Name:_____Key_____

Playing Marco Polo with the Atom

Instructions:

1) Go to the PhET simulations website.
2) Click on the "Models of the Hydrogen Atom" link.
3) Click on the Green Button "Run Now!"

Questions:

1) The game "Marco Polo" is an example of **indirect observation.** In the game, the person who is "it" closes his/her eyes and tries to locate other people with their voice. Because atoms are extremely small, chemists and physicists can not **directly** observe them. Rather, they have to **indirectly** observe them by firing particles at them. Explain why this method is like the Marco Polo game.
   In the MP game, a player is trying to find out something that is unknown: the location of the other players. Instead of directly touching the other players, the person sends out a signal (sound wave). The sound wave reaches the other player and the player responds by emitting a similar signal back to the observer. The observer can then use the that information to better induce the unknown location of the other player.
   This is exactly like the original experiments with the atom. Researchers couldn't directly observe the atom because it was too small but they knew that photons were small enough to interact with atoms, so the photons became the "signal."
2) Make sure the "Experiment" switch is selected. The "?" box in the middle of the screen represents the atom that cannot be seen. ***Turn on the gun.*** How does the simulation explore what is on the inside of the box without showing you what is on the inside of it?
   By passing photons into the box.

2) ***Make sure the white light button is selected.*** Make some observations.

Observation #1:_Most photons go through the box without stopping
Observation #2: Some photons go into the box and do not come out immediately
Observation #3: The photons that are absorbed eventually come out but at a different angle.
Observation #4: Sometimes the photon that comes out is not the same as the photon that was absorbed.

3) What happens to most of the particles?
They go directly through
4) What happens to a few of them?
They get absorbed into the box___

Click on the "Prediction" switch at the top left. A list will appear of the different models of the atom. For each model, explain why it "works" with the experimental observations. Explain why it "does NOT work" with the experimental observations.

Billiard Ball Model -

How is it similar to the experiment?

Photons bounce off of the billiard ball at different angles, photons are observed coming out of the box at different angles.

How is it different?

There seems to be a time lag between when the photon goes in and comes out in the experiment, while if the billiard model was correct there would be an immediate bounce off in another direction.

Plum Pudding Model -

How is it similar to the experiment?

Most particles pass right through, some get absorbed and then are emitted at different angles.

How is it different? (Hint: Click on the "Show Spectrometer" button to count the particles that are emitted.)

The only particles that are emitted are in the extreme UV region, while in the actual experiment there are photons emitted of all wavelengths

Bohr Model -

How is it similar to the experiment?

Photons of of the same wavelengths are emitted in both the model and experiment.

How is it different?

UV Photons seem to be absorbed more frequently in the model and less in the experiment.

Which model of the atom most accurately predicts what is observed in the experiment?

The Bohr Model

It has been said that "Seeing is believing." Is that true in this case?

In the case of the atom, the model of its structure was never directly observed...yet the scientific community formed a theory that they believed in and continue to believe in to this day.