



RELATING ELECTRONS AND PROBABILITY

Early theories of the structure of the atom described the movement of electrons around the nucleus as similar to the movement of the planets around the sun. Today scientists know this is not the case. Electrons do not travel around the nucleus in fixed orbits. Electrons move in an area known as the electron cloud. The electron cloud is a region in which electrons are *likely* to be found. Within the electron cloud, electrons are

arranged in energy levels. Energy levels represent the most probably location in which an electron can be found. An energy level should not be confused with a specific path. For electrons do not have a path. In fact, scientists can speak on of the chances, or probability, of finding electrons at various locations – not of their exact position. In this investigation, you will get a better understanding of probability and how it relates to position.

Question

How can the movement of electrons outside the nucleus be described?

Materials (per group)

- 1 die labeled with 1-, 2-, and 3-dots on various sides
- 1 sheet of graph paper having 1.5 squares/cm
- Red colored pencil
- Standard pencil

Procedure

1. Select a square near the center of the graph paper and color it red. This red square will represent the nucleus.
2. Roll the die and with each roll pencil in a square according to the following rules:
 - If a one is rolled, pencil in any square that is between 0 and 3 cm from the nucleus.
 - If a two is rolled, pencil in any square that is between 3 and 5 cm from the nucleus.
 - If a three is rolled, pencil in any square that is between 5 and 7 cm from the nucleus.
3. Repeat this procedure of rolling the die and marking the graph for 50 throws. Record your results in the data table.

Observations

Copy this data table in your notebook and record data.

	Number of Squares Penciled In
0-3 cm (first energy level)	
3-5 cm (second energy level)	
5-7 cm (third energy level)	

Analysis

Answer the following questions in your notebook, restating the questions in your answers.

1. The modern view of the movement of electrons in an atom is based on the concept of probability. How would you define probability?
2. In which range do you have the most darkened squares on your diagram?
3. Compare your diagram to that of another classmate. Are they identical? Explain any similarities or differences.

Conclusion

Answer the following questions in your notebook, restating the questions in your answers.

1. Based on your data, in what energy level is an electron most likely to be found? Least likely to be found?
2. If each square that you penciled in represents a chance of finding an electron in a particular location around the nucleus, where would you look first for an electron? Explain your answer.
3. Can the exact position of an electron around the nucleus be determined? What can be known about location of electrons?

Critical Thinking Questions

Answer the following questions in your notebook, restating the questions in your answers.

1. Mathematically, the probability of an event occurring is equal to the number of favorable outcomes divided by the number of possible outcomes. According to the way the die were

marked in this investigation, what is the probability of an electron being found in the first energy level? The second? The third?

2. Suppose you had rolled the die 100 times. How do you think your results would have compared with the results you obtained by rolling the die 50 times?