Artificial Selection

Introduction

Lesson Introduction

The process of artificial selection has been used to develop specific, valuable traits in crops and domesticated animals. In this activity students will be able to engage in the process of artificial selection and determine how quickly it can produce results.

Grade Level: 9-12
Time Needed: Approximately 10 weeks

Learning Objectives

After completing this lesson, students will be able to:

1. Effectively apply the process of artificial selection to plants
2. Design and execute a scientific investigation
3. Compare and contrast the concept of artificial selection to natural selection

Next Generation Science Standards (NGSS)

As a result of activities for grades 9-12, all students will learn content in these areas:

Topics

- **LS2:** Inheritance & Variation of Traits
- **LS5:** Natural Selection & Evolution

Performance Expectations

- **HS-LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population
- **HS-LS4-3:** Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- **HS-LS4-2:** Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Dimension

Practices:

- Asking Questions
- Carrying out investigations
- Analyzing & Interpreting data
- Using Mathematics
- Constructing explanations

Disciplinary Core Ideas:

- **LS3.A**: Inheritance of Traits
- **LS3.B**: Variance of Traits
- **LS4.B:** Natural Selection

Cross-Cutting Concepts:

- Patterns
- Stability & Change

Materials

- ☐ Fast Plant Growing Systems
- ☐ Lights
- ☐ Wild type Wisconsin Fast Plant seeds
- ☐ Magnifying glasses or dissecting scopes

Instructional Process

1. You will need to begin growing Wisconsin Fast Plants a couple of weeks before this lesson begins. This can be done by you as the teacher, or it can also be done as part of a class period.
2. Prior to the activity, conduct a class discussion regarding how crops have changed over the years and how agricultural animals and pets have been bred for different purposes.
3. If your students are not already familiar with Fast Plants and how to grow them you will need to devote some time to teaching about them.
4. The lab continues for around 10 weeks, but should take less than 5 minutes most days as students may just need to add water or check on other needs. On 3 occasions students will need to spend around 20 minutes on the lab.
5. Divide the class into groups of 3-4 people.
6. Hand out the Artificial Selection - Student Sheet to students. Overview the lab activity with the class.

Follow-Up Questions

1. Was the change in the number of hairs more or less than you expected?
2. Height is also a genetic trait in fast plants. Describe a method by which you could breed very short fast plants.
3. Describe three examples of characteristics humans have artificially selected for in organisms.
4. Observing how humans had used artificial selection in organisms including dogs helped Darwin figure out the mechanism of natural selection. Compare and contrast the processes of artificial and natural selection.
5. Describe the steps by which a plant could evolve to be tall through the process of natural selection.

Artificial Selection – Student Sheet

Introduction

Hundreds of years ago the plant we now call corn began as a plant called teosinte. In fact, the corn of today is really a variety of plants that have been grown for specific characteristics to fit different functions. Popcorn and sweet corn are different from each other and even more different than the corn grown to feed livestock. How did these varieties of corn come into being and how did they become so different from their ancestor, teosinte? The answer is artificial selection. Artificial selection has shaped the characteristic of all crops and domesticated animals that are a part of our everyday lives. In this lab, you will breed Wisconsin Fast Plants to have a specific trait through natural selection.

Materials

- ☐ Fast Plant Growing Systems
- ☐ Lights
- ☐ Wild type Wisconsin Fast Plant seeds
- ☐ Magnifying glass or dissecting scope

Procedure

1. You will begin your investigation by examining the wild type plants that have been growing and have begun to flower. After your teacher provides your group with these plants, list at least three traits that show variation between the plants.
2. Take a magnifying glasses or dissecting scope and examine the plant. Notice there are small "hairs" on the surface of the plant. The number of these hairs is a genetic trait that shows variation. We will use this trait as our focus. In order to keep the data collection practical you will not count the hairs on the entire plant, but instead just on the petiole of the lowest true leaf.
3. Begin by counting hairs on the first petiole of each of your plants. Create a data table to organize your information.
4. Create a graph comparing the number of individuals with each number of hairs.
5. Calculate the average number of hairs for the initial population.
6. Make a hypothesis about how much the average number of hairs will change by the third generation.
7. You will be crossing plants of your choosing. You can choose to breed your plants to either increase or decrease the numbers of these hairs. Which plants will you cross to create the next generation? (breed no more than 10% of the population.) Use either bee sticks or other method to pollinate the plants you choose and then cover each to prevent further pollination.
8. Throw out the plants you did not choosing to reproduce. Clean the containers they were growing in.
9. Continue to care for plants and watch for seed pods. Once seed pods are formed dry them and plant the next generation.
10. When the second generation flowers take data on the number of hairs on the petiole of the first leaf of each plant. Organize that information in a data table.

11. Create a graph comparing the number of individuals with each number of hairs.
12. Calculate the average number of hairs for the population in this second generation.
13. Now it is time to make the 3rd generation. Which plants will you cross to create the next generation? (Do not breed more than 10% of the population.) Use either bee sticks or other method to pollinate the plants you choose and then cover each to prevent further pollination.
14. Throw out the plants you are not choosing to reproduce. Clean the containers they were growing in.
15. Continue to care for plants and watch for seed pods. Once seed pods are formed dry them and plant the next generation.
16. When they flower, take data on the number of hairs on the petiole of the first leaf of each plant.
17. Organize that information in a data table.
18. Create a graph comparing the number of individuals with each number of hairs.
19. Calculate the average number of hairs for the population in this third generation.
20. Compare your hypothesis to the actual change in the number of hairs.

Follow-Up Questions

1. Was the change in the number of hairs more or less than you expected?

2. Height is also a genetic trait in fast plants. Describe a method by which you could breed very short fast plants.

3. Describe 3 examples of characteristics humans have artificially selected for in organisms.

4. Observing how humans had used artificial selection in organisms including dogs helped Darwin figure out the mechanism of natural selection. Compare and contrast the processes of artificial and natural selection.

5. Describe the steps by which a plant could evolve to be tall through the process of natural selection.