Visualisation in the learning of Mathematics

Pauline Carter
Project Officer Thinking Maths

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS

VISUALISATION IS ……

STUDENTS NEED VISUALISATION IN MATHEMATICS WHEN ……

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS

Research says:

Neuroscience:
When we work on mathematics, brain activity is distrib
many different networks, which include **two visual path**

Jo Boaler and colleagues:
When students learn through visual approaches, mathematics change
for them, and they are given access to deep and new understandings
(Boaler, Chen, Williams & Cordero, 2016).

Historically, based on words and numbers, new knowledge of the world is based largely on images, that are 'rich in content and information'
(West, 2004).

Mathematical thinking is grounded in visual processing

Government of South Australia
Department for Education
[THINKING] MATHS SENIOR YEARS

Visuals… Manipulatives… Motion

These approaches support our most disadvantaged and disengaged learners in mathematics.

- Read the article *Seeing is Understanding*: *The Importance of Visual Mathematics for our Brain and Learning* (Boaler et al, 2016).
- Use visuals and manipulatives to stimulate thinking, discussion and estimation.
- Plan to include movement, experimentation, physical models and images in learning experiences and the work students produce
- Use number lines to represent and manipulate number quantities visually

Government of South Australia
Department for Education
[THINKING] MATHS SENIOR YEARS

Grapes of Maths – Greg Tang

While scallops on the beach look great,
I'd rather see them on my plate.
Unfortunately it's their loss,
They swim their best in butter sauce!

How many scallops in this bunch?
Count them quick, it's time for lunch.
Find a group that does repeat,
Add them up and we can eat!

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS

Kids can't do word problems

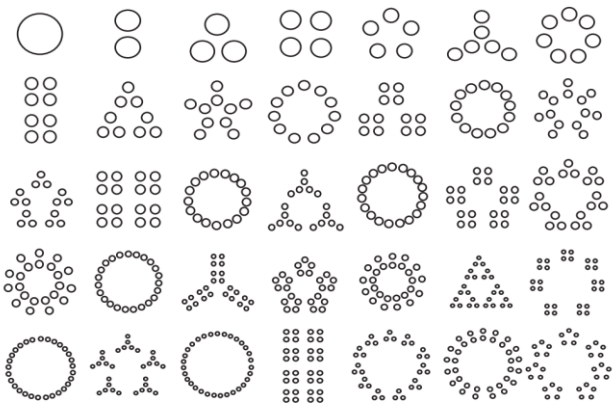
Two different candles are lit. They burn at different rates and one is 3 cm longer than the other.
The longer one was lit at 5.30 pm and the shorter one at 7 pm.
At 9.30 pm they were both the same length.
The longer one, burned out at 11.30 pm and the shorter one burned out at 11 pm.
How long was each candle originally?

Visualise the problem
Visualisation in mathematics allows students to step into a problem, to model, and to plan ahead 'what will happen if? '.
Interrogate the context, visualising a video or a comic strip representation of stages of any action, if relevant.
Secondary Numeracy Guide book INSPIRE

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS

What do you notice?



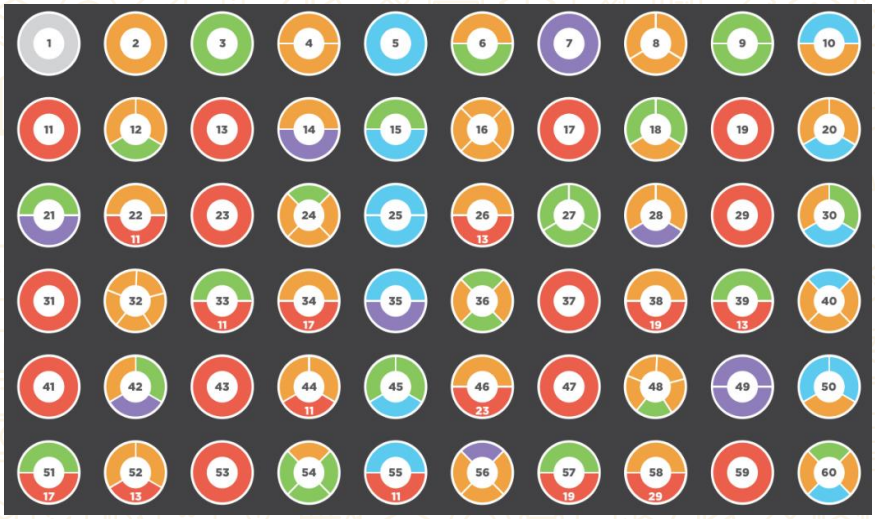
What might the next image be?

Use colour to show your pattern

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS

What do you notice?



How can we support students to develop their visualisation?

- Value multiple representations eg pictures, models, graphs, even doodles (Vi Hart)
- finger representations - to all levels of mathematics
- number line representation of number quantity is a precursor of children's academic success
- introduce mathematical ideas visually, support students to visuals to think and make sense of mathematics
- ask them to draw what they see, give activities with visual questions , ask them to provide visual solutions

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS

1, 4, 9, 16, 25, ……

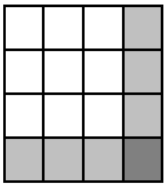
What do you notice?

Use the flip tiles to explain …

- **why the difference between consecutive perfect squares is always an odd number**
- **Why $n^2 - 1 = (n - 1) \times (n + 1)$**
- **To get every second square number you just add 4 times the original number plus 4 e.g. $3^2 + 4 \times 3 + 4 = 5^2$**

Government of South Australia
Department for Education

[THINKING] MATHS SENIOR YEARS



For a 3x3 square, 3 units are added to the side and the bottom and one for the corner and this made a 4x4.

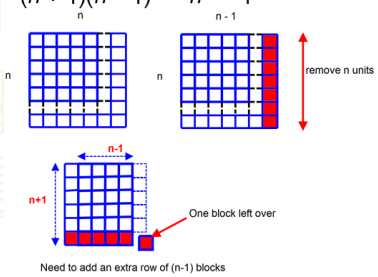
$3^2 + (2 \times 3 + 1) = 16 = 4^2$

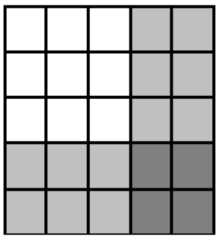
In the general case:

For a n x n square, n units are added to the side and the bottom and one for the corner and this made a (n+1) x (n+1).

$n^2 + (2 \times n + 1) = (n+1)^2$

$(n + 1)(n - 1) = n^2 - 1$





$3^2 + 4 \times 3 + 4 = 5^2$