Bottle Flipping
Lesson 3: Develop Phase

Australian Curriculum: Mathematics (Year 3)

ACMMG061: Measure, order and compare objects using familiar metric units of length, mass and capacity.

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.

Lesson abstract

Students use feedback to adjust and improve existing evidence before continuing their data collection and systematically organizing their evidence.

Mathematical purpose (for students)

Evidence needs to be clearly organised and represented to enable it to be easily interpreted by others.

Mathematical purpose (for teachers)

The lesson demonstrates that inquiry solutions need to be supported with sufficient mathematical evidence to convince others that the solution answers the question. Students should identify the strengths and weaknesses of the methods used for collection and organisation of the evidence, and its overall appropriateness (through checkpoints). At the end of the Develop phase, groups should be able to describe systematic ways of recording, displaying and presenting data and also to share their mathematical thinking to support their answer to the inquiry.

Lesson Length 2 x 30 minutes (recommended) or 1 x 60 minutes

Vocabulary Encountered

- iteration
- Rotating
- millilitres
- data collection

Lesson Materials

- Student workbooks (or tablets, optional)
- Equipment for measuring and bottle flipping from previous lesson.
- Student Sheet 1 – The Fraction Flip (optional)
- Evidence Triangle poster from previous lesson.

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

Mathematics by Inquiry is an initiative of, and funded by, the Australian Government Department of Education and Training

Australian Academy of Science

aamt

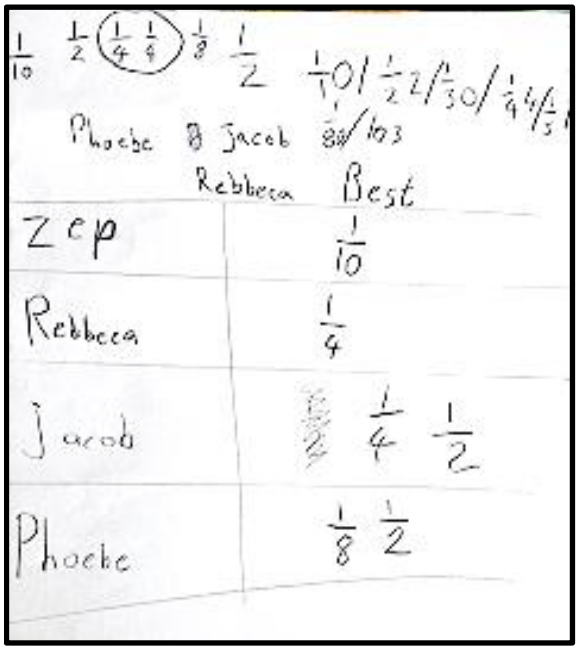
Improving Evidence

1. Inform students that in the Develop phase they will be adjusting, improving and adding to their existing evidence. Have them add the title DEVELOP underneath the previous lesson's ideas and representations.
2. Focus students on the need for mathematical evidence (revisit the Evidence Triangle, if desired). Discuss with students the connections between the inquiry question, the evidence gathered and the conclusion. For example:
   - *Evidence* is a record of the mathematical thinking and processes used to answer the inquiry *question*.
   - Sufficient *evidence* is required to convince others that the *conclusion* answers the inquiry *question*.
3. Give groups about 20 minutes to adjust and improve their existing data and collect additional data on all fractions tested. Students can continue collecting and organising data using the same method as in the Devise Phase or they might use a more efficient method.
4. It is important that students carefully consider if their data collection if being carried out to make a fair test. Students may need to start again once or even twice.
5. Observe groups as they are working and look for examples where students are, and are not, providing useful evidence. These can be used in the Checkpoint below.

Checkpoint

6. After 20 minutes bring the class together to share ways they have recorded their mathematical evidence. Invite a couple of groups (based on your observations) to share their evidence with the class. Collect ideas for recording and organising evidence on a class poster as the groups share, including other useful ideas that are raised. Ask groups to consider how they can improve their display.

   Here is an example of student work and a possible discussion with the group.



Teacher: *Do you think this way of recording your trials will be easy for everyone to understand how you decided which fraction was best?*

Jesse: *Well, you can't really see what the unit fraction in the table means and there are fractions at the top of the page too.*

Teacher: *How did you decide which is best? Have you recorded the number of flips for each fraction somewhere?*

Pip: *No, we didn't keep track of the unsuccessful ones at first and didn't write down how many were successful, we just remembered. We noticed another group showed the tallies for both the successful and unsuccessful flips. Theirs was much easier to read and easier to compare the number of successful and not successful flips. We might try that.*

Teacher: *Good suggestion.*

Preparing Inquiry Solution

7. Have students reflect on the evidence they have collected so far and whether it is sufficient to convince others they have determined the best fraction to successfully flip the bottle to an upright position. Have groups consider what they still need to do to improve their evidence.

    - Groups are likely to identify they could still do more flips so they have stronger evidence – discuss how many more they might need.
    - Some groups should see that their data recording and organisation may be difficult to read or confusing, and can discuss ways to improve.

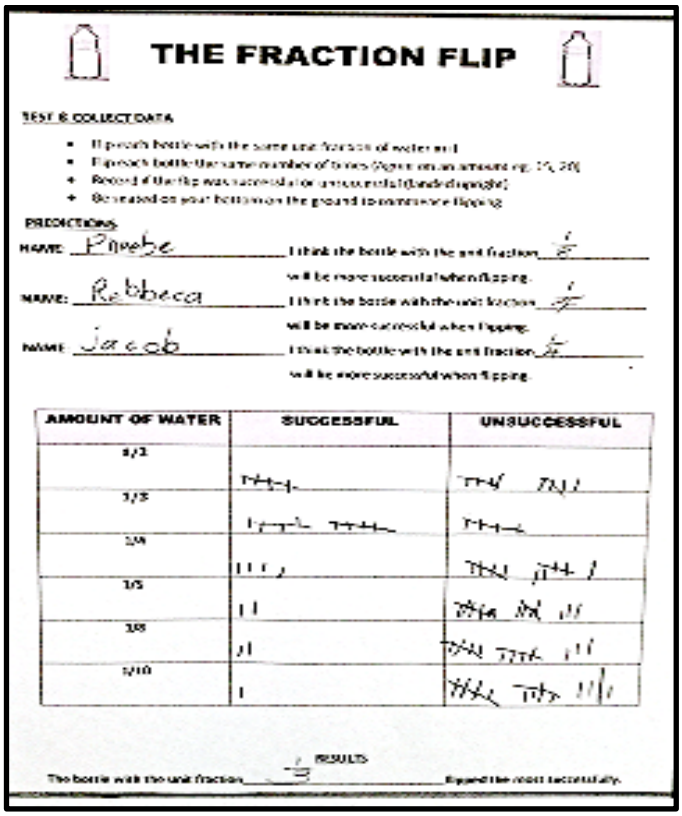
8. Brainstorm with the class what they consider sufficient evidence could include. Discuss suggestions adding useful ones to a poster. Suggestions should include:

    - Their labelled recording sheet including at least 10 data entries for each tested fraction
    - The best fraction and the reasons for choosing that fraction
    - Explanation of the mathematics used
    - A clear representation of the data (graph)
    - Photographs or drawings of bottles used for the flipping (optional)

9. As groups are working on preparing their evidence, visit each group to ensure they are using and recording mathematical reasoning. Refer them to the poster just made to see if they are providing sufficient and convincing evidence of their findings.

Conclusion

10. Allow at least twenty minutes for students to work on their Inquiry solution. Solutions are likely to be incomplete so referring them back to the poster as a checklist at the end of the lesson is useful to remind them of quality evidence.



THE FRACTION FLIP

TEST & COLLECT DATA

- Fill each bottle with the same unit fraction of water and
- Flip each bottle the same number of times (figure out an amount eg. 10, 20)
- Record if the flip was successful or unsuccessful (landed upright)
- Be seated on your bottom on the ground to minimise flipping

PREDICTIONS

NAME: Phoebe — I think the bottle with the unit fraction 1/2 will be more successful when flipping.

NAME: Rebbeca — I think the bottle with the unit fraction 1/2 will be more successful when flipping.

NAME: Jacob — I think the bottle with the unit fraction 1/2 will be more successful when flipping.

AMOUNT OF WATER	SUCCESSFUL	UNSUCCESSFUL
1/2	𝍸	𝍸 𝍸
1/3	𝍸 𝍸	𝍸
1/4	𝍸	𝍸 𝍸
1/5	𝍸	𝍸 𝍸
1/8	𝍸	𝍸 𝍸
1/10	𝍸	𝍸 𝍸

RESULTS

The bottle with the unit fraction 1/2 flipped the most successfully.

Data collected in a systematic way to convince others.

.

The Fraction Flip

Name: _____

- Carefully prepare the amounts of water for the bottle
- Sit on the ground for flipping
- Test each fraction of water the same number of times (e.g. 15)
- Record if the flip was successful (landed upright) or unsuccessful
- Tally the number of successes for each test and compare

Recording Sheet

FRACTION OF WATER	 SUCCESSFUL	 UNSUCCESSFUL
1/2		
1/3		
1/4		
1/5		
1/8		
1/10		

Mathematics by Inquiry is an initiative of, and funded by, the Australian Government Department of Education and Training

Australian Academy of Science

aamt