Natural Selection of Leaf Thickness on Planet Eorthe, Galaxy Tlaloc

A Carolina Essentials™ Activity

Student Worksheet

Overview

The year is 3030 and intergalactic space travel is common. You are part of an agricultural team sent to Eorthe, in the Tlaloc galaxy, to initiate an agricultural program with a genetically engineered plant, XR-45.

XR-45 is similar to a soybean plant, with large leaves and fruit produced in pods. There are 3 naturally occurring varieties of XR-45, identified by the thickness of leaves, ranging from less than 0.5 mm thick to slightly over 1.0 mm thick. The varieties are represented in equal proportions in the initial seed stock of 5,000,000 seeds. The fruit of XR-45 is highly nutritious, and it can be eaten raw or cooked. It can also be ground into flour. The roots of the plant are similar to potatoes. Your team is assigned to keep detailed records of plant growth, fruit production, and evidence of XR-45's adaptation to the Eorthen environment.

Eorthe is similar to Earth in size, and its atmosphere consists of oxygen, water vapor, carbon dioxide, nitrogen, hydrogen, and helium. Eorthe's atmosphere is higher in oxygen, carbon dioxide, and helium and lower in nitrogen and ozone than Earth's atmosphere. Because Eorthe's sun is a binary star system and not a single star, and Eorthe's axis is tilted at 18 degrees instead of 23 degrees, seasons are quite different on Eorthe. There are 2 sets of spring- and summer-type seasons with frequent all-day rain in the spring and sparse, nightly rain in the summer, followed by a long period of dry, cold temperatures (similar to fall in the northern latitudes of North America).

Consequently, there are 2 growing seasons on Eorthe: planting can be done in both early springs and harvesting done in the early falls. Soil on Earth contains higher amounts of ammonia and nitrate salts than soil on Earth, so there is little need for typical fertilizers.

SAFETY REQUIREMENTS

No PPE is required for the activity.

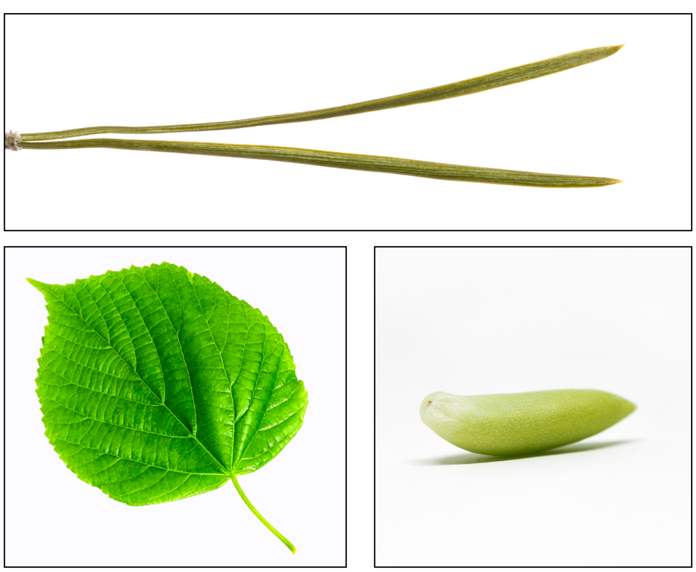
MATERIALS

Copies of student pages or online access

Graph paper or digital graphing access

Phenomenon

These are examples of leaves. How can they be used as evidence for adaptation among plants?



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Essential Question

How can data be used to support an argument that natural selection is occurring in an organism?

Activity Objectives

1. Use data to explain if natural selection may be taking place.
2. Use data to argue that adaptations in the plants are taking place since their arrival on Eorthe.

Safety

No PPE is required for the activity.

Activity Procedures

1. Graph the information for numbers of plants according to leaf thickness. Time should be on the x-axis and should include year and season. Color-code or symbol-code the 3 plant variations.
2. Calculate the average number of plants of each variety per a 1000 plant random sample for each year.
3. Your teacher may direct you to calculate summary descriptive statistics for each variety of plant.
4. Graph the information for numbers of fruit produced by leaf variation. Time should be on the x-axis and should include year and season. Color-code or symbol-code the 3 plant variations.
5. Calculate the average number of fruits for each variety per a 1000 plant random sample for each year.
6. Your teacher may direct you to calculate summary descriptive statistics for each variety of plant.

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Data and Observations

Plant Data

Number of XR-45 Plants/1000 Plant Random Sample by Leaf Thickness (mm)				
Year	**Season**	**Leaf Thickness <0.5 mm**	**Leaf Thickness 0.5–1.0 mm**	**Leaf Thickness >1.0 mm**
3030	Spring 1	320	342	338
	Spring 2	315	344	341
	Summer 1	316	338	346
	Summer 2	303	335	362
3031	Spring 1	302	331	367
	Spring 2	299	331	370
	Summer 1	299	330	371
	Summer 2	283	332	385
3032	Spring 1	282	329	389
	Spring 2	280	300	420
	Summer 1	280	298	422
	Summer 2	260	287	453
3033	Spring 1	258	288	454
	Spring 2	255	287	458
	Summer 1	254	288	458
	Summer 2	250	287	463

XR-45 Leaf Thickness and Number of Fruit (1000 plant random sample)				
Year	**Season**	**Average Number of Fruit/Plant (Thin Leaf)**	**Average Number of Fruit/Plant (Moderate Leaf)**	**Average Number of Fruit/Plant (Thick Leaf)**
3030	Summer 1	12	14	18
3030	Summer 2	14	14	17
3031	Summer 1	9	14	19
3031	Summer 2	9	13	19
3032	Summer 1	9	12	20
3032	Summer 2	7	13	18
3033	Summer 1	4	10	19
3033	Summer 2	3	8	21



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Analysis and Discussion

1. What is the percent abundance of each variety of XR-45 at spring 1 of 3030, at summer 2 of 3030, 3031, 3032, 3033?

Year	<0.5 mm	0.5–1.0 mm	>1.0 mm
Spring 1 3030			
Summer 2 3030			
Summer 2 3031			
Summer 2 3032			
Summer 2 3033			

2. Use the data, statistics, and graph to explain the trend in abundance of each variation in leaf thickness within the 1000 plant samples.

3. Use the data, statistics, and graph to explain the trend in abundance of fruit for each leaf thickness variation within the 1000 plant samples.

4. Explain the difference in fruit production among the 3 variations of plant leaf thickness that could lead to increased survival.

5. Use your data to explain if natural selection and adaptation may be taking place in the plants since being transplanted to Eorthe.