Model the Chances
of Getting an Autoimmune Disease

Name: _____

Date: _____

Student worksheet

Word Bank (when appropriate, use these words in your short answers):

Autoantibody	Healthy body cells	Immune system
Autoimmune	Infection	Immune response
DNA	Inheritance	Probability
Environment(al)	Immune cells	Variation
Genetic(s)		

1. Before the Experiment

a. Look at the data and graphs in your autoimmune disease handout and discuss within your group the distribution and causes of autoimmune diseases. In the table below (and on the next page), state your claims and evidence for three factors you think contribute to a higher risk of getting an autoimmune disease. Give reasons for why you think these might be true.

Question: *What factors contribute to a higher risk of getting an autoimmune disease?*		
Claim: (What is your opinion? What do you think?)		
Claim 1	**Claim 2**	**Claim 3**

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Evidence: (What support do you have for your opinion? How do you know		
Evidence 1	**Evidence 2**	**Evidence 3**
Reasoning: (What do you think could be the biological reason for your		
Reasoning 1	**Reasoning 2**	**Reasoning 3**

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b. The human body has developed several checkpoints that the immune system follows in order to stop an autoimmune response from becoming an autoimmune disease. In your own words, briefly explain what happens at each of the checkpoints, using the appropriate words listed in the Word Bank on the first page.

Checkpoint 1	
Checkpoint 2	
Checkpoint 3	

Name _____

2. Experiment

Follow these steps to model an autoimmune response in your body.

In *simulation 1*, you will represent a *person with no predisposition* to an autoimmune disease, meaning that you have a normal chance of developing an autoimmune disease.

In *simulation 2*, you will represent a *person with an existing predisposition* to an autoimmune disease, meaning that you will have an increased chance of developing an autoimmune disease.

a. Follow your teacher's instructions and the directions at each desk.

b. Make sure to close your eyes and mix the M&M's with your hand before picking a candy from the bowl. Then, return the M&M to the bowl before you move on to the next desk.

c. Record your results on the log sheet attached at the end of this worksheet.

3. After the experiment

a. Calculate the percentage of students in your class that did and did not get an autoimmune disease in either simulation. Enter your results in the table below.

	Simulation without predisposition	**Simulation with predisposition**
Students with autoimmune disease [%]		
Students without autoimmune disease [%]		

b. Draw a bar graph below that compares both percentages. Remember to add labels to your graph.

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c. In which simulation did more students get an autoimmune disease? Explain in your own words why, using the relevant terms from the Word Bank on the first page.

Note: Complete steps d.-f. only if your teacher asks you to. Otherwise, continue with step g.

d. Determine the probability to get an autoimmune disease for each of the steps within a checkpoint. Enter your results in the table below.

	Probability of:	Checkpoint 1	Checkpoint 2	Checkpoint 3
Without Predisposition	**Picking matching color**			
	Rolling high* number			
With Predisposition	**Picking matching color**			
	Rolling high* number			

*The number(s) on the die that lead(s) to an autoimmune disease.

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e. Draw a probability tree on an extra sheet of paper, where you include each possible path for going through all of the checkpoints. Include the probability for each step along the path.

f. Next, calculate the final probabilities of getting an autoimmune disease in each simulation. To do this, multiply all probabilities along one single path that leads to an autoimmune disease. Then, add up the individual probabilities that lead to an autoimmune disease. Remember to change the probabilities for rolling the die at Checkpoints 2 and 3 in the simulation with an existing predisposition. You can do your calculations on an extra sheet of paper. Then, enter your final results in the table below.

	Simulation without predisposition	**Simulation with predisposition**
Final probability to get an autoimmune disease [%]		

g. Based on your results, present arguments for why, in a given population, only a few people have an autoimmune disease. Use the relevant words from the Word Bank in your explanation.

Name _____

Simulation log sheet

Station	Without predisposition (Simulation 1)		With predisposition (Simulation 2)	
Setup	M&M color: _____		M&M color: _____	
Checkpoint 1	M&M color: _____		M&M color: _____	
	Die number: _____		Die number: _____	
	Autoimmune disease? □ Yes □ No		Autoimmune disease? □ Yes □ No	
Checkpoint 2	M&M color: _____		M&M color: _____	
	Die number: _____		Die number: _____	
	Autoimmune disease? □ Yes □ No		Autoimmune disease? □ Yes □ No	
Checkpoint 3	M&M color: _____		M&M color: _____	
	Die number: _____		Die number: _____	
	Autoimmune disease? □ Yes □ No		Autoimmune disease? □ Yes □ No	
Class results	Number of students with autoimmune disease	_____	Number of students with autoimmune disease	_____
	Number of students without autoimmune disease	_____	Number of students without autoimmune disease	_____