Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Playing Marco Polo with the Atom**

Instructions:

1) Go to the [PhET simulations website](http://phet.colorado.edu/en/simulations/category/chemistry).

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.

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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?

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

Observation #1:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation #2:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation #3:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observation #4:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3) What happens to most of the particles?

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4) What happens to a few of them?

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***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?

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How is it different?

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**Plum Pudding Model -**

How is it similar to the experiment?

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

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B**ohr Model -**

How is it similar to the experiment?

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How is it different?

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

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