

# MAKING DECISIONS WITH DATA

## Lesson 3: What's the best?

### Australian Curriculum: Mathematics - Year 5

ACMSP118: Pose questions and collect categorical or numerical data by observation or survey.

ACMSP119: Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies.

ACMSP120: Describe and interpret different data sets in context.

### Lesson abstract

Students use their knowledge of data collection and representations to conduct their own inquiry. The lesson commences with a review of the elements that make a good graph and how to choose an appropriate representation of data. Students then choose an area in which to investigate "What's the best?", and must also decide on criteria for "best". The lesson concludes with students presenting and justifying their findings.

### Mathematical purpose (for students)

To collect data and analyse it to make choices and decisions.

To represent data using a graph.

### Mathematical purpose (for teachers)

This lesson provides an opportunity for students to use all their skills of investigation to conduct an inquiry of their own choice.

At the end of this lesson, students will be able to:

- Pose questions that require data to be answered.
- Collect and represent data.
- Analyse data to answer a question or make a decision.

Lesson Length                      Variable but not less than 90 minutes

Vocabulary Encountered

- variable
- inquiry
- criteria

Lesson Materials

- Is this a good graph? - slideshow ([3a Is This A Good Graph powerpoint](#))
- [Student Sheet 1 - What's the Best](#) (1 per student)
- [Student Sheet 2 - My Cricket Team](#) for students choosing the cricket option
- (optional) extra Cricket data from <http://cricketarchive.com/>

We value your feedback after this lesson via <http://tiny.cc/lesson-feedback>.



# Representing Data Appropriately

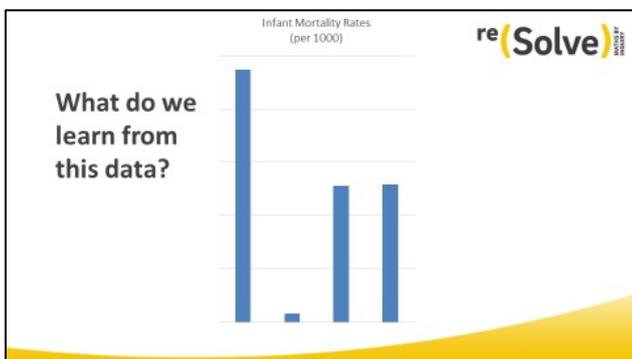
## Is this a good graph?

- View the slideshow Is this a good graph? ([3a Is This A Good Graph powerpoint](#))
- At each slide, pause and consider what is being shown - and what isn't.
- Use this conversation to decide on the important features of a good graph.

### Teacher Notes

- The data displayed on these slides shows infant mortality rates for several countries. The data is sourced from CIA World Factbook: <https://www.cia.gov/library/publications/the-world-factbook/>
- As the data relates to a serious worldwide issue, be mindful of the impact that it may have on students.

### Slide 3 - Is this a good graph?



### Expected Student Response

- The graph is about Infant Mortality Rates (number of deaths of babies per 1000 births).
- There are four groups being compared. We don't know what the four groups are.
- Two of the groups are pretty even. One is much higher and one is much lower.
- We don't know what the scale on the vertical axis might be.

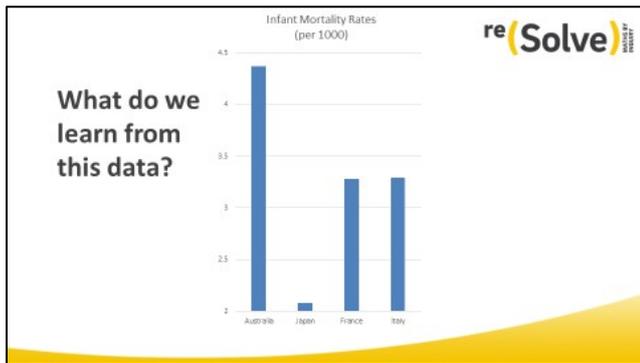
### Slide 4 - Is this a good graph?



### Expected Student Response

- Now we have a scale on the vertical axis. We can estimate the values for each group.
- The vertical scale starts at 2 rather than 0.

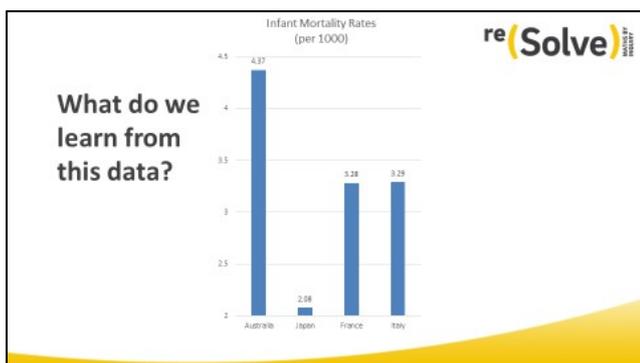
## Slide 5 - Is this a good graph?



### Expected Student Response

- Now the groups are labelled.
- We can see that the data relates to four countries - Australia, Japan, France and Italy.
- Japan has the lowest infant mortality rate of these four countries.
- Australia has the highest infant mortality rate for these countries.
- Australia's infant mortality rate is about 4.4 per 1000. It is a bit more than double the rate in Japan, which is about 2.1 per 1000. The column for Australia is about 25 times longer than the column for Japan. This is because the vertical scale starts at 2 rather than 0. It exaggerates the difference between the two countries.

## Slide 6 - Is this a good graph?



### Expected Student Response

- Now we can see the precise infant mortality rate for each country.
- France and Italy are very close.
- Now that we have numerical values, we can work out that the infant mortality rate in Australia is about 20% higher than the rate in France and Italy. The columns make the difference look a lot bigger because the vertical scale starts at 2 rather than zero.

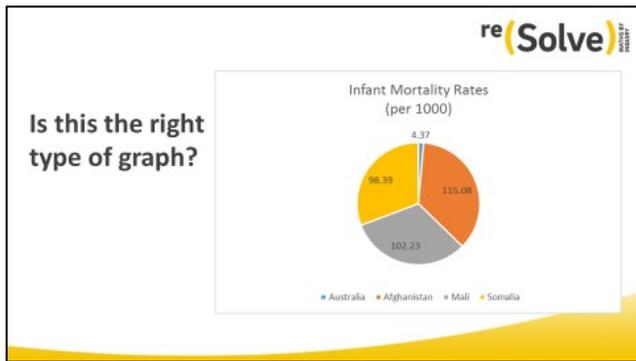
### Teacher Notes

- The data for these graphs is taken from the CIA World Fact Book and is based on 2015 information.
- Infant Mortality is the number of deaths in the first 12 months of life per 1000 births.
- It is uncertain if Japan used the same definition to determine infant mortality rate.

## Slides 7-10 - Is this a good graph?

- These slides follow a similar progression to that shown in slides 3-6 except this time Australia is compared with three third-world countries.
- By doing this activity twice, using different comparisons, students will get to see the importance of each element of the graph.

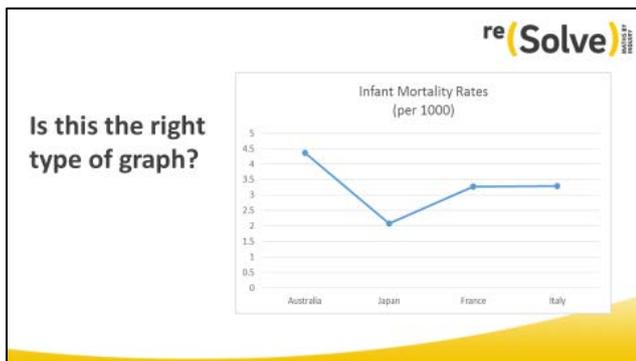
## Slide 11 - Is this a good graph?



### Expected Student Response

- A pie chart shows how the parts of a complete object, group or population are divided up. This is not a good type of graph for our data because we are comparing rates from different groups. We are not looking at parts of a whole population.

## Slide 12 - Is this a good graph?



### Expected Student Response

- A line graph shows how a quantity varies in relation to change in a given variable such as time or distance. Drawing such a graph implies a relationship between the categories on the horizontal axis. Our data does not have this relationship. Each of our categories is discrete. This is not a good graph to use for our data.

## Slide 13 - Is this a good graph?

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What are the important things you need on a graph?

- Title
- Labels for the data
- Scale
- Coding/colour key whatever

### Teacher Notes

- This is an appropriate point to review the essential elements of a good graph.
- Students will need to be able to apply these ideas when they are presenting the data from their own research.

# Conducting the Inquiries

## Posing Questions and Collecting Data

- Students are invited to pose a question that they will inquire into, collect data about and present conclusions on. A guide for this task is found in [Student Sheet 1 - What's the Best](#).
- The discussion on using graphs appropriately is an important starting point for this process. Once they have collected data they will need to display it to an audience.
- Students are given some topic suggestions or they can choose their own area to investigate. Additional information for students choosing the cricket option is found in [Student Sheet 2 - My Cricket Team](#).
- Data collection in a school can be disruptive for other classes and staff. It is important to minimise the impact of this activity on other classes by establishing operational parameters for the students. This will be part of the conversation when they establish their procedure for data collection in the early phase of their inquiry.

## Using spreadsheets to create graphs

- Teachers can take this opportunity to work with students to explore the creation of simple tables and graphs using spreadsheet software.
- Students may have previous experience with creating graphs from spreadsheets.
- Important steps to reinforce:
  - Each cell represents one piece of information - a label, a value, a variable etc.
  - Information about one variable (e.g. population of countries) should go in one row.
  - You create a graph by selecting the cells that contain the data you want to represent, and then choosing the type of graph you want to use.
  - Labelling is always important to explain the data.
  - Aesthetic elements such as size, colour, backgrounds etc can be modified after the data has been represented effectively. This is not a priority and can be a distraction for students.
  - Students will become more familiar with the use of spreadsheets with experience. Allow them time to explore and experiment with different controls.

# Option 1 - What is the Best Book in the Library?

Make a list of the “top 10” best books in your school library.

- As a group decide what is meant by “best”. Is it “most frequently borrowed”? Is it the book that the library has the most copies of? Is it the book that everyone knows the name of? Is it most highly regarded by the literary world? There are many lists available on-line of the best books for children.

## Data collection

- Once the group has defined what they mean by “best” they can start to consider data collection:
  - What data will be collected?
  - How will data be collected?
  - Who will collect the data?
- Students will need to collect data on at least 10 books.
- Remember to consider fiction and non-fiction books.
- If several groups are going to research this topic it might be good for them to focus on different, specific types of books - such as picture books, non-fiction books, novels etc.

## Data analysis

- Data once collected needs to be analysed. Students may have different opinions on how to interpret their data. This is significant since an inquiry that asks to find the “best” of anything is going to depend on how different students value the various features.

## Data presentation

- Students will need to ensure that they consider the elements of effective graphs:
  - Title
  - Labels
  - Scale
  - Coding and keys
- They will also need to ensure that they choose an appropriate type of graph for their data.
- Decide which book is the “best” and explain why.

## Teacher Notes

- For this inquiry, students will need to decide what is meant by “best” and collect data to measure this. Defining this at the start will help greatly in the final analysis and decision as to which book is the “best”.
- Students can work in groups to collect and analyse data. They will be able to make individual decisions about which book they think is the “best” as the data collected may not be conclusive.
- It is expected that students will choose to use a column graph. This should be appropriate for most circumstances in this activity.
- This is an excellent opportunity for students to develop and demonstrate their skills with technology.

# Option 2 - What is the Best Cereal for Breakfast?

## Make a list of 10 popular breakfast cereals.

- Working in pairs, make a list of 10 breakfast cereals. This list will identify the cereals that you will investigate and collect data about.

## Data collection

- Students next discuss what information they need to collect to decide which cereal is best, eg:
  - Nutritional considerations - sugar content, fat, carbohydrates, salt etc.
  - Taste - how will this be measured?
  - Cost - how will you compare different sized boxes?
- Students will need to collect data on at least 10 breakfast cereals to help answer these questions.

## Data analysis

- Data once collected needs to be analysed. Students may have different opinions on how to interpret their data. This is significant since an inquiry that asks to find the “best” of anything is going to depend on how different students value the various features.

## Data presentation

- Students present the data that they find about each cereal using graphs.
- Students will need to ensure that they consider the elements of effective graphs:
  - Title
  - Labels
  - Scale
  - Coding and keys
- They will also need to ensure that they choose an appropriate type of graph for their data.
- Using the data they have collected, students need to decide which cereal they are going to have for breakfast.

# Option 3 - Australia's Best Ever Cricket Team?

Choose 11 players to represent Australia as our best ever cricket team.

- Using the data below, and any additional data you would like to include, decide on your final line up. You need to include a wicket keeper and at least four bowlers.
- Nominate a team captain.
- Explain why you have chosen each of the players in your team.

<p><b>Batters (Batting average)</b> - from 10 or more innings</p> <p>D. Bradman (99.94) A. Voges (95.5) D. Annetts (81.9) S. Barnes (63.05) L. Hill (62.37) S. Smith (60.18) B. Haggett (58.61) E. Wilson (57.46) B. Hodge (55.88) G. Chappell (53.86)</p> <p>Others (Your suggestions):</p>	<p><b>Bowlers (Bowling average)</b> - from 10 or more innings</p> <p>R. Farrell (9.88) J. Mullagh (10.0) E. Wilson (11.80) S. Moffat (12.73) E. Liddell (13.0) P. Antonio (13.9) J. Ferris (14.25) J. Iverson (15.23) K. Brown (15.72) E. Perry (16.11)</p> <p>Others (Your suggestions):</p>	<p><b>Wicket keepers</b> (Best performance in a match)</p> <p>A. Gilchrist (10 catches) R Marsh (9 catches) I. Healey (9 catches) G. Langley (8 catches, 1 stumping) C. Matthews (8 catches, 1 stumping)</p> <hr/> <p><b>All-rounders</b> (Best performance in a match)</p> <p>E. Wilson (100 runs; 7-7) A. Davidson (80 runs; 6-87) J. Gregory (100 runs; 7-69)</p> <hr/> <p><b>Captains (% of games won as captain)</b></p> <p>W. Brown (100%) A. Blackwell (100%) R. Harvey (100%) M. Jennings (100%) M. Lanning (100%) H. Massie (100%) H. Trumble (100%)</p>
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Data from <http://cricketarchive.com/>

## Extending Prompt

- For each of the batters you choose, research their top score in a test match.
- Create a table showing the top score and the average for your batters.
- Graph the data from this table as a column graph.

## Teacher Notes

- Note that this data includes male and female players as well as some players who have not played many matches. This is deliberate. Allow students to discover this for themselves as they sort the data.
- Data needs to have a context so that it makes sense. The data that is presented here needs to be interpreted and may require additional information for it to be useful. For example, it might be useful to know how many games each of the captains played to make their 100% record.
- Data from other sports may be used instead of cricket.

## Option 4 - Insert My Own Inquiry Question Here

Suggestions might include:

- What's the best lunch?
- How much sleep do we need to be at our best?
- What is the best length for an ideal day?
- A question related to current topic of inquiry in class.

It is important for teachers to be able to encourage students to use data to support their inquiries.

Some suggested sources include:

- The Data and Story Library
- Australian Bureau of Statistics
- World Health Organisation

In groups of 3 or 4 you will be conducting an inquiry into "What's the Best".

### 1. Choose a Category

Think of a category that you could investigate to find out what the best thing is in that category.

Suggestions include:

- What's the best book in the library?
- What's the best breakfast cereal?
- What's the best ever Australian cricket team?
- What's the best number of hours to sleep per night?

### 2. Define "Best"

As a group, define what "best" means. Different people might have different criteria for deciding which things are better than others. For example:

- Is the best library book the one that your group likes the most? Or is it the most frequently borrowed? Or is it a book that has won awards?
- Is a breakfast cereal the "best" because it is healthy? Or tastes good? Or is good value for money? Or a combination of these criteria?

### 3. Collect Data

What information does your group need to collect? For example:

- To decide if a breakfast cereal is healthy you might look at sugar content and other nutritional information.
- To decide which cricket players to include you might want to find out their batting averages.

How will you collect this information? For example:

- Researching on-line.
- Making a survey for your class.

### 4. Interpret the Data

Based on the data, your group needs to decide "What's the Best" in your chosen category.

If you are using multiple criteria you will need to weigh up the importance of each one. For example, which book is better: a book that everyone likes but hasn't won any awards OR a book that has won an award but only some people like?

### 5. Present the Data and Your Reasoning

Present the data you have found using an appropriate graph or graphs and explain carefully why your choice is "the best". Ensure that you include the elements of effective graphs:

- Title
- Labels
- Scale
- Coding and keys if necessary

# My Cricket Team

Name: \_\_\_\_\_

## Choose 11 players to represent Australia as our best ever cricket team.

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