

MONT 104N – Modeling the Environment
Exponential Modeling Examples
October 22, 2018

(A) The Syn 3.0 synthetic life organism mentioned in the background for the essay on the upcoming midterm exam is a bacterium whose genetic information (DNA) was synthesized by humans in a lab and then inserted into the cells of an existing strain of bacteria (after the “host’s” DNA was removed). The resulting synthetic bacteria was placed into a nutrient bath and it successfully divided (reproduced) in such a way that the number of bacteria was *doubling every three hours*.

- 1) Is this situation explained by a linear model or an exponential model? Why?
- 2) Starting from a single bacterial cell, write down a formula for the number of Syn 3.0 cells present x hours after the start of the experiment.
- 3) How many hours would go by before the number of bacteria reached 10,000?

(B) The radioactive isotope strontium-90 decays in such a way that if a sample contains c grams at any time t , then after 1 year, the mass of the remaining strontium-90 is 97.6% of the original amount (i.e. there are $.976c$ grams left).

- 1) Is this a situation for a linear model or an exponential model? Why?
- 2) If a sample of strontium-90 consists of 100g of the material at time $t = 0$, how much will be left after 20 years?
- 3) How long does it take for the amount to decay to 50g (half the original amount? (This length of time is called the *half-life*.)