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Simulating the Formation of Protective Colors: Improvement of Experiments in Teaching

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ABSTRACT

Students are very interested in the Inquiry experiment of Simulating the formation of protective colors. However, it is often influenced by the subjective factors of students in practice, so the simulation experiment is improved twice in teaching. After the second improvement, the experiment achieves good results.

1. Introduction

The experiment of simulating the formation process of protective color enables students to understand the process and causes of biological evolution from a perceptual perspective, so as to pave the way for a better understanding of Darwin's natural selection theory. The simulated activity is to simulate a certain environment and various organisms in the environment, and to simulate predators to prey on prey and count the number of surviving prey.Its purpose is to find out the most suitable living organisms in a certain environment through the statistics of the number of various organisms in the environment, so that students can understand that protective color is gradually formed in the process of biological evolution [1].

In practice, there are mainly the following difficulties and problems: (1) The colored cloth is used as a living background, the material is soft, and is easy to be grabbed together with small pieces of paper in the process of predation, so that the distribution of the small pieces of paper is affected; (2) In the simulated investigation, the progress of investigation was regulated by controlling the number of small pieces of paper left on the colored cloth, namely the number of prey, which deviated greatly from the real predation situation; (3) Although the predator is required not to deliberately look for a small piece of paper of a certain color, it is difficult to exclude the influence of factors such as the predator's preference for color and the distance between the predator and various prey in the actual predation process, which ultimately affects the accuracy of the research results [2].

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2. Initial Improvement

Based on these problems, we have made the first improvement to this simulation inquiry in our teaching [3], and the method steps are as shown in Table 1.

Table 1. Steps of "Simulating the Formation Process of Protective Color"

Step 1	Large colored paper (0.5 * 0.5 m) of three colors and a plurality of small pieces of paper of corresponding colors are prepared, wherein the small pieces of paper are used as "certain organisms", and the large colored paper is used as the "living environment" of the organisms.
Step 2	Four students form a group, one person is the group leader, and the predation time is controlled; Man-made predator; One person is a recorder. Small pieces of paper are prey.
Step 3	Predator in advance back to the table, the team leader chose a large piece of colored paper spread on the table, and evenly sprinkled on the top of three colors of small pieces of paper each 20, write down the color of the paper.
Step 4	At the beginning of the timer, the Predator quickly turned around to grab the paper, each time turning to the table, and grabbed a small piece of paper (using only eyes to determine its position). After 20 seconds, each group counted the number of various colors of paper in the Survivor.
Step 5	Assume that each survivor produces three offspring of the same color as his own. Place 3 small pieces of paper of the same color under each survivor. Mix the survivors and their descendants thoroughly. Repeat the two steps in 2. The number of small pieces of paper of various colors is recorded in each round.

However, in practice, some students will still deliberately look for small pieces of paper of a certain color, which will affect the accuracy of the results of the inquiry. If the predator is no longer a student simulation with strong subjective consciousness, but a real predator, the results will be closer to the real natural environment conditions and more convincing. Therefore, the simulation experiment is improved for the second time.

3. Secondary Improvements

Protective coloring is usually used to describe the body color of animals that is very similar to the color of the surrounding environment. Plants generally do not have protective colors, but they may also be eaten in different quantities due to differences in color. Black rice, red rice and white rice are natural variations without human interference. Quails are omnivorous animals, and have no deliberate choice of rice grains of various colors, but in different color backgrounds, hungry quails will actively choose food with relatively obvious colors, which also shows that under natural conditions, organisms with similar colors to the environment are easier to retain.

3.1 Materials

Each group took a quail, black rice, red rice, white rice, white paper, black paper. A shoe box (to prevent the quail from moving around and affecting the results of the experiment).

3.2 Simulation

Experiment 1: Explore the protective color effect of different color backgrounds. 30 rice grains of each color are taken, evenly mixed and scattered on white paper in a shoe box. Put the hungry quail on the white paper and let it peck at the rice grains. After one minute, the quails are removed, and the number of the remaining rice grains is counted; Repeat 3 times and record.

Figure 1. Quail pecking rice on a white background

Table 2. Records the remaining of rice grains of different colors on a white background

	Black	Yellow	White
1	3	6	16
2	2	5	20
3	1	3	18
Average	2	4.7	18

Replace the white paper with black paper, and then repeat the steps of the above experiment, you can further compare the number of predators under different color backgrounds.

Figure 2. Quail pecking rice on a black background

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Experiment 2: Explore changes in the number of individuals of different colors after many generations of evolution. Repeat the first three steps of the Experiment 1, assuming that each survivor produces three offspring and the color is the same as before, and then add the corresponding number of grains of rice according to this law. Record the number of colored rice grains of each round.

Table 3. Simulates changes in the number of individuals of different colors after three generations of white backgrounds

	The first generation		Second generation		The third generation	
The color of the rice grain	The number of starts	Number of survivors	The number of starts	Number of survivors	The number of starts	Number of survivors
Black	30	2	8	0	0	0
Yellow	30	4	16	2	8	2
White	30	15	60	43	172	150

3.3 The Results of the Experiment

(1) Under the white background, in the rice grains which the quail eats in the unit time, the black is most, the brown and the yellow are next, and the white is least; (2) after several generations, the white grains left on the white paper are the most, and the other colors are very few.

4. Conclusions

Individuals with protective colors similar to ambient colors were selected to remain as few individuals who were ceded during evolution.

With the second improved exploration, there are the following advantages:

(1) Easy to pick. Quail and rice of different colors are easy to buy in the market, and shoe boxes are easy to collect in life.

(2) Reducing subjective impact. Students simulating a "predator" can have a negative impact on the outcome of the study because of their different preferences for color. The dragonfly is the real predator in nature, and the experimental conclusions closer to the real natural condition.

(3) Table design facilitates conclusion analysis. By filling out the form, it is convenient to compare the relationship between "survivor" body color and background color, and to explore the conclusion. Based on the actual exploration to obtain data, this inquiry design three generations of organisms can meet the needs of exploration.

(4) Improve the reliability of the experimental results. Different color backgrounds can be selected to explore in groups, so that the experimental results are more reliable, the experimental conclusions are more scientific, and students can easily understand that the formation of different protective colors is the result of biological evolution, and the adaptability in nature is also universal.

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