

Possible extension – Digital Roots

(See also the article [Digital Roots](#) on NRICH.)

| days | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-------------|---|---|----|----|-----|------|------|-------|-------|--------|
| x2 | 1 | 3 | 7 | 15 | 31 | 63 | 127 | 255 | 511 | 1023 |
| diff | | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 |
| x3 | 1 | 4 | 13 | 40 | 121 | 364 | 1093 | 3280 | 9841 | 29524 |
| diff | | 3 | 9 | 27 | 81 | 243 | 729 | 2187 | 6561 | 19683 |
| x4 | 1 | 5 | 21 | 85 | 341 | 1365 | 5461 | 21845 | 87381 | 349525 |
| diff | | 4 | 16 | 64 | 256 | 1024 | 4096 | 16384 | 65536 | 262144 |

A table such as that above may help pupils notice things that are happening. When viewed as digital roots other things may be shown up that the pupils wish to explore.

| days | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-------------|---|---|---|---|---|---|---|---|---|----|
| x2 | 1 | 3 | 7 | 6 | 4 | 9 | 1 | 3 | 7 | 6 |
| diff | | 2 | 4 | 8 | 7 | 5 | 1 | 2 | 4 | 8 |
| x3 | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| diff | | 3 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| x4 | 1 | 5 | 3 | 4 | 8 | 6 | 7 | 2 | 9 | 1 |
| diff | | 4 | 7 | 1 | 4 | 7 | 1 | 4 | 7 | 1 |

Older and/or more experienced pupils may feel happy about exploring further using a calculator or spreadsheet. Taking the multiplying factor each time all the way up to 10 will reveal all kinds of patterns.

Those children who get on well with this may be asked the all important question as to "WHY?" these things are happening.

So, just to whet your appetite, look at the patterns evident in the digital roots of the six rows following on from those above:

| | | | | | | | | | | |
|-------------|---|---|---|---|---|----------|---|---|----------|---|
| 2's | 1 | 3 | 7 | 6 | 4 | 9 | 1 | 3 | 7 | 6 |
| 3's | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 4's | 1 | 5 | 3 | 4 | 8 | 6 | 7 | 2 | 9 | 1 |
| 5's | 1 | 6 | 4 | 3 | 7 | 9 | 1 | 6 | 4 | 3 |
| 6's | 1 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 7's | 1 | 8 | 3 | 4 | 2 | 6 | 7 | 5 | 9 | 1 |
| 8's | 1 | 9 | 1 | 9 | 1 | 9 | 1 | 9 | 1 | 9 |
| 9's | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10's | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 1 |

Also, along the way pupils may be extending their understanding of powers, and their use of calculators and spreadsheets.