

## Atomic Model-Change Over Time

Bring history alive with a fascinating look at how the model of the atom has changed over the past 100 years. Scientists like Dalton, Thomson, Rutherford, and Bohr make huge discoveries that force these changes.

**Materials per group-** Clay, bb's or ball bearings, piece of aluminum foil, marbles, cardboard box, 2 identical copies of a magazine, 2 bar magnets, florence flask and stopper, 1 inch roofing nails

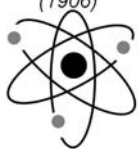
**Prep:** Roll 2 balls of clay, one plain (Dalton model of the atom) and the other with a few bb's or ball bearings pushed into the outside of it so they're visible (Thomson). Put water in florence flask, boil it for 10 minutes and stopper to create a small vacuum. For the Rutherford demo- see step #5 below or instructions.

1. Introduce the lesson by making the point that every-thing is made of atoms. Hold up the florence flask with a vacuum inside and ask what's inside. There's water....and nothing else. The water is made of atoms, but the space above the water is nothing, so there are no atoms there.

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2. Have students set up their papers as shown below.

This is available as a Student Handout (see last page).

<p><b>Experiment</b></p> <p>Fired positively-charged particles at a piece of gold foil. Most of them passed right through. A few did not.</p> <p>That meant that...</p> <ul style="list-style-type: none"><li>•Atoms are mostly empty space</li><li>•Except for something that's very hard</li><li>•And positively charged</li></ul>	<p><b>Ernest Rutherford (1906)</b></p>  <p>➤ He pictured an atom of mostly empty space where negatively charged particles move around a small positively charged sphere.</p>
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## Models Of The Atom

<i>John Dalton</i> (1803)	<i>J.J. Thomson</i> (1897)	<i>Ernest Rutherford</i> (1906)	<i>Niels Bohr</i> (1913)	Electron Cloud (Current)	The Future
➤	➤	➤	➤	➤	

### 3. JOHN DALTON

If your book mentions Dalton, read about him.

Go over his statements shown in black (students don't need to copy this), hold up the plain ball of clay to represent his model.

When you get to the statement about all atoms being exactly alike, hold up the 2 identical magazines. That's what we mean when we say identical.

Have students draw his concept of the atom (hard sphere), followed by words in red describing it.

This is also available as a PowerPoint (see last page).

"Matter is made of atoms too small to be seen."

"Each type of matter is made of one kind of atom."

"All the atoms of one kind of matter are exactly alike."

*John Dalton*  
(1803)



➤ Dalton pictured atoms as a hard sphere

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#### 4. JJ THOMSON

If your book mentions Thomson, read about him.

When going over the statements in black, take 2 bar magnets and try to put the like poles together (they repel). Switch one around and put opposite poles together (they attract). Since opposites attract, you know that stream of particles inside the cathode tube bending towards the north pole (+) **MUST** be negative.

Hold up the ball of clay with bb's/ball bearings represent Thomson's model. Compare the Dalton plain ball of clay with the Thomson ball with bb's- there's not much difference, is there? But he had to devise a model with those little negative charges to explain the existence of the purely negative particles he discovered

Have students draw the model and copy the words in red.

##### Experiment

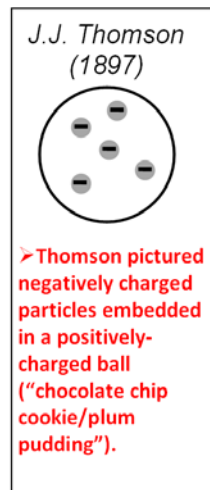
Particles bent towards + end of a magnet

That means that...

- They have a charge
- And that charge is negative
- Atoms must be made of even smaller particles

These turned out to be electrons

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## 5. ERNEST RUTHERFORD

If your book mentions Rutherford, read about him

To get things going, hold up a piece of aluminum foil so students understand what we're working with (the gold foil, however, was much more thin than the aluminum foil). It's amazing to think that in 1906 Rutherford predicted that all the alpha particles would slip through. That means that the understanding of atoms was already that they are mostly empty space. To think that this was already known 100 years ago is amazing.

Student Activity (10 minutes)- cut pieces of cardboard just a little bigger than a standard sized sheet of paper. Poke a 1 inch roofing nail through the cardboard (it doesn't matter where) then tape a sheet of paper on top (2 pieces of clear tape at the top of the sheet is best; that way later you can lift the sheet, pull out the nail, and store it conveniently until next year). Lay the ends of the cardboard on textbooks to elevate it so that the nail comes close to touching the table top. Have student roll a marble below and try to figure out where the nail is without looking. Once they hit it with the marble, try to figure out where it's hitting, then check to see if they're right. Make enough of these boards for students to work in pairs. What they'll "discover" is that most of the time the marble goes through without touching anything. That's because it's mostly empty space (just like the atom). Occasionally,

### Experiment

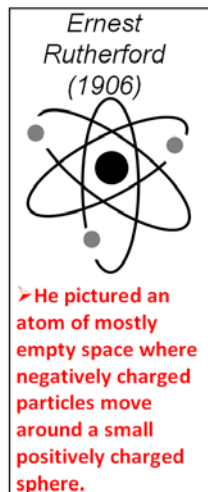
Fired positively-charged particles at a piece of gold foil.

Most of them passed right through. A few did not.

That meant that...

- Atoms are mostly empty space
- Except for something that's very hard
- And positively charged

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however, it hits something small and hard (the nail, likened to the nucleus) that makes it change directions. Have students switch boards one or two times with each other and repeat the activity. It takes a little time to make these boards (about an hour), but you've now got something you can quickly and easily pull out every time you talk about Rutherford, and it really helps kids understand what he was doing and why he interpreted the results the way he did.

Compare the Dalton plain clay ball, with the Thomson clay ball with bb's, with the Rutherford model on the PowerPoint- all we've done is take those embedded electrons and make them fly around the nucleus. Still not much difference.

Have students draw the model and copy the words in red.

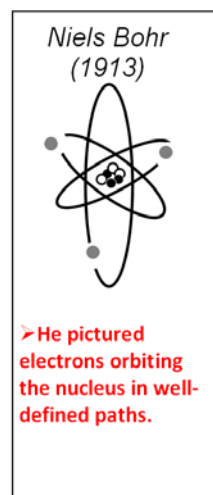
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## **6. NIELS BOHR**

If your book mentions Bohr, read about him.

Bohr's big contribution - energy levels. Notice there are 2 electrons that are close and 1 further out. Changes are still gradual.

Came across evidence that suggested electrons are in energy levels.



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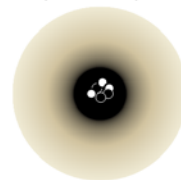
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7. This one is a huge change from the previous model. We're keeping the nucleus, but everything we're finding out about electrons is bizarre.

Electrons are similar to waves and particles.

They do *not* travel in defined paths.

### Electron Cloud (Current)



➤ Electrons move around in what is called an electron cloud. It shows where they are most likely to be found.

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8. Anyone's guess.

Have students put the question mark down for this model.

### The Future



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*John Dalton*  
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➤ Dalton pictured atoms as a hard sphere

Experiment  
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➤ He pictured an atom of mostly empty space where negatively charged particles move around a small positively charged sphere.

Electrons are similar to waves and particles. They do not travel in defined paths.

**Electron Cloud (Current)**



➤ Electrons move around in what is called an electron cloud. It shows where they are most likely to be found.

**Student Handout**

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