
Photo by James Gathany

The Nasty Mr. Sneeze

An Addition Puzzle

Contents

Standards for Mathematical Practice

All MathPickle recommendations, including **The Nasty Mr. Sneeze**, are guaranteed to engage a wide spectrum of student abilities while targeting the following Standards for Mathematical Practice:

MP1 Toughen up!
This is problem solving where our students develop grit and resiliency in the face of nasty, thorny problems. It is the most sought after skill for our students.

MP3 Work together!
This is collaborative problem solving in which students discuss their strategies to solve a problem and identify missteps in a failed solution. MathPickle recommends pairing up students for all its puzzles.

MP6 Be precise!
This is where our students learn to communicate using precise terminology. MathPickle encourages students not only to use the precise terms of others, but to invent and rigorously define their own terms.

MP7 Be observant!
One of the things that the human brain does very well is identify pattern. We sometimes do this too well and identify patterns that don't really exist.

Common Core State Standards

The Nasty Mr. Sneeze targets Common Core State Standards for students learning addition. I also find large cases very difficult to solve. It's always a good sign when a mathematician has trouble with a K-2 puzzle ;-)

Grades K-2

CCSS.MATH.CONTENT.K.MD.A.2
Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute.

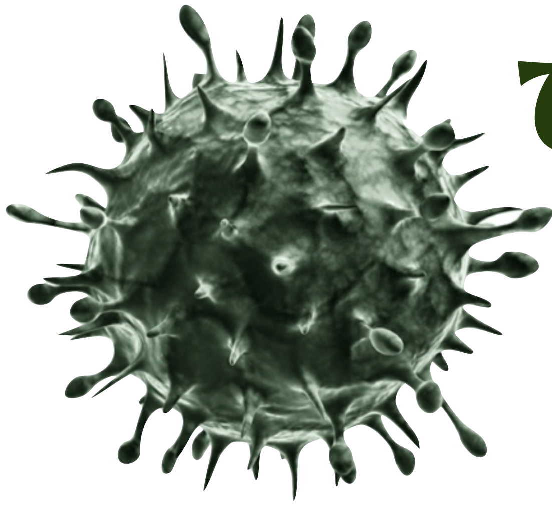
CCSS.MATH.CONTENT.1.OA.C.6
Add and subtract within 20, demonstrating fluency for addition and subtraction within 10.

CCSS.MATH.CONTENT.2.OA.B.2
Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers.

CCSS.MATH.CONTENT.2.NBT.B.5
Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.

CCSS.MATH.CONTENT.2.NBT.B.6
Add up to four two-digit numbers using strategies based on place value and properties of operations.

http://www.corestandards.org/Math/Practice/



The Nasty Mr. Sneeze

Students gather in a line, loop, grid or some other pattern. Some are connected to others. The objective is to make the Nasty Mr. Sneeze score the fewest points. He scores a point for each student:

- sent home.
- in the biggest connected group.

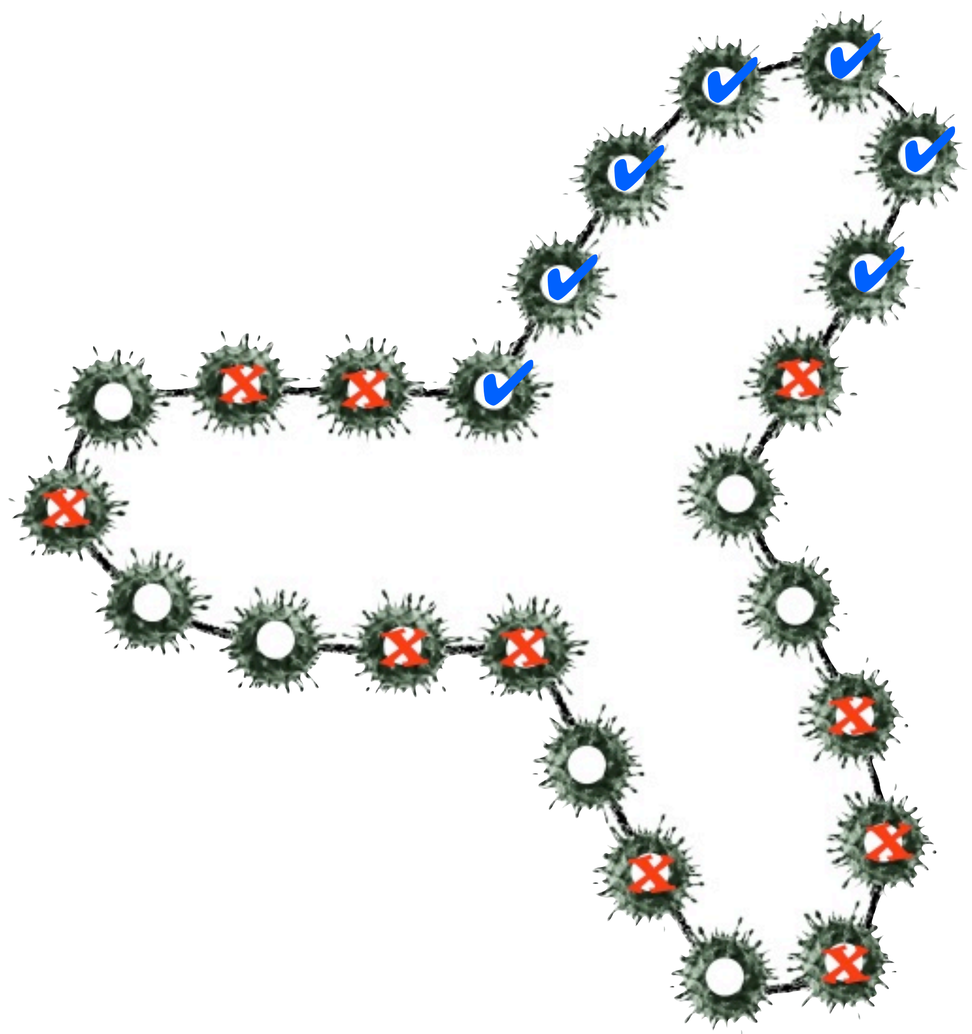
Number Children Sent Home **10**

+

Biggest Connected Group **7**

=

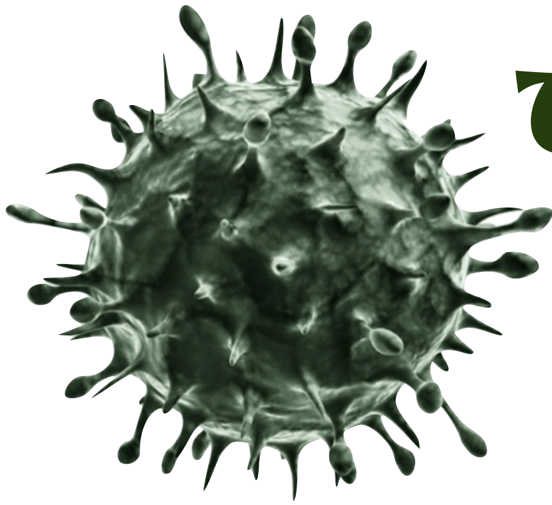
Mr. Sneeze Score **17**



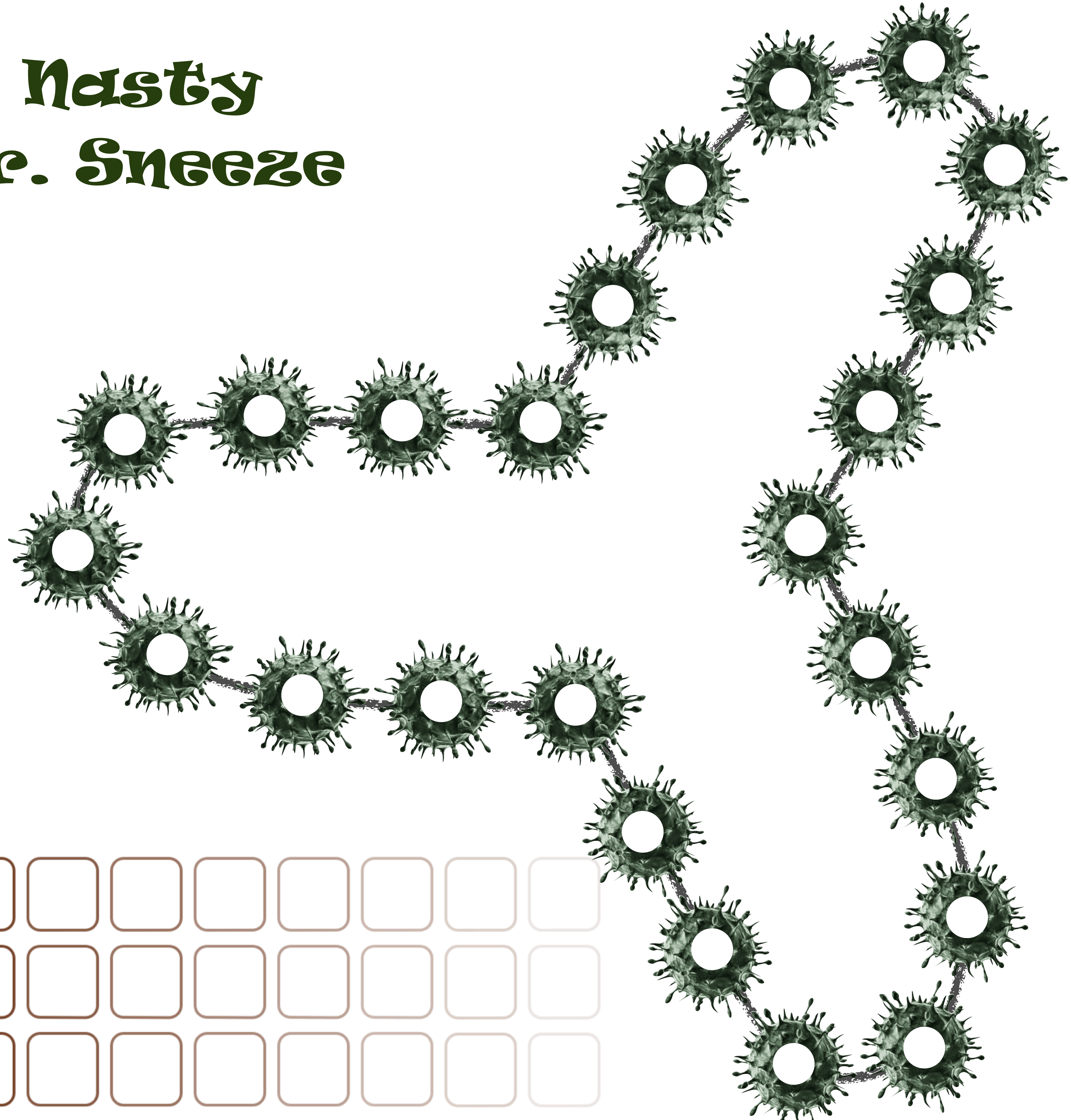
Example: 24 children are in this loop. Which students should be sent home so that Mr. Sneeze gets the lowest score? Calculate his score by adding the number of students sent home plus the number of students in the largest connected group. In the example on the left the number of students sent home (red Xs) is 10. The largest connected group remaining are the 7 students with blue checkmarks. Mr. Sneeze has scored 17 points.

Next page - try to make him score less!

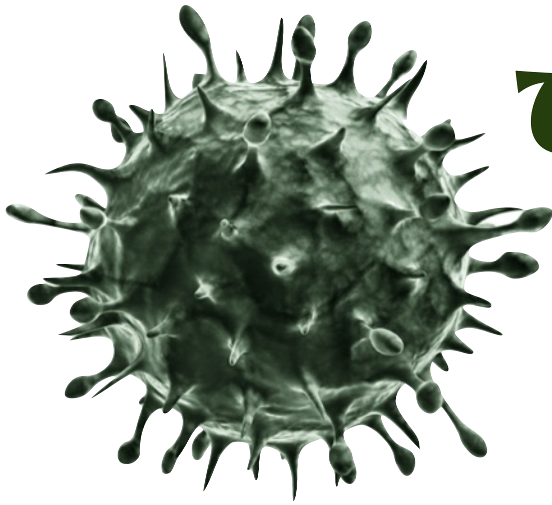
After the next page I'll solve the puzzle. In front of your class, you always want to write down successive additions and we'll do that as well. There are interesting patterns going on in the numbers as well as in the final pattern of students sent home.



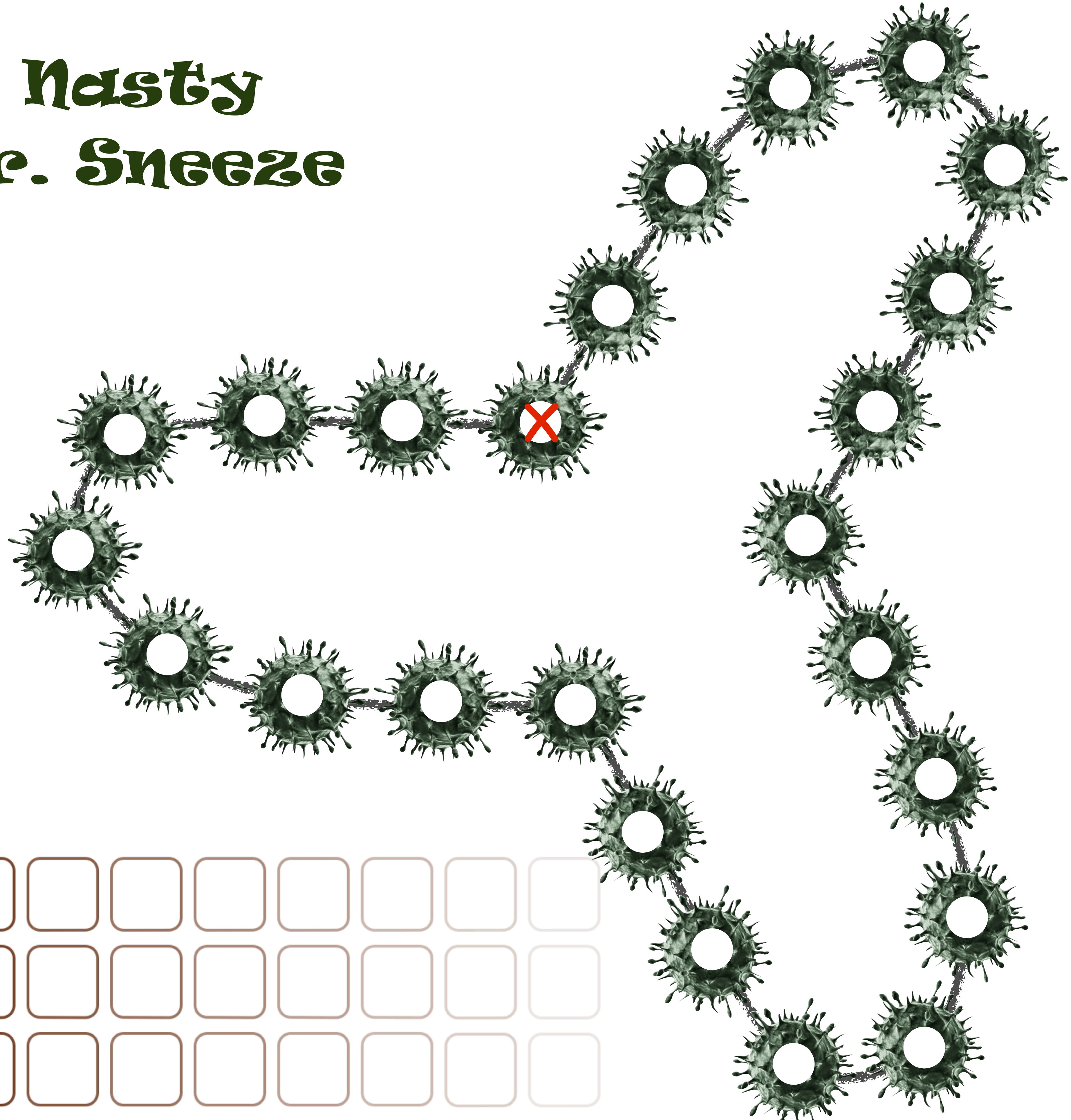
The Nasty Mr. Sneeze



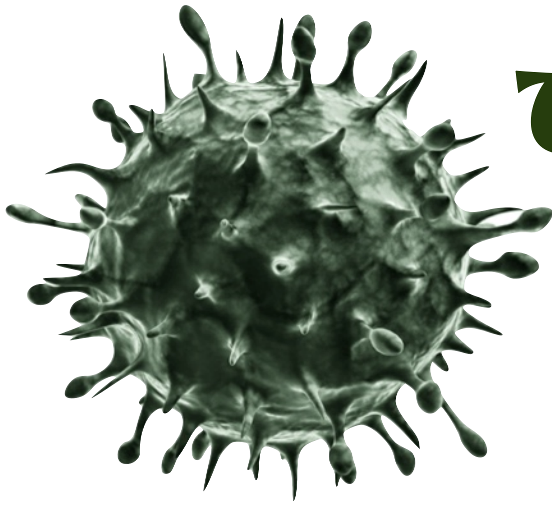
Number Children Sent Home	0									
+										
Biggest Connected Group	24									
=										
Mr. Sneeze's Score	24									



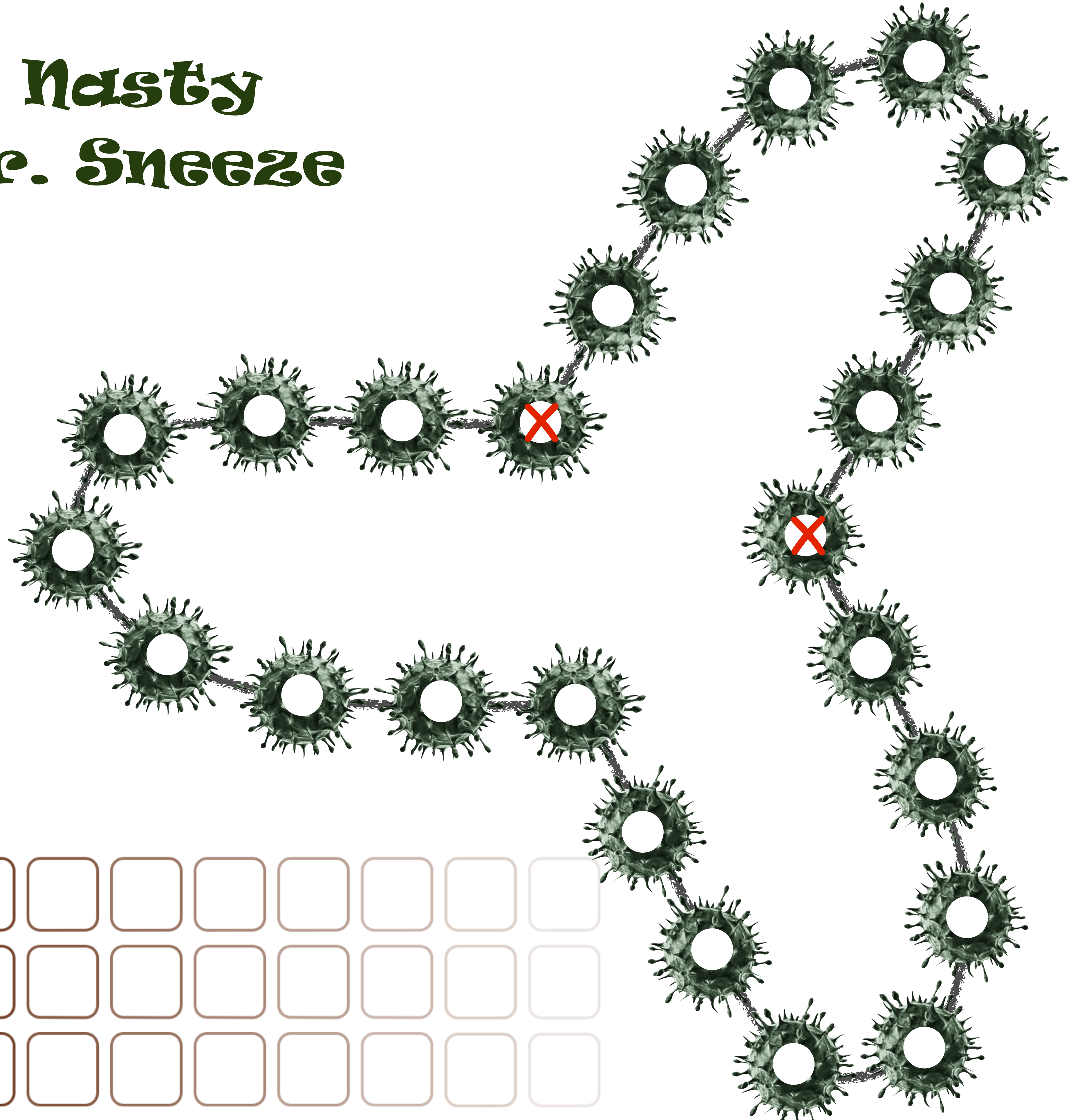
The Nasty Mr. Sneeze



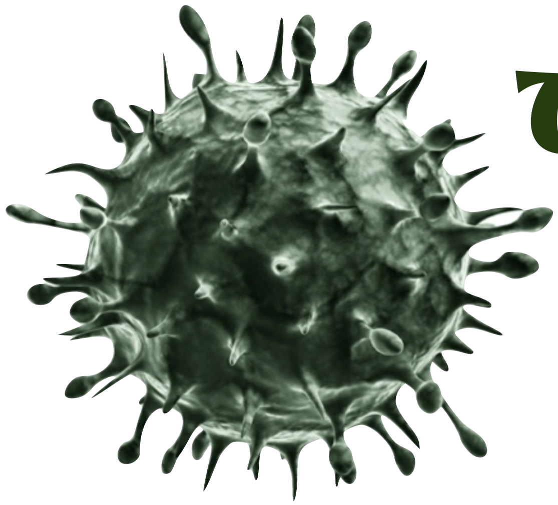
Number Children Sent Home	0	1								
+										
Biggest Connected Group	24	23								
=										
Mr. Sneeze's Score	24	24								



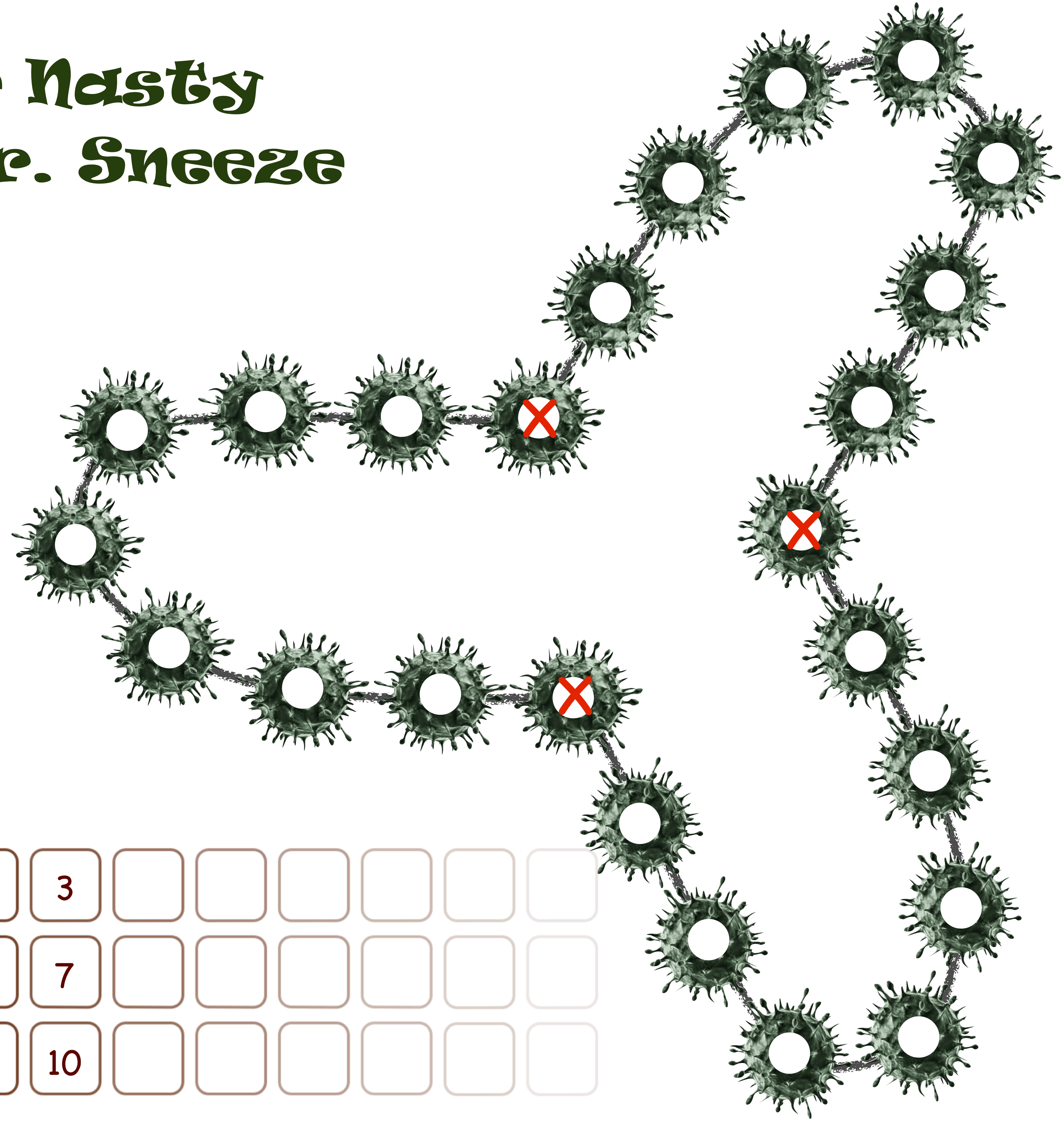
The Nasty Mr. Sneeze



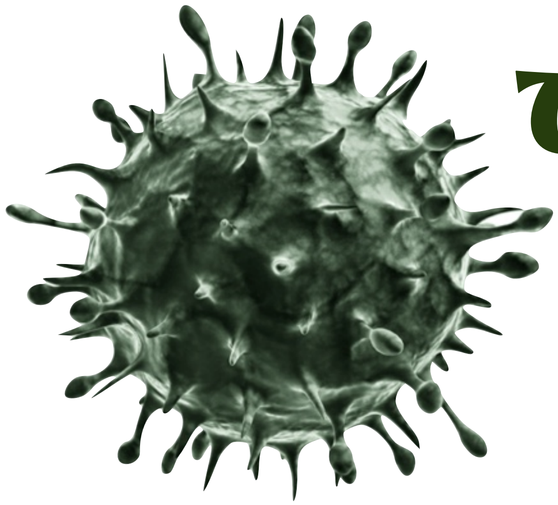
Number Children Sent Home	0	1	2							
+ Biggest Connected Group	24	23	15							
= Mr. Sneeze's Score	24	24	17							



The Nasty Mr. Sneeze



Number Children Sent Home	0	1	2	3						
+										
Biggest Connected Group	24	23	15	7						
=										
Mr. Sneeze's Score	24	24	17	10						



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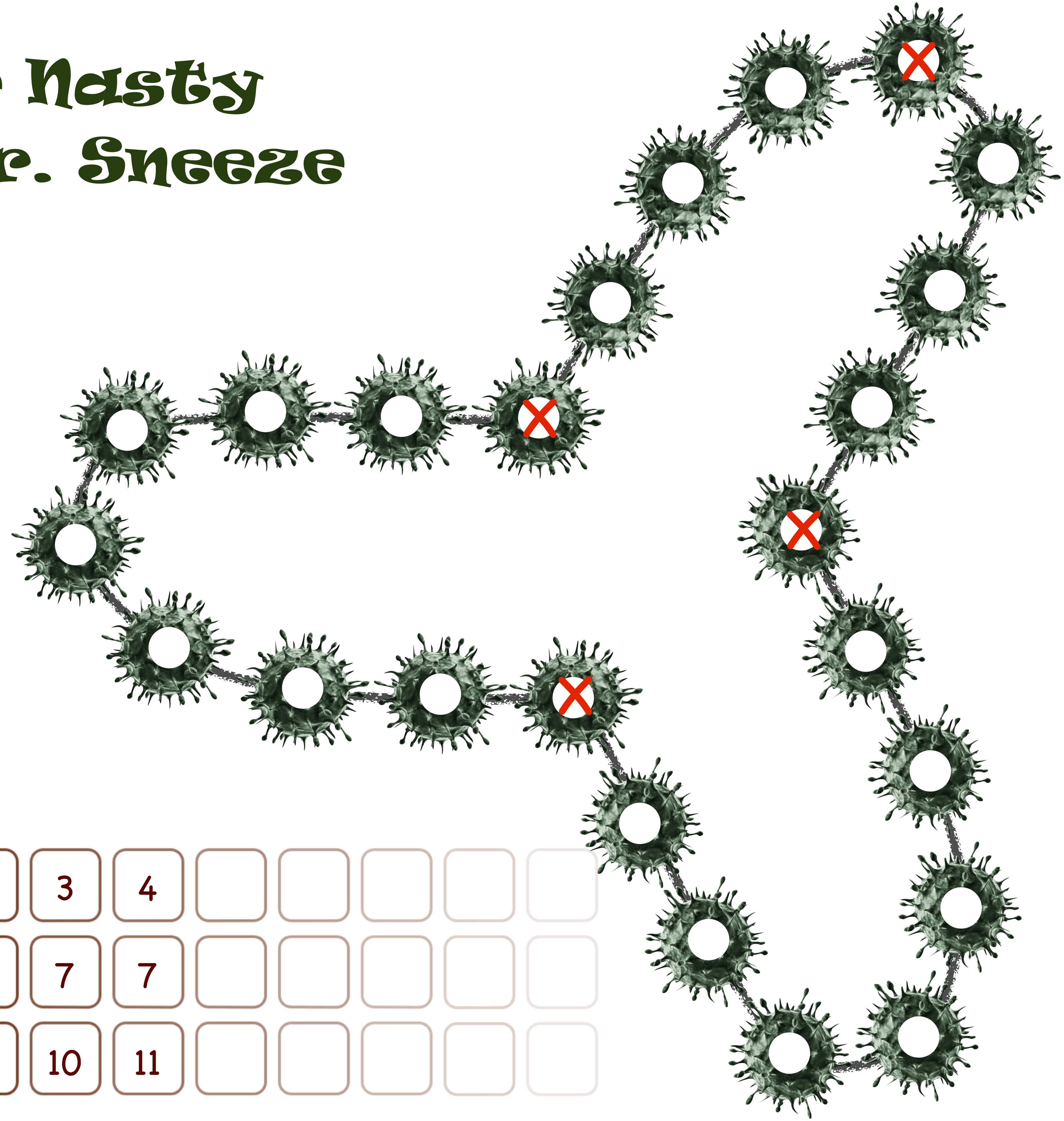
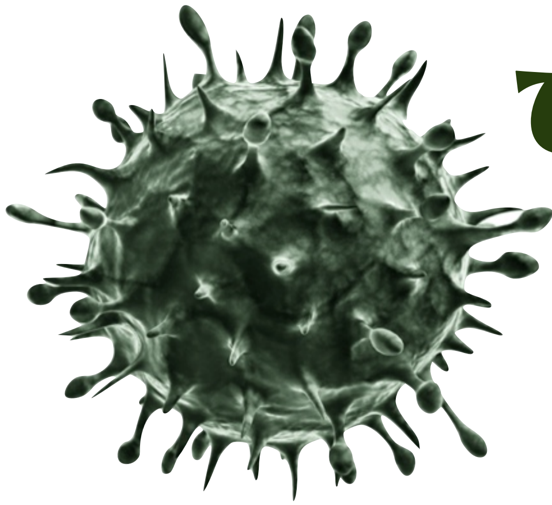
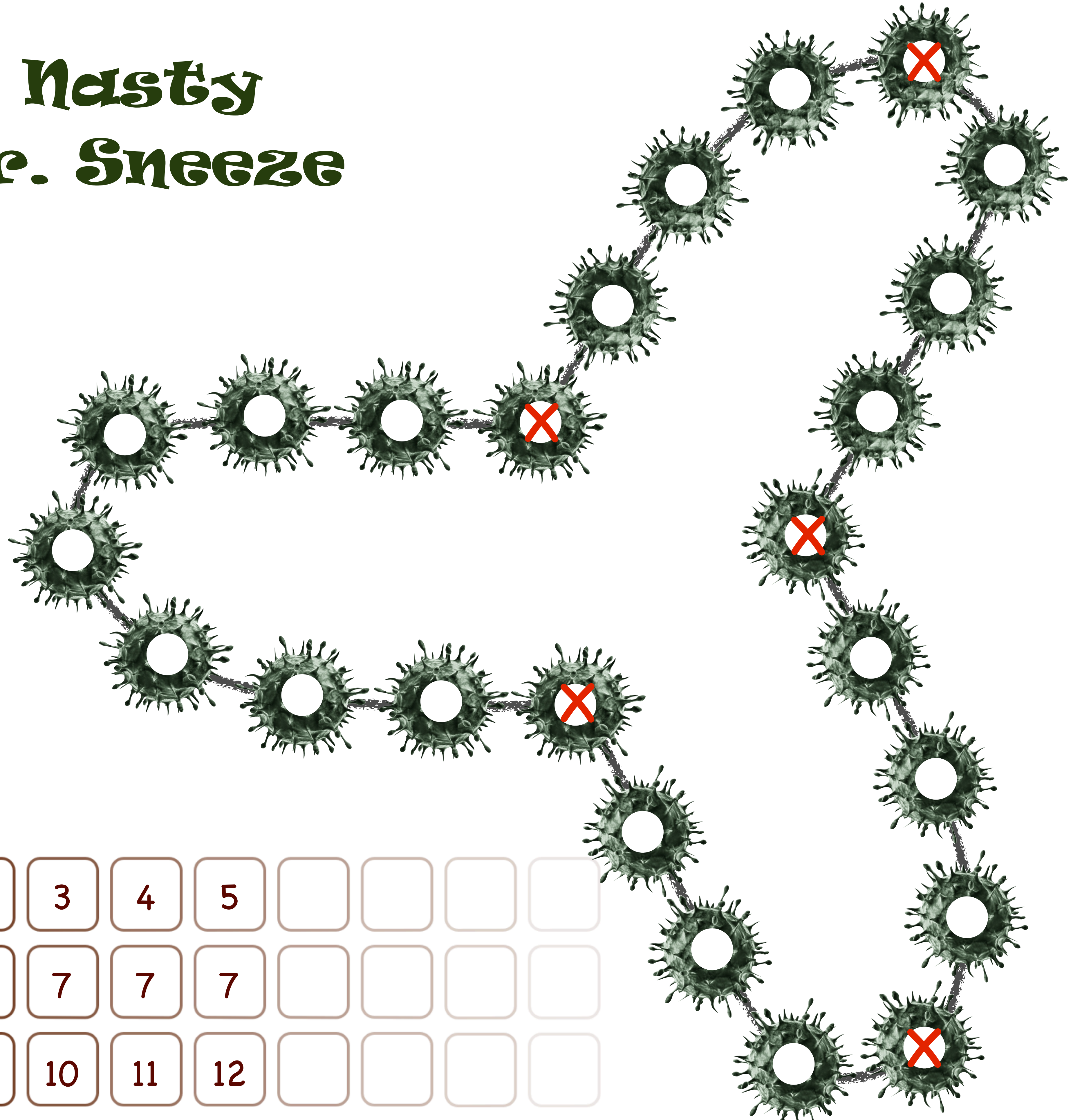


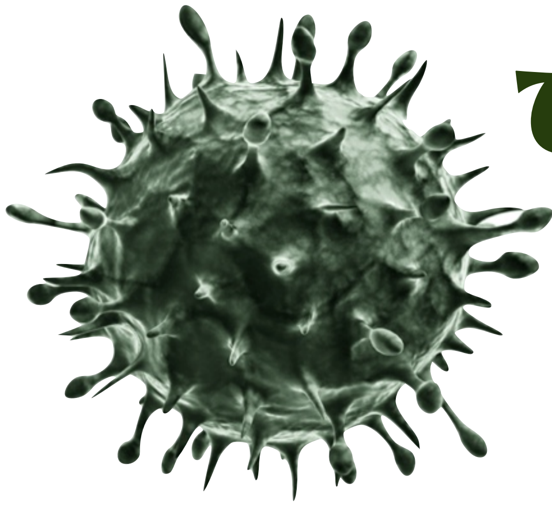
Number Children Sent Home	0	1	2	3	4					
+										
Biggest Connected Group	24	23	15	7	7					
=										
Mr. Sneeze's Score	24	24	17	10	11					



The Nasty Mr. Sneeze



Number Children Sent Home	0	1	2	3	4	5				
+ Biggest Connected Group	24	23	15	7	7	7				
= Mr. Sneeze's Score	24	24	17	10	11	12				



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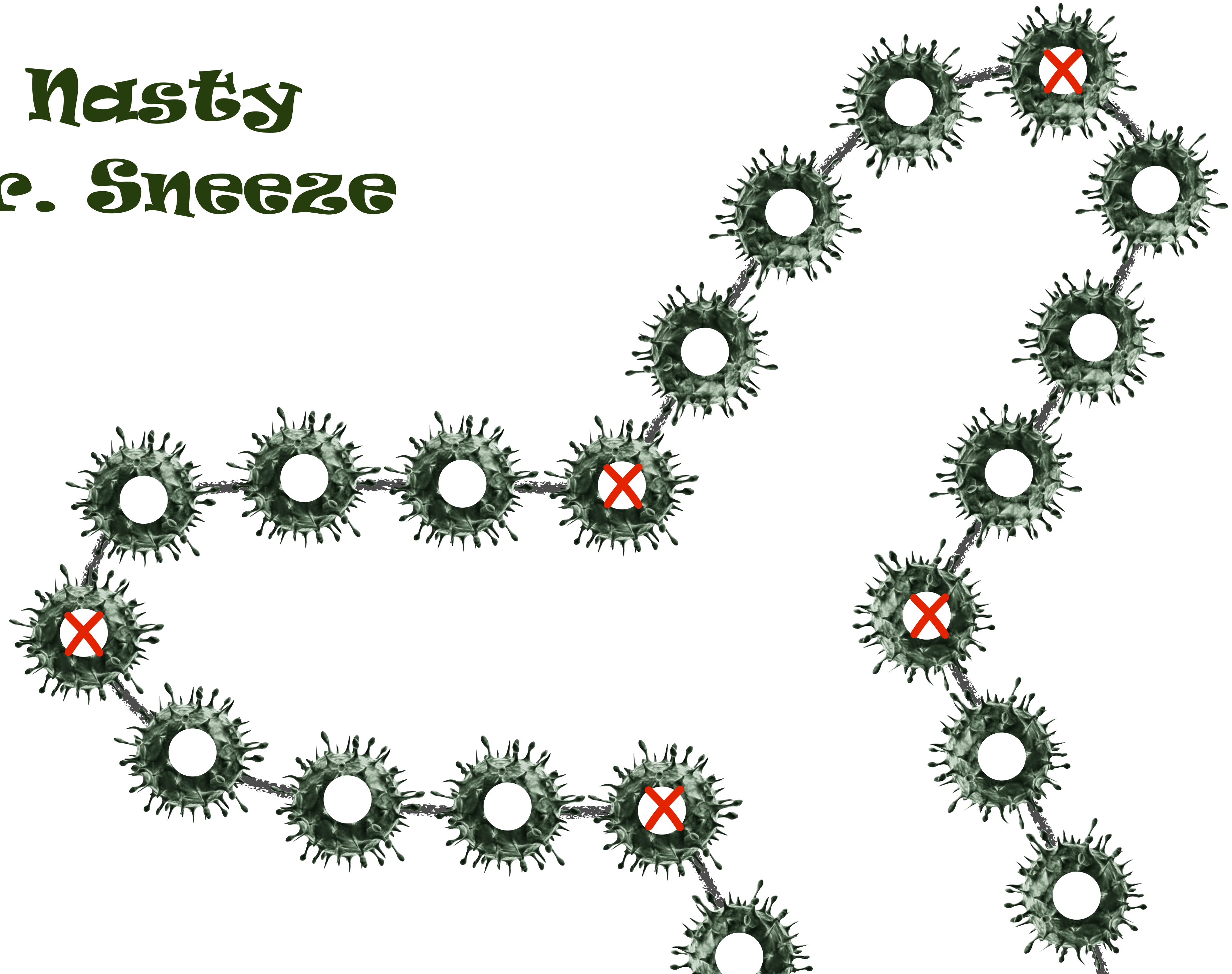
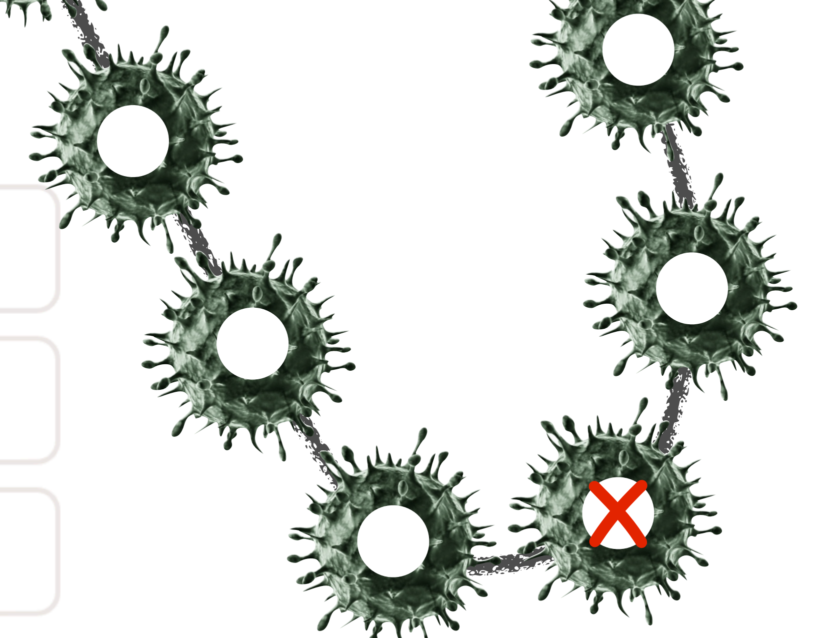
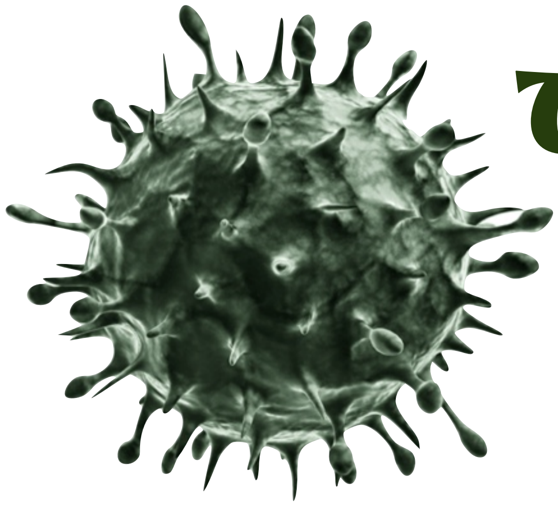



Do not expect your children to find this solution, but if they do, ask how they arrived at their solution.

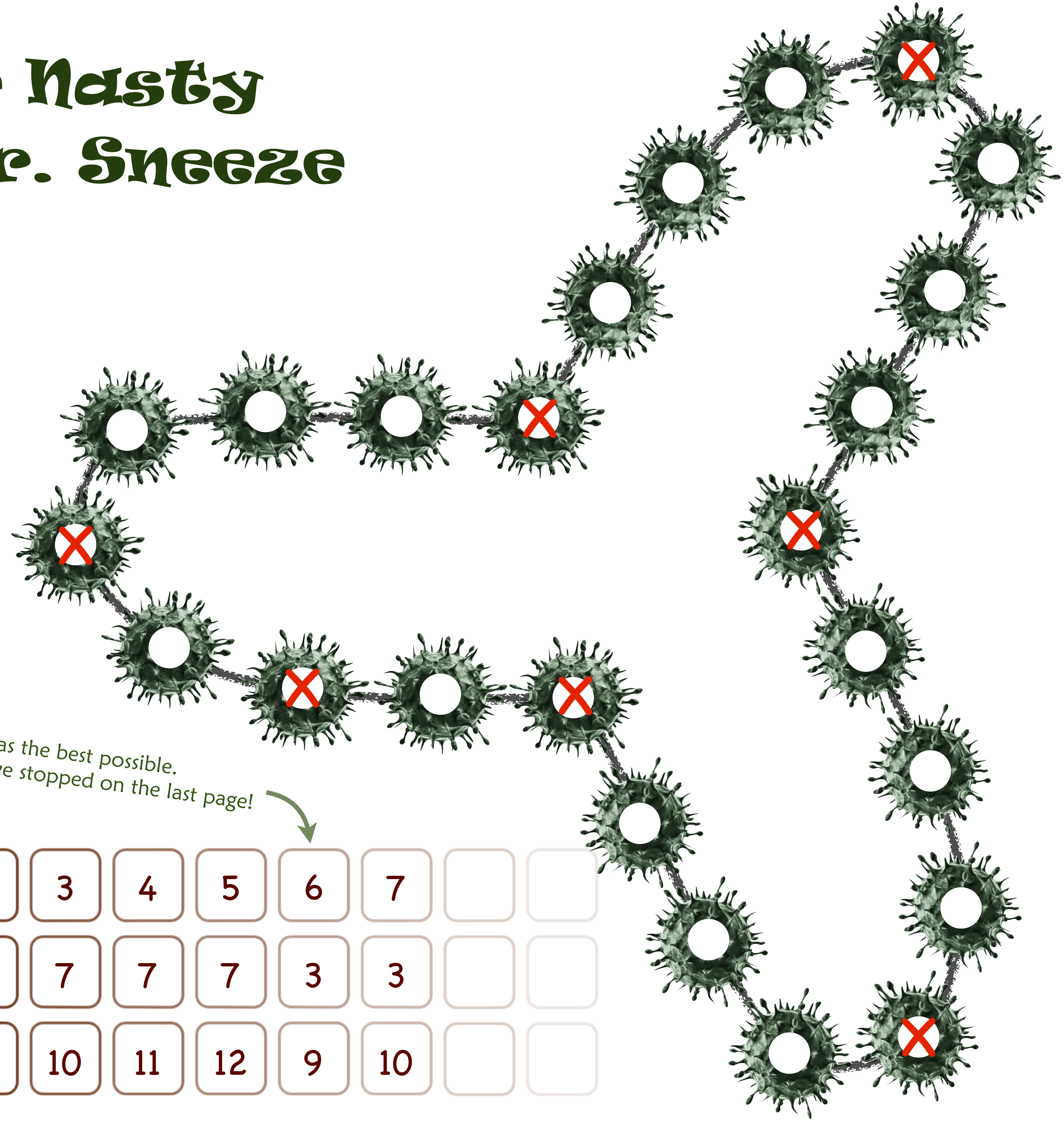
Some might have skip counted (skipping over three students... sending the next one home... skipping three... sending one home... all around the loop.)

Other students may arrive at this answer by noticing the symmetry of the loop and experimenting with the three Xs near the centre.

Number Children Sent Home	0	1	2	3	4	5	6			
+ Biggest Connected Group	24	23	15	7	7	7	3			
= Mr. Sneeze's Score	24	24	17	10	11	12	9			

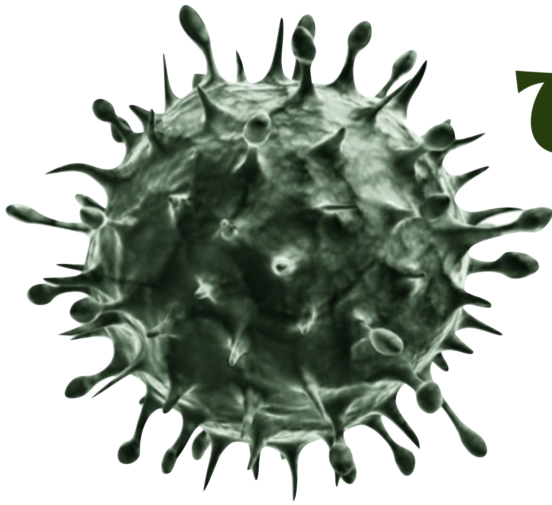


The Nasty Mr. Sneeze

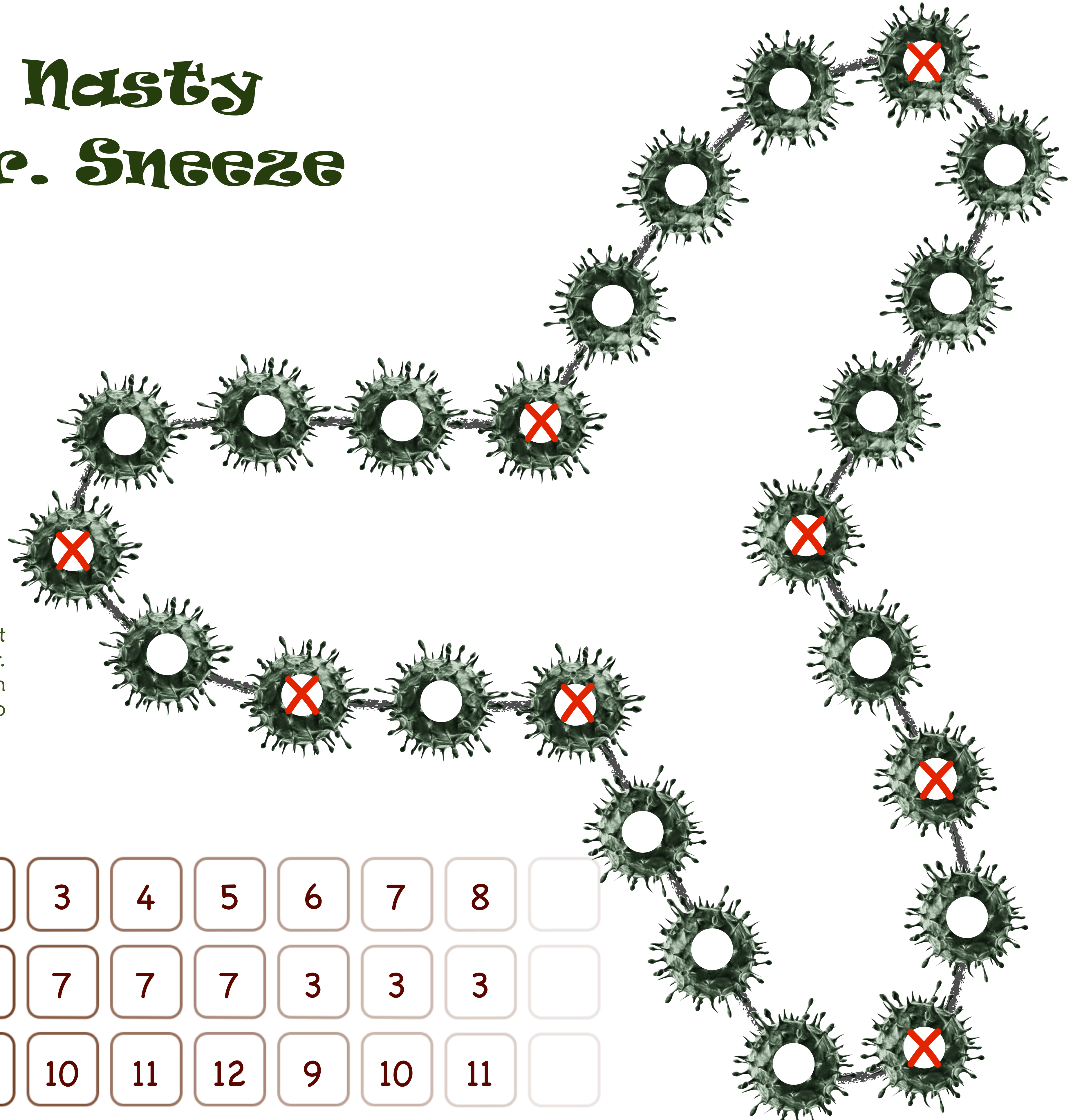


That was the best possible.
They should have stopped on the last page!

Number Children Sent Home	0	1	2	3	4	5	6	7		
+										
Biggest Connected Group	24	23	15	7	7	7	3	3		
=										
Mr. Sneeze's Score	24	24	17	10	11	12	9	10		

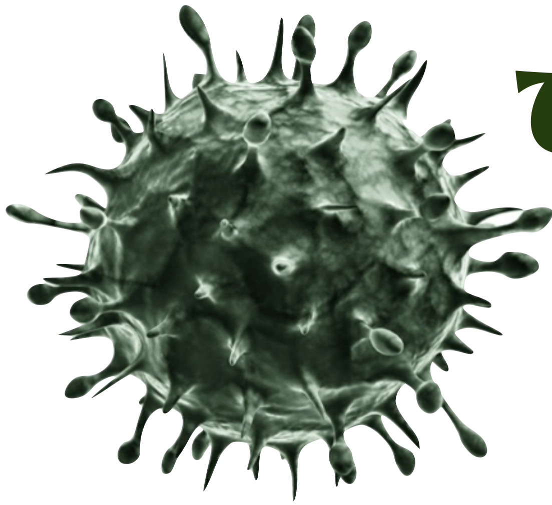


The Nasty Mr. Sneeze

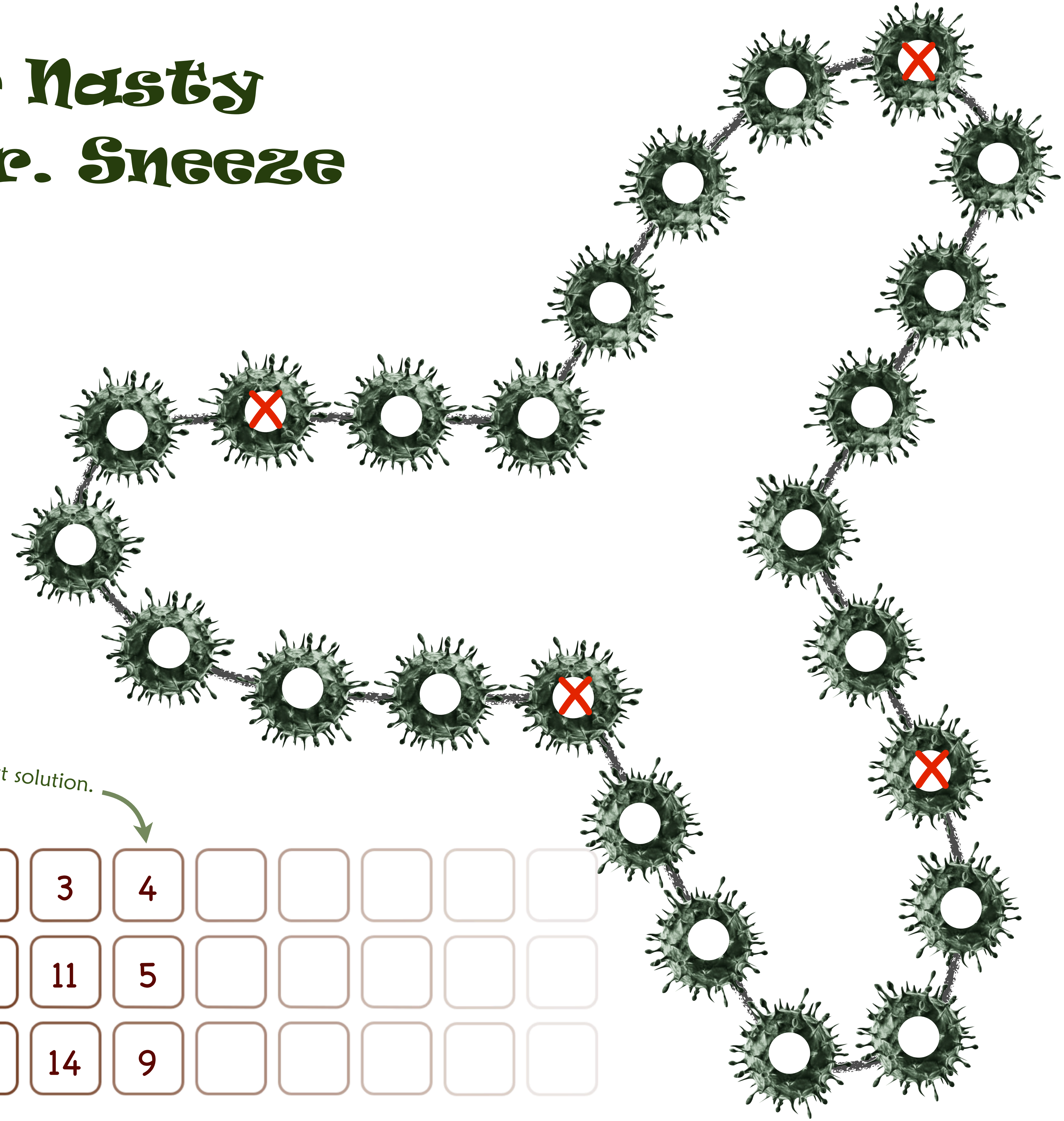


Sally decides to stop. You point out that the class did very well - Reducing Mr. Sneeze from 24 points all the way down to 11 points... but if you had stopped two turns ago it would have been better still!

Number Children Sent Home	0	1	2	3	4	5	6	7	8	
+ Biggest Connected Group	24	23	15	7	7	7	3	3	3	
= Mr. Sneeze's Score	24	24	17	10	11	12	9	10	11	

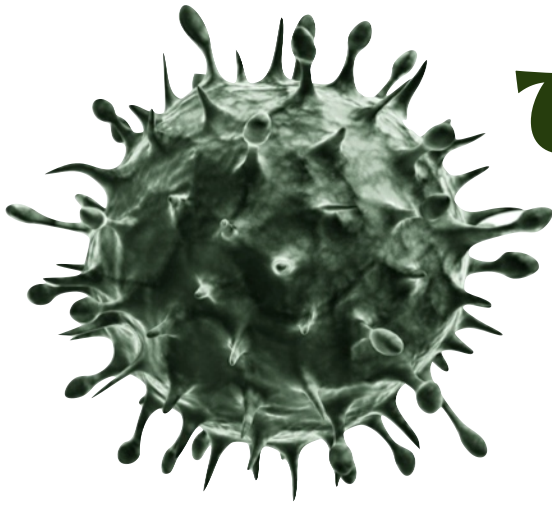


The Nasty Mr. Sneeze

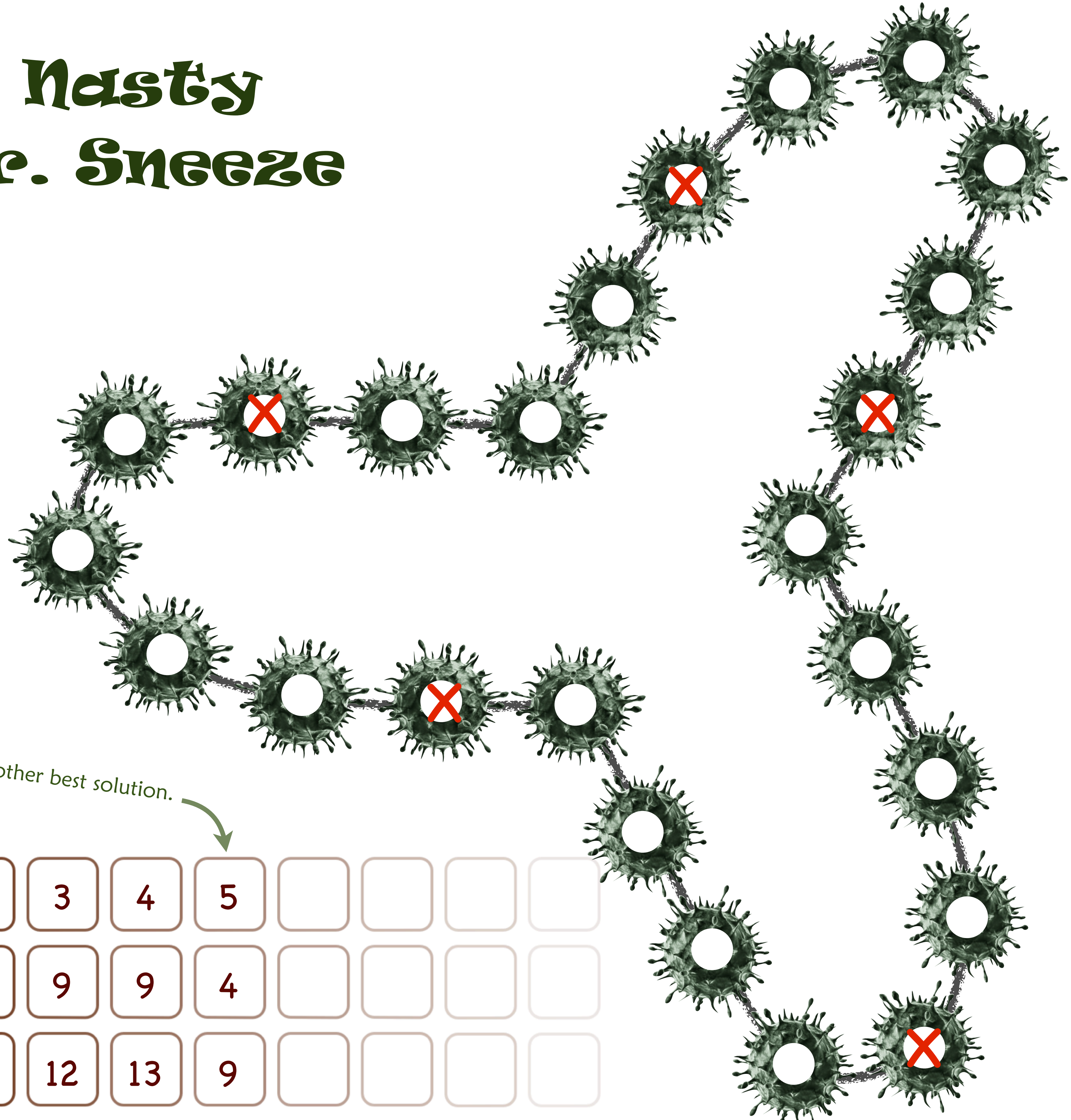


Another best solution.

Number Children Sent Home	0	1	2	3	4					
+										
Biggest Connected Group	24	23	11	11	5					
=										
Mr. Sneeze's Score	24	24	13	14	9					

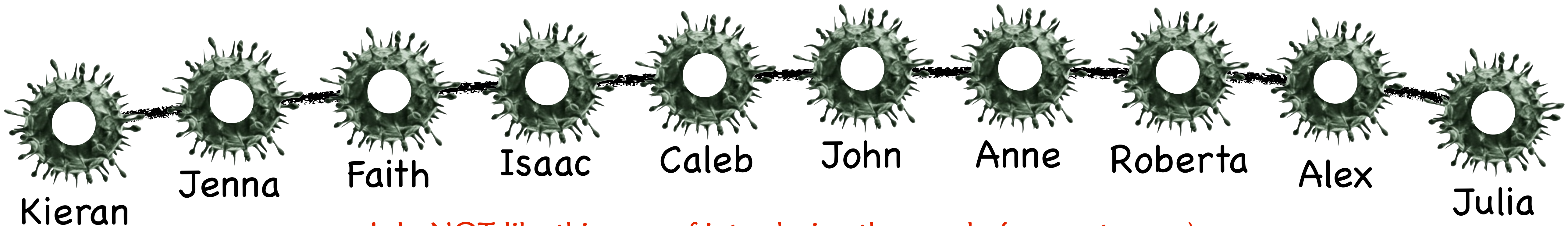


The Nasty Mr. Sneeze



Another best solution.

Number Children Sent Home	0	1	2	3	4	5				
+ Biggest Connected Group	24	23	13	9	9	4				
= Mr. Sneeze's Score	24	24	15	12	13	9				



I do NOT like this way of introducing the puzzle (see next page.)

Too many boring rules upfront lose some students.

When introducing this puzzle - start by writing some of your class in a line. Perhaps explain how the flu spreads.

"If John gets the flu - who do you think the next people will be who get it?" Caleb answers "Anne and me". "And then? Roberta and Isaac - and eventually the whole class gets sick."

"The Nasty Mr. Sneeze gets a point for every child that gets sick.

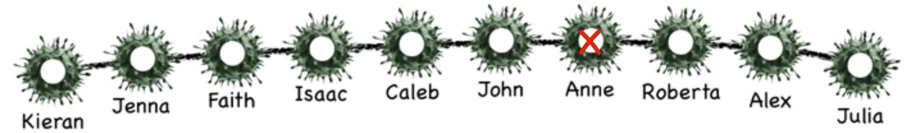
"The Nasty Mr. Sneeze also gets a point for every child who is sent home.

"Every child is connected in this big group got sick so I'm going to write down 10 here.

"No child stayed home so I'm going to write down zero here.

Number Children Sent Home: 0
+
Biggest Connected Group (Sick Children): 10
=
Mr. Sneeze's score: 10

"Who do you want to send home?
Katrina answers: "Anne"



"How many people have been sent home?

Kieran answers "one."

"How many students get sick? Well let me tell you how it works... It's only the largest connected group that gets sick. Roberta, Alex and Julia are connected - is that the largest connected group?

Most answer "No."

"What group is largest?

Kieran answers: "My group"

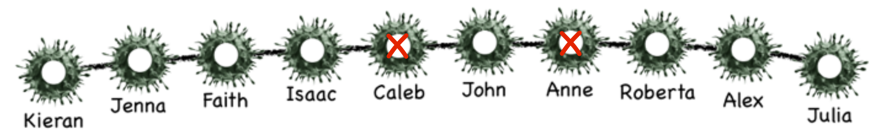
"Kieran, Jenna, Faith, Isaac, Caleb, and John - that's right. 6 people.

Number Children Sent Home: 0 | 1
+
Biggest Connected Group (Sick Children): 10 | 6
=
Mr. Sneeze's score: 10 | 7

Oh - we are doing much better! The Nasty Mr. Sneeze only scores 7!

Who would you like to send home - or do you want to stop?

Jen - "I want to send Caleb home."



"How many people have we sent home?

Kieran answers: "two"

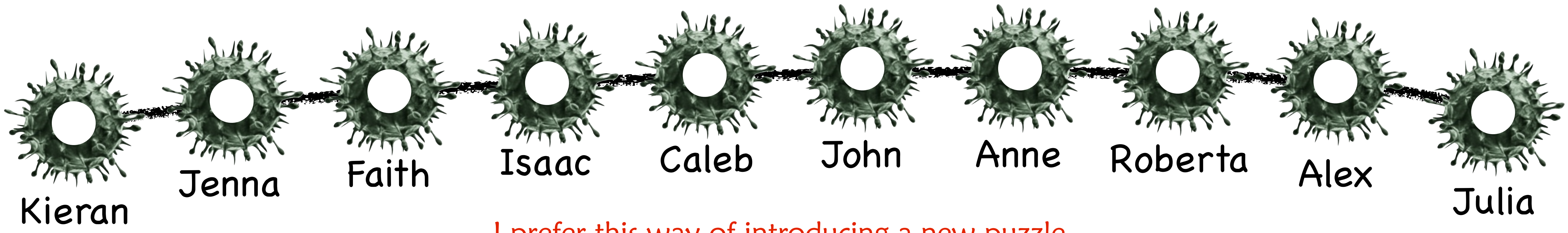
<Kieran clearly understands, but if you keep on asking for his input you both risk losing engagement of non-contributing students and limit your ability to read where the class is at. Experiment not allowing hands to go up - except to ask a question.>

...and the largest connected group?

"four"

Number Children Sent Home: 0 | 1 | 2
+
Biggest Connected Group (Sick Children): 10 | 6 | 4
=
Mr. Sneeze's score: 10 | 7 | 6

Yippee!! The Nasty Mr. Sneeze is scoring only six now!



I prefer this way of introducing a new puzzle.

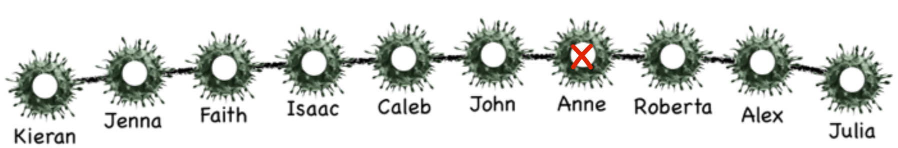
When introducing this puzzle - start by writing some of your class in a line. Perhaps explain how the flu spreads.

"If John gets the flu - who do you think the next people will be who get it?" Caleb answers "Anne and me". "And then? Roberta and Isaac - and eventually the whole class gets sick."

"Who do you want to send home because she's feeling icky?" <This emotionally awakening question engages the class.>

Katrina answers: "Anne"

"Anne - can you rub your belly ;-) Okay - Anne has been sent home because she's feeling icky. What is the largest group?"



<Many students don't know what you're talking about, but they're still hooked because poor Anne has just been sent home. Engagement is high.

The class, with your help, arrives at the answer 6. Write it down. Don't comment if this is good or bad. You still have their attention... keep the mystery alive by not revealing how they are doing.>

"One plus six is..."

Andrew answers (not because he's raising his hand, but because it is his turn to answer. Hands are not raised because we want all students to contribute. That's a good way to keep them engaged) "7"

"So the Nasty Mr. Sneeze gets 7 points..."

Number Children Sent Home	1
+	
Biggest Connected Group	6
=	
Mr. Sneeze's score	7

"Cynthia - who do you want to send home?"

Cynthia answers: "Caleb"

"Caleb - can you rub your belly ;-) Okay - Caleb has been sent home. How many have been sent home?

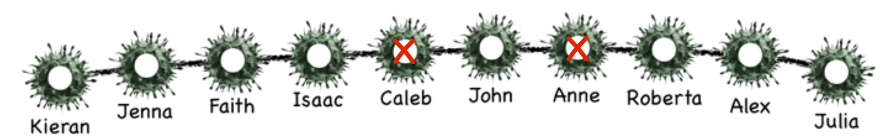
Vicky: "2"

"What is the largest group?"

<Many students still don't know what you're talking about, but engagement is still high so you have time to bring them on board.>

With your help they arrive at a consensus that the four students on the left is the biggest group...

Everyone: "4"



Number Children Sent Home	1	2
+		
Biggest Connected Group	6	4
=		
Mr. Sneeze's score	7	6

"Two plus four..."

Faith answers: "6"

"Whew! The Nasty Mr. Sneeze is down to six points!" <Only now do you reveal the goal is to get Mr. Sneeze's score as low as possible. Now it is framed in an emotional reaction rather than just a rule... We continue like this... and only after a while do we do the slightly less interesting reflection on where we started from...>

Number Children Sent Home	0	1	2
+			
Biggest Connected Group	10	6	4
=			
Mr. Sneeze's score	10	7	6

$500 classroom challenge

Perhaps your students have created a beautiful puzzle for their parents or a student who is not usually excited about math has become engaged. Perhaps a pair of students discovered a pattern about how to solve some of these difficult puzzles. Whatever your inspirational experience with this gem of a puzzle, I'd like to know.

I'll offer $500 for a photograph and/or story highlighting The Nasty Mr. Sneeze in the classroom.

All students featured must have appropriate consent. All photographs and stories submitted may be used in an updated version of this pdf file and to promote this puzzle elsewhere.

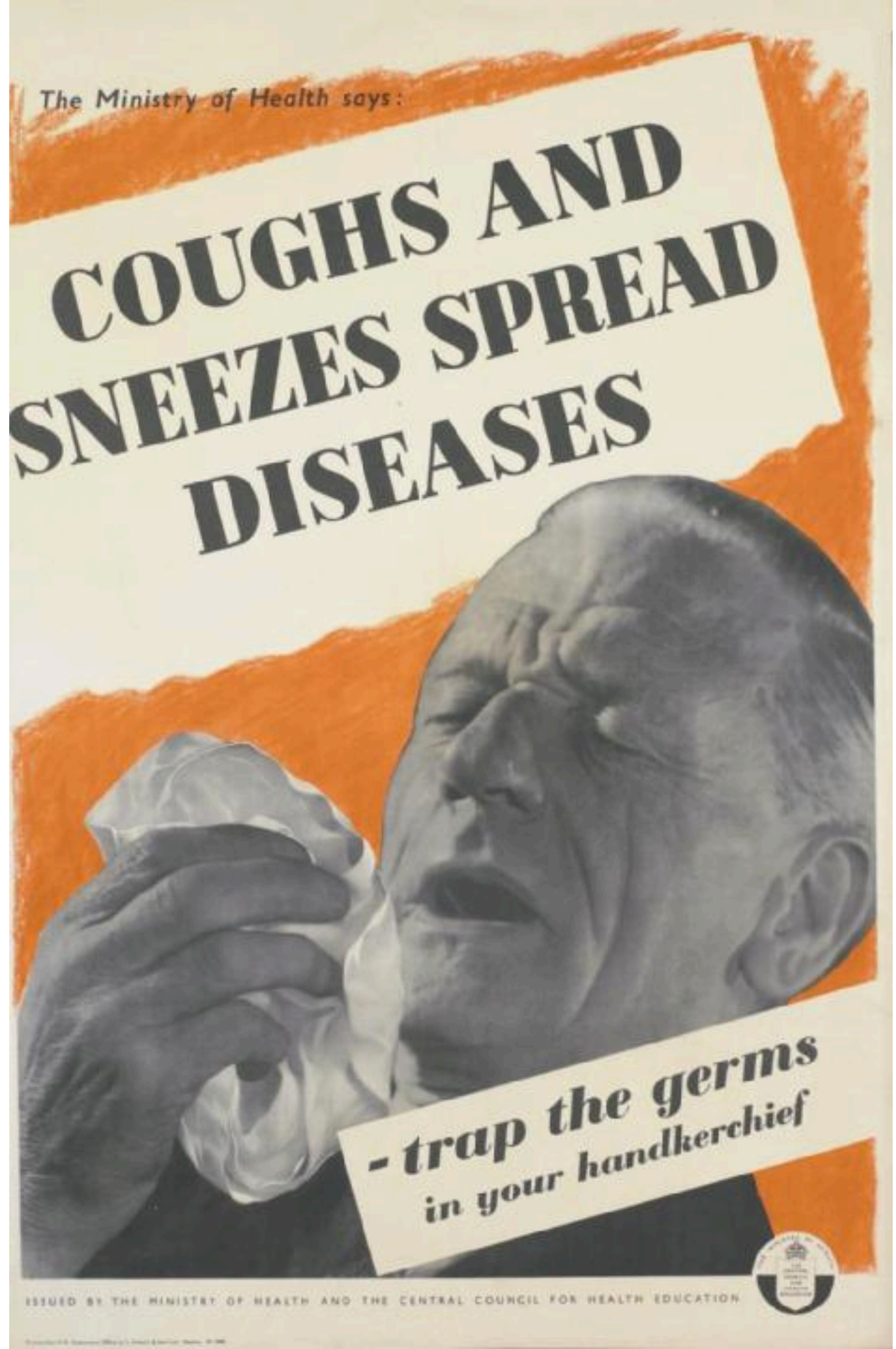
Send submissions to gord@mathpickle.com. Use "$500 Mr. Sneeze challenge" as the subject of the email. The winning classroom will be announced the first March 14th that I have at least 10 submissions from different schools. I hope this will be March 14th, 2016.

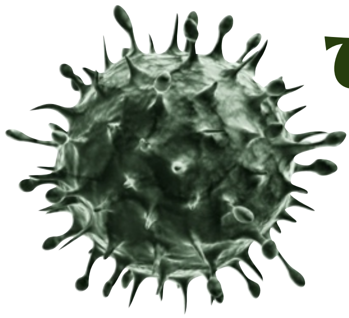
$100 challenge for computer programmers

Find the optimal solution for squares of size 1x1 to 25x25. See pages 38 through 43 for my best guesses.

Send submissions to gord@mathpickle.com. Use "$100 Mr. Sneeze challenge" as the subject of the email. The winning submission (if any) will be announced on March 14, 2016.

If I receive more than one correct entry the winner will be the earliest one received.





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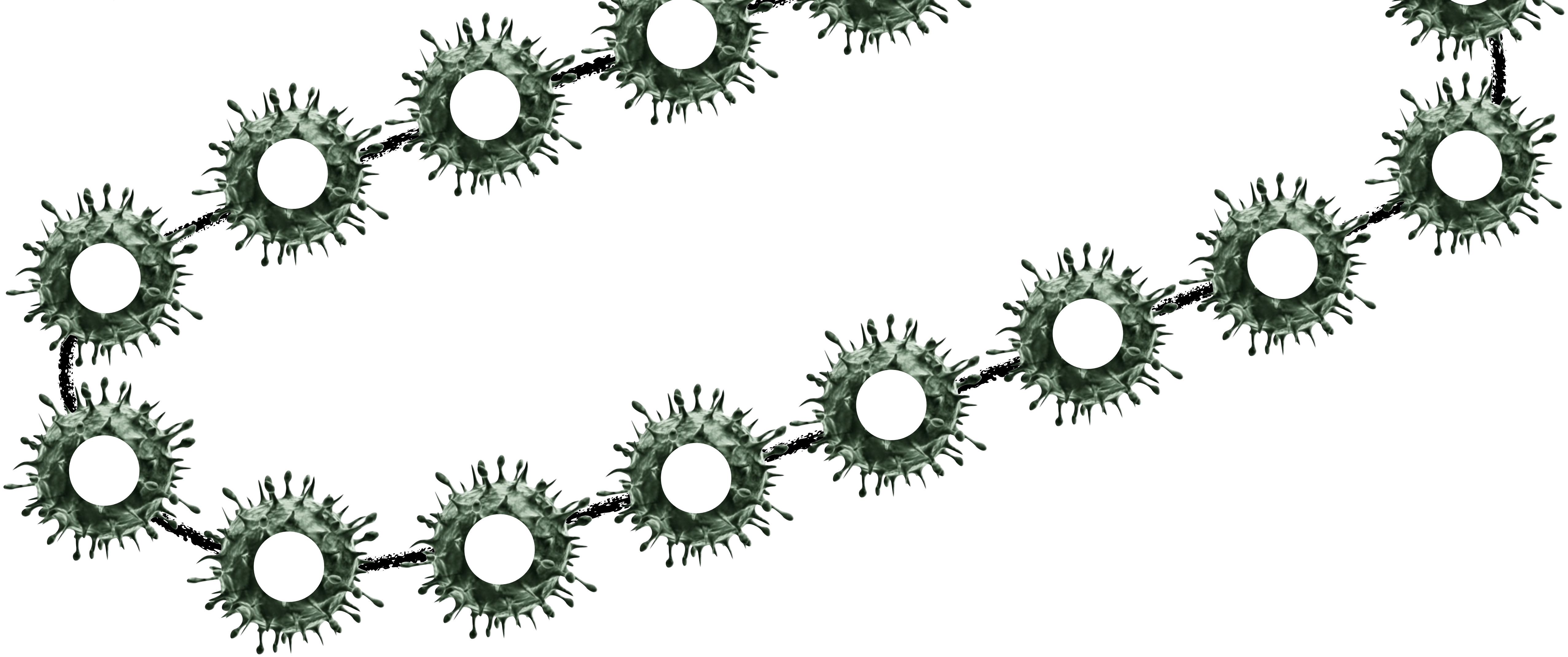
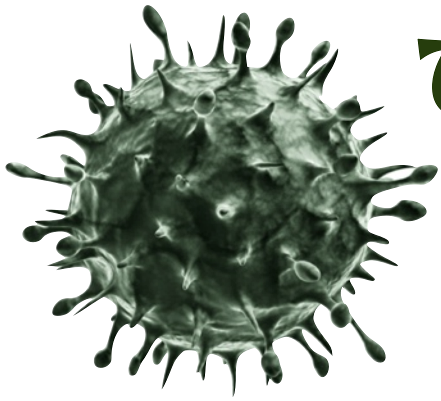
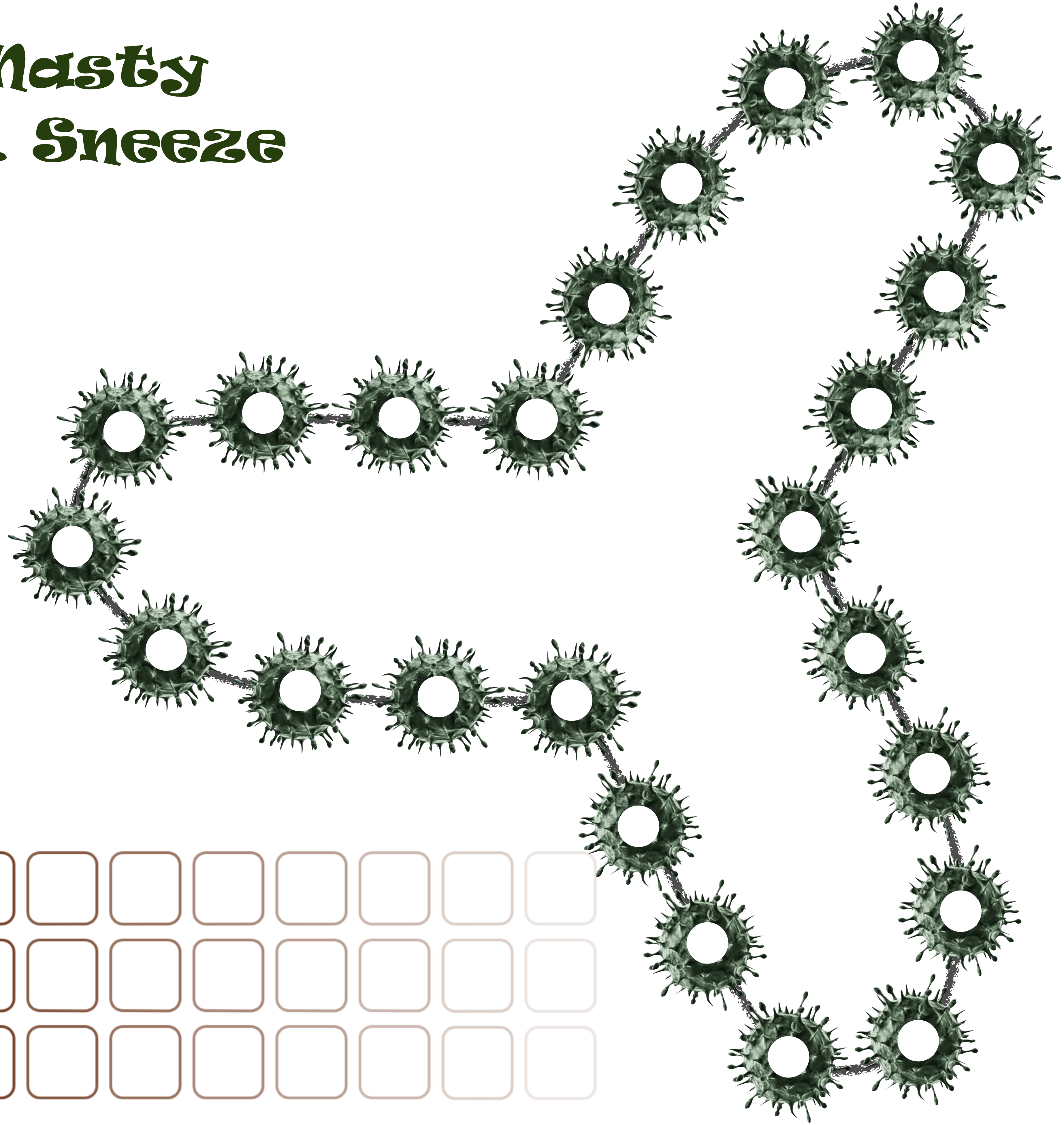


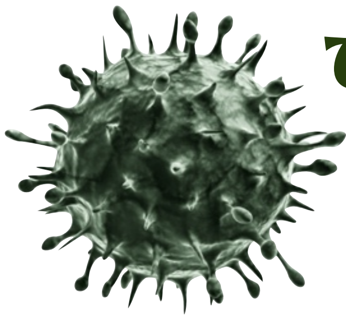
Number Children Sent Home										
+										
Biggest Connected Group										
=										
Mr. Sneeze's Score										



The Nasty Mr. Sneeze



Number Children Sent Home										
+										
Biggest Connected Group										
=										
Mr. Sneeze's Score										



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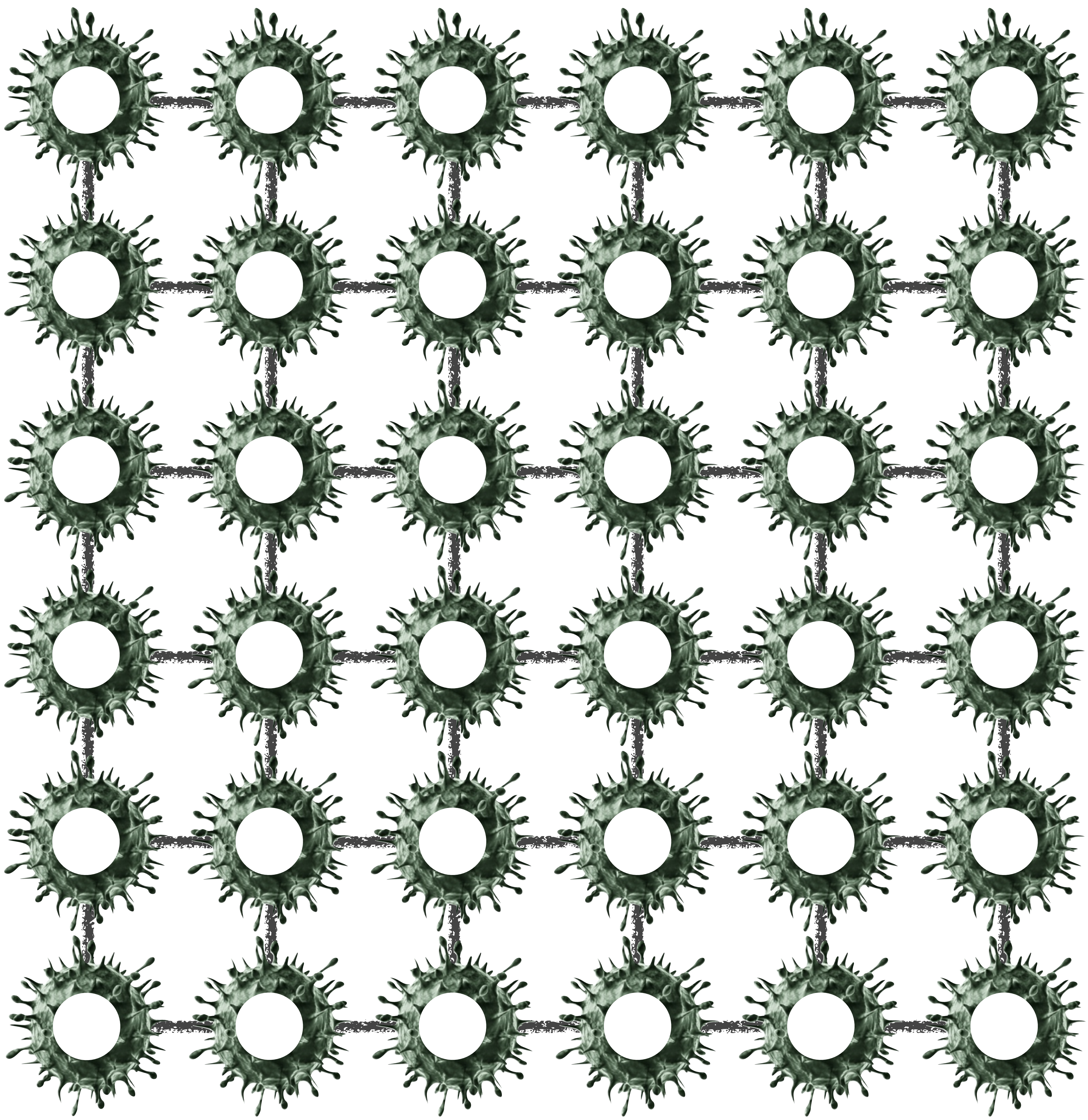
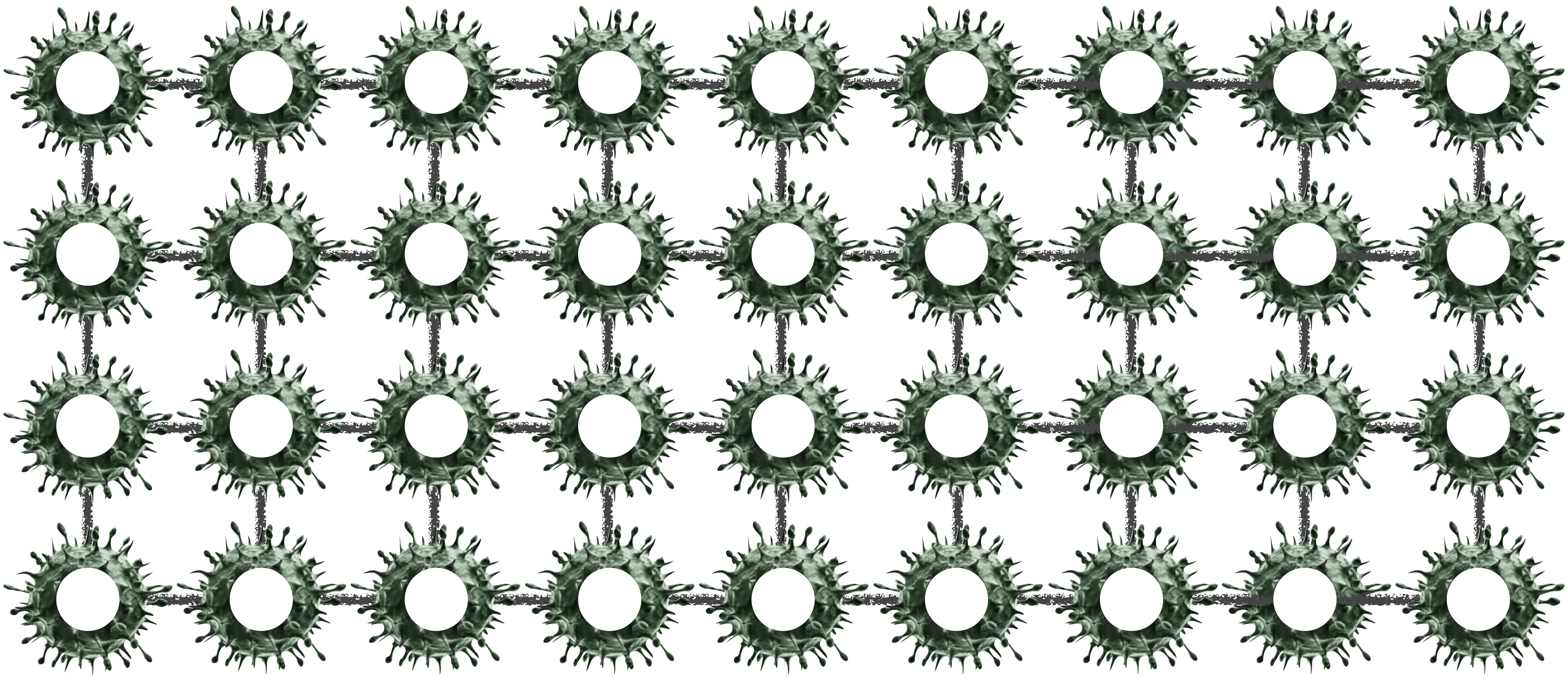
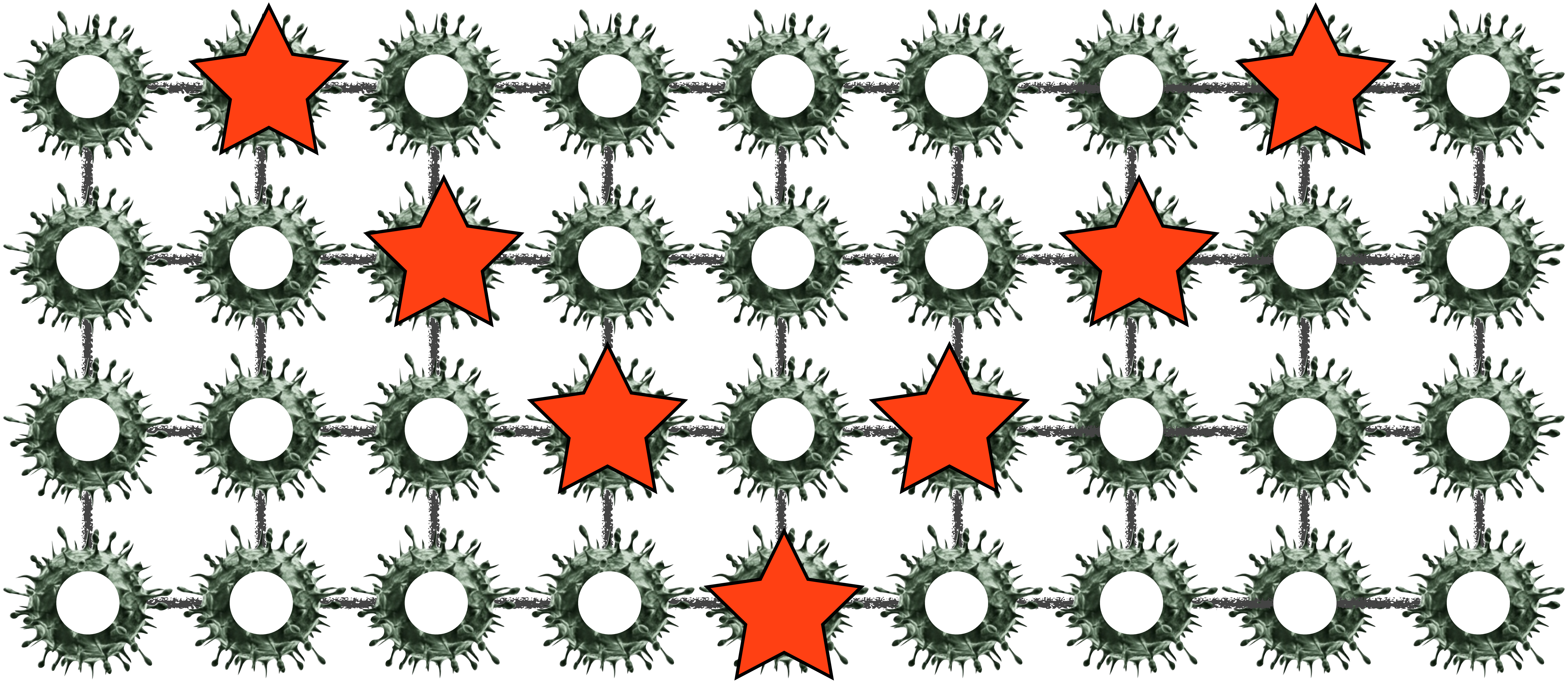


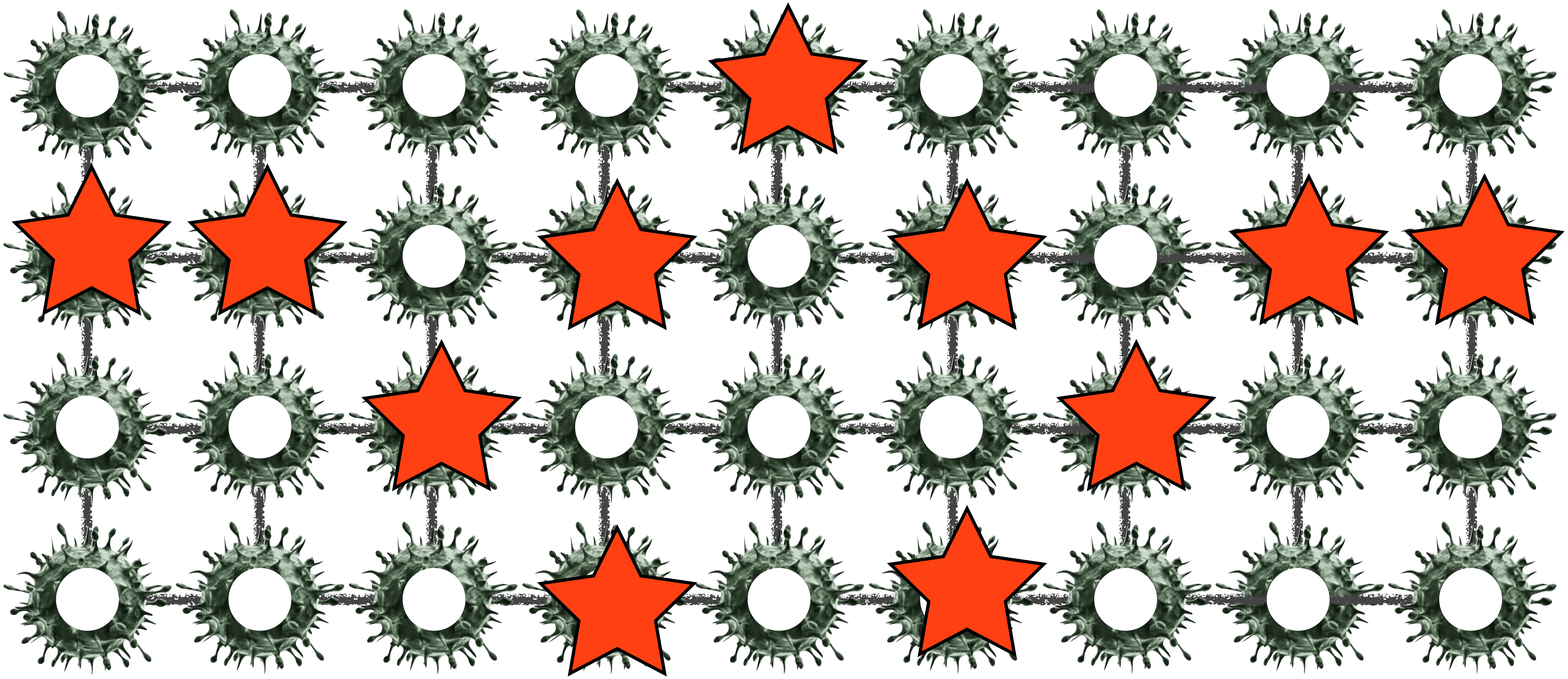
Number Children Sent Home										
+										
Biggest Connected Group										
=										
Mr. Sneeze's Score										



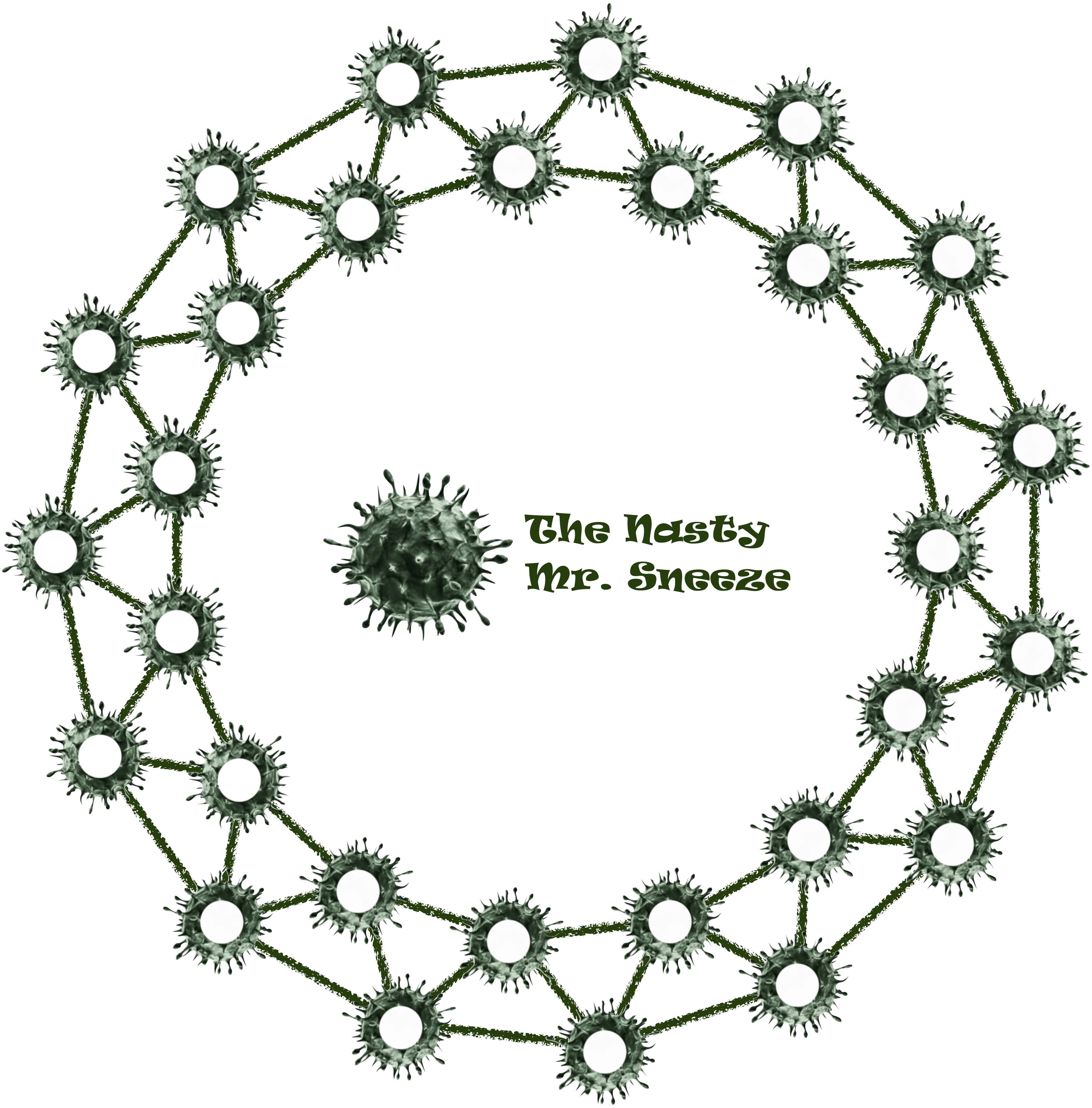
Number Children
Sent Home
+
Biggest
Connected Group
=
Mr. Sneeze's
Score



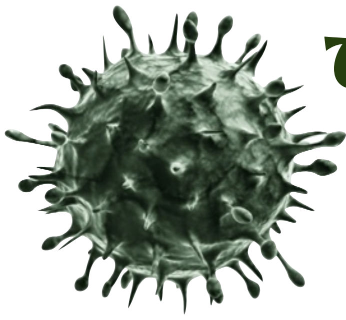
Number Children
Sent Home
+
Biggest
Connected Group
=
Mr. Sneeze's
Score



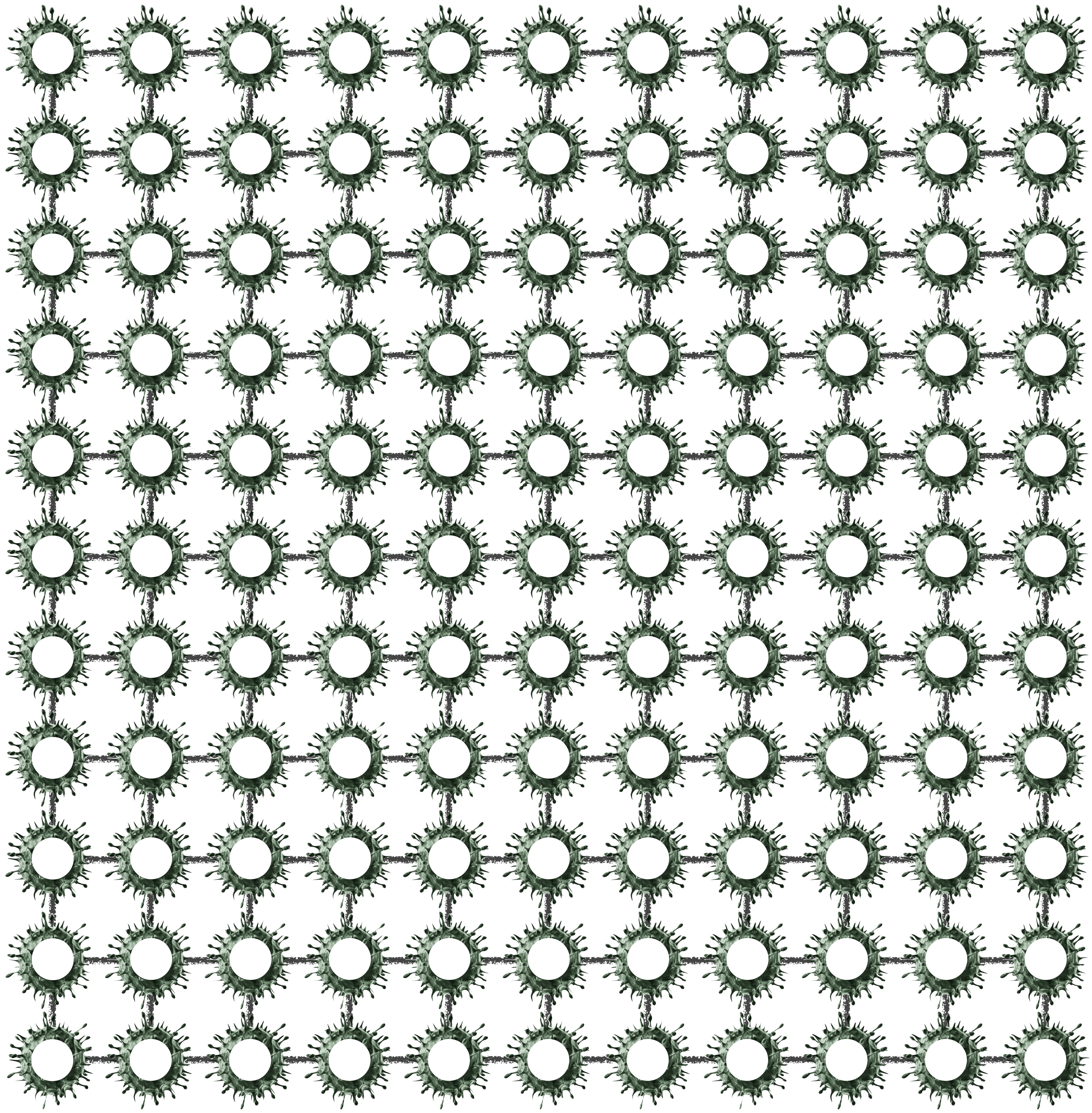
Number Children
Sent Home
+
Biggest
Connected Group
=
Mr. Sneeze's
Score



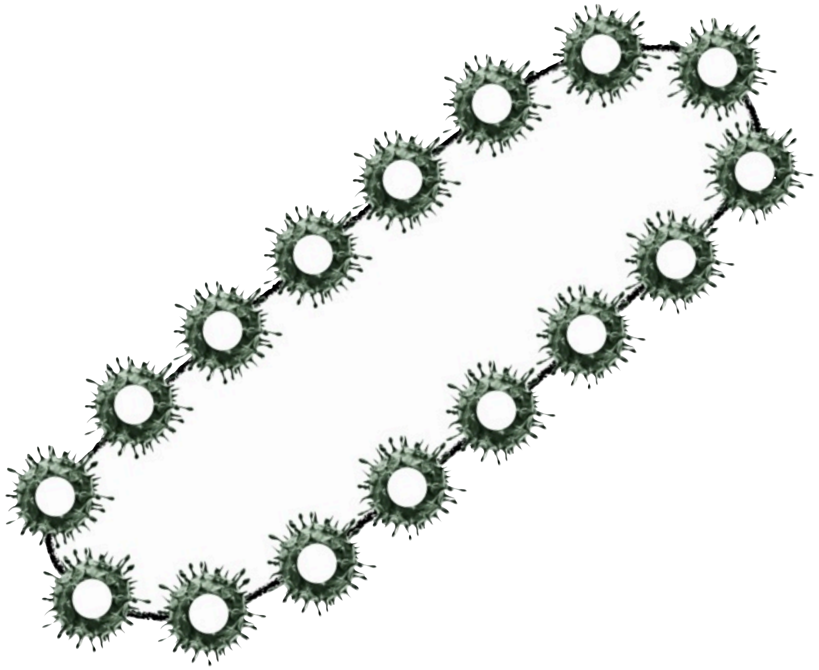
Number Children Sent Home										
+										
Biggest Connected Group										
=										
Mr. Sneeze's Score										



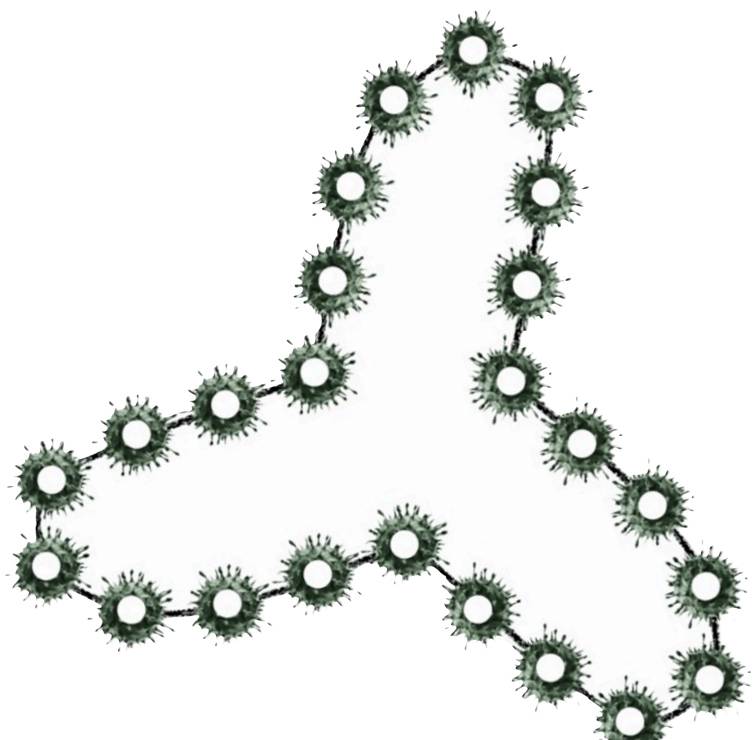
The Nasty Mr. Sneeze



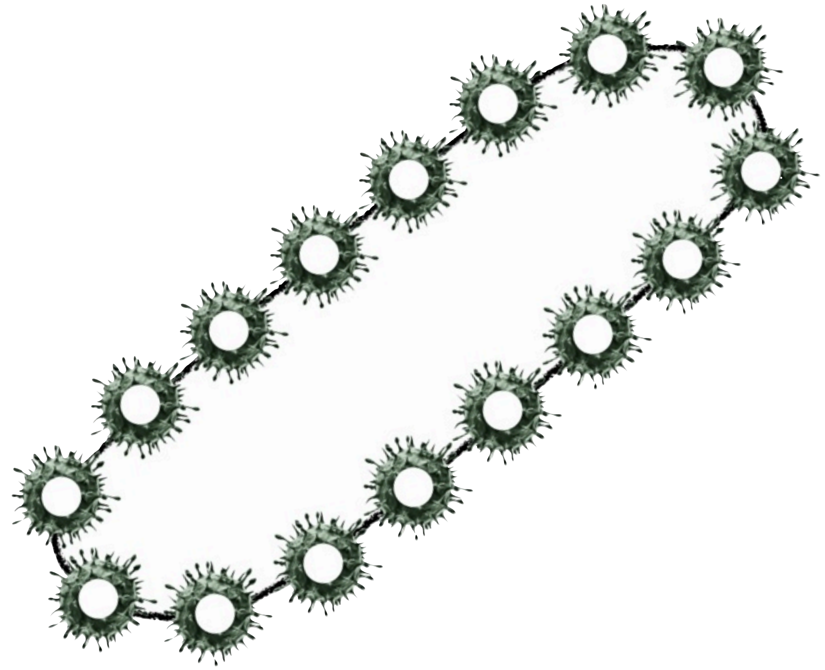
Number Children Sent Home										
+ Biggest Connected Group										
= Mr. Sneeze's Score										



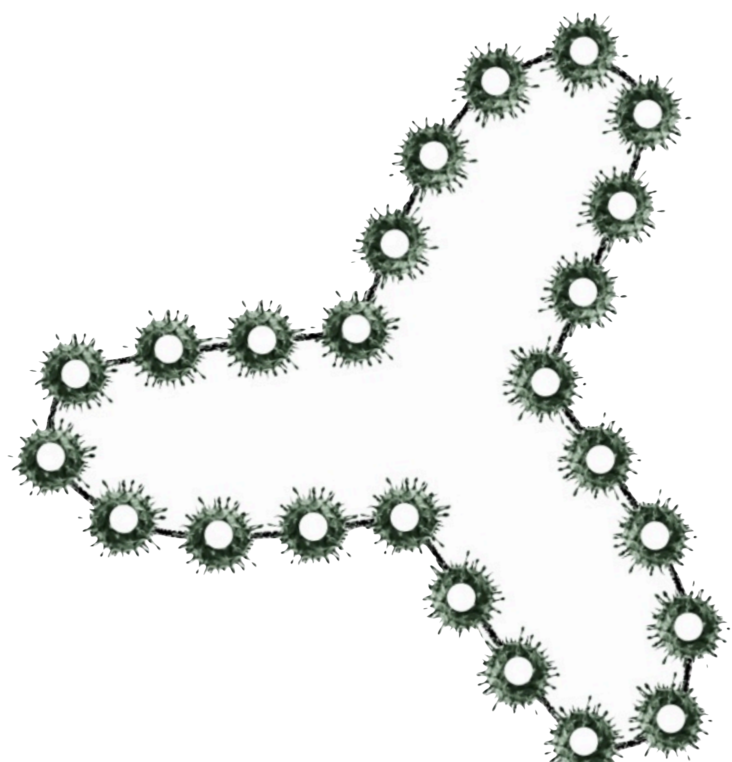
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



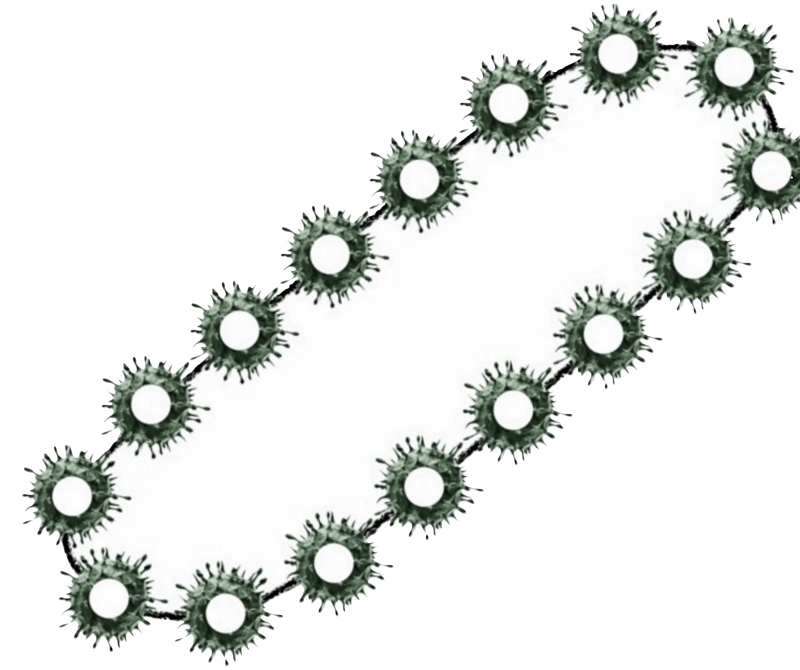
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



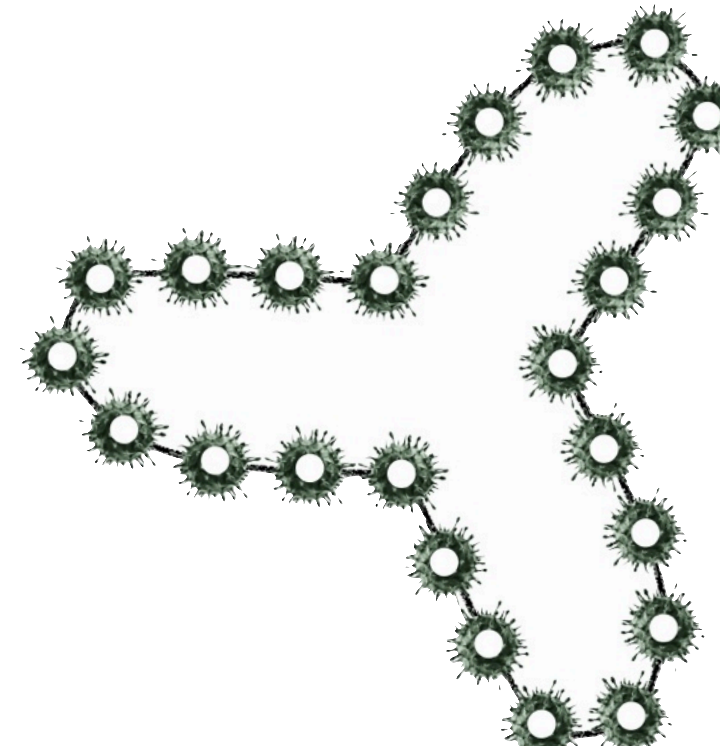
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



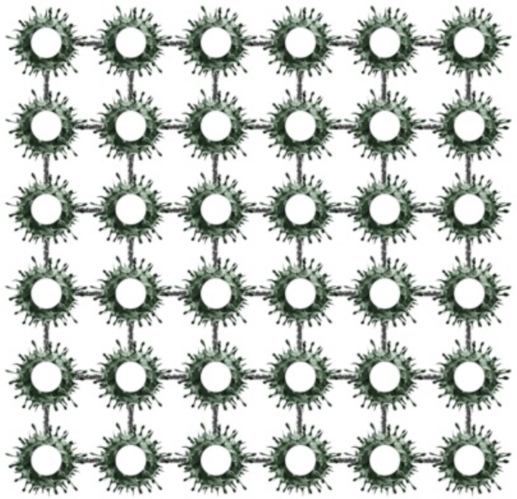
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



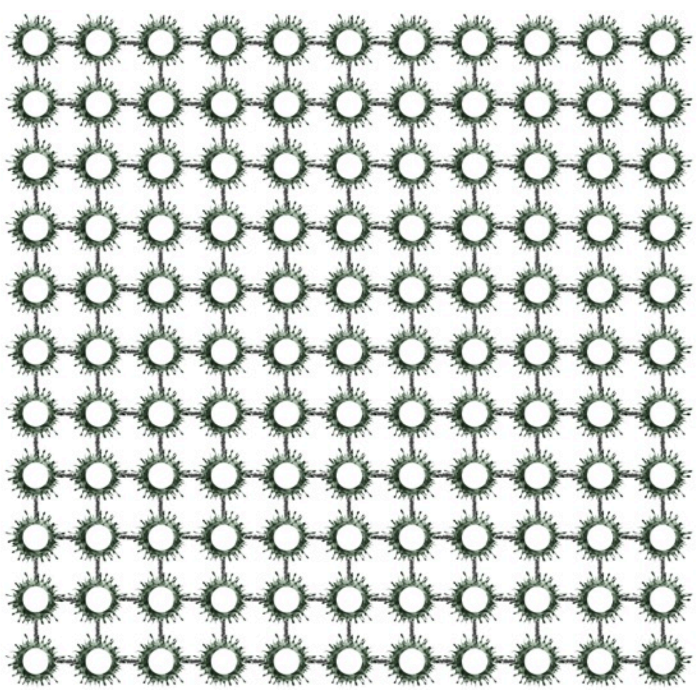
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



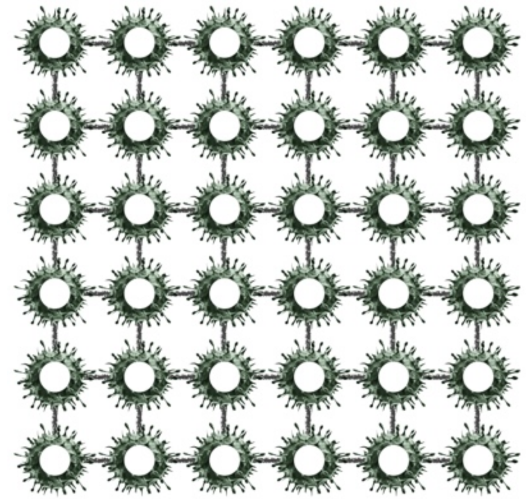
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



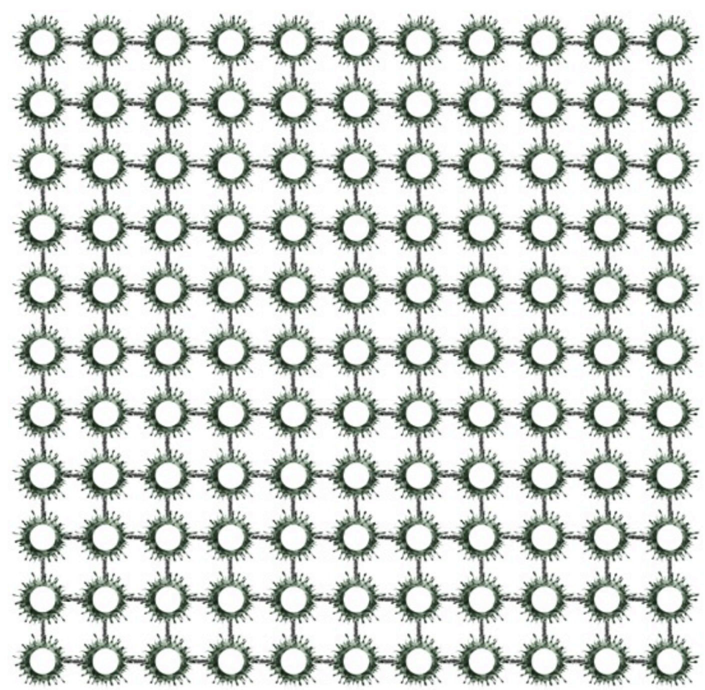
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



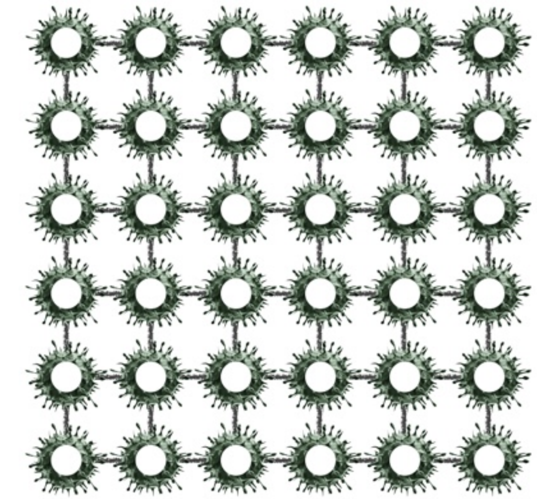
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



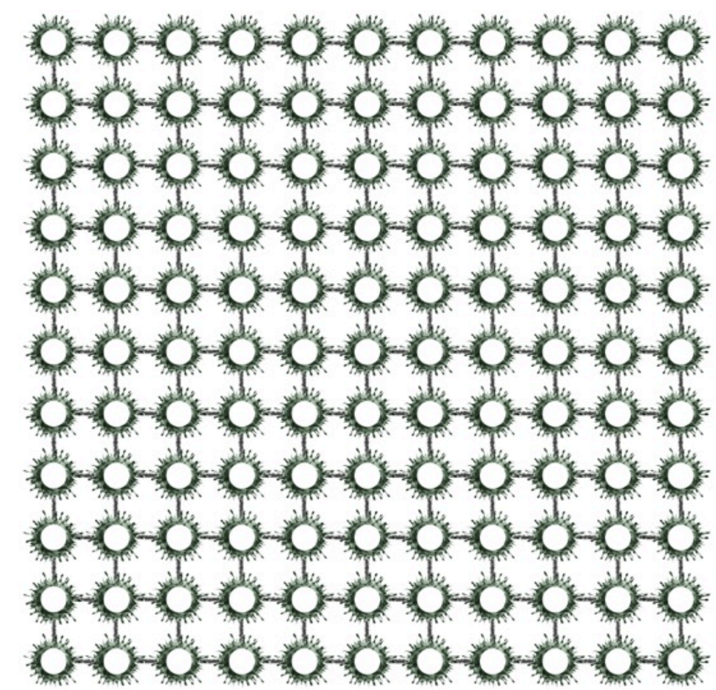
Number Children Sent Home
+
Biggest Connected Group
=
Virus score



Number Children Sent Home
+
Biggest Connected Group
=
Virus score



Number Children Sent Home
+
Biggest Connected Group
=
Virus score



Number Children Sent Home
+
Biggest Connected Group
=
Virus score

$100 challenge for computer programmers

Find the optimal solution for squares of size 1x1 to 25x25. See pages 38 through 43 for my best guesses.

Send submissions to gord@mathpickle.com. Use “$100 Mr. Sneeze challenge” as the subject of the email. The winning submission (if any) will be announced on March 14, 2016.

If I receive more than one correct entry the winner will be the earliest one received.

6x6

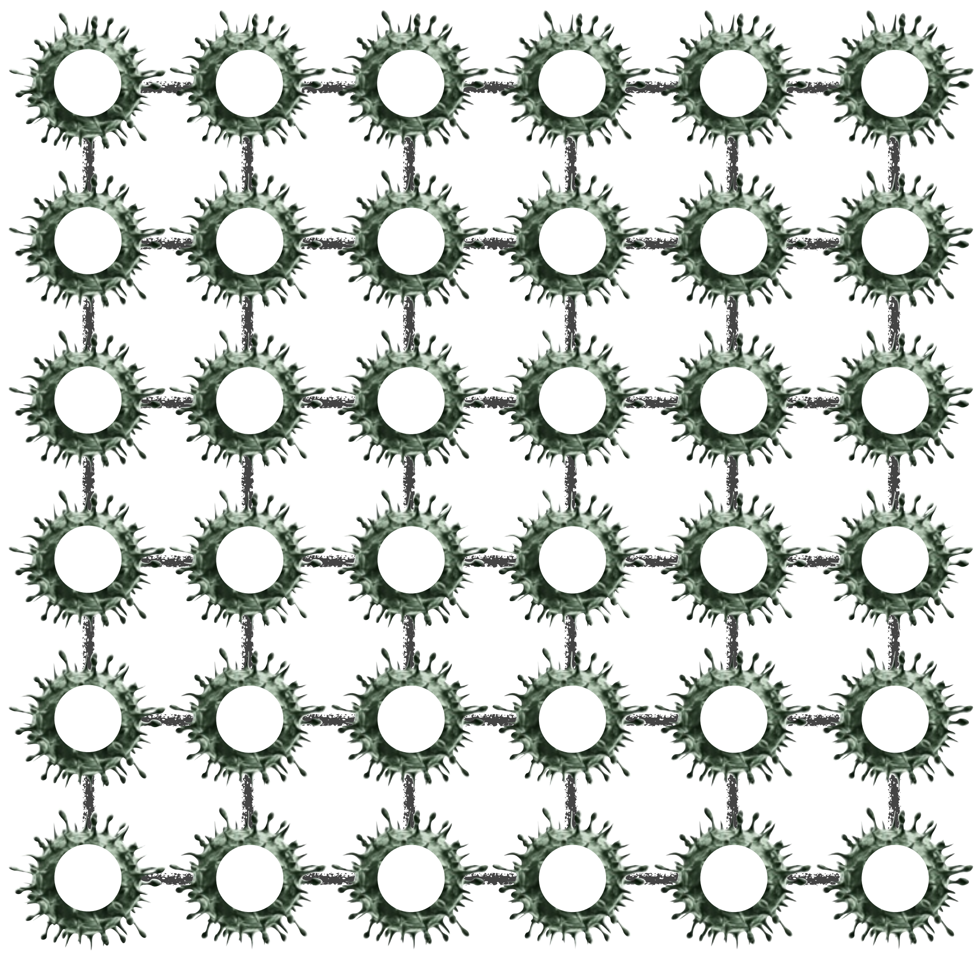
Number Children Sent Home

+

Biggest Connected Group

=

Mr. Sneeze's Score



7x7

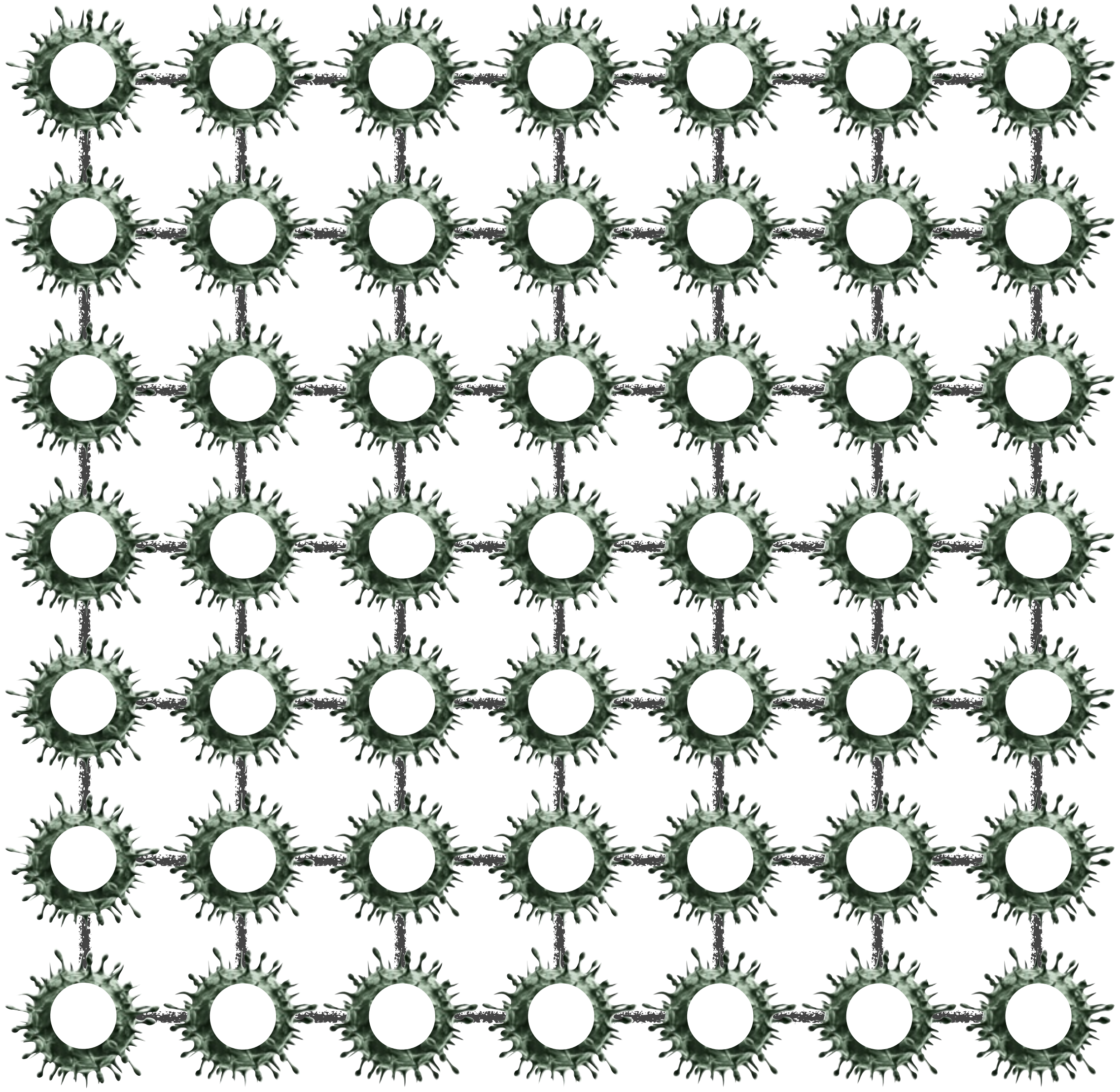
Number Children Sent Home

\+

Biggest Connected Group

=

Mr. Sneeze's Score



8x8

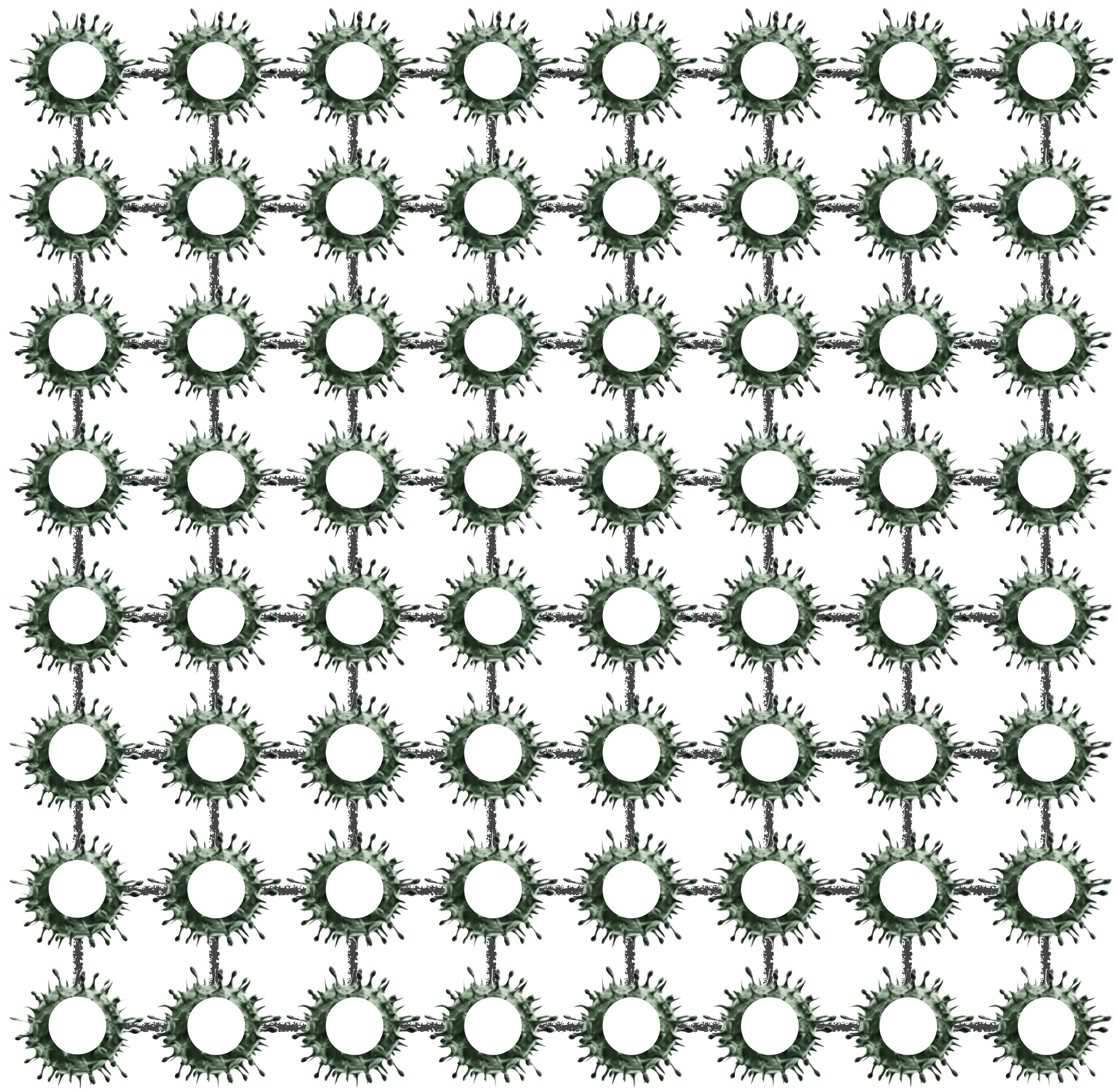
Number Children Sent Home

+

Biggest Connected Group

=

Mr. Sneeze's Score



9x9

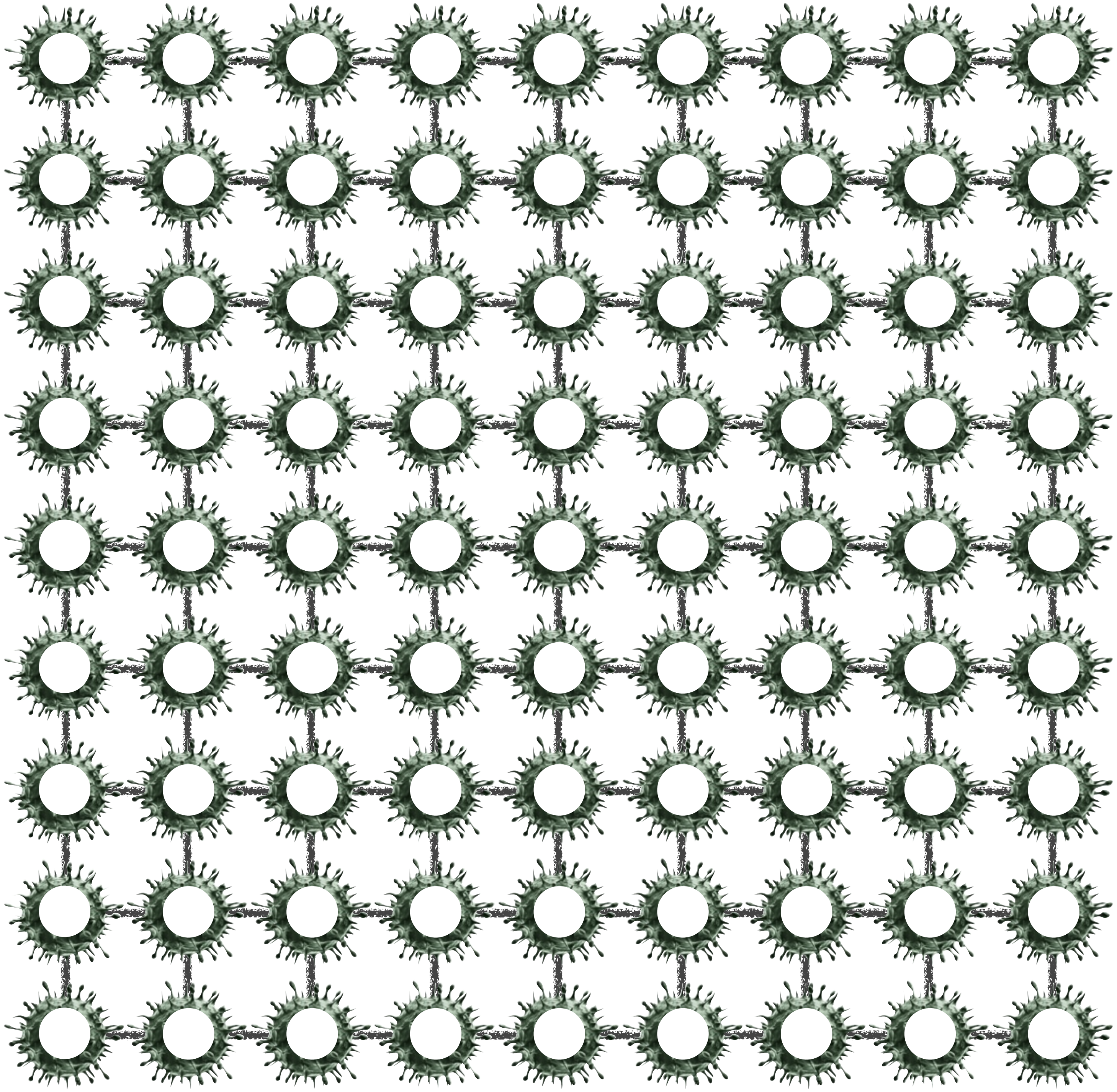
Number Children Sent Home

+

Biggest Connected Group

=

Mr. Sneeze's Score



10x10

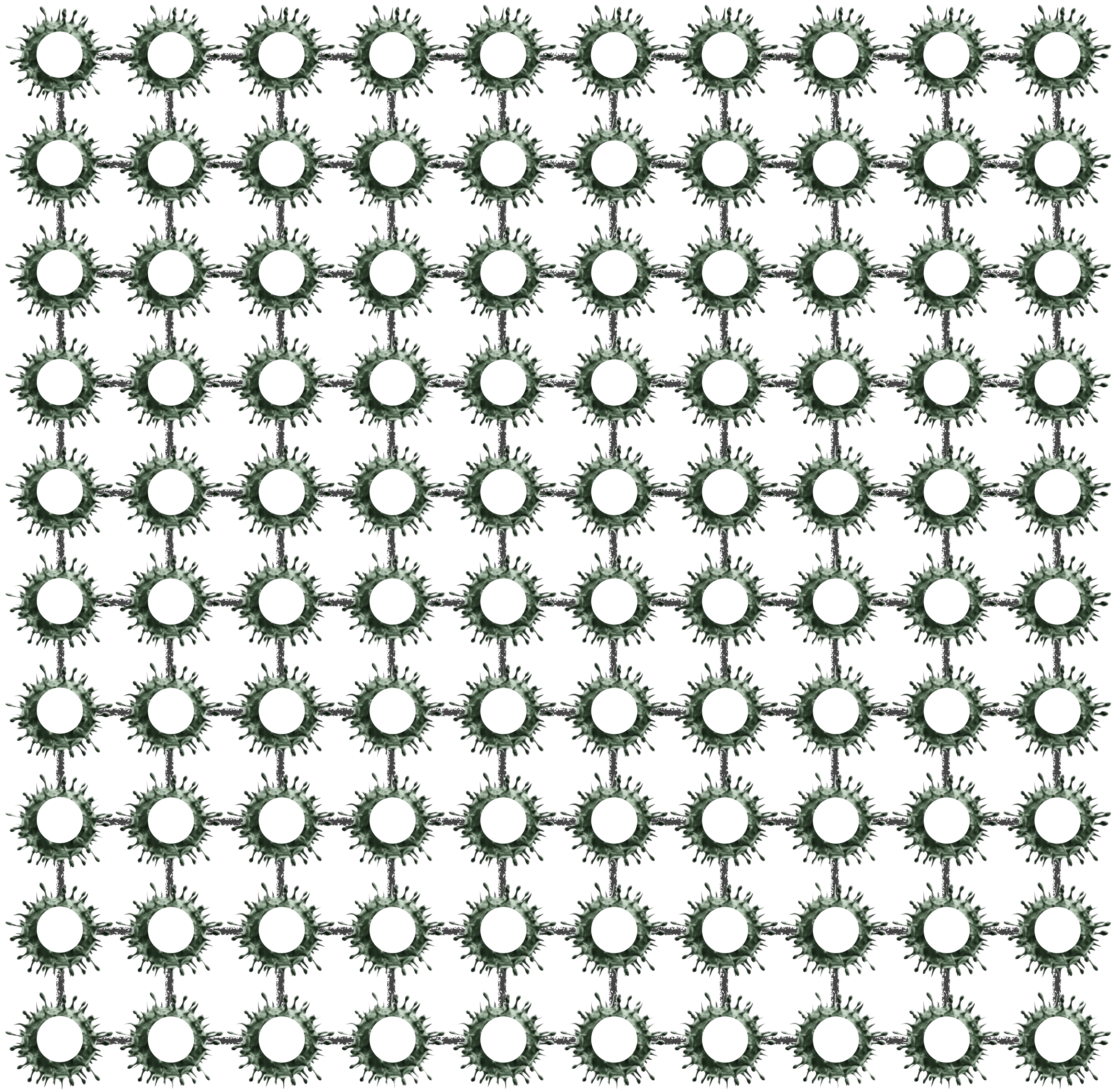
Number Children Sent Home

+

Biggest Connected Group

=

Mr. Sneeze's Score



11x11

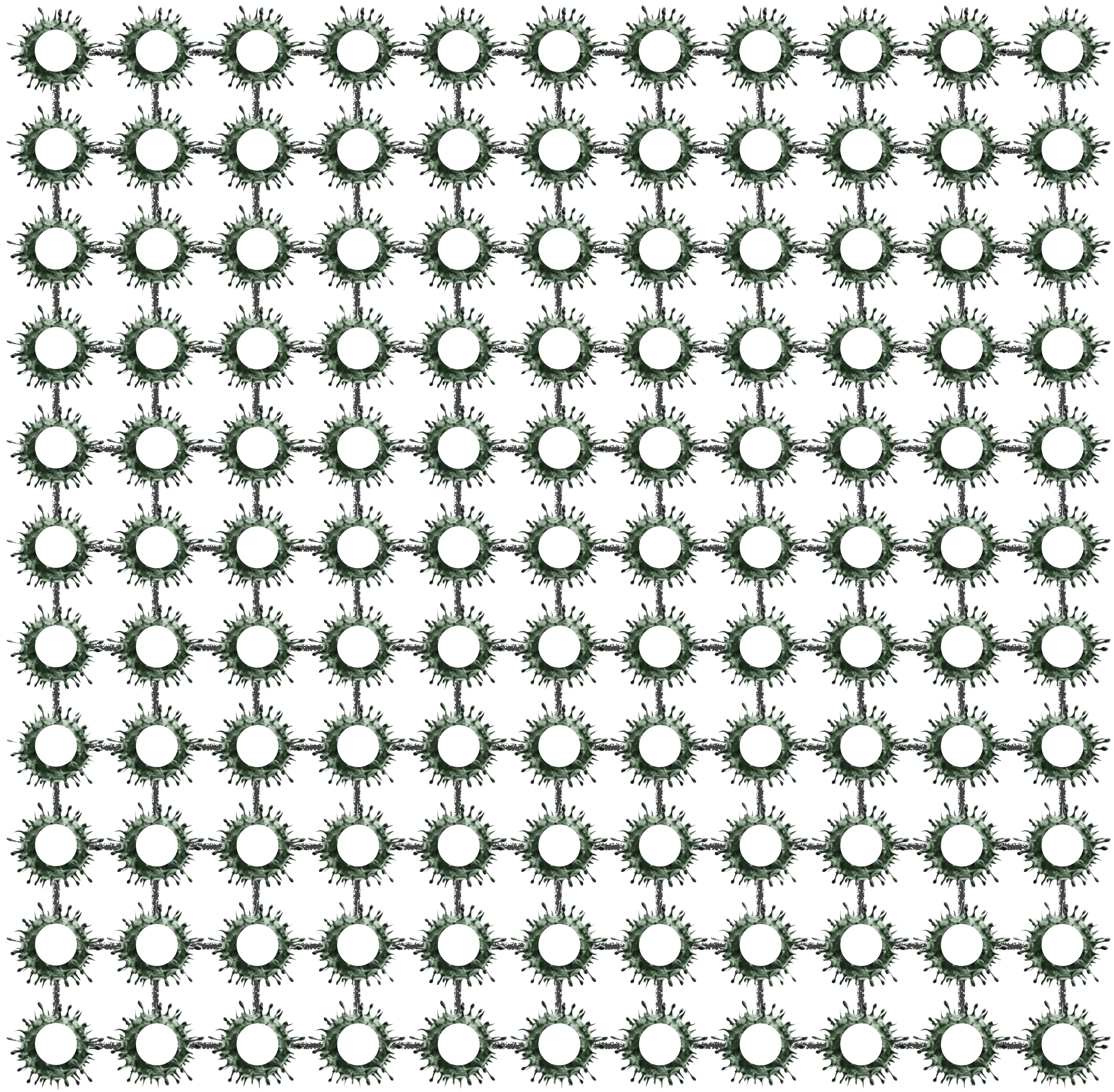
Number Children Sent Home

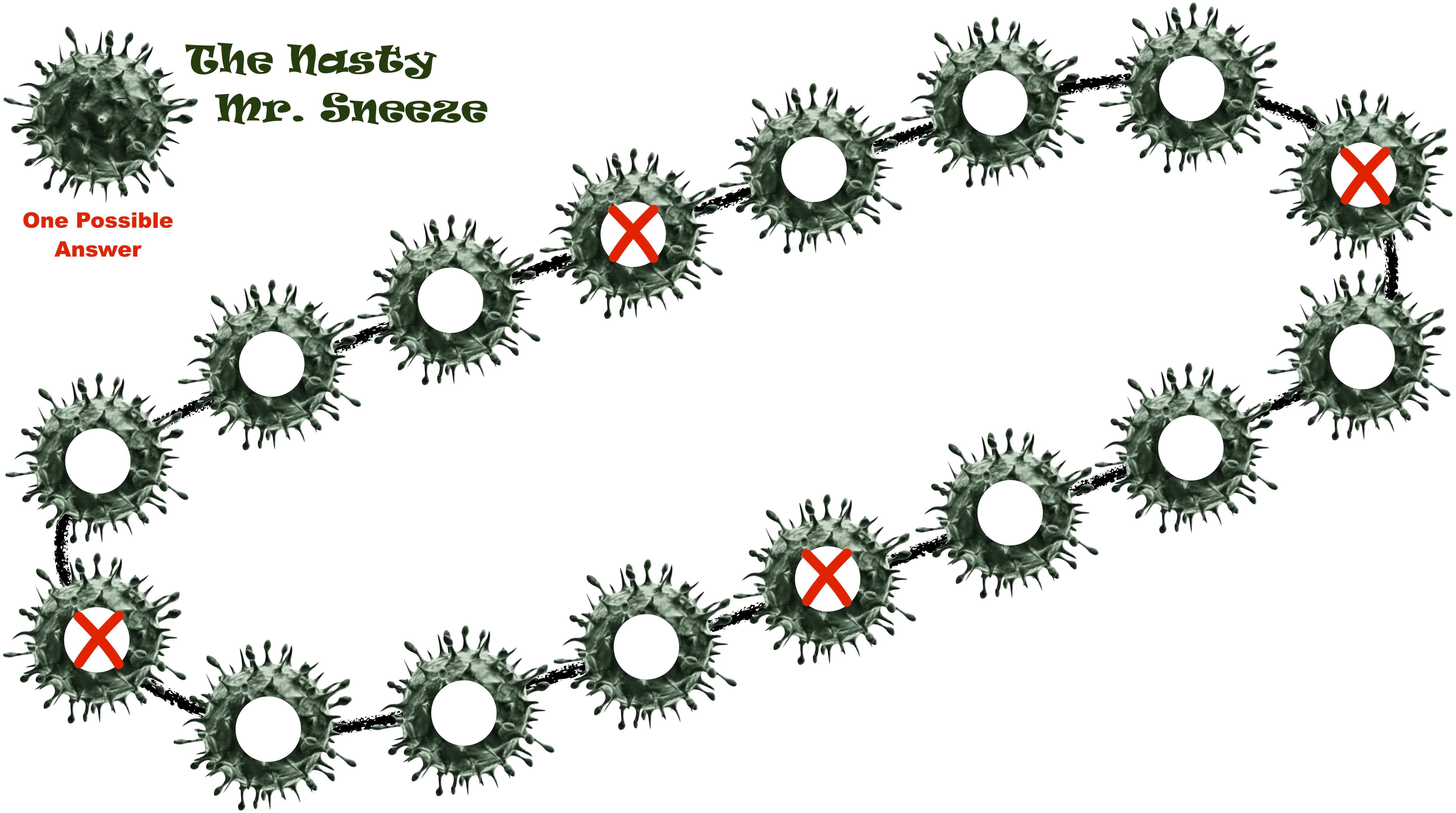
+

Biggest Connected Group

=

Mr. Sneeze's Score



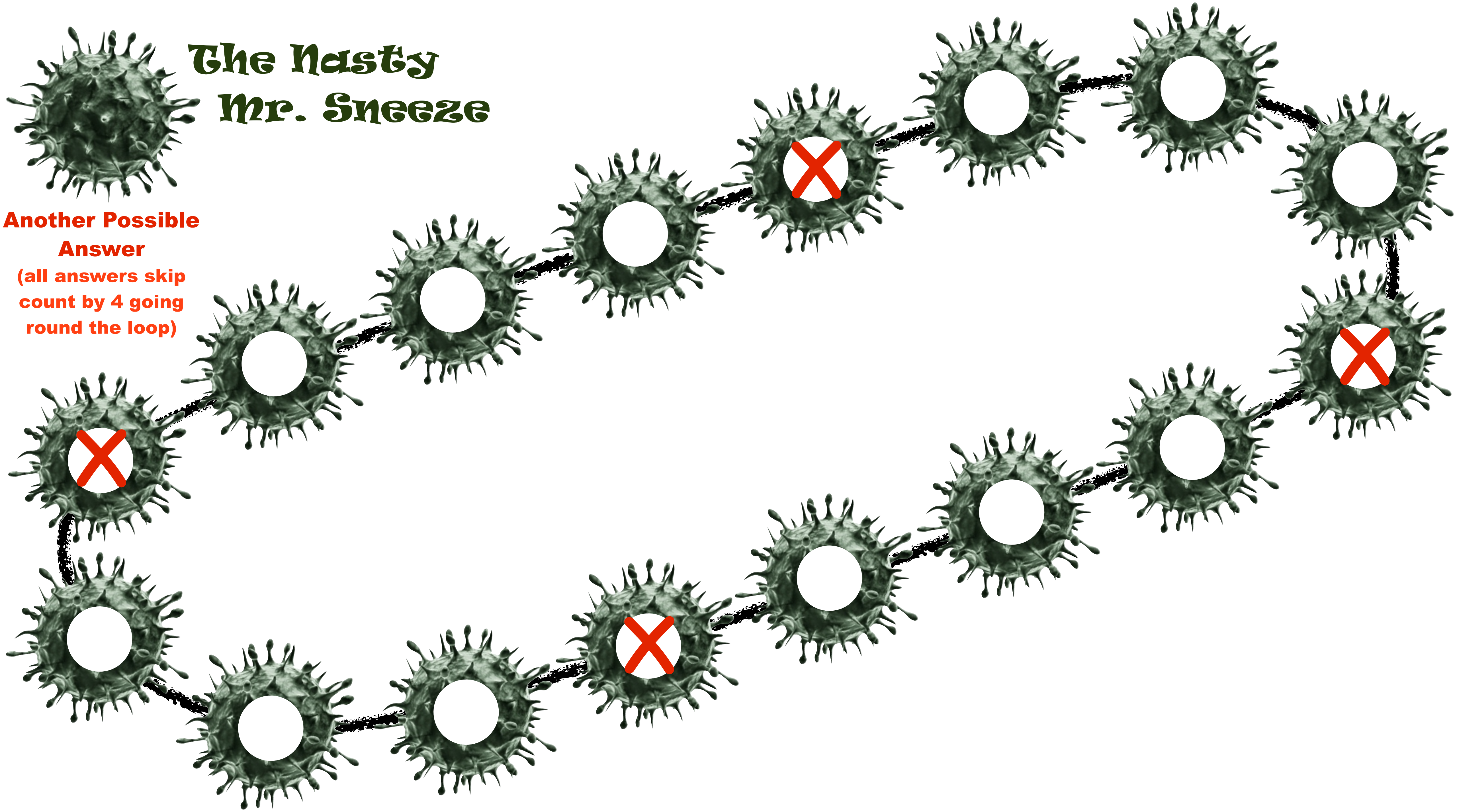


The Nasty Mr. Sneeze

One Possible Answer

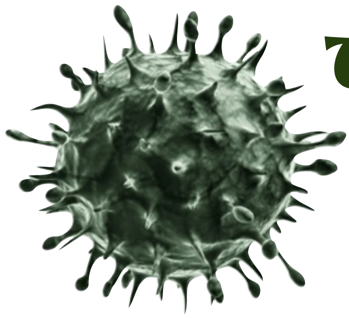
Number Children Sent Home	0	1	2	3	4					
+ Biggest Connected Group	16	15	7	7	3					
= Mr. Sneeze's Score	16	16	9	10	7					

The Nasty Mr. Sneeze



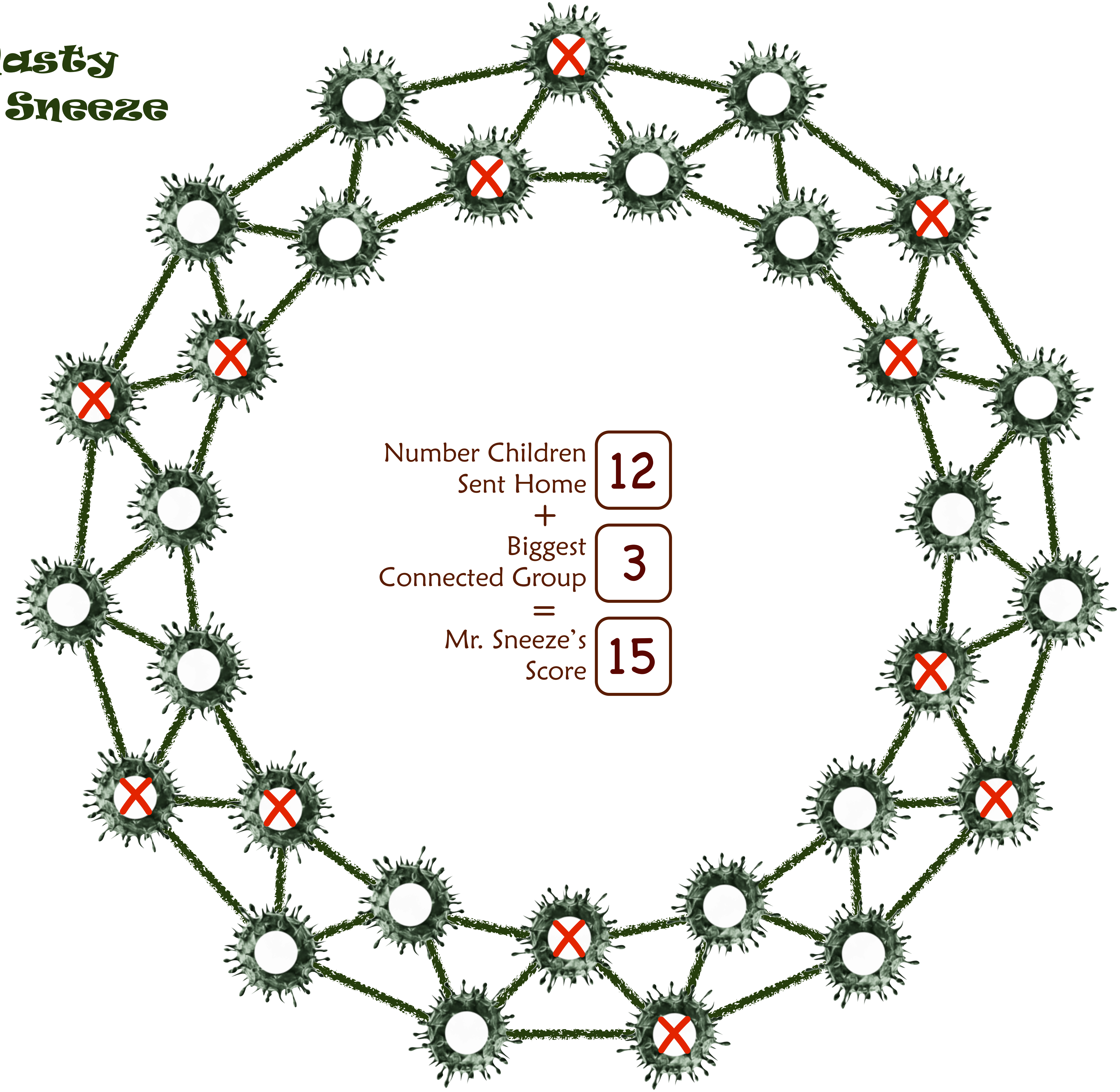
Another Possible Answer
(all answers skip count by 4 going round the loop)

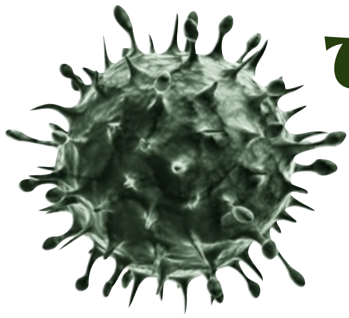
Number Children Sent Home	0	1	2	3	4					
+ Biggest Connected Group	16	15	7	7	3					
= Mr. Sneeze's Score	16	16	9	10	7					



The Nasty Mr. Sneeze

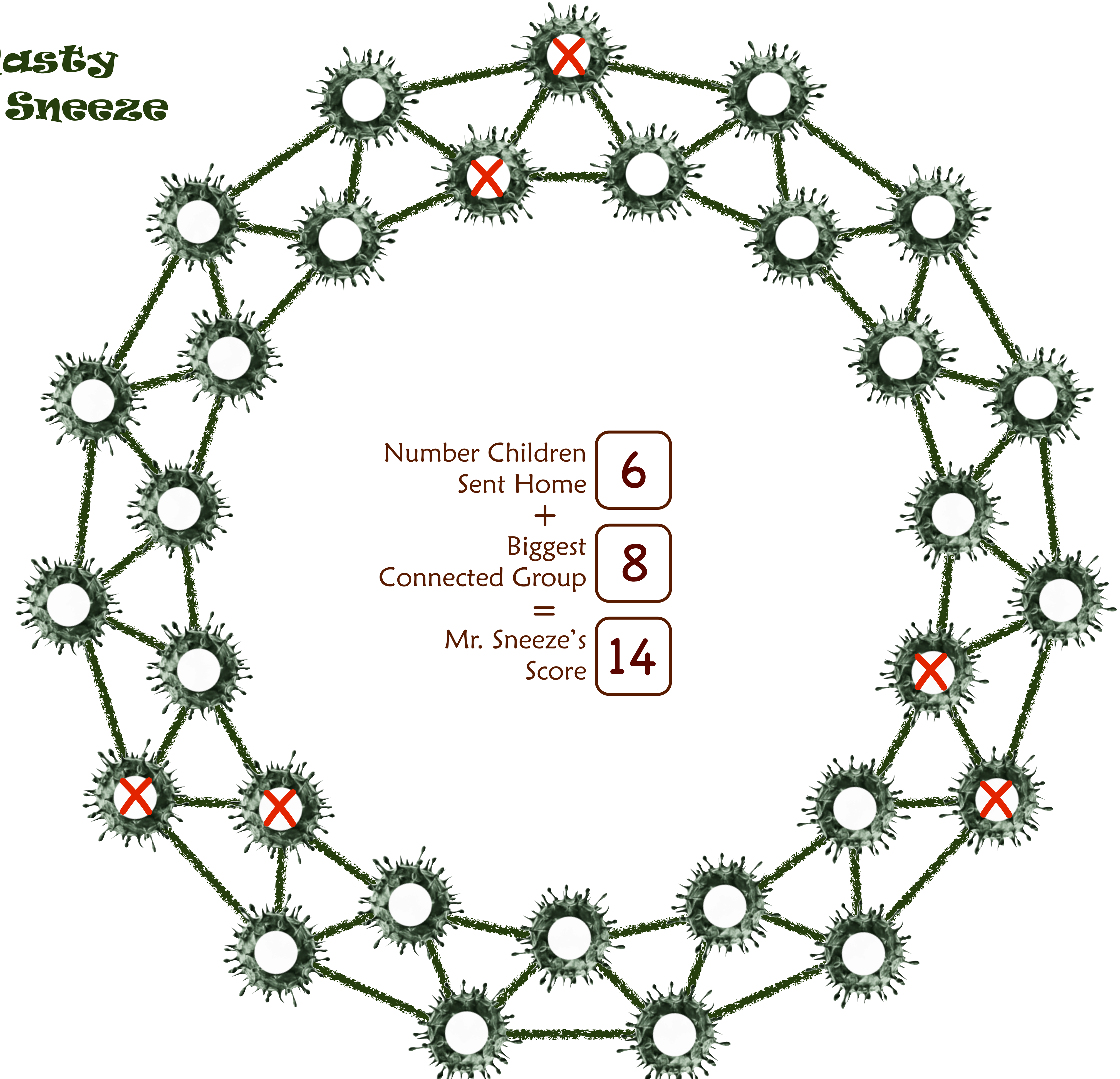
One Idea
(not the best, but I like it because it has both rotational and mirror symmetry)





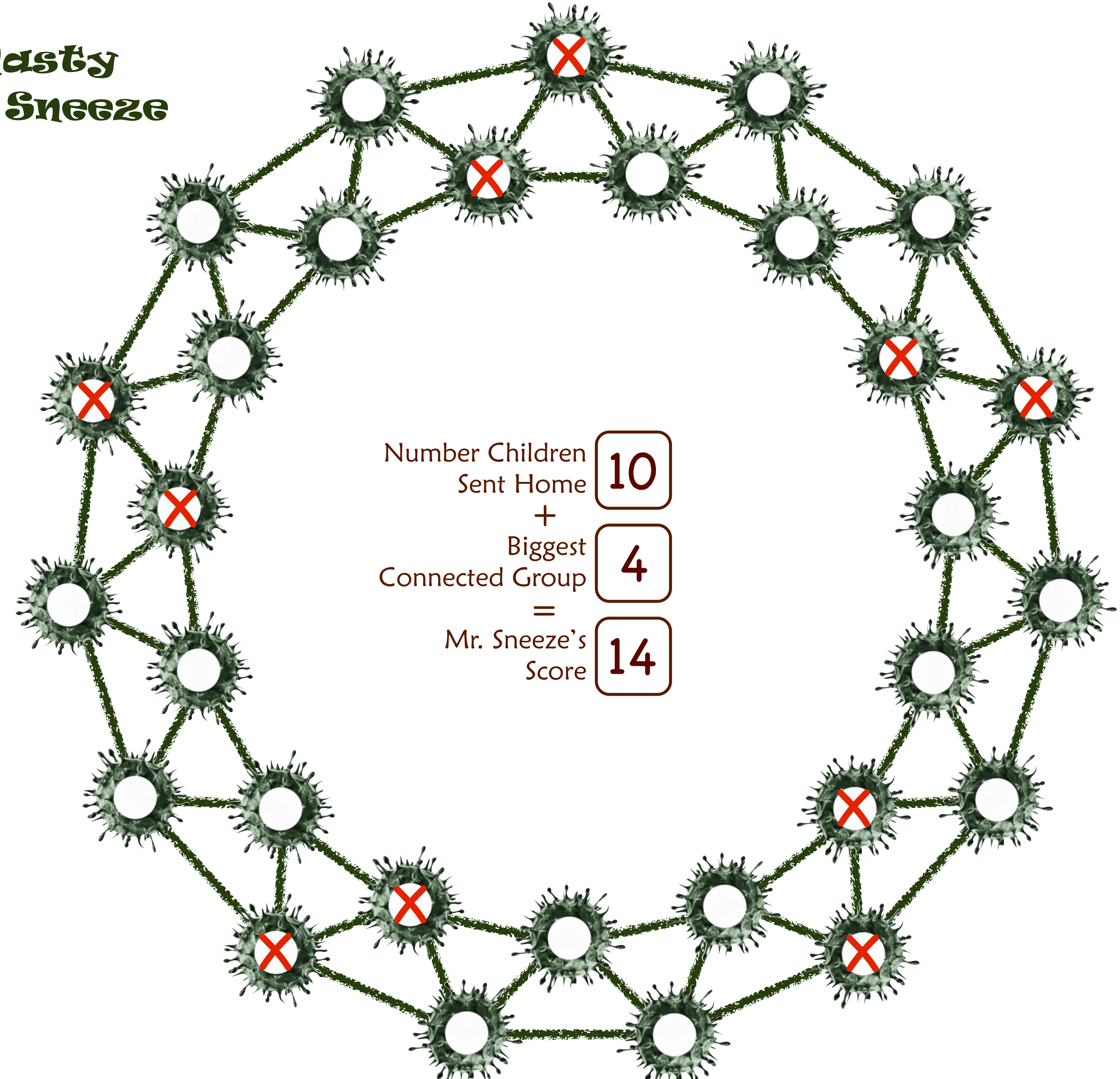
The Nasty Mr. Sneeze

One Possible Answer



The Nasty Mr. Sneeze

Another Possible Answer



6x6

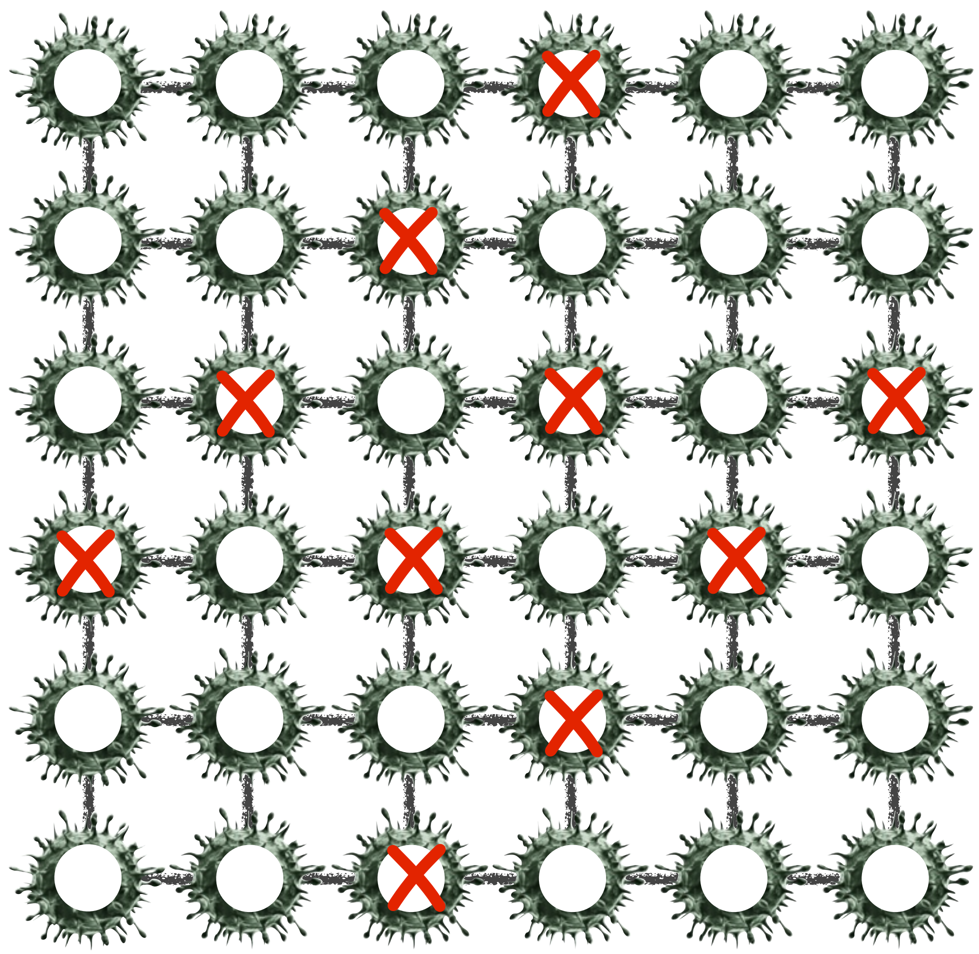
Number Children Sent Home **10**

+

Biggest Connected Group **6**

=

Mr. Sneeze's Score **16**



This took me a long time to find. On my first video I actually got this wrong and suggested that the best possible was 17.

7x7

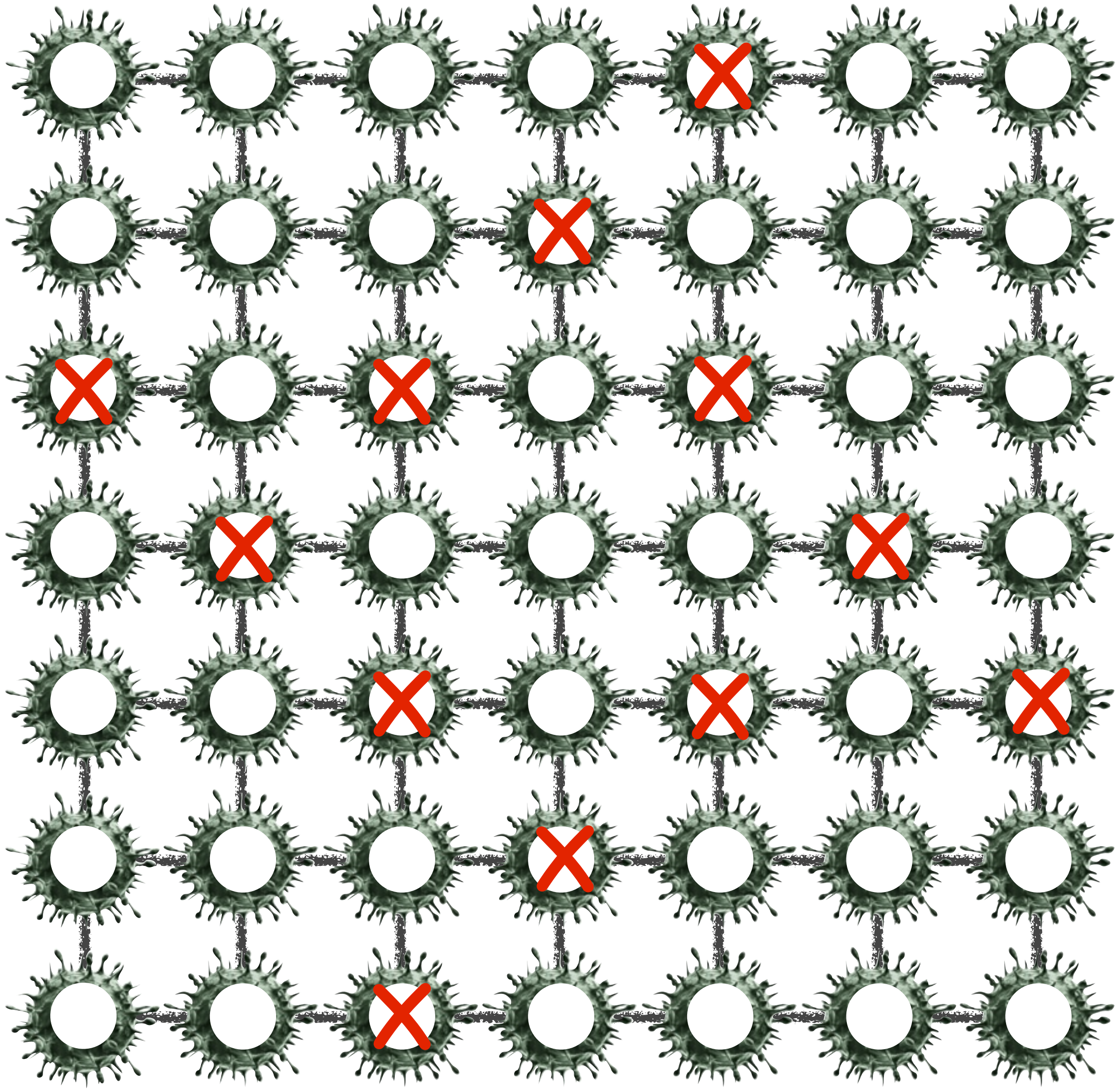
Number Children Sent Home $\boxed{12}$

$+$

Biggest Connected Group $\boxed{8}$

$=$

Mr. Sneeze's Score $\boxed{20}$



I don't know if this is as good as possible.

8x8

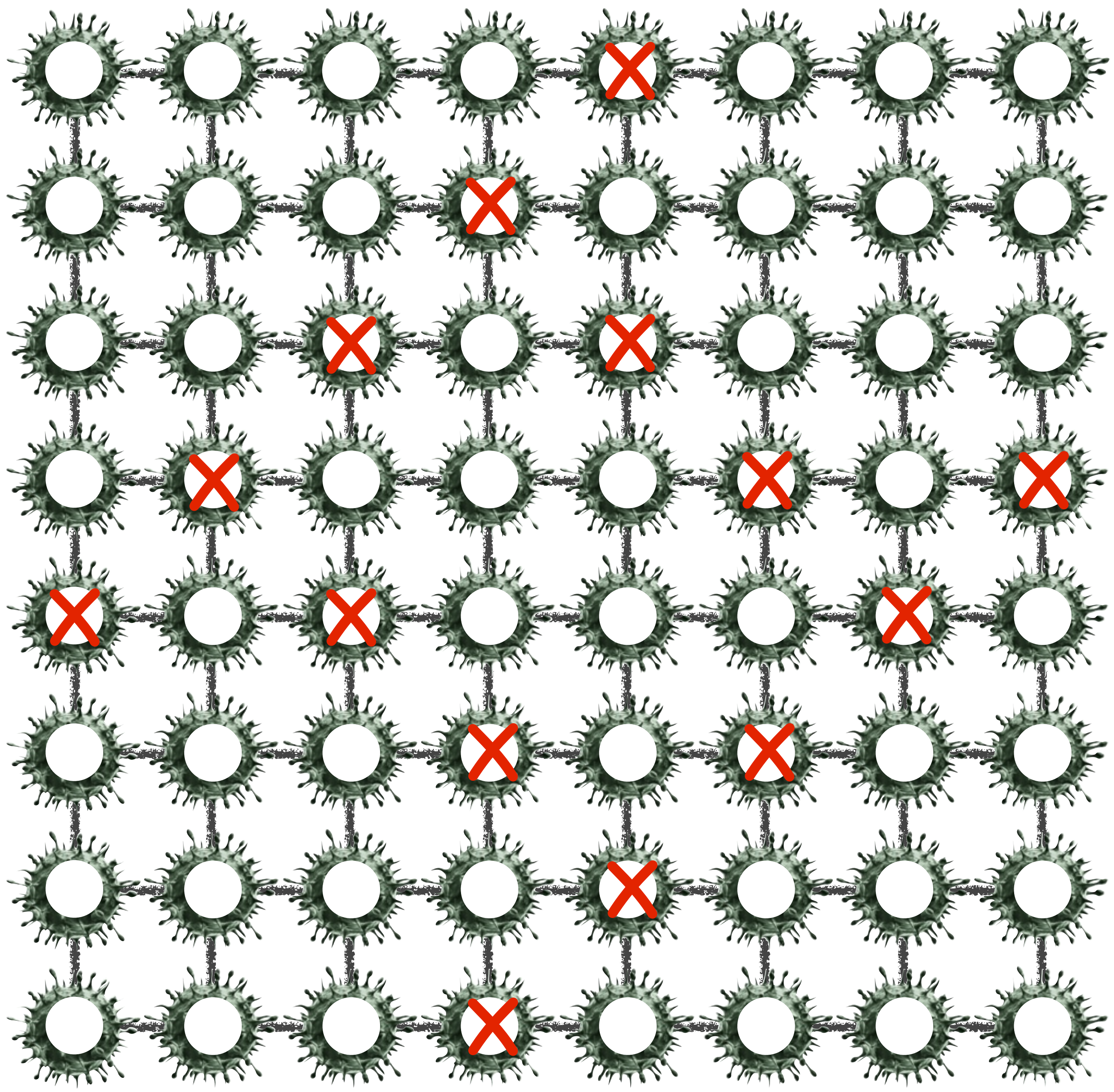
Number Children Sent Home **14**

\+

Biggest Connected Group **11**

=

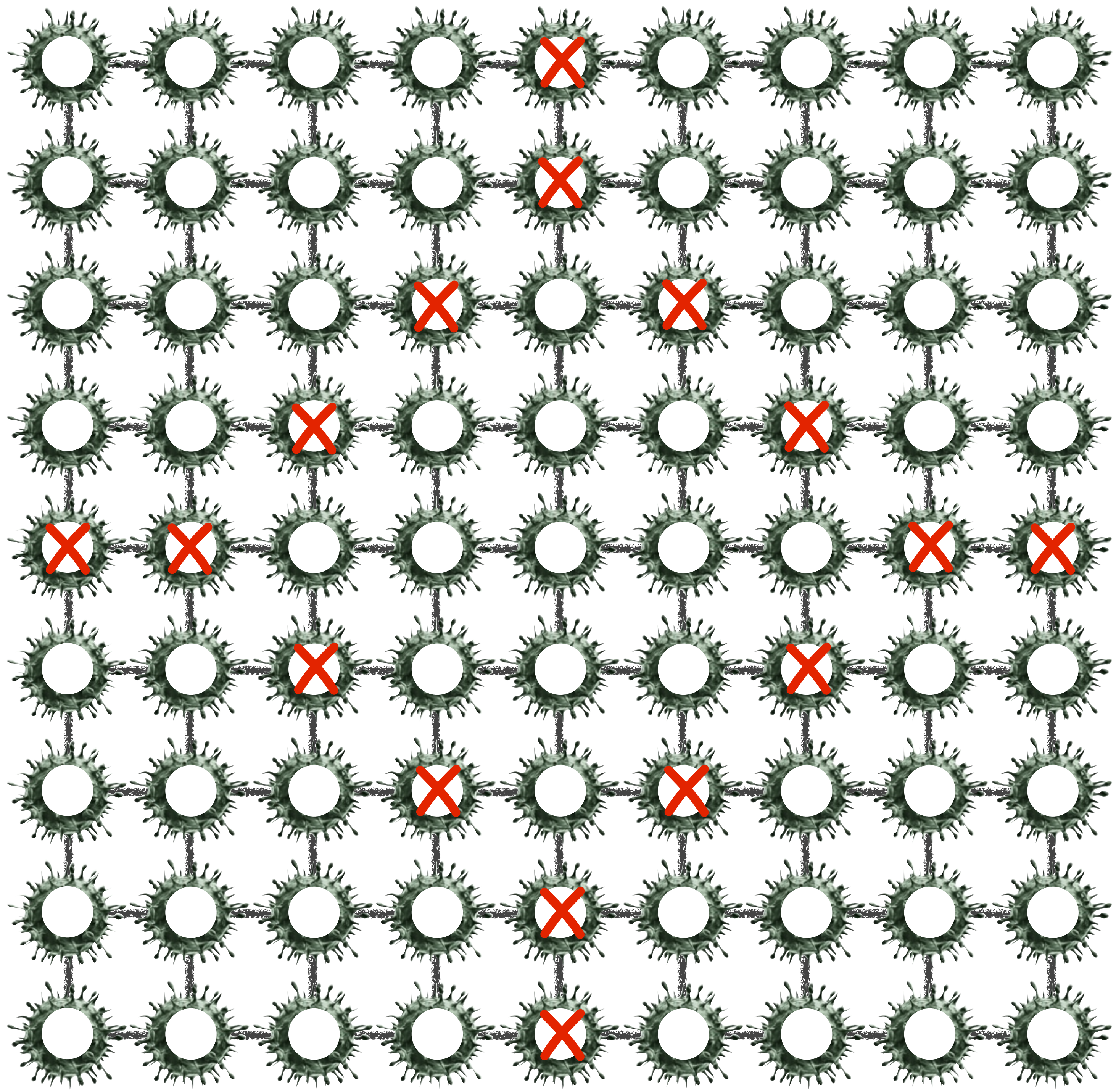
Mr. Sneeze's Score **25**



I don't know if this is as good as possible.

9x9

Number Children Sent Home $\boxed{16}$
+
Biggest Connected Group $\boxed{13}$
=
Mr. Sneeze's Score $\boxed{29}$



I don't know if this is as good as possible, but it looks so nice and symmetric and all groups have exactly 13. I think it has to be optimal.

10x10

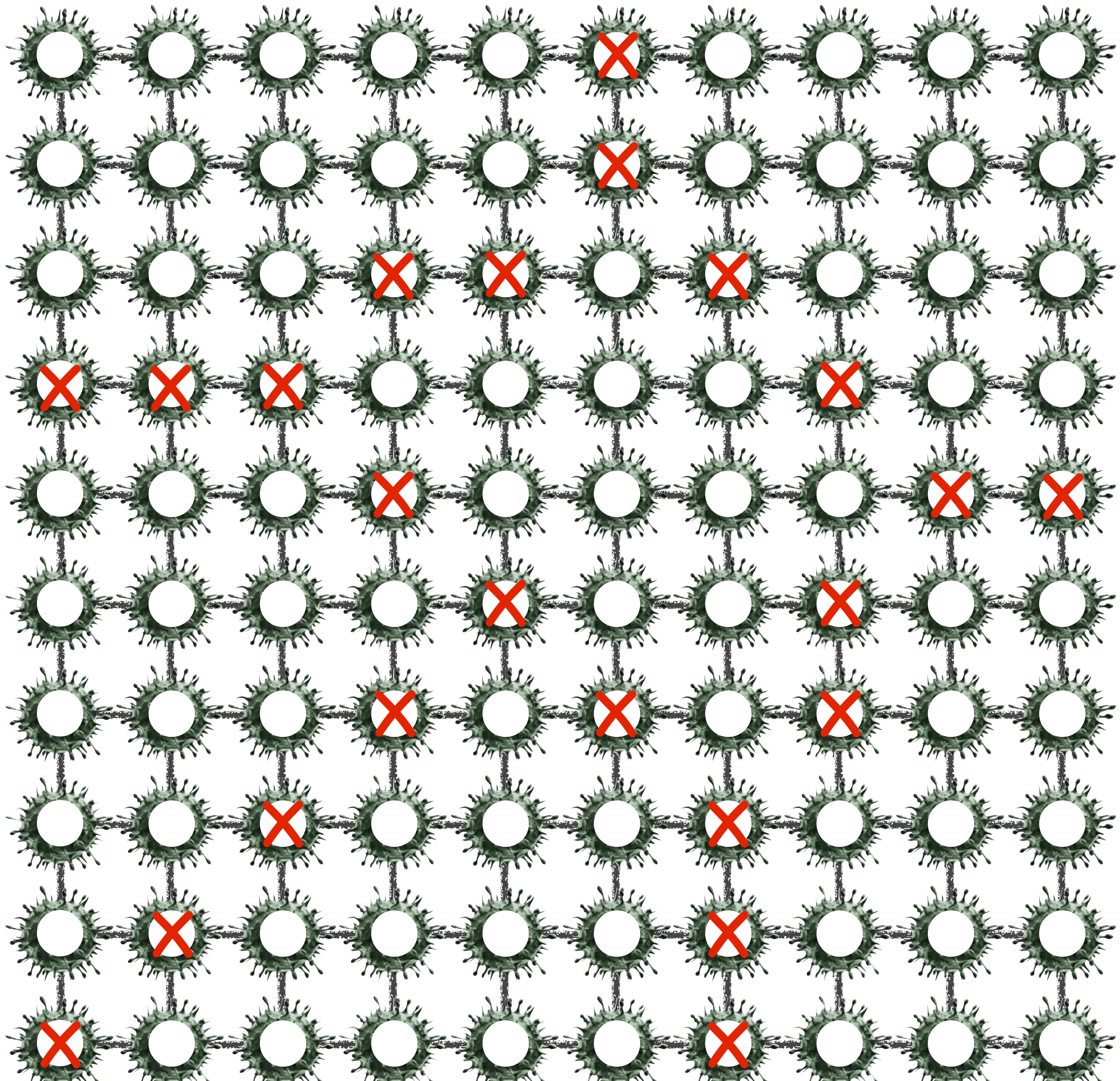
Number Children Sent Home $\boxed{23}$

+

Biggest Connected Group $\boxed{13}$

=

Mr. Sneeze's Score $\boxed{36}$



I don't know if this is as good as possible.

11x11

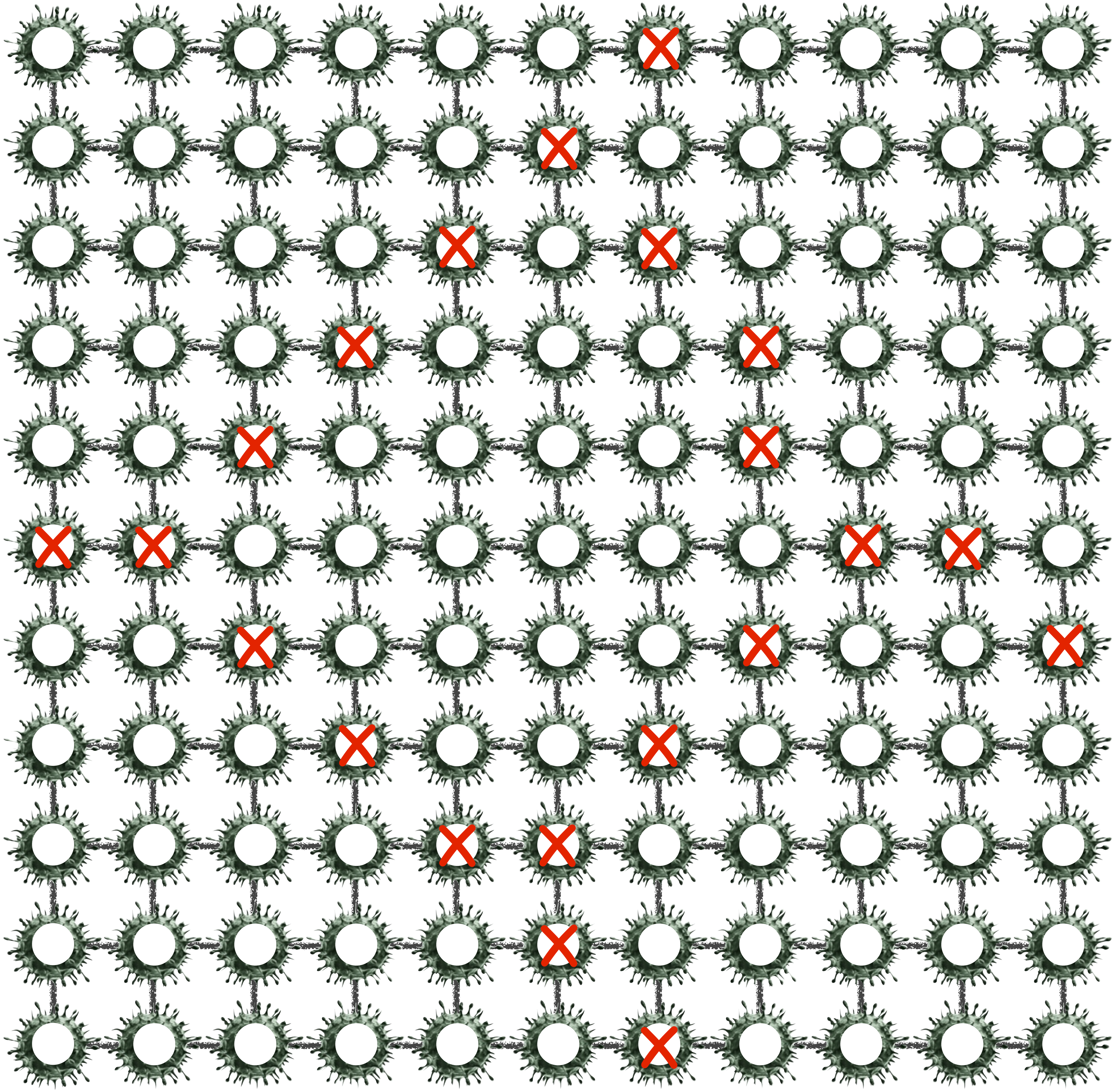
Number Children Sent Home: 21

+

Biggest Connected Group: 20

=

Mr. Sneeze's Score: 41



I don't know if this is as good as possible, but I'm really happy with it!

Put Your Students in a Pickle!

I'm a father of two elementary school children, a mathematician, and designer of puzzles and board games. Students call me Dr. Pickle. There is nothing I enjoy more than stumping students and having them stump me.

I founded MathPickle.com in 2010 to inject new ideas into the classroom. MathPickle's primary objective is to get thirteen curricular unsolved problems into classrooms worldwide - one for each grade K-12. A conference in November 2013 established the thirteen unsolved problems. To aid with the dissemination of these awesome problems, MathPickle is looking at setting up a $1,000,000 reward for each - the prize money to be split between the person who solves the problem and their most inspirational K-12 educator.

MathPickle is also developing a range of curricular puzzles like the ones you'll find at TpT. These help teachers them with their number one challenge:

"How to engage the spectrum of student ability?"

Whenever an elementary school teacher wants to teach addition, she will invariably face 20% of students who already know how to add and another 20% who are struggling with last year's curriculum. How can she engage the top students without losing the bottom students? How can she engage the bottom students without boring the top students?

One solution: Parents of top students often ask that their child be allowed to accelerate through the curriculum. This exacerbates the problem for future teachers, and sets up a failure-impoverished education experience for the bright student.

A wiser approach is to use curricular puzzles, games and mini-competitions to simultaneously teach curriculum to the students who need it, and to deflect top students into tough problem solving activities. This is never time wasted, because problem solving is the primary reason we teach mathematics.

The experience of mathematics should be profound and beautiful. Too much of the regular K-12 mathematics experience is trite and true. Children deserve tough, beautiful puzzles.

Gordon Hamilton
MMath, PhD