Mathematics: a spirit of inquiry

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Always, sometime, never

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I use inquiry in my teaching.

If you add a number to 5, your answer will be bigger than 5

- Are the statements always true, sometimes true or never true?
- How do you know?
- Can you find examples or counter-examples for each one?
- For the “sometimes” cards can you explain when they are true? Or rewrite them so that they are always true or never true?

Inquiry

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Was seen

- As another subject of the curriculum

Is now seen

- As a way of being, what ever they're learning or doing
- It's how we position ourselves, and our students as learners

Inquiry as a stance

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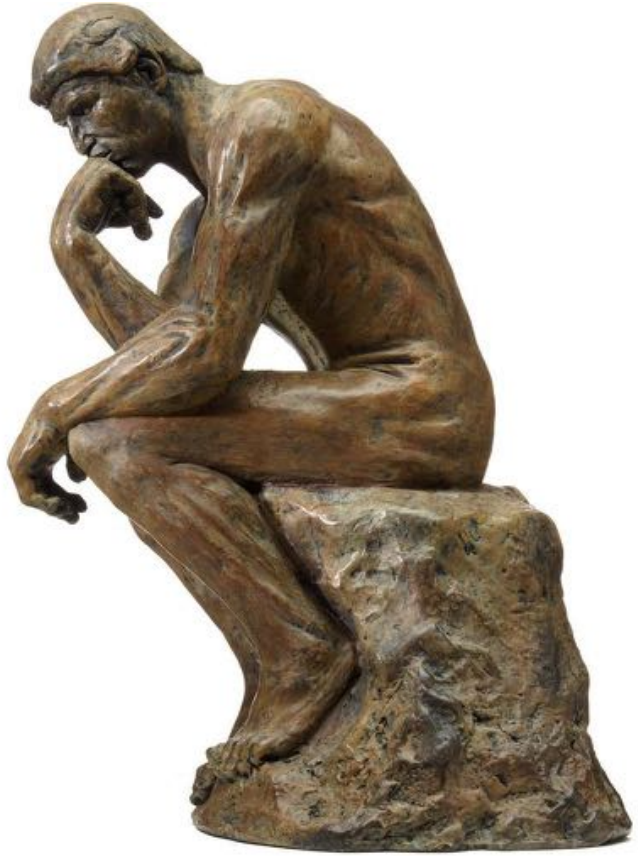
- Inquiry is a belief about learning
- A philosophy
- We enact curriculum as inquiry
- Inquiry is exploring the tensions significant to the learner
- Involves going beyond our current understandings
- Begins with current understandings
- Requires support of a collaborative community



Inquiry

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Is not

about filling heads with soon to be forgotten facts

It is

about instilling a passion and hunger for learning

Think, Pair, Share

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- Think of something you have learned recently
- Write down the steps you took or the process that led you to your new understanding
- Share with the person sitting next to you
- What are the similarities between your partners experience and yours
- Could you plot the

process as a framework?

Inquiry is natural to learning

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- Outside of school contexts inquiry is the way **children** and **adults** learn
- Engaging with life : **curiosity** leads the need to know and leads to new knowledge
- From curiosity to knowledge and more in depth investigation
- **Explorations and investigations** support the construction of new understandings and in asking new and more complex questions

Inquiry is based on connections

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- Inquiry begins in the learner's own experience and current understandings
- Without points of connection learning is difficult and easily forgotten
- Inquiry starts by immersing students in engagements so they may find connections to their experiences
- The teachers job is to observe and listen for current understandings

Time Differences

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The time is now 1.45.

The conference ends at 10 to 4.

How long is it until the conference ends ?

Work with a partner to find an answer in 2 different ways.

Discuss: How does this problem create a connection with you?

Inquiry is conceptual

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Why is 5 five?

Inquiry is conceptual

- The emphasis is on the big ideas behind the topics
- Knowledge becomes a tool to explore the conceptual understandings

that underlie that knowledge

Time Differences

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Work with a partner to find an answer in 2 different ways.

Discuss: What are the big mathematical ideas behind this question?

Inquiry is problem posing and problem solving

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- The distinction between problem posing and problem solving distinguishes between guided inquiry, personal inquiry and collaborative inquiry
- Guided inquiry: teacher poses problems; students are problem solvers
- Students actively engage in reasoning to develop own understanding of that strategy

Types of Inquiry

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Project oriented

Project

- Design and make a vegetable garden

Question

- How do we attract more native birds and animals to our school?

Philosophical/ethical

- What makes me who I am?
- Does the past make sense?

Issues/problem-oriented

- What can we do about the schools waste?
- How can I manage to go to the bathroom, collect lunch and vist MAVShop during my lunch break?

The learning environment

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The role of the teacher is to create a learning environment (or experiences) that has the most potential for anomaly or tension for the learners (Dewey 1938)

The emotional environment

A collaborative community*

Learning is visible

A space that honors the aesthetics

A flexible space

A space that helps teach

An intellectually challenging space

A place of possibilities

Enacting Inquiry in the Classroom

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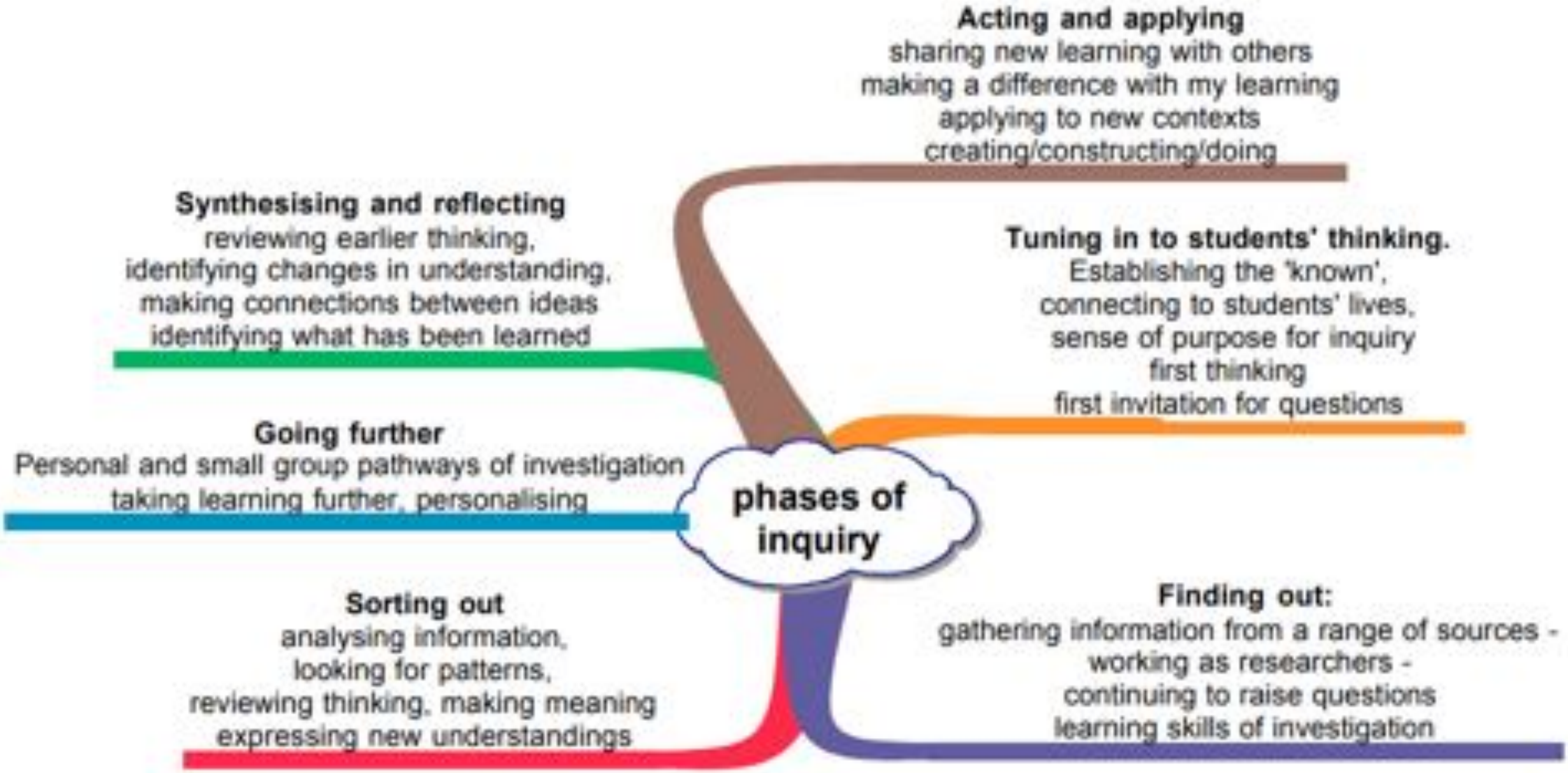
- Frameworks provide a bridge between theory and practice
- Frameworks ensure consistency of practice
- Links a set of beliefs about the learning process



Kath Murdoch

models for structured inquiry

Kathy Short

1. Building from the known
browsing, talking, listening

2. Taking the time to find questions for Inquiry
wondering & wandering
observing & exploring

7. Taking thoughtful new action
invitation for action

The Inquiry Cycle

3. Gaining new perspectives
inquiry groups
In-depth researching
tools for Inquiry

6. Planning New Inquiries
group reflection

4. Attending to Difference
revision on inquiry
learning logs

5. Sharing What Was Learned
inquiry presentations

International Baccalaureate
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Kath Murdoch Inquiry Process Model	Scientific Inquiry Process and Skills	Technology Design Process and Skills	Bloom's Taxonomy	Solo Taxonomy	5 E's
Tuning In	Question Predict	Explore & define task	Creating	Uni-Structural	Engage
Finding Out/ Sorting out	Plan Investigations	Research existing ideas/ solutions	Remembering Evaluating Understanding	Multi-structural Relational	Explore
Going Further	Conduct Investigations	Test/ make solutions	Analysing Understanding	Relational	Explore
Making / Drawing Conclusions	Process and analyse data	Re-do Test/ make	Evaluating Understanding	Relational Multi-structural	Explain
Taking Action	Communicate	Communicate	Creating	Extended Abstract	Elaborate
Reflection	Ongoing	Evaluate	Reflect	Extended Abstract	Evaluate

Inquiry and mathematics

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- It is the way you teach, not what you teach
- It is the way students think and engage in the learning, not what is being done to them

Structuring the lesson
Peter Sullivan et al

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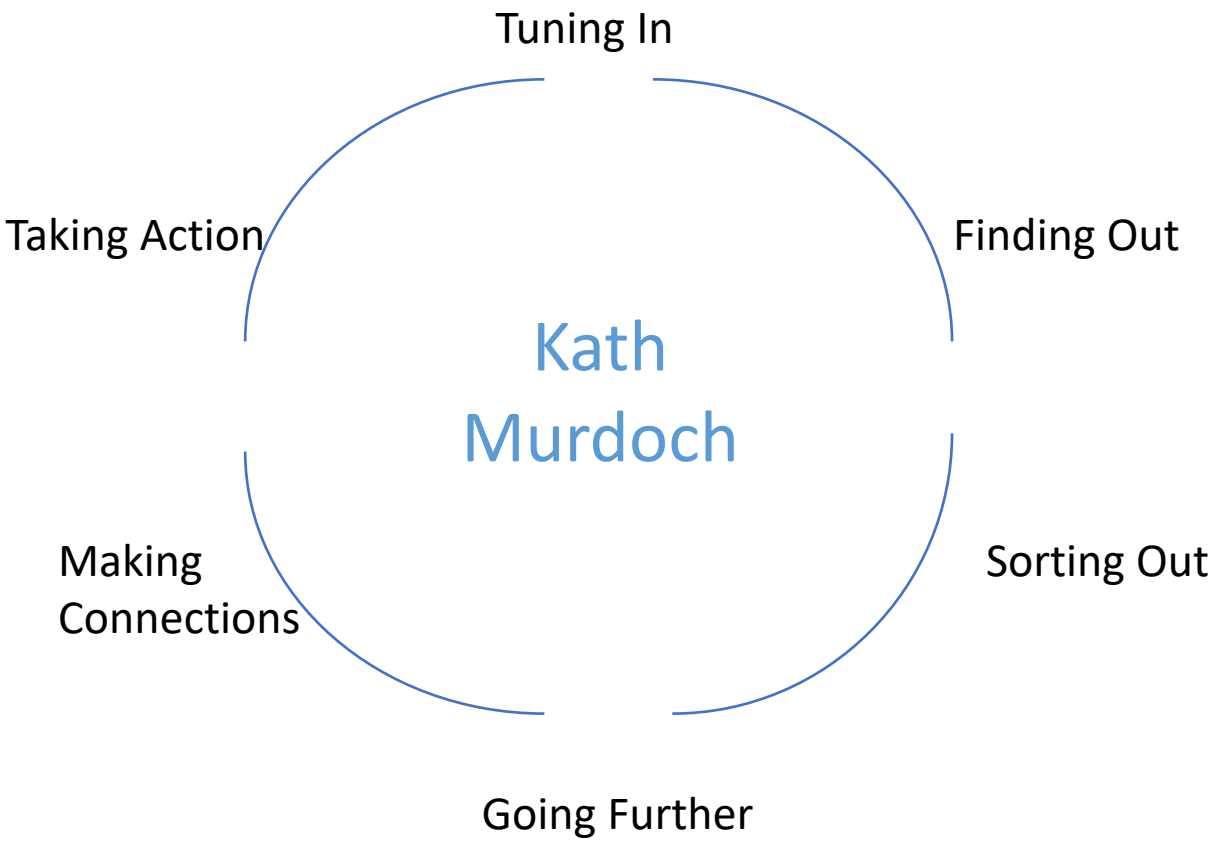
Launch: Warm up, Learning Focus, Introduction, Key Mathematical Language

Explore: Learning task, Enabling and Extending Prompts

Summarise: Supplementary Tasks, Possible Student Solutions



Blocks in my pocket

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I have some blocks in my pocket. I noticed that when I shared the blocks into two equal groups that there was one left over. When I shared them into three equal groups, there were two left over.

How many blocks might I have in my pocket?

Do the task. Record your working and your thinking as you go.

Dianne Siemon et al *Teaching Mathematics* 2015

Blocks in my pocket

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Enabling Prompt: –

- Have paper plates and small blocks or counters for students to use.
- Ensure the students understand the concepts of sharing and remainders. Ask a student to take a handful of blocks and share them evenly with a few friends. Discuss how the results may be recorded.
- Break the task into two smaller steps: sharing with 2 groups and then sharing with 3 groups.

Dianne Siemon et al *Teaching Mathematics* 2015

Blocks in my pocket

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Extending Prompt: –

- How many solutions are there? And How do you know?

Summary/Reflection

A conclusion should include

- Possible Student Solutions to the Learning Task
- A summary of the main points
- A final check for understanding
- A reminder of why the topic is important
- Where the topic leads to

Supplementary Tasks

Dianne Siemon et al *Teaching Mathematics* 2015

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How many blocks might I have in my pocket?

1. Now that you have worked on the task, consider how you might plan to use this in the classroom.

2. What introduction would you use to ensure students understand the task?

Dianne Siemon et al *Teaching Mathematics* 2015

Connection

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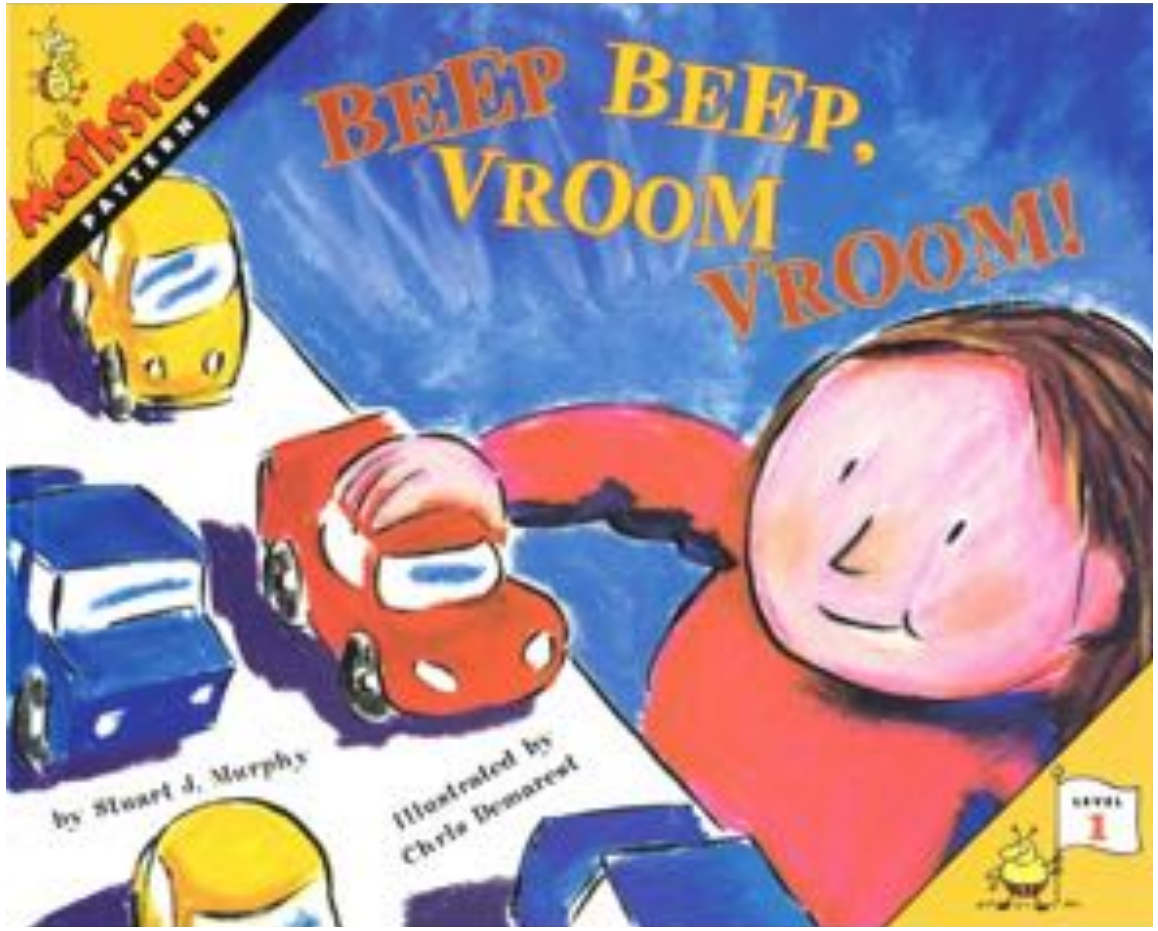
- Provocation
- Stories support the development of mathematical understanding through **emotional engagement**, promoting visualisation and mental imagery, and providing **shared context** for students (Averill, 2018).
- Example: *Beep, beep, vroom, vroom!*



Building from the known:

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I saw 10 some stripes on a dress, and I knew that it was a pattern.
Can you draw what the pattern might have looked like?

Differentiation:

Enabling Prompt: for those stuck in the ‘zone of confusion’

- What if there were two colours in the pattern?

Extending Prompt: For those who finish quickly

- What if there were 3 colours in the pattern?

Wondering Observing and Exploring

Action

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- Do what?
- What do we do with new understandings?
- What difference does it make to our broader understanding?
- What are our new questions?
- If action is not addressed, knowledge becomes siloed (is that a word?), artificial, school knowledge and not connected to the real world.

Reflection

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I USED TO THINK…, BUT NOW I THINK…

A routine for reflecting on how and why our thinking has changed

Use these sentence starters:

I used to think……

But now I think……..

Lastly, a reminder

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- Inquiry is not a set of instructional practices but a theoretical shift
- A stance of inquiry influences who learners become as human beings
- Inquiry transforms education from learning *about* to learning to *be* (Short 2009)