Tutors only—Queens of the Castle

In this activity students must place as many Queens as they can on the board without them attacking each other

Base workbook : 4 queens, 5 queens , 6 queens, 7 queens, 8 queens

Bonus: find as many solutions to the 8 queens problem OR/AND find how many rooks, bishops or knights can be placed on the 8x8 board

Once students have their first solution to the 8-queens problem, they can test it on the Giant Chessboard. They can then get the bonus worksheets from the front of the room

Your task as tutors

- See if help is needed to set up the giant chessboard
- Some tutors will stay with the giant board to help students test their solution. You may be acting as a piece on the board!
- Everyone else will be helping groups. They may need hints (on next page), you can also help check answers.

This is a surprisingly hard challenge, help them work as a team and give it a go alongside them!

8x8 challenge

There are 12 unique solutions to the 8-queens problem. At the end of the activity we want to see how many we found! Keep track of solutions found with tally marks on the solutions page. Before the end of the activity make sure to go to the computerless lead (front of the room) so they can add solutions to the list.

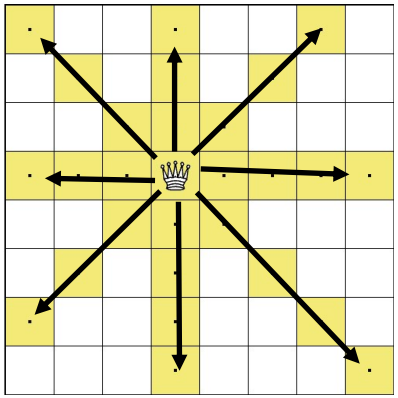
Tips

Here are some tips and tricks you can use to help the students!

Checking answers

For the smaller grids its much easier to just check if any of the queens can attack each other rather than compare the co-ordinates to a solution

A quick way to verify co-ords is to make sure each letter is included, and each number is included only once

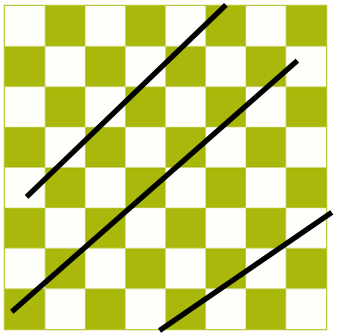


Starting square

The centre tiles give the queen maximum visibility (She can see 27 tiles!)

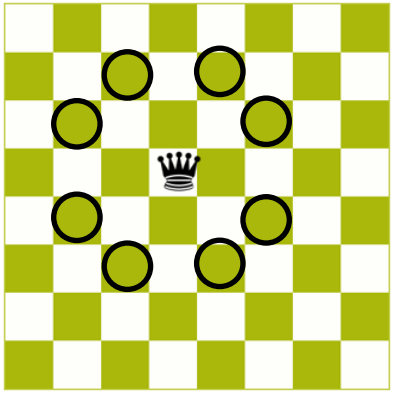
The corners also give her a lot of visibility (21 tiles!)

If students are getting stuck, suggest not using those as starting positions



Patterns

Build on your solutions from the smaller grids. What patterns can you see? Sometimes you can reuse a solution, just adding an extra row and column.



Many solutions involve creating diagonal lines. Pieces aren't actually on the same diagonal in the grid, but visually they look to be in a diagonal line

Blind spots

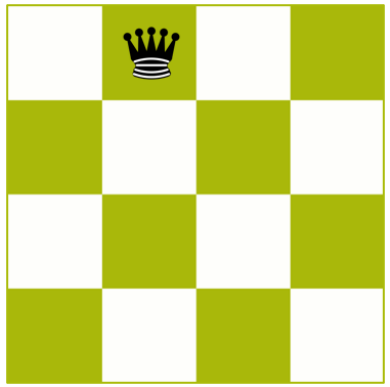
Place a queen down. What are the closest safe spots? You'll see that safe spots appear in an L shape, just like a knights move-ment.

Hint—Starting Positions

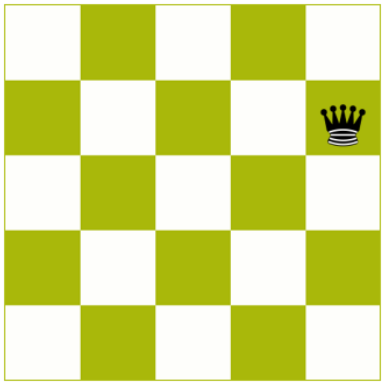
We've provided you the starting position for a solution to each problem. Give students the starting position if they are stuck. Show them more queens if needed.

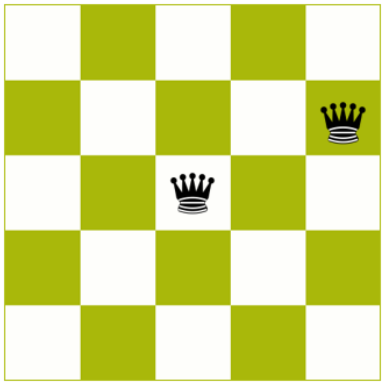
Remember—many solutions are the same, just rotated or flipped

4 Queens

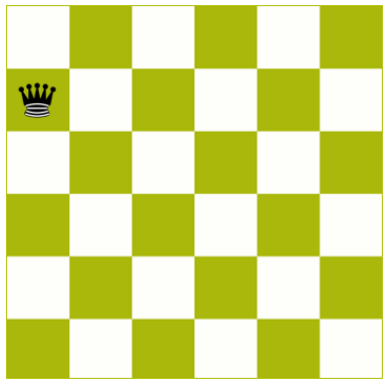


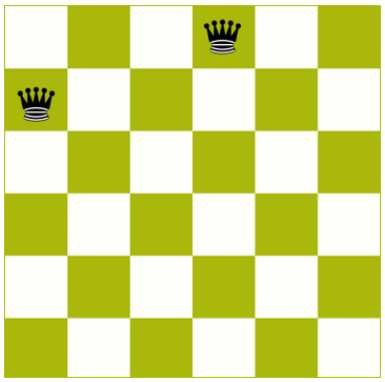
5 Queens

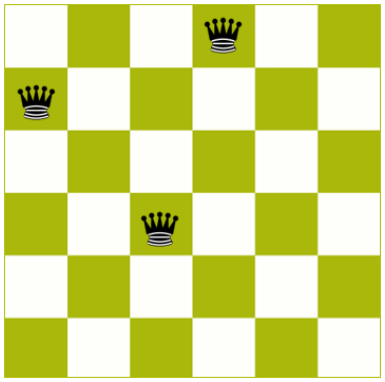




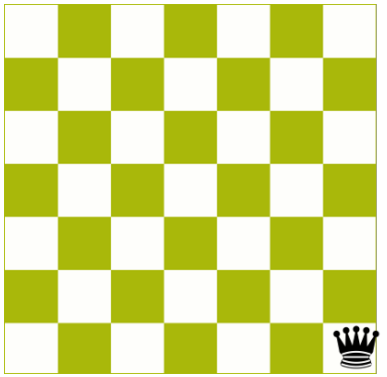
6 Queens

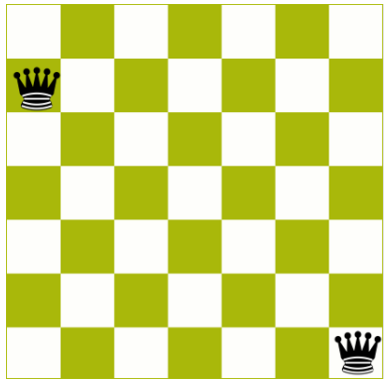


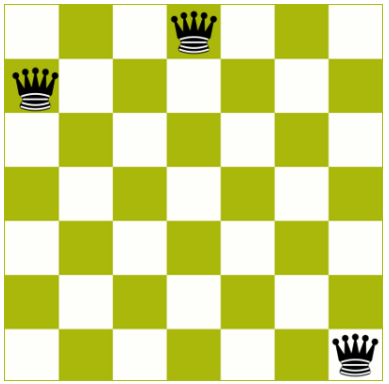


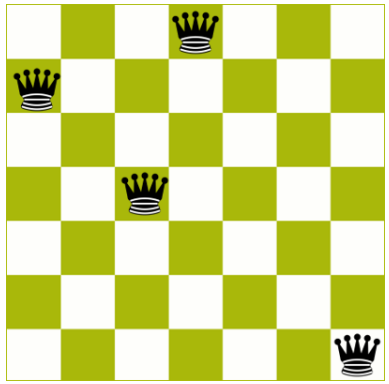


7 Queens







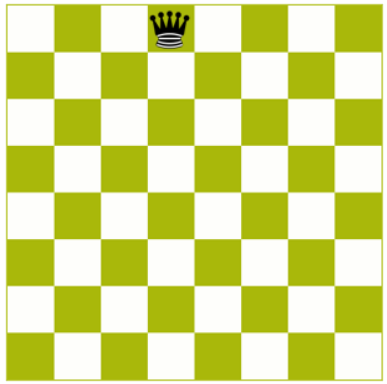


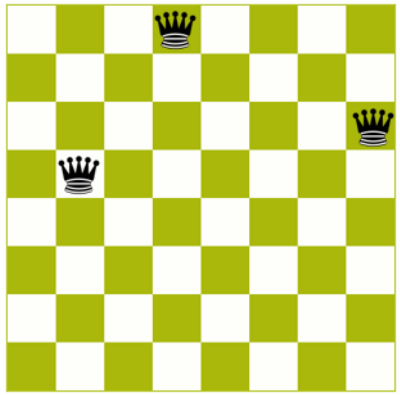
Hint—Starting Positions

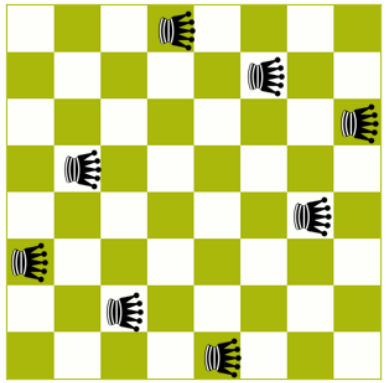
We've provided you the starting position for a solution to each problem. Give students the starting position if they are stuck. Show them more queens as needed.

Remember—many solutions are the same, just rotated or flipped

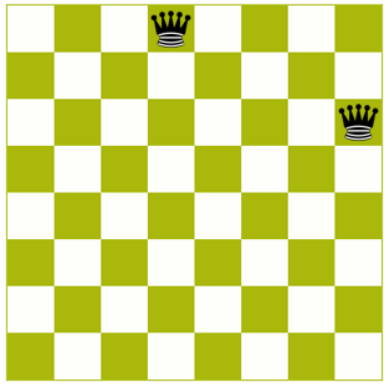
8 Queens

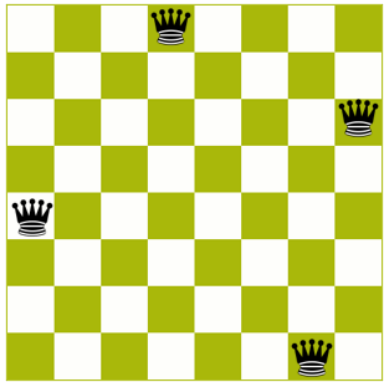


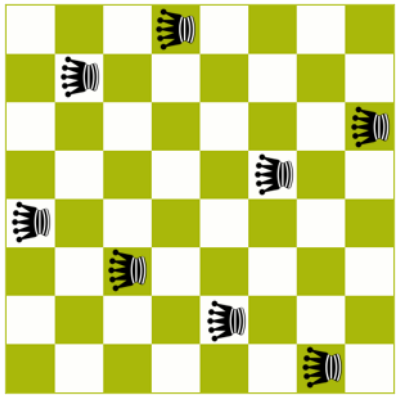




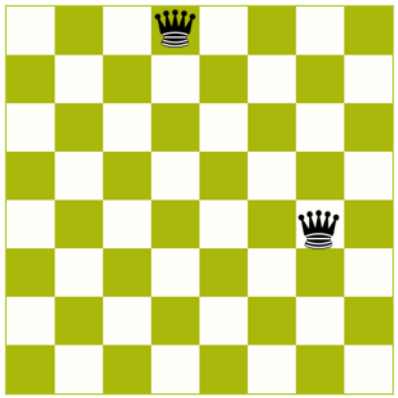
8 Queens

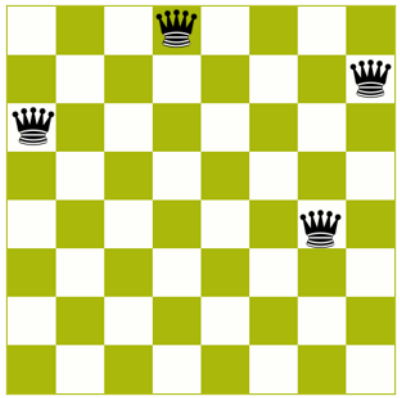


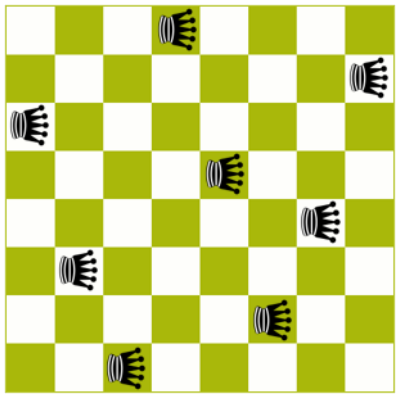




8 Queens







The 8x8 board has 92 possible solutions! (12 unique) We've started you with 3 that we think are fun.

The full solution has been provided so that you can keep revealing/confirming queen positions as needed without having to flip to the back of the booklet

Reading the solutions

It's much easier to check for errors than try check if their answer matches one on the list

Here's a handy guide to reading the solutions!

1. Start by checking each row & column has only 1 queen
2. Then check the co-ordinates. You can do this by visually comparing their answer to the pictures, or by reading the numbers

Example

Our answer sheet says: 4,8,1,5,7,2,6,3

⇒ Go to the first column. Our queen will be placed 4 squares up.

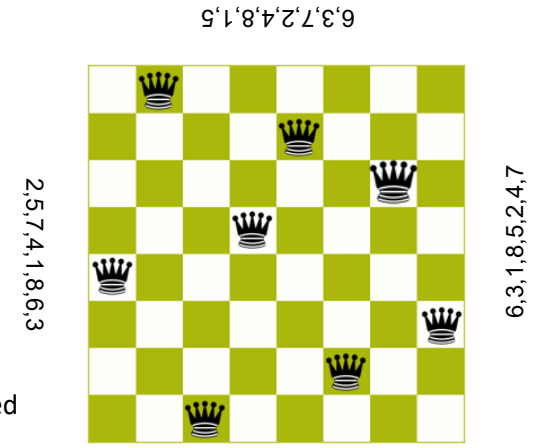
⇒ Go to the second column. Our queen will be 8 squares up.

⇒ Continue for all 8 columns

This lets us quickly check isomorphic answers (aka where it's the same positions, but the board has been rotated or flipped)

Just choose which corner of the grid you are starting from

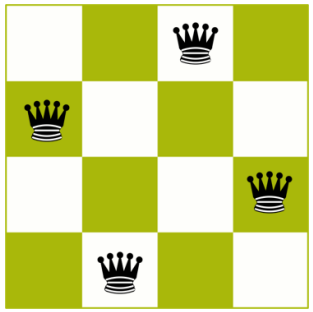
E.g. Read the set back-to-front for the flipped version



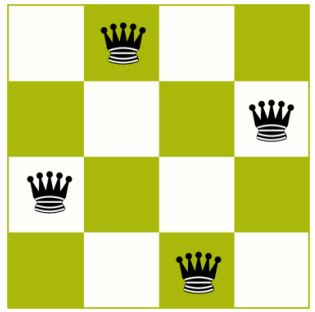
These are all correct co-ords for the same solution!

In this case, solution 5

4 Queens



3,1,4,2

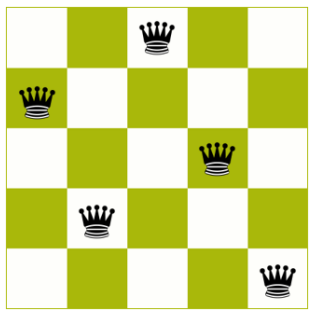


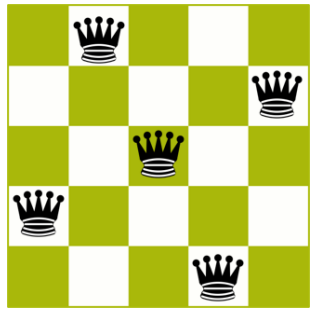
2,4,1,3

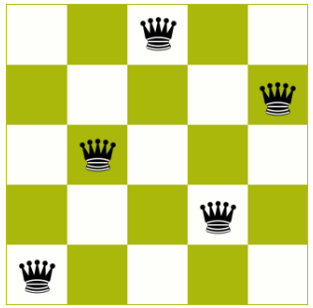
This is just rotated!

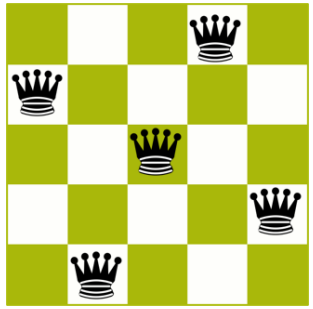
Here are all the solutions (2 total, 1 unique)

5 Queens





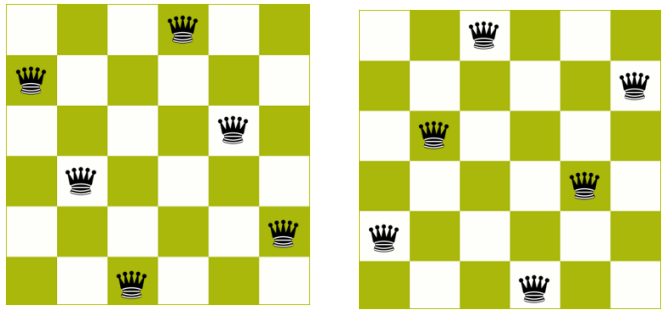




Here are all the unique solutions (10 total, 2 unique), flipped horizontally and vertically, so rotate the solution until it matches the students versions

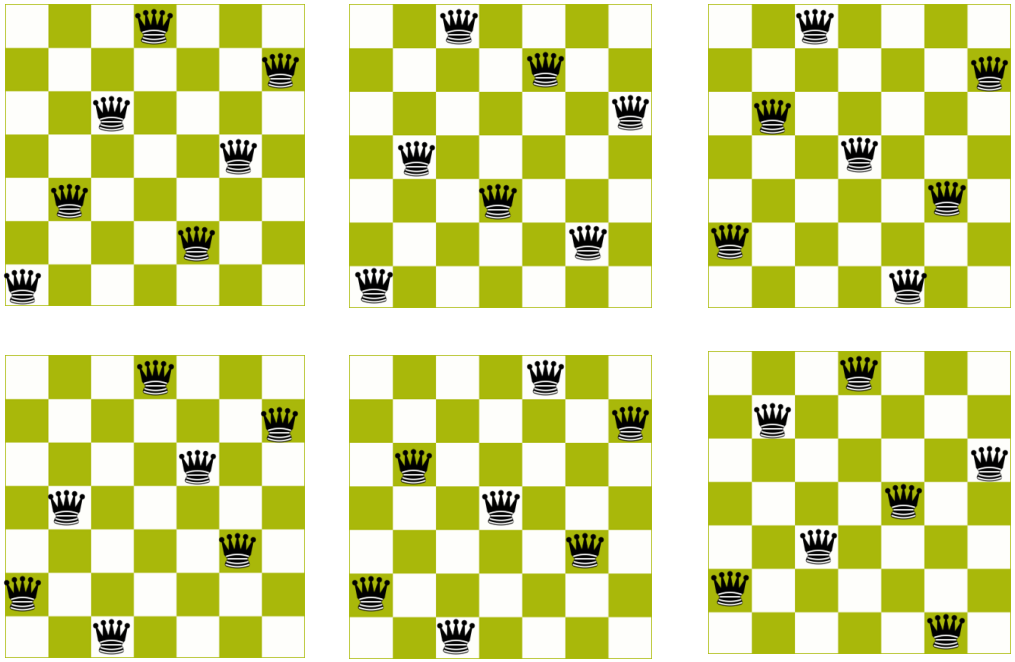
SOLUTIONS

6 Queens



Here are all the unique solutions (4 total, 1 unique), flipped horizontally and vertically, so rotate the solution until it matches the students versions

7 Queens



Here are all the unique solutions (40 total, 6 unique)

Bonus solutions

Remember—many solutions are the same, just rotated or flipped

Maximum possible pieces that can be placed on the board without them attacking eachother



Rook

8 Rooks



Bishop

14 Bishops



Knight

32 Knights, aka

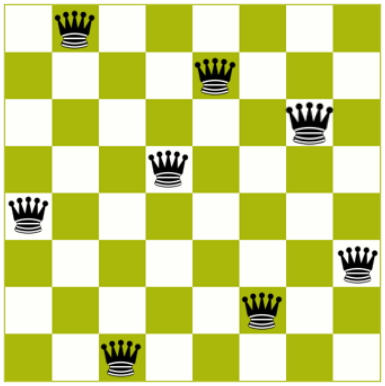
$\frac{n^2}{2}$

Queens are just a mashup of a Rook + Bishop

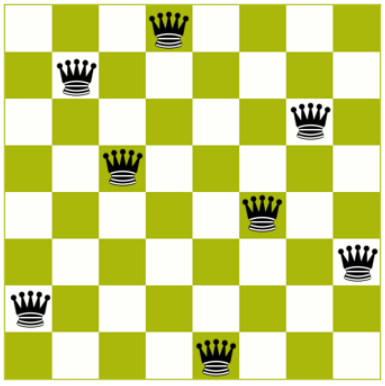
These means the 8-queens solutions are a subset of the 8-rooks problem, as well as a being subset of the 8-bishops problem.

The Knight's L shaped movement reveal safe spots from a queens eye…

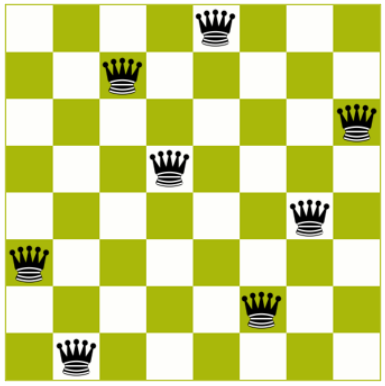
SOLUTIONS—8 Queens



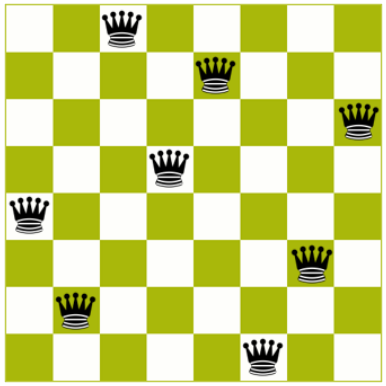
4,8,1,5,7,2,6,3



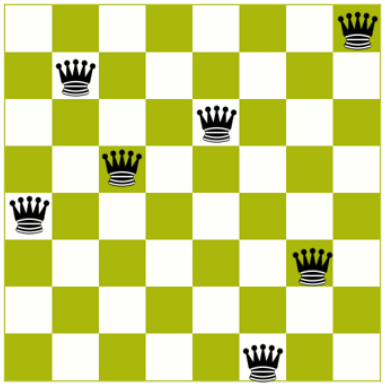
2,7,5,8,1,4,6,3



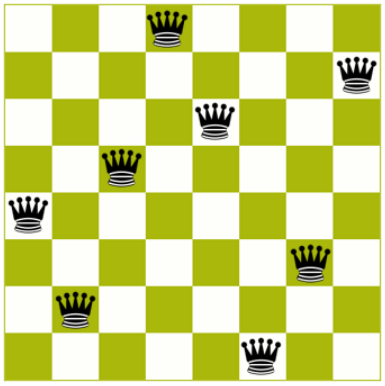
3,1,7,5,8,2,4,6



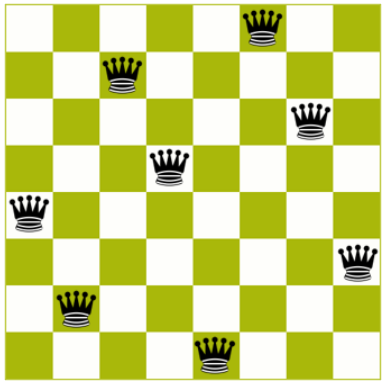
4,2,8,5,7,1,3,6



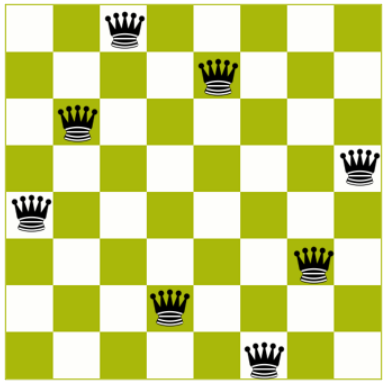
4,7,5,2,6,1,3,8



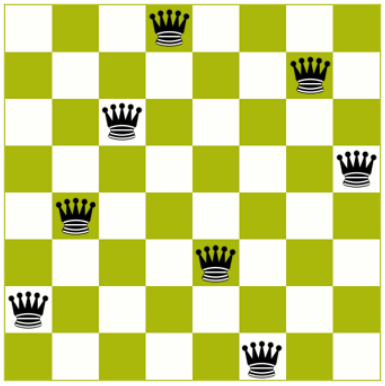
4,2,5,8,6,1,3,7



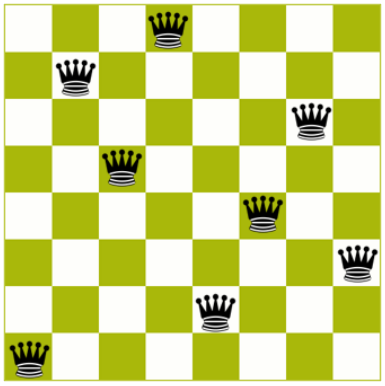
4,2,7,5,1,8,6,3



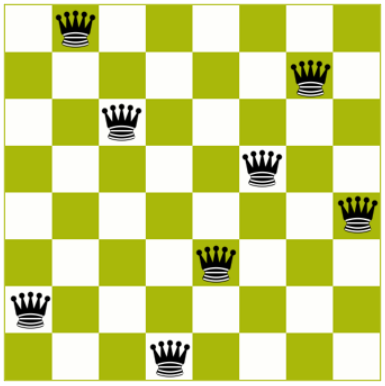
4,6,8,2,7,1,3,5



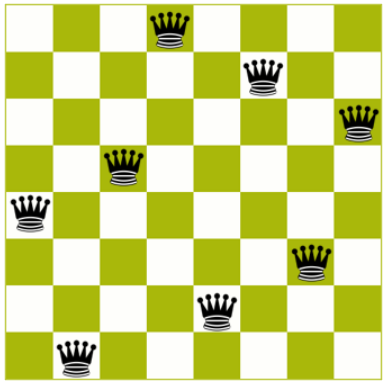
2,4,6,8,3,1,7,5



1,7,5,8,2,4,6,3



2,8,6,1,3,5,7,4



4,1,5,8,2,7,3,6

There are 12 *unique* solutions

This makes for 92 possible correct answers. Use the tricks from the earlier page to identify which one has been found!

Mark with a tally each solution confirmed to be found. Remember to bring this page to the Computerless Lead before the activity ends so they can record all the solutions found!

4,8,1,5,7,2,6,3
2,7,5,8,1,4,6,3
3,1,7,5,8,2,4,6
4,2,8,5,7,1,3,6

4,7,5,2,6,1,3,8
4,2,5,8,6,1,3,7
4,2,7,5,1,8,6,3
4,6,8,2,7,1,3,5

2,4,6,8,3,1,7,5
1,7,5,8,2,4,6,3
2,8,6,1,3,5,7,4
4,1,5,8,2,7,3,6