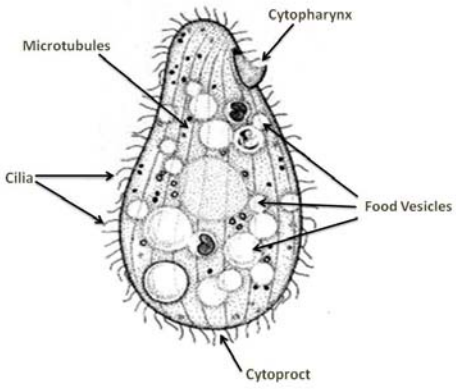
SUPPLEMENT 3
Calculation of Membrane Turnover in *Tetrahymena*

Tetrahymenas' shape approximates that of a prolate spheroid in which the surface area (SA) is given by

$$SA = 2\pi(a^2 + ab(1.2))$$

where a is the horizontal, transverse radius (r), and b is the vertical radius. Using the occular micrometer determine the length and width of your *Tetrahymena* and divide each by 2 to obtain the radius value for each parameter. Next, calculate the SA of your *Tetrahymena*.



Tetrahymena pyriformis
Adapted from: http://www.zoology.ubc.ca/courses/bio332/Labs/CiliateProject/tetrahymena/TETRAweb.htm

Phagosomes are ~1/6 the diameter of the *Tetrahymena* organism. Thus, if your *Tetrahymena* are 20 microns in diameter, then your phagosome diameter is 3.3 microns (r =1.65 microns). Check this assumption with the occular micrometer. To calculate the SA of the phagosomes, assume they are spherical objects, and use the equation for SA of a sphere

$$SA = 4\pi r^2$$

Now, to determine the rate of membrane turnover (RMT) multiply your initial rate of phagosome uptake (dves/dt, or if your uptake is linear with time by $\Delta ves/\Delta t$) by phagosome SA. For example, if dves/dt is 0.5/min and phagosome SA is ~34 microns squared (with r = 1.65 microns), we have

RMT = 0.5ves/min x 34 microns^2/ves = 17 microns^2/min

Data Analysis

If surface membrane is entering the cell at, say, ~20 microns^2/min, what must be the rate of membrane addition to the surface membrane by exocytosis to maintain surface membrane SA constant? And why is exocytosis necessary?

Next, how long will it take to completely turnover the surface membrane, assuming the rate of phagocytosis is sustained?