Objective:

To develop an understanding of the concept of carrying capacity in relation to a particular ecosystem.

Background:

An ecosystem can be as small as a drop of water or as large as the entire Earth. The productivity of an ecosystem limits its carrying capacity, that is, the mass of living organisms that the ecosystem can support. The carrying capacity of the Earth usually refers to its ability to support human life, because it is the human population that is currently undergoing explosive exponential growth. But the carrying capacity can be applied to any life form and to any part of the biosphere, such as the number of deer that can be supported by an oak forest.

As any population increases in size, the same resources must be shared by a greater and greater number of individuals. The decreasing supply of resources may lower the population's birth rate, increase its death rate, or both - until birth and deaths are in balance. At that point of balance, and as long as the resource supply remains constant, the population should stabilize at some equilibrium size. Ecologists call this balance point of a population's equilibrium the carrying capacity of the environmental system inhabited by that particular species.

Ecologists use the term carrying capacity to define the maximum population of a particular species that a given area of habitat can support over a given period of time. The ecological principles that govern a habitat's carrying capacity are the same for all species. A sustainable supply of resources-including nutrients, energy, and living space-defines the carrying capacity for a particular population in a particular environmental system.

Acorns, produced by oak trees, are a favorite food for squirrels, as well as for deer, jays, quail, crows, woodpeckers, raccoons, rabbits, and foxes. In areas with mild winters, acorns may be available for 8 months of the year and constitute about 80-90% of the diet of squirrel . Acorns are higher in fat and easily-digested carbohydrates than other food sources, such as leaves, twigs, small green plants, and fungi.

In this activity, you will create a model of an oak forest and estimate the number of squirral that can be supported by the forest.

APES Carrying Capacity Lab

Title: **The effect of the type and size of oak trees on the number of squirrels that a forest can support.**

Procedure:
This is a simulation lab since our campus does not have very many oak trees. This lab could be done at places like Puddingstone.

1. Assume that all trees in the Quad area are oak trees of a given species. You will be assigned a species.
2. Create an Oak Forest on a Poster Board. Obtain construction paper and a compass and make different size circle to represent an oak tree. For Lab purposes 10mm will be equivalent to 10 cm (Therefore a 10mm circle will represent a 10 cm tree). Be creative with your poster. Your forest can be in different setting, you can draw animals, ponds, rivers cabin or anything that will make your poster more creative. Record data in data table.
3. Use an acorn production data table to determine the kilogram yield of acorns per tree. Then calculate the yield of all trees of each size in the survey. Total the production to get a total production for all trees in the Quad forest.
4. Convert kilograms of acorns into kilocalories (kcal), a unit of energy. One kilogram of acorns will yield 4500 kcal of energy.
5. Calculate the number of squirrels that the Quad forest can support. Assume that a 0.5 kg squirrel needs 137 kcal/day. Use 365.25 days for one year.
6. After each team has completed its calculations, prepare a table that will combine all class results.
7. Include complete calculations in lab report.

Questions

1. Define carrying capacity? What factors affect it?
2. Which team achieved the greatest carrying capacity? What factors affected the outcome?
3. Why was it necessary to convert kilograms to kilocalories before making the calculations?
4. It would be fair to predict that the carrying capacity is actually less than the teams calculated. Explain.
5. Is the carrying capacity greater with many small trees or a few larger ones?
6. As much as 25% to 50% of the diet of the black bear, raccoon, white-tailed deer, and wild turkey is made up of acorns. What would happen to the carrying capacity of your plot if any of these animals were present?
7. Assume the population of squirrels in the Quad has been stable for some time. A fire in the nearby hills occurs and the squirrels from that area move into the Quad. Describe what will happen to the population of squirrels.

Sketch a graph of time versus the number of squirrels. Indicate on the graph when the fire occurred.

Table 1:Oak Species in Virginia

Common Name	Scientific Name	Habitat
White Oak	Quercus alba	dry or moist woods
Post Oak	Quercus stellata	dry soil
Blackjack	Quercus marilandica	dry, barren soils
Spanish Oak	Quercus falcata	woods
Water Oak	Quercus nigra	coastal plain

Table 2: Acorn Yield Per Year (kilograms)

Diameter (cm)	Oak Species				
	White Oak	Post Oak	Blackjack	Spanish Oak	Water Oak
10	-----	0.3	-----	-----	-----
15	-----	0.6	-----	-----	-----
20	0.2	1.0	-----	0.5	0.7
25	1.2	1.3	0.8	1.4	1.8
30	2.2	1.6	1.5	2.3	3.1
35	3.2	1.9	2.2	3.2	4.2
40	4.2	2.3	3.0	4.1	5.4
45	5.2	2.6	3.7	5.0	6.6
50	6.2	3.0	4.6	5.9	7.8
55	7.2	3.3	5.2	6.7	9.0
60	8.2	3.6	5.9	7.6	10.1
65	9.2	4.0	6.7	8.5	11.3

Conclusions:

Size of Tree	# of trees	Acorn Yield Per Year	Convert to Kcal	# of Squirrels
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				
65				
Totals				

Class Results:

	Acorn Yield Per Year	# of Squirrals
White Oak		
Post Oak		
BlackJack		
Spanish Oak		
Water Oak		