### Mathematical Powers

John Mason has identified a set of 8 “Mathematical Powers” that all children possess and which we need to foster and develop in order to create “able mathematicians” who are able to reason about maths and problem solve. The powers, which come in pairs, are as follows:

<table>
<thead>
<tr>
<th>Conjecture</th>
<th>Convince</th>
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<tbody>
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<td>Children should be encouraged to <strong>make conjectures</strong>, that is say what they think about what they notice or why something happens. E.g., “I think that when you multiply an odd number by an even number you are always going to end up with an even number.”</td>
<td>Children should then be encouraged to <strong>convince</strong>, that is to persuade people (a partner, group, class, you, an adult at home etc) that their conjectures are true. In the process of convincing, children may use some, or all, of their other maths powers.</td>
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<th>Organise</th>
<th>Classify</th>
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<td>Children should be encouraged to <strong>organise</strong>, putting things (numbers, facts, patterns, shapes) into groups, in an order or a pattern, e.g., sorting numbers or shapes</td>
<td>Children should then be encouraged to <strong>classify</strong> the objects they have organised e.g., identifying the groups odd and even numbers, irregular and regular shapes, etc.</td>
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<th>Imagine</th>
<th>Express</th>
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<td>Children should be encouraged to <strong>imagine</strong>, objects, patterns, numbers and resources to help them solve problems and reason about mathematics.</td>
<td>Children should be encouraged to <strong>express their thinking</strong>, that is show and explain their thinking and reasoning e.g., about a problem, relationship or generalisations.</td>
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<th>Specialise</th>
<th>Generalise</th>
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<td>Children should be encouraged to <strong>specialise</strong>, that is to look at specific examples or a small set examples of something. For example, looking at the odd number 7 and the even number 8 to test their conjecture that an odd X even number = odd number. Children can also specialise in order to start to see patterns</td>
<td>Children should be encouraged to <strong>generalise</strong>, that is to make connections and use these to form rules and patterns. For example, from their specific example they could generalise that any odd number multiplied by an even number gives an even number. Children should also be encouraged to use algebra to</td>
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**Key Pedagogies**

**Prompting children’s thinking through questions:**
What do you notice?  
What is the same and what is different?

**Providing opportunities for children to:**
Engage in talk (listen, analyse, discuss)  
Manipulate, experience, visualise

**Developing children’s thinking through:**
Investigation  
Scaffolding

**Enabling learning through:**
Drawing attention to….
Developing reasoning and making connections

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**Developing Reasoning**

**Reasoning and conceptual understanding**
Encouraging children to reason in maths helps to support children to develop a conceptual and relational understanding of maths: an understanding of why maths “works”, rather than just following a set of instructions. This leads to a far greater understanding and confidence in maths.

**Key Strategies**

**Always, sometimes, never**
Give the children a statement and ask whether it is always, sometimes or never true.

*Is it always sometimes or never true that the product of two even numbers is even?*

**Another, another and another**
Give the children a statement and ask them to give you examples that meet the statement, and then ask for another example, and another……

*Can you give me a way of partitioning the number 3104? Another, another, another…..*

**Convince me**
Make a statement to the children and ask them to decide whether it is accurate or not, then explain their reasoning to convince you.

*Convince me…..that multiplication is commutative.*

**Hard and Easy**
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’

*Give me a hard and easy example of a 4 digit subtraction number sentence.*

**If this is the answer, what’s the question?**
Give children an answer and ask them to come up with as many questions as possible that could have that answer.

*The answer is 36, what could the possible questions be?*