Reaction Times
Lesson 3: Develop Phase

Australian Curriculum: Mathematics (Year 5)

ACMNA105: Compare, order and represent decimals.

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 the plans from the Devise Phase to conduct a statistical investigation. They organise and conduct data collection, record and interpret reaction times, construct appropriate displays to reveal patterns and communicate findings, and make generalisations.

Mathematical purpose (for students)

Comparing graphs and other data displays is a good way to see differences between groups.

Mathematical purpose (for teachers)

Students consider exactly how to record their data, constructing recording sheets. Relevant data is organised and displayed in ways appropriate for the data type, including column graphs, dot plots and tables. Cautious generalisations can be made about the data to answer the statistical question posed.

At the end of the Develop phase, students will be able to:

- Collect data in efficient ways.
- Compare, order and represent reaction times involving decimals.
- Construct displays, appropriate for data type.
- Describe and interpret data sets to form generalisations about reaction times.

Lesson Length 90 minutes

Vocabulary Encountered

- Data collection
- Graphs, dot plots and tables
- Evidence
- Generalisations, interpret

Lesson Materials

- Plans for data collection from the previous lesson
- Equipment for measuring reaction times (see lesson 1)
- Digital cameras (to illustrate data collection) (optional)

We value your feedback after these lessons via https://www.surveymonkey.com/r/CV2TXTT

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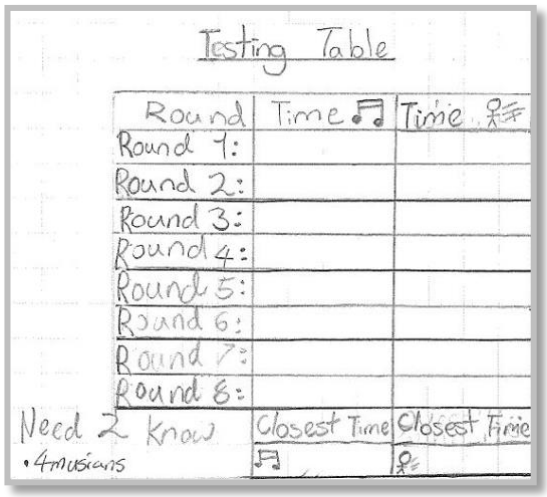
Collecting Data

Inquiry Question: Who has the best reaction time?

Identify the mathematical purpose

1. **Tell students that in the Develop phase,** groups work together to collect data, organise and interpret their findings, and refine the best way to communicate any generalisations they make.

2. **Have groups reflect on their plans from the Devise phase.** These decisions will inform what students will be 'doing' in this phase. Recall:
    - **The inquiry question:** each group should have a modified inquiry question that provides the focus for data collection.
    - **Evidence:** the data needed to answer the question. Encourage students to make predictions about what the data will show (students can sketch what they think their dot plot might look like, for example).
    - **The process of data collection:** participants, data collection method, test conditions and ways to record data.
    - **Data recording and representation method:** students should design a sheet to record the data they collect. They might consider dot plots to compare the reaction times of different groups.



These students wish to test the reaction times of musicians and athletes.

They need to think how many people they will test, and how many times they will test each one.

Collecting the data

3. **Students follow their plans** to efficiently collect and record the data. Where possible throughout this process, pause for **checkpoints** where the whole class can focus on the process of investigation, including both effective and non-effective processes. Checkpoints may focus on three key areas:

    - **Recording the data:** How are students recording the data as they collect it?
        - making sure there is data for each person tested and that this is identifiable to the students investigating,
        - data is neatly recorded for the data collection process to continue, and
        - each student in the group conducting the test takes part in the data collection process.

    - **Organising the data:** Once all the data is collected, how can we display this effectively, so we can see any patterns, and so it easily communicates our findings?
        - identifying which information is important and needs to be displayed,
        - the need to label the display
        - making it clear to the audience what the evidence is and how it relates to the question.

- **Interpreting the data:**
    - making mathematical statements about the data
    - how to make a generalisation about the data,
    - refining data displays to effectively communicate generalisations, and
    - linking the data in the display to the generalisation/s made by the students in the group.

Interpreting the Data

4. Making generalisations about data can be difficult for students when they have had little experience with interpreting data. First students can successfully make literal interpretations and these are important to include. Literal interpretations may include quantitative statements about the data e.g. There were 10 girls whose reaction times were under 300ms. Guide students to include comparative language of 'more', 'most', 'fewer', etc. as they make such statements.

5. Discuss with students whether the data appears to support a generalisation. For example, if "*there were 10 girls whose reaction times were under 300 ms*", does this indicate that "*Girls have a faster reaction time than boys*"?

6. **Prompts** to consider links between generalisations made, the inquiry question and data collected could include:

    - What is the inquiry question? Does the generalisation you made answer your inquiry question?
    - Would others believe your generalisation? Would they be convinced?
    - How do you know your justification is convincing? Can you find evidence on the poster to support your thinking?
    - Can you think of any other generalisations that you could make?

    A sample report is given at the end of this lesson plan.

Review

7. Students will be expected to defend their findings in the next phase of the inquiry: the Defend phase. Jointly construct a list of criteria (items to include) for the displays students will share.
    Teacher: *What information would you expect to see in a presentation that explains who has the best reaction time?*

    Record on the board suggestions students make. Guide classroom discussion around the importance of each suggestion and if others in the class also consider this aspect important to include. Criteria may include:

    - The inquiry question
    - An explanation of the test method (photos or diagrams)
    - The raw data collected
    - Any calculations that had to be performed
    - The organised data (graphs and displays)
    - Generalisations linked to evidence and the inquiry question

8. **Provide time for groups to consider** how their presentation will defend any generalisations they make, using the data displays they have created. Encourage groups to provide each group member with something to share in the presentation and defence of their solution.

Work Sample

Which kind of athlete has the best reaction time?

Tennis player	Runner	Swimmer	Netballer
23cm = 217ms	12cm = 156ms	3cm = 78ms	20cm = 202ms
24cm = 221ms	13cm = 163ms	12cm = 156ms	11cm = 150ms
17cm = 186ms	20cm = 202ms	5cm = 101ms	13cm = 163ms
17cm = 186ms	9cm = 136ms	9cm = 136ms	3cm = 78ms
19cm = 197ms	11cm = 150ms	13cm = 163ms	15cm = 175ms
19cm = 197ms	30cm = 237ms	12cm = 156ms	4cm = 90ms
18cm = 192ms	8cm = 128ms	11cm = 150ms	3cm = 78ms
15cm = 175ms	18cm = 192ms	6cm = 111ms	7cm = 120ms
9cm = 136ms	15cm = 175ms	6cm = 111ms	11cm = 150ms
19cm = 197ms	8cm = 128ms	17cm = 186ms	12cm = 156ms

These students collected data using the Ruler Drop Test. They converted their distance measurements to reaction times and displayed their data using a dot plot (below).

The students used a key to colour code their data points so that they can compare the reaction times of different kinds of athletes:

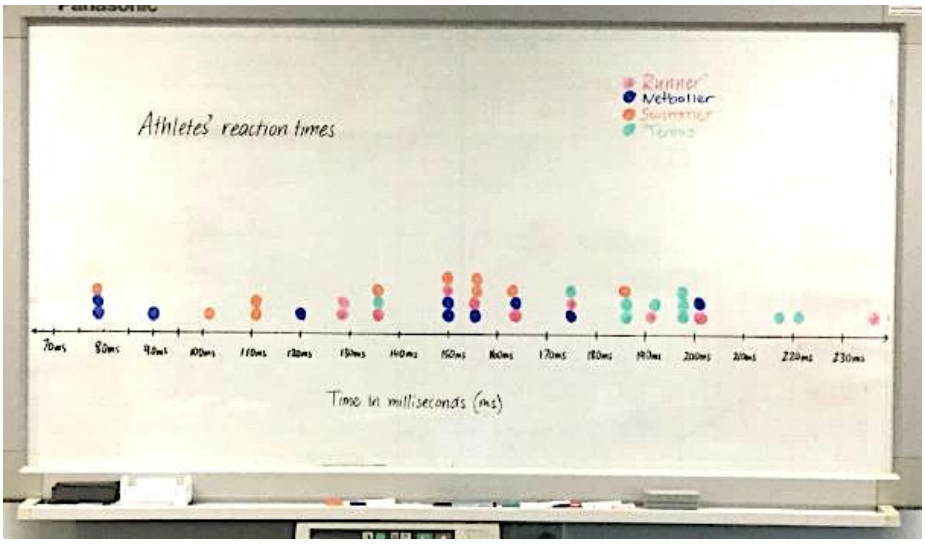
Red = Runner

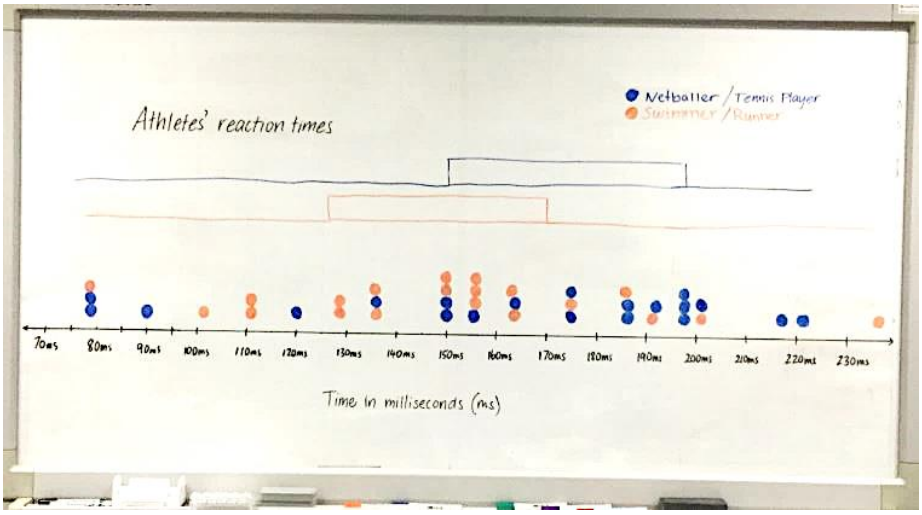
Blue = Netballer

Orange = Swimmer

Green = Tennis player

It is difficult to see any patterns in these data other than the spread of data that represents each athlete.





Here we can see that the students have combined categories to create two groups: athletes that require a quick reaction time throughout a game (Blue = Netballer/Tennis player) and athletes where reaction times are more important at the start of a race (Orange = Swimmer/Runner). With teacher assistance, a hat plot has been created to identify the middle 50% of the data. The 'brim' of the hat (on each side) shows the high and low data points.

The hat plot helps the reader identify athletes whose reaction times are more important at the start of a race (orange data points) as typically having a quicker reaction time than athletes who require a quick reaction time throughout a game (blue data points). The athletes represented by the orange data points typically caught the ruler more quickly than the athletes represented by the blue data points.