SI Environmental Science - Full Discipline Demo

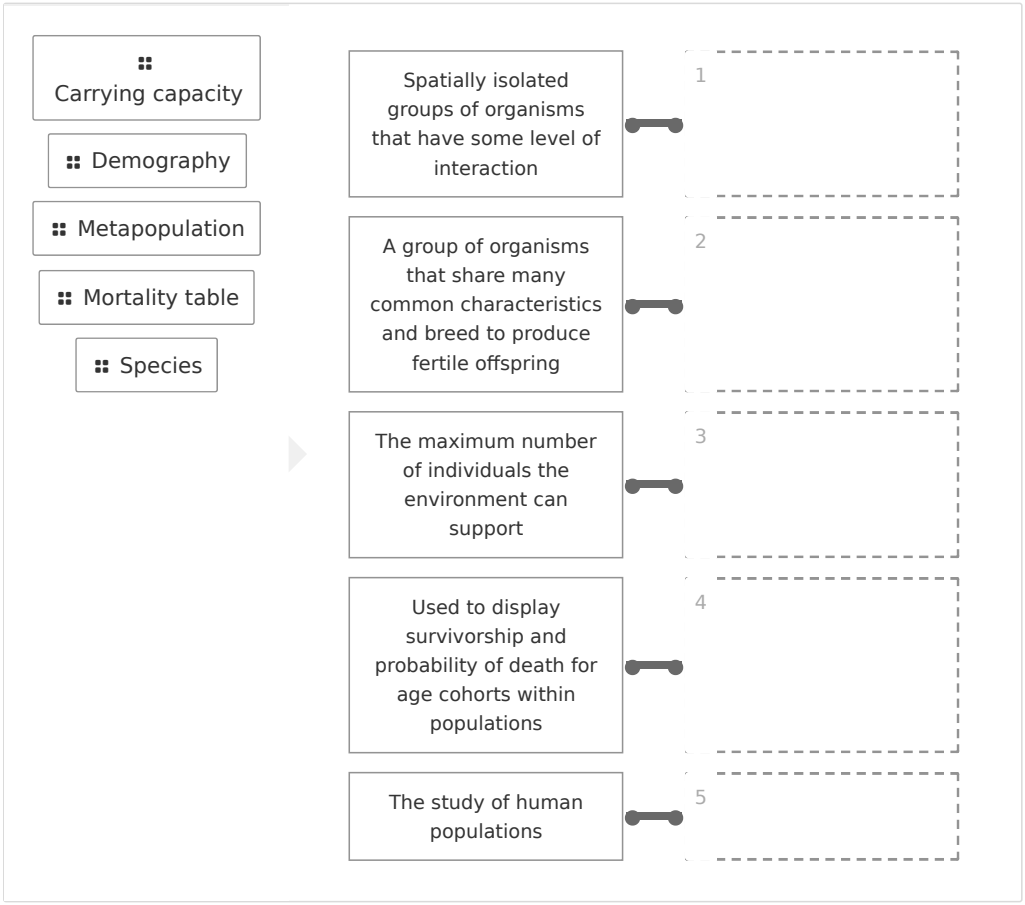
Population Ecology

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Environmental Science - Full Discipline Demo
Course	SI Environmental Science - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

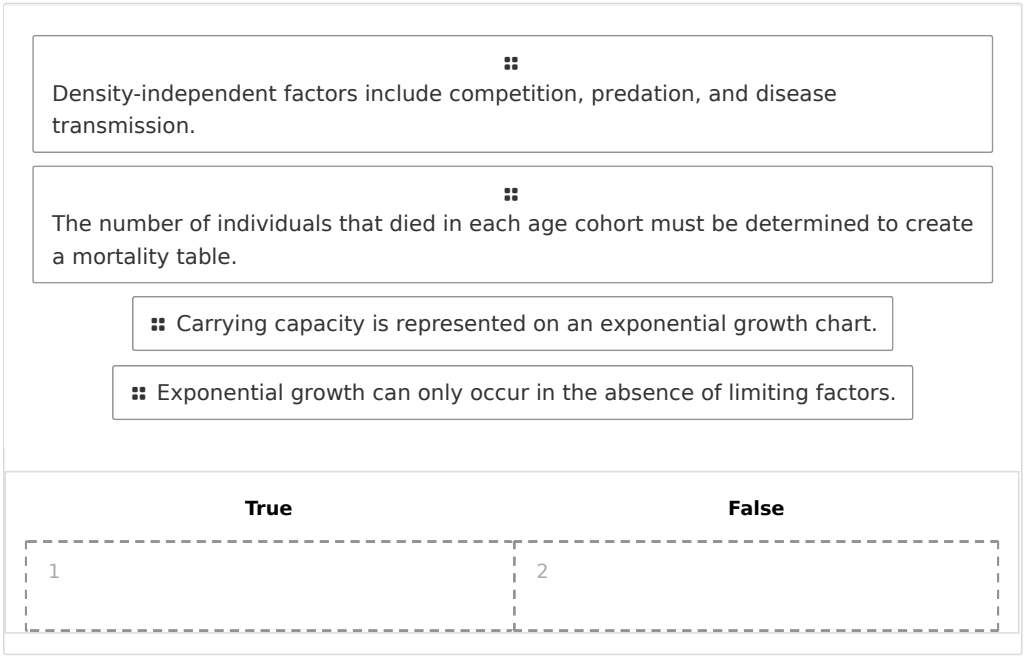


Correct answers:

1 Metapopulation 2 Species 3 Carrying capacity 4 Mortality table

5 Demography

Classify each statement as true or false.



Correct answers:

1

The number of individuals that died in each age cohort must be determined to create a mortality table.

Exponential growth can only occur in the absence of limiting factors.

2 Carrying capacity is represented on an exponential growth chart.

Density-independent factors include competition, predation, and disease transmission.

Exploration

In nature, populations are enclosed within geographical boundaries, such as rivers or mountains.

- True ✔
- False

Density-dependent factors include _____ .

- [x] competition
- [ ] natural disasters
- [ ] weather events
- [ ] pollution

Logistic growth plateaus when carrying capacity is reached.

- [x] True
- [ ] False

The probability of mortality within a cohort is equal to the _____ divided by the frequency of survivorship entering the cohort.

- [ ] cohort size
- [x] frequency of population in the cohort
- [ ] number of deaths
- [ ] total population size

Exercise 1

How many generations did it take to reach a population size of 100? Reference Data Table 1 in your explanation.

Student answers will vary but should reflect the number of rows occupied in Data Table 1. Internal testing required 24 generations.

Did your model population exhibit logistic growth, exponential growth, or no pattern? Reference Graph 1 in your explanation.

The modeled population exhibited exponential growth, as evidenced by the upward-curved (J-shaped) line produced by Graph 1.

Were changes in population size greatest when the population was smaller or larger? Which generation exhibited the greatest change in size? Reference Graph 2 in your explanation.

Changes in population size were greatest when the population was larger. Students answers will vary but should reflect the largest bar of Graph 2. Internal testing results indicated generation 22 had the greatest size change.

What resource constraints were placed on the modeled population? How could the rules of the simulation be changed to increase the effects of resource constraints?

No constraints were placed on the population. The rules could be changed to increase resource restraints by having die five and six representing deaths instead of only die 6, or by having only die 1 represent births.

Was carrying capacity modeled in your simulation? What happens to natural populations that exceed carrying capacity? Include natural factors that determine carrying capacity in your explanation.

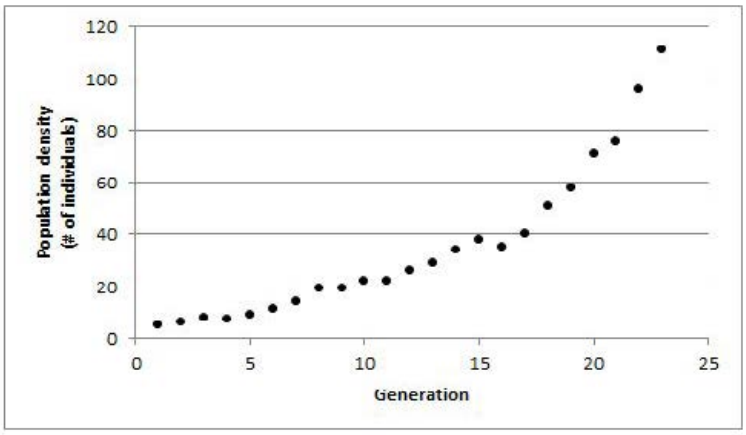
Yes, carrying capacity was reached at 100 individuals. When the carrying capacity is exceeded, a population collapse can occur; whereby the population size decreases dramatically. Carrying capacity in natural systems is determined by density-dependent factors such as resource availability, predation rates, and disease transmission and density-independent factors such as weather events and wildfires.

Data Table 1: Population Growth Model
(SAMPLE ANSWER BELOW)

Generation	Initial Population Size (N)	Number of Births (B)	Number of Deaths (D)	Final Population Size (N + B - D)	Change in Population Size (Final-Initial)
1	Note to instructors: Internal testing data recorded, student replies will vary since die roll outcomes are random. 4	1	0	5	1
2	5	1	0	6	1
3	6	2	0	8	2
4	8	1	2	7	-1
5	7	2	0	9	2
6	9	3	1	11	2
7	11	5	2	14	3
8	14	7	2	19	5
9	19	4	4	19	0
10	19	4	1	22	3
11	22	5	5	22	0
12	22	7	3	26	4
13	26	8	5	29	3
14	29	10	5	34	5
15	34	10	6	38	4
16	38	6	9	35	-3
17	35	10	5	40	5
18	40	15	4	51	11
19	51	16	9	58	7
20	58	17	4	71	13
21	71	19	14	76	5
22	76	29	9	96	20
23	96	30	15	111	15
24	111				
25					
26					
27					
28					
29					
30					

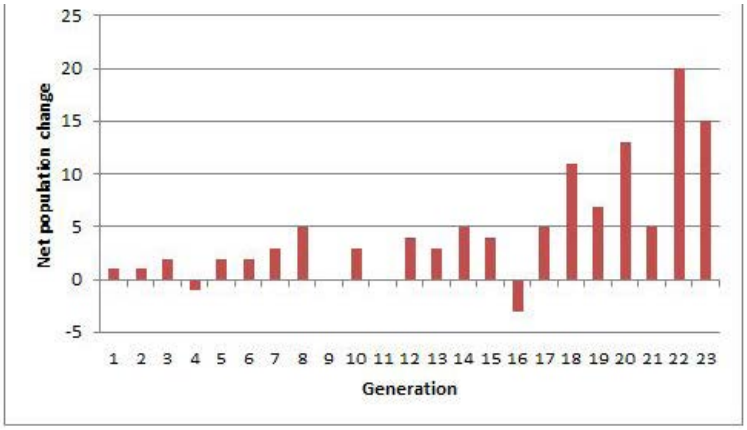
Graph 1: Population Size and Generations - Scatter Plot

(SAMPLE ANSWER BELOW)



Graph 2: Population Size and Generations - Bar Graph

(SAMPLE ANSWER BELOW)



Exercise 2

Which cohorts had the greatest and least probability of death? Reference Graph 3 in your explanation.

Individuals age 70+ had the greatest probability of death and individuals age 20 – 29 had the least probability of death as illustrated by the tallest and shortest bars on Graph 3.

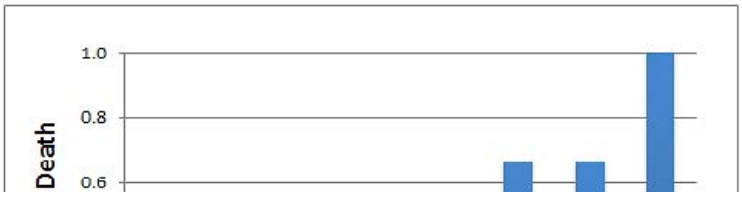
How would your results in Graph 3 differ if the mortality data was collected for a population that lacked access to modern pediatric health care facilities?

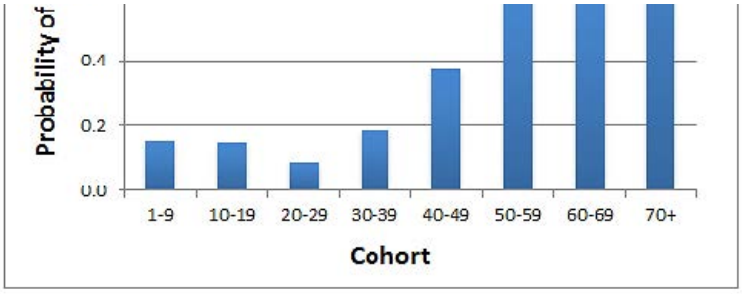
Graph 3 would have taller bars on the leftmost two cohorts illustrating higher mortality probabilities for ages 1-19 if children had no access to proper medical care.

Data Table 2: Cemetery Demography Data
(SAMPLE ANSWER BELOW)

#	Age Cohort	Number of Deaths (D)	Frequency of Population in Cohort (d)	Frequency of Survivorship Entering the Cohort (I)	Probability of Death within a Cohort (Q)
1	0-9	12	0.15	1.00	0.15
2	10-19	10	0.13	0.85	0.15
3	20-29	5	0.06	0.72	0.09
4	30-39	10	0.13	0.66	0.19
5	40-49	16	0.20	0.53	0.37
6	50-59	18	0.23	0.33	0.67
7	60-69	6	0.08	0.10	0.67
8	70+	3	0.04	0.02	1.00
	Total	80	1.00		

Graph 3: Probability of Death by Cohort
(SAMPLE ANSWER BELOW)





Competency Review

A ____ is a group of organisms that share many common characteristics and breed to produce fertile offspring.

- cohort
- metapopulation
- population
- species ✔

A population is composed of individuals of a species that occupy a defined area at the same time.

- True ✔
- False

Density-independent factors include _____.

- disease transmission
- competition
- natural disasters ✔
- All of the above

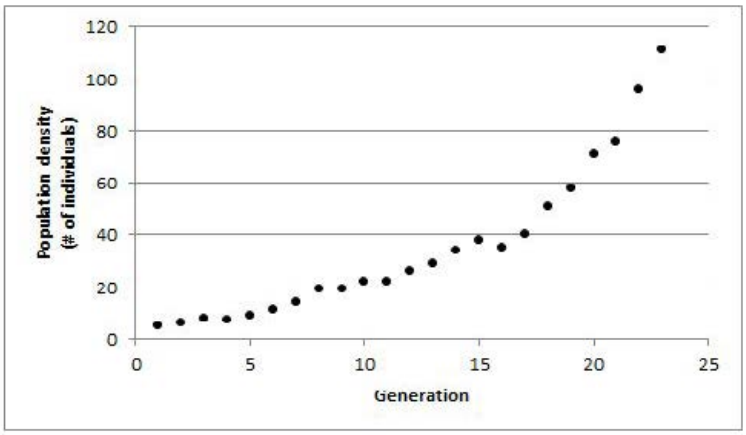
Most natural populations exhibit exponential growth.

- True
- False ✔

Mortality tables used to determine the probability of death contain information for _____ for each cohort.

- frequency of population
- frequency of survivorship
- number of deaths
- All of the above ✔

Population growth was modeled and the data graphed in the image. The population is experiencing overall _____ growth.



- exponential ✔
- linear
- logistic
- negative

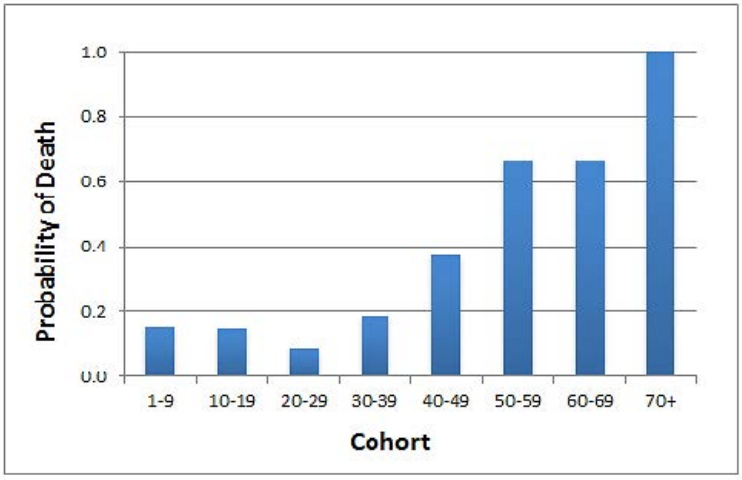
A population was analyzed and found to exhibit exponential growth. The population is being influenced by _____.

- unlimited resources ✔
- density-dependent factors
- density-independent factors
- competition

A cohort consisting of 13 individuals from a total population of 100 has a frequency of survivorship of 0.66. The probability of death within the cohort is _____. (Note: Q=d/l)

- 0.09
- 0.20 ✔
- 0.37
- 0.70

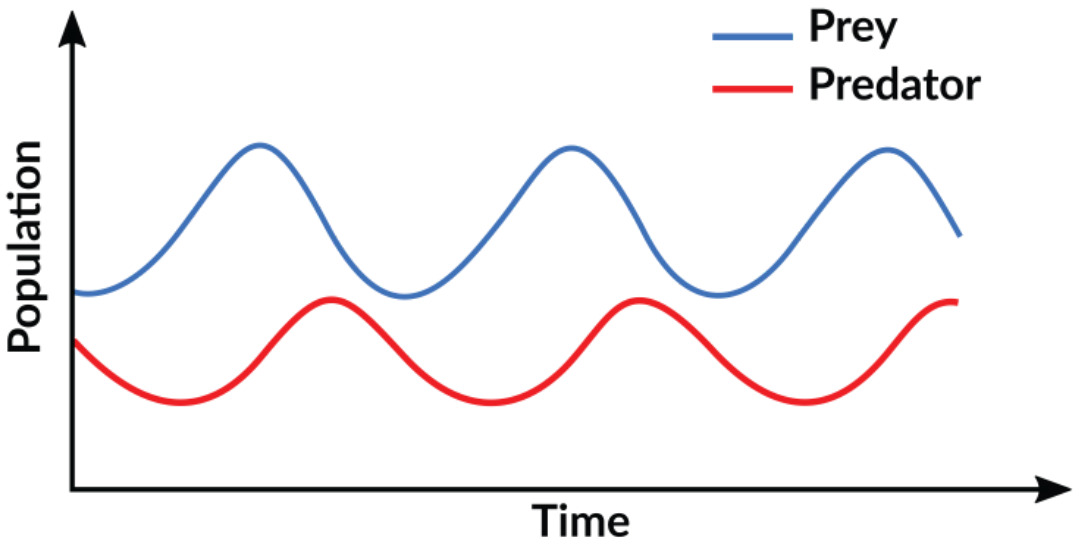
The probability of death within cohorts of a human population were graphed. Individuals in the _____ cohort are least likely to die.



- 1-9
- 20-29 ✔
- 50-59
- 70+

Extension Questions

Some populations undergo cyclical oscillations in size resulting from the interactions between two species. Apply your knowledge of population growth rates to explain the relationship between the prey and predator species illustrated in the graph below.



(SAMPLE ANSWER BELOW)

The growth rate of the prey population initially exceeds that of the predator population. Prey numbers decline rapidly after reaching a maximum in each cycle while predator numbers continue to increase. Predator numbers then decline rapidly as prey number near their lowest levels of each cycle. Predator numbers continue to decrease as prey numbers begin to rapidly increase. Throughout the cycle, predator numbers lag, but mirror, those of prey.