

Mathematics process categories

PT MATHS 5

All of the UK curricula define multiple categories of mathematical proficiency that require pupils to be able to use and apply mathematics, beyond simple recall of facts and standard procedures. While the intentions are very similar, the terminology varies between regions. *Progress Test in Maths' (PTM)* categories are based on the *Curriculum Aims* in the KS1, KS2 and KS3 National Curriculum for England (2013), and are also comparable with the GCSE Assessment Objectives: they adopt some language from both. The main change has been to divide 'Fluency' into two strands.

FF: Fluency in facts and procedures

Pupils can, for example:

- recall mathematical facts, terminology and definitions (such as the properties of shapes);
- recall number bonds and multiplication tables;
- perform straightforward calculations.

FC: Fluency in conceptual understanding

Pupils can, for example:

- demonstrate understanding of a mathematical concept in the context of a routine problem (for example, calculate with or compare decimal numbers, identify odd numbers, prime numbers and multiples);
- extract information from common representations, such as charts, graphs, tables and diagrams;
- identify and apply the appropriate mathematical procedure or operation in a straightforward word problem (for example, knowing when to add, multiply or divide).

MR: Mathematical reasoning

Pupils can, for example:

- make deductions, inferences and draw conclusions from mathematical information;
- construct chains of reasoning to achieve a given result;
- interpret and communicate information accurately.

PS: Problem solving

Pupils can, for example:

- translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes;
- make and use connections between different parts of mathematics;

- interpret results in the context of the given problem;
- evaluate methods used and results obtained;
- evaluate solutions to identify how they may have been affected by assumptions made.

There is a limit to how thoroughly MR and PS can be assessed in a short, whole-curriculum test such as *PTM*, especially at younger ages where reading and English comprehension restrict the sorts of questions that can be asked. Teachers are urged to ensure that their curriculum includes a balanced diet of extended tasks, investigations, problem solving and collaborative activities.

The Mathematics Early Years curriculum does not list separately any process categories for pupils in the age range 4-5. This table shows how the questions in *PTM5* map onto the process categories listed for pupils who are more than 5 years old.

Process category	
FF: Fluency in facts and procedures	3a, 4a, 5a, 5b, 5c, 7a
FC: Fluency in conceptual understanding	1a, 1b, 2a, 2b, 3b, 7b
MR: Mathematical reasoning	1c, 2c, 3c, 4b, 6a, 6b
PS: Problem solving	2d, 6c, 7c

Mathematics process categories in Wales, Scotland and Northern Ireland

The process categories shown above are based on the National Curriculum and GCSE syllabuses for England. The curricula for Wales, Scotland and Northern Ireland have similar requirements, although there is wide variation in the way they are defined.

Wales	Closest <i>PTM</i> process categories			
Foundation Phase Skills	FF	FC	MR	PS
1. Solve mathematical problems				•
2. Communicate mathematically		•	•	
3. Reason mathematically		•	•	
Foundation Phase Range	•			

The Mathematics National Curriculum for Northern Ireland does not list separately any process categories for pupils in the age range 4-6. This table shows how the questions in *PTM5* map onto the process categories listed for pupils in the age range 6-8.

Northern Ireland	Closest <i>PTM</i> process categories			
Processes in Mathematics	FF	FC	MR	PS
Making and monitoring decisions				•
Communicating mathematically		•	•	
Mathematical reasoning		•	•	•
Individual mathematical topics	•			

Scotland *	Closest <i>PTM</i> process categories			
Experiences and outcomes	FF	FC	MR	PS
develop a secure understanding of the concepts, principles and processes of mathematics and apply these in different contexts, including the world of work			•	•
engage with more abstract mathematical concepts and develop important new kinds of thinking			•	
understand the application of mathematics, its impact on our society past and present, and its potential for the future				
develop essential numeracy skills which will allow me to participate fully in society	•			
establish firm foundations for further specialist learning	•	•		
understand that successful independent living requires financial awareness, effective money management, using schedules and other related skills			•	•
interpret numerical information appropriately and use it to draw conclusions, assess risk, and make reasoned evaluations and informed decisions				•
apply skills and understanding creatively and logically to solve problems, within a variety of contexts			•	•
appreciate how the imaginative and effective use of technologies can enhance the development of skills and concepts				

* Education Scotland 'Curriculum for Excellence: Numeracy and Mathematics' 14 May 2009.
 Accessed: 31 July 2014. www.curriculumforexcellencescotland.gov.uk

Assessment for learning: following up the test activities

Each *PTM* assessment test is designed to align with the mathematics curriculum at a level appropriate for the pupils in the relevant age group. The activities may therefore be used to obtain diagnostic information about each pupil's strengths and weaknesses, and may also be used to provide a basis from which pupils' mathematical understanding may be further developed.

This section discusses some of the ways in which pupils may be helped to improve areas of weakness and to build on what they already know in order to deepen their understanding. These notes cover only a few of the possibilities. In talking to pupils and discussing the activities in which they did well, in addition to those they were unable to complete correctly, you may find approaches that are helpful to them, building on their own strengths and interests.

You will need to refer to the activities in the Pupil Booklet and the Teacher's script in the At a Glance Guide when reading these notes, as they form the basis of the ideas suggested. The activities are referred to here by both their numbers and their names.

Formative notes on the questions

The standardised total scores on *PTM* give you an indication of the overall performance of your pupils and a basis for progress monitoring. This section is intended to help you identify the specific difficulties that pupils have with individual questions, and to suggest possible activities to help guide your future teaching.

Question 1: Growing flowers

A picture showing five flowers of varying heights is shown: pupils are asked to compare the heights of the five flowers, recognising the terms tallest and smallest (part a); say which two flowers are the same height (part b); then identify which flower has the most leaves and count them (part c).

It may be beneficial to devise some classroom activities and games in which similar heights are compared. For example, have a group of pupils stand in line and ask one pupil to pick out two or more pupils who are the same height.

Question 2: Stickers

Here pupils have to compare the value of an array of coins. A diagram showing six coins is provided: pupils are asked to identify the coin that is worth the most and the coin that is worth the least (part a); which coin will pay for a 5p sticker (part b); which coin will pay for two 5p stickers (part c); then which two coins will pay for three 5p stickers (part d).

In order to obtain correct answers to parts c and d of this activity, pupils need to use more mathematical reasoning and problem-solving skills, such as the ability to count in multiples of five, as well as selecting the correct coins. Classroom activities such as practical shopping situations could improve the pupils' abilities to understand that the size of a coin does not necessarily determine its value. Games which involve doubling numbers could also help to improve fluency and conceptual understanding.

Question 3: Broken phone

A diagram of a 'broken' phone, with three missing numbers is shown: pupils are asked to write in the missing numbers (part a); identify the biggest number on the phone (part b); then draw rings around the numbers they would press to dial forty-five (part c).

In this task, pupils are asked to write the missing numbers on a diagram of a telephone keypad. However, this is not a regular number line.

Pupils could be exposed to using numbers in a variety of situations, especially those in familiar practical contexts. For example, filling in missing numbers on a calendar and playing board games which involve ordering numbers. Also, looking at situations in everyday life where numbers are not ordered consecutively, such as house numbers.

Question 4: Cake competition

This question is concerned with ordinal numbers in the context of a cake baking competition. In part a of this activity, a picture of the five winning cakes in a competition is shown. The cakes are arranged in order with the labels 'First' and 'Fourth' on the appropriate cakes. Pupils are asked to draw lines from the other three word labels to the appropriate cakes.

In part b, four photos Jake took on the day his mother made her cake are shown, with a line drawn from the label 1st to a photo of her shopping. Pupils are asked to draw lines from 2nd, 3rd and 4th to the appropriate photos.

There are many classroom situations where the use of ordinal numbers could be highlighted. For example, when the pupils 'line up', questions could be asked, 'Who's first in the line today for P.E.? Who's third? Who's second?' When there is a case of 'turn taking', ordinal numbers could be stressed, 'Who wants to be first to change his/her reading book?', 'What is the third month of the year?', 'Which is the second day of the week?' Many opportunities are available every day and their usage could be pointed out.

Question 5: Tiles

This activity requires pupils to recognise some common 2D shapes and position them correctly using the terms left, right, above and below. A 3×3 square grid with a circle in the centre square is shown. Square, circle and triangle stickers are provided. Pupils are asked to stick one triangle above the circle and one triangle to the left of the circle (part a); stick one square below the circle and one square to the right of the circle (part b); then stick a circle in each corner (part c).

Pupils could use 2D shapes in different orientations and sizes in order to develop fluency and problem solving. More terms could be added to the language of position such as in front, top, bottom, middle, between, around, near, close, far, up, down, forwards, backwards, inside, outside and so on.

Question 6: Deepak's day

This activity requires pupils to tell the time on the hour and half past the hour using an analogue clock face. A picture showing four clock faces is provided: pupils are asked which clock shows 7 o'clock (part a); which clock shows 8:30 (part b); and which clock shows half an hour after 8:30 (part c).

Many children may be more familiar with digital time-pieces, however, more practice in the use of the analogue variety will be beneficial. If there is an analog clock in the classroom, regular reference could be made to it during normal classroom activities. For example, 'It's 2 o'clock now and we have half an hour for our games lesson in the hall, so when will we be back in the classroom? Where will the hands of the clock be then?'

Question 7: Clowns

In this activity, several pictures showing a clown juggling balls with numerals written below him are provided. Pupils are asked to count eight balls and draw a ring around the numeral 8 (part a); turn over the page and draw three extra balls before counting how many balls there are altogether and ring the numeral 6 (part b); on the next page, drop five balls then count how many are left and ring the numeral 2 (part c). Pupils need to be able to count, read numerals, and add and subtract single-digit numbers.

Practical activities to develop mathematical reasoning and problem-solving skills would be useful.

Feedback to parents and carers

A report on the individual pupil is available to support feedback to parents or carers. This *Individual report for parents* strips away much of the technical detail that is included in the *Group report for teachers*. A series of statements, tailored for parents, is included to explain what the results mean and how learning may be affected. Recommendations focus on how the parent or carer can work with the school to support the pupil at home.

In addition to the *Individual report for parents*, you may wish to provide supporting information, either orally or in writing, explaining the process and outcomes. The following list provides you with guidelines to assist with this communication.

- Stress the school's commitment to identifying and addressing the needs of each individual pupil in order to understand and maximise their potential.
- Explain that testing with *PTM5* is part of the school's regular assessment regime and that all pupils in the year group(s) have been tested.
- You may wish to summarise the specific outcomes and recommendations from the test for that individual pupil (which are also shown on the *Individual report for parents*).
- Parents or carers should be reassured that if they have any questions or concerns or would like any further advice on how best to support their child, then they should contact the school.

A sample letter (Figure 1) is provided to support your communications with parents/carers after testing with *PTM5*.

Figure 1: Sample parent/carer feedback letter

Dear Parent or Carer,

In school, we wish to assess all our pupils to see what their needs are and how we can best help them learn and achieve.

As part of this process, your child has completed the Progress Test in Maths 5, which assesses key aspects of maths, such as shape, number and mathematical concepts (like money, place value and time).

A copy of the Individual report for parents is included*. This shows your child's results and describes what these mean in terms of the ways in which he/she will learn best and how you can support him/her at home.

[If the report is not included a relevant short extract can be included instead.]

If you have any queries or concerns please contact us.

Yours faithfully,

[School/Establishment name]

* If possible, it is helpful to parents to discuss the report with them on a suitable occasion before sending it out.