Name_____Period_____Assignment#_____

LAB 1 ARTIFICIALSELECTION Guided Practice

How does artificial selection affect traits?

Annotate the text and answer questions 1-4.

Annotating Text
☐ **<u>UNDERLINE</u>** concepts you think might be useful for understanding or solving the problem
☐ **Box** information you think might be helpful for designing your investigation
☐ ← Write **notes** in the left margin
☐ → Write **questions and answers** in the right margin
Each paragraph (including each step of the procedures) must have something underlined or boxed, **AND** have something written in the margins (a question and/or note).

BACKGROUND

Evolution is a change in the frequency of genes in a population. One of the key driving forces of evolution is natural selection. Natural selection is the only theory of evolution that can explain adaptive evolution. Natural selection requires the following: 1) variation in inheritable traits 2) more offspring born than can survive resulting in competition for limited resources 3) differential survival resulting in some individuals reproducing more than others 4) Inheritance of traits that result in differential survival. It is important to understand that natural selection selects genes through the individual. In other words, individuals live or die and populations evolve. Environmental factors play a key role in determining which organisms reproduce and how many of their offspring survive.

In artificial selection, humans determine which organisms reproduce or provide some survival advantage consciously or unconsciously to certain individuals in a population allowing some individuals to reproduce more than others. Artificial selection results in organisms adapted to living with humans.

1) **What is the difference between natural selection and artificial selection?**

For the first part of this investigation, you and your classmates will perform one round of artificial selection on a population of Wisconsin Fast Plants. First, you will identify and quantify several traits that vary in the population and that you can quantify easily. You will then perform artificial selection by cross-pollinating only selected plants. You'll collect the seeds, plant them, and then sample the second-generation population and see if it is different from the previous one. Your results will generate questions, and you then will have a chance to test your own ideas about how selection works.

The plants here are 7-12 days old

2) **What are some easy to quantify traits of Wisconsin Fast plants?**

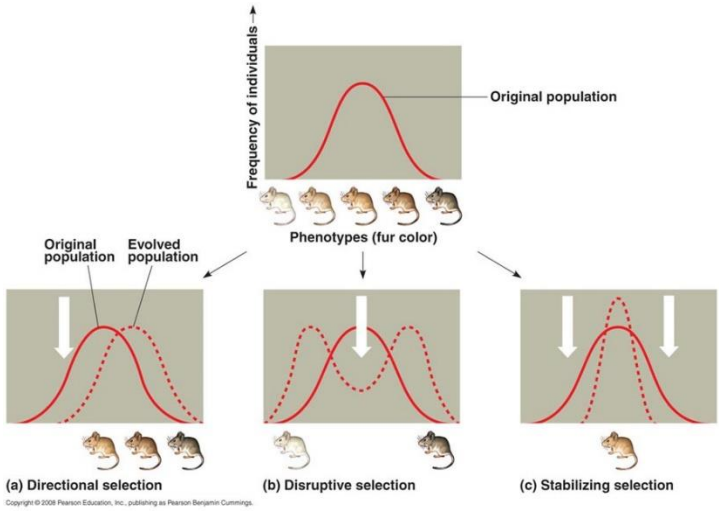
3) **How will you know if artificial selection has changed the genetic makeup of your population?**

Getting Started

In *On the Origin of Species*, Charles Darwin used artificial selection — the kind of selection that is used to develop domestic breeds of animals and plants — as a way to understand and explain natural selection. Like natural selection, artificial selection requires variation in the population under selection. For selection to work, the variations must be inheritable. To conduct artificial selection, humans decide on a specific trait of a plant or animal to enhance or diminish and then select which individuals with that desired trait will breed, producing the next generation and the next population.

4) **Use the diagram below to explain directional selection, disruptive selection and stabilizing selection. Use Wikipedia to find examples of each found in nature.**

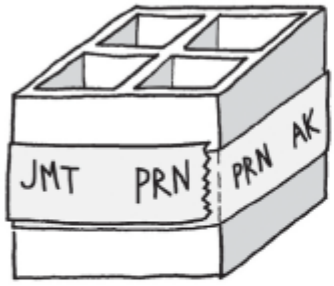
https://en.wikipedia.org/wiki/Directional_selection



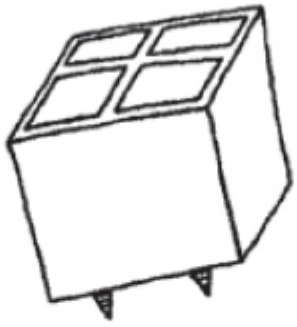
Procedure

Step 1

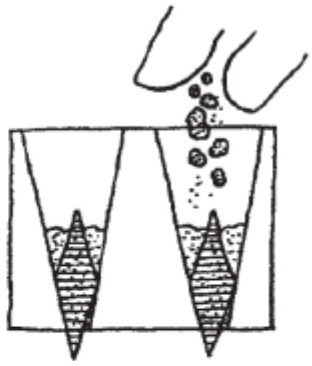
1. Label each cell as your teacher directs so that every student will know which plant is hers or his.



2. Drop one wet wick into each cell so that the tip extends 2 cm out of the hole in the bottom.

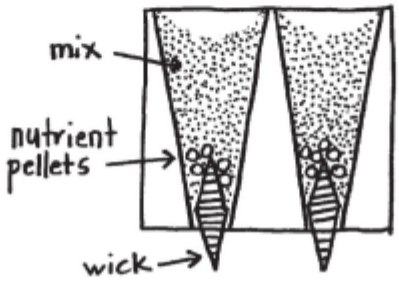


3. **F**ill each cell halfway with slightly moistened planting mix.



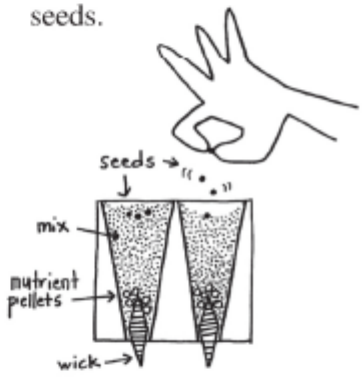
4. Add 3 pellets of fertilizer to each cell.

5. Fill each cell nearly to the top with planting mix.

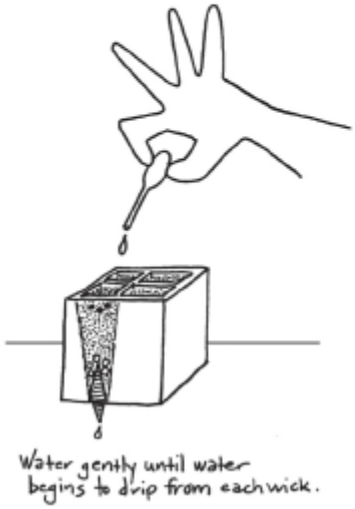


6. **D**rop 3 seeds on top of the planting mix.

- Fill to the top of each cell with mix to just cover the seeds.

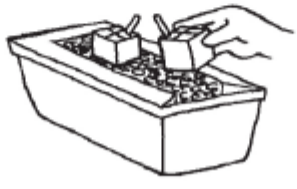


7. Water very gently with a pipette or dropper.

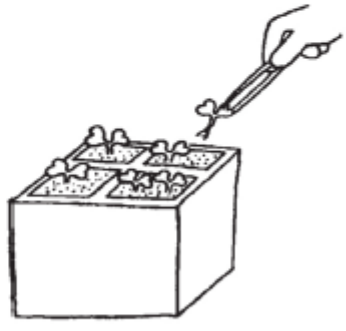


8. Put your group's quad on a water reservoir as your teacher directs.

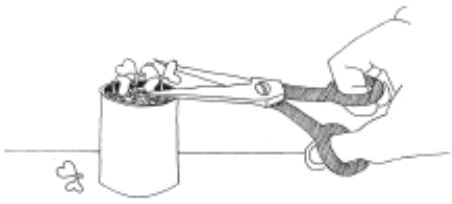
- The class quads (on their reservoirs) will all be placed under fluorescent lights that are on 24 hours/day and kept 5–10 cm from the top of the plants.



9. **U**se tweezers or scissors to thi**n** to one plant per cell when your plants have just pushed through the planting mix.



Day 4: Thin the Plants

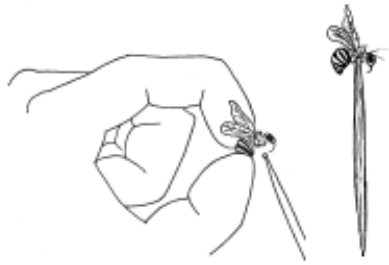


After the plants germinate, remove all but one or two plants per pot to prevent crowding. This is called **thinning**.

Days 5-12: Tend the Plants

Replenish the nutrient solution often—a big growth spurt is coming! Every other day, adjust the growing systems so the top of the plants is 10 cm from the light.

Day 13: Make Beesticks



Place a drop of glue on the tip of a toothpick. Poke the toothpick into the tip of the thorax (mid-section) of a bee. Let the beestick dry overnight.

Days 15-17: Pollinate Flowers

Brush the bees into the flowers to pick up and distribute pollen. Transfer pollen back and forth among several plants. (Wisconsin Fast Plants™ do not self-pollinate.) Pollinate the flowers for 2-3 days. Look at the bees to see if they are picking up pollen. (For more information on pollination and making specific crosses,

Day 18: Terminate Buds

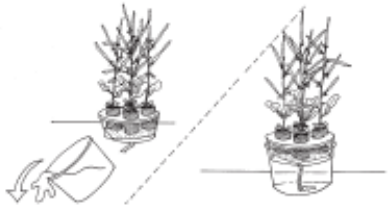
One day after the final pollination, cut off any new flowers or buds so the plant can channel its energy toward seed growth. **Do not cut off flowers that were pollinated.**

Days 19-36

Reminder:

Keep the containers full of nutrient solution until day 37.

Day 37: Stop Watering



Twenty days after final pollination, remove plants from the nutrient solution and allow them to dry for **one full week** in their pots until they are brown and crispy.

Day 44: Harvest Seeds

Cut off the stems and seed pods with a scissors.

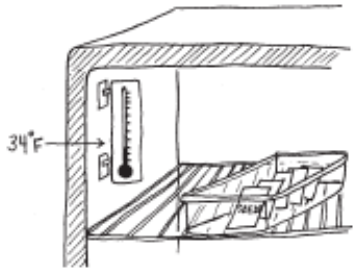
To harvest a few seeds, or if small children are harvesting seeds:

Place seed pods between two pieces of clear tape with the ends folded over. Crush the pods inside the tape, then peel open to get the seeds.

To harvest many seeds:

Place the stems and pods in a paper bag and crush them inside. Pour the contents into a dish, blow off the chaff, and pick out the seeds.

Seed Storage



Store the seeds in a dark, cool, dry place... or plant them for another experiment or activity.

Clean Up

Soak the reservoirs, pots, watermats, and wicks for 10 minutes in a solution made up of 95% water and 5% bleach. Scrub, rinse, and let air dry.

Step 2 Each day, check your plants and make sure that the reservoirs are full, especially on Fridays.

As your plants grow, record your observations daily in the observations section below. Also try to identify a trait that you could measure or observe reliably. Look for variation in the plants you are growing and describe any you see in the observation section.

Note: Carefully read Steps 3–7 *before* the plants begin to lower.

Step 3 When the plants are about 7 to 12 days old, the class needs to choose a variable trait for artificial selection. Several variable traits can work for this. Compare your observations with those of other students. You want a trait that varies among all plants. The trait should not be something that is Yes or No, but rather something that varies within a range. Look for traits that you can score on a continuum (length, width, number, and so on).

Possible traits for artificial selection

Abiotic and biotic factors that could affect traits

Step 4 Score each of your plants for the trait that your class chose to evaluate. You may need a magnifier to do this accurately.

Step 5 List the appropriate descriptive statistics for individual and class data for the first generation that you will calculate below (**use your quantitative analysis notes**).

Calculate statistics and create a chart that shows the frequency distribution of the trait that you have selected. Record individual and class results in the results section below.

Step 6 You are now ready to make selection decisions. Directional selection tends to move the variability of a trait in one direction or the other (increase or decrease the trait in the next population). As a class, find the top (or bottom) 10% of plants with the chosen trait in the entire class's population (e.g., out of a population of 150 plants, the 15 hairiest plants), and ***mark any that are in your plant container. Figure out a way to mark the plants that are not in the 10% you want to select.***

Step 7 Just as you did in Step 5, construct a new chart and calculate descriptive statistics for the selected population of plants. Record the data in the results section below. Once you have finished, isolate these selected plants from the rest of the population. Move the selected plants to another light system so that the plants can finish out their life cycle in isolation. This population will serve as the parents for a new generation.

Step 8 On about day 14–16, when several flowers are present on each of the selected plants, cross-pollinate the selected plants with a single bee stick or pollinating device. Fast Plants are self-incompatible — each plant must be fertilized by pollen from another plant. Collect and distribute pollen from every flower on every plant in the selected population. **Reserve this bee stick for only the selected population.** Avoid contaminating with the pollen from the remaining Fast Plants. Pollinate flowers in the selected population for the next three days with the same bee stick. Be sure to record observations about pollination in observation section below. Likewise, with separate bee sticks pollinate the plants from the larger population, but **be careful to keep them separate from the selected population**.

Step 9 Maintain the plants through the rest of their life cycle. ***As the seedpods form be sure to limit each of the plants to 8 to 10 seedpods.*** Any more will likely result in poor seed quality. Once the seedpods start to turn yellow (about day 28–36), remove the fertilizer water from the reservoirs and allow the plants to dry for several days. After the plants and seedpods have dried (about a week later), harvest the seedpods from the selected population into a small paper bag for further drying. Be sure to record observations about the plants' life cycle in your observation section below.

Step 10 Continue to monitor, pollinate, and maintain your control plants throughout the rest of their life cycle. Just be careful to keep the original population and the selected population separate.

Step 11 You should now have two populations of second-generation seeds: (1) a population that is the offspring of the selected plants from generation one and (2) a population that is the offspring of the remaining plants from generation one. Take seeds from the selected population and plant them to grow the second generation of plants under conditions that are identical to those you used for generation one. **Make sure that you thoroughly clean the systems and sterilize with a dilute (10%) bleach solution. Use new wicking cord and new soil.** To get your seed, break open the seedpods into a small plastic petri dish lid.

Step 12 When the second-generation plants are about seven to 12 days old, reexamine the plants and score for the trait you selected. Score the plants at the same life history stage using the same method.

Step 13 Compile, analyze, and graph the class data as you did for the first generation in the results section below

Daily Observations

Results:

Preselection individual results (statistics calculations and chart)

_____Teacher initials

Preselection class results (statistics calculations and chart)

Preselection top 10% (statistics calculations and chart)

Offspring of top 10% (statistics calculations and chart)

t-test using mean

t-test using median

Analyzing and Evaluating Results

Up to this point of the investigation, your analysis has largely been descriptive, but your data should raise some questions (**use your data analysis notes** and results to answer the questions below).

1) Are the two populations/generations before and after selection actually different?

2) Are the means significantly different?

3) Should you use median or mean as a measure of central tendencies at this point in the investigation?

4) Did evolution occur in your Fast Plant population? Justify your conclusion. A justification has 3 components: 1) Scientific knowledge and/or theory: 2) specific data from your analysis related to the knowledge; 3) an explanation of HOW the data from your analysis supports the knowledge.