re(Solve) MATHS BY INQUIRY Place Value Cards

Y2

Summary of learning goals

- These tasks explore the multiplicative place-value properties of numbers. Students learn to represent numbers up to 1000 as multiples of 100s, 10s and 1s. For example, $664 = (6 \times 100) + (6 \times 10) + (4 \times 1)$.

Australian Curriculum: Mathematics (Year 2)

ACMNA026: Investigate number sequences, initially those increasing and decreasing by twos, threes, fives and tens from any starting point, then moving to other sequences.

ACMNA027: Recognise, model, represent and order numbers to at least 1000.

ACMNA028: Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting.

Summary of lessons

Who is this sequence for?

- The sequence introduces the multiplicative place-value properties of numbers. Students should have a sound understanding of the additive place value of numbers; that is, 64 is made up of 60 and 4.
- Students also need experience skip counting off the decade by 10s and 100s.

Lesson 1: Counting Cards

The teacher uses a set of cards with 1, 10 and 100 printed on them and asks students to skip count according to the number printed on the card. The cards are shuffled and again skip counted according to the number on the card. Students are asked to consider why they reach the same total when the cards are presented in a different order. They then explore the relationship between the cards and the place-value property of the final number in the count.

Lesson 2: Counting with Plato

Students look at the fact that counting ten 1s is equal to 10, ten 10s is 100 and ten 100s is 1000. Plato the counting robot is introduced to the students. The students count with Plato and then, using the total of the count, reflect on how many 1s, 10s or 100s may have been shown in the counting sequence.

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Reflection on this sequence

Rationale

The place-value properties of a number can be represented additively; for example, $136 = 100 + 30 + 6$. They can also be represented as a multiplicative; for example, 136 = one 100 + three 10s + six 1s, which can also be represented as $136 = (1 \times 100) + (3 \times 10) + (6 \times 1)$. The latter representation is more typically used in classrooms but, considering students do not learn to multiply until the middle primary years, stating 'one 100' or 'three 10s' can hold little or no meaning to students. This sequence is focused on building students' understanding of multiplicative place-value representation while still allowing them to draw on additive representation.

The sequence also builds the idea of regrouping. In the first lesson, students count no more than eight cards each of 100s, 10s and 1s, meaning that the cards neatly represent the place value parts of the number. In the second lesson, the students count more than ten cards each of 100s, 10s and 1s. When exploring the place value of the number, the cards no longer neatly represent the place value parts. Students are asked to regroup; that is, group ten 10s together to form one 100 or ten 1s together to form one 10.

reSolve mathematics is purposeful

- Students build fluency with counting and place value. The sequence also explores substantial mathematical idea regrouping.
- Although the focus of the sequence is on place value, the first lesson also touches on the important mathematical understanding of commutativity. Students see that the order in which the cards are counted does not matter, as they will always reach the same total.

reSolve tasks are inclusive and challenging

- This sequence provides prompts to enable access and challenge for all students. Limiting the size of the numbers to just 1s and 10s still allows students to explore the same important mathematical ideas as those explored when counting with 100s, 10s and 1s.

reSolve classrooms have a knowledge-building culture

- This sequence requires students to work collaboratively with fellow classmates. Their collaboration is more than just completing the task together. They are encouraged to listen carefully to each other, question, critique, discuss and correct as needed.

LESSON 1

re(Solve) MATHS BY INQUIRY

Place Value Cards

Counting Cards

Y2

About this lesson

The teacher uses a set of cards with 1, 10 and 100 printed on them and asks students to skip count according to the number printed on the card. The cards are shuffled and again skip counted according to the number on the card. Students are asked to consider why they reach the same total when the cards are presented in a different order. They then explore the relationship between the cards and the place-value property of the final number in the count.

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ACMNA028: Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting.

Mathematical purpose

- To build students' understanding of commutativity and the multiplicative place-value properties of numbers through the context of skip counting.

Learning intention

- To build understanding of place value and skills in skip counting.

Time

A lesson of approximately 1 hour.

Vocabulary

- place value
- equivalence

Resources

- reSolve PDF *1a Number Cards*
  - ◊ One set of Teacher Cards, including at least eight copies of each number
  - ◊ Sets of Student Cards (one per pair of students)

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Counting as a class

Resources: One set of Teacher Cards from reSolve PDF *1a Number Cards*.

Explain to the students that they will be skip counting as a class according to the numbers shown on each card. Make sure the cards are presented in a random order.

As you hold up each card, the students skip count forwards according to the number shown. After counting through once, ask students to count the cards again. This time, place the cards that have been counted into a separate pile. Continue for a sequence of 10 to 20 cards. Record the final number arrived at in the counting sequence. Pick up the cards that have been counted and shuffle them.

Pose the questions: *If we count using these shuffled cards, what number do you think we might land on?*
If we count backwards using these cards, what number do you think we might land on?

Counting in pairs

Resources: Provide pairs of students with a deck of Student Cards (see reSolve PDF *1a Number Cards*).

Ask students to skip count through at least 10 cards according to the number on the card.

Enabling prompt:

- Have students count using the 1s and 10s cards only.

After they have counted through once, ask the students to shuffle the cards and to predict what number they think they might count up to. Have the students count the cards again.

Questioning to direct the investigation and challenge students' thinking and reasoning

- *Why do both counting sequences end on the same number?*
  - ◊ It is not necessarily obvious that both sequences will end on the same number. Students are likely to think that the end number will be different, as the cards are presented in a different order. This is an example of the commutative property: the order in which the numbers are counted (or added) does not affect the result. To help highlight this, students can model both sequences using Base 10 materials and rearrange the cards.
- *What is similar and what is different about the two sequences?*
  - ◊ It is important for students to see that the number of 1s, 10s and 100s in each collection is the same. The order in which these numbers appear differs, as does the sequence of numbers in the count.
- *How many 1 cards were counted in the sequence? How many 10 cards? What about 100s? How do these relate to the final number in the sequence?*
  - ◊ This is a nice exploration into place value.

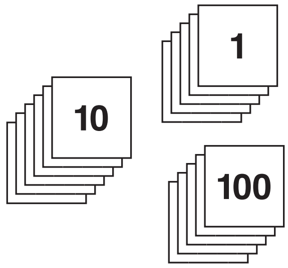
Exploring place value

Pose the question: *How could you check your count?*

Answering this question requires students to explore the place value of the final number in the count.

Teacher notes:

- To show how the cards represent the place value of the numbers:
    - ◊ Rearrange the cards to group the 100s, 10s and 1s together. This introduces students to the multiplicative place-value property of numbers.
        - ■ *There are six 10s, five 1s and five 100s. This is equivalent to 565.*
    - ◊ Note that these cards have not been presented in order of their place value. This requires students to think carefully about where each collection belongs in a number.



Have the students reshuffle the cards. Ask the students to count backwards this time. Have them first predict what number they think they might land on. Ask the students to record the numbers on the cards and the numbers that they counted.

Extending prompt:

- *Look back at one of your counting sequences. What other combinations of 1s, 10s and 100s could have got you to the same total?*

Questioning to direct the investigation and challenge students' thinking and reasoning

- *Why does the count end on zero? If you shuffled the cards again, would the count still end on zero?*
    - ◊ Once again, it may not be immediately obvious that *any* backwards counting sequence using the same cards will end on zero. To help highlight this, students can model the sequence of counting backwards using Base 10 materials.
- *What is similar and what is different about the two sequences?*
    - ◊ It is important for students to see that number of 1s, 10s and 100s in each collection is the same. The order in which these numbers appear differs as does the sequence of numbers in the count. Additionally, one count is ascending and one is descending.

Reflection

Select some students to share their work and thinking to the class.

Questions for discussion with students to reflect on learning and build connections

- *Why do you reach the same total when the cards are shuffled and counted again?*
  - ◊ This is an example of the commutative property of addition. The order in which the cards are counted does not matter; it will still result in the same total. Prompt students to consider if this will be the same for any skip counting sequence. What if we were skip counting in 2s, 3s or 5s? Would it still apply?
- *How do the cards relate to the place value of the number? Why is this the case?*
  - ◊ Our place-value system is built on 10. The cards counted are powers of 10 and therefore represent the place value of the final number. Skip counting by other numbers, such as by 2s, 3s or 5s, does not represent the place value of numbers in the same way. This demonstrates the power of 10.

Where to next?

Lesson 2: Counting with Plato is the second activity in this sequence. Although Lesson 1 counts no more than eight cards each of 100s, 10s or 1s in the count, Lesson 2 examines what happens to the numbers when ten or more of each of the 100s, 10s or 1s cards are counted. This explores the understanding that ten 1s equal 10, ten 10s is 100 and ten 100s is 1000.

LESSON 2

re(Solve) MATHS BY INQUIRY

Place Value Cards

Counting with Plato

Y2

About this lesson

Students look at the fact that counting ten 1s is equal to 10, ten 10s is 100 and ten 100s is 1000. Plato the counting robot is introduced to the students. The students count with Plato and then, using the total of the count, reflect on how many 1s, 10s or 100s may have been shown in the counting sequence.

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Mathematical purpose

- Use place value to demonstrate that ten 1s is equal to 10, ten 10s is 100 and ten 100s is 1000. Students apply this understanding to rearrange and regroup numbers.

Learning intention

- To explore the place-value property of numbers.

Time

A lesson of approximately 1 hour.

Vocabulary

- place value
- equivalence

Resources

- reSolve PowerPoint *2a Plato Number Generator* (for display)
- reSolve PDF *1a Number Cards*
  - ◊ One set of Teacher Cards, including at least 15 copies of each number
  - ◊ Sets of Student Cards, including at least 15 copies of each number (one per pair of students)

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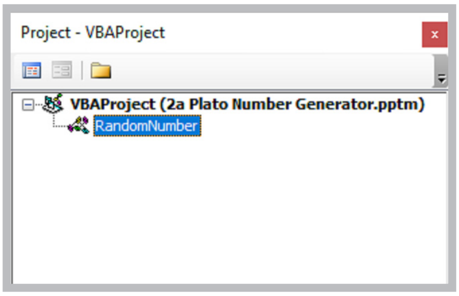
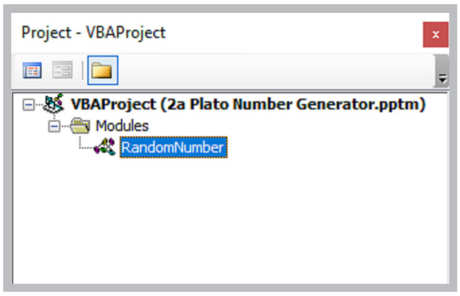
Teacher background information

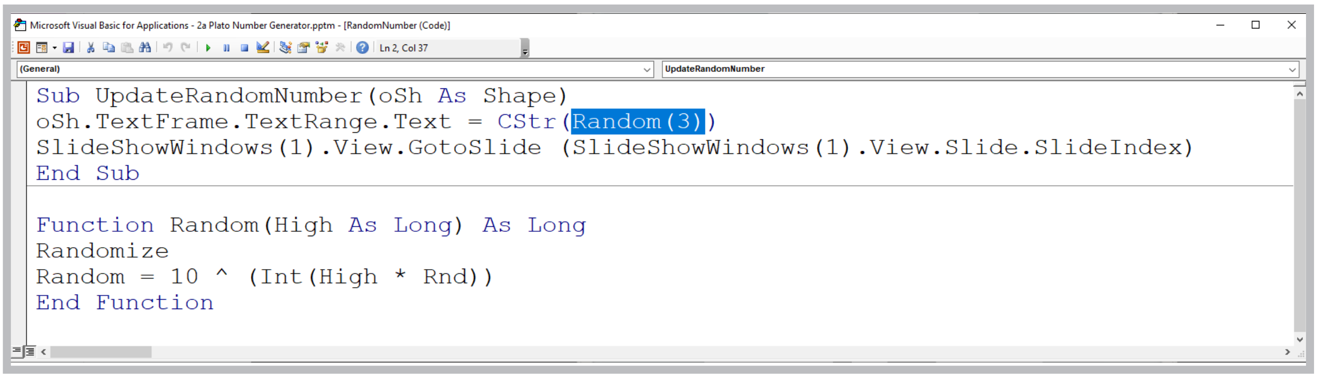
This resource uses a PowerPoint with a macro embedded in it that randomly displays 1s, 10s and 100s. The content of the PowerPoint must be enabled when you open it so that the macro works. When the slide show is being played, click on the screen that Plato the Robot is holding. Each mouse click will change to a new number.

It is possible to change the number in which Plato counts. To change the number, open the presentation. Press Alt+F11 to open the VB editor. Press Ctrl+R to see the projects. Make sure the Modules folder is open.





Double click on the file RandomNumber to reveal the code. At the end of the second row of code is (Random(3)).



```
Sub UpdateRandomNumber(oSh As Shape)
oSh.TextFrame.TextRange.Text = CStr(Random(3))
SlideShowWindows(1).View.GotoSlide (SlideShowWindows(1).View.Slide.SlideIndex)
End Sub

Function Random(High As Long) As Long
Randomize
Random = 10 ^ (Int(High * Rnd))
End Function
```

- To make Plato generate only 1s and 10s, change the 3 to 2.
- To make Plato generate 1s, 10s, 100s and 1000s, change the 3 to 4.
- To include 10 000, change the 3 to a 5.
- To make Plato generate 1s, 10s and 100s, change the number back to a 3.

Close the coding and editor windows.

Counting cards

Resources: Use the Teacher Cards to create a shuffled deck of cards with at least 15 copies of each number.

Have students skip count the cards out loud as in Lesson 1: Counting Cards. Stop at a convenient point, making sure that you have counted more than ten of each of the 1s, 10s and/or 100s.

In the following example, more than ten of each of the 10s cards and 1s cards were counted, but only nine of the 100s cards.

1	**1**	**100**	**10**	**1**	**1**	**100**	**10**	**100**	**100**
1	*2*	*102*	*112*	*113*	*114*	*214*	*224*	*324*	*424*
1	**10**	**10**	**100**	**1**	**1**	**10**	**1**	**10**	**10**
425	*435*	*445*	*545*	*546*	*547*	*557*	*558*	*568*	*578*
10	**10**	**100**	**100**	**100**	**10**	**10**	**1**	**100**	**1**
588	*598*	*698*	*798*	*898*	*908*	*918*	*919*	*1019*	*1020*

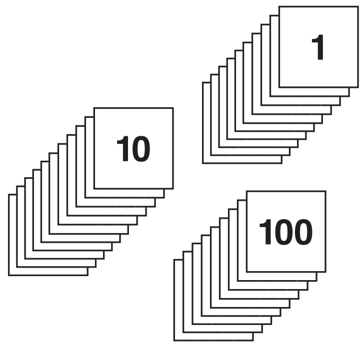
Students repeat this counting with a partner, using the Student Card decks.

Pose the question to the student pairs: *How can you check your count?*

Allow students the chance to group cards to check their count, as in the previous lesson.
Using the previous example, students will see that they have nine 100s, eleven 10s and ten 1s.

Possible student response:

- *Rearrange the cards to group the 100s, 10s and 1s together.*
- There are nine 100s, ten 1s and eleven 10s.
- This is equivalent to $(9 \times 100) + (11 \times 10) + (10 \times 1) = 1020.$
  $900 + 110 + 10 = 1020$
- In this case, ten 10s create another 100 and ten 1s create an additional 10.



Questioning to direct the investigation and challenge students' thinking and reasoning

- *Why is this number over 1000 even though there are only nine 100s? Why are there no 1s in the number even though we counted some 1s in the sequence?*
  - ◊ This question highlights the regrouping of the 10 and 1s in our place-value system. Ten of the eleven 10s were regrouped to make 100, and the ten 1s were regrouped to make a 10.
- *What are some other combinations of 100s, 10s and/or 1s that that would give 1020?*
  - ◊ There are many ways that 1020 could be reached. Some include:
    - ▪ ten 100s and two 10s — this combination uses the least number of cards.
    - ▪ 1020 1s — this combination uses the most number of cards.
    - ▪ 102 10s
    - ▪ ten 100s and twenty 1s.

Plato the robot

Resources: Introduce students to the counting robot Plato shown in reSolve PowerPoint *2a Plato Number Generator*.

Click on the sign that Plato the robot is holding (the mouse will change to a hand). Each mouse click will change the screen to a new number.

Count as a class, using the numbers that Plato generates, and record the total on the board. Make sure that more than ten cards each of the 1s, 10s and/or 100s have been counted (as with the count earlier).

Pose the question: *We counted to [number]. How many 1s, 10s and 100s might Plato have shown in his counting sequence?*

- Students do not have to use 100s, 10s and 1s in all answers. For example, they may answer with just 1s or just 10s and 1s.

For example, if the total of the count is 1135, Plato could have shown:

- eleven 100s, three 10s and five 1s
- ten 100s, thirteen 10s and five 1s
- ten 100s, twelve 10s and fifteen 1s.

Questioning to challenge students' thinking and reasoning about place value

- *We counted to [number]. What might the numbers have been if Plato counted only in 10s and 1s?*
- *We counted to [number]. Could we count to this number without 10s? What about without 1s?*
  - ◊ It is possible to count to any number without 10s or 100s. All numbers are composed of 1s. In this context, if the digit at the end of the number is not a zero, then it is not possible to count to this number without using 1s. Further questions:
    - ▪ *What numbers could you count to with only 100s?*
      - ▸ Only numbers with whole 100s
    - ▪ *What numbers could you count to with only 10s?*
      - ▸ Only numbers with whole 10s
    - ▪ *What numbers could you count to with only 1s?*
      - ▸ All numbers can be counted with only 1s.

Reflection

Select some students to share the different numbers that Plato could have shown to get to the total in the count. Record some of the different combinations that students find.

Questions for discussion with students to reflect on learning and build connections

- *Which option uses the most number of cards?*
  - ◊ Showing the count in 1s will use the most cards for any count.
- *What other options have a large number of cards?*
  - ◊ Combinations of cards that require a lot of regrouping will use many cards.
- *Which option uses the least number of cards?*
  - ◊ The least number of cards will always be the collection of cards that represents the place value neatly without needing regrouping. For example, 987 is most efficiently represented using nine 100s, eight 10s and seven 1s.

Further activities

Activity 1: Choral Counting

Divide the students into three groups. One group represents 1s, the second represents 10s and the final group represents 100s. The teacher takes the role of conductor. The teacher points to one of the groups and it begins counting in its allocated number. After a few numbers, the teacher points to another group who count in its allocated number, starting from the number that the previous group finished on. For example:

1. The teacher points to the 10s group — 10, 20, 30, 40.
2. The teacher points to the 100s group — 40, 140, 240, 340, 440, 540.
3. The teacher points to the 1s group — 540, 541, 542, 543, 544, 545, 546, 547, 548.

Activity 2

The Reflection section, including the questions, can be used as a short activity (e.g. a class warm-up or review) at other times. Plato can be used to count in any power of 10 (see Teacher background information).