$$\frac{dx}{dt} = 4x - 2xy$$
$$\frac{dy}{dt} = -3y + 3xy$$

Predator-Prey system

or

Lotka-Volterra System

Solution: pair of functions $x(t)$ and $y(t)$.

1. predators: y

   prey: x

2. equilibrium solutions: $(0,0)$, $(1,2)$

   $4x - 2xy = 0 \quad \Rightarrow \quad 2x(2-y) = 0$

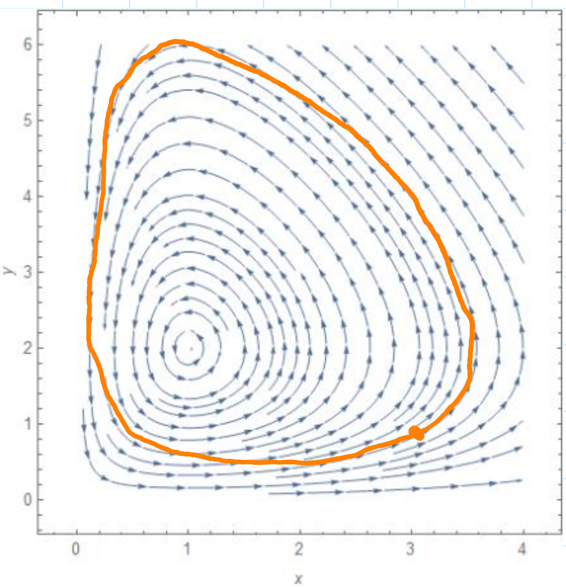
   $-3y + 3xy = 0 \qquad\quad 3y(x-1) = 0$

3. If $x(0) = 3$, $y(0) = 1$, then

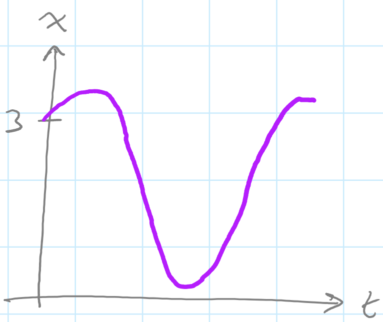
   both populations increase in short term.

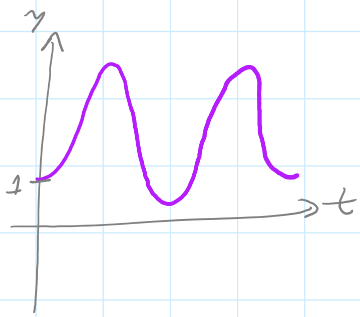
4.

Phase Portrait



5.





$$\frac{dx}{dt} = 2x\left(1-\frac{x}{3}\right) - xy$$

$$\frac{dy}{dt} = 3y\left(1-\frac{y}{5}\right) - 3xy$$

1. Competing

FACTOR!

2. $2x\left(1-\frac{x}{3}\right)-xy=0$ $\qquad x\left(2-\frac{2}{3}x-y\right)=0$

$3y\left(1-\frac{y}{5}\right)-3xy=0$ $\qquad 3y\left(1-\frac{y}{5}-x\right)=0$

$2-\frac{2}{3}x-y=0$

$1-\frac{y}{5}-x=0$

(x,y): $(0,0)$, $(0,5)$, $(3,0)$, $\left(\frac{9}{13}, \frac{20}{13}\right)$