The national young mathematicians' awards 2017

On the 13th of December, Joel, Daisy, Brooke, and Vincent from Ladbrooke School went up to Cambridge University. We were going to the final for the National Young Mathematicians' Awards 2017, hosted by NRICH and Explore Learning. Being one of only five schools that had passed the 1st and 2nd round, we had already done amazingly. We had to solve questions to do with jigsaw puzzles and our parents were there with us.

We were served a buffet which was a selection of foods from M&S. There were even... puzzle sandwiches (however we didn't know that we would be doing jigsaw puzzles)! I think I might have eaten too much desert – profiteroles, millionaire's shortbread, rocky road squares, macaroons, fruit tarts –

After lunch, we walked into a separate room and had to design an icebreaker. It was a shield shape separated into 4 corners. In the top left we put our names, in the bottom left we put top tips for winning, in the bottom right we put our motto (Work together, achieve together) and in the top right something interesting about our town. We racked our brains, but could not think of anything interesting in our town, Potters Bar, so we drew... our school.

After presenting our icebreakers, the parents and teachers were asked to leave the room. The man who wrote all the problems, Bernard, explained what we had to do. After explaining what to do, we got a sheet with the problem and were allowed to start. This is the problem:

Imagine you can create any puzzle piece, including corners, edges, and middle pieces. EACH PIECE MUST HAVE AT LEAST ONE PEG AND HOLE.
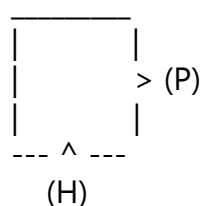
Challenge 1

Find all the possible puzzle pieces you can do, following the rules above.

Challenge 2
Using a 3x2 grid (3 along the bottom), what arrangements can you make using the pieces from challenge 1 using a flat edge?

Challenge 3
Using a 4x2 grid (4 along the bottom), what arrangements can you make using the pieces from challenge 1 using a flat edge? You have to have the following piece in the top-left corner:

```
_____
|      |
|        > (P)           (Hole on the bottom and peg on the right)
|      |
--- ^ ---
   (H)
```

For challenge one, the first thing we thought of was Pascal's triangle to check how many possibilities there were. Here are the first few rows:

```
   1          0
  1 1         1
 1 2 1        2
1 3 3 1       3
1 4 6 4 1     4
```

Pascal's triangle shows possible ways of doing something. We had to see the ways to do a middle piece. We counted how many joining points a middle piece has and went to that row (I have put the row numbers to the right of the triangle). This is row 4: |1 4 6 4 1|. This means 1 way of having no pegs, 4 ways of having one peg, 6 ways of having two pegs, 4 ways of having three pegs and 1 way of having 4 pegs. We ignored the way of having no pegs and the way of having 4 pegs because we need to have at least one peg and at least one hole. We did this process for corner and edge pieces and were sure we had every piece.

For challenges 2 and 3, we split into two groups – Vincent & Brooke and Joel & Daisy. Daisy and I did challenge two while Vincent and Brooke did challenge 3. We found 6 possibilities for each challenge.

After working hard for 1 ½ hours, we got to go on a tour around the Cambridge maths department. Things we saw were:
- A half printed and half 3d world record breaking fractal.
- A direct descendant of Isaac Newton's apple tree
- A painting of Stephen Hawkins
- A lecture hall
- A coffee place – a famous mathematician said that mathematicians are machines that turn coffee into theorems
- A common room

When we went back to the work room, Kjartan Poskitt, the man who writes Murderous Maths, gave us a talk and showed us lots of cool facts.
After half an hour of waiting, the winners were revealed – us!
We got:
- A trophy each
- A goodie bag with amazing prizes
- A M.A.X Meccano robot
- A school trip to Kidzania
- A school trophy
- £500 worth of stationary for the school

I had an amazing day and am so proud that we won
By Joel Swedensky