Due by Wednesday March 22!

Name: _____ Period: _____

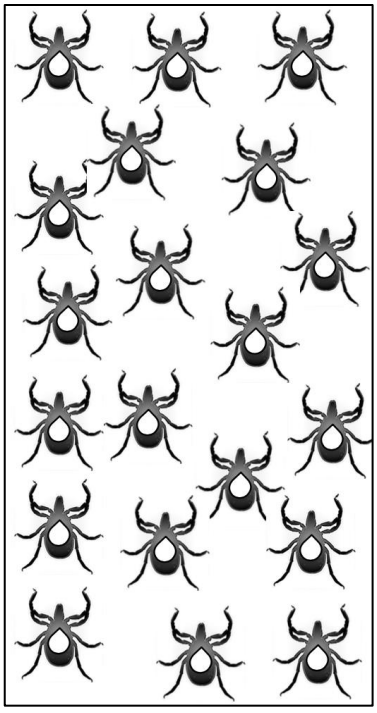
Mini-Lab 19: Tricky Ticks: Modeling Evolution of Drug Resistance of Ticks

Permethrin is a man-made chemical that mimics naturally occurring chemicals found in the Chrysanthemum flower. It directly affects the nervous system of insects, causing paralysis and death. Permethrin is the main ingredient found in many tick repellents for dogs. In a hypothetical population of deer ticks in eastern Massachusetts, there are some ticks that, due to a mutation, have formed a resistance against Permethrin. Resistance means that the ticks are not affected or are not killed by the drug. The population resides on and around mice and their nests. A town has suffered infestation problems with ticks and high rates of Lyme disease, a disease in humans caused by bacteria transmitted from tick bites. The town provided residents with Tick Tubes, which contain cotton balls laced with Permethrin. The mice took the cotton back to their nests, and the Permethrin gradually killed the ticks living in the mice nests. The tick problem was soon taken care of, and the number of ticks was reduced to a reasonable number. However, 15 years later, there is a bigger problem: the ticks are rising in numbers again, and they seem to be resistant to Permethrin. A local scientist has identified a possible DNA mutation that may be associated with Permethrin resistance where ticks can break down Permethrin prohibiting the effects of paralysis on the ticks.

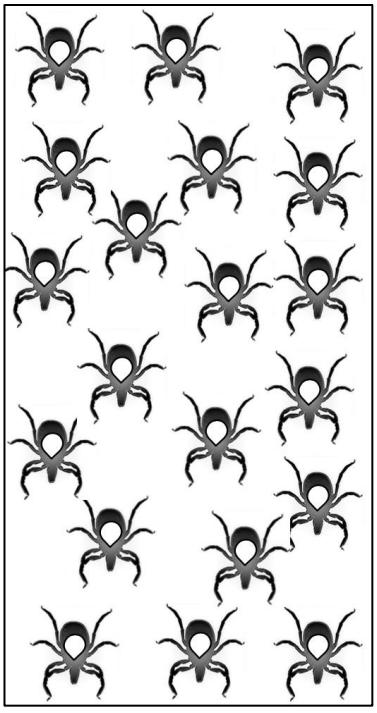
In this activity, you will show the change or evolution of ticks over time. In order to determine how many ticks in each generation that are resistant or normal, you will need to do some basic math. On the tick generation diagrams you will represent **Normal Ticks** as **RED** and **Permethrin-Resistant Ticks** as **BLUE** by coloring the drop of blood on each tick. Each generation is represented has 20 ticks. For each generation, the percentage of Permethrin-resistant ticks is given in the table below. To determine the number of ticks to color **blue**, simply multiply 20 by the given percent. For example, if 5% of the population is resistant, then times 20 by 0.05. This will equal 1, so you will color only 1 tick in Generation 1 blue, the rest will be red. Complete the table and color your generation diagrams to visual the change over time in the tick population.

Generation	Percentage of Permethrin-Resistant Ticks	# of Resistant Ticks (out of 20)	Generation	Percentage of Permethrin-Resistant Ticks	# of Resistant Ticks (out of 20)
1	5%		**4**	65%	
2	15%		**5**	80%	
3	40%		**6**	90%	

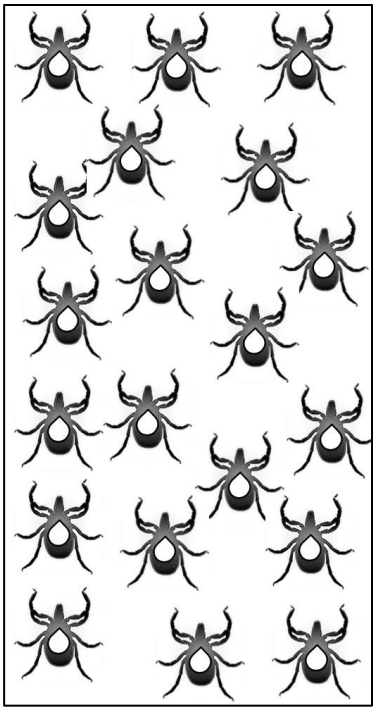
Generation 1



Generation 2



Generation 3



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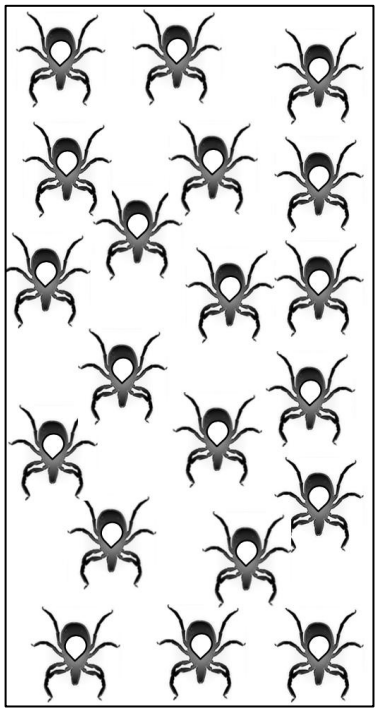
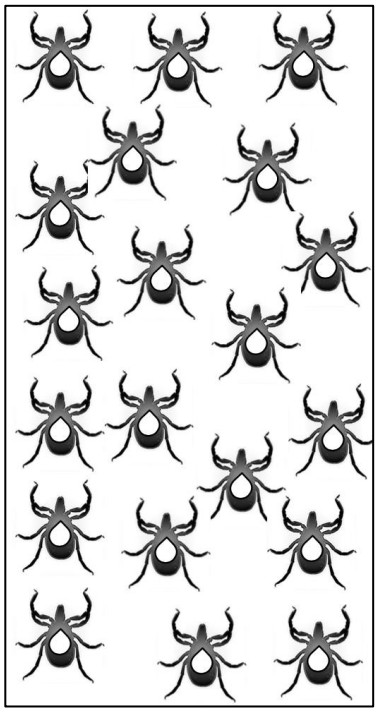
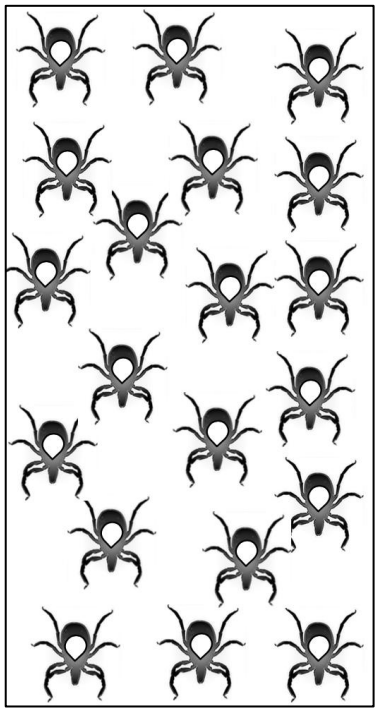
Generation 4



Generation 5



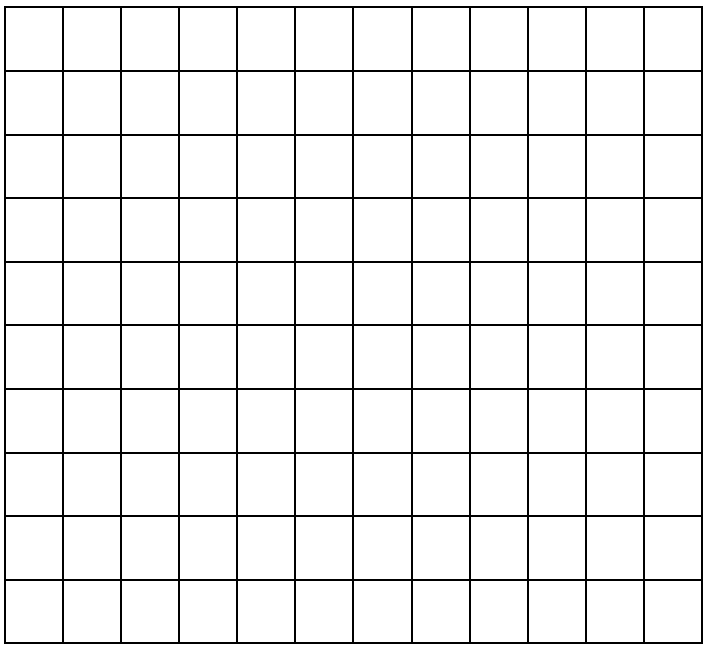
Generation 6



Graph of Data:

Use the data of tick population numbers for each generation to complete the graph below. This will have TWO lines (make sure to complete the graph key to show which line is associated with which type of tick).

Y Axis: _____



X Axis: _____

Graph Key:

- ☐ Normal Ticks
- ☐ Permethrin-Resistant Ticks

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Analysis Questions: **Answer in FULL sentences!**

1. Given your graph, describe how the populations of normal ticks and permethrin-resistant ticks change over time. Be specific and cite evidence from your graph!

2. Explain how this example of resistance in ticks is an example of biological evolution.

3. How could this example of tick resistance be similar to antibiotic resistance among bacteria?

4. Give two reasonable solutions to slow or deter resistance to certain chemicals (pesticides or antibiotics) in insects and bacteria.

5. Given generations 1-6, make an inference about what generation 7 will be.

6. Given this scenario of ticks changing over time, describe how each of Darwin's four principles is used. Apply your knowledge of each principle!
   A. Heredity

   B. Variation

   C. Competition

   D. Survive & Reproduce

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7. Because of the rise of permethrin-resistance, the town switched to using Tick Tubes with the chemical DEET instead of permethrin. The local scientist was concerned about what the outcome would be given the experience with permethrin-resistance. In a full paragraph (3-5 sentences at least!) describe what you think the data, graph, etc. would look like if the town started using a new chemical.

Mini-Lab 19 Score:			
1	2	3	4