Algebra 2

ELG HS.F.9: **Model periodic phenomena with trigonometric functions.**

Vertical Progression:

8th Grade	**8.F.B Use functions to model relationships between quantities.** o **8.F.B.4** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
Geometry	**ELG.MA.HS.G.SRT.1 Define trigonometric ratios and solve problems involving right triangles** o **G.SRT.6** Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. o **G.SRT.7** Explain and use the relationship between the sine and cosine of complementary angles. o **G.SRT.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.★
Algebra 2	**ELG.MA.HS.F.9 Model periodic phenomena with trigonometric functions.** o **F-TF.5** Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.★
	ELG.MA.HS.F.9 Model periodic phenomena with trigonometric functions. o **F-TF.6 (+)** Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. o **F-TF.7 (+)** Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.★

Students will demonstrate command of the ELG by:

- Modeling periodic phenomena with cosine, sine, or tangent functions given a table of values.
- Modeling periodic phenomena with cosine, sine, or tangent functions given a graph.
- Determining which trigonometric function to use in modeling periodic phenomena.
- Identifying amplitude, frequency, and midline given periodic phenomena.

Vocabulary:

- amplitude
- cosine function
- frequency
- midline
- periodic phenomena
- sine function
- tangent function

Sample Instructional/Assessment Tasks:

1) **Standard(s): F-TF.5**
Source: https://www.illustrativemathematics.org/content-standards/HSF/TF/B/5/tasks/816

Item Prompt:

Given below is a table that gives the populations of foxes and rabbits in a national park over a 12 month period. Note that each value of t corresponds to the beginning of the month and $t = 0$ corresponds to the beginning of January.

t, month	0	1	2	3	4	5	6	7	8	9	10	11
r, number of rabbits	1000	750	567	500	567	750	1000	1250	1433	1500	1433	1250
f, number of foxes	150	143	125	100	75	57	50	57	75	100	125	143

Note that the number of rabbits and the number of foxes are both functions of time.

a. Explain why it is appropriate to model the number of rabbits and foxes as trigonometric functions of time.

b. Find an appropriate trigonometric function that models the number of rabbits, $r(t)$, as a function of time, t, in months.

c. Find an appropriate trigonometric function that models the number of foxes, $f(t)$, as a function of time, t, in months.

d. Graph both functions and give one possible explanation why one function seems to "chase" the other function.

Correct Answer:

a. If graphed, we see the general shape of a sine or cosine function.

b. $$r(t) = -500\sin\left(\frac{\pi}{6}t\right) + 1000$$

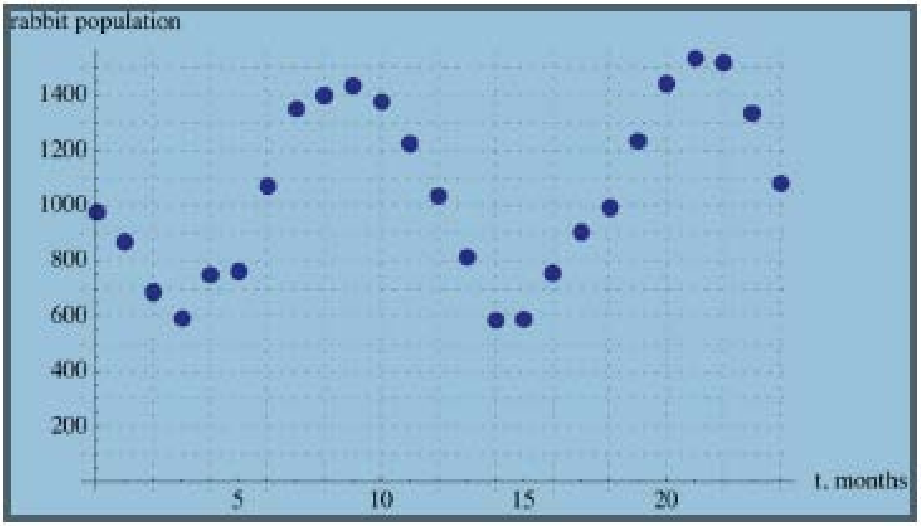
c. $$f(t) = 50\cos\left(\frac{\pi}{6}t\right) + 100$$

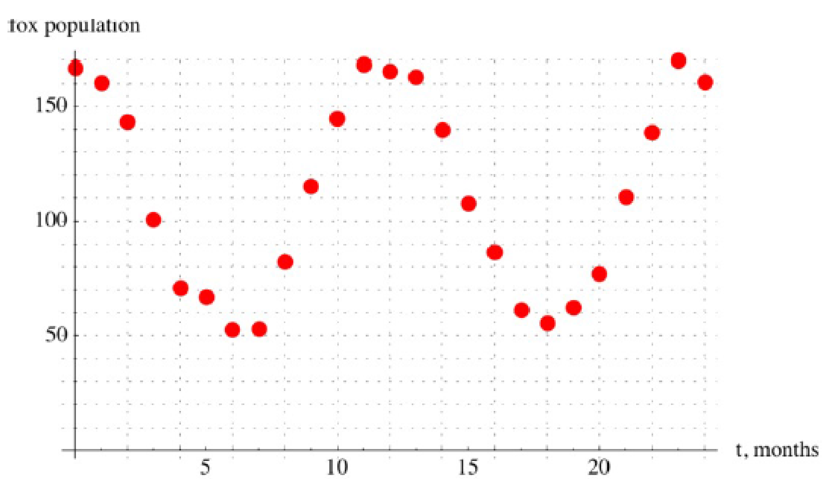
2) **Standard(s): F-TF.5**

Source: https://www.illustrativemathematics.org/content-standards/HSF/TF/B/5/tasks/817

Item Prompt:

Given below are two graphs that show the populations of foxes and rabbits in a national park over a 24 month period.





a. Explain why it is appropriate to model the number of rabbits and foxes as trigonometric functions of time.

b. Find an appropriate trigonometric function that models the number of rabbits, $r(t)$, as a function of time, with t in months.

c. Find an appropriate trigonometric function that models the number of foxes, $f(t)$, as a function of time, with t in months.

Correct Answers:

a. From the graph, we see the general shape of a sine function or cosine function.

b. $r(t) = -450\sin\left(\frac{\pi}{6}t\right) + 1050$

c. $r(t) = 60\cos\left(\frac{\pi}{6}t\right) + 110$