

## NRICH MATHS CHALLENGE - Frogs

### Rohan - Wilson's School

First, I experimented using an equal number of red and blue frogs on each side. The table below shows my results:

Red frogs	Blue frogs	Total frogs	No of moves	Change in moves
1	1	2	3	-
2	2	4	8	5
3	3	6	15	7
4	4	8	24	9
5	5	10	35	11
6	6	12	48	13

I realised that the change in moves were all odd numbers and increased in increments of 2. From this, I could create a formula to predict the number of moves required using  $n$  as the number of blue or red frogs (since, in this instance, they are equal):

$$\text{No. of moves} = n^2 + 2n$$

From experimenting with red and blue frogs, I concluded that you could always swap the frogs over without moving any frogs backwards. The key thing to remember was that an alternating pattern of red and blue frogs should be maintained whilst moving the frogs.

Next I experimented when the number of red and blue frogs are not the same. The table below shows my results where there is always one more blue frog than red:

Red frogs	Blue frogs	Total frogs	No of moves	Change in moves
1	2	3	5	-
2	3	5	11	6
3	4	7	19	8
4	5	9	29	10
5	6	11	41	12

Again, I concluded that you could always swap the frogs over without moving any frogs backwards as long as the alternating pattern of red and blue frogs was maintained whilst moving the frogs. This time, the change in moves were all even numbers but still increased in increments of 2. From this, I could create a formula to predict the number of moves required.

Let "r" be the number of red frogs

Let "b" be the number of blue frogs

$$\text{No. of moves} = b^2 + r$$

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Next, I experimented where there were two more blue frogs than red frogs. The table below shows my results:

Red frogs	Blue frogs	Total frogs	No of moves	Change in moves
1	3	4	7	-
2	4	6	14	7
3	5	8	23	9
4	6	10	34	11
5	7	12	47	13

This time, the change in moves were all odd numbers but still increased in increments of 2. From this I could create a formula to predict the number of moves required.

Let "b" be the number of blue frogs

$$\text{No. of moves} = b^2 - 2$$

I also experimented where there were three more blue frogs than red frogs. The table below shows my results:

Red frogs	Blue frogs	Total frogs	No of moves	Change in moves
1	4	5	9	-
2	5	7	17	8
3	6	9	27	10
4	7	11	39	12
5	8	13	53	14

This time the change in moves were all even numbers but still increased in increments of 2. From this I could create a formula to predict the number of moves required.

Let "r" be the number of red frogs

Let "b" be the number of blue frogs

$$\text{No. of moves} = b(r + 1) + r$$