

Mathematics

Dyslexia and Dyscalculia

Why do some dyslexics struggle with math?

Mathematics is often a problem for students with dyslexia. 50-60% of dyslexics do have difficulties with maths. Children may excel in some area of mathematics especially where thinking skills or visualisation skills are needed but paradoxically they may struggle in basic areas especially when memorisation is required.

"Dyscalculia is a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence. Dyscalculia and dyslexia occur both independently of each other and together. The strategies for dealing with dyscalculia will be fundamentally the same whether or not the learner is also dyslexic."

<http://www.bdadyslexia.org.uk/about-dyslexia/schools-colleges-and-universities/dyscalculia.html>

"There are a number of factors which can affect the learning of maths. (Chinn and Ashcroft, 1998, Mahon et al 1999) These may occur in isolation or may interact to create a potential learning difficulty. With appropriate help most of the difficulties associated with these factors can be alleviated or circumvented." Steve Chinn

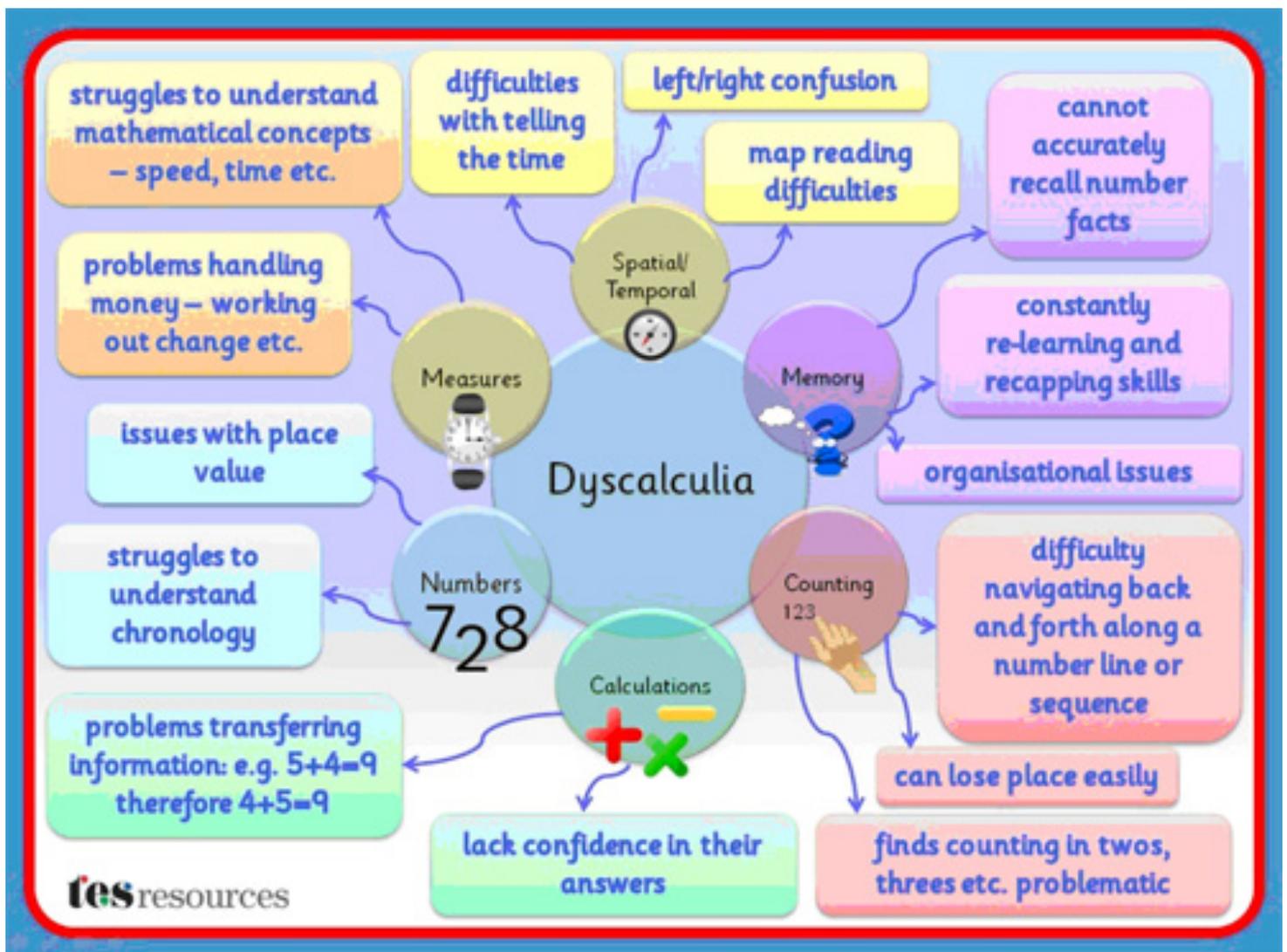
Professor Tim Miles

•'If there is bad practice it seems likely that intelligent non-dyslexics may in many cases survive it without any major disaster, whereas its effect, even on the most intelligent dyslexics is likely to be catastrophic.'
'Dyslexia and Mathematics' Miles T and Miles E (1992)

Beliefs, anxiety and avoiding failure in mathematics.
Steve Chinn, "Beliefs, Anxiety, and Avoiding Failure in Mathematics," *Child Development Research*, vol. 2012, Article ID 396071, 8 pages, 2012.
 doi:10.1155/2012/396071.

Some of the demands of mathematics that contribute to a sense of failure, anxiety and helplessness are based on beliefs, rather than academic necessity. These beliefs also have an effect on the way mathematics is taught with a focus on the curriculum whilst overlooking the characteristics of the learners.

Finally, a 12 year old student summed up his experiences of mathematics teaching as, 'All I hear is talking, talking. It's a river.' Perhaps it is time to challenge some of the mathematics beliefs that have a profound influence on the way the subject is perceived



Areas of weakness and difficulties	Affect on mathematics	Strategies and adjustments to learning
Working memory, Long term memory and sequencing	<ul style="list-style-type: none"> - Difficulty learning and recalling number facts, formulae and vocabulary. - Forgets explanations. - Forgets equipment - Forgets processes - Loses place in a multi step problem. - Fails to follow sequence of instructions - Has difficult with maths mentals - difficulty organising - Unlikely to retain by rote learning 	<ul style="list-style-type: none"> - allow manipulatives and memory aides - use maths dictionaries - Provide model answers - Break into steps - Allow students to develop own processes - spare equipment - use portable strategies like counting with fingers and using the ruler as a number line. - Use memory strategies - Reduce the need for memorisation. - Present concrete examples - Provide scrap paper for working - Allow mastery before moving on to next concept
Motor skills and visual issues.	<ul style="list-style-type: none"> - poor written presentation -difficulty with diagrams and graphs - problem with distinguishing between symbols, and /or the layout of the work on the page 	<ul style="list-style-type: none"> -provide graph paper and guidelines - work in groups - Allow use assistive technology - Scribe - Provide clear and well set out texts and worksheets
Language	<ul style="list-style-type: none"> - Confuses maths language - Cannot connect the subject specific vocabulary to concept. - Difficulty with word problems - Substitutes and transposes letters, numbers, signs and symbols. - Loses place when reading - Difficulty reading information from tables and graphs - Difficulty copying 	<ul style="list-style-type: none"> - Use memory cards with the vocabulary or maths dictionary - Provide a glossary of terms or maths dictionary - Enlarge graphs, tables and drawings. - Use coloured paper - read questions for the student. - Highlight maths signs - Need to understand meanings as relevant to mathematics.
Processing speed	<ul style="list-style-type: none"> - Increases anxiety - Decreases accuracy - slow to complete work - Loses place - Difficulty with problem solving. 	<ul style="list-style-type: none"> - extra time - Expect less work - Focus on accuracy and understanding not amount

Anxiety	<ul style="list-style-type: none"> - decreases working memory - Decreases processing speed 	<ul style="list-style-type: none"> - allow mastery before moving on - Motivation - Encouragement and positive reinforcement - Enable success through appropriate level of questions - Fun and games - Reduce stressors such as timed tasks
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General principles

- Allow enough time for pupils to master a basic concept before moving on.
- Include lots of revision
- Use manipulatives to give a concrete and visual basis of concepts. Students must be able to explore concepts with manipulatives to enable an adequate understanding. This is essential for any concept at any age. Manipulatives should not be just used for teacher examples.
- Work throughout the concept or maths problems with manipulatives before writing answers or progressing to written problems. Do not insist everything is written. Practical and concrete experience with manipulatives should come first.
- Concepts need to be broken down as much as possible into explicit steps.
- Playing mathematical games are an essential part of learning
- Students should be allowed to come up with their own strategy or memory aid.
- Give examples and use maths in real situations.
- Concepts should be taught using a number of activities so students are able to explore concepts.
- Allow students enough time to complete tasks. Time constraints for dyslexics produce stress as it is common for them to have processing difficulties.
- Minimise the need for wrote learning if facts as dyslexics often have memory problems. Instead focus on understanding of concepts.
- Maths games are really important.
- Make math active and fun.
- Allow mastery to foster a positive attitude towards math.
- It is essential that students are given the opportunity to understand mathematical concepts. dyslexic and dyscalculia learners gain most from understanding of concepts and find it very difficult to wrote learn concepts that they do not understand!
- **"For visual and kinaesthetic thinkers they must understand the mathematics that they are taught. Otherwise they may learn ... but they will forget." Steve Chinn**

Ideas for home

Simple everyday things can have an enormous impact. Try to incorporate math into daily living.

- Give your child pocket money.
- Use play or real money to play shops, restaurants, movies theatres.
- Use any sort of counters to illustrate concepts. Coloured paddle pop sticks, plastic pirate coins or any cheap bulk item.
- Cook with your child to illustrate measurement concepts.
- Solve real life problems with money, measurement and time.
- Help a child learn to read a map and calculate distances when you take trips by car.
- Use weekend sale fliers, catalogs or on line advertisements

Multisensory

- A multisensory approach helps to exercise a dyslexic student's weak areas such as auditory processing whilst utilising their strengths in visual processing and kinaesthetics.
- A multisensory approach has the added benefit of appealing to all learning styles so no one student is disadvantaged.
- These activities are also generally a lot of fun!
- Some of these activities are aimed at the classroom whilst some are better suited for reinforcement of spelling at home. Some activities can be varied to work equally as well at home as in the classroom.

We remember

20% of what is said

30% of what we hear 40% of what we see

50% of what we say 60% of what we do

90% of what we see, hear, say and do

- The aim is multisensory for every activity.
- Multisensory learning happens when more than one sense is used to acquire and retain information. Learning is typically categorized into three modes or types: **auditory, visual, and kinaesthetic.**
- **Auditory learners** acquire information best when it is presented verbally- by listening.
- **Visual learners** acquire information best when it is presented visually- by seeing..

- **Kinaesthetic learners** acquire information best when it is presented in a way that can be touched and experienced- hands-on. They succeed best by participating in field trips, science labs, using manipulatives (blocks, felt, props), and by being actively involved in some type of activity.

Maths activities

These activities are designed as examples of activities that work well for dyslexic and dyscalculia students. They should be used as a sample guide of ideas. See references for suitable books and links are included for a wider range of activities.

Maths dictionaries and textbooks

Maths dictionaries can help with the vocabulary of mathematics. Aim for one that is very visual such as the Targeting Maths dictionary. Textbooks need to be clear, colourful and well set out. Good texts for NSW syllabus are the targeting maths textbooks. Photocopies of maths texts that have been reduced to fit 2 pages on one are not adequate as text becomes too crowded and small.

Manipulatives

Maths manipulatives such as Cuisenaire rods are essential for building up a foundation of numeracy. Children need a solid numeracy foundation. Pupils often have weak basic counting skills and rely on counting with their fingers. Manipulative materials can assist with giving children a stronger sense of a number.

Students need to be allowed to manipulate concrete materials themselves .

Great source of maths manipulatives are \$2 shops. Great for everything from large dice, gambling games, counters, clocks to play money, calculators, money, buttons, paper clips, tooth picks, string, playing cards, rulers, measuring cups, spinners, drinking straws and more. professional items and maths games modern teaching aids has everything you can think of! <http://www.teaching.com.au>

Paddle pop sticks

Purchase a box of craft sticks from a craft store and use them to illustrate place value concepts. Bundle groups of ten sticks together with hair bands from the drug store. Then bundle ten groups of ten together, again with an elastic band, to form one hundred. Using this manipulative it is easy to model quantities and their names, to model addition and subtraction with and without regrouping.

Abacus

The abacus is a great mathematical tool which can even be made with string and beads, fruit loops, noodles or even pool noodles for a giant outdoor abacus. It is best to get an abacus with 10 beads on each string or pole rather than a traditional abacus. It is better to have a vertical abacus so understanding of 10's, 100's can be visualised in appropriate place that approximates a sum.

- Basic counting
- Adding and subtracting
- Place value
- Skip counting in 2s etc. great for learning times table concepts.
- Patterns see free pattern cards at <http://blog.melissaanddoug.com/wp-content/uploads/2013/05/abacus-pattern-cards-2.pdf>
- http://www.mathsaheadobs.com/activity/b3_p7.pdf
- <http://rightstartmath.com/home-school/ipad-sample-lessons>

Dice activities

Large Eva dotted dice or small dice can be purchased cheaply at \$2 shops and can be used for a range of activities.

- Timetables up to six can be taught using dotted dice. 6 dice showing 6 can be counted out to 36 for instance before writing sum and answer down.
 - Dotted Dice can be used for addition and subtraction.
- http://www.granby.k12.ct.us/uploaded/faculty/wyzika/Dice_and_Card_Games_to_Practice_Math_Facts.pdf

Dot card activities

Students can make dot cards with sticky dots and a basic number activity can be followed by other more complex activities such as addition using the dot cards. Children can add the dot cards together. Counters can also be placed on the dots as numbers are added to increase the understanding of number concepts. Subtraction can be taught using counters on the dots and then taking some away.

<http://www.k-5mathteachingresources.com/ten-frames.html>

Pack of cards activities

Small packs of cards or oversized cards are cheap and easily available from \$2 shops.

- Hand out cards. Students have to pick which card has the largest/smallest number
- With pack of cards students can add 2 cards together
- Students can also search for 2 cards that add up to a specific number

<http://www.granby.k12.ct.us/uploaded/faculty/wyzika/>

[Dice and Card Games to Practice Math Facts.pdf](#)

Dominoes activities

Dominoes can be used for a variety of games.

- Number awareness - draw a large number on a sheet of paper and around it place dominoes that add up to 5.
- Challenge students to add up any number of dominoes
- http://www.curriculumsupport.education.nsw.gov.au/primary/mathematics/assets/pdf/moreactivities/domino_act.pdf
- <http://www.learningresources.com/text/pdf/7580book.pdf>

Cuisenaire rods

Cuisenaire rods have been around for a long time, my husband still has his set from 40 years ago! They are ideal for learning the relationship between numbers. Basically they are rods 1 to 10 that vary in colour and size to represent each number. They are a wonderful manipulative that can be used for a range of activities. They can be used for basic numeracy, Patterns, Skip counting, Multiplication, Division, Fractions, Ratio and more!

Available at educational stores and online <http://www.teaching.com.au/catalogue?catalogue=MTA&category=MTA-CUISENAIRE-RODS>

Activities

<https://mindfull.files.wordpress.com/2012/03/cuisenaire-rod-tasks.pdf>

<http://www.learningresources.com/text/pdf/7528book.pdf>

<http://www.nurturedbylove.ca/resources/cuisenairebook.pdf>

<http://www.cuisenaire.co.uk>

Number lines

"The number line offers far more than this sequential set of 'rules' for getting the right answer. The picture itself – whether printed, drawn, or just imagined – carries within it an explanation of why the method works. In this way, mathematical ideas from the simplest to the most complex can be made manifest, and so become meaningful and memorable to all our pupils – not just to the visual and kinaesthetic learners." Steve Chinn

Number lines can be used for a range of activities. They allow visualisation and manipulation of numbers for number sense, addition, subtraction and multiplication. Also fraction number lines.

- Students can use their ruler in exams as a number line.
- Large number lines can be made on the ground using chalk, masking tape or butchers paper. Students can use these number lines for a range of concepts from hopping through numbers, jumping twos. Students can place counters on the number line to match the number.
- Number lines don't have to just been on a sheet or a plastic number line they can be made out of a range of materials such as; shoelace and bead, ziplock bag and marker (can put sum cards in the bag), string with paper numbers folded in half and strung up, clothes pegs and a cardboard number line, number line blocks in different colours (in 5's for instance).
- http://www.curriculumsupport.education.nsw.gov.au/secondary/mathematics/numeracy/countingon/co_supp.htm
- http://bridges1.mathlearningcenter.org/media/Bridges_Gr1_OnlineSupplement/B1SUP-A3_AddSubNumLn_0709.pdf

Lego

Lego is a wonderful manipulative that can be used for a range of activities and their are many activities available online.

- Fractions
- Part/whole
- Basic numeracy
- Fractions
- Patterns
- And more!

- <http://www.littlebrickschoolhouse.com/mathactivities.pdf>
- <http://www.scholastic.com/teachers/top-teaching/2013/12/using-lego-build-math-concepts>
- <http://livingmontessorinow.com/2013/06/20/free-lego-printables-and-70-plus-lego-learning-activities/>

Hundreds chart

The hundreds chart should not just be used as a poster or teacher demonstration. Students need to be able to get a feel for numeracy doing a range of activities with the number chart.

<http://letsplaymath.net/2008/09/22/things-to-do-hundred-chart/>

<http://www.classroomgamenook.com/index.php/144-5-games-to-play-with-a-hundreds-chart-plus-a-freebie>

Times tables

Learning timetables is often a difficult problem for dyslexic and dyscalculia learners. Memorisation is very difficult. For understanding of multiplication facts.

TIMETABLES GRID

It may be of more benefit for students to learn the multiplication table or grid so they can reproduce this on paper quickly in an examination. This requires less rote learning and removes the need to draw quickly from memory for every question. Often dyslexics are quite good at patterns and may benefit from seeing the pattern in the grid. Students are then able to refer to the chart for any multiplication a, division and equivalent fraction questions! Tricks can be used such as the chart is duplicated 2 times 3 can be copied into the 3 times 2 column. **9 times tables can be filled in by adding to the ten and taking off the ones as 18 becomes 27 for instance.** **10 times tables are written by writing 1 to 10 and adding 0 to each number.** The grid shows equivalent fractions. $\frac{1}{2}$ $\frac{2}{4}$ this works across the grid by ruling under the appropriate line.

×	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
<hr/>										
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80

9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

<http://hubpages.com/hub/How-To-Learn-Times-Tables> this is a great explanation of how to learn the time tables grid !

Time

Telling the time tends to be a particular area of difficulty for dyslexics. Concepts such as 60 minute in an hour and 12 hours etc are quite difficult to grasp. A number of strategies may need to be used. Manipulation of a clock or other hands on activities are often far more effective than just worksheets.

USING A TEACHING CLOCK

- Provide student with a teaching clock if doing worksheets so it is more multisensory.

PAPER PLATE CLOCK

- Make clocks with paper plates as a class activity. Make post it note flaps. So under the 3 the flap can reveal 15 etc.

CLOCK BLOCKS

- Arrange a number line in 5's with different coloured blocks such as Lego for each 5 until have 60 minutes
- On butchers paper arrange blocks in 5's representing 5 minutes in a large circle. Draw the outline of the circle and then students write on the times around the circle. On the outside draw 5,10,15 etc and on the inside draw 1 to 12.

MINUTE MINDMAP

- 60 seconds in a minute.
- Brainstorm list or mindmap of what you can do in 1 second and then 1 minute. Can even act actions out in class. Jump for 1 second. Jump for 1 minute.

IPAD Apps (some also available android)

- **Jungle Coins** - learn coin math on the App Store <https://itunes.apple.com/au/app/jungle-coins-learn-coin.../id380864501?mt=8>
- **Squeebles Maths Bingo** <https://itunes.apple.com/au/app/squeebles-maths-bingo/id580882257?mt=8>

- **Skoolbo timetables**- <https://itunes.apple.com/au/app/times-tables-by-skoolbo/id805424969?mt=8>
- **Dexteria Dots** - Get in Touch with Math <https://itunes.apple.com/au/app/dexteria-dots-get-in-.../id815345306?mt=8>
- **Targeting maths** - use in conjunction with the very bright and set out Targeting Maths text which follows syllabus. Targeting Maths 2 on the App Store on iTunes <https://itunes.apple.com/au/app/targeting-maths-2/id687159844?mt=8>
- **Bright Ninja Tells Time** – Learn to Tell the Time with an Analog ...<https://itunes.apple.com/au/app/bright-ninja-tells-time-.../id480441482?mt=8>
- **Talking Calculator** <https://itunes.apple.com/au/app/talking-calculator/id424464284?mt=8>
- **Timetables Lab**- <https://itunes.apple.com/us/app/times-table-lab/id415519163?mt=8>
- **Montecalculator- Montessori bead frame abacus**- <https://itunes.apple.com/au/app/montecalculator-montessori-.../id466860008?mt=8> this is a great abacus app with exercises.
- **ModMath** on the App Store on iTunes - Apple <https://itunes.apple.com/us/app/modmath/id821892964?mt=8> ModMath is an adaptive program that improves math skills. Designed for dyslexics.

Software /online

- **Numbershark** is a motivating computer program that uses 45 games to teach and reinforce numeracy and improve understanding and use of numbers. The wide variety of carefully designed games provide many ways in which to practise.
- **Math games developed by Dr. Brian Butterworth to remediate dyscalculia.** FREE <http://www.number-sense.co.uk>
- **Number catcher** online free <http://www.thenumbercatcher.com/nc/home.php> The Number Catcher is primarily designed for children aged 5 to 10 The game is especially designed to address mathematical learning disabilities (dyscalculia), by strengthening the brain circuits for representing and manipulating numbers.
- **Number race** For children who make their first steps with numbers, consider using our more basic game The Number Race. free maths software download <http://www.thenumberrace.com/nr/home.php>
- **Nessy Numbers** has video learning strategies and multi-sensory games. This is ideal for children who struggle with maths. Tables of Doom -A sequence of learning games improve different multiplication skills and demonstrate how using strategies will help them succeed.Clock Island-These difficult mathematical concepts have been broken down into manageable stages and explained in a way that is much easier to understand. A range of different games help learn every aspect of time, from basic facts to converting digital time into the 24 hour clock.A

subscription to Nesy Numbers gives access to two islands – <http://www.nesy.com/uk/product/nessy-numbers/>

Resources and references

<http://dyslexia.yale.edu/math.html>

<https://www.dynaread.com/dyslexia-and-math-struggles-how-do-they-relate>

<http://journals.cluteonline.com/index.php/JIER/article/viewFile/7502/7568>

[http://archives.gadoe.org/DMGetDocument.aspx/Math_Chart_revised_8-10.pdf?](http://archives.gadoe.org/DMGetDocument.aspx/Math_Chart_revised_8-10.pdf?p=6CC6799F8C1371F6CFC3EAE26FFD23831AA37596E6C907F54E26E070D9A5463C&Type=D)

[p=6CC6799F8C1371F6CFC3EAE26FFD23831AA37596E6C907F54E26E070D9A5463C&Type=D](http://www.aboutdyscalculia.org/teachers.html)

<http://www.aboutdyscalculia.org/teachers.html>

http://www.speld-sa.org.au/index.php?option=com_content&task=view&id=59&Itemid=108

Mathematics for Dyslexics including Dyscalculia by S. Chinn & R. Ashcroft (2006) Wiley-Blackwell. ISBN 978-0470026922.

<http://www.ode.state.or.us/teachlearn/subjects/mathematics/numbersenseactivitiesbfinal.pdf>

The Trouble with Maths: A Practical Guide to Helping Learners with Numeracy Difficulties by S. Chinn (2004) Routledge. ISBN 978-0415324984.

The Dyscalculia Assessment by J. Emerson, P. Babbie & B. Butterworth (2010)

Dyscalculia Guidance: Helping Pupils with Specific Learning Difficulties in Maths by B. Butterworth & D. Yeo (2004)

The Dyscalculia Toolkit: Supporting Learning Difficulties in Maths by Ronit Bird (2007).

Dyscalculia: Action Plans for Successful Learning in Mathematics by Glynis Hannell. (2005).

Dyslexia, Dyspraxia and Mathematics by Dorian Yeo. (2003).

Mathematics for dyslexics including dyscalculia by Steve Chinn and Richard Ashcroft. (2007, 3rd Edn).

The Trouble with Maths: A Practical Guide to Helping Learners with Numeracy Difficulties by Steve Chinn. (2004).

Maths and Dyslexia. A View from the UK, Dr Steve Chinn, Ex-Principal of Mark College, Somerset, UK

Teaching Math to Dyslexic Students - Dr Steve Chinn - YouTube

www.youtube.com/watch?v=JnaBj491rVk

Audio may be better at this link: <http://bit.ly/157Oz9U> Dyslexic Advantage webinar with teaching strategies to help students with dyslexia learn ...

PINTEREST BOARD

Dyslexia Sydney Support Group

A collection of maths games and ideas that are multisensory and make math fun!

<http://www.pinterest.com/bdekker0059/dyslexia-dyscalculia-multisensory-math/>

Written by Belinda Dekker

Dyslexia Sydney Support Group

A support group for dyslexics, parents, teachers, tutors and others wishing to share and learn information about dyslexia.

Twitter

Dyslexia Sydney@sydney_dyslexia

Facebook group

Dyslexia guides available

<https://www.facebook.com/groups/DyslexiaSydney/>

Email dyslexiasydney@yahoo.com.au