# Estimating and rounding decimals

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| Year level  Strand(s)  Lesson length  CD Code | Year 7  Number  60 mins  [AC9M7N05](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N05&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M7N06](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N06&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick), [AC9M7M09](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N09&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Lesson summary | In this lesson, students draw on prior knowledge of rounding whole numbers to develop their understanding and fluency when rounding decimals and are encouraged to reason and problem-solve through a variety of contextual activities. Students will also develop an appreciation of the role of estimation in mathematics and science. |
| Learning intention | * We are learning to reflect on the role of estimation in mathematics and science and explain how reasonable estimates are dependent on the context. * We are learning to apply appropriate strategies to round decimals and use these strategies to solve problems and justify solutions. |
| Success criteria | By the end of this lesson, students can:  justify whether an estimate is reasonable for a given context  fluently apply strategies to round decimals  use rounding strategies to solve problems and provide justifications for solutions. |
| Why are we learning about this? | Developing reasonable estimates is central in many areas of science, technology, mathematics and engineering. Estimating is used in daily life, whether it be cooking, making judgements about appropriate measurements around the home, or financial calculations. Therefore, fluent application of rounding strategies to develop reasonable estimates that can be justified is an important skill to develop. |
| Prerequisite student knowledge and language | Students:  use strategies for rounding whole numbers (for example, the rule of 5: that 5 or more rounds up, and less than 5 rounds down)  recognise place value (to thousandths)  understand decimal multiplication (with or without technology)  convert between cents and dollars (with or without technology).  The meaning of the terms rounding, estimate, approximate, reasonableness are found on the [Version 9 mathematics glossary](https://v9.australiancurriculum.edu.au/downloads/learning-areas#accordion-b71b085f07-item-f1428171c5).  In this lesson, an emphasis is placed on describing decimals using language descriptively, such as, tenths, hundredths and thousandths. This is purposeful so that students can make deeper connections between how decimals are rounded with respect to place value. For instance, the number 11.65 usually spoken as 'eleven point six five' is rather less meaningful than saying 'eleven and sixty-five hundredths'. |
| Resources | Teacher’s slides (PowerPoint)  Reasoned rounding decimals game  Rounding decimals reference sheet (Word)  I have, who has game (Word)  Ten-sided dice labelled 0 to 9 (enough for one between two students) |

Curriculum information

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| Achievement standard | Students use all 4 operations in calculations involving positive decimals, choosing efficient calculation strategies. They use mathematical modelling to solve practical problems involving rational numbers in financial and other applied contexts, justifying choices of representation. |
| Content description(s) | * Students round decimals to a given accuracy appropriate to the context and use appropriate rounding and estimation to check the reasonableness of solutions. [AC9M7N05](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N05&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) * Students use the 4 operations with positive rational numbers including fractions, decimals and percentages to solve problems using efficient calculation strategies. [AC9M7N06](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N06&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) * Students use mathematical modelling to solve practical problems, involving rational numbers including financial contexts; formulate problems, choosing representations and efficient calculation strategies, using digital tools as appropriate; interpret and communicate solutions in terms of the situation, justifying choices made about the representation. [AC9M7M09](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=MATMATY7&content-description-code=AC9M7N09&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| General capabilities  Cross-curriculum priority | Numeracy   * Number and place value [Level 9](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N05&general-capability-code=N&element-code=NN&sub-element-index=0&sub-element-code=NNNPV&load-extra-subject=MATMATY7_MATMATY8_MATMATY9_MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=03c879d2-7f52-4094-9156-a76c87cfeaf3&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick)   Critical and Creative Thinking:   * Drawing conclusions and provide reasons [(Level 7–8)](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N05&general-capability-code=CCT&element-code=CCTANA&sub-element-index=0&sub-element-code=CCTANAB&load-extra-subject=MATMATY7_MATMATY8_MATMATY9_MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=03c879d2-7f52-4094-9156-a76c87cfeaf3&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) * Evaluate actions and outcomes ([Level 7–8](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/general-capability-snapshot?subject-identifier=MATMATY7&content-description-code=AC9M7N05&general-capability-code=CCT&element-code=CCTANA&sub-element-index=1&sub-element-code=CCTANAC&load-extra-subject=MATMATY7_MATMATY8_MATMATY9_MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=03c879d2-7f52-4094-9156-a76c87cfeaf3&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick))   Related content: Science [AC9S7I03](https://v9.australiancurriculum.edu.au/f-10-curriculum/learning-areas/mathematics/year-7_year-8_year-9_year-10/content-description?subject-identifier=SCISCIY7&content-description-code=AC9S7I03&load-extra-subject=MATMATY7_MATMATY8_MATMATY9_MATMATY10&detailed-content-descriptions=0&hide-ccp=0&hide-gc=0&achievement-standard=03c879d2-7f52-4094-9156-a76c87cfeaf3&side-by-side=1&strands-start-index=0&subjects-start-index=0&view=quick) |
| Areas of challenge | Some students may:  believe that the longer decimal always means a larger value  believe that the shorter decimal always means a larger value  evaluate the wrong key digits when rounding  believe that trailing zeros on decimal values change the numbers value  believe that the decimal point itself rather than the integer sitting in the ‘ones’ column, defines how we treat decimals. This may lead students to believe in the existence of a ‘oneths’ column after the decimal point, rather than a ‘tenths’ column  believe that multiplying always makes a number bigger  struggle to name decimals with internal zeros, or trailing zeros  struggle to rename decimals (for example, twenty-hundredths as the same as two-tenths)  struggle to name decimals using correct place-value language (for example, 0.23 is twenty-three-hundredths, rather than oh-point-two-three)  believe that decimals are rounded by truncation. |
| Strategies | [Questioning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/questioning/)  [Classroom talks](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/classroom-talks/)  [Collaborative learning](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/collaborative-learning/)  [Differentiated teaching](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/differentiated-teaching/)  [Explicit teaching](https://www.mathematicshub.edu.au/plan-teach-and-assess/teaching/teaching-strategies/explicit-teaching/) |

Lesson structure

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| Learning hook  20 mins | Use the teacher’s slides to support this lesson. Please note that more detail is presented in the slides in the teaching notes accompanying each slide, including further notes on differentiation.  Begin by introducing students to the topic, learning intention and to answer the question: Why do I need to know this? (slides 1–3)  **Hook: engage student interest**  Project slide 4 from the Hubble telescope showing a part of the universe. Explain to the class that scientists use telescopes like the [ESA Hubble](https://esahubble.org/science/deep_fields/) to take photographs of sky segments, and in this photo every light is a galaxy. Pose the following opening discussion question to students. ‘How do scientists determine how many galaxies there are in the universe?’   * Allow students to think-pair-share their answers, encouraging them to write down their answer during the ‘think’ phase. * Explain to the class that scientists use Hubble photos to count the number of galaxies in the photo of the sky segment. How they do this is found in the teaching notes. The current reasonable estimate we have for the number of galaxies in the universe is between 100 and 200 billion ([*The Conversation,* 18 Nov 22](https://theconversation.com/curious-kids-how-many-galaxies-are-there-in-the-universe-193420)). Record this number on the board for students, using the ‘approximately equal to symbol’ (), and explain what the symbol means. Point out to students that this is a very large range (for example, students might be asked to offer possible values in between 100 and 200 billion). * Discuss what a ‘reasonable estimate’ might be for the number of textbooks needed for Year 7 in their current school. Record this number on the board, along with the stars estimate. * Discuss as a whole group what range might be acceptable for the two different estimates (of stars and books) to be reasonable. Guide students to consider that the problem context is important and helps determine what we consider reasonable.   **Introduction: engage student knowledge**  Explain that estimating is one of the mathematical skills that they will use most often in life (slide 5). If you are having a barbecue with friends, you don’t need to survey every individual person to find out precisely how many sausages each will eat before you buy them, you use an estimate (an educated guess that is tolerably close to the exact answer). Use the barbecue, galaxy and textbook scenarios to discuss the idea of ‘tolerably close’ (for example, a guess that is +/– 10 textbooks is tolerably close, but +/– 100 would not be tolerably close for the school budget). To obtain a tolerably close estimate, we often use rounding prior to calculating. This tells us a tolerably close answer might be an estimate rounded to the nearest tens.  Introduce students to the idea that often we also want to round and estimate using decimals. See the teaching notes on this slide to give examples. Brainstorm as a group the places and scenarios we might round decimals.  **Differentiation (support):** Download and print out the rounding decimals reference sheet for those students requiring further support for slides 6, 7 and 8. Explain how to find the ‘cut’: consider the digit immediately to the right of the place value you are rounding to. If this digit is less than 5, then round down. If this digit is 5 or more, round up.  Now together as a class, model a further example of rounding a swimming record of 10.4567 seconds to one and two decimal places (to tenths and hundredths).  **Differentiation** (enable): The I have, who has? game provides excellent revision if this is required. |
| Explore  30 mins | **Investigate and explore the concept**   * Download and print the Reasoned rounding decimals game and hand out one between two. This rich collaborative task builds fluency and understanding and is fun to play engaging students and making explicit connections with the content. During the activity, the teacher can circulate and ask various questions shown on slide 9designed to check understanding(adapted from [NRich](https://nrich.maths.org/10945)). * Next go to slide 10. This is another collaborative task designed to build communication, reasoning and problem-solving skills. In groups of 3, give students the petrol-price dilemma shown in the slide. Students are encouraged to produce an argument that is either ‘for’ or ‘against’ rounding petrol prices to a tenth of a dollar. * Slide 11 gives several prompts to investigate their arguments. Students use real figures and do several examples to test whether you would agree to round Australian petrol prices using these figures as an example case. They are also given the choice to support their case from different perspectives: station owners, or the customer. * As a whole class, allow students to present their decision and provide justification. |
| Summary and reflection  10 mins | As a whole group, summarise the lesson by asking students to think about where they might encounter decimals, rounding and/or estimation in their lives (slide 12). |
| Assessment | The following assessment opportunities are shown below.  Short formative assessment (slide 13)   * Write 90.56 in words. * Round 125.65 to the nearest tenth. * When rounded to the nearest tenth, what numbers might round to 10.6? * What might be a reasonable estimate for the number of pens you use each year? Tell us your estimate, how you calculated it, and explain why you think it is reasonable. * Why are estimating and rounding important? * Give an example of where you use estimating and rounding in everyday life.   **Differentiation:**   * Vary the complexity of exit ticket questions by changing the values given for different classes or students. * Support students’ affective needs by allowing them to report on how well they felt they understood how to round decimals (for example, drawing a ☺ 😐 ☹ face at the bottom of their exit ticket answers). |