HS-LS2 Ecosystems: Interactions, Energy, and Dynamics		
HS-LS2-1 **Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.** [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1)	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	**Scale, Proportion, and Quantity** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

TASK 1

On June 1, a fast growing species of algae is accidentally introduced into a lake in a city park. It starts to grow and cover the surface of the lake in such a way that the area covered by the algae doubles every day. If it continues to grow unabated, the lake will be totally covered and the fish in the lake will not be able to breathe. At the rate it is growing, this will happen on June 30.

a. When will the lake be covered halfway?

b. On June 26, someone who walks by the lake every day warns that the lake will be completely covered soon. Her friend just laughs. Why might her friend not believe the person's warning?

c. On June 29, a cleanup crew arrives at the lake and removes almost all of the algae. When they are done, only 1% of the surface is covered with algae. How well does this solve the problem of the algae in the lake? Include a description of the criteria and trade-offs that account for reliability and environmental impacts.

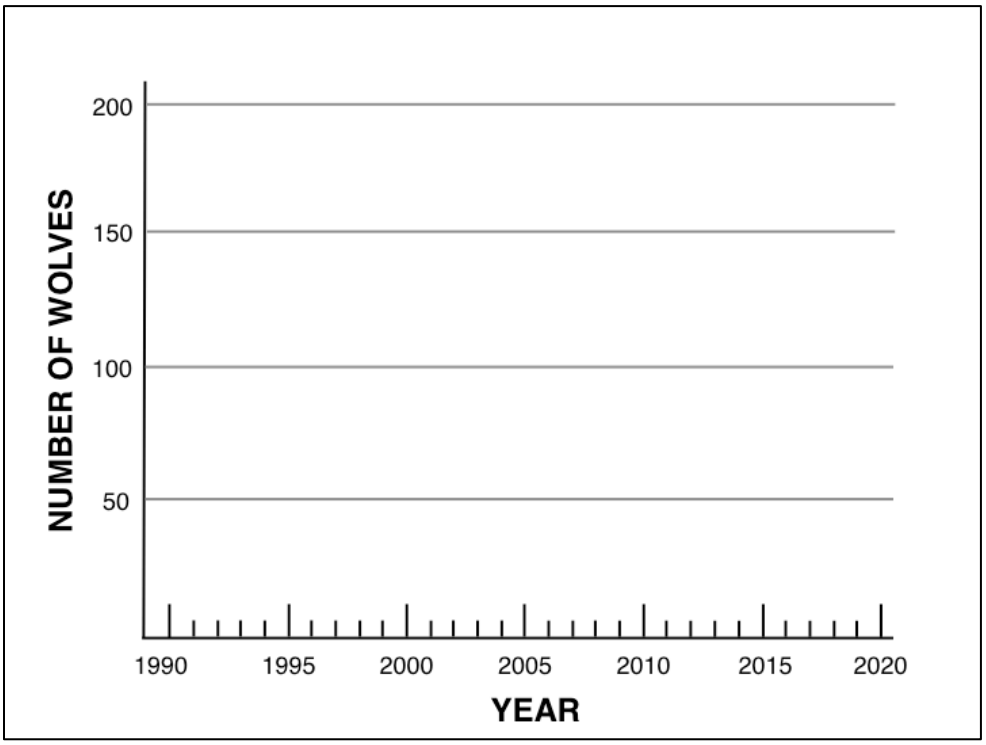
d. Using the available data, construct an argument that supports or refutes the problem's claim that the fish will suffocate if the algae species is allowed to grow unabated. Your argument should use evidence regarding carry capacity, resource availability and other environmental factors specifically including competition for resources and the effect on the stability of the ecosystem.

e. Given the disturbance created by the algae, design a solution to ensure the stability of the lake ecosystem. Be sure to include claims with supporting evidence as to the time needed to return the lake to a stable state and an analysis to reduce the impact of human intervention on the ecosystem. The design should be fully supported in a written report or oral presentation.

Source: Achieve, Inc. (adapted)

TASK 2

When Yellowstone National Park was created in the late 1800s, wolves were on the decline. The last wolves in Yellowstone were killed in 1926, but in the 1800s, there were between 100-160 wolves in the park. In 1995, gray wolves were reintroduced to the park. Using what you know about populations, predict the growth of the wolves on the graph below.



Write a scientific explanation that says why your graph is shaped the way it is.

Adapted from: Concord Consortium

TASK 3

Are there any wild populations that undergo endless population growth? Why or why not?

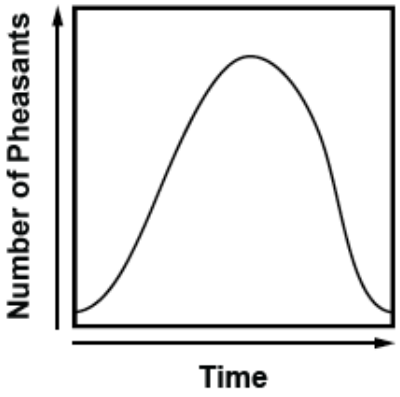
Adapted from: Concord Consortium

TASK 4

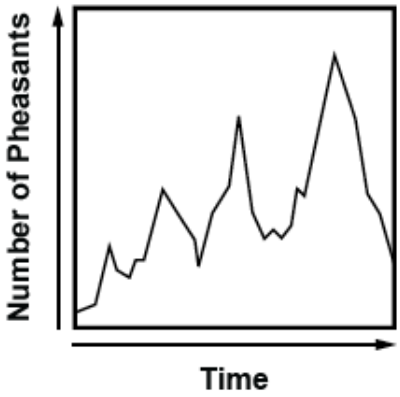
Scientists introduce ten male pheasants and thirty female pheasants to an island on which pheasants have not previously lived. The island has a natural food source and no predators of pheasants.

Which graph best predicts the number of pheasants on the island 50 years after their introduction to the island?

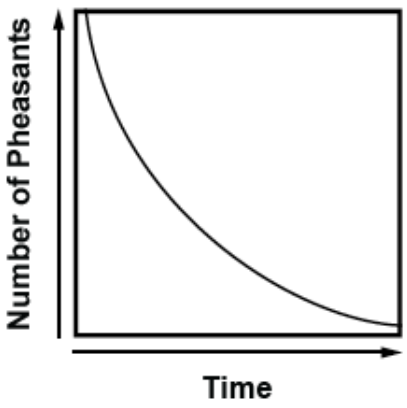
A.



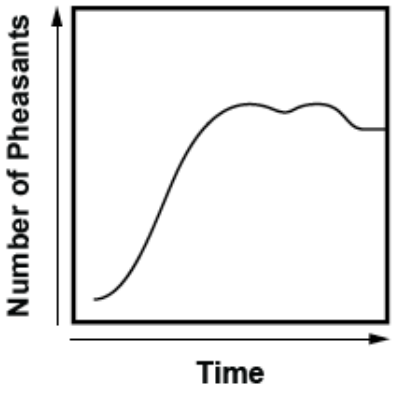
B.



C.



*D.



TASK 5

_____ is the total number of individuals the environment can support over an indefinite period of time.

TASK 6

The Black-Footed Ferret, a member of the weasel family, is considered an endangered species. 250 miles west of Denver at the Wolf Creek Management Area, scientists are trying to increase the number of Black-Footed Ferrets living in the wild. In 2001, scientists released a group of Black-Footed Ferrets into this area. The scientists chose this area because it has a large population of prairie dogs, the preferred prey of the Black-Footed Ferret. The prairie dogs' mainly eat grasses and short shrubs.

The scientists have been collecting data for several years on the number of prairie dogs and ferrets in the Wolf Creek Management Area as well as the amount of precipitation the area receives. Table 1 shows the data for each month in 2008. Yearly data for 1997 to 2007 are shown in Table 2.

The scientists want a stable population of 20 Black-Footed Ferrets and 25000 prairie dogs within the Wolf Creek Management Area. Looking at the data below, write an explanation that argues whether or not you think a stable population will be reached. Include a discussion of how factors that affect the carrying capacity of the area matter for reaching a stable population.

Table 1. Population and Precipitation Measurements for 2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Prairie Dogs	45674	43843	42530	57048	52336	46032	38845	36288	34876	28465	26068	24646
Black-footed Ferrets	16	16	16	16	35	32	30	28	24	18	14	13
Monthly Precip. (inches)	1.01	0.97	0.85	0.29	1.10	1.30	0.18	0.12	2.06	0.90	1.05	1.90

Table 2. Population and Precipitation Measurements for 1997 to 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Prairie Dogs	40287	39878	31351	25056	26168	17473	16564	15581	27794	49519	47082
Black-footed Ferrets	0	0	0	0	9	8	7	7	12	16	16
Annual Precip. (inches)	17.76	16.72	14.32	10.81	11.18	10.99	9.71	14.01	18.53	14.59	13.82