



Inspiring Teaching: learning lessons from Maths and Science

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Fostering curiosity

The most exciting phrase to hear in science, the one that heralds new discoveries, is not Eureka!, but rather, “hmmm... that’s funny...”

Isaac Asimov

Summing consecutive numbers

Give me a whole number...

Pair products

Choose four consecutive whole numbers.

Multiply the first and last numbers together.

Multiply the middle pair together.

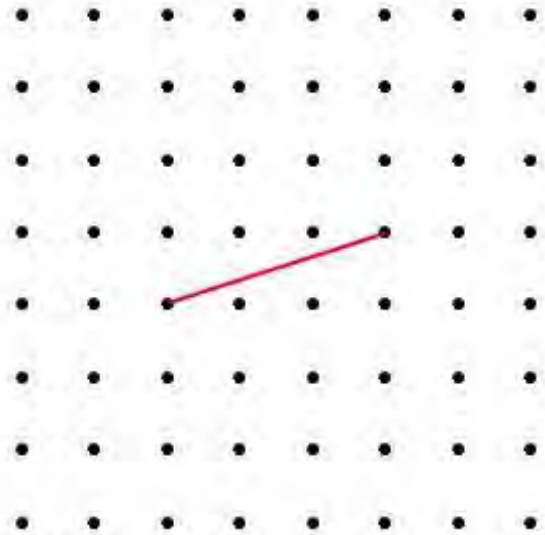


What do you notice?

Opposite vertices

If I give you a line, can you tell me straight away if that line could be:

- the side of a square?
- the diagonal of a square?



Who, what, when, where, why?

- ▶ Take it in turns to ask one of these w-questions about the object below.



What happens if you stand on your head?

- ▶ Decide in pairs or threes who you agree with, or suggest an alternative...

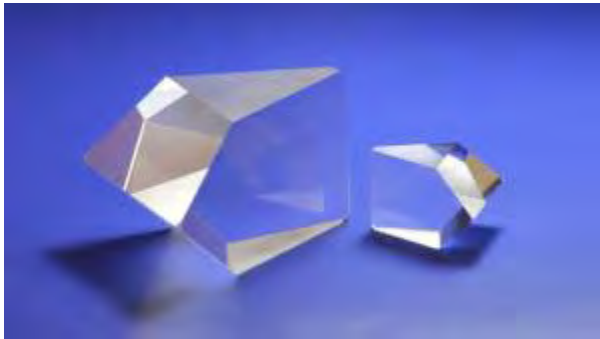
-“If you stand on your head your feet won’t get any blood

-“Your brain will get too much blood”

-“Your heart will need to pump harder”

-“It won’t make any difference to your heart or blood circulation”

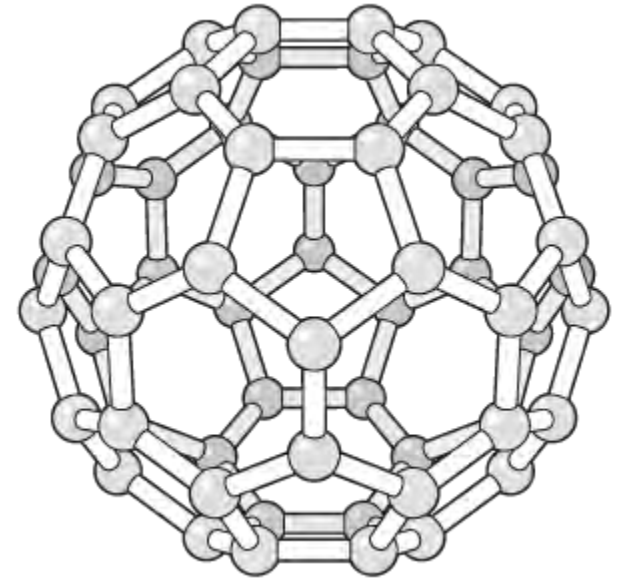
Mystery pictures



<http://www.cryslaser.com/Optical%20Element/453.htm>



http://en.wikipedia.org/wiki/Sociable_weaver



<http://ngm.nationalgeographic.com/2013/05/125-explore/super-materials>

Low threshold, high ceiling tasks

Teacher's role:

- To choose tasks that allow students to explore new areas of mathematics / science
- To give students the time and space to explore
- To bring students together to share ideas and understanding, and draw together key insights

Valuing Thinking

What learning behaviours do we value and how can we encourage them in our classrooms?

Higher Order Thinking





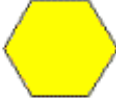











- working systematically
- looking for connections
- conjecturing
- explaining
- generalising
- justifying

What's it worth?

Each symbol has a numerical value.

The total for the symbols is written at the end of each row and column.

Can you find the missing total that should go where the question mark has been put?

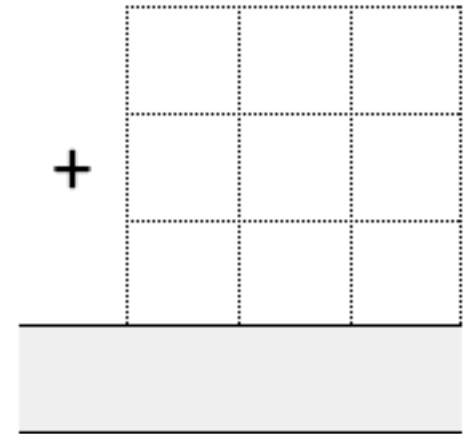
				28
				30
				18
				20
?	30	23	22	

Dicey operations

Find a partner and a dice.
Each of you draw an addition grid.

Take turns to throw the dice and
decide which of your cells to fill.

Throw the dice nine times each until all the cells are full.
Whoever has the sum closest to 1000 wins.



Summing consecutive numbers

Give me a whole number...

Use the table to decide if each statement at the bottom is definitely true, probably true or if it's impossible to say.

	Top of the heap	Middle of the pile	Bottom of the pile
Description	Peelings, bits of dead plant	Slimy and rotting plants and pieces of plant. Mushy	Looks like soil.
Temp?	23C	32C	27C
Wet or dry?	Dry	Wet	Wet
Worms present?	No	Yes	Yes

	Definitely	Probably	Can't tell
The compost heap is hottest in the middle			
You never get worms in the top part of the compost heap			
Moisture helps things rot			

What happens if it's missing?

Think of a bird of prey.

Make a list of its body parts (beak, legs etc.)

Next to each body part, write down what would happen if it was missing.

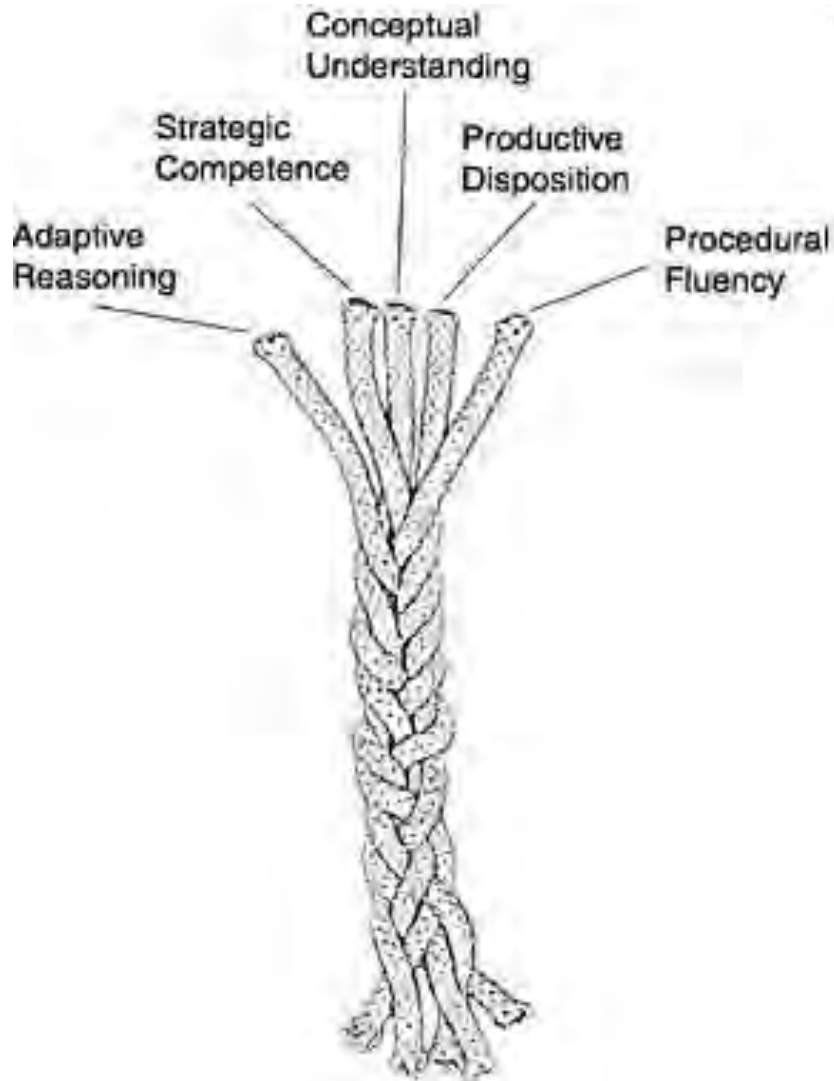
Some underlying principles

Teacher's role: move from presentation to exploration of students' ideas, involving them in the exploration.

Student's role: more active, realising that learning depends on readiness to express and discuss ideas, not on spotting right answers.

Teachers spend more effort framing questions to explore issues critical to development of students' understanding.

(Black & Wiliam, Inside the Black Box)



Five strands of mathematical proficiency

NRC (2001)

Adding it up: Helping children learn mathematics

Conceptual understanding -

comprehension of mathematical and scientific concepts, operations, processes, and relations

Procedural fluency -

skill in carrying out procedures flexibly, accurately, efficiently, and appropriately

Strategic competence -

ability to formulate, represent, and solve mathematical problems, and to plan and implement inquiry into scientific questions.

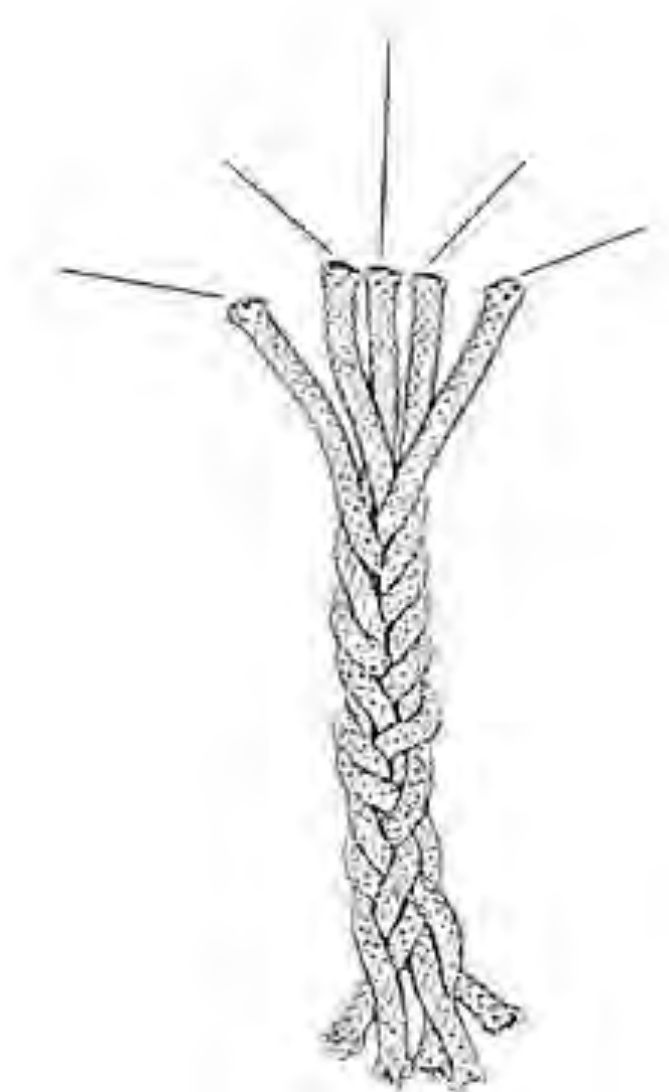
Adaptive reasoning -

capacity for logical thought, reflection, explanation, and justification

Productive disposition -

habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

Which are the five most important strands in your subject?



I don't expect, and I don't want, all children to find mathematics an engrossing study, or one that they want to devote themselves to either in school or in their lives. Only a few will find mathematics seductive enough to sustain a long term engagement. But I would hope that all children could experience at a few moments in their careers ... the power and excitement of mathematics ... so that at the end of their formal education they at least know what it is like and whether it is an activity that has a place in their future.

David Wheeler

... a teacher of mathematics has a great opportunity. If he fills his allotted time with drilling his students in routine operations he kills their interest, hampers their intellectual development, and misuses his opportunity. But if he challenges the curiosity of his students by setting them problems proportionate to their knowledge, and helps them to solve their problems with stimulating questions, he may give them a taste for, and some means of, independent thinking.

Polya, G. (1945) How to Solve it