Bottle Flipping
Lesson 4: Defend Phase

Australian Curriculum: Mathematics (Year 3)

ACMSP069: Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies.

ACMSP070: Interpret and compare data displays.

Lesson abstract

Students prepare their justified solution to the inquiry question and provide feedback on others' presentations, focusing on the mathematical evidence used. Students reflect on the feedback given to determine what they did well and what they could do to improve their results and presentation.

Mathematical purpose (for students)

Mathematical evidence is required to convince others the solution answers the Inquiry question.

Mathematical purpose (for teachers)

Evidence which includes mathematical thinking and reasoning helps convince others that the solution answers the Inquiry question. Whole class feedback sessions allow for the giving and receiving of feedback on the solution. Offering feedback provides an opportunity to seek clarification and question the validity of others' mathematical evidence. Receiving feedback offers suggestions on the strengths and weaknesses of the Inquiry solution.

At the end of the Defend phase, groups will be able to:

- Answer the inquiry question using mathematical evidence and explain the reasoning used to determine why their recommended fraction is best.
- Validate mathematical evidence provided using labelled graphs and tables (optional use of technologies).
- Provide and reflect on constructive feedback on the strengths and weaknesses of their mathematical evidence.

Lesson Length 60 minutes

Vocabulary Encountered
- consistent

Lesson Materials
- From previous lesson: poster for presentations, Evidence Triangle poster, completed Fraction Flip recording sheets of data (from Lesson 3), bottles and water for display
- Student workbooks or tablets
- Student Sheet 1 – Reflection (optional)

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

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Presenting the Best Fraction

1. Inform students that in the Defend Phase they will complete their inquiry. They will present and also provide feedback on the presentations of others, focusing on the mathematical evidence given. Have them add the title DEFEND underneath the previous lesson's work. Work.

2. Allow groups 20 minutes to prepare their presentation. Encourage them to revisit the poster constructed in the Develop Phase to ensure they have met all the requirements.

Presenting findings

3. Prior to the presentations, remind non-presenting groups to actively listen so that they can analyse each presentation, considering whether presenters have used appropriate mathematical terminology and given evidence to support their solution.Inform non-presenting groups the expectation is for them to provide constuctive feedback on the strengths and weaknesses of the mathematics used as evidence.

4. Have groups present their evidence, marked water bottles and justifications for the 'best' fraction. Use the presentations as an opportunity to:

   - Ensure the inquiry question has been answered.
   - Reiterate the use of appropriate mathematical terminology e.g. *On your bottle you have labelled this level as 3. What fraction could you have written there?*
   - Highlight the importance of the evidence including the recorded tally marks from the bottle flipping trials, the justification of the best fraction and a final representation of the best filling.

   Below are three examples of questions to focus on the mathematical evidence and explanation. Asking students to elaborate emphasises the evidence and checks their understanding of why evidence is important.

Teacher:	Are your marked water measurements really different amounts? When I put two bottles together the marks look very similar eg. 1/8 and 1/10.
Student:	Here are the bottles with the coloured water. You can see that their marks are actually different. If I put mine next to them as a check, you can see they match up. Also I used the jug to measure and I measured the water on a flat surface and poured the water carefully at eye level.
Teacher:	Thanks for clarifying this. The marked bottles, together with your comparison with the coloured water, were useful evidence to convince me that your bottles were accurately filled.

Student:	First, we carefully measured the water into our bottles using a measuring jug that had millilitres on the side. We made sure the bottle was on a flat surface and we measured our unit fraction at eye level. We also placed the matching bottles with the coloured water beside our trial bottle to see the unit fraction of water was level. Then we realised that we needed to be very accurate to make a fair test.
Teacher:	Can you tell us why you needed to make this a fair test and why you needed to be accurate with measuring the required amount of water for your fractions?

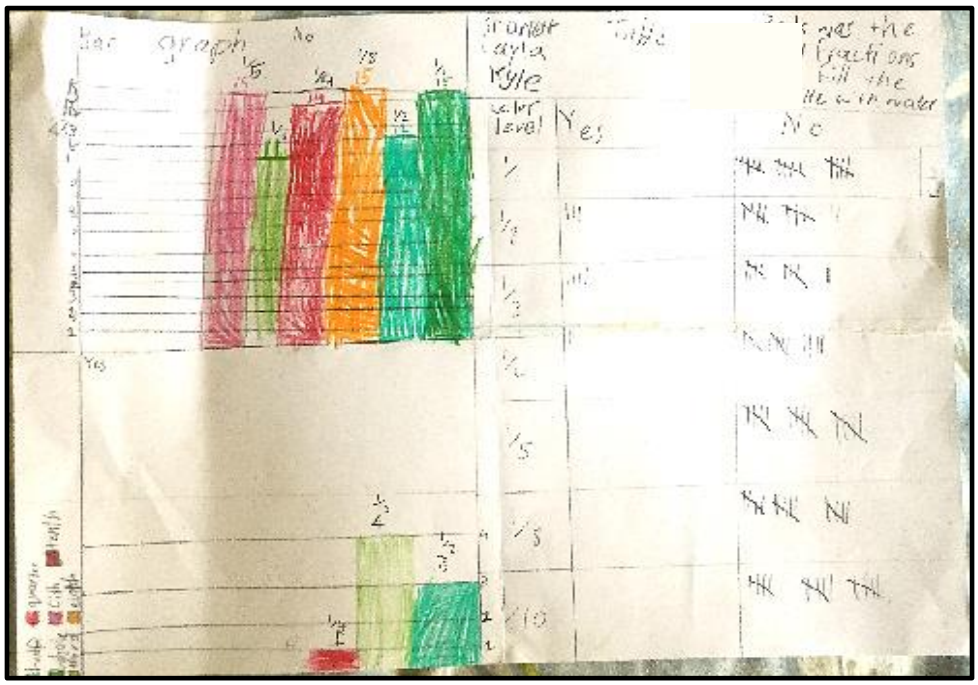
Student:	We collected our data which was the number of successful trials versus the number of unsuccessful trials when we flipped our water bottle and it landed upright. We used tally marks to keep track of our results. We used our tablet to record these and then made a bar graph to show our final results as evidence to convince the class that 1/3 is the best fraction of water to have in our bottle.
Teacher:	Can you tell us why you needed this mathematical evidence?

Reflection

5. Have students spend 10 minutes reflecting in their journals or on Student Sheet 1 – Reflection, on what they did well and how they would improve their presentation if they had the opportunity to repeat the task. Encourage them to consider any feedback addressed to them and good ideas that other groups used. Remind students their reflections should focus on mathematics. For example:

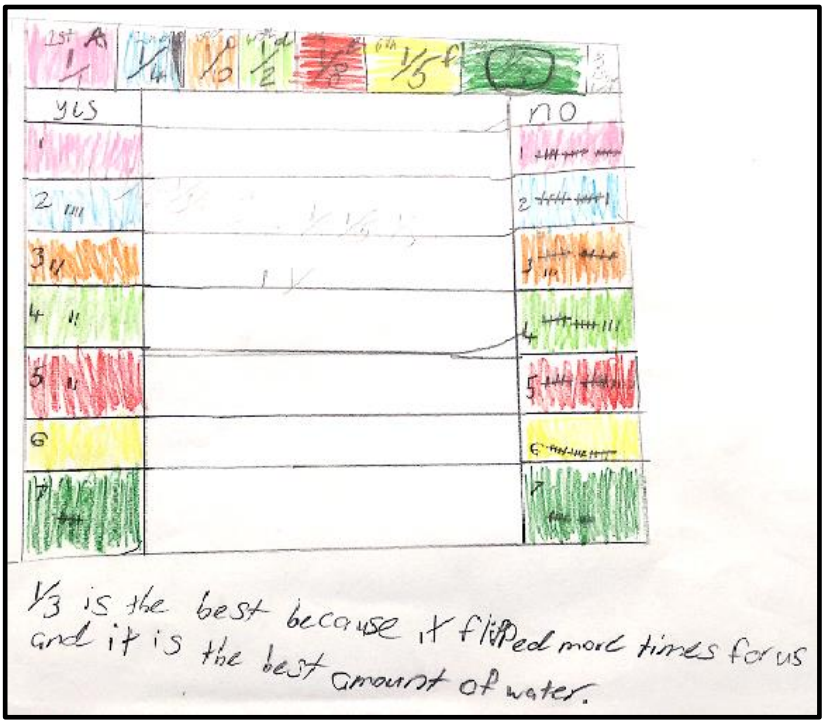
    - *Next time we will organise our data from the beginning as this took a lot of time to sort out afterwards and we were not sure if we were actually recording our flips accurately.*
    - *Using recording sheet was easier to record our findings as it took too long to write the information in my book. The headings and prompts told me what to write.*

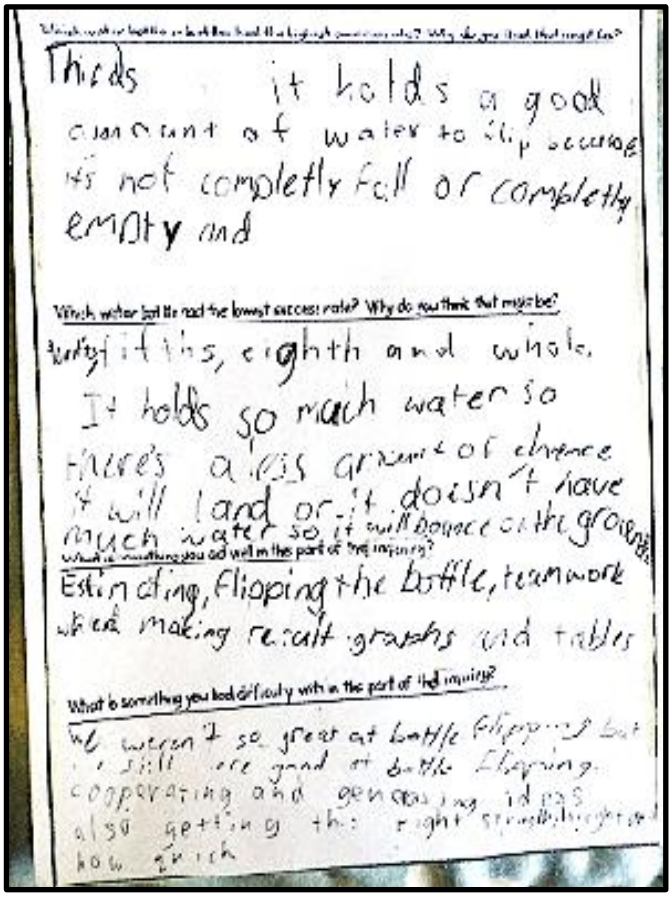
Examples of Student Work



These students show a tally of successful and unsuccessful flips, and a column graph for each.

These students put small tally marks on the colour coded regions. (One colour per fraction)



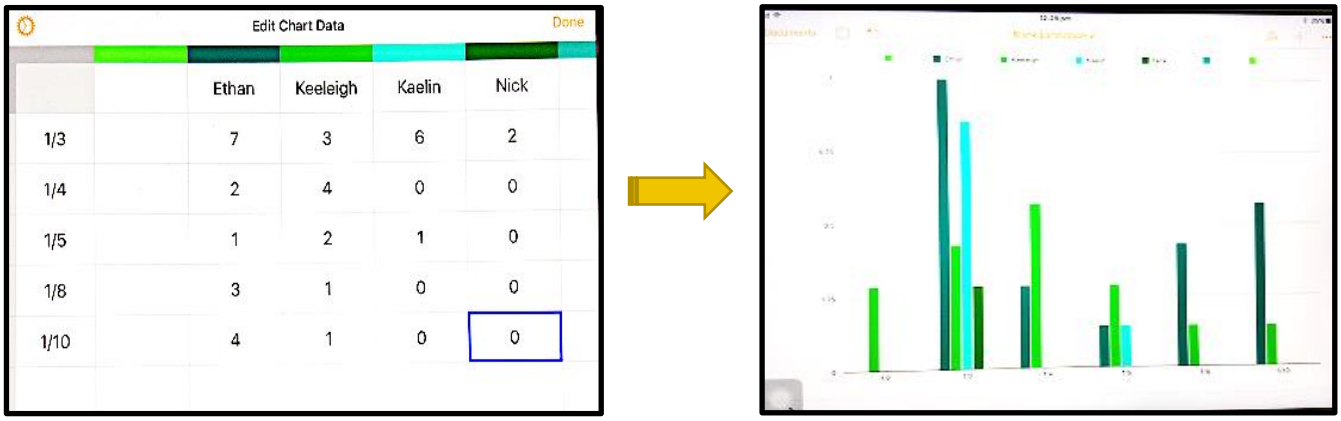

Thirds it holds a good
amount of water to slip accurate
its not completly full or completly
empty and

Which water bottle do you think had the lowest success rate? Why do you think that might be?
thirds, it's, eighth and whole.
It holds so much water so
there's a less amount of chance
it will land or it doesn't have
much water so it will bounce on the ground

What is something you did well in this part of the inquiry?
Estimating, flipping the bottle, teamwork
when making result graphs and tables

What is something you had difficulty with in the part of the inquiry?
We weren't so great at bottle flipping but
we still are good at bottle flipping.
cooperating and generating ideas
also getting the right strength/height and
how much

A student's response to questions from Student Sheet 1 – Reflection



If students have tablets, they can graph the data. This enables presenters to share evidence clearly.

Reflection

Name: _____

1. Which bottle had the highest success rate? Why do you think that might be?

2. Which bottle had the lowest success rate? Why do you think that might be?

3. What is something you did well in this part of the Inquiry?

4. What is something you had difficulty with in this part of the Inquiry?

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