Let it Flow

www.mrhinchliffe.net/let-it-flow/

General Capabilities

N ***Numeracy***

Estimating and calculating with whole numbers

L3 estimate a solution to a problem and then check the solution by recalling addition, subtraction, multiplication and division facts

L4 solve problems and check calculations using efficient mental and written strategies

CCT ***Critical and Creative Thinking***

Inquiring – identifying, exploring and organising information and ideas

L3 pose questions to expand their knowledge about the world

L4 pose questions to clarify and interpret information and probe for causes and consequences

L3 select and clarify information from a range of sources

L4 identify and clarify relevant information and prioritise ideas

WA Proficiency Strands

YR 3 **Problem Solving** formulates and models authentic situations involving operations

YR 4 **Problem Solving** formulates, models and records authentic situations involving operations

YR 5 **Problem Solving** formulates and solves authentic problems using measurements

YR 6 **Problem Solving** formulates and solves authentic problems using measurements

Learning Intentions

WALT What are good questions we can ask to solve a problem?

WILF Can you ask questions that might provide useful information to solve a problem? Can you clarify what information is needed to solve the problem?

TIB In order to solve a problem, we need to know what information is going to help use move towards an answer.

Planning

The Big Idea (setting up the lesson)

Dripping bottle into a jar. Coloured water so visibility clear.

Guidance and Philosophy

- Create or find/use a clear visual which tells a brief, perplexing mathematical story. Video or live action works best.
- Video/visual should be real life and allow students to see the situation unfolding.
- Remove the initial literacy/mathematical concerns. Make as few language and/or maths demands on students as possible. You are posing a mathematical question without words.
- The visual/video should inspire curiosity or perplexity which will be resolved via the mathematical big idea(s) used by students to answer their questions. You are creating an intellectual need or cognitive dissonance in students.

Act 1 (the question)

How long will it take for the bottle to empty?

The lid is left on, however there is a hole in the lid. There is also a hole in the base of the bottle, which when the finger is released, allows the water to flow.

Focus on terminology – bottle and jar. We don't want to know how long it will take for the jar to fill, we want to know how long it will take for the bottle to empty.

Set up student curiosity by sharing a scenario

- Teacher says, "I'm going to show you something I came across and found interesting" or, "Watch this."
- Show video/visual.
- Teacher asks, "What do you notice/wonder?" and "What are the first questions that come to mind?"
- Students share observations/questions with a partner first, then with the class (think-pair-share). Students have ownership of the questions because they posed them.
- Leave no student out of this questioning. Every student should have access to the scenario. No language or mathematical barriers. Low barrier to entry.
- Teacher records questions (on chart paper or digitally-visible to class) and ranks them by popularity.
- Determine which question(s) will be immediately pursued by the class. If you have a particular question in mind, and it isn't posed by students, you may have to do some skilful prompting to orient their question to serve the mathematical end. However, a good video should naturally lead to the question you hope they'll ask.
- Teacher asks for estimated answers in response to the question(s). Ask first for best estimates, then request estimates which are too high and too low. Students are now defining and defending parameters for making sense of forthcoming answers.
- Teacher asks students to record their actual estimation for future reference.

Act 2 (information gathering)	

The bottle holds 2 litres
2L = 2000mL
 	
Water Flow: It takes 8.8 seconds to pour 80mL of liquid
 	
How many lots of 8.8 seconds will there be? OR
How many seconds to pour 1mL? OR
How many mL in 1 second?
 	
Refer students who incorrectly choose multiply/divide back to their estimates – is their answer reasonable?
	Students gather information, draw on mathematical knowledge, understanding and resources to answer the big question(s) from Act 1.
	• Teacher asks, "What information do you need to answer our *main question*?"
	• Students think of the important information they will need to answer their questions.
	• Ask, "What mathematical tools do you have already at your disposal which would be useful in answering this question?"
	• What mathematical tools might be useful which students don't already have? Help them develop those.
	• Teacher offers smaller examples and asks probing questions.
	  ○ What are you doing?
	  ○ Why are you doing that?
	  ○ What would happen if…?
	  ○ Are you sure? How do you know?

Act 3 (the reveal)	
2000mL bottle. 8.8 seconds to pour 80 millilitres. **Option A – How many lots of 8.8 seconds will there be?** 2000mL ÷ 80mL = 25 lots This means there will be 25 lots of 8.8 seconds. 25 x 8.8 = 220 seconds 220 seconds = 3 minutes and 40 seconds **Option B – How many seconds to pour 1mL?** Flow speed = 8.8sec ÷ 80mL = 0.11 seconds to empty 1mL 0.11sec x 2000mL = 220 seconds 220 seconds = 3 minutes and 40 seconds **Option C – How many mL in 1 second?** Flow rate = 80mL ÷ 8.8sec = 9.09mL per second 2000mL ÷ 9.09mL every second = 220 seconds 220 seconds = 3 minutes and 40 seconds	The payoff. • Teacher shows the answer and validates students' solutions/answer. • Teacher revisits estimates and determines closest estimate. • Teacher compares techniques, and allows students to determine which is most efficient.
The Sequel (consolidating the learning)	
Bottle size x flow speed = time to empty Bottle size ÷ flow rate = time to empty	• Students/teacher generalise the maths to any case, and "algebrafy" the problem. • Teacher poses an extension problem – best chance of student engagement if this extension connects to one of the many questions posed by students which were not the focus of Act 2, or is related to class discussion generated during Act 2. • Teacher revisits or reintroduces student questions that were not addressed in Act 2.

References

*Guidance and Philosophy content drawn from the *Three-Act Task Guide*, Georgia Department of Education Effective Instructional Practices Guide, (https://hcpss.instructure.com/courses/97/files/2026564/download?verifier=DIvkLa8CLmsyMVQb23l2LBo7GJwrmn5loPBF4z8K&wrap=1, retrieved 03/05/2018)

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