












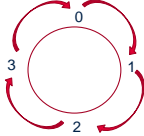












Slide 1	 <p>Advanced Mathematics Support Programme®</p>	
Slide 2	  <p><b>Mind Reading Trick</b></p> <ul style="list-style-type: none"> <li>▪ This trick enables you to look like you're reading someone's mind <ul style="list-style-type: none"> <li>• Watch <a href="#">this</a> video or</li> <li>• Watch your teacher or</li> <li>• Watch two students demonstrating it to each other or</li> <li>• Have many students demonstrate things to each other</li> </ul> </li> </ul>	<p>This trick takes a little demonstration. You could set two keen students some homework to learn the trick prior to your session, or demonstrate it yourself ( a visualiser OR large cards would be useful ) or watch the video in the link. Only demonstrate it once, you could demonstrate the set up again if you felt it beneficial, but allow students to explore the coin mechanics themselves.</p>
Slide 3	  <p><b>How it works</b></p>	
Slide 4	  <p><b>Unpicking the trick</b></p> <ul style="list-style-type: none"> <li>▪ What did you notice about the number of counters being used?</li> <li>▪ Do you think it mattered where the counters were placed?</li> <li>▪ Do you think it matters how many counters were being placed?</li> </ul>	<p>Generate some discussion to see what students have noticed from the trick. Don't give too much away, see what conclusions they have drawn. Some will be wrong at this stage, and that's ok.</p>
Slide 5	  <p><b>Unpicking the trick</b></p> <ul style="list-style-type: none"> <li>▪ Start with 3 pairs of cards.</li> <li>▪ How many counters will you need?</li> <li>▪ Can you use different amounts of counters and get the same result?</li> <li>▪ Does how you choose to set up the cards matter? Can you shuffle them? Do you have to cut them in a certain place? Does the order matter?</li> </ul> <p><i>(You may want to do the trick with the cards face up to examine the mechanics of the trick)</i></p>	<p>Using the cards upturned is very useful. Students can see that it doesn't matter where you cut the cards, but there must be one of each number in each pile, in reverse order.</p>
Slide 6	  <p><b>Unpicking the trick</b></p> <ul style="list-style-type: none"> <li>▪ Start with 4 pairs.</li> <li>▪ How many counters can you start with in which piles?</li> <li>▪ Can you create the trick straight away?</li> </ul>	<p>Start to guide the students to see if they realise that you can do this trick with 3 moves, or 7 moves, or 11 moves etc for 4 counters. They might describe it as <math>4n-1</math>.</p>

<p>Slide 7</p>	  <h3>Modulo arithmetic</h3> <ul style="list-style-type: none"> <li>The trick works on modulo arithmetic. Modulo arithmetic is also called clock arithmetic, and is best understood by a diagram such as this</li> </ul>  <p>This is a modulo four, or Mod 4 diagram. Use the diagram to show that</p> <ul style="list-style-type: none"> <li><math>6 \text{ Mod } 4 = 2</math></li> <li><math>11 \text{ Mod } 4 = 3</math></li> <li><math>8 \text{ Mod } 4 = 0</math></li> </ul>	<p>Emphasise that in Mod 4, you don't see a number greater than 3.</p>																
<p>Slide 8</p>	  <h3>Unpicking the trick</h3> <ul style="list-style-type: none"> <li>Now you should be able to change the trick.</li> <li>The trick is based on clock arithmetic.</li> <li>After completing the trick, can you fill in this table</li> </ul> <table border="1" data-bbox="261 546 523 674"> <thead> <tr> <th>Number of cards</th> <th>Number of coins</th> </tr> </thead> <tbody> <tr><td>8</td><td></td></tr> <tr><td>7</td><td></td></tr> <tr><td>6</td><td></td></tr> <tr><td>5</td><td></td></tr> <tr><td>4</td><td></td></tr> <tr><td>3</td><td></td></tr> <tr><td>2</td><td></td></tr> </tbody> </table>	Number of cards	Number of coins	8		7		6		5		4		3		2		
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<p>Slide 9</p>	  <h3>Extending the trick</h3> <ul style="list-style-type: none"> <li>Martin Gardner (an amazing recreational mathematician) presented this trick using the phrase 'last two cards match' so the first swaps would have 4 swaps, then 3, then 5, then 5.</li> <li>Can you explain how this works?</li> <li>Can you make your own phrase? You don't have to start with 10 cards, you could start with 8, or 12, or even the whole deck!</li> </ul>	<p>Students can use their own ideas to come up with a funny phrase, or joke, or a twist.</p>																
<p>Slide 10</p>	  <h3>Contact the AMSP</h3> <ul style="list-style-type: none"> <li> 01225 716 492</li> <li> <a href="mailto:admin@amsp.org.uk">admin@amsp.org.uk</a></li> <li> <a href="http://amsp.org.uk">amsp.org.uk</a></li> <li> <a href="https://twitter.com/Advanced_Maths">Advanced_Maths</a></li> </ul>																	

How the trick works:

The trick works by utilising modulo arithmetic.

The 10 cards start with abcdeabcde

When the cards are first shuffled, they're not shuffled, but just rearranged with some cards moved from the back to the front – cards are never put in the middle of the deck.

This means that after the shuffle and cut the cards are still in the same order just maybe with a different start and end point, ie they may be abcdeabcde or cdeabcdeab or deabcdeabc etc.

When you deal the first 5 cards out, you are reversing the order of the first 5 but keeping the same order of the second 5, so you will end up with

e	a
d	b
c	c
b	d
a	e

If you move any letter one at a time from top to bottom, after 4 moves you will have two letters the same on the top ( or 9 moves, or 14 moves etc )

You are then left with

d	a
c	b
b	c
a	d

3 moves then leaves you with the same cards at the top (or 8, 13 etc).

The same procedure continues for the next pairs, leaving you with a pair at the end and no moves required.

The Martin Gardner introduction of showing the trick is detailed here

<https://www.pleacher.com/mp/puzzles/tricks/cardtrk5.html>

An alternative approach is shown in this video

<https://www.youtube.com/watch?v=l9dXo5f3zDc>