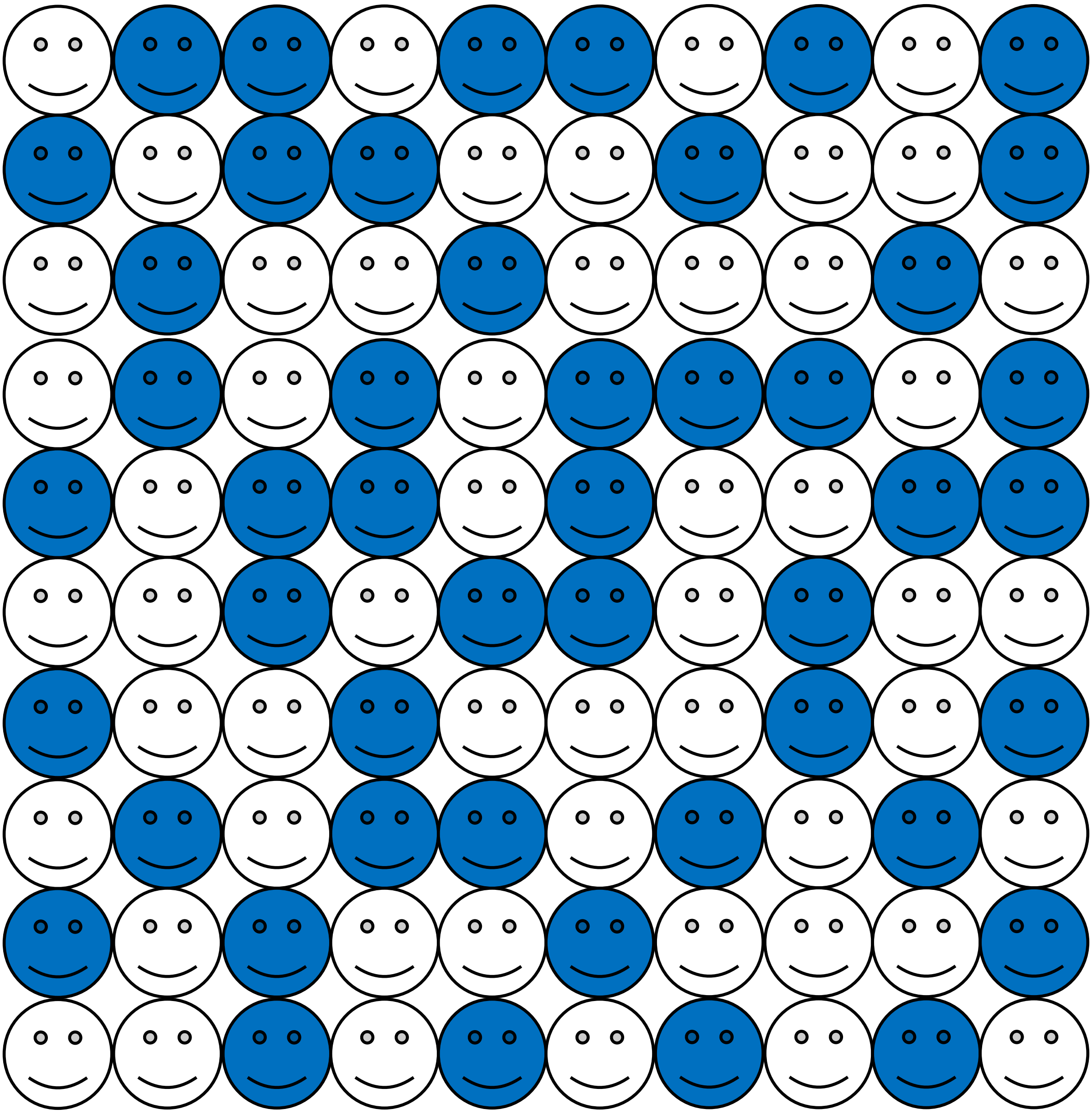
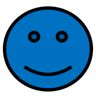
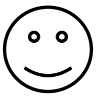
Workshop title: The Immune System and Vaccination
Document: Student handout

Modelling a pathogen outbreak: Experiment 1

50% vaccinated population



 **Vaccinated person**

 **Un-vaccinated person**

Does a 50% vaccinated population provide herd immunity and stop the pathogen spreading?

Hypothesis

Equipment

- Green colouring pencil
- A 50% vaccinated population sheet
- A coin or dice

Method

1. Pick one of the unvaccinated people. Label that person 1 and colour them in green.
2. If they are connected to another unvaccinated person – flip a coin or roll a dice so they have a 50% chance of infecting them.
    a. Heads or Even numbers = Infected
    b. Tails or Odd numbers = Uninfected
3. Infected people are coloured in green and numbered. Write the number of new infections in the Results Table.
4. If the newly infected people are connected to an unvaccinated person repeat steps 2 and 3.

Results

Results table 1			
Infected Person	Number of new infections	Infected Person (cont.)	Number of new infections (cont.)
1			

Total number of infected people =

Analysis

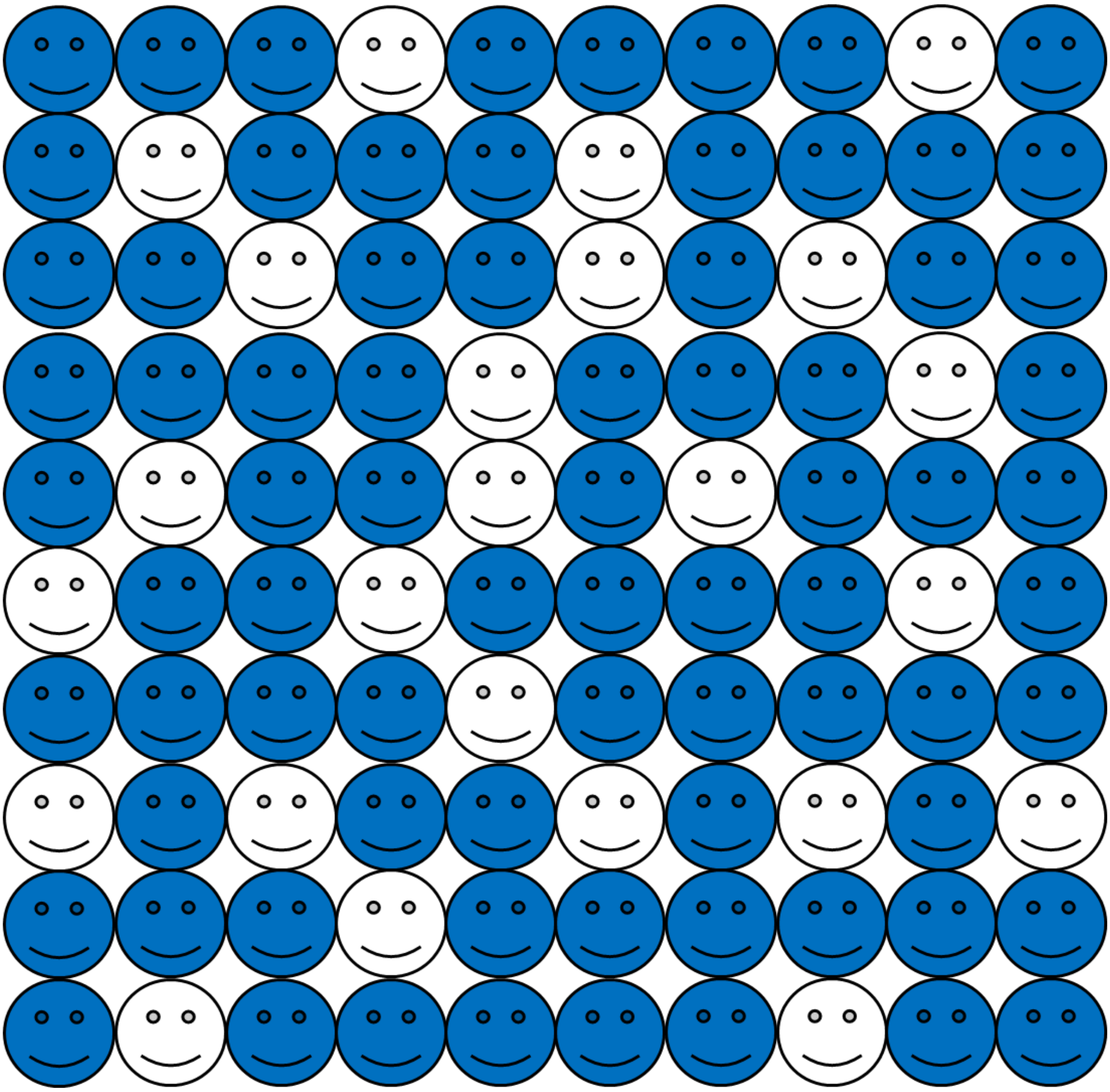
In this experiment, does a 50% vaccinated population stop the pathogen spreading? Why might this be?

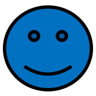
Conclusion

How does your finding fit in with the hypothesis?

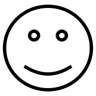
Modelling a pathogen outbreak: Experiment 2

80% vaccinated population





Vaccinated person



Un-vaccinated person

Does an 80% vaccinated population provide herd immunity and stop the pathogen spreading?

Hypothesis

Equipment

- Green colouring pencil
- An 80% vaccinated population sheet
- A coin or dice

Method

1. Pick one of the unvaccinated people. Label that person 1 and colour them in green.
2. If they are connected to another unvaccinated person – flip a coin or roll a dice so they have a 50% chance of infecting them.
    a. Heads or Even numbers = Infected
    b. Tails or Odd numbers = Uninfected
3. Infected people are coloured in green and numbered. Write the number of new infections in the Results Table.
4. If the newly infected people are connected to an unvaccinated person repeat steps 2 and 3.

Results

Results table 2	
Infected Person	Number of new infections
1	

Total number of infected people =

Analysis

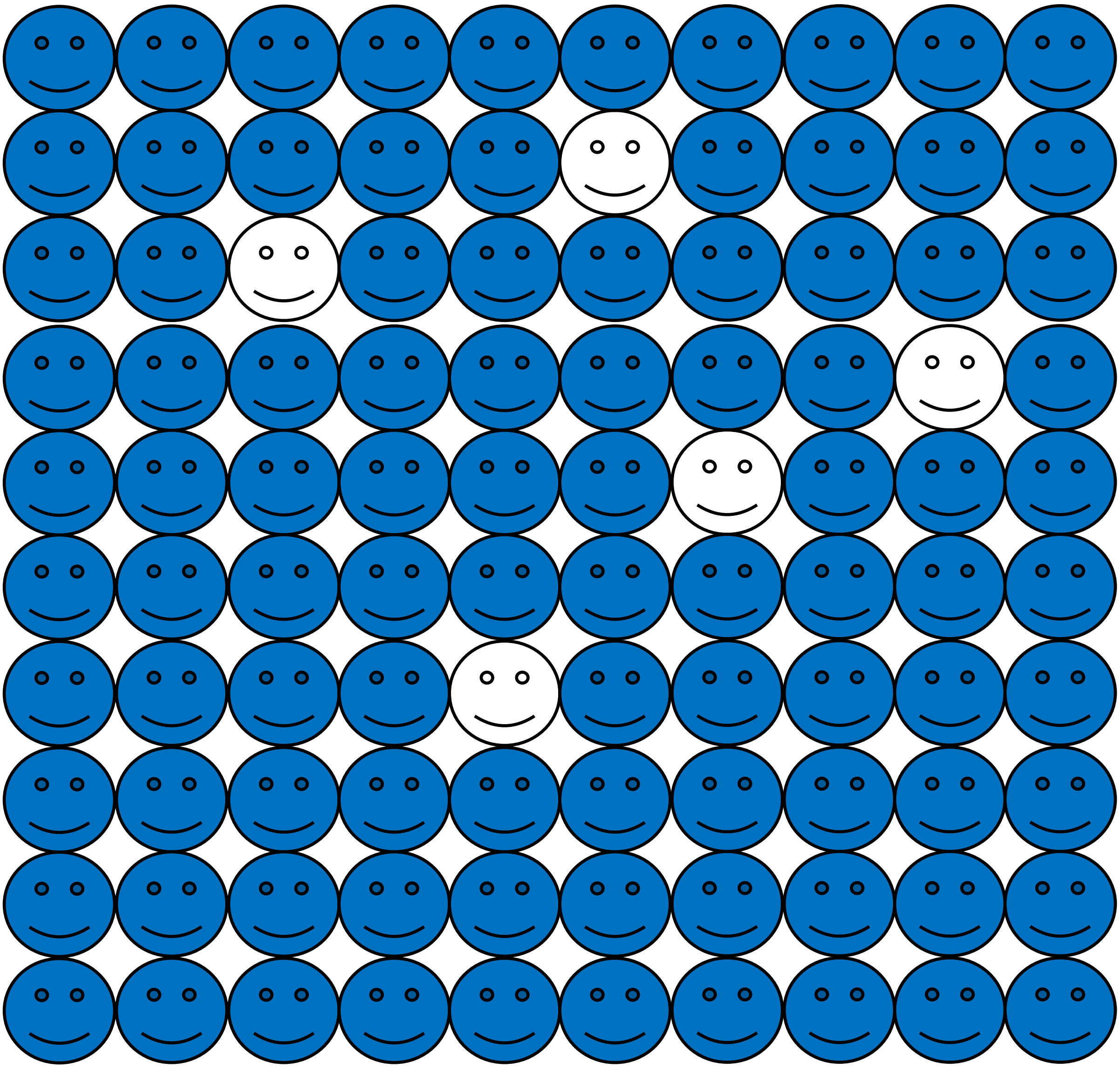
In this experiment, does an 80% vaccinated population stop the pathogen spreading? Why might this be?

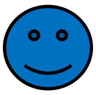
Conclusion

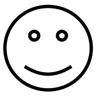
How does your finding fit in with the hypothesis?

Modelling a pathogen outbreak: Experiment 3

95% vaccinated population



 **Vaccinated person**

 **Un-vaccinated person**

Does a 95% vaccinated population provide herd immunity and stop the pathogen spreading?

Hypothesis

Equipment

- Green colouring pencil
- A 95% vaccinated population sheet
- A coin or dice

Method

1. Pick one of the unvaccinated people. Label that person 1 and colour them in green.
2. If they are connected to another unvaccinated person – flip a coin or roll a dice so they have a 50% chance of infecting them.
    - Heads or Even numbers = Infected
    - Tails or Odd numbers = Uninfected
3. Infected people are coloured in green and numbered. Write the number of new infections in the Results Table.
4. If the newly infected people are connected to an unvaccinated person repeat steps 2 and 3.

Results

Results table 3	
Infected Person	Number of new infections
1	

Total number of infected people =

Analysis

In this experiment, does a 95% vaccinated population stop the pathogen spreading? Why might this be?

Conclusion

How does your finding fit in with the hypothesis?

Modelling a pathogen outbreak: Conclusions

- Does your data match your hypotheses?
- Overall, what percentage of vaccinated population is needed to stop it spreading?

- Is this a fair test?

- How could this experiment be improved?

- What further experiments could you perform?

Modelling a pathogen outbreak: Further Experiment 4

Some pathogens spread more or less easily than others. Experiments 1, 2 and 3 had a 50% chance of infecting people around them.

Does decreasing the chance of pathogen infection (from 50% to 25%) change the vaccinated population percentage needed to stop it from spreading?

Hypothesis

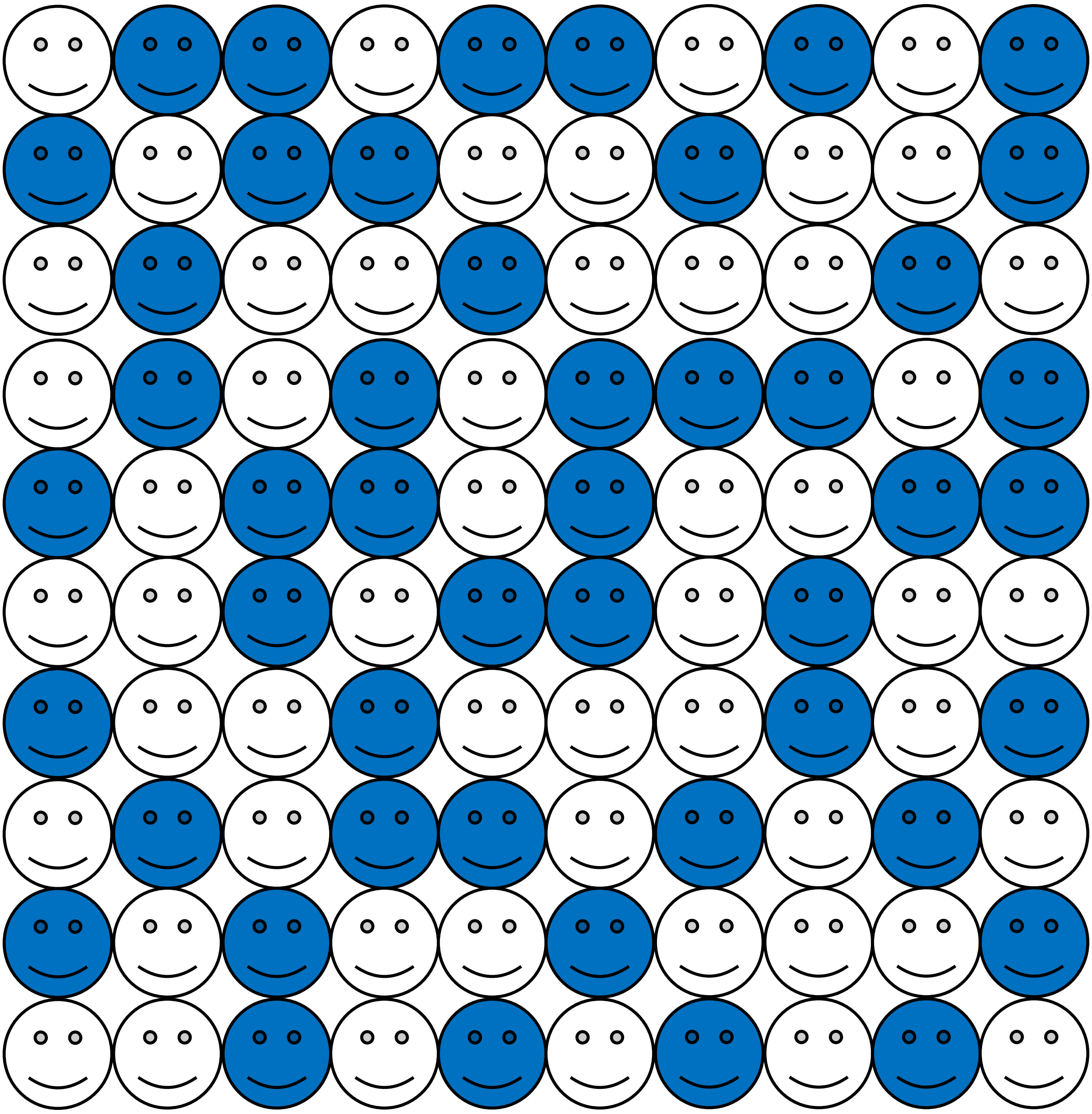
Equipment

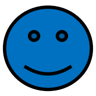
- Green colouring pencil
- A 50% vaccinated population sheet
- An 80% vaccinated population sheet
- A deck of cards with the face cards removed so all cards 1 (Ace) to 10 of the four suits are used. Shuffle the deck.

Method

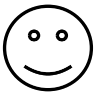
1. Pick one of the unvaccinated people on the 50% vaccinated population sheet. Label that person 1 and colour them in green.
2. If they are connected to another unvaccinated person – draw a card so they have a 25% chance of infecting them.
    a. Spade or clubs = Infected
    b. Hearts or diamonds = Not Infected
3. Infected people are coloured in green and numbered. Write the number of new infections in the Results Table.
4. If the newly infected people are connected to an unvaccinated person, repeat steps 2 and 3.
5. Once there are no new infections – repeat steps 1-5 for the 80% vaccinated population sheet. Always replace the card in the deck and shuffle.

50% vaccinated population



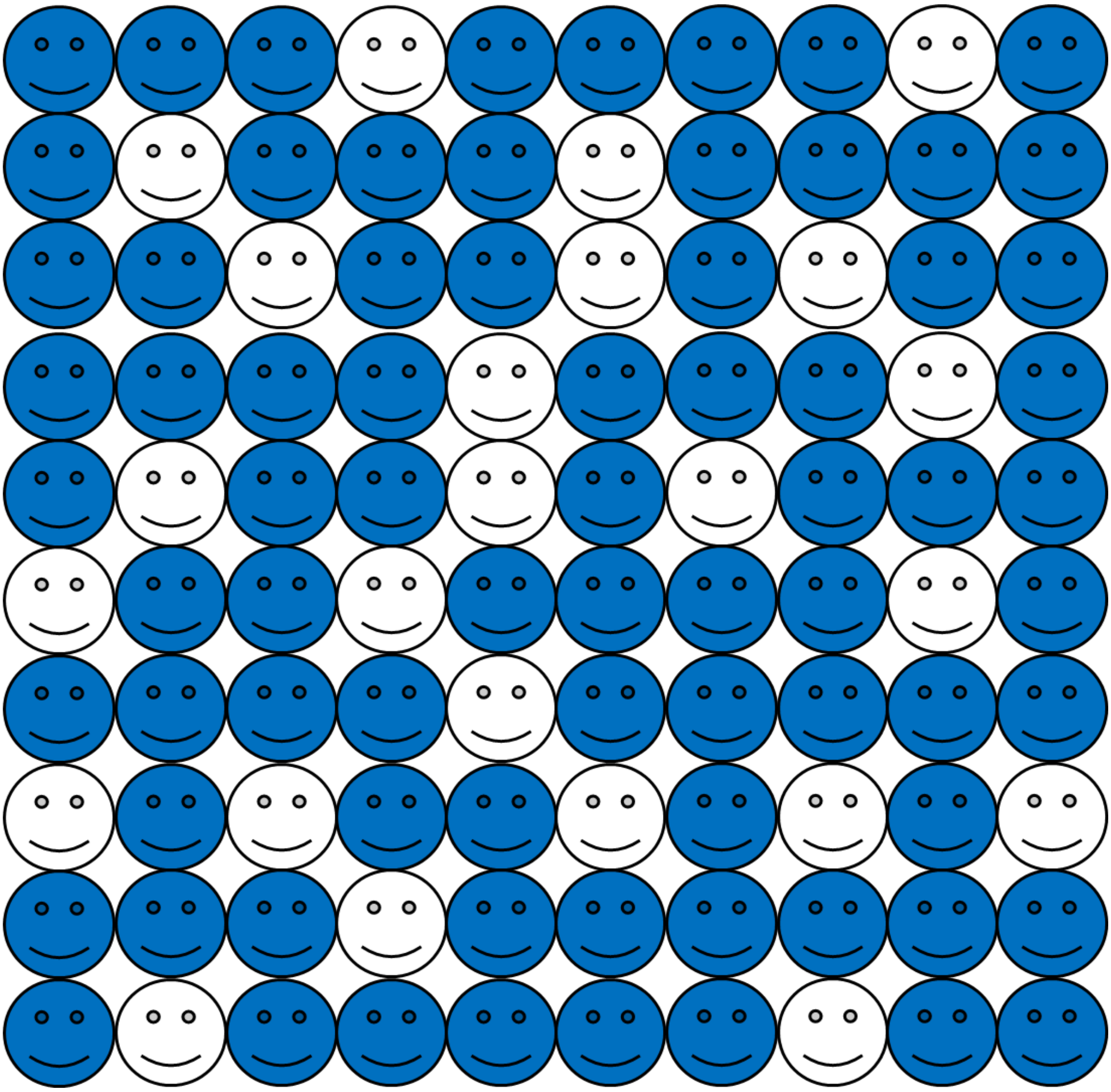


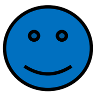
Vaccinated person

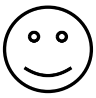


Un-vaccinated person

80% vaccinated population



 **Vaccinated person**

 **Un-vaccinated person**

Results

Results table 4 (data from 50% vaccinated population sheet)			
Infected Person	Number of new infections	Infected Person (cont.)	Number of new infections (cont.)
1			

Total number of infected people =

Results table 5 (data from 80% vaccinated population sheet)			
Infected Person	Number of new infections	Infected Person (cont.)	Number of new infections (cont.)
1			

Total number of infected people =

Analysis

In this experiment, does a 50% vaccinated population stop the pathogen spreading? Why might this be?

In this experiment, does an 80% vaccinated population stop the pathogen spreading? Why might this be?

Conclusion

How does your finding fit in with your hypothesis?

How does the number of infected people from experiment 1 and 2 compare to this experiment? Does the number of new infections change?

Modelling a pathogen outbreak: Further Experiment 5

Some pathogens spread more or less easily than others. Experiments 1, 2 and 3 had a 50% chance of infecting people around them.

Does increasing the chance of pathogen infection (from 50% to 75%) change the vaccinated population percentage needed to stop it from spreading?

Hypothesis

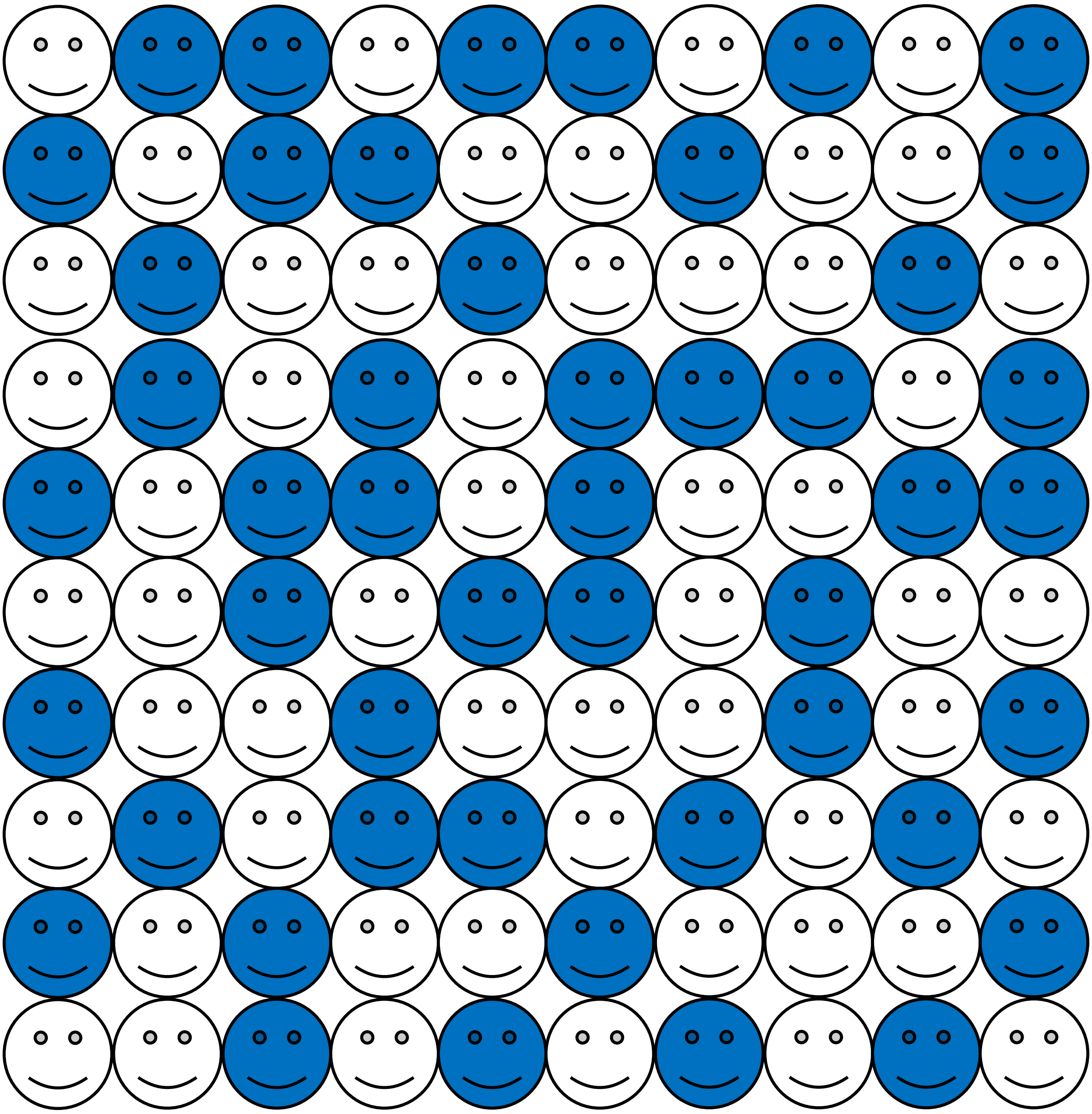
Equipment

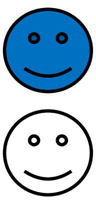
- Green colouring pencil
- A 50% vaccinated population sheet
- An 80% vaccinated population sheet
- A deck of cards with the face cards removed so all cards 1 (Ace) to 10 of the four suits are used. Shuffle the deck.
-

Method

1. Pick one of the unvaccinated people on the 50% vaccinated population sheet. Label that person 1 and colour them in green.
2. If they are connected to another unvaccinated person – draw a card so they have a 75% chance of infecting them.
   a. Spades, clubs or hearts = Infected
   b. Diamond = Not Infected
3. Infected people are coloured in green and numbered. Write the number of new infections in the Results Table.
4. If the newly infected people are connected to an unvaccinated person repeat steps 2 and 3.
5. Once there are no new infections repeat steps 1-5 for the 80% vaccinated population sheet. Always replace the card in the deck and shuffle.

50% vaccinated population

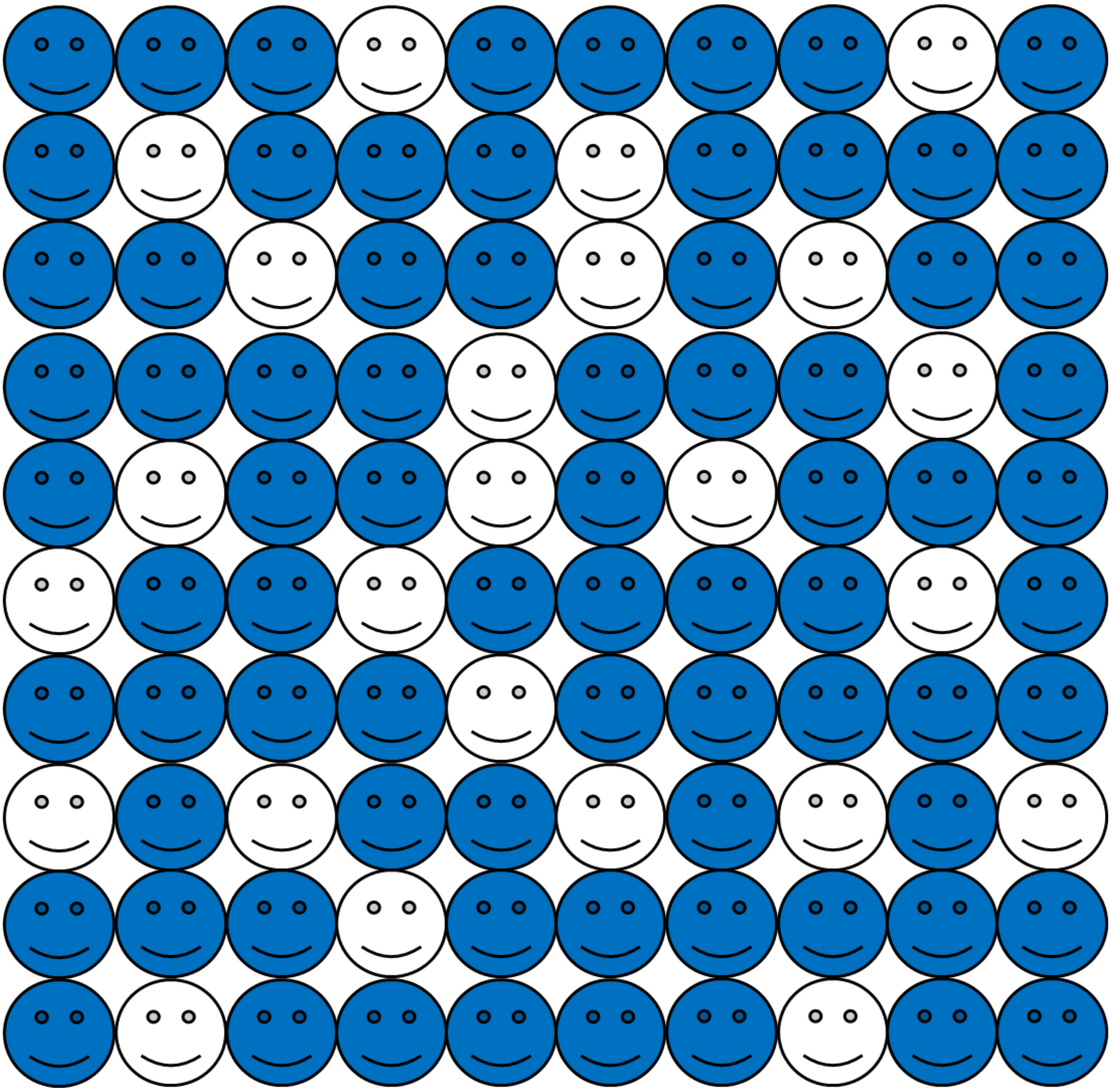


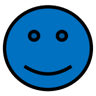


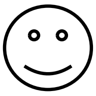
Vaccinated person

Un-vaccinated person

80% vaccinated population



 **Vaccinated person**

 **Un-vaccinated person**

Results

Results table 6 (data from 50% vaccinated population sheet)			
Infected Person	Number of new infections	Infected Person (cont.)	Number of new infections (cont.)
1			

Total number of infected people =

Results table 7 (data from 80% vaccinated population sheet)			
Infected Person	Number of new infections	Infected Person (cont.)	Number of new infections (cont.)
1			

Total number of infected people =

Analysis

In this experiment, does a 50% vaccinated population stop the pathogen spreading? Why might this be?

In this experiment, does an 80% vaccinated population stop the pathogen

spreading? Why might this be?

Conclusion

How does your finding fit in with your hypothesis?

How does the number of infected people from experiment 1 and 2 compare to this experiment? Does the number of new infections change?