Investigating the Size of Atomic Particles

Background
In this lab, you will build a scale model of a hydrogen atom. Your teacher will provide information regarding the relative size of the proton compared with the relative distance of an electron from a proton in a hydrogen atom.

Pre-lab Questions
Before beginning this lab, define the following terms:
1. Atom:
2. Proton:
3. Electron:
4. Neutron:
5. Nucleus:
6. Relative Distance:

Objective
Build a model to demonstrate aspects of atomic structure.

Materials
For each pair of students:
- Calculator
- Meter stick
- Peas, dried
- Pencil
- Ruler, metric
- Scissors
- Yarn, 70 meters

Procedure
1. Draw a small circle, about 1 millimeter (mm) (0.1 centimeter) in diameter on your data sheet.
2. Measure and record the diameter of the circle in the data table below.
3. Assuming the diameter of the circle represents a proton, calculate the relative distance of the electron from the proton in a hydrogen atom. Show your calculations in the section below.
4. Roll out a length of yarn to reflect the length you just calculated; this will illustrate the relative distance of the electron from the proton.
5. Record the length of yarn you used in the data table below.
6. Measure the diameter of a pea with the metric ruler and record this value in your data table.
7. Assuming the diameter of the pea represents a proton, calculate the relative distance of the electron from the proton in a hydrogen atom.
Data

<table>
<thead>
<tr>
<th>Diameter of your circle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Length of yarn</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Diameter of pea</td>
</tr>
</tbody>
</table>

Calculations

1. Calculated relative distance of the electron from the proton in a hydrogen atom (using the drawn circle diameter). Show all your work! Remember: the relative distance is not the actual distance of a proton from an electron. Atoms are too small to be seen by the human eye, so relative distances are used to help model what an atom looks like.

2. Calculated relative distance of the electron from the proton in a hydrogen atom (using pea diameter). Show all your work!

Analysis

1. What can you conclude when comparing the size of the proton with the distance of the electron from the proton?

2. What do you think lies between the proton and the electron in a hydrogen atom?

3. Is the electron always in one spot in a hydrogen atom, or does its position change?
Conclusion
1. After learning how the atomic model has changed over time, what new information was applied when scientists stopped using the “plum pudding” model and started using the Bohr model?

2. What are other ways you could model an atom and its subatomic particles?

3. Why did we not analyze the relative size of a neutron?