Quiz 1 - Monod's Nightmare

Under ideal growing conditions in the laboratory, the population size of the common bacterium *Escherichia coli* can double in around 20 minutes. *E. coli*'s cells are rod-shaped and are roughly approximated by a rectangular box that is 2 μm long, 1 μm wide, and 1 μm high. (1 μm = 1 micro-meter = 1 x 10-6 meters = 0.000001 m). For comparison, a strand of human hair is roughly 100 μm wide.

(a) Would a continuous-time model (the solution for which is $N_t = N_0 e^{rt}$) or a discrete-time model (the solution for which is $N_t = \lambda^t N_0$) be more appropriate for describing this population? Why?

(b) What is *E. coli*'s growth rate r (in minutes) under these ideal growing conditions. Express your answer by solving for the equation you would use to calculate r to the simplest solution possible.

(c) Let's assume that our classroom is roughly 10 m long, 10 m wide, and 8 m high (its not, I just made up these numbers). How long it would take for an exponentially growing population of *E. coli* under ideal conditions to fill our empty classroom when starting from a single individual bacterium?