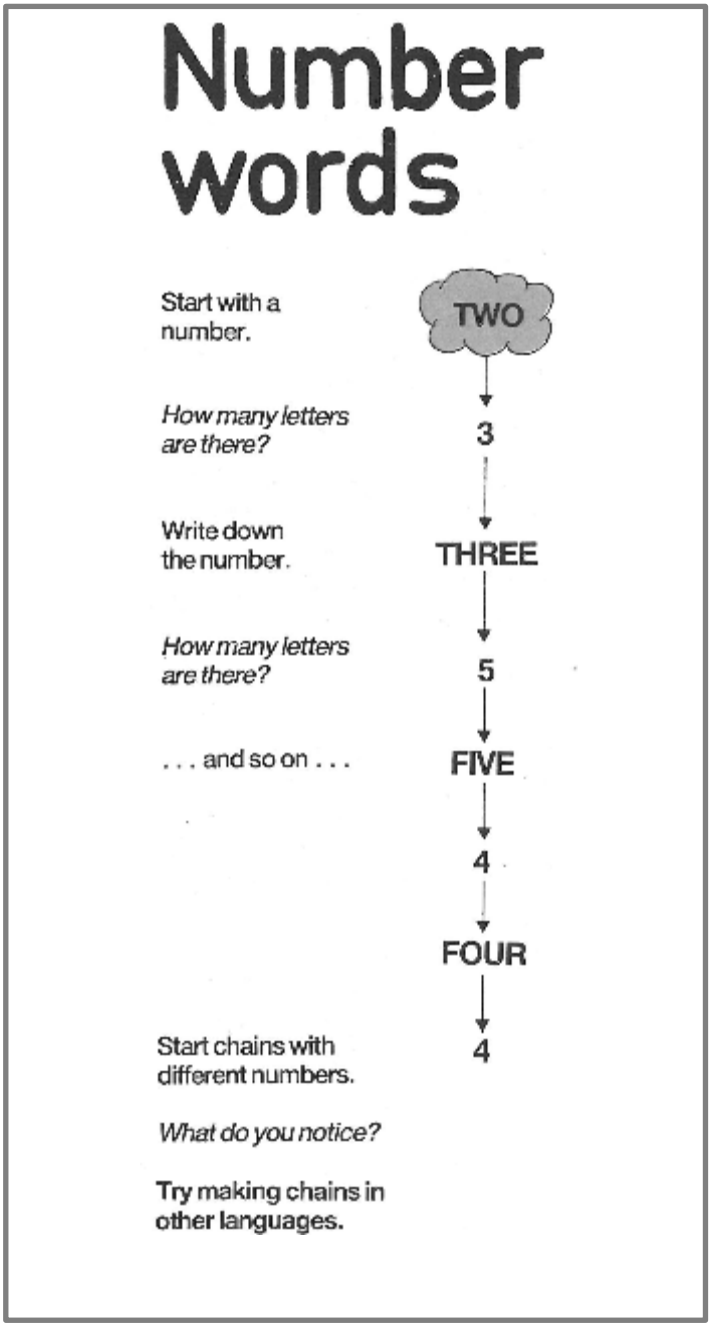
**Patterns and Generalisations part 1**

Whether you are a parent, teacher or home school educator, we've compiled examples of activities, games and puzzles which can be used to support the learning of algebra.

These examples are taken from the 'Patterns and Generalisations' packs found in our SMILE resource collection. The mathematical demand increases as you work through the packs. There are lots more ideas in the complete packs, which can be downloaded at https://www.stem.org.uk/rxzee

Answers to cards can be found at https://www.stem.org.uk/rxxo5



# Doubling Patterns

Smile Worksheet **0292**

Example

3 $\xrightarrow{\times 2}$ 6 $\xrightarrow{\times 2}$ 12 $\xrightarrow{\times 2}$ 24 $\xrightarrow{\times 2}$ 48 $\xrightarrow{\times 2}$ 96 $\xrightarrow{\times 2}$ 192 $\xrightarrow{\times 2}$ 384 $\xrightarrow{\times 2}$ 768 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐

This sequence is made from the last digit of each number above:

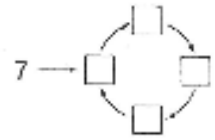
3 → 6 → 2 → 4 → 8 → 6 → 2 → 4 → 8 → ☐ → ☐

We could write the sequence like this:


Fill in the missing numbers in these sequences:

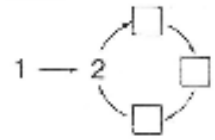
(1) 7 $\xrightarrow{\times 2}$ 14 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ 896 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐

7 → 4 → ☐ → ☐ → ☐ → ☐ → ☐ → 6 → ☐ → ☐ → ☐




(2) 1 $\xrightarrow{\times 2}$ 2 $\xrightarrow{\times 2}$ 4 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ 32 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ 256 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐

1 → 2 → 4 → ☐ → ☐ → 2 → ☐ → ☐ → 6 → ☐ → ☐




Turn over

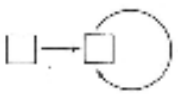
(3) 9 $\xrightarrow{\times 2}$ 18 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ 1152 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐

9 → 8 → ☐ → ☐ → ☐ → ☐ → ☐ → 2 → ☐ → ☐ → ☐

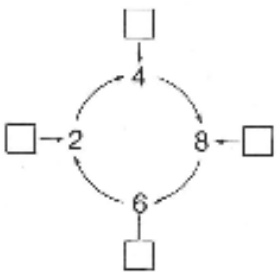
9 →

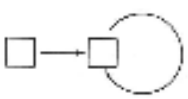
(4) 5 $\xrightarrow{\times 2}$ 10 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ 640 $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐ $\xrightarrow{\times 2}$ ☐

5 → 0 → ☐ → ☐ → ☐ → ☐ → ☐ → 0 → ☐ → ☐ → ☐



(5) All these patterns can be shown on a single diagram.
Can you fill in the missing numbers?



# Nine Nine Nine

Smile 2385

1. Copy and complete the following multiplication sequences.

| | | | | |
|---|---|---|---|---|
| 1 x 9 = 9 | 1 x 99 = 99 | 1 x 999 = 999 | 1 x 9999 = 9999 | 1 x 99999 = 99999 |
| 2 x 9 = 18 | 2 x 99 = | 2 x 999 = | 2 x 9999 = | 2 x 99999 = |
| 3 x 9 = 27 | 3 x 99 = | 3 x 999 = | 3 x 9999 = | 3 x 99999 = |
| 4 x 9 = | | | | |
| 5 x 9 = | | | | |
| 6 x 9 = | | | | |
| 7 x 9 = | | | | |
| 8 x 9 = | | | | |
| 9 x 9 = 81 | 9 x 99 = | 9 x 999 = | 9 x 9999 = | 9 x 99999 = |

**Do not use a calculator**

2. Write about your methods. How did you work out the sequences?

3. Do your methods still work for:

| | | |
|---|---|---|
| 10 x 9 = | 10 x 99 = | 10 x 999 = |
| 11 x 9 = | 11 x 99 = | 11 x 999 = |
| 12 x 9 = | 12 x 99 = | 12 x 999 = |
| 13 x 9 = | 13 x 99 = | 13 x 999 = |

# Mind Reversal


Enter 2 digits, smallest first.

26

Repeat them to make a 6 figure number.

262626

Add a number to get the digits reversed.
What number did you have to add?

626262

Repeat for other pairs of digits.
Make sure the smallest is first.

383838

What number do you have to add?

838383

Try this several times.
What do you notice about the numbers that have to be added?

If you are interested in this work, Nine Links (1374) will extend the investigation.