Activity #5

Well Behaved Fireflies

1. A cubical box with 10 cm sides contains 300 fireflies. The fireflies are in constant motion, but they are evenly spread through out the box (on average).

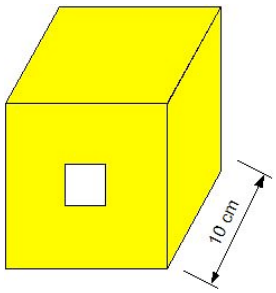

Illustration 1: Cubical Fly Box

The box has a small viewing window on two opposite sides. The window has an area of 5 cm^{2}. Through this window, approximately 15 flies can be seen at any given time.

If the number of fireflies in the box doubled, how many flies would you see in the window?

2. The 300 flies are now moved to a box with a height and width of 10 cm, but a length of 20 cm. How many flies would be visible in the viewing window now?

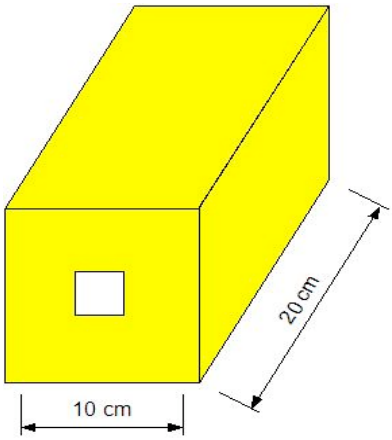

Illustration 2: Fly Box with Double Length

3. Now consider the situation in which 600 fireflies are placed in the box of Figure 2 (10cmx10cmx20cm long). What is the concentration of fireflies in the box. How many flies will be in the viewing window?

4. In the previous exercise, what quantity relates to moles? Explain.

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5. Notice that if you double the area of the viewing window, you will double the number of flies you see (e.g., number of flies seen is proportional to viewing area). Considering this along with the results of exercises 1 and 2, write an expression for the concentration of flies in the box. Be sure to include units.

6. How does doubling the length of the box change the number of flies seen in the viewing window if the concentration of flies is held constant? [Hint: consider the answer to Exercise 3 compared to the original situation (Fig 1a)]

7. Make an equation that relates the number of flies seen in the window to the concentration of flies, length of box, and the area of the viewing window.

8. Based on the previous exercise, predict how changing the concentration and/or pathlength would affect absorbance in a spectroscopy experiment.

9. To test your prediction from question 8, retrieve a series of v-shaped cuvets. Blank and obtain the UV-vis spectra for the copper solutions with the two largest concentrations. Do this twice: first insert the cuvet with the long path facing the light beam and then turn the cuvets sideways (make sure to blank the machine with the cuvet sideways as well). How does the absorbance change if the path length is changed for identical concentration?

10. Quantitatively compare the absorbances for the different path lengths (the long path length is 10 mm, the short path length is 4 mm).