	$\frac{0}{36}$
2	1	$\frac{1}{36}$
3	2	$\frac{2}{36}$
4	3	$\frac{3}{36}$
5	4	$\frac{4}{36}$
6	5	$\frac{5}{36}$
7	6	$\frac{6}{36}$
8	5	$\frac{5}{36}$
9	4	$\frac{4}{36}$
10	3	$\frac{3}{36}$
11	2	$\frac{2}{36}$
12	1	$\frac{1}{36}$
Total	36	

Diagram 1: Order of likelihood



Students should not be penalised if they do not include the sum of 1 in ordering in the likelihood in Diagram 1.



Stop here: Wait for your teacher's directions.

Model response

Making and justifying a strategy

On page 3 we posed the question:

"What are the best number/s to place my five ladybirds on in order to cross them out the fastest?"

3. a) **Predict which numbers will give you the best chance of winning this game.**
Draw your five ladybirds on the number/s you selected.



- b) **Justify the choices you made.**
I chose petal 7 to place my first ladybird as it has the highest chance of being rolled (6 out of 36 rolls). I did not want to put all my ladybirds on there, as the number 7 will not always be rolled. So I put my next ladybirds on the numbers which have the next highest frequencies... (6 and 8 each have a chance of 5 out of 36 rolls). I also think that they won't come up all the time, so I put my last two on the next frequent numbers (5 and 9, each have a chance of 4 out of 36 rolls). This way I think I increase my chances at removing them faster.



Stop here: Wait for your teacher's directions.



Model response

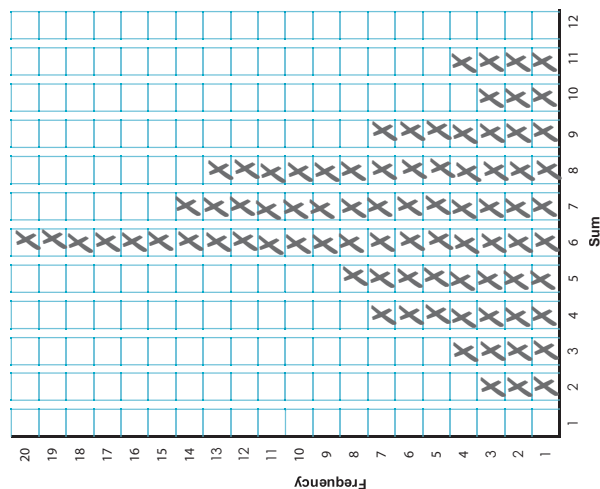
Evaluating your strategy

Your teacher will organise you into your groups to play the game again for fifteen minutes. Use your strategy from page 6.



- Use a cross (X) to record each of the sums rolled by you and your partner while you play the game. Stop recording all rolls if one of the sums reaches a frequency of 20.

Graph 2: Frequency of each sum



Look at the shape of Graphs 1 and 2 on pages 4 and 8, and complete the sentence below.

- The two graphs may not be the same shape because: the first graph shows the theoretical likelihood, which is what is expected when the dice are rolled, and the second graph shows the frequency of the sums that were actually rolled. The number 7 was expected to be rolled the most, but the number 6 was what came up the most in this small sample. The graphs might look the same if I had a much larger sample size.

- Use Graph 2 on page 8 to help you complete the table below. You do not need to simplify the likelihood by cancelling down.

- Complete Diagram 2 by ordering the sums in Table 2.

Table 2: Likelihood of rolling each sum

Sum	Frequency	Likelihood
1	0	$\frac{0}{83}$
2	3	$\frac{3}{83}$
3	4	$\frac{4}{83}$
4	7	$\frac{7}{83}$
5	8	$\frac{8}{83}$
6	20	$\frac{20}{83}$
7	14	$\frac{14}{83}$
8	13	$\frac{13}{83}$
9	7	$\frac{7}{83}$
10	3	$\frac{3}{83}$
11	4	$\frac{4}{83}$
12	0	$\frac{0}{83}$
Total	83	

Diagram 2: Order of likelihood

Sum	Likelihood
6	most likely
7	
8	
5	
4, 9	
3, 11	
2, 10	
1, 12	least likely

- What are the best numbers to put the five ladybirds on according to the data?

6, 7, 8

- Would these numbers always be the best numbers to pick?

Yes (No) (circle one)

Explain: These numbers will only improve my chance at winning, but will not always guarantee a win. I might have a streak of bad luck! Also, these numbers were taken from only one small sample of data.

- Was the strategy you developed on page 6 an effective strategy? Explain your answer. I think my strategy was effective because the petal numbers that I predicted were the ones that were rolled a lot during the collecting of data (in Graph 2). I also won 4 out of 5 games.

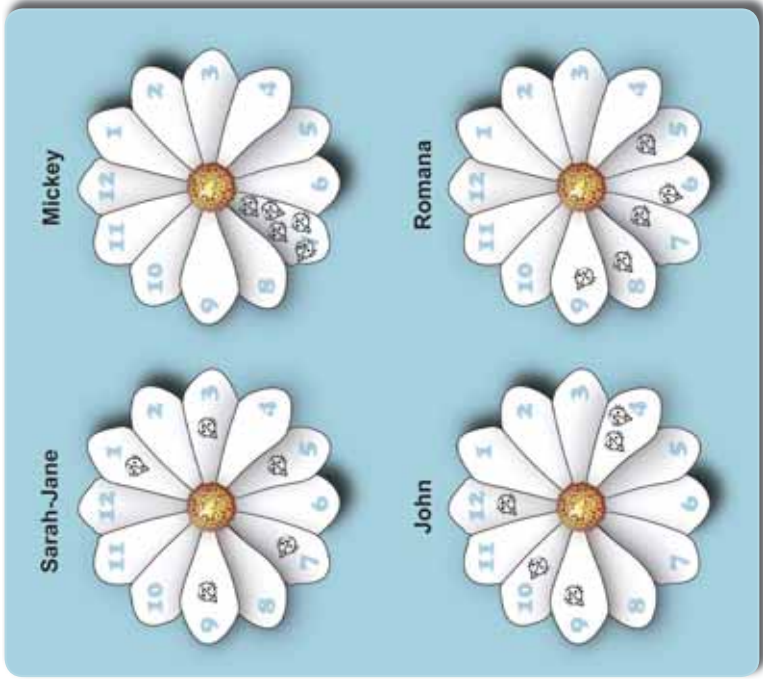


Stop here: Wait for your teacher's directions.

Model response

Applying your learning

Sarah-Jane, Mickey, John and Romana played "Fly away home". Each player has a different strategy, which is shown below. They use the same strategy for every game they play.



7. Examine the strategies that the students developed for playing the game. Decide on what chance they have of winning, and justify your thinking.

- a) Sarah-Jane has **a good** chance of winning because: **a poor** (circle one)
she has placed one of her ladybirds on petal 1, which is impossible to roll on two six-sided dice.
- b) Mickey has **a good** chance of winning because: **a poor** no (circle one)
he has placed all his ladybirds on petal 7, which is the number most likely to be rolled.
- c) John has **a good** chance of winning because: **a poor** no (circle one)
he has placed his ladybirds on petals which have numbers that do not have a very high chance of being rolled.
- d) Romana has **a good** chance of winning because: **a poor** no (circle one)
she has spread her ladybirds out on a range of petals which have a high likelihood of being rolled.

Notes

Notes

Notes

Guide to making judgments — Year 6 Mathematics

Name

Focus: Apply knowledge of chance events and variation to make predictions, explain results and evaluate game strategies.

Knowledge and understanding	Thinking and reasoning	Thinking and reasoning Reflecting	Communicating
<p>Uses possible outcomes and frequency to estimate likelihood as a common fraction. Compares and orders estimates of likelihood. Identifies and explains investigation results and differences between graphs.</p> <p>Questions 1a–b, 2, 5, 6a–d</p>	<p>Makes and justifies a prediction of the best placement of ladybirds.</p> <p>Question 3</p>	<p>Reflects on learning and applies new understandings to evaluate the effectiveness of game strategies.</p> <p>Questions 6e, 7</p>	<p>Communicates using mathematical language and representations to justify thinking and reasoning.</p> <p>Questions 1c, 3b, 4, 5, 6d–e, 7</p>
<p>Explains investigation results and differences between graphs using an understanding of the factors influencing chance events and variation.</p> <p>Correctly compares and orders estimates of likelihood in Diagrams 1 and 2.</p> <p>Correctly expresses likelihoods as common fractions in Tables 1 and 2. Identifies obvious mathematical differences between graphs.</p> <p>Expresses likelihoods as common fractions in Table 1, which are generally correct. Identifies outcomes with equal likelihoods.</p> <p>Translates information from graphs into tables. Identifies a most and least likely outcome, and an impossible event.</p> <p>Identifies numbers of outcomes from grid.</p>	<p>Justifies placement of each ladybird using comprehensive mathematical interpretation of chance events and variation.</p> <p>Considers chance events in prediction and explanation.</p> <p>Supports placement of ladybirds with an appropriate explanation.</p> <p>Makes a prediction by placing ladybirds on petals.</p>	<p>Considers and uses quantitative data from multiple sources to support judgment about the ability of own strategy to win.</p> <p>Accurately judges each of the four player's chance of winning, and justifies using an understanding of chance events.</p> <p>Considers and uses a mathematical source to support judgment about the ability of own strategy to win.</p> <p>Supports judgments about the four player's chance of winning with relevant explanations.</p> <p>Makes judgments about the effectiveness of own and four player's strategies.</p>	<p>Communicates and justifies thinking and reasoning using clear mathematical language.</p> <p>Makes logical and well-reasoned explanations.</p> <p>Communicates thinking and reasoning using appropriate mathematical language.</p> <p>Records possible outcomes and frequency in graphs.</p>
			A
			B
			C
			D
			E

Feedback