STANDING ROOM ONLY

Summary of task: Students will study population data for several organisms, graph the data, and interpret it.

Curriculum: Population Dynamics, Ecology, Predator/Prey Relationships, and Carrying Capacity.

Prerequisites: Students should have some background knowledge on population dynamics, ecology, and predator/prey relationships. The Project Wild game "Oh Deer" is an excellent precursor to this activity. Students should also have a background in making and interpreting graphs.

Post assessment: This performance task correlates well with the performance test entitled "Rabbit and Lynx Populations". Ideally students would participate in this task and then be ass3essed using the "Rabbits and Lynx" performance test.

Equipment:

graph paper
1 copy of Parts I, II, and III per student
1 copy of Tables 1 and 11 per student
copies of Table 2-10 ---- Each student group should receive a different table. Each group does NOT need a copy of every table.

Suggested time: 3-4 class periods

Participation: Small groups and individual

Safety: No special safety considerations are needed.

Objectives: Students will:

1. apply the concepts of populations dynamics to solve problems
2. identify the implications of limited natural resources
3. organize data into graphs
4. read and interpret data presented in graphic form
5. analyze and evaluate data pertinent to a problem
6. make inferences based on pertinent information
7. draw reasonable conclusions and defend them rationally
8. develop generalizations
9. identify cause and effect relationships
10. communicate the results of their interpretation by oral and written means
11. work cooperatively in a group

Teacher Instructions:

Part I:

Distribute copies of Part I and Table I to each student.
Students should work individually.
Assign one row of data from Table I to each student. You will probably have to give each row to more than one student. For example, you may have to give Sue and Tom the data from "Team A" on Table I.
Students will graph their data.
Students should write a short essay about their graph.
Once they have graphed their data, they will compare their graphs with the graphs of at least two of their classmates and explain any differences they see.
As a class, compare and contrast the graphs of all ten rows of data. Discuss the similarities and difference. Allow students to hypothesize explanations for the similarities and differences. You may want to make a master graph to aid discussion or you may have students construct a graph on the board or overhead.

Part II:

Students should work in groups of 2-3 on Part II. Do NOT make more than nine groups. Each group should receive a DIFFERENT table. Tables 2-10 should be distributed to the groups.
Give the groups the Graph Rubric, the Oral Presentation Rubric, and the Peer Evaluation Rubric. Explain the expectations.
Each group will graph their data.
Each group will present their graph to the rest of the class. Their presentation should include an interpretation of the data that offers a tentative explanation for the change in population of their organism.
During each presentation, the other members of the class will use the Peer Evaluation Rubric to evaluate each other's presentations.
Each group should work together to evaluate and summarize all the population data. Together they will answer three questions.
Although they are working together to come up with the answer, each student should turn in an individual paper.
In a class discussion, guide the students in a discussion of their results. They should mention things like overpopulation, carrying capacity, limited resources, waste accumulation, competition, and predator/prey relationships. Focus on these ideas and introduce any unfamiliar terms at this time. Encourage them to identify cause and effect relationships, to draw conclusions, and to make generalizations.

Part III:

Students will work individually.
Give each student a copy of Table 11.
Students will graph the data and answer questions about the graph.
DO NOT TELL STUDENTS that these data represent human populations until after they have completed steps 1-3 on the worksheet.

Scoring Guide:

Part I

1. Score using the Graph Rubric (included at the end of this guide).
2. Answers will vary. Students should mention the population fluctuations and should present a plausible explanation for the fluctuations. The following is a sample answer.

> The populations fluctuated dramatically. When the population was relatively few in number the yeast multiplied quickly. Whenever there was a large yeast population, soon thereafter the population crashed. It seems the habitat could not support a large number of yeast. This could be because of the limited resources or waste accumulation.

3. Answers will vary. Students should mention that, although their numbers were different, the patterns of fluctuation are similar. They should also present a plausible explanation for the differences, i.e. different habitat size, different amount of food available, different environment conditions.

Part II

1. Score using the Graph Rubric.
2. Score using the Oral Presentation Rubric (included at the end of the Scoring Guide).
3. Students will complete using the Peer Evaluation Rubric included in their handout.
4. a. Student's answer should include the following information:

> **At least three similarities:** Examples: populations fluctuate, when population numbers are relatively low population numbers increase, when population numbers are relatively high populations decrease, there is a limit to the number of organisms that a habitat can support.
>
> **At least two differences:** Examples: the actual number of organisms varied, the time frame was different, the number of organisms each habitat can support differed.

4. b. Students should suggest at least three reasons. Following are possible reasons for the differences: different organisms have different needs, different environmental factors, different available resources, waste accumulation, and predators.

4. c. Students should write at least three generalizations. Following are plausible generalizations: populations do not increase without check, populations fluctuate, each habitat can support a limited number of organisms, a small population will increase the capacity of the environment, predator/prey relationships aid in balancing populations, when populations exceed the habitat's carrying capacity there is a large die off.

Part III

1. Score using the Graph Rubric.
2. Students should observe that the graph is similar in that the population fluctuates and is growing and that it is different because it shows nearly constant increase in numbers.
3. Students should predict the population crash. The factors that would cause the predicted trend are waste accumulation, limited resources, exceeding the carrying capacity of the environment.
4. Student answers will vary. Some will continue to predict a population crash. They will justify their prediction with examples of pollution, resource depletion, and/or waste accumulation. Other students will say that the population will not crash because humans can alter their environment. They will justify their prediction with examples of increased food production, advanced medical technology, and/or improved pollution control and purification techniques. It does not matter what the student predicts; however, it is important that the student predictions are supported by at least two reasons.

Graph Rubric:

4	Axes are labeled, grid is numbered appropriately, data plotted correctly.
3	Axes improperly labeled or not labeled, grid is numbered appropriately, data plotted correctly.
2	Grid numbering not sequential or data incorrectly plotted.
1	Grid numbering not sequential and data incorrectly plotted.

Oral Presentation Rubric:

4	Presentation organized, demonstrates clarity of thought. Includes graphs that are easy to see and understand. All members of group participate and are able to respond to questions. Audience interest maintained throughout presentation.
3	Presentation organized, demonstrates clarity of thought. Graphs not easy to see or not used. At least 2 group members participate and respond to questions. Audience interest maintained through most of the presentation.
2	Presentation demonstrates minimal organization and understanding. Graphs not used or not easily seen. At least 1 group member was able to respond to questions. Audience interest was low.
1	Presentation lacks clarity and organization. No group members were able to respond to questions. Presentation was confusing and audience interest low.

Source: Adapted from “Standing Room Only”, by Steve Weinberg and Ralph Yulo, Connecticut Core of Learning Performance Assessment Project, sponsored by the National Science Fountain.

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PART I

Student Worksheets

One of the major reasons scientists study natural phenomena is to look for recurring patterns. As part of this search for patterns, scientists have studied the changes in population sizes of many organisms.

In the investigation you will study population data for several organisms, search for patterns, and make generalizations.

Complete the Following on Your Own:

1. A set of students studied a population of yeast over a ten-day-period of time. At the beginning of the observation period a small number of yeast were introduced into a test tube containing appropriate food source. Their numbers were sampled on a daily basis. The data obtained is shown on Table 1. Your teacher will assign one row of data to you. Use this data to prepare a graph that shows the changes in the yeast population during the ten-day-period.

2. Write a short paragraph that discusses the population changes revealed by your graph. Be sure to include your thoughts on why the yeast population changed as it did.

3. Obtain the graphs of two different rows of data prepared by your classmates. Compare and contrast the two graphs with your graph. Write an explanation for any differences that you see.

4. As a class, compare and contrast your graphs to the graph of all nine rows of data combined.

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PART II

Complete the following in your group:

Though you are working together as a group, each person must submit his or her own graph and explanations. Your graph and answers may be identical to the graphs and answers of the other members of your group but you must turn in your own paper to receive credit.

1. Obtain the population data for a new organism from your teacher. Study the data and use it to prepare a graph showing the changes in population over time.

2. Prepare a brief oral report and share your group's data with the rest of the class. Your presentation should include an interpretation of your group's data, which offers a tentative explanation for the changes in population of your organism.

3. Using the Peer Evaluation Rubric, evaluate the findings of the other groups as they make their presentations.

Peer Evaluation Rubric

4 Data properly graphed. Conclusions fit data. Finding reported accurately.
3 Data properly graphed. Conclusion somewhat fit data. Findings embellished or exaggerated.
2 Data improperly graphed. Conclusion did not fit data.
1 Data improperly graphed. No conclusion offered.

4. Once you have listened to the presentations of the other groups in your class, answer the following questions.

a. In what way(s) were all of the population curves similar? In what way(s) were they different? Identify at least three similarities and two differences.
b. Suggest at least three possible reasons for the differences.
c. Write at least three generalizations about the changes in populations of various organisms over time.

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PART III

Complete the following on your own:

1. Obtain the population data for a new organism (Table 11). Use this data to prepare a graph showing population changes over time.

2. Write a brief summary explaining the similarities and differences of this graph to the graphs of other populations that you just studied.

3. Predict what this population curve will look like in the future and predict what factors would cause this predicted trend.

4. Once you have answered the questions 1-3, have your teacher tell you the organism for which this population data was taken. Now that you know the identity of the organism, what is your prediction about its future population trend? State at least two reasons for your prediction.

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TABLE 1

Number of Yeast Cells

Team	Days										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
A	18	218	219	162	355	95	175	132	167	485	136
B	24	63	69	283	281	161	147	365	199	227	314
C	39	61	363	56	20	114	322	41	66	87	38
D	36	53	75	710	56	240	230	190	200	630	340
E	31	30	210	45	59	46	82	453	93	60	88
F	47	71	73	170	20	192	242	660	73	110	55
G	16	25	35	980	540	50	350	165	14	160	212
H	48	42	36	650	760	500	305	356	313	165	69
I	23	344	60	45	90	30	54	250	37	138	74

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TABLE 2

Changes in the abundance of hares, as indicated by the number of pelts received by the Hudson Bay Company

Number of Hares (in thousands)	Year
20	1845
40	1850
65	1855
19	1860
140	1865
10	1870
100	1875
10	1880
135	1885
30	1890
90	1895
17	1900

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TABLE 3

Changes in the number of lynx as indicated by the number of pelts received by the Hudson Bay Company

Number of Lynx	Year
35	1845
7	1850
37	1855
7	1860
60	1865
10	1870
40	1875
12	1880
80	1885
30	1890
50	1895
15	1900

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TABLE 4

Pheasants introduced on Protection Island, Washington, 1937.

A small number of pheasants escaped from a farmer's cage on Protection Island, Washington, during December 1936.

Number of Pheasants	Year
0	1936
20	1937
100	1938
500	1939
800	1940
1000	1941
1600	1942
1800	1943
1500	1944
1400	1945
1600	1946

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TABLE 5

Sheep population introduced in Tasmania.

People brought sheep to Tasmania (a large island south of Australia) during the second decade of the nineteenth century. The sheep were allowed to roam free.

Number of Sheep (in thousands)	Year
0	1800
1	1810
100	1820
500	1830
1100	1840
2000	1850
1700	1860
1300	1870
700	1880
1300	1890
1400	1900
1600	1910
1500	1920
1800	1930

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TABLE 6

Population of Kiabab Deer, Grand Canyon.

In 1905, four thousand Kiabab Deer were found in the Grand Canyon. Populations of mountain lions, coyote, and wolves existed along with the deer. These animals are natural predators of the deer.

Between 1907 and 1917, six hundred mountain lions were removed or killed. Another 74 mountain lions were removed between 1918 and 1923. Between 1924 and 1939, 174 more were removed.

Between 1907 and 1923, about 3,000 coyote were killed or removed by people from the Grand Canyon. Between 1923 and 1939, another 4,388 were taken.

Between 1907 and 1923, eleven wolves were killed. In 1939, there were no longer any wolves in the Grand Canyon.

Number of Kiabab Deer	Year
4,000	1905
9,000	1910
30,000	1915
60,000	1920
75,000	1925
26,000	1930
12,000	1935
7,000	1940

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TABLE 7

Population of thrips (a tiny insect) living on roses, 1935-1938

Number of Thrips	Month/Year
10	Feb 1935
5	Apr 1935
10	Jun 1935
4	Aug 1935
60	Oct 1935
80	Dec 1935
40	Feb 1936
7	Apr 1936
17	Jun 1936
6	Aug 1936
20	Oct 1936
40	Dec 1936
5	Feb 1937
4	Apr 1937
5	Jun 1937
5	Aug 1937
140	Oct 1937
120	Dec 1937
10	Feb 1938
15	Apr 1938

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TABLE 8

Population of bass in a lake in Northern Minnesota, 1937-1958.

Number of Bass	Year
242	1937
222	1938
139	1939
102	1940
94	1941
Data not available	1942
155	1943
240	1944
316	1945
289	1946
212	1947
187	1948
165	1949
188	1951
198	1951
244	1952
260	1953
254	1954
271	1955
211	1956
184	1957
166	1958

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TABLE 9

Growth of bacteria introduced to an agar plate.

Number of Bacteria	Hour
1	1
8	2
61	3
492	4
3550	5
4988	6
6222	7
5447	8
4780	9
3643	10
3264	11
2145	12
1290	13

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TABLE 10

Population of mice in an abandoned apartment building, New York City, 1950-1953.

Number of Mice	Month/Year
4	Apr 1950
12	Jun 1950
40	Sep 1950
90	Dec 1950
189	Mar 1951
356	Jun 1951
392	Sep 1951
348	Dec 1951
301	Feb 1952
234	May 1952
202	Aug 1952
137	Oct 1952
75	Jan 1953
40	Mar 1953

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TABLE 11

Number (in millions)	Year
694	1750
110	1850
1600	1900
1800	1920
2070	1930
2300	1940
2500	1950
3000	1960
4080	1970
4450	1980