

Matter: Atoms and the Periodic Table

Grade level: 8th grade physical science

Instructor: Cori Pontious

1. NGSS framework and Idaho Core Standards

<p>NGSS Performance expectations:</p> <ul style="list-style-type: none">● MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.● MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.● MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.● MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.● MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	<p>NGSS scientific practices:</p> <ul style="list-style-type: none">● Developing and Using Models● Analyzing and Interpreting Data● Constructing Explanations and Designing Solutions <p>NGSS crosscutting concepts:</p> <ul style="list-style-type: none">● Patterns● Cause & effect● Scale, proportion and quantity● Stability and change● Structure and Function
<p>NGSS disciplinary core ideas:</p> <ul style="list-style-type: none">● Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2), (MS-PS1-3)● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)● Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	
<p>Idaho Core Standards:</p> <ul style="list-style-type: none">● Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.● Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.● Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.● Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.● Establish and maintain a formal style.● Provide a concluding statement or section that follows from and supports the argument presented.● Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.● Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.● Use precise language and domain-specific vocabulary to inform about or explain the topic.	

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| <ul style="list-style-type: none">● Provide a conclusion that follows from and reflects on the narrated experiences or events. |
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2. Culminating outcomes:

- ASSESSMENT: End of Course Exam (in conjunction with ongoing assessments... see section 7 for more information)
- PROJECT: Family Characters of the Periodic Table (lesson attached)

3a. Essential question(s):

- What characteristics define the families of the periodic table?

Our approach to the periodic table is to view the element as individual characters with traits and personalities unique to each of them, just as each of my students are unique individuals in their own families. Patterns can be coaxed out through observation and the table can be a useful tool for student-guided inquiry. Substituting real-life families (the reactive Kardashians and the noble British Royal family) demonstrates unique aspects of periodic table families. Once engagement in the table is achieved, then even more detail and learning can be accomplished.

3b. Guiding questions:

- How do our characteristics define us?
- How do the families of the periodic table interact with other families?
- How do the elements act as individuals?
- What is considered a “dangerous” element and why?
- How does atomic structure help us to classify atoms?
- What determines the atom on the subatomic level?
- What determines an isotope on the subatomic level?
- What determines chemical properties on a subatomic level?
- How do atoms combine to make molecules?
- How do opposites attract in ionic and covalent bonds to make compounds?

4. Threshold Knowledge

This section is provided if students are not quite ready for this unit. Prior knowledge regarding atoms on a subatomic level will be very helpful and ideally, they should have the basics before starting this unit. Can the students draw an atom if they know how many protons, neutrons, and electrons there are? Avoid giving students answers too quickly. The best learning place for them to be in is trying to figure things out on their own, but not reaching a point of extreme frustration.

- Structure of the atom
 - Proton, Neutron, Electron Bingo (lesson attached)
 - Building an atom online (lesson attached)

5. Frontloading

- Controversial Question: Ask essential question and brainstorm how our characteristics

define us. Which characteristics define you? Your family members?

- Life Application: “Why the Periodic Table Matters” article
- Controversial Question: What makes an element “dangerous”?
- Build prior knowledge: show different elements (drawn on board). How might they fit together? Have students study the shape of the atoms like a puzzle before getting into bonding.

Life Application: Research into how isotopes have been useful and how they have expanded our technology.

6. Progression of learning:

- WEEK ONE: Characteristics of periodic table families
 - Frontloading crosscutting concepts, essential question
 - Discussion of characteristics
 - Activate base knowledge of the periodic table, atoms and their set-up
 - Video resources for periodic table (periodicvideos.com, etc)
- WEEK TWO: Characteristics of elements within families
 - Liquid Nitrogen Day!
 - The “Dangerous” elements (as characters)
 - What is the most dangerous element? Discussion and Debate
 - “Tale of the Radioactive Boy Scout”
 - “A Killer Tan”
- WEEK THREE: Characteristics of elements within families
 - Project: Design/Create/Draw/Describe a family member of a family in the periodic table
 - Assign, Group Discuss, Create and Design, Present Project
 - Design a Firework
- WEEK FOUR: Atom Bonding
 - Ions, Isotope, Compound vs Ionic Bonding
 - Isotope usefulness and technology growth research.
 - Isotope matching cards activity
 - Compounds and ions worksheet
 - Act out bonding activity

7. Ongoing formative assessment:

- Bell ringers (opening moments)
- Closing moments
- Over-the-shoulder work checks
- Exit tickets
- Small group and individual check-ins
- Quarter EOC practice assessment
- EOC assessment

Threshold Knowledge Lessons

Lesson 1:

Objective: Students will be able to explain the structure of an atom

Enduring Understanding/Guiding Questions: Atoms are the basic unit of matter. How does atomic structure help us to classify atoms?

Standards: 8-9.PS.1.1.1 Explain the scientific meaning of system, order, and organization. 8-9.PS.2.4.1 Describe the properties, function, and location of protons, neutrons, and electrons.

Accommodations: copy of notes provided or pictures taken of the board. Instructions written and given orally, visual explanations and descriptions provided.

Introductory Activity/Warm-up: Do you remember from years past how many electrons are held in the 1st 3 shells?

Lesson Procedure:

1. Discussion of above question
2. Add to matter notes the 3 shells and show periodic table w shells
3. If carbon has 6 electrons... how do you think they look in their shells... see if students can figure out before telling
4. Practice drawing several together on the board and show briefly how 1 O and 2 H can bond to make water
5. Build an atom website: <https://phet.colorado.edu/en/simulation/build-an-atom> (students share if one doesn't have ipad)
6. Make several together and students hold up
7. Individual practice and release to play games on the website

Materials: ipad, notes

Assignment: notes

Closure: draw a Chlorine atom and leave with me on the way out the door

Lesson 2:

Objective: Students will be able to explain the states of matter and the structure of an atom

Enduring Understanding/Guiding Questions: Atoms are the basic unit of matter. How does atomic structure help us to classify atoms?

Standards: 8-9.PS.1.1.1 Explain the scientific meaning of system, order, and organization. 8-9.PS.2.4.1 Describe the properties, function, and location of protons, neutrons, and electrons.

Accommodations: copy of notes provided or pictures taken of the board. Instructions written and given orally, visual explanations and descriptions provided.

Introductory Activity/Warm-up: get out your periodic table and start looking it over

Lesson Procedure:

1. How familiar do you feel with the periodic table?
2. Bingo game naming Protons, Neutron, Electrons

Materials: blank bingo sheets, list of numbers, answer sheet, markers for sheet, candy for bingos

Assignment: participation

Closure: clean up pieces of bingo

Atomic Number

Ca Calcium 20

Ti Titanium 22

Pt Platinum 78

Si Silicon 14

S Sulfur 16

Bi Bismuth 83

Protons

B Boron 5

N Nitrogen 7

P Phosphorus 15

O Oxygen 8

Au Gold 79

Pb Lead 82

Electrons

Fe Iron 26

Zn Zinc 30

Ar Argon 18

Kr Krypton 36

Xe Xenon 54

F Fluorine 9

Neutrons

Cd Cadmium 64

Cu Copper 35

H Hydrogen 0

Li Lithium 4

F Fluorine 10

I Iodine 74

Name: _____

What Defines Us?

You will be given a few minutes to free-write on each question, then please discuss within your groups when I tell you the time is up. We will be coming together as a class at the end.

What characteristics do you have that you feel make you who you are?

Where do you think you got those characteristics?

Do you think you are born with these characteristics or is it something you create as you grow?

Are there characteristics you share with your family?

Elements have characteristics... do you know of any already?

Look up the following elements on your iPad and find their characteristics:

Lithium

Sodium

Neon

Hydrogen

Argon

Helium

Copper

Zinc

Do they share anything? How are they different?

Characterizing the Elements

Elements can generally be described as either metals or nonmetals. Metal elements are usually good conductors of both electricity and heat. The dividing line between metals and non-metals is not hard and fast, thus the distinction between "Post-transition metals" and "Metalloids" is represented differently on different versions of the Periodic Table. For example, in some tables, Group 12 is categorized with the post-transition metals, and in others, aluminum and tin are included characterized as Metalloids or poor metals. In our version of the table, we have chosen the most commonly accepted demarcations between these elements.

- **Alkali metals.** The alkali metals make up group 1 of the Table, and comprise Li through Fr. They have very similar behavior and characteristics. Hydrogen is group 1 but exhibits few characteristics of a metal and is often categorized with the nonmetals.
- **Alkaline earth metals.** The alkaline earth metals make up group 2 of the periodic table, from Be through Ra. The alkaline earth metals have very high melting points and oxides that have basic alkaline solutions. Their characteristics are well described and consistent down the group.
- **Transition metals.** The transition elements are metals that have a partially filled *d* subshell (CRC Handbook of Chemistry and Physics) and comprise groups 3 through 12 and the lanthanides and actinides (see below).
- **Post-transition metals.** The post-transition elements are Al, Ga, In, Tl, Sn, Pb and Bi. As their name implies, they have some of the characteristics of the transition elements. They tend to be softer and conduct more poorly than the transition metals.
- **Metalloid** (or "semi-metal" or "poor metal"). The metalloids are B, Si, Ge, As, Sb, Te, and Po. They sometimes behave as semiconductors (B, Si, Ge) rather than as conductors.
- **Lanthanides.** The lanthanides comprise elements 57 (lanthanum, hence the name of the set) through 71. They are grouped together because they have similar chemical properties. They, along with the actinides, are often called "the f-elements" because they have valence electrons in the *f* shell.
- **Actinides.** The actinides comprise elements 89 through 103. They, along with the lanthanides, are often called "the f-elements" because they have valence electrons in the *f* shell. Only thorium and uranium are naturally occurring actinides with significant abundance. They are all radioactive.
- **Nonmetals.** The term "nonmetals" is used to classify the elements H, C, N, P, O, S, and Se.
- **Halogens.** The halogen elements are a subset of the nonmetals. They comprise group 17 of the periodic table, from F through At. They generally very chemically reactive and are present in the environment as compounds rather than as pure elements.

- **Noble gases.** The noble gases comprise group 18. They are generally very stable chemically and exhibit similar properties of being colorless and odorless.

Examples of using famous families to teach the periodic table:

Alkali Metals (Group 1): Reactive, Explosive



Kardashians

Bonds well with the Halogen Metals (Group 17):



Kardashian Men

Noble Gases: Do not bond with others, are “above” them



British Royal Family

Lesson: characters of the periodic table project

Objective: Students will be able to identify characteristics that define an element and the family an element belongs to on the periodic table

Enduring Understanding/Guiding Questions: Atoms are the basic unit of matter. How does atomic structure help us to classify atoms? What characteristics define the families of the periodic table? How do the families of the periodic table interact with other families? How do

the elements act as individuals?

Standards: 8-9.PS.1.1.1 Explain the scientific meaning of system, order, and organization. 8-9.PS.1.1.2 Apply the concepts of order and organization to a given system. 8-9.PS.1.2.1 Use observations and data as evidence on which to base scientific explanations. 8-9.PS.1.2.2 Develop models to explain concepts or systems. 8-9.PS.5.2.1 Explain how science advances technology. 8-9.PS.5.2.3 Explain how science and technology are pursued for different purposes.

Accommodations: copy of notes provided or pictures taken of the board. Instructions written and given orally, visual explanations and descriptions provided.

Introductory Activity/Warm-up: We have discussed how our characteristics define us... how do the characteristics of the elements on the periodic table define them?

Lesson Procedure:

1. Discussion of above question
2. Introduce the periodic table families as “characters” (ex: reactive elements such as the Alkali metals are like the Kardashians, noble gases are like British royalty)
3. Have students shade and label families on their periodic table.
4. Introduce “Character Creation” Project
5. Assign groups into families
6. Today’s task in your group: research you group (using iPad and my books) and decide which element you will do as individuals.

Materials: periodic table, coloring utensils, character creation worksheet

Assignment: Character Project

Closure: within your groups, please discuss what needs to be done to continue forward on your project. Please use each other for help planning and implementing your finished project in the days to come!

Self-Reflection:

Character Examples: <http://www.zmescience.com/other/great-pics/illustrated-elements-periodic-table-0423/>

Name: _____

Periodic Table: Build a Character in a Family

Which periodic table family am I working in?

Which element did my group decide I would do? _____

Atomic Number: _____ Atomic Mass: _____

Protons: _____ Neutrons: _____ Electrons: _____

Draw it below, using the appropriate number of electron levels or rings:

realize there are different levels of artistic talent, but I do expect you to take your time and put a lot of effort into this. You will be presenting your family as a group to the class on the due date

Rough Draft

Final Draft

Character Name: _____