Lab: What's an 'Orbital'?

Objective: To demonstrate the probability of finding an electron in the Electron Cloud model of the atom (also called the Modern Model, Quantum Mechanical Model or Wave Mechanical Model).

Background:
We know that the. model of the atom has evolved over a long period of time. There have been many scientists that have contributed to the current model of the atom. For instance, we have seen how the Bohr model was based on a solar system idea of electrons in fixed orbits. After many experiments, we now know that the 'electron cloud model' is the most accurate representation of the atom.

The following lab is an 'exercise' to help you understand the probability model of the atom. The probability model of the atom mis a difficult process to 'see' - so you are going to actually create a model of probability. There was a scientist name Heisenberg who theorized that it is impossible to know both the speed and location of an electron at the same time. This makes perfect sense because electrons move at the speed of light and change in direction trillions of times a second. The 'cloud model' was designed using math and laws of probability.

If we were able to take a screenshot of an electron in motion the resulting picture might resemble a dot suspended in mid air. As the electron moves about randomly we could then take another screenshot of the electron that would end up in another location around the nucleus. Now, lets say you took hundreds of screenshots of this electron. You would end up with hundreds of pictures of this electron in all different locations around the nucleus. If you were to overlay all these screenshots into one picture, you would end up with a picture of the nucleus with hundreds of dots around it.

That's exactly what the cloud model looks like. The areas where there is a high concentration of dots would be the areas where the electron spends most of its time. This would be the most likely place to find an electron at any given time. These pictures of dots typically look like clouds when there are thousands overlaying watch other. Therefore, they are call the 'electron cloud models'.

Procedure:
1. Read the background section above and underline key ideas.
2. Tape a target onto your unit folder and place it onto the floor.
3. Stand over your target with your pencil/pen against your nose with the sharpened end pointing down.
4. Aim for the nucleus at the center of the target and drop the pencil/pen so it makes a mark on the paper. If it doesn't leave a mark then it's a DO-OVER.
5. Repeat 99 times for a total of 100 trials.

6. Count the dots that fell in each area and complete the data table below:

Diameter	# of Marks	Running Total	Percent of Total
0-3 cm			
3-6 cm			
6-9 cm			
9-12 cm			
12-15 cm			
15-18 cm			
18+ cm			

7. Show a sample calculation of how you calculated the "Percent of Total" column for the 0-3 cm diameter area.

8. On your target, which areas did your pencil fall in 90% of the time?

9. Which areas of the target had the highest probability of finding a pencil mark? Explain your answer.

10. One pencil made all of the marks on your target. How many electrons make all the dots that form an electron cloud?

11. How is the Electron Cloud model *similar* to the Bohr model of the atom, AND how is it *different*?