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## Mathematics for elementary students: Engaging ALL learners

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**In this workshop we will:**

1. Be introduced to the Framework for Engagement with Mathematics (FEM);
2. Engage with a range of high quality mathematics activities that integrate the elements of the FEM;
3. Reflect together on how the tasks can be differentiated;
4. Explore how the subtleties in the ways in which the tasks are administered;
5. Discuss how the activities can be used to gather formative assessment data; and
6. Reflect on how the content and theory presented in this session can/will be applied in participants' own classrooms.

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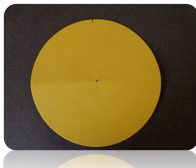
### The Circle

The diagram shows a circle with several labeled parts:
 

- Radius:** A line segment from the center to the circumference.
- Circumference:** The outer boundary of the circle.
- Diameter:** A line segment passing through the center from one side of the circumference to the other.
- Chord:** A line segment connecting two points on the circumference.
- Tangent:** A line that touches the circle at exactly one point.

## Circle Geometry

1. Fold the circle in half. *What is the creased line called?*
2. Fold the circle in half again to find the centre of the circle. *What is the distance from the centre to the circle's circumference called?*
3. Mark a point on the circumference of the circle.



4. Fold the point to the centre of the circle.



*What is the crease called?  
What is this new part of the circle called?  
What is the part of the circumference called?*

5. Fold again to the centre, using one endpoint of the chord as an endpoint for the new chord.



*Are the two chords equal? How can you tell?*

6. Fold the remaining arc to the centre.



*What type of triangle is formed? How do you know?  
How many axes of symmetry does this triangle have?  
Does it have rotational symmetry? To what order?*

7. Find the midpoint of one of the sides of your triangle. Fold the opposite vertex to the midpoint.



*What shape is formed?*

*What is the relationship between the parallel sides?  
How do you know?*

*How many congruent equilateral triangles make up the trapezoid?*

8. Fold one vertex onto its diagonally opposite vertex.



*What shape is formed?*

*How many times larger was the original equilateral triangle?*

*What is the relationship between the initial and final perimeters?*

*What is the relationship between the initial and final areas?*

9. Open up the triangles to form a three-dimensional object



*What would you call this polyhedron?*

*How many faces does it have?*

*How many vertices and how many edges?*

10. Return to the original equilateral triangle and make a regular hexagon.



*Does this shape tessellate?*

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Was the circle task engaging?  
Why/why not?

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What do we really mean when we talk about  
student 'engagement'?

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*"The first job of a teacher is to make  
the student fall in love with the  
subject. That doesn't have to be done  
by waving your arms and prancing  
around the classroom; there's all sorts  
of ways to go at it, but no matter  
what, you are a symbol of the subject  
in the students' minds" (Teller, 2016).*

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Defining engagement

Reflectively involved in deep  
understanding of mathematical  
concepts and applications, and  
expertise

Genuinely valuing –  
this learning will be  
useful to me in my life  
outside the classroom

Cognitive

Operative

Affective

Actively participating -  
group discussions,  
practical, relevant  
activities and homework  
tasks

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## Foundations for Engagement with Mathematics

Positive pedagogical relationships

- Awareness of individual student backgrounds, needs & preferences
- Continuous interaction
- Teacher enthusiasm & PCK
- Constructive & timely feedback

Engaging Pedagogies

- Substantive conversation about mathematics
- Relevance
- Success
- Challenging
- Choice/variety
- Student-centered technology

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## Influences on Student Engagement

The Teacher

Pedagogical Repertoires

Pedagogical Content Knowledge

Peers

Social Interaction

Curriculum

Family

'New Times'

Transition

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## Domino Dilemmas

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## Add to Twenty

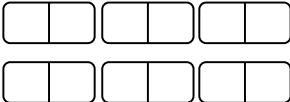
- Find pairs of dominoes that add to make 20. (They don't have to join)
  - How many different pairs can you find?
  - How will you know when you have found them all?
- Can you find two dominoes that add to 15? How many combinations?
- What is the largest number of dominoes that may be joined to make 20?
  - Investigate pairs of dominoes that make different numbers.

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# Spotty problems

Six dominoes are laid out in two rows



Place six dominoes in this pattern so that:  
the number of spots is the same in the two rows, and  
the number of spots is the same where the dominoes touch (the spots have to match)

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# AMY'S DOMINOES

Amy has a box containing ordinary domino pieces but she doesn't think it's a complete set.

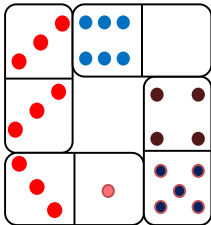
She has 24 dominoes in her box and there are 125 spots on them altogether.

Which of her domino pieces are missing?



# Domino Windows

The spots on each side of this domino window all add up to 9.  
Can you make any more domino windows so that all sides add up to the same number? How many are there? What is the smallest/biggest side sum possible?



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# 20 cubes

Using twenty cubes, make four piles so that:

- the first pile contains four more cubes than the second pile;
- the second pile contains one cube less than the third pile; and
- the fourth pile contains twice as many cubes as the second pile.




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20 Cubes

Rearrange the 20 cubes into four different piles.

Write a new problem for another group to solve.



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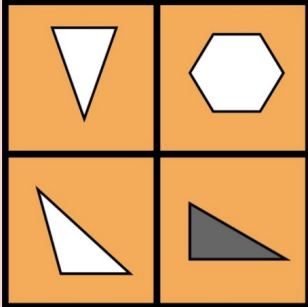
Reflection on 20 Cubes

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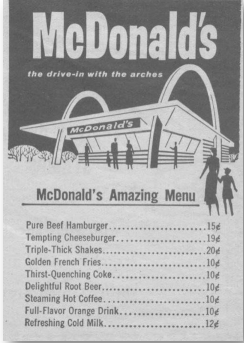
How were these tasks engaging, and how does the Framework for Engagement with Mathematics link to the content and processes of mathematics?

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Promoting substantive conversation



Which one doesn't belong?



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Use mathematics to:


- Investigate how prices have changed over time (comparing similar items)
- Explore the popularity of McDonald's food compared to other fast food options
- Analyse the nutritional value of a McDonald's meal compared to a typical home cooked meal
- Consider the cost of a McDonald's meal for your family, compared to your favourite home cooked meal
- Analyse the financial cost of eating takeaway compared to cooking the same food at home

Is this an appropriately sized budget tin for 2018?

If you save all your allowance, how much would you have at the end of the year? What could you buy?

Design and make an improved budget tin

Investigate the price of your wants & needs, then plan a monthly budget





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How much do my school lunches cost every week/month/year?

Investigate the cost of living for a child in a third world country

Investigate how the cost of living has changed since the 1970s

**Budgeting in the 1970s**



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Order the scores within your group from lowest to highest

Use a numeral expander to write out your score

Represent your score with base 10 material

Write out your score in words

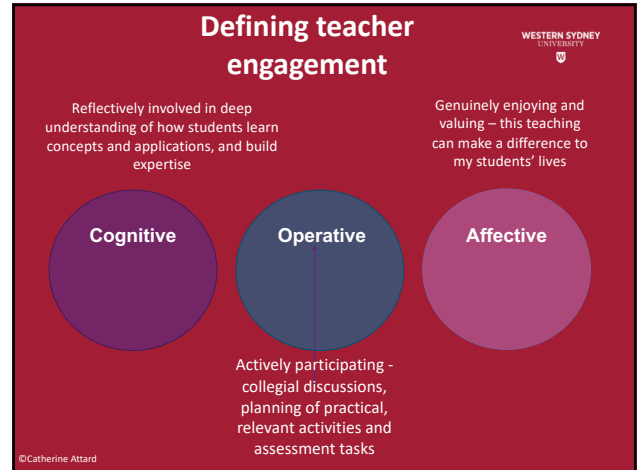
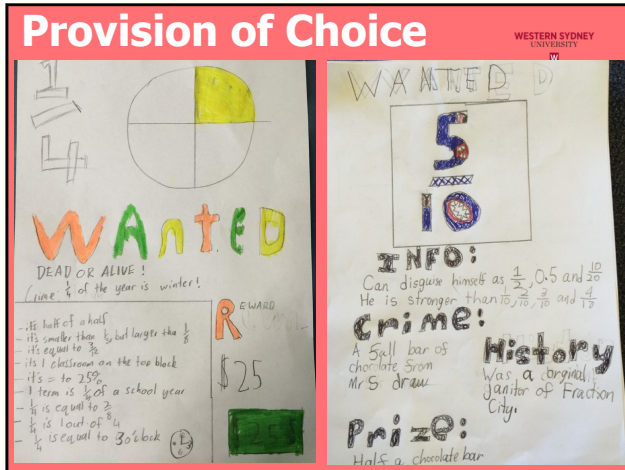
Write out your score using expanded notation

Calculate your group's mean score

Add the total scores in your group

Round your score to the nearest ten/hundred/thousand

Is your score an even number or an odd number?



## And some things to reflect on.....

- Could you adopt the Framework for Engagement with Mathematics (FEM) as a lens through which you view your own teaching and learning practices?
- How can you adapt your practices to ensure they are engaging for your students?
- How could you improve your own engagement with the teaching of mathematics?

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