Your Guide to Using Rapid Reasoning

Resource overview, how to use and support for developing reasoning and problem solving

Years 3 to 6

THIRD SPACE LEARNING

About this resource

Rapid Reasoning provides at least three questions a day for Years 3–6, and is designed to help children develop and practise their reasoning skills. It is designed to complement Third Space Learning's ***Fluent in Five*** resource, which provides daily fluency practice.

Rapid Reasoning has been carefully structured with progression through the KS2 curriculum in mind. As you work through the activities, pupils will gradually learn new concepts whilst also revisiting content from earlier in the curriculum.

What's included

Weekly slides for each Key Stage 2 year group contain:

- ☑ The week's In a Nutshell statement, which helps teachers see at a glance which skills are focused on during this week's challenges.
- ☑ Five sets of daily challenges, each following this format:
  - **Question sheet** of approximately 3 questions
  - '**At a glance**' answer sheet – this provides full mark answers only, and it is important that the full mark scheme is referred to.
  - **Full mark scheme**. This has been designed so it can be shared with the children so that they begin to gain understanding of what types of response certain question types ask for.
- ☑ In addition, each week there is also one modelled question.

Why is reasoning important?

Regular opportunities for children to practise, recap and apply their reasoning and problem solving skills are important. Problem solving and reasoning is what makes maths; 'maths' rather than just an exercise in recalling and following instructions or facts.

Two of the three aims of the National Curriculum for maths focus on problem solving and reasoning.

"The national curriculum for mathematics aims to ensure that all pupils:

- *become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately*
- *reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language*
- *can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions."*

National curriculum in England: mathematics programmes of study, 2014. DfE.

These aims are the 'lenses' through which the government expects children to be taught the content within the maths curriculum. They therefore form the basis of the end of key stage statutory assessments.

Effective problem-solving and reasoning skills have also been shown to be the key to children understanding and enjoying maths:

"Research on mathematical learning has made it increasingly clear that ***children's ability to reason about mathematical problems plays an extremely important part in the progress that they make in this subject at school****. To solve mathematical problems, including problems that are not used routinely in the classroom, one needs to be able to reason about the problems as well as to calculate their solutions. This is true even of apparently quite simple problems". Nunes and Bryant, 2015*

"Reasoning enables children to make use of all their other mathematical skills and so ***reasoning could be thought of as the 'glue' which helps mathematics makes sense****". Nrich, 2014*

"Real mathematical thinking lies at the heart of learning mathematics. It involves making sense of mathematics through engagement, reasoning and making connections. Sometimes this may involve significant challenge in terms of the requirement to think. But it is only through ***their own thinking that children will develop real depth of learning****." Ofsted, 2011*

How is the resource structured?

The objectives covered by ***Rapid Reasoning*** can be found in the ***Rapid Reasoning Progression Document*** for each year group. This document also breaks down which objectives are contained within each daily challenge.

The daily challenges are designed within a clear progression structure, starting the year with questions that all sit within the previous year groups objectives. They then progress throughout the year to cover all of the objectives for the current year group. The introduction of objectives throughout the year follows the framework used by a number of popular schemes and medium-term plans and resources, and is designed to work alongside whatever resource you use for your medium-term and daily planning.

The resource also provides opportunities to apply the focus from that week's ***Fluent in Five*** challenges to a reasoning context.

The resource is structured so that certain objectives are introduced each week, and that these objectives are focused upon, appearing multiple times within the week, providing opportunity for you to develop these skills throughout the week. In addition, each challenge also contains a mix of other questions, taken from the previous year group alongside objectives from the current year group that have already been introduced, so that both the full breadth of the objective document is covered and that children are challenged to recall and apply different areas of maths each day.

Should we print out the resource?

The resource is designed to be used either on screen or printed. If your school printing budget allows, we suggest that each daily challenge sheet is printed for each child, so that they have their own copy to work on, and can annotate any diagrams etc.

If you are not able to print the challenge sheets, it is important that children are provided with paper on which to make jottings and carry out any workings.

Suggested timings for using the resource

Children should be given **five minutes** to tackle each day's ***Rapid Reasoning*** challenge.

If children do not manage to complete the full challenge in the set time limit, they should not be given more time to complete – instead, they will see the proportion of the

challenge they are able to complete increase as they develop, practise and improve their reasoning skills.

Ideally, each day, children should complete the ***Fluent in Five*** challenge followed by ***Rapid Reasoning***. Both resources can be delivered together in just 20 minutes of class time.

5 Minutes – Children complete the ***Fluent in Five*** Challenge

The teacher and any support staff use this time to look at how children are approaching the questions and begin to identify any misconceptions or common errors.

2 Minutes – Children self-mark their challenge sheet. The teacher can take the opportunity here to assess the full range of the children's answers and to identify any common misconceptions.

2–3 Minutes – The teacher completes any quick teaching/re-caps focusing on any common misconceptions.

5 Minutes – Children complete the ***Rapid Reasoning*** Challenge. The teacher and any support staff use this time to look at how children are approaching the questions and begin to identify any misconceptions or common errors.

3–5 Minutes – Teacher leads the children through marking their responses, using the mark schemes provided within the resource. This time could also be used for any modelling needed to quickly address any common misconceptions.

Why is a modelled question provided each week?

Just like the knowledge content of the maths curriculum, in order for pupils to successfully develop reasoning and problem-solving skills, it's important that they are explicitly taught. Modelling the response to reasoning style questions is one effective way in which to teach reasoning skills. To help you with this, a modelled question is provided each week. The modelled question is intended for teacher use and provides further insight into the question, what examiners may be looking for, key misconceptions and approaches to teaching and modelling the question, so that you are able to effectively model the question to your class.

Reasoning is often a very internal process. When modelling the response to reasoning questions, it's therefore important that you 'think out loud' so that children can 'hear' and 'see' the thought processes you are going through. Of course, you can also use other modelling approaches, which could include children modelling responses to each other and sharing their thinking.

Question types included in the resource

Each week of ***Rapid Reasoning*** will showcase a variety of different question types. These include questions which are 'test style' along with questions which are more open-ended and aim to develop wider reasoning skills.

Each question is assigned a mark weighting; however, marks for questions are primarily provided to enable children to begin to judge the type of responses needed for 1, 2 or 3 marks in formal summative assessments. Each day of ***Rapid Reasoning*** contains between 3 and 6 marks.

Here are the common question types that occur throughout ***Rapid Reasoning***, along with some 'top tips' on what to look for, and what strategies children can use when tackling them.

1. Single step worded problem

This question type involves children interpreting a written problem, and carrying out a single mathematical step in order to solve it.

Top Tips:

- Ask children to 'spot the maths' within the question- what type of maths do they need to use to solve it?
- Encourage children to represent the problem- either using concrete apparatus or sketches/drawings in order to help them break into the question and identify the maths that they need to use.
- Remind children to check the answer box for any provided units.
- Remind children to check their answer makes sense in the context of the question and with any units or other information provided in the answer box.

2. Multiple step worded problem

This question type involves children interpreting a written problem which requires two or more mathematical steps in order to solve it.

Top Tips:

- Ask children to identify what information they know, and what information they need to know in order to solve the problem. They can then begin to form the 'steps' needed to solve the problem.
- Encourage children to represent the information they know, and the information they need to find out- either using concrete apparatus or sketches/drawings in order to help them break into the question and identify the maths that they need to use.
- The bar model can be a particularly useful way of approaching these types of questions. For more insights, please read our Ultimate Guide to Bar Modelling.
- Remind children to check the answer box for any provided units.
- Remind children to check their answer makes sense in the context of the question and with any units or other information provided in the answer box.

3. Problems involving measures

This question type involves children solving problems that involve units of measurement.

Top Tips:

- Encourage children to check that the units of measurements provided in the question match, and if they do not, to convert one or more measurements so that the measurements are all provided in the same unit (e.g. convert kg to g).
- Remind children to check the answer box, to see if there is any units provided. If there are units provided, they should work so that their final answer is expressed in these units.
- If no units are provided, encourage children to remember to express their answer with appropriate units. Whilst in most summative assessment questions, the answer is still credited without units, this is not always guaranteed to be the case.
- Ensure that children express units correctly. For example, 3m 20cm, 320cm or 3.20m would be a creditworthy answer, but 3m 20 would not.

4. Problems involving drawing

This question type involves children constructing an accurate drawing- either by reflection, translation, scaling or through following a set of instructions.

Top Tips:

- Encourage children to check the units of measurements provided, and ensure that they measure using the same units (e.g. they do not measure 3cm as 3mm).
- When drawing straight lines, a ruler must be used.
- Remind children that accuracy is important. They are normally only allowed an error of +/- 2mm in any line length or points.
- Remind children to ensure that any points in a shape or drawings they produce are clear.

5. Explanation questions

This question type involves children explaining either a mathematical statement or error.

Top Tips:

- Encourage children to be as concise as possible in their answers.
- Where possible, encourage numerical responses only.
- When 'disproving' a statement, children generally only need to provide one counter example.
- Ensure that everything provided by the child is mathematically correct. Even if it does not form part of their explanation, they will lose the mark for these types of questions for any mathematical inaccuracy.

6. Sequence questions

This question type involves children completing mathematical sequences.

Top Tips:

- If the 'rule' for the sequence is provided (e.g. this sequence increased by 150 each time) ensure that children do not spend time trying to calculate the rule themselves.
- If the 'rule' is not provided, encourage children to consider out what information they have and how they can work out the rule from this.
- If two numbers next to each other in the sequence are not provided, encourage children to calculate the difference between the two closest numbers in the sequence, and divide this by the number of gaps in the sequence between the two numbers.

7. Ordering questions

This question type involves children ordering numbers, fractions or measures.

Top Tips:

- Remind children to pay attention to the instructions for the question, which will say if they need to order with the highest or lowest value first. This instruction must be followed- credit is not given if the order is reversed.
- Encourage children to make sure that all the items they are ordering are in the same format- for example, that the units of measure are all the same, or the fractions are all expressed with the same denominator.
- Remind children to cross out a value when they have placed it in their order, so that they do not re-use the same value twice.
- Encourage children to check their completed order to make sure it fully follows the instructions given.

How else can you embed and develop problem-solving and reasoning skills?

In order to develop children who are proficient at reasoning and problem solving, it is important that ***Rapid Reasoning*** forms part of your approach to practising and developing problem solving and reasoning.

Every child should be given the opportunity to reason and problem solve as part of their day-to-day, quality-first maths teaching. One way in which you can do this is to develop the use of 'key constructs'– these are question stems that you can use as part of your normal teaching which will get children reasoning – without even realising it!

Key constructs are an easy way to get reasoning into every maths lesson, and some examples of the types of key constructs you could use have been provided below.

Key construct: What's the same, what's different?
In a nutshell: Give the children at least two statements, objects or numbers and ask them to compare thorn by asking: 'What's the same? What's different?'
For example: *What's the same and what's different about 2^2 and 2^3?*

Key construct: Always, sometimes, never
In a nutshell: Give the children a statement and then ask whether it is always, sometimes or *never* true.
For example: Is it always, sometimes or never true that angles inside a quadrilateral total *360°?*

Key construct: What do you notice?
In a nutshell: Ask the children, 'What do you notice?' about a number, set of numbers, shape or mathematical statement.
For example: *What do you notice about the total of angles around a point?*

Key construct: Hard and easy
In a nutshell: Ask the children to give you an example of a 'hard and 'easy' answer to a question, explaining why one is 'hard' and the other 'easy'.
For example: *Give me a hard and easy example of an equation with the answer 7/12 What makes it hard/easy?*

Key construct: Peculiar, obvious, general
In a nutshell: Give the children a statement and ask them to give a peculiar example that satisfies it, an obvious example and a general example.
For example: *Can you give me a peculiar, obvious and general example of a number sentence that has a negative number answer?*

Key construct: If this is the answer, what's the question?
In a nutshell: Give the children an answer and ask them to come up with as many questions as possible that could have that answer.
For example: *If the answer is 60cm what could my question be?*

Key construct: Convince me
In a nutshell: Give the children a statement and ask them to decide whether it is true or not, then explain their reasoning to convince you.
For example: *Convince me that on odd number plus an odd number always equals even number.*

Key construct: Odd one out
In a nutshell: Give the children a set of three or more numbers or statements and ask them to identify which number/statement is the odd one out and why.
For example: *Look at these numbers: 436, 456, 654. Which is the odd one out and why?*

Key construct: Another, another, another
In a nutshell: Give the children a statement and ask them to give you examples that satisfy the statement, and then ask for another statement, and another...
For example: *Draw me a shape where the total of the angles equal 180°. Another, another, another.*

Where to find the resources

Rapid Reasoning is one of Third Space Learning's premium Maths Hub resources and can be found by visiting mathshub.thirdspacelearning.com

Like all our resources they have been created by primary maths expert authors and practising teachers to support schools on their journey towards mastery in maths.

When you have identified those target pupils in your school who need more intensive and personalised support than classroom teaching can provide, our 1-to-1 interventions will enable any child to make rapid progress and develop conceptual as well as procedural understanding.

Reasoning and problem solving questions similar to those within this resource are at the heart of the online lessons that our specialist maths tutors provide.

Get in touch if you want to find out more: thirdspacelearning.com

Do you have a group of pupils who need a boost in maths this term?

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- Raise attainment
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Speak to us:

thirdspacelearning.com

0203 771 0095

hello@thirdspacelearning.com

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