Play to Win

65 = 64 + 1

	Power of 2	
64	2^6	1
32	2^5	0
16	2^4	0
8	2^3	0
4	2^2	0
2	2^1	0
1	2^0	1

65 = 1000001

Exercise 1 – Converting from Decimal to Binary

a. 7
b. 24
c. 53
d. (Challenge) 160
e. (Challenge) 1080

Exercise 2 – Converting from Binary to Decimal

a. 101
b. 1010
c. (Challenge) 1001011
d. (Challenge) 1000110
e. (Challenge) 10101001

Exercise 3 – Scenarios

Transform the number of sticks in each row into binary and decide which move to make next.

a. 3 sticks on the 1st row, 4 sticks on the 2nd row, 5 sticks on the 3rd row.

Exercise 4

Using the binary grids from the second presentation, try to win the game of Nim against your partner. Take turns to go first or second.

Exercise 5

Combine sticks with another pair and use new starting set ups. Now play a game of Nim with in teams of 2. Can you still use the strategy to win?

Play to Win

Extension Question

1) What is 1/2 + 1/4?
2) What is 1/2 + 1/4 +1/8?
3) What is 1/2 + 1/4 +1/8 + 1/16?
4) What is 1/2 + 1/4 +1/8 + 1/16 + ... (Think: If we keep going with this pattern what will this sum get closer and closer to)

Just like whole numbers, we can also convert fractions into binary form:

$$\frac{1}{2} = 0.\overset{\frac{1}{2}}{1}\ \overset{\frac{1}{4}}{0}\ \overset{\frac{1}{8}}{0}\ \overset{\frac{1}{16}}{0}\ \overset{\frac{1}{32}}{0}\ \cdots$$

$$\frac{1}{4} = 0.\overset{\frac{1}{2}}{0}\ \overset{\frac{1}{4}}{1}\ \overset{\frac{1}{8}}{0}\ \overset{\frac{1}{16}}{0}\ \overset{\frac{1}{32}}{0}\ \cdots$$

$$\frac{1}{8} = 0.\overset{\frac{1}{2}}{0}\ \overset{\frac{1}{4}}{0}\ \overset{\frac{1}{8}}{1}\ \overset{\frac{1}{16}}{0}\ \overset{\frac{1}{32}}{0}\ \cdots$$

We see that:

- 1/2 + 1/4 = 0.11000...
- 1/2 + 1/4 + 1/8 = 0.111000...
- 1/2 + 1/4 +1/8 + 1/16 = 0.1111000...

Continuing this idea:

- 1/2 + 1/4 +1/8 + 1/16 + ... = 0.1111111111...

5) Using your answer to Q4, what is a (much) easier way of storing the binary sequence 0.11111111...

Play to Win - Hint

Hint for those who have learnt binary using a different method.

	Remainder
65	
32	1
16	0
8	0
4	0
2	0
1	0
0	1

÷2 ÷2 ÷2 ÷2 ÷2 ÷2 ÷2

65 = 1000001

Here is a quick method for converting binary to decimals.

Divide your starting number by 2 until you reach 0.

Each time you do this write your remainder (0 or 1).

Read your remainders from top to bottom.

This should be your binary conversion!