Problem solving and growth mindset
Aims of the session

- To see the importance of mathematics and problem-solving beyond the classroom
- To understand the benefits of a growth mindset approach
How do you feel about mathematics?
How do you feel about mathematics?

- Mathematics is often a really emotive subject; it is very linked to confidence!
- From their own experiences of school mathematics, people often think that it is a set of rules that you either ‘get’ or ‘don’t get’
- There is a often a belief that people are either born with a gift for mathematics (a ‘maths gene’) or they are born set to always struggle with mathematics
Developing and embedding mathematical skills

- Actually, mathematics is for everyone
- We use mathematical skills all the time in life – planning, managing, strategy, analysing, solving problems, being resilient
- Lots of people enjoy doing puzzles like Suduko or playing games like chess
- We feel that mathematics isn’t about learning and applying rules; it is about understanding structures and creatively approaching problems
What do you need to become a great mathematician?

- Confidence
- Resilience
- Creativity
- A love of learning
Mathematically resilient learners ... 

- are willing to seek help
- know how to ask questions
- see asking as clever and understand that persistent asking allows them to become even more clever
- take responsibility for their own understanding
- actively seek understanding
- know how to get help
- know it is good to help others
- know they have the right to understand
- know that learning mathematics may involve struggle
- refuse to feel mathematically stupid
- refuse to feel mathematically isolated and are willing to share their energies
- feel part of a mathematical community
- refuse to just accept
Therefore to develop mathematical resilience learners must:

- be encouraged to talk about mathematics and have the skills to do so;
- be given opportunities that ask for thinking and reasoning and exploring mathematical concepts;
- consolidate ideas and develop fluency through meaningful practice;
- develop a growth mindset and lose the fixed mindset;
- collaborate when learning;
- have choice, independence and the opportunity to experiment, make mistakes and grow as a mathematician.
Kookens’s questionnaire

Janice Kookens’s questionnaire and extensive survey confirms and allows the measurement of three affective dimensions when studying mathematics: value, struggle and growth

1. **Value**: the belief that mathematics is a valuable subject and is worth studying,

2. **Struggle**: the recognition that struggle with mathematics is universal even with people who have a high level of mathematical skill,

3. **Growth**: the confidence that all people can develop mathematical skill and the belief that everyone can learn more mathematics with effort and support.
Recently, there has been a lot of national research into ‘mastery’ and the success of this approach in other countries.

The essential idea behind ‘mastery’ is that all children need a deep understanding of the mathematics they are learning.
1. A mastery approach; a set of principles and beliefs. This includes a belief that all pupils are capable of understanding and doing mathematics, given sufficient time. Pupils are neither ‘born with the maths gene’ nor ‘just no good at maths.’ With good teaching, appropriate resources, effort and a ‘can do’ attitude all children can achieve in and enjoy mathematics.
2. A mastery curriculum.

One set of mathematical concepts and big ideas for all. All pupils need access to these concepts and ideas and to the rich connections between them. There is no such thing as ‘special needs mathematics’ or ‘gifted and talented mathematics’. Mathematics is mathematics and the key ideas and building blocks are important for everyone.
3. Teaching for mastery.
A set of pedagogic practices that keep the class working together on the same topic, whilst at the same time addressing the need for all pupils to master the curriculum. Challenge is provided through depth rather than acceleration into new content. More time is spent on teaching topics to allow for the development of depth. Carefully crafted lesson design provides a scaffolded, conceptual journey through the mathematics, engaging pupils in reasoning and the development of mathematical thinking.
4. Achieving mastery of particular topics and areas of mathematics.

Mastery is not just being able to memorise key facts and procedures and answer test questions accurately and quickly. It involves knowing ‘why’ as well as knowing ‘that’ and knowing ‘how.’ It means being able to use one’s knowledge appropriately, flexibly and creatively and to apply it in new and unfamiliar situations.
Growth Mindset

- Ability is not fixed, but we can build our abilities
- Focus on the importance of learning and the process – effort is the way to grow
- Understanding that setbacks are a part of growth
- Research shows that students with a growth mindset progress better over time than those with a fixed mindset (even students who have a fixed mindset and believe that they have high ability)
Mixed ability groupings

All children should be taught in mixed-ability classes to boost standards and self-esteem among all students, according to a report carried out by Teach First. Researchers said that:

• Setting pupils was often done purely for the “benefit of teachers”.

• “Mixed-ability classes have a positive effect on the attitudes and self-esteem of all pupils regardless of their ability level, whereas pupil allocation has been shown to reinforce divisions along lines of class, gender, and race, and in any case appears to affect high-ability students less than their low-ability peers.”

• Researchers suggested the importance of “redistributing skills and abilities” and pairing high-performing pupils with those struggling in class.

(Research carried out by Teach First in Nov 2009)
Mixed ability groupings

To a large extent, the set a pupil is placed in determines the mathematics he/she will encounter and potentially caps what he/she might attain. Too many pupils who have a poor start or fall behind early in their mathematics education never catch up. The 10% who do not reach the expected standard at age 7 doubles to 20% by age 11, and nearly doubles again by 16.

Mathematics: made to measure
22 May 2012 Ofsted
Ref: 110159
Mixed ability groupings

- Pupils with a growth mindset will embrace challenge, persist longer and not regard the fact that at times they find Maths difficult, as an indication that Maths is just 'not their thing.'

- Mixed ability teaching embraces and supports the concept of growth mindset whereas 'setting by ability / attainment' places a ceiling on learning for many pupils and can undermine pupil 'confidence and discourage the belief that attainment can be improved through effort.' (The Sutton Trust EEF Teaching and Learning Toolkit Summer 2013.)
Mixed ability groupings

Pupils and teachers valuing progress over attainment.

Pupils confident to ask clarifying questions, make conjectures and receive feedback from their peers.

Pupils have the power to surprise us and themselves with what they can achieve.

Pupils helping each other and actively involved in the learning process.

Pupils making suggestions about their learning.

We will see....

Pupils taking responsibility for their own actions and their own learning.

Assessment and feedback should be formative to enable progression.

Pupils aware of how to progress.

We believe....

Pupils should have high aspirations.

All pupils have potential.

Grouping pupils by ability can limit their learning experiences.

Good teacher/pupil relationships.

‘The Aim – Promoting a growth mindset through mixed ability teaching.’

Pupils can learn from one another.

Pupils need to ‘see’ progress.

Empowering pupils to make decisions about how much challenge they can attempt helps them to make progress.

Less reliance on the teacher, more independent learning.

Resilience.

Engagement.

Enthusiasm.
Why is growth mindset in mathematics more important now than ever before?

- The new national mathematics GCSE (that will be taken by years 10 and below) has been designed to be more challenging.

- The questions assess problem-solving skills and resilience. They are deliberately designed so that they will not be straightforward for any child.
What can you do to support your child to enjoy and develop mathematical skills?

- Don’t speak negatively about your own experiences of mathematics at home, try to speak positively about mathematics

- Enjoy doing mathematics together at home

- Promote a growth mindset and focus on the right things – praise the process rather than talent
Questions to extend children’s thinking

“Can you tell me what to do in your own words?
How are we going to do this?
What information do we have? What do we need to find out or do?
What do we need?
How are we going to record what we are doing?
How are we going to start?
Could there be a simpler way to do this?
What do you mean by...?
What do you notice when...
Have we thought of all the possibilities?
Is there something that we already know that might help?
Would a picture/table/graph/diagram/photo help?
Would any equipment or counters help?
Why not make a guess and see if it works?
How did you get that answer?
What could you try next?
How could we check this is correct?
What if...
What do we do if we get stuck? Is it a reasonable result?
What have we learned or found out?
If you were doing it again, what would you do differently?
Did we learn any new words today?
What skills have we used?
What else could we do with this activity? How could we make it a bit more challenging?
How can we show the rest of the class what we have done?

Comments to encourage children

“
I’m enjoying this!
I’d like to.../My idea is...
I’m going to do this differently to you so we can compare.
That’s a really good idea.

Sometimes things are hard, but you learn a lot more when something is tricky than when it’s easy.

Let’s have fun! Let’s challenge Mum... Dad... Granny... Uncle... You’re doing so well because you’ve worked so hard!
I like the way you thought about that.
This will be useful in real life because...
People in work use this skill when they...
I like the way you kept at it and didn’t give up!
Celebrate struggle
Solve some problems together
www.nrich.maths.org

14 Divisors

Stage: 3 ★ ★

The list below shows the first ten numbers together with their divisors (factors):

1. 1
2. 1, 2
3. 1, 3
4. 1, 2, 4
5. 1, 5
6. 1, 2, 3, 6
7. 1, 7
8. 1, 2, 4, 8
9. 1, 3, 9
10. 1, 2, 5, 10

What is the smallest number with exactly twelve divisors?

What is the smallest number with exactly fourteen divisors?
Use images and multiple representations

3 \times 4

\frac{24}{3:5}

6 + 11

3x + 5 = 23
\Rightarrow x = 6

3 \times 4

24 in the ratio 3:5

6 + 11

3x + 5 = 23
\Rightarrow x = 6
Society of Young Mathematicians

Members will receive the following every term (3 times a year), delivered direct to their homes:

- **Mathematical Pie** - an eight-page A5 magazine aimed at pupils from 10 to 14 years of age (but is read by people of all ages) which contains interesting maths problems, puzzles and activities. The questions vary in their difficulty so that there are suitable starting points for all ages.

- **SYMmetryplus** - The SYMS sixteen-page A4 newsletter, aimed at all ages but particularly those aged 10 to 18 contains short articles, news, things to do, calculator hints, book reviews, games, puzzles and competitions.

- There is a small charge of £9.99 per year. Please complete the **SYMS - Application Form** and return to the Mathematical Association or you can complete via the website [http://www.m-a.org.uk/SYMS](http://www.m-a.org.uk/SYMS) if you are interested.
Encourage your child to try puzzles for fun!
Chess club runs every Thursday after school in OG5
Interested in finding out more?

- [https://www.youtube.com/watch?v=pN34FNbOKXc](https://www.youtube.com/watch?v=pN34FNbOKXc)
- [https://www.youtube.com/watch?feature=player_detailpage&v=njae5qGhxEw](https://www.youtube.com/watch?feature=player_detailpage&v=njae5qGhxEw)