*This should be the first time students start to look into the idea of particles to understand subatomic particles.

Instructional Segment Title: Atoms, Elements and Molecules

Guiding Questions for the Instructional Segment:

- What is inside atoms and how does this affect how they interact?
- What models can we use to predict the outcomes of chemical reactions?

Anchoring Phenomenon: Substitutions of one atom for another in gem structures will create a new gem (for example: Rubies and chromium versus Sapphires and titanium/iron)

Investigative Phenomenon Describe the event or instance that can be observed, explored, or investigated.	**Driving Questions** What question(s) will drive the exploration or investigation of this phenomena?	**3 Dimensional Content:** **DCI** **SEP** **CCC** What DCIs, SEPs, and CCCs would be needed to explore, explain, or investigate this phenomena?	**Possible Activities/Resources** List activities or readings that would help students in building their understanding of the concept.
Alkali metals have increasing reactivity as you move down the group.	What causes the reactivity of alkali metals to be similar and also to increase in strength down the group?	Developing and Using Models Using Mathematics and Computational Thinking Constructing Explanations and Designing Solutions Patterns Energy and Matter Each atom has a charged substructure consisting of	1. Introduce the anchoring phenomenon - pictures of the two gems and their chemical structure, ask students to look and ask their questions and make observations. 2. Explore the periodic table. What information does it contain? How was it created? Why is it useful? How do the patterns of the periodic table explain the investigative phenomenon of Alkali metal reactivity patterns? a. The Living By Chemistry periodic table card sort would be appropriate here if you still have it at your site. Any other pattern based periodic table would be appropriate also. b. Students will explore a data set (http://static.nsta.org/extras/adi-chem/Lab7ListOfEleme

		a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1) The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7).	ntsWithProperties.xlsx) of element properties. They will have to decide how to investigate periodic relationships among the elements and then write an argument describing which properties have patterns related to the periodic table. (for the full teacher edition information, see Argument-Driven Inquiry in Chemistry from NSTA). 3. Have students explore the History of the Atom. Focus on the strengths and limitations of each model in history. Also focus on why more experimentation led to the changes in atomic models. This can be done using a variety of method depending on the Science and Engineering practice you feel students need to build skills in: a. Students my research the history of the atom and create a timeline b. Use the CA NGSS Rollout #3 Physcial Science 5E to create a series of explorations that allow your students to explore this hisory of the atom model: http://workshops.sjcoe.org/Session/PrintSessions/322 c. Use the Living by Chemistry History of the Atom activities. d. Ask students to think about the anchoring phenomenon. How might an atom model help them understand gemstone structures. 4. Further explore the current models of the atom using the pHet simulation https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html which allows students to practice with subatomic particles.

$Na + Cl \rightarrow NaCl$	Why is NaCl so neutral energetically when both Na and Cl are not?		5. Introduce the investigative phenomenon. What do students know about salt, sodium, and chlorine. Ask students to share their thinking about why the neutrality of salt is so amazing? 6. Introduce basic bonding based on students' understanding of valence electrons. a. Hydrocarbons b. Ions c. Octet rule d. All bonding should focus on the electrostatic interactions between atoms or ions and the energy changes created when bonds occur (stability = energetically neutral). e. Students should be able to explain the investigative phenomenon of salt.
Baking soda and Vinegar react to form carbon dioxide and water.	Where does the gas come from when baking soda and vinegar are mixed?		7. If energy has to remain conserved, there must also be some conservation of the elements involved in these chemical reactions of bonds making and breaking. Use the dehydration of $CuSO4\ 5H2O$ to explore balancing reactions, molar mass, and prediction of amounts of products. Students should not just be able to complete stoichiometric calculations, but should be able to describe the flow of energy and cycling of matter in these reactions. 8. Circle back to the anchoring phenomenon. How does bonding and the interactions of different atoms create a different gemstone?