

## Mathematics and dyslexia

Mathematics requires the acquisition, organisation and access to knowledge, rules, techniques, skills and concepts with the aim of solving problems. It can be seen as a combination of organised knowledge and creative activity. It requires abilities in visual and verbal skills; spatial skills; linear and sequential skills. It requires large amounts of information to be stored and retained ready for swift and automatic access and retrieval from long-term memory. The language of mathematics is full of challenges – offering no support from context and often using words which have a completely different meaning in mathematics than in English.

It may, therefore, place huge demands on the dyslexic student. This table can only provide some limited general information on the teaching of mathematics to dyslexic students. For more detail see Chinn, S. and Ashcroft, R. (1998) *Mathematics for Dyslexics: a teaching handbook*, 2<sup>nd</sup> edition. London: Whurr Publishers. You may also like to visit the British Dyslexia Association website for information on dyscalculia, dyslexia and maths: [www.bdadyslexia.org.uk/dyscalculia.html](http://www.bdadyslexia.org.uk/dyscalculia.html)

<b>Factors to take into account and characteristics of some dyslexic students which will affect learning</b>	<b>Effect on learning in the mathematics classroom. Students may have difficulty with the following</b>	<b>Strategies which may be incorporated into classroom teaching</b>	<b>Additional support which may be needed</b>
<p><b>Memory</b></p> <ul style="list-style-type: none"> <li>• Working memory (the ability to hold and juggle information in short-term memory) – if overloaded, information may be lost</li> <li>• May be inaccurate representations in long-term memory</li> <li>• Manipulating and sequencing information</li> <li>• Difficulty with rote learning.</li> </ul>	<ul style="list-style-type: none"> <li>• Remembering and carrying out instructions</li> <li>• Remembering recently-learned vocabulary</li> <li>• May know the answer but cannot verbalise it</li> <li>• Remembering facts, figures, technical/specialised vocabulary</li> <li>• Placing things in order.</li> </ul>	<ul style="list-style-type: none"> <li>• Present new information in small chunks</li> <li>• Set limited but realistic targets</li> <li>• Make learning multisensory</li> <li>• Allow plenty of time for recall.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide support materials to be used at home or with teaching assistants</li> <li>• Provide concise revision notes with lots of visual rather than textual information – flow charts, diagrams, concept maps.</li> </ul>

<p><b>Sequencing</b></p> <ul style="list-style-type: none"> <li>• Putting things in order – alphabet, letter order in words, word order in sentences, etc.</li> <li>• Answering questions which require events/information to be put in order.</li> </ul>	<ul style="list-style-type: none"> <li>• Find it difficult to hold information in their heads and reorder it.</li> </ul>	<ul style="list-style-type: none"> <li>• Have charts, lists of vocabulary, diagrams, etc. on display in the classroom</li> <li>• Teach strategies to aid memory and sequencing, e.g. list the information and cross it off as it is used.</li> </ul>	<ul style="list-style-type: none"> <li>• Make use of e-learning tools such as calculators</li> <li>• Encourage the use of memory strategies such as mnemonics.</li> </ul>
<p><b>Basic number</b></p> <ul style="list-style-type: none"> <li>• Tables and number bonds may not be well established</li> <li>• No automatic access to number facts</li> <li>• May understand the problem but simple arithmetic holds them back</li> <li>• Processing may be slow</li> <li>• Confuse algorithms and procedures.</li> </ul>	<ul style="list-style-type: none"> <li>• Multiplication tables may not be established</li> <li>• Number bonds to ten and 20 not well established.</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage use of table squares and calculators</li> <li>• Make processes as explicit as possible</li> <li>• Emphasise the choices of ways forward so the students can choose the ones which work best for them</li> <li>• Use practice cards, e.g. six on one side and four on the other, student looks at one side and works out bond to ten</li> <li>• Articulate algorithms and procedures into words – use mnemonics to aid memory.</li> </ul>	<ul style="list-style-type: none"> <li>• Devise exercises to allow for lots of repetition and over-learning.</li> </ul>

<p><b>Speed of information processing</b></p> <ul style="list-style-type: none"> <li>• Slower in responding to incoming information</li> <li>• Slow pace of work</li> <li>• Poor concentration span</li> </ul>	<ul style="list-style-type: none"> <li>• Responding to information or instructions</li> <li>• Understanding and responding to a continuous flow of information</li> <li>• Pulling back information from long-term memory.</li> </ul>	<ul style="list-style-type: none"> <li>• Allow extra time for processing by slowing down presentation</li> <li>• Allow student extra time to answer questions and complete work</li> <li>• Focus on key techniques and concepts.</li> </ul>	<ul style="list-style-type: none"> <li>• Apply for extra time or other special arrangements in national tests</li> <li>• Use teaching assistants to help with reading, note-taking, recording homework accurately.</li> </ul>
<p><b>Visual discrimination/perception</b></p> <ul style="list-style-type: none"> <li>• Poor ability to discriminate/differentiate between words/similar shaped letters, similar symbols.</li> </ul>	<ul style="list-style-type: none"> <li>• Differentiating between similar-looking words</li> <li>• Problems with similar symbols, e.g. <math>x^2</math>, <math>2x</math>, and <math>x+2</math>, or between <math>x</math> and <math>+</math>, and <math>-</math> and <math>\div</math>.</li> </ul>	<ul style="list-style-type: none"> <li>• Make use of picture cards for association</li> <li>• Make a symbol pack for repetition and rehearsal</li> <li>• Make differences explicit.</li> </ul>	
<p><b>Auditory discrimination/perception</b></p> <ul style="list-style-type: none"> <li>• Difficulty in perceiving the difference between similar sounds</li> <li>• Difficulty identifying sounds</li> <li>• Problems identifying where one spoken word ends and a new word begins.</li> </ul>	<ul style="list-style-type: none"> <li>• Problems knowing if a sound is correct when repeating after a teacher</li> <li>• Recognising the difference between two words containing similar sounds</li> <li>• Listening tasks</li> <li>• Answering oral questions.</li> </ul>		

<p><b>Phonological processing</b></p> <ul style="list-style-type: none"> <li>• Weak sound/symbol correspondence</li> <li>• Lack of awareness of individual sounds within words.</li> </ul>	<ul style="list-style-type: none"> <li>• Pronunciation, even of words encountered quite frequently</li> <li>• Recognising familiar words and phrases</li> <li>• Confusion of similar-sounding words.</li> </ul>	<ul style="list-style-type: none"> <li>• Make sure new material is introduced in a multisensory way – show it, listen to it, look at it, hear it, say it, write it.</li> </ul>	<ul style="list-style-type: none"> <li>• Use practice cards for reinforcement</li> <li>• Use tapes to accompany printed materials</li> <li>• Pair the student with a good reader wherever possible.</li> </ul>
<p><b>Reading</b></p> <ul style="list-style-type: none"> <li>• Affected by weak working memory and thus lose meaning</li> <li>• May be slow</li> <li>• Reading without expression</li> <li>• Difficulty reading aloud.</li> </ul>	<ul style="list-style-type: none"> <li>• Unable to decode words quickly</li> <li>• Remembering what has been read</li> <li>• Selecting important areas to read</li> <li>• Skimming and scanning for information.</li> </ul>	<ul style="list-style-type: none"> <li>• Highlight key words to identify crucial information</li> <li>• Encourage use of line markers to help keep place: rulers, Perspex® strips, rule a line on an A5 sheet of overhead transparency and use as a guide.</li> </ul>	<ul style="list-style-type: none"> <li>• Read questions to students or provide audio tapes</li> <li>• Enlarge papers and texts.</li> </ul>
<p><b>Writing</b></p> <ul style="list-style-type: none"> <li>• Handwriting may be slow</li> <li>• May be difficult to read</li> <li>• May break down under pressure</li> <li>• Letter formation may be inaccurate.</li> </ul>	<ul style="list-style-type: none"> <li>• Copying from the board</li> <li>• Writing down what can be produced orally</li> <li>• Notes may be incomplete or illegible.</li> </ul>	<ul style="list-style-type: none"> <li>• Allow the use of wordprocessing if writing is illegible</li> <li>• Encourage student to use plenty of space for each question</li> <li>• Make sure the student is facing the board/written source.</li> </ul>	<ul style="list-style-type: none"> <li>• Allow the student to present work in other formats such as taped or wordprocessed</li> <li>• Allow access to teacher's notes or set up a buddy system where another student will take notes and share with the dyslexic student</li> <li>• If writing is illegible: apply for extra time and use a scribe if available.</li> </ul>

<p><b>Spelling</b></p> <ul style="list-style-type: none"> <li>• Difficulty remembering what a word looks like</li> <li>• Lack of knowledge of spelling conventions</li> <li>• Linked to phonological processing difficulties.</li> </ul>	<ul style="list-style-type: none"> <li>• Words spelled in different ways in the same piece of text</li> <li>• Words spelled phonetically</li> <li>• All the right letters there but in the wrong order.</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage use of personal dictionaries</li> <li>• Help students to find ways of remembering spellings – mnemonics, words within words, base words and suffixes, etc.</li> <li>• Highlight the part of the word which is causing difficulty and use visual clues to help reduce the load on memory</li> <li>• Teach key words explicitly</li> <li>• Do not cover a student's book with red corrections identifying each and every spelling mistake.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide support to reinforce spellings – target word sheets with strategies for spelling</li> <li>• Homework and study diaries should contain a list of words and specialist vocabulary for each subject needed during each year.</li> </ul>
<p><b>Grammar/syntax</b></p> <ul style="list-style-type: none"> <li>• Poor understanding of syntax and grammar.</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulty forming accurate sentences</li> <li>• Difficulty understanding what a paragraph is/looks like</li> <li>• Problems with the rules of grammar.</li> </ul>	<ul style="list-style-type: none"> <li>• Use diagrams, cards, etc. to show sequences and patterns of language</li> <li>• Teach vocabulary associated with science explicitly.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide revision cards with rules and formula for use as reference in class and at home.</li> </ul>

<p><b>Planning</b></p> <ul style="list-style-type: none"> <li>• Tasks – weak grasp of time required</li> <li>• Writing – tendency to ‘lose the plot’</li> <li>• Organisation of notes and equipment</li> <li>• Work may be laid out in an untidy or chaotic way.</li> </ul>	<ul style="list-style-type: none"> <li>• Planning and allocating time to complete tasks</li> <li>• Planning a revision schedule</li> <li>• Keeping notes in order</li> <li>• Knowing where one topic ends and another starts.</li> </ul>	<ul style="list-style-type: none"> <li>• Use planning calendars to work backwards from the hand-in dates to show when work should be done</li> <li>• Set up binders with labelled dividers and poly pockets</li> <li>• Clear out unnecessary papers regularly.</li> </ul>	
<p><b>Directionality</b></p> <ul style="list-style-type: none"> <li>• Tendency to confuse left/right, up/down, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Following and giving instructions</li> <li>• Following instructions which rely on prepositions.</li> </ul>	<ul style="list-style-type: none"> <li>• Provide symbols/pictures/arrows as well as text</li> <li>• Provide visual clues wherever possible.</li> </ul>	<ul style="list-style-type: none"> <li>• Pair the students with someone who can support them in this.</li> </ul>

It is important to recognise that, although the dyslexic student may have difficulties in many areas, there will be areas of strength. Recognising and utilising these strengths is important to the student’s academic and intellectual development. These strengths are important to the self-esteem of the dyslexic student.

As with the areas of possible difficulty listed above, dyslexia is very diverse and some strengths will be found in some students and not in others.

<p><b>Factors to take into account and characteristics of some dyslexic students which will affect learning</b></p>	<p><b>Recognising these talents within the classroom</b></p>
<p><b>Creativity</b></p> <ul style="list-style-type: none"> <li>• A high degree of curiosity</li> <li>• Ability to concentrate intensely and for a long period of time on something they are interested in</li> <li>• May have excellent spatial skills – the ability to perceive and interact with three-dimensional space</li> <li>• Can think abstractly.</li> </ul>	<ul style="list-style-type: none"> <li>• Look for strengths</li> <li>• Notice areas of interest</li> <li>• Provide a wide variety of activities</li> <li>• Talk with the students about what they like to do</li> <li>• Ask parents about a student’s interests and talents</li> <li>• Ask other teachers about the strengths they have noticed.</li> </ul>
<p><b>Problem solving</b></p> <ul style="list-style-type: none"> <li>• Ability to think ‘outside the box’</li> <li>• To see other ways of approaching the problem</li> <li>• To visualise a solution</li> <li>• Ability to see patterns in seemingly unrelated data.</li> </ul>	
<p><b>Leadership</b></p> <ul style="list-style-type: none"> <li>• Good social abilities</li> <li>• Enthusiasm</li> <li>• Willingness to take risks</li> <li>• Willingness to work hard</li> <li>• A strong sense of humour</li> <li>• Empathy with others</li> <li>• Good observational skills.</li> </ul>	<p><b>Nurturing these talents within the classroom</b></p> <ul style="list-style-type: none"> <li>• Recognise them</li> <li>• Provide opportunities for students to demonstrate their talents within the classroom</li> <li>• Utilise the talents within literacy and numeracy tasks – work to the interests, e.g. football – write game reports, produce league tables, train or bus timetable to get to away matches, etc.</li> <li>• Provide opportunities to discover and create new interests and talents.</li> </ul>
<p><b>Verbal skills</b></p> <ul style="list-style-type: none"> <li>• May be good at communicating verbally.</li> </ul>	