Pink moth simulation: Natural selection at work

THE REAL THING:
Before the year 1845, in the city of Manchester, England a population of light gray colored moths known as Peppered moths lived in the surrounding forests. They would cling to the trunks of trees that were themselves covered with a light gray colored bark. The fact that these moths were able to blend in with this light gray background served as an adaptation, providing protection in the form of camouflage from birds (predators). Due to natural variations within the moth population, as a result of random mutation, multiple color alleles existed. Around 1845 the city started becoming more industrialized, with factories pouring black coal smoke into the air. This pollution fell into the surrounding forests and slowly turned the bark of the trees to a darker gray color thereby making the lighter gray moths more vulnerable to predation. Suddenly the dark gray colored moths possessed an adaptation. As a result, over a period of approximately fifty years the moth population experienced a "shift" in the frequency of the alleles that determine moth coloration. Due to the effects of natural selection, the frequency of the allele for light gray color decreased and the frequency of the allele for dark gray color increased. Natural selection says that those individuals best suited for survival in a specific environment are likely to live longer and reproduced more.

THE SIMULATION: We will be using pink moths to simulate this same type of change. All trees will start white and gradually turn to pink, and then back to white again. The populations will change as well as the trees change showing natural selection.

MATERIALS: 4 white strips (trees), 4 pink strips (trees), 3 cups labeled – White, Pink and Living, handful of white and pink "moths"

PROCEDURE:

1. On your table, lay four white trees out in front of you about two inches apart.
2. Put 25 white moths and 10 pink moths into the "living" cup. Put all extra moths in either "pink" or "white" cups.
3. Simulate the moths flying by sprinkling the moths from above the trees. If some fall on the ground, pick them up and place them on the table, not a tree.
    a. If a moth lands on a tree of opposite color, **it dies** and it returns to either the "pink" or "white" cup.
    b. If a moth lands on the table or ground, **they survive but do not reproduce**. Put them in the "living" cup.
    c. If a moth lands on a tree of their own color, it lives and reproduces **two offspring**. Place all three into the "living" cup.
4. Count up the number of both the pink and white moths and record them in the data table.
5. For the second generation, replace one white tree with a pink tree. Repeat steps 3 and 4.
6. For all other trials, replace a white tree with a pink tree until all are pink and then phase out the pink back to white again.
7. Graph data. Tree color variation on the X axis and number of moths on the Y axis. Use a different color for showing the white and pink populations.
8. Answer analysis questions.

Trees	White	Pink	Total
4 white			
3 white, 1 pink			
2 white, 2 pink			
1 white, 2 pink			
4 pink			
3 pink, 1 white			
2 pink, 2 white			
1 pink, 3white			
4 white			

1. Define Natural Selection.

2. What adaptation did certain moths have that increased their ability to survive?

3. What color were the trees around Manchester before 1845? What color did they change to?

4. What caused the change?

5. What color were the majority of the peppered moths before 1845?

6. What caused the first dark gray moths to appear within the population?

7. Was the change in moth color, from light gray to dark gray, a beneficial change for the moth population as a whole? Why or why not?

8. What happened in your simulation?

9. Why did your simulation go from white to pink?