deepen their conceptual understanding through use in new context?	beginning of class. Have students modify it into a Bohr model with rings containing the correct number of electrons/ring based on the electron configuration. An extension of this is an online game where students place elements in the correct location on the periodic table based on how many electrons are located in each ring.	http://vitalnj.pbslearningmedia.org/asset/phy03_int_ptable/	Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)Developing and Using Models Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)	Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Lesson Title/Number: Day 5 Electron Configuration and Orbital Diagram		**Learning Objective(s):** SWBAT write and electron configuration SWBAT write an orbital diagram			**Lesson Duration:** 80 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: Place a partially filled in table of quantum numbers/definitions on the board. You can have students complete this at their seat before coming to the board or cold call students to complete it. Also have students recall that quantum numbers are like an address of a single electron. Electron configurations are a way to list the locations of many electrons at once - all the			ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	

	electrons in an element.				
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Direct instruction: Teacher must lead lesson on electron configurations and orbital diagrams. This lesson must include orbital filling rules and example problems. For orbital diagrams relate the arrow drawing rules to real life experiences. For example, Hund's Rule can be explained as the "Empty Bus Seat" Rule. When you take a public bus you fill empty seats before doubling up anywhere. Aufbau Principle is the "Lazy Tenant Rule" - Tenants fill lower apartments before upper apartments because they are too lazy to walk up all the stairs.	• This website has a slide show that may be helpful for this lesson https://njctl.org/courses/science/chemistry/electron-configurations-and-the-periodic-table/# • This website has an electron configuration tutorial with various visual representations of the topic. http://www.chemtutor.com/struct.htm#con	Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-3) Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Training wheel activity - students are given problems that are partially solved to begin and then slowly are given problems with less and less solved for them. Eventually they will complete the problem all by their own. This can be used for electron configurations and orbital diagrams.	• Alternate Idea: Online activity where students visually build an orbital diagram and the atom itself. It is an excellent re-enforcement of quantum numbers/connection of quantum numbers to orbital diagrams. Online activity: http://www.learner.org/interactives/periodic/elementary_interactive.html	Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-3) Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

				ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Students can label periodic tables with the letters and numbers of electron configuration. For example "2s". This can also be color coded for more visual students.		Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-3)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	1) Provide students with an electron configuration and have them determine which element it is. 2) Give students an electron configuration with a mistake and have them explain why it's wrong.	• Pg. 99 Holt Chemistry TE Section 3 Review #4 and 8	Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of 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	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-3) Stability and Change Much of science deals with constructing explanations of how things change and how they

				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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	remain stable. (HS-PS1-6)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Administer an exit ticket, quiz or other assessment	• Pg. 99 Holt Chemistry TE Section 3 Review and additional practice			
Extend: How will students deepen their conceptual understanding through use in new context?	1) Have students answer a short answer question on the homework explaining why quantum numbers aren't needed to describe the locations of protons. 2) Online activity where students visually build an orbital diagram and the atom itself. It is an excellent re-enforcement of quantum numbers/connection of quantum numbers to orbital diagrams.	• Online activity: http://www.learner.org/interactives/periodic/elementary_interactive.html		PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)	
Lesson Title/Number: Lesson 6 Exceptions and shorthand		**Learning Objective(s):** SWBAT write an electron configuration for an element with an exception and SWBAT write the shorthand/noble gas configuration for an element			**Lesson Duration:** 80 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Before assigning the Do Now, look at the previous day's exit tickets. Determine what level of questioning students had the biggest break down in understanding and assign a similar question as the Do Now.				

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Direct instruction: How many people like shortcuts?!!! Strike a bargain with the students. You'll teach them a shortcut to save how much writing/drawing they must do, but in exchange you need to teach them about a few elements that don't follow the rules. After students are on board then teach them noble gas/shorthand configurations as well as exceptions to the rule. Be sure to include practice problems using both skills.	• This website has a slide show that may be helpful for this lesson : https://njctl.org/courses/science/chemistry/electron-configurations-and-the-periodic-table/#			Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-3) Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students will complete a "Climb the Ladder" Activity with practice problems. Students work independently solving #1 posted on the wall. If they get it correct they move onto #2. If they get it incorrect they sit at table #1 and complete remedial problems similar to the one they couldn't complete on the wall. If they complete the remedial work they then move onto #2 on the wall. Students must correctly complete all problems through #5 or #6 (depending on how many steps are added). For these objectives steps could be as follows 1 - simple electron configuration 2- longer configuration perhaps with d or f orbitals #3 short orbital diagram #4 longer orbital diagram perhaps with d or f orbitals. #5 shorthand configuration #6 shorthand configuration with exception. Students that quickly complete through #6 without mistakes can then be re-assigned to students at lower levels to help them learn the material. This activity sorts students into differentiated groups as well as shows the teacher which students are in most need of remediation.			ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-3) Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Students can be provided with incorrectly completed shorthand or exception problems. They must find the mistake and explain in a short answer/essay why it is incorrect.		Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and		Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of

			the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)		phenomena. (HS-PS1-1), (HS-PS1-3) Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Administer an exit ticket, quiz or other assessment				
Lesson Title/Number: Lesson 7Periodic Table Labeling		**Learning Objective(s):** SWBAT identify metals, nonmetals, metalloids, families, periods on the Periodic table			**Lesson Duration:** 80 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Do Now: Give students three minutes to write down everything they know about the periodic table and how it's organized. They students can make a class list on the board.		Developing and Using Models Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)		
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Direct Instruction: Teacher leads lesson on the organization of the periodic table including families, periods, rows, diatomic elements, metals, nonmetals, and metalliods.	• This website has a slide show that may be helpful for this lesson https://njctl.org/courses/science/chemistry/electron-configurations-and-the-periodic-table/#		PS1.A: Structure and Properties of Matter 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	

Explore: What hands-on/minds-on common experience(s) will you provide for students?	1) Students can use crayons/markers to color code the periodic table with all the information presented on family names, metals, nonmetals, metalloids, diatomic elements and groups/periods. 2) Online game: What doesn't belong - reinforces idea that elements from the same family have similar properties. Low rigor activity perhaps best for lower level students or intro activity.	• Pg. 124-131 in Holt Chemistry book is an excellent reading section for families and groups of the periodic table. Students can color code a blank periodic table as mentioned left, they can fill in a periodic table with notes on families or they could read this section with guided notes where they fill in important information. This section of the book can be well used with any form of graphic organizer. • Online game http://www.learner.org/interactives/periodic/box_interactive.html	Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.) ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-3)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Administer an exit ticket, quiz or other assessment	• Pg. 122 Holt Chemistry TE Quiz or Section Review #8-14			

Extend: How will students deepen their conceptual understanding through use in new context?	Students can be provided with samples of elements from each family to hold and touch while completing the exploration of the periodic table activity.	• Element activity: Holt Chemistry Pg. 119 Teacher's edition • Article on which elements are in the human body: http://www.sciencelearn.org.nz/Contexts/Just-Elemental/Science-Ideas-and-Concepts/The-essential-elements There is a similar "consumer focus" article on essential elements on Pg. 123 of the Holt textbook. • Article on properties of metals and metal alloys : http://www.sciencelearn.org.nz/Contexts/Just-Elemental/Science-Ideas-and-Concepts/Metals-alloys-and-metal-compounds • Interactive Periodic Table: http://www.sciencelearn.org.nz/Contexts/Just-Elemental/Science-Ideas-and-Concepts/The-essential-elements		PS1.A: Structure and Properties of Matter 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-3)
Lesson Title/Number: Lesson 8 Review		Online Quiz for Review: http://www.learner.org/interactives/periodic/testskills.html			**Lesson Duration:** 40 minutes
Lesson Title/Number: Lesson 9 Test		**Learning Objective(s):**			**Lesson Duration:** 40 minutes
Lesson Title/Number: Lesson 10Flame Test Lab		**Learning Objective(s):**SWBAT draw a Bohr model of an element SWBAT identify an element based on its flame color			**Lesson Duration:** 80 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***

Elicit: How will you access students' prior knowledge?	Do Now: Assign students one of three metals to draw a Bohr Model. After they complete it they can share it with two students of other metals and check each other for mistakes.		Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)	
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Direct Instruction or pre-reading material on fireworks. This will connect today's lesson to how fireworks are created.	• Show introductory video of how fireworks gain their coloring: http://vitalnj.pbslearningmedia.org/resource/phy03.sci.phys.matter.fireworkcol/fireworks-making-color/		PS1.A: Structure and Properties of Matter 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Flame Test Lab - students are given different chloride chemicals which they can test in a flame. If limited supplies this can be done with Q-tips and candles. List of Flame test chemicals LiCl, SrCl2, BaCl2, CaCl2, NaCl, CuCl2, and KCl. If these are not available the Holt Chemistry Textbook version completes the experiment with sulfates as well.	• Pg. 772 Holt Chemistry TE	Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)	PS1.A: Structure and Properties of Matter 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-3)
Explain: How will you help students connect their	Students will use observations on colors of known elements to		Planning and Carrying Out Investigations Plan and conduct	PS1.A: Structure and Properties of Matter	Patterns

exploration to the concept/topic under investigation?	identify an unknown element.		an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)	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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.) ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-3)
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Extension/Review of Pre-reading and Direct Instruction. Students will be presented with how electrons can jump orbitals when put in a flame before dropping back down producing a flash of colored light.			PS1.A: Structure and Properties of Matter 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) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)	Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Students will write a lab report of their findings including an introduction, hypothesis, procedure, data section and conclusion. This lab report should be graded with a rubric or even a checklist that details all the information students should include and in what order. Because it is still early in the		Obtaining, Evaluating, and Communicating Information Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats	ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	

	year students can be given a fill in the blank type handout for the lab report instead of being expected to write a report from scratch. This project can be tailored to the student's academic level or experience with lab reports. Another approach to teaching lab report writing is to focus on one section per report for the beginning of the year. Teach a lesson on introductions and have students focus their efforts on writing a strong introduction. Then focus on procedure, analysis and so on.		(including orally, graphically, textually, and mathematically). (HS-PS2-6)		
Extend: How will students deepen their conceptual understanding through use in new context?	This lab focuses on elements that provide color to fireworks, but the resource to the right discusses all elements used in fireworks and to what purpose.	• Online Periodic table of elements most used in fireworks and for which purpose: http://www.pbs.org/wgbh/nova/assets/swf/1/periodic-table/periodic-table.html			