Seventh Heaven: Can you discover the ones digit pattern for powers of 7?

(Adapted from http://illuminations.nctm.org/BrainTeasers.aspx?id=4686)

Investigation Brief:

Working with exponents makes numbers grow in huge leaps.

Powers or exponents require you to multiply numbers by themselves.

So a^2 means a x a (not 2a) and a^6 means a x a x a x a x a x a (not 6a)

Replace a with the number 10 and you discover that a^2 = 10 x 10 = 100

And a^6 = 10 x 10 x 10 x 10 x 10 x 10 = 1,000,000!

The following challenge requires you to work with multiplication to find a pattern. But the numbers will get too big for your regular calculator – you'll have to use your reasoning powers!

$$777 \times 777 = 777^2$$
and
$$777 \times 777 \times 777 = 777^3$$

What will be the ones digit of 777^7 when it is multiplied out to a whole number?

Why might someone need to predict the different digits of very large numbers?

Resources:

- calculator

Prompts and Suggestions

Prompts	Suggestions
What do you know about the multiples of 7?	Try a few exploratory ideas with your calculator and then try to set up a systematic way of working out this problem.
What is 7^2 ? 77^2 ?	It may be helpful to try working with smaller numbers first and then trying out larger numbers

Extension

Many cultures place special emphasis on the number 7.

What can you find out about the importance of 7 in art, literature, religion, or other cultural elements?

Can you think of reasons why 7 should be an influential number?