Periodic Table | 10-12 Grade Chemistry

Step 1: Project Idea

Driving Question	How can we build a better battery than the lithium-ion battery? Can we plan to improve the recyclability of the batteries we have?
Standards	SC1. Obtain, evaluate, and communicate information about the use of the modern atomic theory and periodic law to explain the characteristics of atoms and elements. b. Construct an argument to support the claim that the proton (and not the neutron or electron) defines the element's identity. d. Construct an explanation that relates the relative abundance of isotopes of a particular element to the atomic mass of the element. f. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms (i.e. including atomic radii, ionization energy, and electronegativity). g. Develop and use models, including electron configuration of atoms and ions, to predict an element's chemical properties.
Learning Goals	Students will be able to identify the different parts of the periodic table and the way it is arranged (metal/nonmetal, arrangement of periods/groups, and characteristics of each). SWBAT explain the different subatomic parts of the atom, first explaining the proton. SWBAT explain the different subatomic parts of the atom, explaining the neutron and varying amounts can change the mass of the atom. SWBAT draw Bohr and Quantum models and electron configurations of the first 20 elements. SWBAT interpret different periodic table trends. SWBAT create an informative graphic that gives their reasoning on how the components of a lithium-ion battery can change.
Project Summary	Students will be introduced to the many different uses of the lithium-ion battery (cell phone, devices, laptops, cars, medical devices, etc.) After discovering how important these are through open discussion, students will explore the battery supply chain of a phone's lithium-ion battery using Xplorlabs: the Science of Extraction to E-Waste to learn more about the process of obtaining lithium to the process of manufacturing a lithium-ion battery and its products.

	Individual Products	Team Products
Major Product(s)	Periodic tables classified by: • *Periods (new shells with each period) and groups (family names)* • *Metal (cations) and nonmetals (anions)* • *Valence electrons (Lewis Structures)* • *Periodic trends (ionization energy, electronegativity, atomic radius)* • *Bohr and quantum models for first 20 elements* • *Electron configuration for first 20 elements*	Gallery walks of the difference metals and nonmetals on posters which include characteristics of each Atom boards of different elements for students to walk and take notes Candy Isotope lab Penny Isotope lab Illustration (poster, PowerPoint, PSA, student choice) of what different metal/nonmetals can be used to construct a new battery. Students will address environmental issues that may be better using the different elements than lithium. Flyer for Lithium-Ion battery collection drive
Making it Public	Display hard copies of project on the chemistry hallway. Students will also create flyers for collection of lithium-ion batteries for recycling.	
Key Project Documents	Gallery Walk Posters, Student Notes, Illustration of New Battery, Flyer for Collection of Lithium-Ion Batteries for Recycle	

Step 2: Project Path Overview

Project Launch		
Milestone	**Anticipated Student Need to Know Question**	**Learning Experiences *(Lessons, Activities, and Scaffolds)***
Introduction to Lithium-Ion Battery: The example I use is an epi-pen trainer that talks to the user, walking them through the steps of how to use EpiPen. Students then start thinking of other devices that may use batteries.	How many Lithium-Ion batteries are in the room, floor, campus?	Identify lithium-ion batteries in the classroom Use Batteries and Safe Cities — Battery Supply Chain to see all the different lithium ion batteries in a cityscape. Formative question: did you discover any thing surprising or new, think-pair-share

Build Knowledge and Develop & Critique		
Milestone	Anticipated Student Need to Know Question	Learning Experiences *(Lessons, Activities, and Scaffolds)*
Categorize the periods and groups of the periodic table	Why is the periodic table arranged in this way? Are all periodic tables the same?	Periodic table trends: students are given mini periodic tables with labels to use as a reference for classifying the elements on the periodic table based on atomic radii, groups/families, metals (cations) and nonmetals (anions); periodic trends (ionization energy, electronegativity, atomic radii). Students also label periodic table for charges in each family (needed for the following chapter); Lewis structures for each family will be included at the top of each family
Proton (Atomic ID)	What is a proton? What happens when the number of protons in an element changes? How is this related to the atomic number? How is this related to the arrangement of the periodic table?	Students will read an article collaboratively and take notes in small group Students will share findings on sticky notes on posters for anonymity Teacher and students will group ideas based on claims, evidence, or reasoning Students will then construct a paragraph making a claim about the proton, supported by evidence, and then reasoning about the atomic number and periodic table
Neutrons (Isotopes)	Why is the mass number of elements not a whole number? How can the same thing have differing masses?	Students will be given a fun size candy package (M&Ms and Skittles work well). Students will first mass the candy and then count the individual pieces. Students will share their data with the class. As a class students will decide what the atomic mass is for the candy. Next students will be given a set of pre-1982 pennies and post-1982 pennies to see that pennies do not all mass the same. Students will go through a lab that has students weigh varying amounts of each type of penny to see how the mass changes as the years of pennies changes. Students write results in learning journals.

Electrons (Ions)	What causes an atom to be charged (ion)? How can an atom be positive (cation) or negative (anion)?	Students set up a page in their learning journals with space for the first 20 atoms. Students use the atom boards to explore how electrons are in the electron cloud of an atom. Each group is given an atom to build. Students walk the room and draw each Bohr model in their notebook. Then students add in the quantum model so they can see how electrons behave on the suborbital. Then students write the electron configuration for each. After this repetitive exercise, the students should be able to see the patterns of the periodic table as one travels through the periods and down the families. Lastly, students are informed of the octet rule. Students then discuss (Think-Pair-Share) if it is easier for certain elements in a family to lose electrons (becoming positive) or gain electrons (becoming negative). Students then put the ion charge and Lewis Structure of the elements on the top of their periodic tables.

Present Products (1 - 2 hours)		
Milestone	**Anticipated Student Need to Know Question**	**Learning Experiences** *(Lessons, Activities, and Scaffolds)*
Informative Illustration	Using your knowledge of the periodic table and atoms, what elements can replace the components of a lithium-ion battery?	Students will create a illustration of a new battery that has similar but different components than the lithium-ion battery. Illustration is a choice for digital or paper, but it must include: • Extraction of new elements used • Justification of why new elements are superior • Possible safety concerns addressed • Justification of environmental benefits

Step 3: Day-by-Day Calendar

Day 1	Day 2	Day 3	Day 4	Day 5
Project Launch: Battery powered items Internet Access for Students to explore the cityscape in Xplorlabs Students are assigned one of the 5 (cobalt, copper, lithium, aluminum, carbon as graphite) to explore the parts of a Li^+ battery to create posters Resource Extraction — Battery Supply Chain	Opening: Categorizing the periodic table: Have students explore periodic tables to decide if all are similar Students may also explore possible historical periodic tables if teacher wishes	Categorizing the periodic table Metal vs. Nonmetal exploration Gallery walks of different metals, metalloid, or nonmetal. Students add to poster paper (with sticky notes) about the characteristics they see. Students then group what they think are alike and come up with descriptions of metals, metalloids, and nonmetals. They put their work in learning journal.	Categorizing the periodic table Article of Periodic Trends with questions (Formative Assessment) Students are given small periodic tables and colored pencils. Students research the different trends and put in notes. Students work collaboratively through this.	Categorizing the periodic table Formative assessment of the periodic table Reteach or Students Choose (Extension): Battery Production Transportation Product Make a graphical display and explain to class
Day 6	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Atomic Structure: Protons Students use interactive to learn about atom: Atomic Structure | PBS LearningMedia (developing learner) Atomic Structure | STEM Resource Finder (advanced learner) Students write vocabulary words and draw simple model of the atom	Students share findings about the atom and specifically the proton Students use academic vocabulary correctly Students write a paragraph using the CER strategy to explain what happens when the number of protons in an element changes	Atomic Structure: Neutrons Students complete two mini labs today. Candy Isotope Penny Isotope All students explore: Disposal — Battery Supply Chain	Atomic Structure: Neutrons Now that students know what an isotope is, they complete a worksheet with real isotopes and abundances to see how closely they can come up with atomic mass on the PT	Atomic Structure: Nucleus and Electron Cloud Students use atom boards to build each of first 20 atom Electrons are added and suborbital and valence electrons are introduced

Day 11	Day 12	Day 13	Day 14	Day 15
HOT: What is a valence electron? **How does an atom become charged?** **Which atoms are positive (cation) and which are negative (anion)?** Atomic Structure: Electrons Students add Lewis structures to PT based on valence electrons Then we talk about ions and how cations and anions are created	Students use atom boards to make models of atoms. They draw the first 20 atoms in their learning journals in Bohr and Quantum models. Students also include electron configuration. Formative assessment: 20 drawings Pattern identification	Atomic structure: Naming Conventions Practice for next few days about the different symbols and how atoms, isotopes and ions can be symbolized. Formative assessment	Summative Assessment	Project Completion Either: 1. Create an action project to collect old Li^+ batteries Solutions — Battery Supply Chain 2. Design a new battery knowing what they know about PT (see example below)