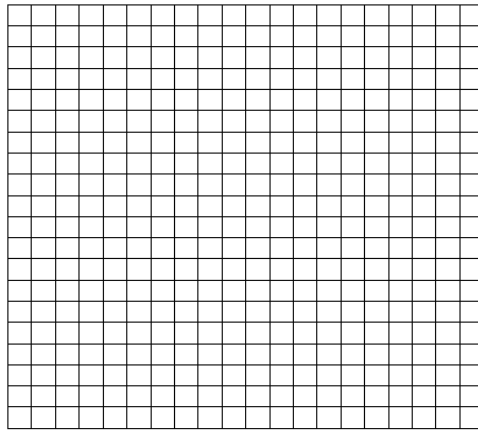


Project #13: Area under a curve and integration

1. Female moths produce a pheromone that is detected by chemical receptors in the antennae of male moths. Once detected, a male will orient towards the scent and move towards it until he reaches the female, in a process called chemotaxis. You want to know how far a male gypsy moth could possibly migrate, so you set up an experiment using a standard flight tunnel using synthetic female gypsy moth pheromone to motivate the male. Because you know that body size (wing length) will influence velocity, you looked at a large moth and a small moth. You measure the velocity at several points during the experiment and these are the results:

Size	Time: 0 min	2 min	4 min	6 min	8 min	10 min
Small	0 cm/s	0.80 cm/s	0.73 cm/s	0.75 cm/s	0.77 cm/s	0.60 cm/s
Large	0 cm/s	0.90 cm/s	0.88 cm/s	0.85 cm/s	0.83 cm/s	0.87 cm/s

a. Make a graph showing the relationship between velocity (in cm/s) and time for the small and large moth. (Plot both on the same graph!) Make sure your graph is properly labeled. (1point)



b. Calculate the distance each moth traveled over the first two minutes of flight (between $t=0$ and $t=2$ minutes), using the formula for area of a triangle. Which moth traveled farther and by how much? (3 points)

c. Now calculate the distance each moth traveled during the last two minutes of flight (between $t=8$ and $t=10$ minutes) . Compare these values to the ones obtained in (b). Propose an explanation to explain the change in your results between (b) and (c). (3 points)

d. Based on these results and results from many more moths that you tested, you determined the equation for the velocity of moth flight in large males is $V(t) = 55 - 0.7t$ and for small males is $V(t) = 50 - 0.9t$, where velocity is in cm/second and t is time in minutes. Moths were measured to fly as long as 60 minutes. Determine the distance flown by each type of moth in 60 minutes. (HINT: Find the indefinite integral of $V(t)$ for each type of male, which you can call $D(t)$, then find the solution using the Fundamental Theorem of Calculus.) (2 points)

e. Which kind of moth do you think has higher fitness and why? (Address both components of fitness: survival and reproduction) (1 point)