**IB Biology** **Name _____**
**DA: Transgenic Pollen and Monarch Larvae** **Period _____Date _____**

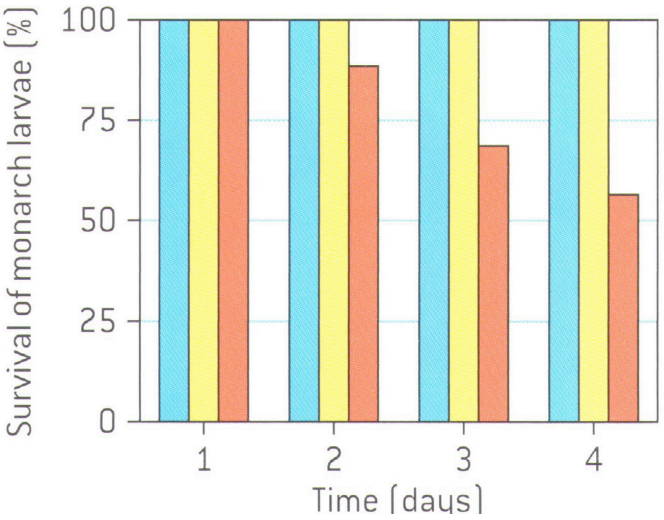
To investigate the effect of pollen from *Bt* corn on the larvae of monarch butterflies the following procedure was used. Leaves were collected from milkweed plants and were lightly misted with water. A spatula of pollen was gently tapped over the leaves to deposit a fine dusting. The leaves were placed in water-filled tubes. Five three-day-old monarch butterfly larvae were placed on each leaf. The area of leaf eaten by the larvae was monitored over four days. The mass of the larvae was measured after four days. The survival of the larvae was monitored over four days.

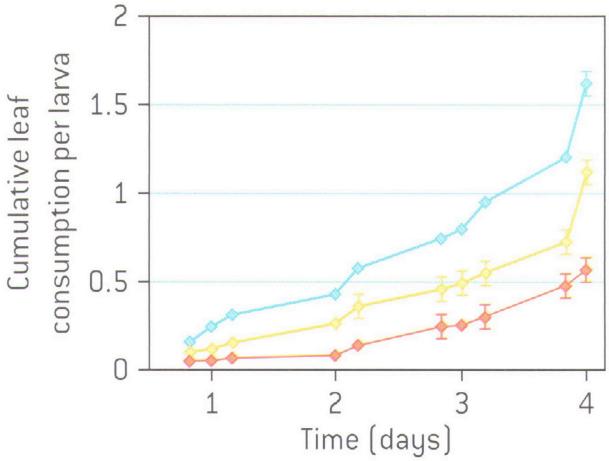
Three treatments were included in the experiment, with five repeats of each treatment:

- leaves not dusted with pollen (light)
- leaves dusted with non-GM pollen (white)
- leaves dusted with pollen from *Bt* corn (dark)

The results are shown in the table, bar chart and graph below:

| **Treatment** | **Mean Mass of surviving larvae (g)** |
|---|---|
| leaves not dusted with pollen | 0.38 |
| leaves dusted with non-GM pollen | Not Available |
| leaves dusted with pollen from *Bt* corn | 0.16 |




*Source*: Losey JE, Rayor LS, Carter ME (May 1999). "Transgenic pollen harms monarch larvae". *Nature* 399 (6733): 214.

1. a) List the variables that were kept constant in the experiment. (2)

   b) Explain the need to keep these variables constant. (1)

2. a) Calculate the total number of larvae used in the experiment. (2)

b) Explain the need for replicates in experiments. (1)

3. The bar chart and the graph show mean results and error bars. Explain how error bars help in the analysis and evaluation of data. (1)

4. Explain the conclusions that can be drawn from the percentage survival of larvae in the three treatments. (2)

5. Suggest reasons for the differences in leaf consumption between the three treatments. (2)

6. Predict the mean mass of larvae that fed on leaves dusted with non-GM pollen. (1)

7. Outline any differences between the procedures used in this experiment and processes that occur in nature, which might affect whether monarch larvae are actually harmed by *Bt* pollen. (2)

As a result of Dr. Losey's findings, some scientists decided to combine their research on this topic and produced a large body of peer-reviewed work on monarch butterflies and Bt corn, which was published in the *Proceedings of the National Academy of Sciences* (PNAS). These studies concluded that monarch butterflies exposed to Bt corn in the environment are not subjected to any significant risk. The CFIA, in co-operation with Environment Canada, commissioned a study that became part of that body of work, called, "*Final Report on the Ecological Impact of Bt Corn Pollen on the Monarch Butterfly in Ontario*". This study concluded that the risks to monarch butterflies from Bt corn pollen is less than 1/100 of 1 per cent.
Source: "Q&A: Bt Corn and Monarch Butterflies." *USDA ARS*, www.ars.usda.gov/oc/br/btcorn/index/#bt6.

8. Do you think these types of studies should be conducted before, during, or after GMO's are allowed to be used in the environment? Explain your answer. (2)

Adapted from: Allott, Andrew, and David Mindorff. *Biology Course Companion*. 2014 ed. Oxford: Oxford UP, 2014. Print.