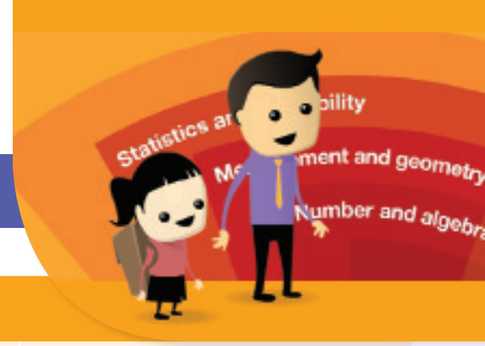
The BitL tool - mathematics years F-2



Fluency: Years F-2

What can you recall?

This is about remembering facts;

being able to name and identify numerals, simple shapes, symbols (such as +, -, =) recognising counting sequences, recognising Australian coins by value, being able to count forwards and backwards to 20/100/1000 (F/1/2) starting from any point; and being able to recall language related to time/duration (eg days of the week, months of the year, seasons).

Pedagogical questions:

- How could you record that mathematically?
- Can you remember the name of that… (shape/number)?
- What words could you use to describe… (the time, the month, the date, the amount of time)?
- What is the value of… (a calculation that you would expect automatic recall of, eg number pairs to 10, to 100 etc)?
- How many…?

Can you choose and use your mathematics flexibly?

This is about choosing and using an appropriate action or appropriate mathematical information and language.

Pedagogical questions:

- Choose a way to record that mathematically.
- Choose a way to (eg count/estimate/rename/measure/compare/order that).
- What mathematical words can you use to describe…?
- What would be an efficient way to...(count/add on/calculate/draw/record) that?

Examples

You have told me that there are twelve balls there. How could you record that?

Questions like this are intended to give students the opportunity to practise their fluency in recording numbers.

What is…? (single digit additions at appropriate level):
2 + 2 1 + 3 6 + 4 etc

Examples

Choose a way to arrange your counters, so that someone else can look at them and count them quickly/efficiently, or just see how many?

Notice that this fluency could have been developed as a result of students experiencing problem solving questions such as:
Are there ways of arranging collections of counters, that make it easier to see at a glance how many counters there are?

Choose a way to find out what day of the week it will be on the first of April this year.

Problem solving: Years F-2

Students benefit from working in a problem solving context in many aspects of the curriculum.

How can you interpret?

This is about creating meaning from the problem that has been presented. It is useful to have the students describe (in their own words) what they have been asked to do. Descriptions of the task could be oral or written, dependent on the students and the task.

Students should be encouraged to pose basic problems about their (immediate) world.

Pedagogical questions:

- What are you being asked to find out or show?
- What information is helpful?
- What information is not useful?

Closed questions can be useful to check if the student has accessed the information given in the question, for example

How many…?

How much…?

When…?

(These questions will vary depending on the context of the problem).

In what ways can you model and plan?

This is about describing a problem using mathematical concepts or language, then deciding what to do with that information.

Pedagogical questions:

- Do you have an idea?
- What could you try?
- Have you done a problem like this one before?
- How could you test your idea?
- How might you start?
- Can you represent the problem as a picture or by using equipment?
- Would (counting, a sum, a picture) help?
- Can you act it out?
- Can you represent the information using numbers and symbols?
- What questions could you ask (to find that out)?
- When we are being good problem solvers, what do we do to get started?
- Speak to someone who you think is being a good problem solver today. Ask them to show you what they are trying.

In what ways can you solve and check?

This is the mechanics of problem solving; the doing of calculations (the counting/adding/subtracting/sharing/grouping/building), and checking how appropriate the answer.

Pedagogical questions:

- How can you... (count that/add those numbers together/subtract that amount)?
- Does that seem right to you?
- How can you check your answer?
- Do other people think that too?

Reflect

Students need to reflect on how reasonable their answer is and also on the method that was used.

There are different ways to solve problems and different ways to explain your thinking. At every stage of development, students benefit from sharing and reflecting on the strategies and reasoning of others.

Pedagogical questions:

- If the sharing is happening part-way through the problem solving process:
  - Would you like to change your mind and try something different?
- If the sharing is happening at the end of the problem solving process:
  - Would you use a different strategy next time?
  - How efficient was this strategy?
  - Which was easiest for you to understand?
  - What did you like about…?
  - What would you do differently now?

Examples

Teachers: Use your creative story telling skills to embellish these facts:

Matt and Jane have just finished playing a game. The winner is the person who has the highest score. The score is determined by the value of the counters they have collected. There are three colours of counters, worth 2, 5 and 10. Give the characters Matt and Jane a selection of counters and ask, "Who won?".

Extension Question 1: Matt thinks his counters add up to 40 points. Is that possible? Prove it!

Extension Question 2: Jane collects 5 counters. What is the highest and lowest score that Jane could have? What is the second highest/lowest score that Jane could have?

This problem facilitates a composite class working on the same problem because it has multiple entry points. It is possible to be successful in finding a solution to this problem through using: a simple counting strategy; skip counting by 2, 5 and 10; and addition strategies or multiplicative thinking.

Are there ways of arranging collections of counters that make it easier to see (at a glance) how many counters are there?

This offers the opportunity to investigate part-part-whole and arrays.

Notice a similar question in understanding and fluency. The problem solving question gives the student the opportunity to establish the idea that arrangement does matter. The fluency question gives students the opportunity to show that they have used an appropriate strategy. The understandings question gives students the opportunity to show that they appreciate that there are different possible strategies that all lead to the same solution. Notice the similarity in this problem solving question from Foundation to year 10.

NB: Problem solving questions can be detailed, but they can also be very brief.

Cathy says that she can make 27 in lots of different ways using tens and ones. What do you think?

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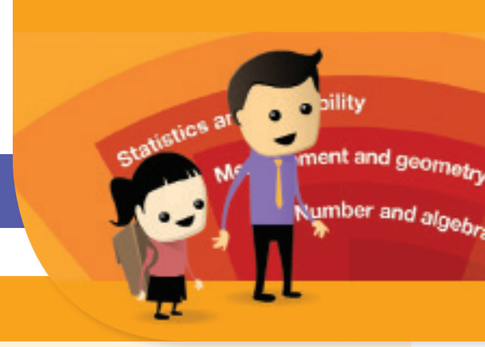

Understanding: Years F-2

What patterns/connections/ relationships can you see?

This is about noticing the characteristics of familiar shapes, objects, quantities and patterns that show similarity and difference, then using these characteristics to sort and order quantities, shapes and objects. It is about looking for patterns in everything- looking for patterns in number, in shape and in data.

Pedagogical questions:

- How are these... (values/number sentences/shapes) the same as each other?
- How are these... (values/number sentences/shapes) different to each other?
- What is the connection between…?
- Which is the odd one out?
- What if... (change something), is it still…?
- Which is greater/bigger/larger/taller?*
- Which is less/smaller/shorter?*

** Asking closed questions such as these can allow the teacher to see the connections that the student is/is not making, even if the student can't articulate the connections. These questions can help the teacher to identify the root of the misconception.*

Examples

Change the object or the physical arrangement, but keep the quantity the same (eg 5 marbles/5 basketballs) and vice versa. What's the same/different?

Use 10 flip tiles; 6 orange, 4 grey. What if... (turn an orange to grey) is it still 10?
When we ask this type of question, we need to observe if the student re calculates or if they build on their understanding.

Count 6 beads into a container. Shake and tip out, asking how many will there be now?

What if I rotate a square... (sides not horizontal and vertical). Is it still a square?
Establish that a square is still a square when it is rotated such that the sides are not horizontal and vertical. Collect photographs/images of squares and rectangles in your environment. Identify that when we see these shapes in our environment, most often sides are horizontal and vertical. Why is this? Can you find examples in your environment where the sides are not horizontal and vertical?

Can you answer backwards/ inverse questions?

This is about working flexibly with a concept.

Pedagogical questions:

- If the answer is… what might the question have been?
- What is missing... (in this number sentence/from this group/in this pattern)?

Examples

I'm thinking of an addition sum and the answer to my sum is 10. What might the questions have been?

I need 10 children to help me, but so far we only have 6. How many more volunteers do I need?

The answer is 'A SQUARE'. What might the question have been?
You could use puppets for this activity. eg Today Mr Maths (puppet) can only say 'A square'. What question can you ask him so that he can answer you?

Can you represent or calculate in different ways?

This is about representing amounts, patterns, shapes and data in different ways.

Pedagogical questions:

- What is another way...?
- What is another way to represent that?
- What is another way to work that out?
- What is another way to check that?

Examples

Is there more than one way to represent five?
Five can be represented as a name, numeral or a quantity, but other senses such as sound or touch could be drawn upon in experiencing or representing an amount.

Is there more than one way to count a large amount quickly/efficiently?
Notice a similar question in problem solving and fluency. The problem solving question gives the student the opportunity to establish the idea that arrangement does matter. The fluency question gives students the opportunity to show that they have an appropriate strategy. The understanding question gives students the opportunity to show that they appreciate that there are different possible strategies, that all lead to the same solution.

Rename 156.
156 can be made from 1 hundred, 5 tens and 6 ones OR 15 tens and 6 ones etc.

Reasoning: Years F-2

In what ways can you prove…?

This is about convincing yourself and others of your mathematical thinking. At this stage proof would involve using equipment, drawings and simple calculations.

It is important to evaluate different ways of proving the same idea and justify the choices that are made.

Pedagogical questions:

- Prove that…
- Convince me, yourself or someone who thinks differently…
- Try not to ask me IF you are correct, but instead try to tell when you KNOW that you are correct. Then share how you know that.
- What else could it be?

Examples

Prove that one ten and seventeen ones is worth the same as two tens and seven ones. Convince me/ convince yourself!

In what ways can you communicate?

This is about making thinking visible. At this stage of development it will often be achieved using simple mathematical language (spoken or written) and drawings.

It is important to evaluate different ways to communicate the same idea.

Pedagogical questions:

- How come…?
- Explain it/why? (To a peer)
- Can you show me how that works?
- Why did you choose to…?
- Why is it not… (followed by an incorrect name or process)?
- Why can't I… (followed by an incorrect name or process)?

Examples

Communication of mathematical ideas can be emphasised in any proficiency, with any content.

In what ways can your thinking be generalised?

This is very strongly connected to looking for patterns and relationships. This is about making statements that describe a pattern that always exists. At this stage general rules are most likely to be described verbally and in every day language.

Pedagogical questions:

- Why are these always the same/ different?
- Is there a rule that we could use to describe…?
- Is there a rule that always works?
- What makes these the same?

Examples

Sammy has found three ways to make 27 using tens and ones (MAB). Can you find these three ways? Will there always be three ways to make a number?
Of course, it's not the same for all numbers there are 4 ways for numbers in the 30's, 5 ways for numbers in the 40's etc
General rules may be about:
Patterns in number sequences, such as: "When you count by tens, the ones number always stays the same".
Expanding or repeating patterns, such as: "The next group always has one more bead than the group before".
Similarities in shapes, such as: "When you join the opposite corners of a square or a rectangle you always make triangles".

What can you infer?

This is about developing logical thought processes. These processes sometimes follow the structure: if…, then… This type of thinking helps to create new information from known information.

Logical thought can also be about working out a set of possibilities and narrowing them down as you get more information.

Pedagogical questions:

- Now that you know… can you work out…?
- I'm thinking of...(a number/a shape) and I'm going to give you some clues… Can you work out what my number/ shape is?
- I'm thinking of... (a number/a shape) and I'm going to give you some clues… Can you work out what the possible answers are?
- I'm thinking of... (a number/a shape). You can ask questions to help you to work out what it is, but I can only answer yes or no.
- You could use sentence structures such as:
  - If… then…
  - Because I know… I also know…

Examples

Following on from the understanding question:
Use 10 flip tiles; 6 orange, 4 grey. What if... (turn an orange to grey) is it still 10?
Now adding in the reasoning (communication) element:
Why is it still the same? How does that work?
Further reasoning (proof):
Prove that to me.
Further reasoning (generalising):
What if we start with 12 flip tiles; 6 orange, 6 grey? If we turn an orange tile over, we have 7 orange and 5 grey. Is it still 12? How is that like our last question? Why is it still the same? Will this work for any number of tiles?

I have some counters in this bag. If I tell you that there are between 10 and 18 counters -how many could it be? If I tell you that the counters can be made into two equal groups, what do you think now? (Alternatively you could say: I would say this number if I skip counted by two, starting at 10).

If I tell you that the counters could be made into groups of 4, what do you think now? Can you ask a question that would help you to decide how many counters there are in this bag? (You can't ask: "Is it 12").