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Mathematics K–6 support materials for students with special education needs

Case study 4

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# Introduction

The Year 5 class teacher is planning a unit of work for the Statistics and Probability Strand (Substrand: Data). The students are working at different Stages of the syllabus for the Statistics and Probability Strand (Substrand: Data). In developing a whole class program to meet the learning needs of all students, the teacher needs to consider the particular learning needs of one student, Andrew.

Andrew has limited expressive language and speaks in four- to five-word utterances. He can effectively express his needs and wants, but experiences difficulties with descriptive language and making requests using appropriate language. Andrew has difficulty taking turns in group situations. He enjoys playing handball and soccer with his peers.

Andrew can read simple stories accurately, with little comprehension. He writes using large script and has underdeveloped spacing skills. Andrew does not stay on the lines provided for writing. He is beginning to use a computer for games, reading activities and story writing.

Andrew can count by ones to more than 100 and read numbers to 100. He experiences difficulty counting with one-to-one correspondence beyond 8. Andrew does not demonstrate an understanding of place value or number size.

Andrew experiences difficulty making connections between previous and new learning. He does not use new strategies unless prompted and guided, preferring to use strategies that he has relied on from early learning, eg when adding and subtracting numbers to 10 he relies on concrete objects rather than using his number line.

Andrew relies on prompting from the teacher or his peers to start work and to remain on task. He relies on assistance from the teacher and his peers to undertake tasks, though he can complete them independently.

The teacher simplifies instructions for Andrew to assist his understanding. If asked if he understands instructions or new learning, Andrew always indicates ‘yes’.

The teacher receives additional support for Andrew in the classroom.

The target audience for this content is: Parents, Students, Teachers, Principals

* [Feedback](#_Feedback)
* [Collaborative curriculum planning](#_Collaborative_curriculum_planning)
* [Determining the starting point for instruction](#_Determining_the_starting)
* [Learning experiences and assessment opportunities](#_Learning_experiences_and)
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# Collaborative curriculum planning

Andrew, his parents, teacher, Stage supervisor, speech pathologist and learning support teacher, have been involved in the [collaborative curriculum planning](http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/mathematics/special-needs-in-mathematics-guide/planning) process. The process has determined that, across the key learning areas:

* Andrew is working towards Stage 1 outcomes
* Andrew is working towards the following goals:
	+ undertaking tasks with increased independence
	+ increasing the use of new strategies through instructional scaffolding, verbal and tangible feedback
	+ trialling computer software, eg sentence construction software
	+ speaking in complete sentences and repeating instructions
* the implementation of the following [adjustments](http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/mathematics/special-needs-in-mathematics-guide/implementation/4-adjustments) enables Andrew to participate in teaching and learning experiences and assessment opportunities:
	+ use of visual scaffolds (text paired with pictures or photographs) to complete tasks and to support his learning
	+ explicitly relating new learning to Andrew’s background knowledge and skills
	+ use of specialised computer software to scaffold Andrew’s writing, as recommended by the learning support teacher
	+ prompting Andrew to repeat instructions and demonstrate tasks using scaffolds
	+ use of a tangible feedback system, where Andrew earns time to spend on preferred activities for independent task completion
	+ Andrew’s teacher, peers, parents and other support staff use consistent interaction strategies to increase his independence
	+ the teacher models short complete sentences using one finger for each word as instructed by the speech pathologist.

Priorities identified for Andrew by the teacher relevant to the unit of work are to:

* engage in learning experiences with increased independence
* develop facility with counting with one-to-one correspondence up to 10 using visual scaffolds such as a number line
* compare the size of numbers to 10 using a picture graph.

# Determining the starting point for instruction

The teacher has gained initial information about the students’ knowledge, skills and understanding in the Statistics and Probability Strand (Substrand: Data) from their Year 4 reports.

The students were recently assessed to determine their achievement in relation to Early Stage 1, Stage 1 and Stage 2 outcomes for the Data Substrand, and the starting point for instruction.

On the basis of the assessment the teacher has organised the class into three tiers for the learning experience.

* Tier 1 consists of three students, including Andrew, working towards the achievement of Stage 1 outcomes for the Data Substrand. The students have demonstrated that they can:
	+ collect data using real objects or pictures of the objects, and organise and present the data in groups or rows.
* Tier 2 consists of 20 students working towards the achievement of Stage 2 outcomes for the Data Substrand. The students are organised into five groups of four students. The students have demonstrated that they can:
	+ identify a picture graph and column graph
	+ use a baseline, equal spacing and same-sized symbols when representing data
	+ use objects or pictures as symbols to represent data using one-to-one correspondence
	+ interpret information presented in picture graphs and column graphs.
* Tier 3 consists of seven students working towards the achievement of Stage 3 outcomes for the Data Substrand. The students are organised into one group of three students and one group of four students. The students have demonstrated that they can:
	+ conduct a survey to collect data and organise data in a simple table
	+ use one-to-one correspondence, mark equal spaces on axes, label axes, and name the display
	+ interpret information presented in picture graphs/column graphs.

# Selection of outcomes and content

Using the evidence of learning from the assessment for Data, the following outcomes and content were selected for each tier.

| **Outcomes** | Syllabus content |
| --- | --- |
| Tier 1MA1-1WM Describes mathematical situations and methods using everyday and some mathematical language, actions, materials, diagrams and symbolsMA1-17SP Gathers and organises data, displays data in lists, tables and picture graphs, and interprets the results | Choose simple questions and gather responses (ACMSP262)* gather data and track what has been counted by using concrete materials, tally marks, words or symbols

Represent data with objects and drawings where one object or drawing represents one data value and describe the displays (ACMSP263)* use concrete materials or pictures of objects as symbols to create [data displays](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#data-display) where one object or picture represents one data value ([one-to-one correspondence](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#one-to-one-correspondence)), eg use different-coloured blocks to represent different-coloured cars
	+ record a data display created from concrete materials or pictures of objects (Communicating)

Create displays of data using lists, tables and [picture graphs](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#picture-graphs) and interpret them (ACMSP050)* represent data in a picture graph using a baseline, equal spacing, same-sized symbols and a key indicating [one-to-one correspondence](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#one-to-one-correspondence)
	+ use digital technologies to create picture graphs (Communicating)
* display data using lists and tables
	+ use displays to communicate information gathered in other learning areas, eg data gathered in a unit on families or local places (Communicating)
* interpret information presented in lists, tables and picture graphs
	+ describe data displayed in simple tables and picture graphs found in books and created by other students (Communicating)
 |
| Tier 2MA2-2WM Selects and uses appropriate mental or written strategies, or technology, to solve problemsMA2-18SP Selects appropriate methods to collect data, and constructs, compares, interprets and evaluates data displays, including tables, picture graphs and column graphs | Collect data, organise it into categories, and create displays using lists, tables, [picture graphs](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#picture-graphs) and simple [column graphs](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#column-graph), with and without the use of digital technologies (ACMSP069)* collect data and create a list or table to organise the data, eg collect data on the number of each colour of lollies in a packetData on the number of each colour of lollies in a packet
	+ use computer software to create a table to organise collected data, eg a spreadsheet (Communicating)
* construct vertical and horizontal column graphs and picture graphs that represent data using [one-to-one correspondence](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#one-to-one-correspondence)
	+ mark equal spaces on axes, name and label axes, and choose appropriate titles for column graphs (Communicating)

Interpret and compare [data displays](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#data-display) (ACMSP070)* represent the same data set using more than one type of display and compare the displays
	+ discuss the advantages and/or disadvantages of different representations of the same data (Communicating, Reasoning)
 |
| Tier 3MA3-1WM Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventionsMA3-3WM Gives a valid reason for supporting one possible solution over anotherMA3-18SP Uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables | Construct displays, including [column graphs](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#column-graph), [dot plots](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#dot-plot) and tables, appropriate for [data](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#data) type, with and without the use of digital technologies (ACMSP119)* construct column and line graphs of numerical data using a scale of [many-to-one correspondence](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#many-to-one-correspondence), with and without the use of digital technologies
	+ name and label the horizontal and vertical axes when constructing graphs (Communicating)
	+ choose an appropriate title to describe the data represented in a [data display](http://syllabus.nesa.nsw.edu.au/mathematics/mathematics-k10/glossary/#data-display) (Communicating)
	+ determine an appropriate scale of many-to-one correspondence to represent the data in a data display (Reasoning)
	+ mark equal spaces on the axes when constructing graphs, and use the scale to label the markers (Communicating)
* consider the data type to determine and draw the most appropriate display(s), such as column graphs, dot plots and line graphs
	+ discuss and justify the choice of data display used (Communicating, Reasoning)

Describe and interpret different data sets in context (ACMSP120)* describe and interpret data presented in tables, dot plots, column graphs and line graphs, eg ‘The graph shows that the heights of all children in the class are between 125 cm and 154 cm’
	+ determine the total number of data values represented in dot plots and column graphs, eg find the number of students in the class from a display representing the heights of all children in the class (Problem Solving, Reasoning)
	+ identify and describe relationships that can be observed in data displays, eg ‘There are four times as many children in Year 5 whose favourite food is noodles compared to children whose favourite food is chicken’ (Communicating, Reasoning)
 |

# Teaching strategies for the learning experiences and assessment opportunities

The teacher:

* models recording the number of insects in a table using tally marks
* reviews the essential components of a graph
* models representing one type of insect on a graph
* guides students to represent a second type of insect on a graph
* monitors students as they represent a third type of insect on a graph during independent practice
* guides students through the steps of recording data using computer software
* models the appropriate mathematics-specific language when rephrasing student responses, eg ‘The graph shows that the beetles are the largest group’.
* provides particular students with additional practice by having the students enter data collected by other groups.

# Learning experiences and assessment opportunities

As part of this unit, the teacher is planning to implement the following learning experiences and assessment opportunities. The teacher has documented the adjustments that Andrew needs in order to access the planned learning experiences and assessment opportunities.

## Explicit teaching

The teacher has explicitly taught the following as part of the unit of work.

|  | Tier 1 | Tier 2 | Tier 3 |
| --- | --- | --- | --- |
| *Constructing* | a picture/column graph using a baseline and title | a vertical/horizontal column graph/picture graph on grid paper, labelling axes andnaming the display | a picture/column graph |
| *Recording of data* | using objects, symbols and tally marks | using tally marks | using tally marks |
| *Scaling* | using equal spacing and same-sized symbols  | using one-to-one correspondence, marking equal spaces on axes | determining a suitable scale for data and recording the scale in a key |
| *Displaying data* | using concrete materials and pictorial representations | representing the same data in more than one way | representing the same data in more than one way, using a key or scale |
| *Interpreting information* | presented in picture graphs/column graphs | presented in simpletables, picture graphs/column graphs | presented in picture graphs/column graphs, using the key or scale |

## Tiered learning experiences

A number of plastic insects are scattered within specific areas of the playground or classroom. In small groups, students record information about the number of plastic insects within a selected square metre.

| **Tier** | Learning experiences and assessment opportunities | Adjustments for Andrew |
| --- | --- | --- |
| 1 | ***Part A***Using tally marks, students record the number of each type of insect within a square metre in the playground using a table or grid | * Andrew is provided with instructional steps supported by photographs on a handout of slides (one slide per page)
* Andrew is referred to his instructional steps to begin a task and to redirect him when he is off-task
* the number of insect groups is reduced to three for Andrew
* the number of each type of insect is limited to 10
* Andrew places the insects within the squares on a grid
 |
| ***Part B***Students display their data using objects or pictures as symbols. They use one-to-one correspondence, a baseline and equal spacing to create their picture graphs | * Andrew replaces the plastic insects with symbols representing the insects on the grid. The grid assists him with one-to-one correspondence and equal spacing
* Andrew uses a [scaffold to record](#_Scaffold_to_record) the total number of each insect
* the teacher models the language of number size when questioning Andrew about the groups of insects, eg ‘Which group is the biggest?’
 |
| ***Part C***Students construct a column graph, using spreadsheet software, from a table of information. They interpret the data by answering questions provided by the teacher | * Andrew constructs a picture graph by dragging and placing symbols in a grid using word processing software
* Andrew is provided with [scaffolded questions](#_Scaffolded_questions)
 |
| **Tier** | Learning experiences and assessment opportunities |
| 2 | ***Part A***Students create a simple table to record the number of each type of insect within a square metre of the playground. They record the number of insects using tally marks***Part B***Students use grid paper to create a picture graph and a column graph using one-to-one correspondence. They label axes, mark equal spaces on the axes, and name the display***Part C***Students enter data into a spreadsheet to create a two-way table. They prepare a column graph using spreadsheet software. Students interpret the data |
| 3 | ***Part A***Students construct and use a table to record data collected about the number of each type of insect within a square metre of the playground***Part B***Students create a picture graph and a column graph. They determine a suitable scale for the data and record the scale in a key. Students label the axes and write the title for the graph***Part C***Students prepare a column graph using spreadsheet software. They interpret the data and record their interpretations. |

## Scaffolds

Scaffold are provided to support Andrew's mathematical learning and his completion of tasks.

### Handout of slides

[Handout of slides 1 (Part A and B)](http://educationstandards.nsw.edu.au/wps/wcm/connect/011c896d-d93d-40a2-b751-af62be29ad68/handout_slides1.pdf?MOD=AJPERES&CVID=)

PDF (14 pages, 1.98 MB)

[Handout of slides 2 (Part C)](http://educationstandards.nsw.edu.au/wps/wcm/connect/fe20a3ae-71da-46a5-958c-0bad1efd1fa4/handout_slides2.pdf?MOD=AJPERES&CVID=)

PDF (7 pages, 52 KB)

### Scaffold to record

[Scaffold to record](http://educationstandards.nsw.edu.au/wps/wcm/connect/65c18ec7-c4a7-488c-8d8d-349103241246/Scaffoldrecord.pdf?MOD=AJPERES&CVID=)

PDF (1 pages, 28 KB)

### Scaffolded questions

Which insects are on your graph?

How many beetles are there?

How many ladybugs are there?

How many flies are there?

Which group is largest?

How do you know?

Which group is smallest?

How do you know?

# Feedback

The teacher monitors students during the learning experiences and assessment opportunities through:

* observation of group work and individual work
* discussion and questioning
* analysis of the students’ work samples.

The teacher monitors Andrew’s level of independence during the learning experiences and assessment opportunities.

The teacher provides specific feedback, such as:

*Tier 1*

* ‘Fantastic, you have placed the symbols on your picture graph using equal spacing.’
* ‘Check your counting. It would be easier to count the insects if you sort them into groups first.’
* ‘Great work Andrew. Your counting matches your graph.’
* ‘Andrew, the beetles should be grouped together. Put this beetle with the other beetles.’

*Tier 2*

* ‘I like your title, “insects in a square metre”. ’
* ‘Your tallying shows that there were 16 ants in the square metre area. The ants’ column shows 15. Fix the column so it represents 16 ants.’

*Tier 3*

* ‘ “Type of Insect” is an appropriate label for the horizontal axis of your column graph.’
* ‘Your table shows that there were 10 flies. The star represents two flies in your key. If a star represents two flies, there should be five stars on your picture graph.’

# Evidence of learning

The teacher uses students’ work samples (records of number and type of insects, graphs), anecdotal notes of observations, checklists of indicators and checklists of target language to determine whether students have made progress as a result of the learning experiences.

Work samples for Andrew may include photographs of his placement of plastic insects and symbols within the squares on a grid.

## Criteria for assessment

Students are assessed on their ability to:

*Tier 1*

* use concrete materials, tally marks or symbols to keep track of collected data
* display data using pictures, symbols or objects to represent the data
* use a baseline and equal spacing when representing data
* display data using a column graph or picture graph
* use simple computer software to create a picture graph from a table of information

*Tier 2*

* create a simple table to organise data
* construct a column graph or picture graph on grid paper using one-to-one correspondence
* mark equal spaces on each axis, label axes and name the column graph or picture graph
* interpret information presented in a column graph or picture graph
* solve problems using strategies such as constructing tables
* use simple computer software to enter data and create a graph

*Tier 3*

* determine a suitable scale for data on a picture graph, column graph or line graph
* draw a picture graph and column graph where one picture or symbol represents more than one item
* interpret information presented in a column graph or picture graph using a key or scale
* use problem-solving strategies, including those based on selecting and organising key information in a systematic way
* use a computer database to organise information collected.

# Evaluating

The teacher makes judgements about the effectiveness of the teaching program based on the evidence of learning. This informs future [programming](http://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/mathematics/special-needs-in-mathematics-guide/programming) and instruction.

The teacher evaluates Andrew’s level of independence during the learning experiences and assessment opportunities and his answers to the scaffolded questions.