

## Exercise 54

The number of bacteria after  $t$  hours in a controlled laboratory experiment is  $n = f(t)$ .

- (a) What is the meaning of the derivative  $f'(5)$ ? What are its units?
- (b) Suppose there is an unlimited amount of space and nutrients for the bacteria. Which do you think is larger,  $f'(5)$  or  $f'(10)$ ? If the supply of nutrients is limited, would that affect your conclusion? Explain.

---

### Solution

- (a)  $f'(5)$  is the rate that the bacteria population increases with respect to time after 5 hours have passed. It has units of bacteria per hour.
- (b) If there's an unlimited amount of space and nutrients, then  $f'(10) > f'(5)$  because there are more bacteria around to reproduce at  $t = 10$  than at  $t = 5$ . If there's a limited amount of space and nutrients, then  $f'(10) < f'(5)$  potentially because of hunger and overpopulation.