GreatHearts
Irving

Remote Learning Packet

Please submit scans of written work in Google Classroom at the end of the week.

Week 7: May 11-15, 2020
Course: Nature of Science
Teacher(s): Mr. Brandolini (david.brandolini@greatheartsirving.org); Mr. Mooney (sean.mooney@greatheartsirving.org); Mr. Schuler (david.schuler@greatheartsirving.org)

Weekly Plan:

Monday, May 11
☐ Read the Lecture on Faraday in this packet
☐ Read pp. 130-131 and the first two paragraphs on p. 133. Please note that pp. 130-131 may sound odd because they are notes from a live lecture the scientist gave.
☐ Complete the reading questions

Tuesday, May 12
☐ Read the Lecture on Thomson and Rutherford in this packet
☐ Look at the diagrams in *Nature of Science* page 135-137.
☐ Complete the reading questions

Wednesday, May 13
☐ Read the lecture document on Niels Bohr and *Nature of Science* page 138
☐ Complete the reading questions

Thursday, May 14
☐ Go to Google Classroom and complete the open note/book Assessment.

Friday, May 15
☐ Attend Office Hours (11:30am-12:00pm)
☐ Catch up on work if needed

Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

I affirm that, to the best of my knowledge, my child completed this work independently

____
Student Signature

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Parent Signature

Monday, May 11

Name: ____
Section & Course: ____
Teacher: ____
Date: ____

Michael Faraday, *The Forces of Matter & Experimental Researches in Electricity*

Instructions for Today:

1. Read the document below. Then, read pp. 130-131 and the first two paragraphs on p. 133. Please note that pp. 130-131 may sound odd because they are notes from a live lecture the scientist gave. Finally, complete the questions at the end of this reading.

Consider water for a moment. We use it to clean and wash and to sustain our own frail bodies. It would be a rare and uncomfortable day indeed that we went entirely without interacting with it. Water is a whole with its own nature, and we are so accustomed to it, that we might sometimes neglect the fact that water has parts!

The fundamental parts of water are the two elements hydrogen and oxygen. These two elements come together in certain ratios (Pythagoras!) that result in the formation of water. You have probably known about these parts of water for a long time, but have you stopped to consider the oddity and wondrousness of this? Have you asked the fundamental questions that ought to bubble up as we consider it?

If it is true that hydrogen and oxygen come together to form water,

1. What is holding the hydrogen and oxygen together?
2. Can the bond holding them together be broken? If so, how?
3. How do two elements (hydrogen and oxygen) with very different natures come together to form a whole (water) that has its own very different nature from its parts?

In today's lesson, we will learn about a man who asked these questions and sought answers to the first two.

But before we get to this new thinker (will he be British again?! French? Where are the Americans?) and his thoughts (will he measure things, too?), let's re-orient ourselves within the Conversation we've been listening in on.

If you recall, going all the way back to Empedocles there has been a theory in some form or other that material substances are made up of some kind of tiny particles that are held together by forces. Empedocles referred to Love & Strife and Lavoisier to Attraction & Repulsion. John Dalton, whom we studied most recently, agreed that there were particles, which he called **atoms**, in a void that were drawn together and drawn apart by some kind of attractive & repulsive force. Both Lavoisier and Dalton were focusing on **heat** (or **caloric**) as having something to do with things, but our new scientist is able to make further headway in understanding.

This is where Mr. Michael Faraday comes in. (And for those who were guessing, yes, he's a Brit!)

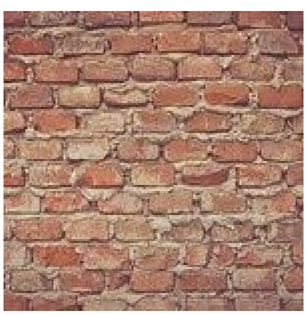
Mr. Faraday had key insights into the nature of these forces, and he, very much in keeping with the new emphasis on measurement and experimentation, set up clever experiments and then measured things that happened during those experiments.

Do you see the slight shift in focus we're having today? Many of the ideas we've studied recently have been about these particles (now called "atoms") themselves or their behaviors in groups (like gases), but **today we are not dwelling too carefully on atoms themselves but on the nature of the force (or forces) keeping them together (or drawing them apart).**

Now that we have focused on the right subject, let's get clear a couple of the key questions we should be asking ourselves:

1. This "force" holding atoms together, what is it?[1]
2. This "force" is it
    a. Material?
    b. Immaterial?
3. Is there one force guiding both Attraction and Repulsion or is it one force for attraction and a different force for repulsion?
4. Is this force part of the atoms themselves or something separate acting on the atoms?

Let's look at that second question on whether the force is material or immaterial. Basically, picture two different images, one each for material and immaterial.



Option A: Mortar is a *Material* substance holding bricks together

These two images are analogies designed to help us consider the fundamental question of whether atoms are held together by something material (like mortar) or immaterial (like gravity). Remember that Lavoisier and Dalton both said that the force drawing atoms *apart* was **material**. They talked about **caloric** being a "subtle fluid" that sits between atoms and helps control how close or far apart they are. Fluids, of course, are material.

Option B: Gravity is an *Immaterial* force drawing the man and Earth together

[1] There is some nuance here. Faraday may be making a distinction between the forces involved in keeping like things together (hydrogen→ hydrogen; water→ water) vs. unlike things (hydrogen → oxygen). There may be different forces involved in these different kinds of attractions/repulsions. See top of p. 131 in *Nature of Science*.

What do you think? Do you think atoms are drawn together by some kind of material substance surrounding them or by some kind of immaterial force? Let's see what Mr. Faraday thought.

Faraday set up a genius experiment with water[2]. Faraday set up two separate tubes upside down in water and, in a particular way, ran **electricity** through the water. And - lo and behold - what do you think started to fill up in each of the two upside down tubes? It was the different parts of water: hydrogen and oxygen! Faraday had separated them! What's more, he was able to **measure the quantity** (a very modern approach) of the hydrogen and oxygen. Remember how Dalton thought water was made up of equal parts hydrogen and oxygen? Well, Faraday was able to calculate that it was actually two parts hydrogen to one part oxygen (H_2O). While Faraday was not the first to discover this, his calculations were yet more evidence of water's parts.

But that measurement is an aside from the main focus. Mr. Faraday conducted more experiments to see if **electricity** really was at the heart of the two thousand-year old mystery of "Attraction and Repulsion". Mr. Faraday came to realize that it was not just that electricity affected the atoms, but that *the atoms themselves had electric charges as part of their very make-up*! He inferred that **electric charge** really was the Attractive & Repulsive force. Compare wind moving the leaves on a tree with what Faraday realized. The wind *affects* and moves leaves but there is no wind *in* leaves. But with atoms, they are *affected* and *moved* by electricity because *electricity exists within and as part of the atoms themselves*. Incredible!

Let's pause and take stock of our three big questions about these Forces that we looked at earlier and see if we've answered them.

1. This "force" holding atoms together, what is it?

We don't know if electricity is the only force, but it is a major player!

2. This "force" is it
    a. Material?
    b. Immaterial?

At this point, we don't know. Is electricity made of matter? Or is it immaterial? Faraday was humble enough to admit he didn't know. This is a mystery to be solved another day.

3. Is there one force guiding both Attraction and Repulsion or is it a different force for each?

Electricity appears to be behind **both** Attraction and Repulsion. But there's some nuance to this answer. How can the same thing be responsible for opposite effects? Competing opposites - which of our Pre-Socratic friends' ears are perking up right now? Additionally, there may be other forces involved (don't forget about heat!).

4. Is this force part of the atoms themselves or something separate acting on the atoms?

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[2] We would have done this experiment together but you can actually do it at home; search for "Electrolysis of Water Experiment" if you're interested!

Mr. Faraday says that this **electric attractive & repulsive force** is part of the atoms themselves. Very interesting! But there's much more to explore here. How can something attract and repel at the same time? Mr. Faraday provided some key insights, but he did not discover everything there is to know with this question, but he is a bridge of sorts connecting the past to our next thinkers, Thomson & Rutherford. You will have to wait until tomorrow to learn more about question 4!

Reading Questions for Monday's Lecture on Michael Faraday

1. Today's lesson focused on

a. The parts of water	b. The nature of atoms	c. The substance/force holding atoms together	d. The movement of atoms in the void

2. Lavoisier and Dalton thought the Attractive Force was

a. Heat/Caloric	b. Magnetism	c. Electricity	d. Particles	e. Connecting Hooks

3. What did Faraday discover was the Attractive & Repulsive force/substance?

a. Heat/Caloric	b. Magnetism	c. Electricity	d. Particles	e. Connecting Hooks

4. According to Faraday, where does this force come from?

a. From lightning	b. From the air	c from fire	d. From outside the atoms	e. From within the atoms

5. Do you think electricity is made of matter (like mortar) or immaterial (like gravity)? Explain.

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Tuesday, May 12

Name: ____
Section & Course: ____
Teacher: ____
Date: ____

Thomson and Rutherford ─ New Models of the Atom

Democritus was the first to think of the atom, and the idea has been taken up again and again by different thinkers, including Lucretius, Newton, Lavoisier, and, most notably, Dalton, who was the first to use the term "atom" since ancient times. Regardless of what they called it, all of these thinkers agreed on one thing about the atom: it was eternal, indestructible, and completely solid (with no void or empty spaces in it). It was, as the Greek roots of the word suggest, "*a - tomos*," or "un-cuttable."

Today, you will learn how their idea of the atom—that it had no parts—was seriously challenged.

From Lavoisier to Faraday

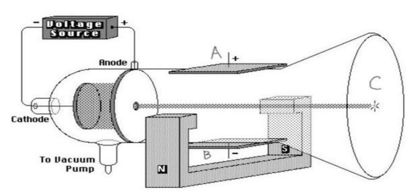
Lavoisier first described how the little particles of matter are affected by the forces of *Attraction* and *Repulsion*. Dalton followed and said that *Attraction* brings atoms together to form "compounds" (e.g., hydrogen + oxygen = water). If compounds form by coming together through *Attraction,* then shouldn't compounds be separable through *Repulsion*? Shouldn't we, for example, be able to separate water into hydrogen and oxygen through *Repulsion*, which, as Lavoisier said, was *heat*, or *caloric?*

This seems like a reasonable hypothesis. But then along came Mr. Faraday, separating water into hydrogen and oxygen *not by caloric*, but by *electricity*. What did this mean? What did atoms and their forces have to do with electricity? Are there *electrical* forces at work in the atom?

J.J. Thomson and the "Cathode Ray Tube Experiment"

A British natural scientist (another Brit!) named J.J. Thomson heard about Faraday's experiments with electricity and was very intrigued. He started to experiment with electricity and atoms.

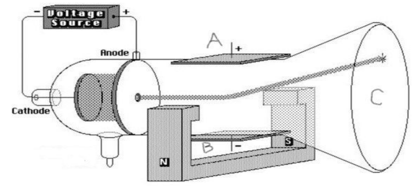
In one very important experiment, Mr. Thomson used a "Cathode Ray Tube" (pictured to the right). A Cathode Ray Tube is a glass tube with little electrically charged pieces in it. There is the *anode*, which is a negatively charged piece of metal, and a *cathode*, which is a positively charged piece of metal. Find these on the diagram (see also *NoS* p.135).



The huge difference in electrical charge (called "voltage") causes rays of particles to flow from the *cathode* to the *anode*; these rays are called *cathode rays*. There is a little hole in the *anode* that allows a ray of particles to pass through to the other end of the tube (which I've labeled C). Can you find the *cathode ray* on the diagram.

Now, notice the little metal plates (A and B), one labeled positive (+) and one negative (-). Thomson charged these metal plates, thus creating an electric field for the ray to pass through on its way to the end of the tube. Take a look at the diagram below to see what happened!

When he created this electrical field, the cathode ray was *bent towards the positive plate!* Thomson inferred that the particles must therefore be negatively charged!



Then, by carefully *measuring how much* the ray was deflected[3], Thomson calculated the *weight* of each particle.

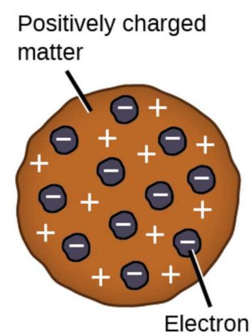
Do you remember Dalton's emphasis on measuring *weight*? Dalton had weighed his twenty elements and had found hydrogen to be the lightest atom. Since, he reasoned, no piece of matter is smaller than an atom—remember, he thought atoms were "solid" and "uncuttable"—that must mean that hydrogen is the very smallest existing piece of matter. Nothing is smaller than a hydrogen atom, said Dalton, and every other natural scientist at the time agreed.

But then Thomson's results came in. The little particle in the beam weighed $\frac{1}{2000}$ of the weight of a hydrogen atom! In other words, what everyone thought to be the smallest material particle in the universe *weighed 2,000 times more than this little particle*.

Thomson tried the experiment with every kind of material he could, and the results were always the same. Thus, he reasoned, *all atoms were actually composed of even smaller parts*. He had just discovered one of those smaller parts in the cathode ray, and he named it the *electron*.[4]

The "Plum Pudding" Model of the Atom

All atoms, then, have little negatively-charged parts, called *electrons*. But since everyone knew that atoms as a whole have neutral charge, therefore all atoms must consist of both positively and negatively charged materials.



He theorized that the positive and negative materials were structured in a particular way, as shown in the diagram on the right: there is positively charged matter, with little electrons evenly spaced throughout it. This model of the structure of the atom has come to be known as the "Plum Pudding" model, due to its resemblance to an English dish by that name.

Can you see it? Each atom had positively charged material (the "pudding"), with little negative *electrons* (the "raisins") sprinkled throughout it.

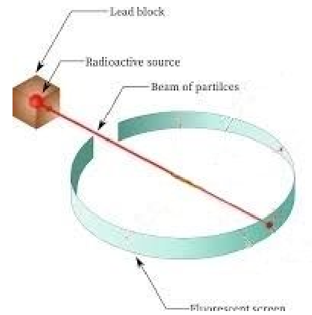
"Plum Pudding" Doesn't Last Forever

Thomson had discovered the existence of the *electron*, thus overturning the ideas of Dalton and others who had thought the atom was the smallest particle of matter. *Atoms themselves are composed of even smaller parts!* This was a groundbreaking discovery and one that was to have a profound effect on the way that we have thought about atoms ever since. But, for all that, his "Plum Pudding" would not last long. Indeed, it was soon tossed out in favor of another model discovered by one of Thomson's contemporaries, a natural scientist named Ernest Rutherford.[5]

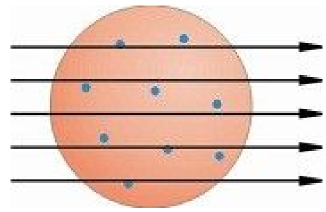
[3] He also used a magnetic field to help with this measurement--do you see the N and S of the magnet in the diagram?
[4] From the Greek "electrum" (amber) + ion (to go). These particles "go" to the electrode of the opposite charge.
[5] Also British! These British natural scientists are really giving the ancient Greeks a run for their money!

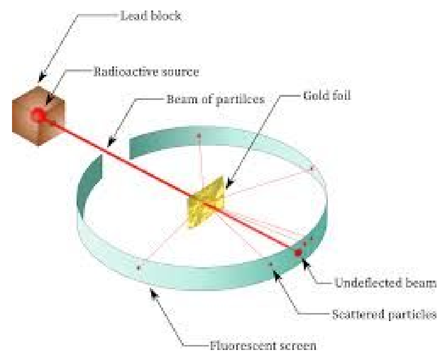
Rutherford and the "Gold Foil Experiment"

Ernest Rutherford, like Thomson, had a knack for devising good experiments. His most famous is called the "*Gold Foil Experiment*." In this experiment, Rutherford fired a ray of *α* particles (pronounced "alpha particles") from a hole in a lead box, aimed at a fluorescent screen. Don't worry too much about how he achieved this (unless you'd like to do some independent research of your own!), but the main thing to know is that this ray of particles was kind of like the *cathode ray* from Thomson's experiment, except that the particles were *much, much heavier*.



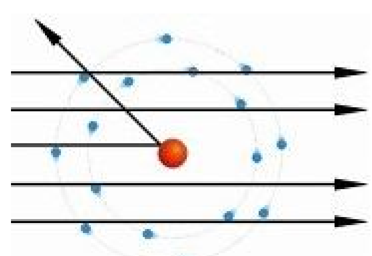
Once he had his little ray of *α* particles, he placed a very, very, *very* thin piece of gold foil[6] in the path of the beam. Imagining the gold atoms to be the "plum puddings" that Thomson had described, Rutherford hypothesized that the super heavy and positively-charged *α* particles would fly straight through the thin gold foil. His hypothesis is shown in the diagram on the right: the black arrows are the paths of the *α* particles. There's simply nothing solid enough in these "plum pudding" gold atoms to stop the *α* particles from passing through, said Rutherford with a confident smile.





But when Rutherford performed the experiment, he found that *most* of the particles passed right through, as he expected, but that certain *α* particles were deflected and ***bounced right back!*** Rutherford described his experience thus:

"It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you."



How could this be explained? In order to repel an *α* particle, there would have to be 1) a highly-concentrated positive charge, and 2) a highly-concentrated and very dense center of mass. Mr. Thomson's "Plum Pudding" model said that both the electrical charge and the mass of the atom were evenly spread out across the whole atom. But this simply couldn't explain what was happening! There must be a highly dense, highly concentrated amount of mass and charge at the center of the atom in order to deflect an *α* particle. Do you see it in the diagram to the right? The center in *this* model has enough density, and weight, and positive charge, to cause one *α* particle to be deflected back.

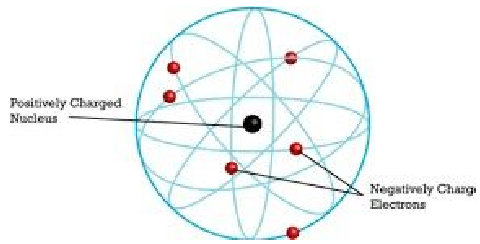
[6] He used gold foil because it is possible to make gold really, really thin--so thin, in fact, that it is only a few atoms thick! This was the closest he could get to making a single layer of atoms.

The "Nuclear" (or "Planetary") Model of the Atom
Rutherford thus made a number of startling inferences:

1) Most of the mass of the atom exists in an extremely dense form at the center of the atom. This mass has a positive charge. He called it the *nucleus*[7].
2) The negatively-charged *electrons* orbit around the nucleus, making up the remainder of the atom's volume—an atom gets most of its size from the wide orbits of its electrons.
3) Almost all of the volume of the atom is *just empty space*. (The theory of "void" continues! Democritus and Lucretius cheer!)

His theory of the atom resulted in picture somewhat like this:

The whole circle represents the total volume of the atom. At the center, is the positively charged nucleus, which contains almost all of the mass of the atom. Orbiting in circular paths around the nucleus are the negatively charged electrons. Because of the resemblance to planets revolving around the sun, this model is sometimes called the "planetary model" of the atom.



Unanswered Questions
Rutherford's theory was brilliant. Yes, it seemed like a great explanation of why the α particles bounced back (something Thomson's model could not explain). But there were still some serious problems with Rutherford's idea. For example, other natural scientists asked him why the electrons would not immediately crash into the nucleus, since positive and negative charges were attracted. Why would they stay evenly spaced out like that? Rutherford had no answer.

There is also the problem of the existence of empty space, or void. The idea keeps coming back as a tempting way to explain things—but how is it possible? Can void *exist*? Can *nothingness* be *something*? Aristotle, 2,000 years earlier, had warned that this was impossible. If void cannot exist, then what is really there between the nucleus and the electrons? Is this what an atom looks like? Or is there a completely different explanation that we simply haven't thought of yet?

It is important to keep in mind that these models of the atom are, well, *models*. They are *theories* about what we think the atom *might* look like. Democritus and Lucretius had theories about what atoms looked like, and Thomson and Rutherford do too. They are *inferences*, or very educated guesses, based on experimental evidence. No one has taken a magnifying glass or a microscope and seen an atom. As nice as Rutherford's little diagram is, we must remember that it is **not** a photograph[8]. It is a *theory*. And Rutherford would have been the first to admit that, though he was doing his best, the atom might not actually look like what he was imagining.

At the same time, however, Rutherford's model was a good one. It was not a random guess. It was based on experimental evidence that he had collected with his gold foil experiment, and it seemed like a good explanation of what he had observed.

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[7] Nucleus comes from the Latin word meaning *nut*, or *kernel*. Imagine the kernel of a sunflower seed (the little, edible part inside the shell). The nucleus is the little kernel of the atom.
[8] To this day, we have no photograph revealing the internal structure of an atom.

Please answer the following questions about the reading.

1. In the introduction to today's reading, it states that the popular idea that atoms have no __________ will be seriously challenged.

2. Upon hearing about Faraday's discoveries, J.J. Thomson began experimenting with __.
   a. Water
   b. Electricity
   c. Gases
   d. Oxygen and Hydrogen

3. Thomson's Cathode Ray Tube used positively and negatively charged electrodes to produce a _________________ ray that traveled across to the other end of the tube.

4. What happened when he created an electrical field for the cathode ray to pass through? ____

5. By measuring this effect, Thomson was able to calculate the weight of each particle in the ray, and found that they each weighed ____________ of the smallest atom, hydrogen.

6. He concluded that, therefore, the atom is *composed of even smaller parts*. He had discovered one of those parts, and he called it the _____________________.

7. He drew up a model of what he thought the inner structure of an atom was like. It came to be called the "Plum Pudding" model of the atom. It said the atom was made of___.
   a. an electron at the center, with protons orbiting around it
   b. solid material, with electrical charge surrounding it
   c. a hollow sphere of positively-charged material, with electrons inside
   d. positively charged matter, with electrons sprinkled throughout it

8. This model was challenged by Rutherford's __________________________ Experiment.

9. When Rutherford fired α particles at a sheet of gold foil, he found, to his surprise that some of the α particles did not pass through the foil, but ____________________!

10. Rutherford thought that this must mean that____.
    a. The atom's positive material was densely concentrated at the center of the atom.
    b. Electrons orbited around the nucleus
    c. Most of the atom was actually just empty space, or void.
    d. All of the above
    e. Choices *a* and *b* only

11. Rutherford called this dense, positive part the ____________, which is why his model is often called the "________________" model. It is also called the "Planetary" model.

12. True / False: Rutherford's model is a *theory* about the atom's structure, not a photograph.

13. True / False: Today we have actual photographs of the internal structure of atoms and thus have no need for theories and models.

Wednesday, May 13

Niels Bohr, "On the Constitution of Atoms and Molecules" (NoS pg. 138)

Instructions: Today, please read the document below. Then, read pg. 138. Finally, complete the worksheet at the end of the reading. Note that the worksheet draws from both the document and the textbook.

The atom continues! Yesterday, we came to the shocking revelation that this *atomos*, the supposedly smallest and "un-cuttable" part, **was made of smaller parts**! Today, we are going to conclude by looking at the contribution of one of Ernest Rutherford's colleagues, the Danish scientist Niels Bohr. Just as each Pre-Socratic thinker stood on the shoulders of the giants before him, so too did Niels Bohr benefit from all of the knowledge and models of atoms that came before him.

I. The Recap

First, let's briefly review how we got to Bohr: remember that Faraday had discovered the importance of *electrical forces* in determining the structure and movement of an atom. It turns out that, just like the North and South magnetic forces, electrical forces come in two opposite varieties: a *positive* charge and a *negative* charge. As you continue to study science in the coming years, you'll find that many fundamental forces in nature work on this principle of opposites.

As you read yesterday, we have J.J. Thompson to thank for the discovery that atoms contain both a positive charge and smaller, negatively charged **electrons**. Then, in 1911 Ernest Rutherford had established his "planetary model"[9] of the atom, having discovered that most of the atom is empty void, and that the negative electrons were drawn towards a nucleus that had a *positive* charge; this is what held each individual atom together. Since the nucleus is positively-charged, Rutherford named its material the **proton**. Rutherford had discovered that the amount of positive charge within an atom's nucleus was closely related to the mass of the atom, and helped determine the number of electrons that surrounded the nucleus.[10]

Yesterday, however, we mentioned that other scientists asked Rutherford why the electrons were not drawn immediately into the protons in the nucleus; Bohr acknowledges a deeper problem, which is that Rutherford's model assumed that the electrons were *unstable.* Bohr argued that in Rutherford's model, the electrons had uneven orbits and would eventually lose energy and then eventually crash into the nucleus due to being attracted to the opposite charge. Since all the observable material in the universe is *not* immediately crashing into its own nuclei, Bohr concluded that Rutherford's model needed several adjustments.

II. The Bohr Model

In 1913, Bohr proposed a new model of the atom that made a few small but significant changes to the Rutherford model. He sought to explain why atoms *didn't* collapse by proposing a model where the

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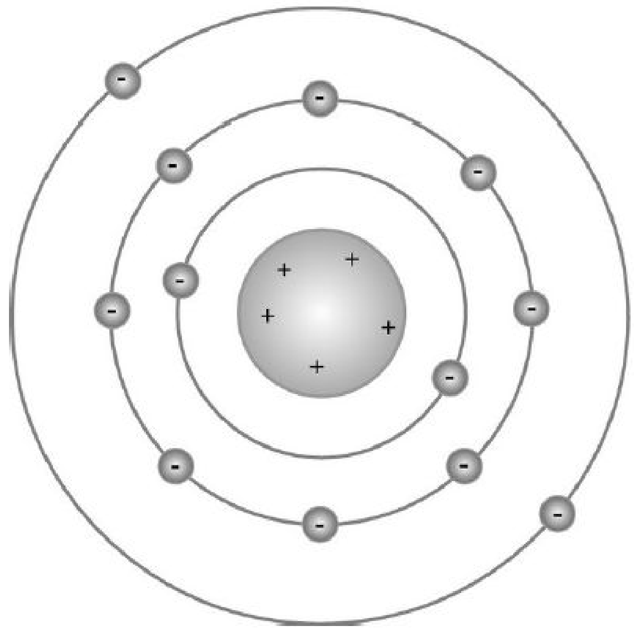
[9] Remember, a model is NOT the same thing as a definitive picture of the thing; it is a theoretical diagram.

[10] You may be familiar with the **atomic number** and the **atomic mass** that we use in the modern table of elements. These unified measurements wouldn't be put into place for a few more decades; what Rutherford was helping us discover was that there was a *numerical relationship* between the amount of electric charge and the mass of an atom.

electrons were in a steady, stable orbit--rather similar to the way the planets orbit around the sun, but in a more regular pattern.

An important principle for understanding Bohr's model is the fact that ***normal atoms always have an electrical charge of 0, meaning that there is an equal number of protons and electrons. Therefore, the size of the nucleus (or in other words, the amount of positively-charged protons) determines how many electrons are in an atom***. Here we can see an example of Bohr's model of the atom:

- The large sphere in the center filled with (+) signs represents the nucleus, made up of those positive protons.
- Surrounding the nucleus, we can see smaller spheres with (-) signs, representing the negatively charged electrons. The circles show the arc of the orbit that the electrons follow.
- Bohr's **major contribution** to atomic models is the idea that there are *multiple layers of electron orbits*.
- Each layer can only contain a specific number of electrons; if a nucleus is big enough to need more electrons, they join on a new layer above the rest. There is a set, mathematically precise distance between each layer, and electrons on one layer will never collide with another layer or the nucleus[11]. This helped scientists come to better understand the properties of larger and heavier atoms.



III. The Pros and Cons

Bohr's model has proven incredibly useful for illustrating an *abstract* picture of the structure of the atom and its subatomic parts. It is not, however, an accurate and literal image of what the internal structure of an atom *actually* looks like, since, as we said Tuesday, no one has ever seen it.

Bohr's model has also proven incredibly useful for illustrating the idea of *molecular bonding*, or when atoms share an electron between each other to form **molecules**. (This very concept is what Faraday's experiment with splitting water molecules observes!). What the model does *not* do, however, is explain *why* exactly those bonds occur, or what they really look like.

Like any diagram, Bohr's model has many practical uses. It is critical to look back over this week, however, and note that for everything we can begin to discover, *the mystery of the ultimate substances is still not resolved!* It's up to us today to take what we learn from these great minds and study them well, so that *we* can continue the great conversation!

[11] No, I am not getting into the physics and quantum mechanics required to calculate these orbits today!

Name:____
Section & Course: ____
Teacher: ____
Date:____

Wednesday, May 13: Niels Bohr, "On the Constitution of Atoms and Molecules" Worksheet

1. Which scientist's work does Bohr's model of the atom hope to most directly address?

a. Newton   b. Thompson

c. Lavoisier   d. Rutherford

2. What word does Rutherford propose for the positively charged material within an atom's nucleus?

a. Proton   b. Nucleon

c. Neutron   d. Electron

3. According to the document, "***normal atoms always have an electrical charge of ___________, meaning that there is an _____________________ number of protons and electrons.***"

4. What was Bohr's major contribution to the already existing atomic models? (Complete Sentence)

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5. On page 138, who does Bohr credit as an inspiration for his theory of regular, circular orbits for electrons? (CS)

____

6. Based on the description in the document above, draw your own copy of the Bohr model of the atom, including positive and negative charge symbols. Then, label the parts of the atom in your diagram using the names of the parts below:

A. Electron	B. Nucleus	C. Electron Orbit

Thursday, May 14

Today, you will be taking the Chemistry Assessment on Google Classroom. You may study as much as you'd like beforehand and, while you are taking the assessment, you are encouraged to look at any notes, readings, packets, or textbook pages that you need to in order to answer the questions correctly. The questions will be based on the readings/questions that you have been doing each day for this Chemistry unit.

Best of luck! I hope you enjoy revisiting all of these most important ideas and discoveries in the great chemistry conversation, beginning with the ancient Greeks and continuing into our own time.

Friday, May 15

Today, use your time to finish up any work from earlier in the week, attend Office Hours, and upload your packet to Google Classroom.

I hope to see you in Office Hours! It will be today, from11:30am-12:00pm. The link to the zoom meeting can be found on the Google Classroom page for this class.