Variables in a Controlled Experiment:

 Professor Farnsworth Foley Fitzsimmons von Farkle conducts an experiment to determine how the concentration of nitrogen in the water affects the mass of tomatoes produced by tomato plants. The experimental design is summarized below.

* The professor has 1000 tomato plants. The plants are divided into ten groups of ten. Group 1 is watered with plain water (0ppm nitrogen). Group 2 is watered with water at 10 ppm nitrogen. Group 3 is watered with 20 ppm nitrogen. Group 4 is watered with 30 ppm nitrogen and so on as shown in table 1.
* Each plant is watered by an automatic system that ensures each plant receives identical volumes of water at the same time.
* All of the plants are placed in the same type of container, with the same type and amount of soil.
* All of the plants are kept at the same temperature as one another. The temperature ranges from a low of 8oC at night to a high of 26oC in the day.
* All of the plants are kept indoors and receive light from special light bulbs designed to simulate sunlight. The plants all receive 14.0 hours of direct light each day and spend the remaining 10.0 hours in the dark.
* The humidity is carefully controlled by computers and the air is circulated by a system of computer controlled fans to maintain proper levels of oxygen and carbon dioxide in the air.

The final results are displayed below:

|  |  |  |
| --- | --- | --- |
| **Group** | **N2 (ppm)** | **Average mass of Tomatoes (g)** |
| 1 | 0 | 540 |
| 2 | 10 | 640 |
| 3 | 20 | 760 |
| 4 | 30 | 960 |
| 5 | 40 | 1140 |
| 6 | 50 | 1120 |
| 7 | 60 | 800 |
| 8 | 70 | 140 |
| 9 | 80 | 0 |
| 10 | 90 | 0 |

QUESTIONS:

1. What does ppm mean?

2. Is this a controlled scientific experiment?

3. What is the dependent variable?

4. What is the independent variable?

5. List 5 controlled variables.

6. Sketch a graph with Mass of Tomatoes on the y-axis, and Concentration of Nitrogen on the x-axis.

7. Do the variables appear to be correlated?

8. What happens to mass of tomatoes as the nitrogen concentration increases from zero to 30ppm?

9. What happens to the mass of tomatoes as the nitrogen concentration increases from 50ppm to 80ppm?

10. Is this a simple positive or negative correlation?

11. What would you predict the mass of tomatoes to be if the nitrogen concentration were 35ppm?

12. What do you predict the mass of tomatoes to be if the nitrogen is increased to 120ppm?

13. Based on the data, what is the optimal range for nitrogen concentration to maximize the mass of tomatoes produced?

14. Give at two possible reasons a tomato producer might choose to use something other than the optimal amount of nitrogen on their tomatoes, assuming they have access to, and understanding of, the data.