Lab 14: Orbitals and Split Peas

Introduction

In lab 13, we saw that Bohr was close to explaining the behavior of electrons (atomic spectra explained by the movement of an electron from an excited to ground state). However, **Bohr's model of quantization** was too simplistic for multi-electron elements. A new type of thinking was needed to describe the electron. Quantum Mechanics and the wave-mechanics model threw out Newtonian physics and applied completely different rules to describe really small and really fast things. In the **wave-mechanics model**, electrons are described by their probability of being in a region, a **probability map** called an **orbital**. There are 4 orbitals based on the quality of their spectroscopic lines: **s**harp, **p**rincipal, **d**iffuse, and **f**undamental. For the sake of simplicity, we write the four orbitals as *s*, *p*, *d*, and *f*.

Purpose

In this activity, we will attempt to show the ideas of quantum mechanics, orbitals, and probability models.

Materials

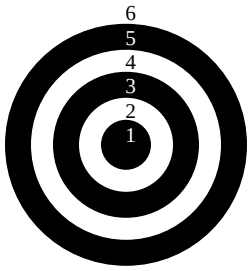
40 ml of split peas
Funnel
Target

Procedure

1. Position the target so that the funnel is directly over the center of the target.
2. Separate the peas into equal volumes in the two 50 ml graduated cylinders.
3. Have one member of the group place a finger over the end of the funnel and then add 20 ml of the peas into the funnel.
4. Release the peas so that they fall onto the target.
5. Use the rules below to count how many peas are in each area of the target.
6. After completing the counting, repeat steps 1-5 with all 40 ml of peas.
7. Record all data on the data table.
8. When done, place all of the peas in a beaker and return to your seat.

Rules for counting:

- If a pea is completely within an area, it belongs to that area.
- If the pea is on a line, it belongs to the area that the greater portion of its volume occupies.
- If the pea is on a line, and seems to be equally in two areas, it belongs to the area nearest the center.
- Any part of a pea counts as a pea.



The areas are numbered as this picture.

Student Name: _____ Period: _____ Score: _____

Data Table 1:

Run 1			Run 2		
Area #	# of peas	% of total	Area #	# of peas	% of total
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
Total			Total		

Data Analysis: Answer the following questions in complete sentences.

1. In the first run, which area did the most peas land?

2. Did this change for the second run?

3. If you were to do this activity again, only you had to predict where 90% of the peas would fall, what would your prediction be?

4. Does your 90% prediction mean that every pea will fall where you think?

5. Explain how these results mimic the orbitals described in the quantum mechanical model of the atom.