Chemistry Unit: The Periodic Table and Bonding

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Chemistry Unit: The Periodic Table and Bonding
Grade: 6
Dates: 12 day unit (12th day is for the Unit Assessment)
Time: 45 minutes to 1 hour each day

NGSS STANDARDS

MS. Structure and Properties of Matter
Students who demonstrate understanding can:

HS-PS1-1. 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.

DISCIPLINARY CORE IDEAS

PS1.A: Structure and Properties of Matter

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 atom has a charged sub-structure 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), (HS-PS1-2)

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3)

SCIENCE AND ENGINEERING PRACTICES

Developing and Using Models

Develop a model to predict and/or describe phenomena. (MS-PS1-1), (MS-PS1-4)
Develop a model to describe unobservable mechanisms. (MS-PS3-2)
Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Analyzing and interpreting data

Using mathematics and computational thinking

CROSSCUTTING CONCEPTS

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)

THE COMMON CORE ENGLISH LANGUAGE ARTS STANDARDS (CCELA)

Reading Standards for Literacy in Science and Technical Subjects 6-8

LITERACY.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

LITERACY.RST.6-8.4
Determine the meaning of symbols, key terms and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

LITERACY.RST.6-8.7
Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

Writing Standards for Literacy in Science and Technical Subjects 6-8

LITERACY.WHST.6-8.1
Write arguments focused on discipline-specific content.
a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim (s) from alternate or opposing claims, and organize the reasons and evidence logically.
b. Support claim(s) with logical reasoning and relevant accurate data and evidence that demonstrate an understanding of the topic or text using credible sources.
c. Use words, phrases, and clauses to create cohesion and clarify the relationship among claim(s), counterclaims, reasons, and evidence.
d. Establish and maintain a formal style.
e. Provide a concluding statement or section that follows from and supports the argument presented.

NATURE OF SCIENCE - PRACTICES

Scientific Investigations Use a Variety of Methods
Science Knowledge Is Based on Empirical Evidence
Scientific Knowledge Is Open to Revision in Light of New Evidence
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

NATURE OF SCIENCE - CROSSCUTTING CONCEPTS

Science Is a Way of Knowing
Scientific Knowledge Assumes an Order and Consistency in Natural Systems

COMMON CORE STATE STANDARDS FOR MATHEMATICS

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively**.**
CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.
CCSS.Math.Practice.MP4 Model with mathematics
CCSS.Math.Practice.MP7 Look for and make use of structure

SAFETY CONCERNS:

- Always wear safety glasses to protect eyes when performing experiments.
- Lab: Breaking the covalent bonds in water (H_2O)molecules

CAUTION: Be careful when using energy sources such as batteries around water.

OBJECTIVE

The objective of this unit is to provide a basic chemistry foundation for middle school students. Chemistry is traditionally taught in high school and college; however, the foundation is laid in middle school science classes during their "impressionable years". (Boyles 2005)

The goals of this unit are to provide students with:

- a brief history on the development of atomic models and chemistry terminology
- a basic understanding of the periodic table of elements
    - how it is organized – patterns and trends
    - what information it provides – atomic symbol, atomic weight, atomic number
    - how it is used and what it reveals about the properties of an element
- an understanding of chemical bonding – ionic and covalent
- an understanding of how to use different models illustrating energy levels and electron configurations of atoms/elements/molecules/compounds
    - Bohr Model and Lewis Dot Structures

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Lesson 1 : The Atom- Neutrons, Protons, Electrons				
Day 1 What is an atom? History of atoms/elements	HS-PS1-1	Where did atoms come from? Video: A Star Turned Inside Out	https://www.youtube.com/watch?v=s2Ho8seXwQg	Discovery of atoms and timeline. Theory vs. Experimentation
Parts of an atom - protons, neutron, electrons	HS-PS1-1 LITERACY.RST.6-8.4	Video: Dogs Teaching Chemistry - The Atom	https://www.bing.com/videos/search?q=fun+ways+to+build+atoms&&view=detail&mid=F093F684824B5B13570AF093F684824B5B13570A&&FORM=VDRVRV	Introduction and definition of terms protons, neutrons and electrons
Does an atom have a charge?	HS-PS1-1 HS-PS1-2 HS-PS1-3 PS1.A	Video: Balloon and Water	http://www.middleschoolchemistry.com/multimedia/chapter4/lesson1#balloon_and_water	Rubbing two dissimiliar material stogether can generate static electricity or a charge.
	HS-PS1-1 HS-PS1-2 HS-PS1-3 LITERACY.RST.6-8.3 LITERACY.WHST.6-8.1 LITERACY.RST.6-8.7	Activity: Paper Straw- Holding Charge	https://www.exploratorium.edu/snacks/holding-charge	Experiment with different objects to see what happens. Observe positive and negative charges.
Day 2 Exploring Charges Lab: Hands-on experimention	HS-PS1-1 HS-PS1-2 HS-PS1-3 LITERACY.RST.6-8.3 LITERACY.WHST.6-8.1 LITERACY.RST.6-8.7	How To Make Electroactive Slime	Have students make slime in the lab and follow directions to generate a charge.	Students will be required to write a lab report. Compare room temperature vs. refrigerated slime.

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Day 3	HS-PS1-1 HS-PS1-2		Teach how to read the element blocks on the periodic table and	Define an element and

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Lesson 2 : The Periodic Table				
Day 1 What is the periodic table?	HS-PS1-1	https://sciencenotes.org/wp-content/uploads/2016/06/PeriodicTableMuted2016.pdf Video :Periodic Table Song https://www.youtube.com/watch?v=2-YN_nK3Xcg	Each student needs a copy to use as a reference during this lesson	Proivde each student with a periodic table to use as a reference. Relate the periodic table to a music score - familiarize students with elements on the periodic table.
Discovery of elements	HS-PS1-1	Video: The Periodic Table: Crash Course Chemistry #4 https://www.youtube.com/watch?v=0RRVV4Diomg	Highlight important facts about the periodic table.	Elements still being developed - last element developed in 2010.
What are the trends/patttems in the periodic table?	HS-PS1-1 HS-PS1-2		Introduce terminology periods/groups/families/ elctron configuration / atomic size and pattern to position on the periodic table.	Elements are arranged in a specific way. Recognize patterns and trends.
Day 2 Electron patterns and modelling electron configiration using the Bohr model	MS-PS1-1 HS-PS1-1 MS-PS1-4 LITERACY.RST.6-8.7 MP4 MP7	https://docs.google.com/document/d/1WR0NThfcVYDLGAsXQbZZjXJeZ1inJlns4KaY07H1UF/edit		Using a Model
		https://www.duplinschools.net/cms/lib01/NC01001360/Centricity/Domain/413/Atomic%20Structure%20Bohr%20models.p	Bohr Model Worksheet- Modeling electrons into energy shells.	

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Activity : Aliens	HS-PS1-1 HS-PS1-3 LITERACY.RST.6-8.3 LITERACY.RST.6-8.7	https://www.wappingersschools.org/cms/lib01/NY01001463/Centricity/Domain/1734/Aliens-Activity modified.ppt	Aliens have many similarities and differences, organize life forms and create a table to arrange new life forms.	Introduction to Periodicity
		http://www.teachnlearnchem.com/Periodicity/PDF/11alienlab.pdf	Describe what the next alien would look like in your periodic table	
Day 3 Exploring trends and patterns in the periodic table. The Alien Periodic Table Challenge	HS-PS1-1 HS-PS1-2 HS-PS1-3 LITERACY.RST.6-8.3 LITERACY.RST.6-8.7 LITERACY.WHST.6-8.1	http://www.nclark.net/alienperiodictable___kulis.pdf	As a scientist studying chemistry, you have been asked to help sort out what is known about the alien elements and to arrange them onto a blank periodic table. Fill in the worksheet and analysis sheet.	Review : Patterns and trends in periodic table. Review table and analysis sheet.
Review		https://sciencenotes.org/wp-content/uploads/2015/06/ScavengerHunt.pdf	Periodic Table Scavenger Hunt	Assessment
		https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html	Review of elements, and periodic table on line -students do independently or in pairs .	Assessment colaborative learning Incoporation of technology
		http://www.chem4kids.com/extras/quiz_elempertable/index.html	On-line Quiz	Assessment on-line
Assign Research Project: Adopt an Element	MS-PS1-1 MS-PS1-2 MS-PS1-3 WHST.6-8.2 WHST.6-8.6 WHST.6-8.7 WHST.6-8.8 RST.6-8.7	https://betterlesson.com/lesson/640282/adopt-an-element-research-project-part-1-3?from=master_teacher_curriculum	Learning how to research. Research done on assigned element.	To be worked on independently throughout the unit. Due at end of unit. Information may be used in speed dating

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Lesson 3: Energy Levels, Electrons, and Bonding (Covalent and Ionic)				
Day 1 Where can you find the electrons in an atom? Electron configuration/energy levels/shells/orbitals	HS-PS1-1 MS-PS1-4	Electron Configuration https://youtu.be/2AFPfg0Como		Introduction to electron configuration/energy levels/shells/orbitals
		https://www.helpteaching.com/tests/502437/electrons	On-line Quiz - Electrons	Quiz will be taken as a class orally.
What is a chemical bond?	MS-PS1-1 HS-PS1-1 HS-PS1-3 MS-PS1-4 LITERACY.RST.6-8.4 LITERACY.RST.6-8.4 LITERACY.RST.6-8.7	http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4 https://www.youtube.com/watch?v=9t8CtMgwUUc	Worksheet on covalent bonding - atoms and molecules. View video *Breaking Covalent Bonds* - Alka Seltzer in water.	Introduce students to ionic and covalent bonds, stable and unstable atoms, valence electrons and compounds. Have students make observations and discuss what is happening.
Day 2 Lab- Breaking covalent bonds	MS-PS1-1 HS-PS1-1 HS-PS1-3 MS-PS1-4 MS-PS3-2 LITERACY.RST.6-8.3 LITERACY.RST.6-8.4 LITERACY.RST.6-8.7 LITERACY.WHST.6-8.1	http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4	Do electrolysis lab and separate hydrogen and oxygen molecules in water	Compare video and electrolysis lab.

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Day 3 Review and Assessment		The Chemical Bond Song https://www.bing.com/videos/search?q=the+chemical+bond+song&view=detail&mid=4C6E9E655840812C453C4C6E9E655840812C453C&FORM=VIRE/	Review of chemical bonding.	Use a music score to summarize important points on chemical bonding.
Activity Dominoes - Ionic bonding		https://sharemylesson.com/teaching-resource/ionic-bonding-using-dominoes-168009	Practice making ionic bonds with domino cards.	Collaborative learning with ionic bonding.
Quiz		http://www.softschools.com/quizzes/chemistry/ionic_bonding/quiz557.html	On-line Quiz	Formative assessement on ionic bonding.

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Lesson 4: Representing Bonds using Lewis Dot Diagrams				
Day 1 Lewis Dot Diagrams: What do those dots and lines mean?	HS-PS1-1 MS-PS1-4 MS-PS3-2	Lewis Diagrams Made Easy https://www.youtube.com/watch?v=cluXl7o6mAw/	Learn how to draw a Lewis diagram.	Introduction to the octet rule.
Connecting the Dots	MS-PS1-1 HS-PS1-1 HS-PS1-3 MS-PS3-2	https://study.com/academy/lesson/lewis-dot-structure-activities-games.html	Activity using bingo dauber - collaborative learning - team building exercise.	Using a different model - compare Bohr and Lewis Dot models.
Review of Unit				
Crossword - Chemical bonding and Atomic Structure		https://crosswordhobbyist.com/448436/Chemical-Bonding-and-Atomic-Structure	Activity to assess knowledge students have gained in this unit.	Assesssment
Day 2 Speed Dating - Bonding		https://sharemylesson.com/teaching-resource/ionic-bond-speed-dating-164517	Activity - assessment of students understanding of chemical bonding and using the periodic table.	Applying the lessons learned in this unit. Summative assessment.
Optional Extra Credit Exercise: Valence Finder Homework	LITERACY.WHST.6-8.1 MP4	https://sharemylesson.com/teaching-resource/build-your-own-valence-finder-249531	Chemistry & Computational Thinking	Integrating computer programing.

Essential Topics	Key Standard	Activating Strategies	Teaching Strategies	Summarizing Strategies
Day 3 Unit Review - Student Presentations	WHST.6-8.7 WHST.6-8.8 RST.6-8.7	Summarize what has been learned throughout the unit in regards to elements, the periodic table, bonding and modelling.	Report research and findings from “Adopt an Element” and “Speed Dating” activities.	Students gain experience in presenting "science".
Everyday use of Periodic Table		Scanning Electron Microscope and Energy Dispersive X-ray Spectroscopy	Elemental Analysis X- ray dot mapping	Relating science/chemistry to real life

Teacher: Margaret Auerbach

Lesson 1: The Atom -Neutrons, Protons, Electrons

Duration: 3 days

Grade Level 6

Objectives – listed above

Materials for lesson:

- Paper and pencils to record observations
- Paper wrapped straws salt, pepper, and confetti, empty soda cans
- Materials for Electro slime lab – cornstarch, vegetable oil, glass or beakers, Styrofoam
- Prior to class teacher will (TW) make some slime and refrigerate it.
- Prior to class, TW make sure computer is set up to project/run lesson videos.
- Prior to class, TW print out lab template https://www.thoughtco.com/how-to-write-a-lab-report-606052and directions for writing a lab report. https://www.thoughtco.com/how-to-write-a-lab-report-606052
- Prior to class, TW print out Lesson 1 Assessment Questions Quiz on Atom from https://www.thoughtco.com/chemistry-quiz-atom-basics-609241 (students complete as an "exit ticket" after class discussion about activity and lesson)
- Prior to class, TW print out an Answer Key to assessment for Lesson 1 from https://www.thoughtco.com/chemistry-quiz-atom-basics-609241
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In this lesson and activity, student will (SW) learn, the parts of an atom and how a negative charge is produced between two dissimilar materials. Learn about an element and what the element block on the periodic table tells you.

Differentiation strategies to meet diverse learner needs:

• TW connect to students' experiences and background knowledge; TW focus on science vocabulary for the unit before, during, and/or after each lesson; TW present information and teach using many different formats including videos, pictures, readings, labs ; TW provide students with enough time to complete work (extra if necessary), discuss, and respond to questions.

• English Language Learners and students with any other disabilities will have a vocabulary word list with definitions, pictures, and examples from the unit to help learning.

• Portions of this lesson and activity can be done in small groups, so students with any learner needs can be placed in groups with students who have different abilities in order to assist learning, model for students, support peers, and double check work and answers.

Engage

Day 1: What is an atom?

Teacher will (TW) capture students' interest by showing them a video - *A Star Turns Inside Out* (3.52 minutes (NASA, 2012) describing the atoms of life itself. This also relates to lessons learned in earlier grades on earth systems.

Video: https://www.youtube.com/watch?v=s2Ho8seXwQg

The TW initiate an engaging discussion on the development of atoms. The timeline on the evolution of the atom first as a theory and then further defined through experimentation will be discussed. The discussion will include the different parts of the atom, who discovered them and when. Definitions of the terms – protons, neutrons, electrons – which will be used throughout this unit will be provided. Kids love animals- the introduction of an atom will be made by showing the video *Dogs Teaching Chemistry- the Atom* (Snuggleplay, 2013).

Video : https://www.bing.com/videos/search?q=fun+ways+to+build+atoms&&view=detail&mid=E093F684824B5B13570AE093F684824B5B13570A&&FORM=VDRVRV

Next the TW engage students in a discussion pertaining to the question: Does an atom have a charge? The TW show a video of a negatively charged balloon brought near water and discuss what is happening. By rubbing the balloon on hair or clothes it picks up extra electrons, which gives the balloon a negative charge. When the balloon is brought near a stream of water, the electrons from the balloon repel the electrons in the water. Why does this happen? Because the water has more protons at the surface of the water, giving it a positive change. Since opposites attract, the water (+) moves toward the balloon (-). (ACS, 2019)

Video:
http://www.middleschoolchemistry.com/multimedia/chapter4/lesson1#balloon_and_water

Explore

Students will (SW) perform an activity using a wrapped straw (an object they may use daily at lunch) to illustrate that electrons and protons attract each other. SW break into groups and try placing two charged straws vertically next to each other, then try picking up salt, pepper, and confetti, and using their charged straw to roll an empty soda can. SW try rubbing other materials on their straw to see what happens. Students should observe and record what happens on the template provided. This will help students understand the concept of a charge and understand how positive and negative materials react to one another (Practice for upcoming lab and lab report assignment.)

Activity: Holding Charge https://www.exploratorium.edu/snacks/holding-charge (Exploratorium, n.d.)

Explain

Discussions between students and teacher will focus on how rubbing two dissimilar materials together can generate static electricity - opposites attract.

Day 2: Lab Day – Do atoms have a charge? Exploring charges.

Elaborate/Extend

SW spend the day in the lab making and experimenting with electroactive slime.

Activity: Electroactive Slime https://sciencenotes.org/cool-electrostatic-slime-reacts-styrofoam (Helmenstine, 2017).

This is a fun lesson to further illustrate the concept of opposites attracting. SW explore how slime reacts to an electrical charge with lab partners. SW make slime and observe both unrefrigerated then refrigerated slime (TW make some slime prior to class and put in the refrigerator) when brought in contact with charged Styrofoam and record the differences in their lab worksheet. Prior to starting the lab a video will be shown of how unrefrigerated slime reacts to a charged balloon to excite students and engage then in the experiment.

Video: https://www.youtube.com/watch?time_continue=124&v=fSlZSjFAERU

During the lab the TW facilitate discussions on what is happening and prompt students to discuss why it is happening. SW document observations and findings. SW compare the reaction of refrigerated slime to unrefrigerated slime. Students will be expected to complete a lab report and turn it in the next day.

Lab Report Template: (Helmenstine, 2018)
https://0.tqn.com/z/g/chemistry/od/chartstables/l/LabSheet1.pdf

Source for writing a lab report https://www.thoughtco.com/how-to-write-a-lab-report-606052 (Helmenstine, 2018).

Day 3: What is an element and what information does an element block on the periodic table contain?

TW introduce an element and explain how the atomic symbol, atomic weight, and atomic number is annotated in the blocks on the periodic table (next lesson). TW introduce students to ions- atoms with a different number of electrons vs protons (anion or cation) and isotopes atoms with a different number of protons vs neutrons.

Evaluate

At the end of lesson 1 the SW complete a lab report demonstrating they understand the concept of electrical charges.
Class will do a "name that atom" activity on the computer as a group or (independently if computers are available for each student). (Annenberg Learner, 2017)

Computer Activity: http://www.learner.org/interactives/periodic/basics_interactive.html

SW take a quiz on Atom Basics (Helmenstine, 2018) an "exit ticket" after a class discussion about the activity and lesson.

Quiz: https://www.thoughtco.com/chemistry-quiz-atom-basics-609241

Lesson 2: The Periodic Table

Duration: 3 days

Grade Level 6

Objectives – listed above

Materials for lesson:

- Prior to class, TW make sure computer is set up to project/run lesson videos.
- Prior to class, TW print out a periodic table for each student (Science notes https://sciencenotes.org/wp-content/uploads/2016/06/PeriodicTableMuted2016.pdf
- Prior to class, TW print out the worksheets for Bohr's model https://docs.google.com/document/d/1WR0NThfcVYDLGAsXQbZZjXJeZIinjlns4KaY07HI1UE/edit https://www.duplinschools.net/cms/lib01/NC01001360/Centricity/Domain/413/Atomic%20Structure%20Bohr%20models.pdf
- Prior to class, TW print out "Aliens" activity with directions and pictures of aliens https://www.wappingersschools.org/cms/lib01/NY01001463/Centricity/Domain/1734/Aliens-Activity modified.ppt worksheet http://www.teachnlearnchem.com/Periodicity/PDF/11alienlab.pdf
- Prior to class, TW print out "The Alien Periodic Table Activity" http://www.nclark.net/alienperiodictable___kulis.pdf with the Answer Key and assessment http://www.nclark.net/PeriodicTable#Activities
- Prior to class, TW print out the worksheet and answer sheet for Periodic Scavenger Hunt https://sciencenotes.org/periodic-table-scavenger-hunt-worksheet/
  Worksheet
  https://sciencenotes.org/wp-content/uploads/2015/06/ScavengerHunt.pdf
  Answer Key
  https://sciencenotes.org/wp-content/uploads/2015/06/ScavengerHuntKey.png
- Prior to class, TW print out the instructions for "Adopt an Element" project. https://betterlesson.com/lesson/resource/3239873/adopt-an-element-project-student_instructions. Elements chosen need to be compatible for the speed dating activity in Lesson 4.

In this lesson and activity, the SW learn, about the periodic table, the trends (periodicity), how to read and use the periodic table.

Differentiation strategies to meet diverse learner needs:

- TW connect to students' experiences and background knowledge; TW focus on science vocabulary for the unit before, during, and/or after each lesson; TW present information and teach using many different formats including videos, pictures, diagrams, readings, labs ; TW provide students with enough time to complete work (extra if necessary), discuss, and respond to questions.

- English Language Learners and students with any other disabilities will have a vocabulary word list with definitions, pictures, and examples from the unit to help learning.

- Portions of this lesson and activity can be done in small groups, so students with any learner needs can be placed in groups with students who have different abilities in order to assist learning, model for students, support peers, and double check work and answers.

Engage

Day 1: What is the periodic table?

Teacher will (TW) capture students' interest by showing them a video on the periodic table using a musical score to name all the elements in the periodic table. (Carballo, 2017

Video: The NEW Periodic Table Song (2017) [LYRICS] https://www.youtube.com/watch?v=2-YN_nK3Xcg

After reviewing some of the key facts about the Periodic Table, the TW show a second video *The Periodic Table: Crash Course Chemistry #4 (*Crash Course, 2013)

Video: https: //www.youtube.com/watch?v=0RRVV4Diomg

Explore

TW give all students a copy of the periodic table (Helmenstine, 2016)

Handout: https://sciencenotes.org/wp-content/uploads/2016/06/PeriodicTableMuted2016.pdf

TW will show several variations of the periodic table to students highlighting patterns and trends. The first variation will show when the elements were developed with the last one being 2010 – highlighting that new elements are still being discovered.
TW will show various periodic tables emphasizing the trends. Horizontal rows –periods and vertical columns- groups or families.

- 7 horizontal rows correspond to the energy levels around the outside of the atom's nucleus - the highest energy level containing electrons
- 18 vertical columns in the periodic table represent elements which have similar properties, such as electrical conductivity
- Pattern of electron configuration
- Pattern of atom sizes across the periodic table.

Day 2: Electron patterns and modelling electron configurations using the Bohr model.

TW introduce the Bohr Model and lead an activity reinforcing electron patterns and the periodic table. TW complete a worksheet (Google doc. (n.d.) in class. SW complete worksheet for homework. (Duplin School, n.d.)

Classwork:

https://docs.google.com/document/d/1WR0NThfcVYDLGAsXQbZZjXJeZIinjlns4KaY07HI1UE/edit

Homework:

https://www.duplinschools.net/cms/lib01/NC01001360/Centricity/Domain/413/Atomic%20Structure%20Bohr%20models.pdf

Students will (SW) perform an activity called "Aliens" which is an introduction to periodicity. (Bergmann & Christopherson, n.d.) SW be divided into teams to perform this activity.

Alien Activity (Chemistry at NCHS, n.d.)
https://www.wappingersschools.org/cms/lib01/NY01001463/Centricity/Domain/1734/Aliens-Activity modified.ppt

Worksheet http://www.teachnlearnchem.com/Periodicity/PDF/11alienlab.pdf

Explain

Working through the activity students will begin to recognize the similarities and differences between the aliens pictured. By creating a table to arrange these new life forms they will begin to understand the patterns associated with the periodic table and be able to describe what the next or missing alien would look like in the periodic table.

TW discuss use of models with students.

Day 3: What are the trends and patterns in the periodic table?

Elaborate/Extend

SW will conduct the next activity The Alien Periodic Table. (Kulis, (n.d.)

Activity: The Alien Periodic Table http://www.nclark.net/alienperiodictable___kulis.pdf, http://www.nclark.net/AlienPTanalysisfillin.pdf,

Students as scientists need to sort out what is known about the alien elements and to arrange them onto a blank periodic table. A worksheet asking questions will reinforce periodicity. This will be done in class (time permitting) or as homework, on an individual basis or in teams to assess the student's understanding and reviewed as a class.

Evaluate

At the end of lesson 2 SW complete "Build an Atom" interactive activity! (Annenberg Learner, 2017) as a group or (independently if computers are available for each student).

Computer Activity:
https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html

SW complete the Periodic Table Scavenger Hunt (Helmenstine, 2015).

Handout: https://sciencenotes.org/wp-content/uploads/2015/06/ScavengerHunt.pdf

SW complete on line quiz. Chem4Kids Quiz: Periodic Table (Radar's Chem4Kids, n.d.)

Quiz: http://www.chem4kids.com/extras/quiz_elempertable/index.html

Assign Project – to be completed by the end of the unit.
Assign "Adopt an Element "(Greenwood, n.d.) project to reinforce the lessons being taught. Sides can be completed as learning takes place. Due at the end of the unit.

Activity: Adopt an Element
https://betterlesson.com/lesson/resource/3239873/adopt-an-element-project-student-instructions

Lesson 3: Energy Levels, Electrons, and Bonding (Covalent and Ionic)

Duration: 3 days

Grade Level 6

Objectives – listed above

Materials for lesson:

- Prior to class, TW make sure computer is set up to project/run lesson videos.
- Prior to class, TW print out the quiz on electrons. https://www.helpteaching.com/tests/502437/electrons
- Prior to class, TW print out the worksheet on covalent bonding. http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4
- Prior to class, TW print out the lab *Breaking the covalent bonds in water (H2O) molecules*. http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4
- Prior to class, TW print out the Dominoes activity https://sharemylesson.com/teaching-resource/ionic-bonding-using-dominoes-168009
- Prior to class, TW print out the quiz on ionic bonding. http://www.softschools.com/quizzes/chemistry/ionic_bonding/quiz557.html

In this lesson and activity, the SW learn, about electron configurations, energy levels, electrons, and bonding (covalent and ionic).

Differentiation strategies to meet diverse learner needs:

• TW connect to students' experiences and background knowledge; TW focus on science vocabulary for the unit before, during, and/or after each lesson; TW present information and teach using many different formats including videos, pictures, diagrams, readings, labs ; TW provide students with enough time to complete work (extra if necessary), discuss, and respond to questions.

• English Language Learners and students with any other disabilities will have a vocabulary word list with definitions, pictures, and examples from the unit to help learning.

• Portions of this lesson and activity can be done in small groups, so students with any learner needs can be placed in groups with students who have different abilities in order to assist learning, model for students, support peers, and double check work and answers.

Engage

Day 1: Where can you find the electrons in an atom? Electron configurations/energy levels/shells/orbitals.

Teacher will (TW) capture students' interest by showing them a video with an overview on electron configuration (Bozeman Science, 2013)

.

Video: Electron Configuration https://youtu.be/2AFPfg0Como

TW introduce the concept of electron configurations showing how electrons are distributed into shells/ energy levels/orbitals and provide multiple examples introducing students to various ways of illustrating this.

TW give students an oral quiz on electrons to ensure they have an understanding of electrons before moving on to bonding. (Helpteaching, n.d.)

Quiz: https://www.helpteaching.com/tests/502437/electrons

TW introduce students to chemical bonds and engage students by showing the video *Dogs Teaching Chemistry – Chemical Bonds*. (Snugglepuppy, 2012)

Video: https://www.youtube.com/watch?v=_M9khs87xQ8

Explore

What is a chemical bond?

TW will introduce students to the various types of bonding – covalent and ionic, valence electrons, stable and unstable atoms, and compounds.
Chemical bonds in daily life will be discussed. Multiple examples of covalent bonds, - hydrogen molecule, oxygen molecule, water molecule, and carbon dioxide molecule and an ionic bond between sodium (Na) and chlorine (Cl) will be discussed. Positive and negative charged ionic bonds will be discussed.
SW fill out activity Sheet 2.2 Student worksheet (ACS, 2019)

Worksheet: http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4

TW will show a video *Breaking Covalent Bonds*

Video: https://www.youtube.com/watch?v=9t8CtMgwUUc

TW begin discussions asking students to explain what is happening with the Alka-Seltzer in the *Breaking Covalent Bonds* video. Then TW show a second video on *Why Does Alka Seltzer Fizz?* Clark, (n.d.)

Video:
https://science.howstuffworks.com/innovation/science-questions/question116.htm

Additional discussions will follow. Explain how, the citric acid in Alka-Seltzer mixes with the base, bicarbonate, to form carbon dioxide bubbles.

Day 2: Lab: Breaking covalent bonds in water (H_2O) molecules.

SW conduct a lab on breaking the covalent bonds in water (H_2O) molecules (ACS, n.d.)

Lab: http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4.

Explain

TW will lead discussions on student observations during the *Breaking Covalent Bond in Water Molecules Lab* and explain what was happening. Describing how each water molecule breaks into 2 hydrogen atoms and 1 oxygen atom. The two hydrogen atoms then bond to form hydrogen gas (H2) and the 2 oxygen atoms bond to form oxygen gas (O2). Each water molecule has all the atoms needed to make 1 molecule of hydrogen gas. But with only 1 oxygen atom, a water molecule only has half of what is needed to make 1 molecule of oxygen gas. So, 2 water molecules will produce 2 molecules of hydrogen gas but only 1 molecule of oxygen gas. There are twice as many hydrogen atoms as oxygen atoms so more hydrogen gas is formed. TW explain ionically bonded compounds – Salt (NaCl) - will dissolve in water and conduct electricity.

SW turn in a lab report answering the two questions 1 - What are the bubbles made out of in the activity? And 2 -Why was there more hydrogen gas produced than oxygen gas?

Elaborate/Extend

SW expand the lab by using sugar which is covalently bonded instead of salt which is ionically bonded. SW observe and record the differences and similarities.

Covalently bonded compounds – table sugar - will dissolve in water but will not conduct electricity
TW explain ionic compounds are made of a metal plus a non-metal; covalent compounds are made of nonmetals combined with other non-metals -elements that are far apart on the periodic table.

Day 3: Review and assessment.

Evaluate

TW will review bonding by playing the *Chemical Bond Song* (Icaza, 2017)

https://www.bing.com/videos/search?q=the+chemicl+bond+song&view=detail&mid=4C6E9F655840812C453C4C6E9F655840812C453C&FORM=VIRE/

SW undertake an activity: Ionic Bonding Using Dominoes. To determine their understanding of ionic bonding. (Dawnsalter, n.d.)

Activity – Dominoes:
https://sharemylesson.com/teaching-resource/ionic-bonding-using-dominoes-168009

TW give a quiz on bonding. (Softschool, n.d.)

Quiz: http://www.softschools.com/quizzes/chemistry/ionic_bonding/quiz557.html

Lesson 4: Representing Bonds using Lewis Dot Diagrams

Duration: 3 days

Grade Level 6

Objectives – listed above

Materials for lesson:

- Prior to class, TW make sure computer is set up to project/run lesson videos.
- Prior to class, TW, create sets of papers with a symbol for a chemical element printed in the center of each paper for connect the dots and make sure there are bingo daubers for each team.
- Prior to class, TW print out the cross word puzzle activity. https://crosswordhobbyist.com/448436/Chemical-Bonding-and-Atomic-Structure
- Prior to class, TW print out the card for the speed dating activity (if being used) or SW use their "adopt an element" block to fill in their "dating" card. https://sharemylesson.com/teaching-resource/ionic-bond-speed-dating-164517

In this lesson and activity, the SW learn, about Lewis Dot Diagrams and how to draw them. TW provide a unit review using a fun activity called "speed dating".

Differentiation strategies to meet diverse learner needs:

• TW connect to students' experiences and background knowledge; TW focus on science vocabulary for the unit before, during, and/or after each lesson; TW present information and teach using many different formats including videos, pictures, diagrams, readings, labs ; TW provide students with enough time to complete work (extra if necessary), discuss, and respond to questions.

• English Language Learners and students with any other disabilities will have a vocabulary word list with definitions, pictures, and examples from the unit to help learning.

• Portions of this lesson and activity can be done in small groups, so students with any learner needs can be placed in groups with students who have different abilities in order to assist learning, model for students, support peers, and double check work and answers.

Engage

Day 1: Lewis Dot Diagrams: What do those dots and lines mean?

Teacher will (TW) engage students' interest by showing a Lewis Dot Diagram and asking what all the dots and lines mean. Then TW show students a video *Lewis Diagrams Made Easy: How to Draw Lewis Dot Structures* (Ketzbook, 2017)

Video: https://www.youtube.com/watch?v=cIuXl7o6mAw/

Explore

TW will explain the Lewis Dot Diagram in relation to how it is drawn, the octet rule, the symbols used (dots vs. lines) and introduce students to this model of representing the valence electrons of an atom.

TW review the steps introduced in the video on how to draw a Lewis Dot Diagram and show diagrams of various elements illustrating the variations possible.

SW participate in an activity called *Connecting the Dots*. This is a team based fun game in which students can practice their Lewis Dot Diagram skills while competing with classmates. (Jenkins, n.d.)

Activity: Connecting the Dots
https://study.com/academy/lesson/lewis-dot-structure-activities-games.html

SW complete their "adopt an element" project. The final side is a Lewis Dot Diagram.

Explain

Upon completion of the *Connecting the Dots* game. TW review the answers provided by each team with the students and the winner will be announced.

Elaborate/Extend

SW will complete the crossword puzzle *Chemical Bonding and Atomic Structure* (Crossword Hobbyist, n.d.)

Crossword: https://crosswordhobbyist.com/448436/Chemical-Bonding-and-Atomic-Structure

Evaluate

Day 2: Activity Speed Dating

SW complete an activity called "Speed Dating". This is a review activity. Students are given a "dating card" which has an element on it or SW complete a dating card on their element using information from their "adopt an element" block including – name, personality, hobbies, likes, dislikes, and facts that someone "dating or bonding" with the element needs to know. A template

for the card will be provided as a guide. SW then "speed date" with each other to find another element (or elements) to form a bond with to make a molecule or compound. Students take turns asking questions to other students. After 1 min or so students move along to the next student and repeat the process. (Sniley1988, (n.d.) Ionic or covalent bonds will be permitted – additional element cards may be required.

Activity: Speed Dating
https://sharemylesson.com/teaching-resource/ionic-bond-speed-dating-164517

Once the student has “bonded” SW answer the questions with their partner on their “Certificate of Bonding”- Why did you choose to bond with your partner? Draw a Lewis dot and Bohr model diagram of the happy compound! And lastly, pronounce if it is an anion or cation bond. Not everyone finds a match! SW explain why they could not find a good bond. Even if it was possible and they missed their opportunity if they can explain their rational they will get credit.

Day 3: Presentations and Discussions on “Adopt an Element” and “Speed Dating” Activities

- Each student will be required to present their element to the class. If the same element was used in the “speed dating” activity they should also discuss the bond they made or explain why they could not make a bond.
- TW review the bonds made and engage the class in discussions on whether the “elements” made good choices or how long they think the “bond” will last. The class will “fix up” elements who did not bond (if any) with a possible “date/bond”.

SW be given an opportunity to earn extra credit by developing a valence finder – developing a computer program on their own time (not in class). (Wenningbo, 2016)

Activity: Valence Finder
https://sharemylesson.com/teaching-resource/build-your-own-valence-finder-249531

This concludes the unit on The Periodic Table and Bonding. TW show some real world applications utilizing ionized energy illustrating how elemental analysis and x-ray dot mapping can be used to identify and map out elements in a material using a scanning electron microscope and energy dispersive spectroscope (EDS).

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Lesson 1

Lab Report Worksheet

Title: _____ Name: _____
Date: _____ Lab Partners: _____

Purpose: _____

Materials: _____

Prooedure: _____

Data: _____

Results: _____

Conolusions: _____

Referenoes: _____

Activity: Holding Charge
https://www.exploratorium.edu/snacks/holding-charge

Tools and Materials
Plastic straw in paper wrapper (if no wrapper is available, use a paper napkin)
Clean, dry vertical surface: a hand, window, wall, or door.

Directions:
Tear off one end of the wrapper on a new straw.
With one hand, tightly hold the newly exposed plastic straw. With the other hand, gently yet firmly grasp the remaining paper wrapper.
Quickly slide the wrapper back and forth over the straw. Keep sliding it until the straw and wrapper feels warm. (Approximately 10 strokes)

Here are some other things to try:
Hold two charged straws vertically next to each other. What do you feel?
Lift small objects with your charged straw: salt, pepper, and confetti, for example.
Use your straw to roll an empty soda can.
Rub other materials on your straw to see what happens.

Lab: Cool Electroactive Slime That Reacts to Styrofoam
https://sciencenotes.org/cool-electrostatic-slime-reacts-styrofoam/

Materials Needed:
3/4 c cornstarch (175 mL)
2 c vegetable oil (475 mL)
glass or tumbler
refrigerator
1x6x6 inch (25x150x150 mm) Styrofoam

How To Make Electroactive Slime

Mix the cornstarch and vegetable oil together in the glass.
Refrigerate the slime mixture until it is chilled. **(The teacher will make some slime and refrigerator prior to class. The students' slime will be at room temperature.)**
Remove from the refrigerator and stir (separation is normal).
Allow the mixture to warm enough so that it can flow.
Take a block of Styrofoam and charge it by rubbing it on hair, wool, or a cat.
Tip the container of slime (which should flow slowly). Place the charged Styrofoam about an inch (2 cm) from the flowing slime. It should stop flowing and seem to gel!
If you wiggle the charged Styrofoam the slime may follow or pieces of it may even break off.
When the Styrofoam is removed the slime will continue to flow.
Compare refrigerated (teacher's) and non-refrigerated (student's) slime.
After use, refrigerate slime in a sealed container.

Atomic Quiz **Answers:** 1 b, 2 d, 3 c, 4 b, 5 c, 6 b, 7 c, 8 a, 9 b, 10 c

https://www.thoughtco.com/what-do-you-know-about-atoms-609620

1. The three basic components of an atom are:
   - protons, neutrons, and ions
   - protons, neutrons, and electrons
   - protons, neutrinos, and ions
   - protium, deuterium, and tritium

2. An element is determined by the number of:
   - atoms
   - electrons
   - neutrons
   - protons

3. The nucleus of an atom consists of:
   - electrons
   - neutrons
   - protons and neutrons
   - protons, neutrons, and electrons

4. A single proton has what electrical charge?
   - no charge
   - positive charge
   - negative charge
   - either a positive or negative charge

5. Which particles have approximately the same size and mass as each other?
   - neutrons and electrons
   - electrons and protons
   - protons and neutrons
   - none - all are different in terms of size and mass

6. Which two particles would be attracted to each other?
   - electrons and neutrons
   - electrons and protons
   - protons and neutrons
   - all particles are attracted to each other

7. The atomic number of an atom is:
   - the number of electrons
   - the number of neutrons
   - the number of protons
   - the number of protons plus the number of neutrons

8. Changing the number of neutrons of an atom changes its:
   - isotope
   - element
   - ion
   - charge

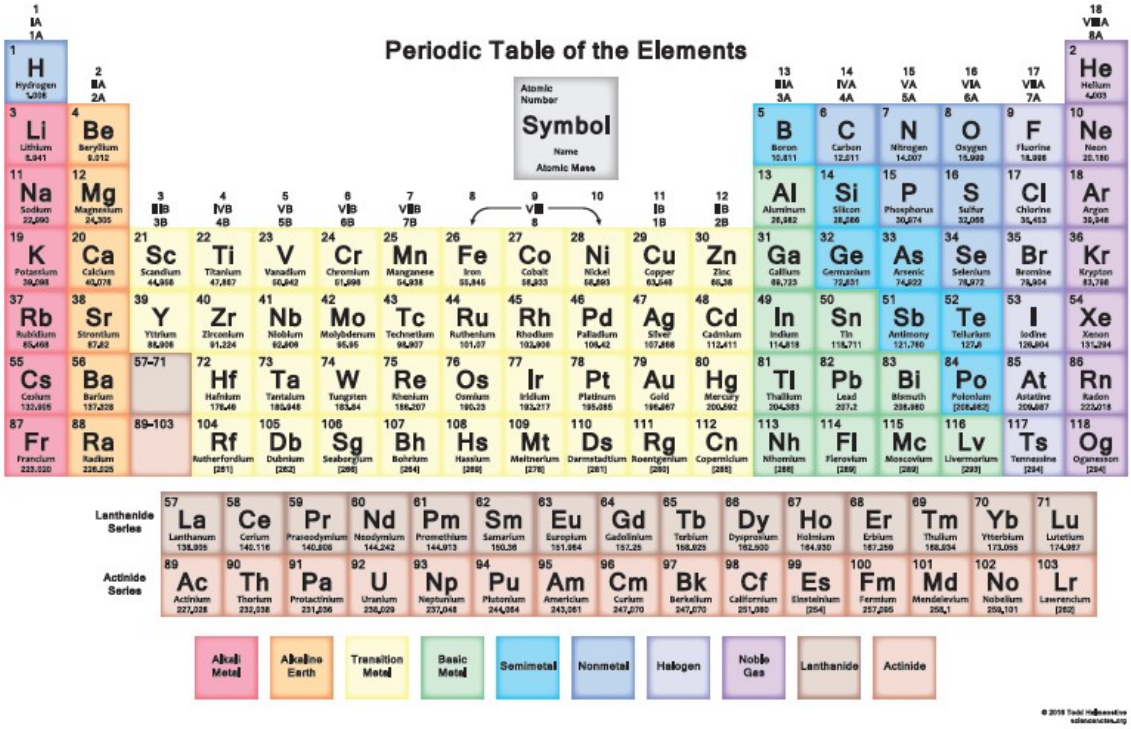
9. When you change the number of electrons on an atom, you produce a different:
   - isotope
   - element
   - ion
   - atomic mass

10. According to atomic theory, electrons are usually found:
    - in the atomic nucleus
    - outside the nucleus, yet very near it because they are attracted to protons
    - outside the nucleus -- most of an atom's volume is the electron cloud
    - anywhere they want to be -- no particular location is more likely than any other

Lesson 2

Periodic Table

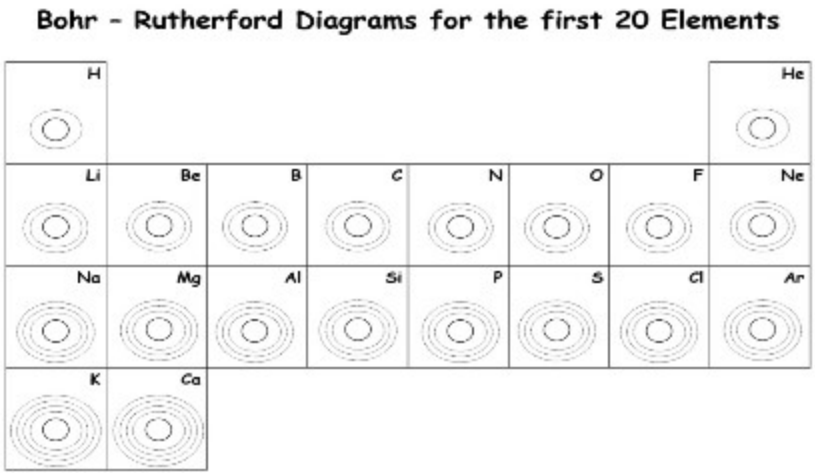
https://sciencenotes.org/wp-content/uploads/2016/06/PeriodicTableMuted2016.pdf



Worksheet – To be done as a class

https://docs.google.com/document/d/1WR0NThfcVYDLGAsXQbZZjXJeZIinjlns4KaY07HI1UE/edit

Electron Patterns and the Periodic Table



Questions:

1. What is a pattern that you see with the rings (energy levels) for each period (row)?
2. What is a pattern that you see for the groups (columns)?
3. Label the columns 1A-8A, moving left to right.
4. Label the electrons for each energy level for each of the atoms above.
5. What pattern do you see in regards to the electrons moving across a period?

What do all the elements in a horizontal row of the periodic table have in common?

Same # of energy levels

What do all the elements in a vertical column of the periodic table have in common?

Same # of outer electrons

Answers:

Number of energy levels in each period

The atoms in the first period have electrons in 1 energy level.
The atoms in the second period have electrons in 2 energy levels.
The atoms in the third period have electrons in 3 energy levels.
The atoms in the fourth period have electrons in 4 energy levels.

Number of electrons in each group

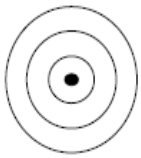
Elements in the same group have the same number of electrons in their outer electronic shell

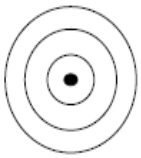
Bohr Model Worksheet
https://www.duplinschools.net/cms/lib01/NC01001360/Centricity/Domain/413/Atomic%20Structure%20Bohr%20models.pdf

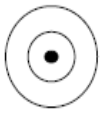
Name _____ Period_____
Date _____

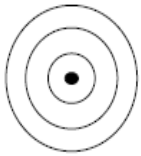
BOHR MODEL WORKSHEET

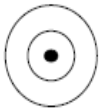
For each element draw the **inner electrons blue** & the **valence (outer) electrons red**.
The circles represent **possible** electron shells.

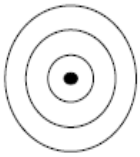

Sodium (Na) _____

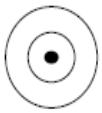

Aluminum (Al) _____

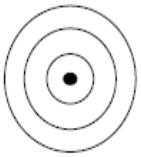

Carbon (C) _____

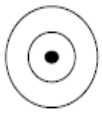

Silicon (Si) _____


Oxygen (O) _____


Chlorine (Cl) _____


Flourine (F) _____


Phosphorus (P) _____


Lithium (Li) _____

Name _____ Period_____
Date _____

The Structure of Atoms

Complete the table

Sub-atomic Particle	Symbol	Location in the atom	Mass of particle
Proton			
Neutron			
Electron			

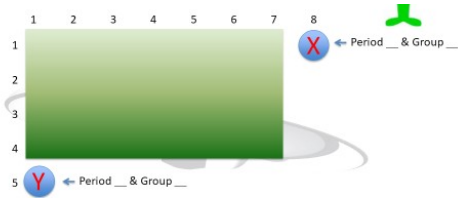
1. What two sub-atomic particles are located in the nucleus of the atom?
2. What is the difference between the atomic number & the mass number of an element?
3. Where is the majority of the mass located in an atom?

Complete the table; the first two rows have been done for you. Use your periodic table to complete the rest.

Element	Symbol	Protons	Neutrons	Electrons
Lithium	Li	3	7-3=4	3
carbon	C	6	12-6=6	6
Sodium				
Aluminum				
	Pb			
	Ti			
	Zn			
		80		
				17
Tungsten				

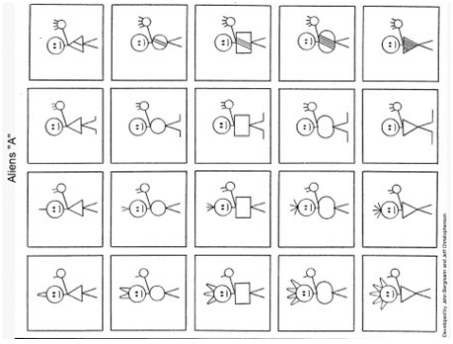
Aliens
https://www.wappingersschools.org/cms/lib01/NY01001463/Centricity/Domain/1734/Aliens-Activity modified.ppt
http://www.teachnlearnchem.com/Periodicity/PDF/11alienlab.pdf

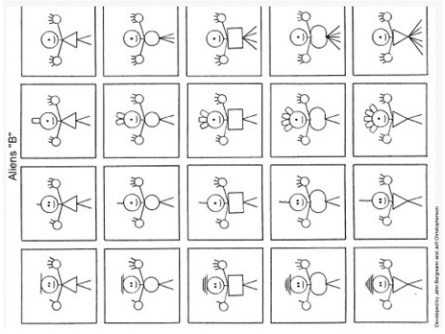
Directions:
Organize the aliens in a rectangular block.
Each group (vertical column) must be the same in some way and must have some feature that changes regularly as you move down the group.
Each period (horizontal row) must also share one thing in common and also must have one fea that changes regularly as you go across the periodic table.



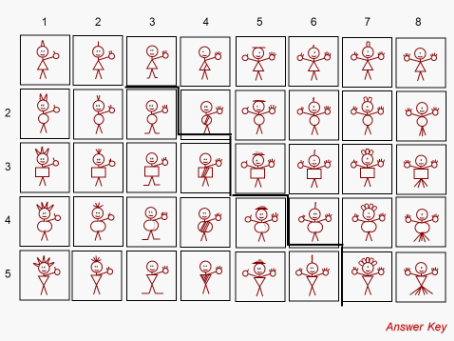
The Aliens We Didn't Find
Describe what the next alien would look like in your periodic table.
Also include a drawing of this alien

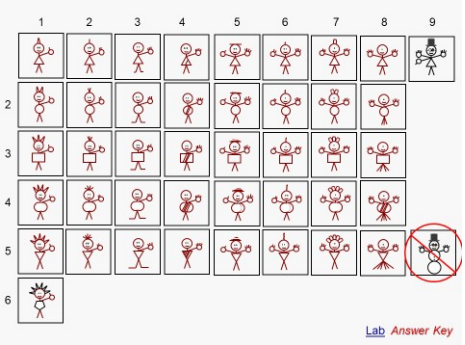
Alien Life Forms – Must be cut into blocks.





Answer Keys:





Alien Worksheet

Name: _____
Hour: ___ Date: _____

Chemistry: *Aliens*

Introduction

Your task is to arrange the Aliens in some logical pattern so that they form an organized rectangular block. Within each **group**, all the Aliens in that group must be *exactly the same* in some way (the **Key Similarity**), AND must also *share some feature that changes regularly* as you move down the group (the **Varying Trait**). Similarly, within each **period**, all the Aliens in the period must be *exactly the same* in some way (the **Key Similarity**), AND must also *share some feature that changes regularly* as you move across the period (the **Varying Trait**). Two Aliens are missing from your set; simply leave empty spaces in your rectangular block for these Aliens. Once you have finished arranging your Aliens, have your teacher look at your block to check it and to sign your paper below. You must have the teacher sign your paper before you proceed to answering the questions that follow. Be prepared to answer any questions the teacher may have about why you placed the Aliens in the order you did. Good luck.

Questions: **Teacher Sign-Off** _____

1. How many **groups** of Aliens do you have? _____ How many **periods** of Aliens do you have? _____

2. *The Missing Aliens…* For each Alien that is missing…
   A) list five statements describing what it looks like, and then
   B) draw it neatly in the space provided.

DESCRIPTION OF MISSING ALIEN #1 **DRAWING OF MISSING ALIEN #1**

I.

II.

III.

IV.

V.

DESCRIPTION OF MISSING ALIEN #2 **DRAWING OF MISSING ALIEN #2**

I.

II.

III.

IV.

V.

3. Now, give detailed information about your chart of Aliens. Circle **group** or **period** and list the group or period number. Then, list the **Key Similarity** and the **Varying Trait** for the Aliens in that group or period. Be specific, yet concise.

Group or Period	Number	Key Similarity	Varying Trait
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			
group period			

4. *The 'Next' Alien?* For one group and one period...

GROUP NUMBER = _____

PERIOD NUMBER = _____

A) Describe what the 'Next' Alien might look like, and
B) draw neatly what it might look like.

DESCRIPTION OF THE 'NEXT' ALIEN **DRAWING OF THE 'NEXT' ALIEN**

"The 'Next' Alien almost certainly has…"

The Alien Periodic Table Challenge

http://www.nclark.net/alienperiodictable__kulis.pdf
http://www.nclark.net/PeriodicTable#Activities

THE ALIEN PERIODIC TABLE CHALLENGE

Earth's scientists have announced that they have finally made radio contact with intelligent life on a distant planet dubbed 2-4-D. One of this alien planet's languages is being translated, and scientific information has begun to be exchanged!

Planet 2-4-D seems to be composed of many of the **same elements** as Earth (and all planets...). However, the scientists from planet 2-4-D have different names and symbols for them. The alien scientists do not know our names for the elements, or how to classify them, but they have radioed data on the known properties of their elements.

As a scientist who has been studying about chemistry, you have been asked to help sort out what is known about the alien elements and to arrange them onto a blank periodic table. Once this table is organized, scientists on both planets will understand each other better and will be able to work to share scientific information and make new discoveries. *(...perhaps they might even vote for President.....)*

YOUR TASK:

Use your knowledge of the Earth's periodic table to help arrange the alien elements onto a blank periodic table. Be sure to complete 1-4 below....Good Luck!!!

1. Each alien element symbol should be located in the **same position** that Earth's corresponding element symbol would be located.
   (NOTE: The symbol is given in parentheses after the element's name.)
2. Label the blank periodic table with each element's name and symbol. List the evidence you used to justify placement of each element.
3. Label the names of groups 1, 17, & 18.
4. Color-code each of the family groups for the alien periodic table and include a key.

Mark Kulis - 8th grade Science – MMS

ALIEN ELEMENT DATA STATEMENTS

(13 total)

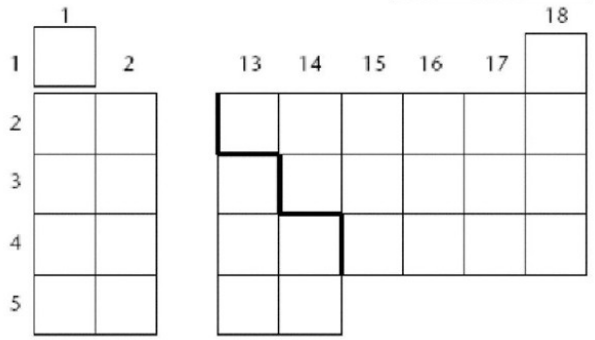
1. Strangely but luckily, there are no "transition metals" or "rare earth elements" on the alien planet 2-4-D. Add the correct Roman numerals to the group numbers.
2. The "noble gases" are Bombal (Bo), Wobble (Wo), Jeptum (J) and Logon (L).
   - Bombal (Bo) is a noble gas but does not have 8 outer electrons.
   - The outside energy level of Logon (L) is its second energy level.
   - Of these inert gases, Wobble (Wo) has the greatest atomic mass.
3. The "alkali metals" are Xtalt (X), Byyou (By), Chow (Ch), and Quackzil (Q).
   - Of these alkali metals, Chow (Ch) has the lowest atomic mass.
   - Quackzil (Q) is in the same period as Wobble (Wo).
4. The "halogens" are Apstrom (A), Vulcania (V), and Kratt (Kt).
   - Vulcania (V) is in the same period as Quackzil (Q) and Wobble (Wo).
5. The element called Doggone (D) has only 4 protons in its nucleus.
6. The "metalloids" are Ernst (E), Highho (Hi), Terriblum (T), and Sississ (Ss).
   - Sississ (Ss) is the metalloid with the highest atomic mass.
   - Ernst (E) is the metalloid with the lowest atomic mass.
   - Highho (Hi) and Terriblum (T) are in Group 14.
   - T has more protons than Hi.
   - The element called Yazzer (Yz) is a metalloid by location but has properties that suggest it is more like a light metal.
7. The most metallic element on the planet is called Xtalt (X). One of the most chemically active nonmetals on the planet is called Apstrom (A).
8. The lightest element on the planet is called Pfsst (Pf).
   -The heaviest element on the planet is Elrado (El), and is highly radioactive.
9. The chemical makeup of the alien planet's oceans seems to be about the same as Earth's oceans. *(NOTE: Earthly salt is the compound NaCl)*
   - When sea water is distilled, the liquid that is boiled off and then condensed has been shown to have molecules consisting of two atoms of Pfsst (Pf) and one atom of Nuutye (Nu).
   - The solid left behind after the distillation consists mainly of a crystal made up of the elements Byyou (By) and Kratt (Kt).
10. Floxxit (Fx) is a black crystal and has 4 electrons in its outermost energy level.
    - Both Rhaatrap (R) and Doadeer (Do) have atoms with 4 energy levels.
    - But Rhaatrap is less metallic than Doadeer.
11. Magnificon (M), Goldy (G) and Sississ (Ss) are all members of Group 15.
    - Goldy has fewer total electrons than Magnificon.
12. Urrp (Up), Oz (Oz) and Nuutye (Nu) all gain 2 electrons.
    - Oz has a lower atomic number than Urrp.
13. The element Anatom (An) tends to lose 3 electrons.
    - The elements Zapper (Z) and Pie (Pi) both lose 2 electrons.
    - Pie loses them from its fifth energy level, while Zapper loses them from its third.

(Use the space below for any notes to help you keep track of what you know so far...)

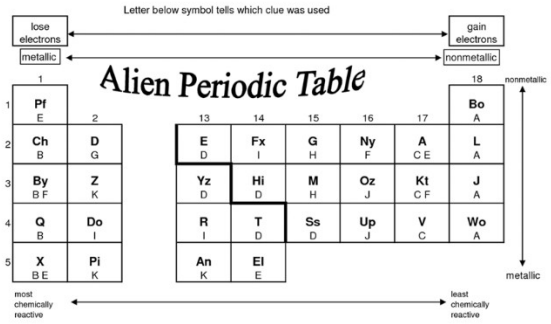
Worksheet

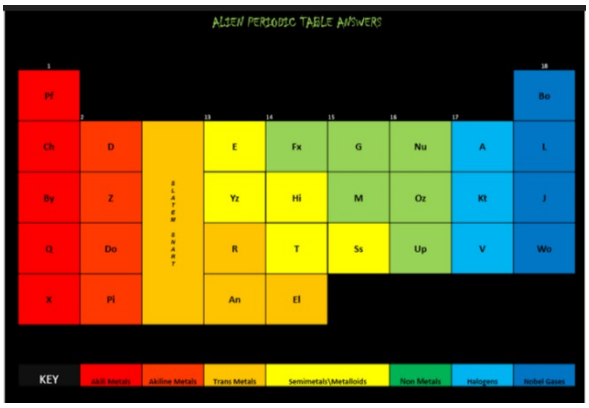
Alien Periodic Table

Name:_____
Per. Date:_____



Answer key





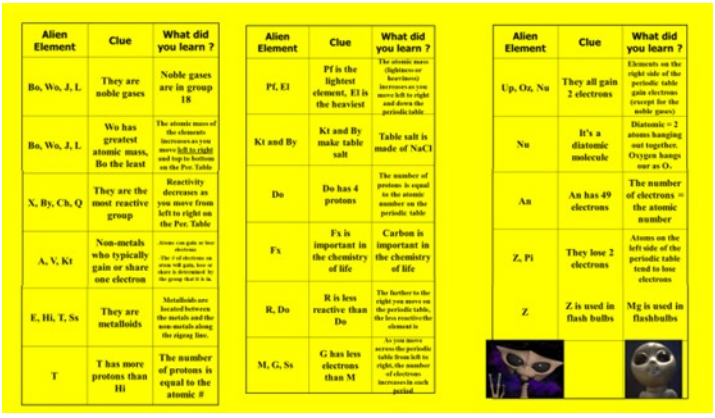
Analysis Worksheet

Alien Periodic Table Analysis

Name_____Period_____

Fill in the missing words under "What did you learn ?" using the power point analyzing the Alien Periodic Table.

Element	Clue	What did you learn ?
Bo, Wo, J, L	They are noble gases	_____ _____ are in group 18
Bo, Wo, J, L	Wo has greatest atomic mass, Bo the least	The atomic mass of the elements _____ as you move right to left and top to bottom on the Periodic Table
X, By, Ch, Q	They are the most reactive group	Reactivity _____ as you move from left to right on the Per Table
A, V, Kt	Nonmetals who typically gain or share one electron	-Atoms can gain or lose _____ -The # of electrons an atom will gain, lose or share is determined by the _____that it is in.
E, hi, T, Ss	They are metalloids	_____are located between the metals and the non-metals along the _____line.
T	T has more protons than Hi	The number of protons is equal to the _____
Pf, El	Pf is the lightest element, El is the heaviest	The atomic mass (lightness or heaviness) _____as you move left to right and down the periodic table
Kt and By	Kt and By make table salt	Table salt is made of _____
Do	Do has 4 protons	The number of _____ is equal to the atomic number on the periodic table
Fx	Fx is important in the chemistry of life	_____is important in the chemistry of life



Periodic Table Scavenger Hunt
https://sciencenotes.org/wpcontent/uploads/2015/06/ScavengerHunt.pdf

Worksheet

Name: _____ Date: _____

Periodic Table Scavenger Hunt

Search your periodic table for the answers to these questions.

_____ 1. Which element is number 14 on the periodic table?
_____ 2. What is the element symbol for californium?
_____ 3. How many protons are in an atom of bismuth?
_____ 4. To which element group does argon belong?
_____ 5. Which element would you expect to have a higher mass: cadmium or zinc?
_____ 6. What is the atomic mass of carbon?
_____ 7. What do you call the element series from atomic number 57-71?
_____ 8. Which element has a symbol that starts with a letter different from the first one in its name: aluminum, copper, gold, rhenium?
_____ 9. Which element has the lowest atomic mass?
_____ 10. What is the first element with an atomic mass greater than 100?
_____ 11. What is the first basic metal on the periodic table?
_____ 12. True or false: Tin and antimony are in the same element group.
_____ 13. What is the heaviest alkali metal?
_____ 14. How many protons are in an atom of magnesium?
_____ 15. Which of the following is not a nonmetal: sulfur, oxygen, silicon, nitrogen?
_____ 16. What is the name of the element with the symbol W?
_____ 17. Which element has an atomic mass of 106.42?
_____ 18. Astatine belongs to which element group: nonmetal, halogen, noble gas?
_____ 19. What is the element with the symbol Ba?
_____ 20. Name a letter never used in any element symbol?

Answer Key

Name: _____ Date: _____

Periodic Table Scavenger Hunt

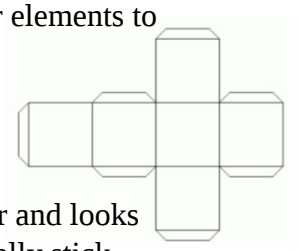
Search your periodic table for the answers to these questions.

Silicon 1. Which element is number 14 on the periodic table?
Cf 2. What is the element symbol for californium?
83 3. How many protons are in an atom of bismuth?
Noble Gas 4. To which element group does argon belong?
Cadmium 5. Which element would you expect to have a higher mass: cadmium or zinc?
12.01 6. What is the atomic mass of carbon?
Lanthanides 7. What do you call the element series from atomic number 57-71?
Gold 8. Which element has a symbol that starts with a letter different from the first one in its name: aluminum, copper, gold, rhenium?
Hydrogen 9. Which element has the lowest atomic mass?
Ruthenium 10. What is the first element with an atomic mass greater than 100?
Aluminum 11. What is the first basic metal on the periodic table?
False 12. True or false: Tin and antimony are in the same element group.
Francium 13. What is the heaviest alkali metal?
12 14. How many protons are in an atom of magnesium?
Silicon 15. Which of the following is not a nonmetal: sulfur, oxygen, silicon, nitrogen?
Tungsten 16. What is the name of the element with the symbol W?
Palladium 17. Which element has an atomic mass of 106.42?
Halogen 18. Astatine belongs to which element group: nonmetal, halogen, noble gas?
Barium 19. What is the element with the symbol Ba?
J or Q 20. Name a letter never used in any element symbol?

Project: Adopt an Element
https://betterlesson.com/lesson/640282/adopt-an-element-research-project-part-1-3?from=master_teacher_curriculum
https://betterlesson.com/lesson/resource/3232430/adopt-an-element-project-birth-certificate
https://betterlesson.com/lesson/resource/3239873/adopt-an-element-project-student-instructions
Instruction Sheet (Modified)

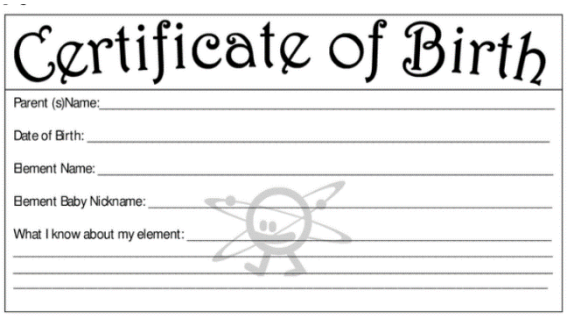
Students "adopt" an element, learn about their element and create a baby block cube to display their research

Directions:
You are now the proud parent of an element baby! Congratulations on your new responsibility. Being a parent can be tough...you really need to understand your element baby, so that you know how to take care of it. Is your baby radioactive? Should you be wearing a protective suit? Is your baby a gas at room temperature? Maybe it needs to be kept in a special container, so it doesn't get away! Maybe your baby is highly reactive! If you know, you can find out what other elements to keep your baby away from.
Build the Baby Block
Students create a three-dimensional baby block using a cube template such as this:



Cut template, fold with ruler and glue or tape the tabs. Glue and patience work better and looks nicer than tape. Students need to use firm pressure for a minute to get the sides to really stick.

Fill in block sides 1-6 and Birth Certificate



Block Characteristics

- Side 1: Element Name
- Side 2: Bohr Model
- Side 3: Element Properties/Characteristics
  - Birth date - When was it discovered?
  - Size
  - Atomic Weight
  - Family /Group
  - Chemical/Physical Properties (What does the element like to do? What elements will it bond with? Include: personality, likes and dislikes)
- Side 4: Uses of the Element (paragraph form)
- Side 5: Fun Facts (In paragraph form - include hobbies,)
- Side 6: Lewis Dot Diagram

Lesson 3

Quiz: Electrons

https://www.helpteaching.com/tests/502437/electrons

Name: _____ Date: _____

Electrons

1. Electrons are found outside the nucleus.
   a. True
   b. False

2. Valence electrons are the electrons in the outermost shell.
   a. True
   b. False

3. The electron cloud is a visual model of the probable locations of electrons in an atom.
   a. True
   b. False

4. Electrons have what type of charge?
   a. positive
   b. negative
   c. neutral
   d. none

5. The scientist who first discovered electrons was_____.
   a. Rutherford
   b. Bohr
   c. Thompson
   d. Democritus

6. What can you conclude from the fact that electrons orbit far away from the atomic nuclei?
   a. Electrons are extremely small.
   b. Protons have a positive charge.
   c. Atoms consist of subatomic particles.
   d. Atoms are mostly empty space.

Electrons Answer Key

1. Electrons are found outside the nucleus.
   a. True
   b. False

2. Valence electrons are the electrons in the outermost shell.
   a. True
   b. False

3. The electron cloud is a visual model of the probable locations of electrons in an atom.
   a. True
   b. False

4. Electrons have what type of charge?
   a. positive
   b. negative
   c. neutral
   d. none

5. The scientist who first discovered electrons was_____.
   a. Rutherford
   b. Bohr
   c. Thompson
   d. Democritus

6. What can you conclude from the fact that electrons orbit far away from the atomic nuclei?
   a. Electrons are extremely small.
   b. Protons have a positive charge.
   c. Atoms consist of subatomic particles.
   d. Atoms are mostly empty space.

7. What is the maximum number of electrons that can fit in the first energy level around the nucleus of an atom?
   a. 2
   b. 8
   c. 13
   d. 18

8. What is the greatest number of valence electrons an atom can have?
   a. 2
   b. 3
   c. 8
   d. 12

Worksheet

http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4

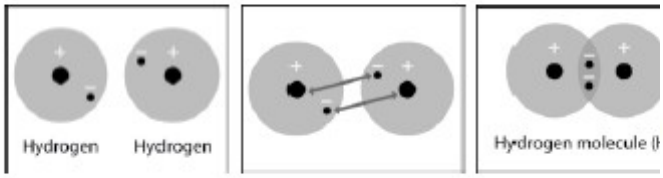
Activity Sheet
Chapter 4, Lesson 4
Energy Levels, Electrons, and Covalent Bonding

Name _____

Date _____

EXPLAIN IT WITH ATOMS & MOLECULES

1. Write a short caption under each picture to describe the process of cova bonding.



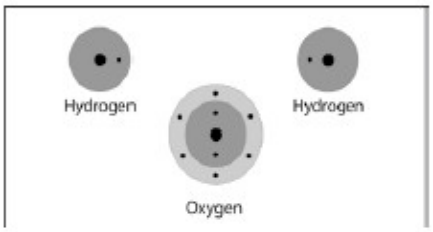
Two hydrogen atoms are near each other.

2. What are two conditions atoms must have in order to form covalent bo with one another?

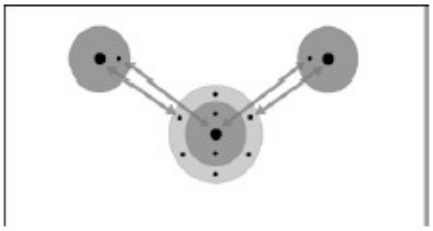
3. Why is a hydrogen molecule (H_2) more stable than two individual hydro atoms?

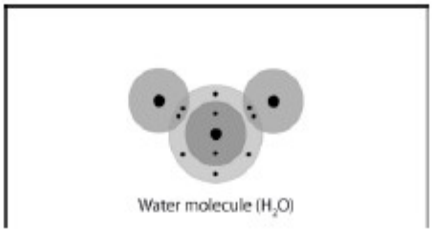
4. Why can't a third hydrogen atom join the H_2 molecule to make H_3?

5. Write a short caption beside each picture to describe the process of covalent bonding.

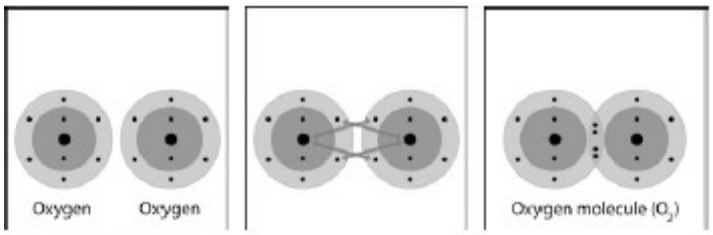


Two hydrogen atoms and one oxygen atom are near each other.



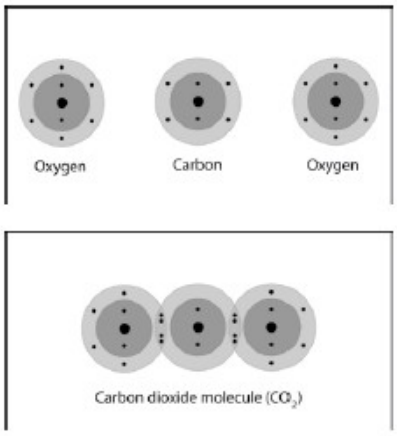


Briefly describe the process of covalent bonding between two oxygen atoms to make an oxygen molecule. Be sure to mention attractions between electrons and protons and the number of electrons in the outer energy level for the atoms in the final molecule.



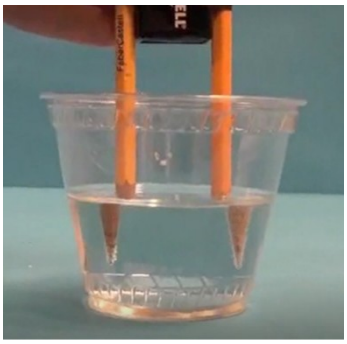
Each oxygen atom has 6 valence electrons in its outer energy level.

1. Briefly describe the process of covalent bonding between the carbon and the two oxygen atoms to make a carbon dioxide molecule. Be sure to mention attractions between electrons and protons and the number of electrons in the outer energy level for the atoms in the final molecule.



Lab: Breaking the covalent bonds in water (H_2O) molecules

http://www.middleschoolchemistry.com/lessonplans/chapter4/lesson4



Materials:

9-volt battery
2 wires with alligator clips on both ends
2 pencils sharpened at both ends
Water
Salt
Clear plastic cup
Tape

CAUTION: Be careful when using energy sources such as batteries around water

Procedure

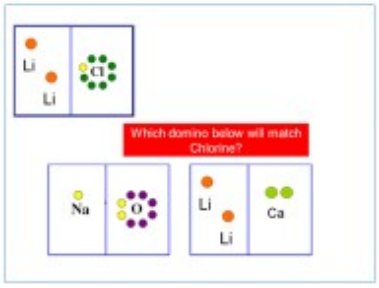
1. Place a battery between 2 pencils. Be sure that the battery is more than half-way up. With the help of a partner, wrap tape around the pencils and battery as shown. (The two pencils should be taped on either side of a 9 volt battery.)
2. Add water to a clear plastic cup until it is about ½-full.
3. Add about ½ teaspoon of salt to the water and stir until the salt dissolves.
4. Connect one alligator clip to one terminal of the battery.
5. Using the other wire, connect one alligator clip to the other terminal of the battery.
6. Connect one end of the pencil lead to the alligator clip at the end of one of the wires.
7. Using the other wire, connect one end of the other pencil lead to the alligator clip at the end of the wire.
8. Place the other ends of the sharpened pencils not connected to the alligator clips into the water as shown.

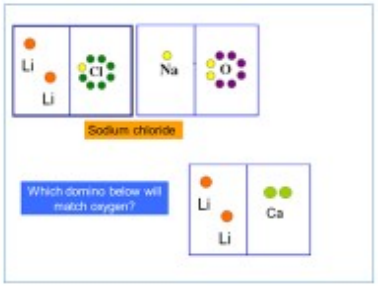
Questions - Answer

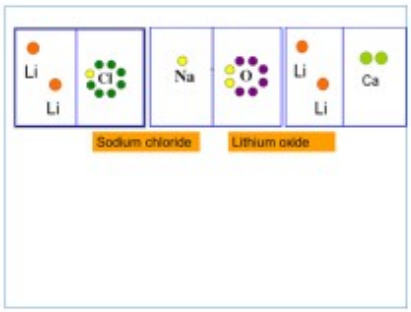
What are the bubbles made out of in the activity?
Hydrogen gas (H_2) and oxygen gas (O_2)

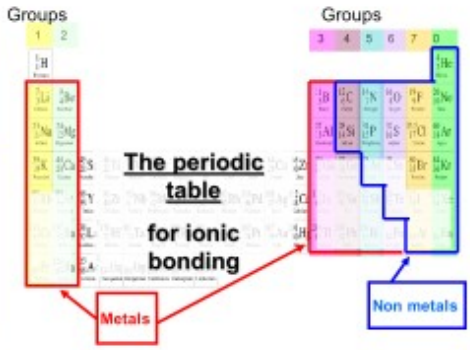
Why was there more hydrogen gas produced than oxygen gas?
Each water molecule breaks into 2 hydrogen atoms and 1 oxygen atom. Two hydrogen atoms then bond to form hydrogen gas (H_2) and 2 oxygen atoms bond to form oxygen gas (O_2). Each water molecule has all the atoms needed to make 1 molecule of hydrogen gas. But with only 1 oxygen atom, a water molecule only has half of what is needed to make 1 molecule of oxygen gas. So, 2 water molecules will produce 2 molecules of hydrogen gas but only 1 molecule of oxygen gas. There are twice as many hydrogen atoms as oxygen atoms so more hydrogen gas is formed.

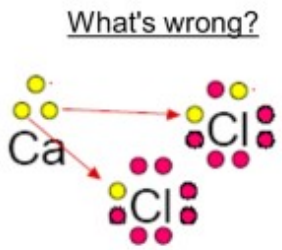
Activity: Ionic Bonding Using Dominoes
https://sharemylesson.com/teaching-resource/ionic-bonding-using-dominoes-168009

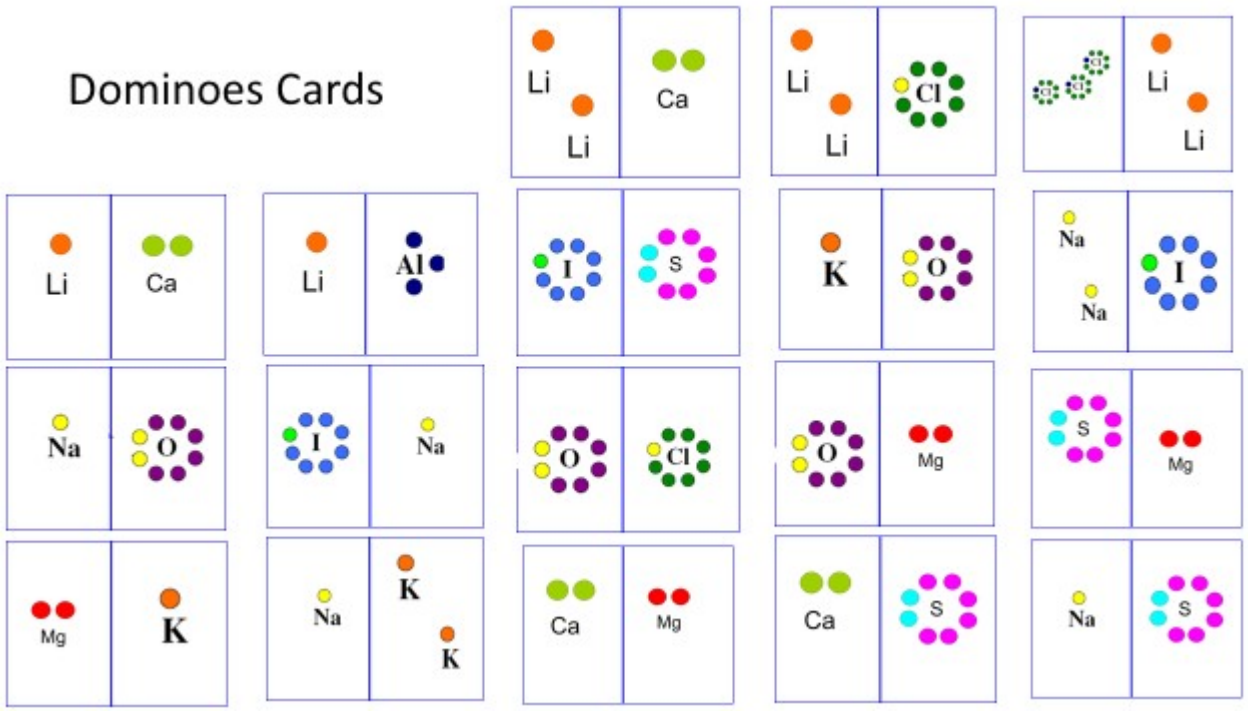










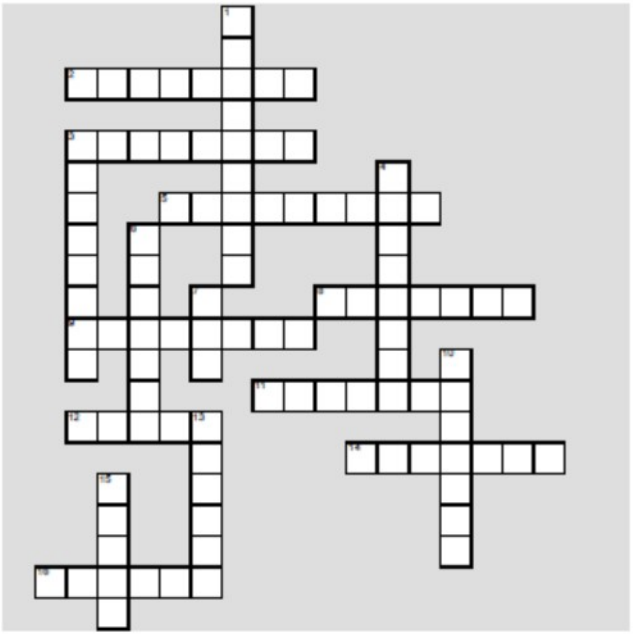


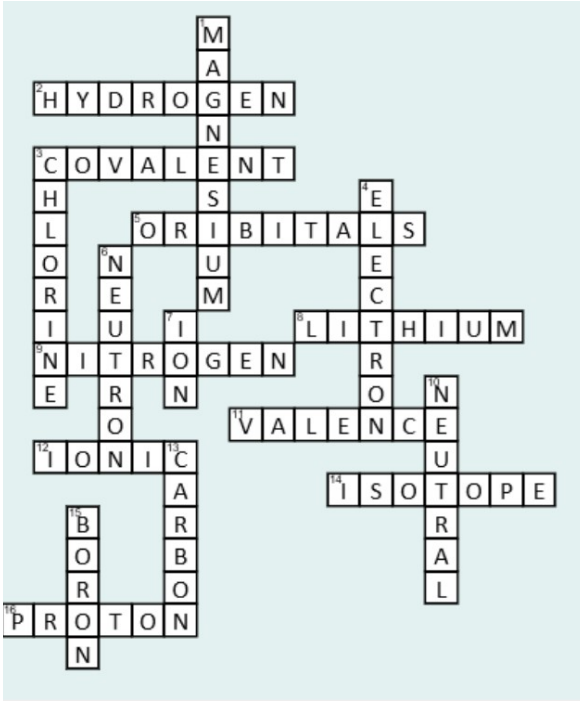
Lesson 4

Activity: Connecting the Dots
https://study.com/academy/lesson/lewis-dot-structure-activities-games.html
Dot Race - Have students use bingo daubers as they race to create Lewis Dot Structures for elements.
Materials
•Copies of element papers
•Bingo daubers
•Periodic table of elements
Preparation
•Prior to the game, create sets of papers with a symbol for a chemical element printed in the center of each paper.
Game

- Show the class the periodic table of elements. Define valence electrons and discuss the number of valence electrons for elements located in different columns of the periodic table.
- Model how to draw Lewis dot structure diagrams for various elements.
- Divide the class into teams and provide each team with a bingo dauber and a set of the element papers created.
- When you say “go” have students on each team take turns using the bingo dauber to put dots around each element to show its Lewis dot structure.
- The first team to correctly create the Lewis dot structures for all their elements wins.

Activity : Crossword Puzzle – Chemical bonding and Atomic Structure
https://crosswordhobbyist.com/448436/Chemical-Bonding-and-Atomic-Structure





Across

2 Atomic Number of 1 with 1 valence electron.

3 Type of bond where electrons are shared

5 Where electrons orbit the atom

8 Atomic Number of 3 and one valence electron.

9 Atomic Number of seven with 5 valence electrons

11 The electrons in the outer shell.

12 Type of bond where elements from column 1 give electrons to those in column 7

14 Same number of protons, different number of neutrons.

Down

1 Atomic number of 12 with 2 valence electrons.

3 Atomic number of 17 with seven valence electrons

4 Negatively charged particle

6 Holds the positive charge in the nucleus together like glue

7 An atom that has gained or lost electons

10 Overall charge when the protons and neutrons are the same.

13 Atomic Number of six with 4 valence electrons.

15 Atomic Number of 5 with 3 valence electrons

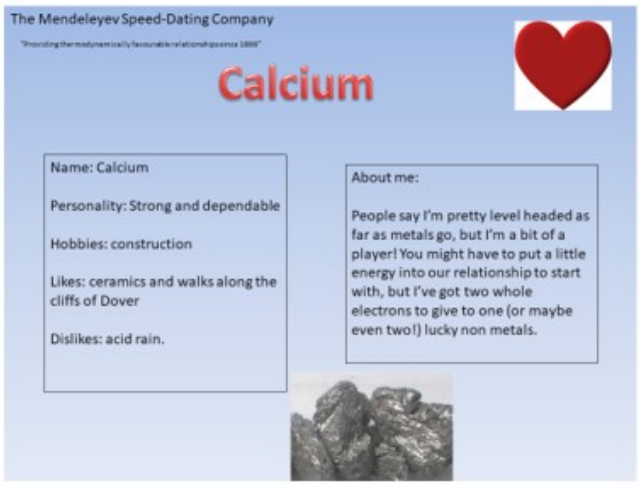
Review Activity – Speed Dating

https://sharemylesson.com/teaching-resource/ionic-bond-speed-dating-164517

Students are given a "dating card" or use their adopted element block - which contains important information and characteristics about their element. Students "speed date" with each other to find another element (or elements) to form a bond with - to make a molecule or compound. Students take turns asking questions to other students. After 1 min or so students move along to the next student and repeat the process.

Wrap up- certificate sheet. Students are given a "Certificate of Bonding sheet"; they must draw a Lewis dot and Bohr diagram for the molecule or compound they made, as well as why they decided to make this bond (covalent or ionic) and if ionic, if it is anionic or cationic.

Sample "Date Card" or information on baby element block to use in activity



Modified to draw a Bohr model and a Lewis Dot Diagram.

Optional Extra Credit Exercise: Valence Finder
https://sharemylesson.com/teaching-resource/build-your-own-valence-finder-249531

Subject: Chemistry & Computational Thinking, Grades levels: 6 - 12

Build a program to determine the valence of any element in the first three rows of the periodic table. SW learn the steps to solve the problem while learning program logic and the need to process data in a sequence. NOTE: The worksheet includes the option of letting students create a bug that they have to fix.

Student Worksheet: Build-your-own Valence finder

What is valence? – Some atoms are "happy" alone and don't care to play or bond with others. Some atoms are "unhappy" alone and really want to play (bond) with others. What determines whether an atom is happy or unhappy and if it wants to form bonds? The number of electrons it has in its outer ring/shell in relationship to number possible in that ring/shell.

For the purposes of determining valence, it is useful to think of the electrons of a particular element as being arranged in layer or shells or rings. The first shell, located closest to the nucleus, can hold 2 electrons. The next two shells, can hold 8 each. The electrons an element has, fill up the closest shell or shells first and any that are left over, fill into the next shell out.

Every atom of any one element usually has the same number of electrons as any other atom of that element. And most elements usually have the same number of electrons as protons. The numbers of protons (and electrons) an element has is known as its atomic number and this number is different for each and every element. The atomic number for fluorine (F on the periodic table) is 7, which means it usually has 7 protons and 7 electrons.
Now let's figure out its valence.

1. How many electrons are on its first shell? _____
2. How many electrons are on its second shell? _____
3. Are there any electrons on its third shell? _____
4. If having a full outer shell is what will make an element "happy" what does fluorine want to do to become happy (hint: it can do two things, but one is more likely)?

_____
_____
The number of electrons an atom/element wants to give or get to become happy is its valence number.

5. What is the valence number for fluorine? _____

Valence also has a sign (or charge) which is what charge the atom will be if it gives or gets electrons.

6. If an atoms gives up an electron or electrons, will it be negatively charged or positively charged – will it have more electrons than protons or less electrons than protons? _____
7. What is the valence charge for fluorine? _____

The combination of an element's valence number and valence charge IS its valence!

For this exercise we will be creating a computer program to determine valence automatically, for any element in the first three rows (periods) of the periodic table. As we work through a valence problem together, we will also write code in the program to do the calculations for us. After we finish writing all the code and save our program, all we need do is run it and enter the any value for an element's atomic number and the program will do the rest!

The programming language we will be using is Python. Don't be scared, it won't bite!

What is Python?
Python is a programming language. It is used to make programs. The programs make the computer do stuff. Computers are stupid but follow directions very well and …fast. Everything that one does with/on a computer or the internet happens within some kind of program that someone created.

Python commands to create an interactive program:
= sets or resets the value for a variable. For example, “x = 5” sets a value for the variable x as 5.
== tests to see if true
print this is needed in a programming window so that the computer will display whatever comes after. For example, “print eval ('35+24')” tells Python to display the answer to 35 + 24.
input allows the program to ask a question of the user and record the answer. For example, “c=input ('How many pets do you have?')” will ask the user for his or her number of pets and store the number entered as the variable c.
if conditional statement to test that a condition has been met
elif next in a series of alternative conditional tests. Used after “if”.
else last in a series of alternative conditional tests. Used after “elif” or “if”.

Procedure:
The first thing we need to do is open up the programming "shell" window. Your teacher will tell you where to find the icon for the application called IDLE. Click to open IDLE also known as the "shell" window. The "shell" window is where we eventually see our program run.
The next thing we want to do is open up a new programming window. Go to the File menu and drag down to New window. The "programming" window is where we will be writing our code. NOTE: the way to easily tell the difference between the shell and program window is that the shell will have the symbol >>> that precedes the blinking cursor.
Since we want our program to be a calculator that can use ANY atomic number let's make it ask for it by typing the following in the new program window:
n = input ("What is the element's atomic number?")
The value will be stored in that variable (holder) and could be used by other equations or it can be displayed by…..this code: print n Let’s code it.
Now let's save our program as ValenceFinder.py and the go to the Run menu and choose run module. NOTE: The program cannot be run until it is saved first. When it asks you "What is the element's atomic number?” type it in and push return.
Now let’s make the program be able to deal with, and find the valence for, the elements on the first row of the periodic table.
8. What is the atomic number for Hydrogen? _____

9. How many electrons does Hydrogen have? _____
10. What is the atomic number for Helium? _____
11. How many electrons does Helium have? _____
12. Why do you think these are the only two elements on the first row (hint: think about shells)?

_____

For this section of our program we want to deal with only elements with these two atomic numbers. How can we specify only these two possible numbers: 1 or 2?

Let's code it! In the programming window, erase print n and type: if n<3:

To have the program deal with hydrogen, whose atomic number is 1, on the next line, indent with one push of the tab key and type If n==1: and push return to get to next line (note: if you put a colon after the if statement it should automatically indent). On this line: print "I'm not happy. I have one electron in a two-possible shell. My valence is positive or negative 1 electron. I'd be happy to give or get one"

To have the program deal with helium, whose atomic number is 1, on the next line, indent with one push of the tab key and type: else: and on the next line: print "I am very happy. I have two electrons in a two possible shell. I don't want to give or get any electrons."

Now let's make the program be able to deal with and find the valence for the elements on the second row of the periodic table. For this section of our program we want to deal with only elements with two atomic numbers between 2 and 10. How can we specify only these two possible numbers: 1 or 2?

Let's code it! In the programming window, on the next line, backspace (twice) to out dent in order to line up with the first if statement, so that we can specify an alternative to if n<3 and type: elif 2<n<11:

13. If we know how many total electrons our elements has, how can we get rid of the electrons on the first shell in order to determine how many are left over to fill in the second shell?

_____

_

Let's code it! On the next line type: v=n-2

There are eight possible electrons on this shell. Only one is "happy", but there are three possible types of "unhappy".

14. Can you think of what the three possible types of unhappy elements there could be?

¬¬¬¬¬¬¬¬-_____

_____

Let's think about the one "happy" element…….

15. If we want the program to deal with the one "happy" valence element, we need help the program to recognize it. How many electrons would a "happy" element in this row have in its outer shell? _____

16. How can we write a conditional if statement to verify that? ¬¬¬¬_____

Code it on the next line.

And put this on the next line: print "I am very happy. I have 8 electrons in an eight-possible outer shell."

Let's think about one of the three "unhappy" types elements that will want to give away electrons (which will give them a positive valence)…….

17. If we want the program to recognize with the “unhappy” positive valence elements, we need help the program to recognize it. How many electrons would a positive valence “unhappy” element in this row have? _____

18. How can we write a conditional if statement to verify that? _____

Code it on the next line. Use elif and a: as this is the second conditional test in a series. AND backspace once to out dent to line up with if v==8:

And put this on the next line: print "I'm not happy. I have", v, “electrons in an eight-possible outer shell. My valence is plus", v, "electrons. I want to give", v," electrons away and when I do I will be more positively charged."

Let's think about another of the three "unhappy" types elements that will want to get electrons (which will give them a negative valence)…….

19. If we want the program to recognize with the “unhappy” negative valence elements, we need help the program to recognize it. How many electrons would a negative valence “unhappy” element in this row have? _____

20. How can we write a conditional if statement to verify that? _____

Code it on the next line. Use elif and a: as this is another conditional test in a series. AND backspace once to out dent to line up with if v==8:

And put this on the next line: print "I'm not happy. I have", v," electrons in an eight-possible outer shell. My valence is negative ", 8-v,". I want to get ", 8-v," electrons and when I do I will be more negatively charged"

Let's think about of the three "unhappy" types elements that would be happy to give or get electrons (which would give it positive OR negative valence)…

21. If we want the program to recognize with the “unhappy” valence elements, we need help the program to recognize it. How many electrons would a positive OR negative valence “unhappy” element in this row have? _____

22. How can we write a conditional if statement to verify that? _____

Code it on the next line. Use elif and a: as this is another conditional test in a series. AND backspace once to out dent to line up with if v==8:

And put this on the next line: print "I'm not happy. I have", v," electrons in an eight-possible outer shell. My valence is negative ", 8-v,". I want to get ", 8-v," electrons and when I do I will be more negatively charged."

We're done for the second row possibilities. You can save and run it.

23. What do you think would be a quick way of creating code for the third row?

_____
__

Out dent all the way, before you paste.

BTW – recycling code and is often done. It saves a lot of typing time!

24. What do we need to change here elif 2<n<11:?

Code it. Save and run it, using a (atomic) number for any element in the third row?

25. What's wrong?

_____

We need to fix something in the program’s code. This is called de-bugging.

26. What do we need to fix?_____

Code it. Save and run it, using a (atomic) number for any element in the third row?

Now the last thing we need to do is write a line that will deal with numbers beyond the third row. We don't really need to test or set up an if condition. All we need to do to catch all the atomic numbers we have not already recognized is out dent all the way and put else:
And put this on the next line print "I'm not on the first three rows so you don't need to know now."
Save and run it!
In our program we had to tell the computer how to recognize and identify valence for any of the elements in first three periods of the table.

27. How did we initially set up the section that dealt with ONLY items on the first row?

_____

28. The second? _____
29. The third? _____
30. How did we enable the program to identify and deal with any of several elements in either the second or third row, which would have a negative valence?
31. A positive valence?
32. A positive or negative valence?
33. Why did we not have to go through such elaborate programming for the first row?

_____

___

If you want you can email the file to yourself, so you can use it to check any valence problems you practice at home. To use your program, you'll need the Python shell (IDLE comes in the bundle) which you can download for free here: http://python.org/download/

Answer key

Now let's figure out its valence.

1. How many electrons are on its first shell? 2
2. How many electrons are on its second shell? 5
3. Are there any electrons on its third shell? None
4. Which shell is the “outer shell”? The second
5. How many electrons can the outer shell hold? 8
6. If having a full outer shell is what will make an element "happy" what does fluorine want to do to become happy? (hint: it can do two things, but one is more likely)

It wants to gain 3 electrons

The number of electrons an atom/element wants to give or get to become happy is its *valence number*.

7. What is the valence number for fluorine? 3

Valence also has a sign (for charge) which matches what charge the atom will be if it loses or gains electrons.

8. If an atom gains an electron or electrons, will it be negatively charged or positively charged – will it have more electrons than protons or less electrons than protons?
   Negatively charged
9. What is the valence charge for fluorine? - 3

The combination of an element's valence number and valence charge IS its *valence*!

For this exercise we will be creating a computer program to determine valence, for any element in the first three rows (periods) of the periodic table. As we work through a valence problem together, we will also write code in the program to do the calculations for us. After we finish writing all the code and save our program, all we need do is run it and enter the value for an element's atomic number and the program will do the rest!

The programming language we will be using is Python. Don't be scared, it won't bite!

What is Python?

Python is a programming language. It is used to make programs. The programs make the computer do stuff. Computers are stupid but follow directions very well … and fast! Everything that one does with/on a computer or the internet happens within a program that someone created.

Python commands to create an interactive program:

=	sets or resets the value for a variable. For example, “x = 5” sets a value for the variable x as 5.
==	tests to see if true
print	this is needed in **a programming window** so that the computer will display whatever comes after. For example, “print eval ('35+24')” tells Python to display the answer to 35 + 24.
input	allows the program to ask a question of the user and record the answer. For example, “c=input ('How many pets do you have?')” will ask the user for his or her number of pets and store the number entered as the variable c.
if	conditional statement to test that a condition has been met
elif	next in a series of alternative conditional tests. Used after “if”.
else	last in a series of alternative conditional tests. Used after “elif” or “if”.

Procedure:

The first thing we need to do is open up the shell window. Your teacher will tell you where to find the icon for the application called IDLE. Open IDLE to get to the shell window. The shell is where we eventually see our program run.

The next thing we want to do is open a new programming window. Go to the File menu and drag down to New Window. The programming window is where we will be writing our code. NOTE: the way to easily tell the difference between the shell and program window is that the shell will have the symbol >>> that precedes the blinking cursor and the programming window will be completely blank.

Since we want our program to be a calculator that can use ANY atomic number let's make it ask for one by typing the following in the new program window:

n = input ("What is the element's atomic number?")

What this does:
asks the user for input, which it will store in a variable named *n*.

The value will be stored in the variable and could be used by other equations or it can be displayed by…this code (type it on the next line):

print n

Now let's save our program as *ValenceFinder.py* and the go to *Run* menu and choose *run module*. NOTE: The program cannot be until it is saved first. When it asks you "What is the element's atomic number?" type it in and push return.


Make sure they put .py at end.

the run

Now let's make the program find the valence for elements on the **first** row of the periodic table.

10. What is the atomic number for Hydrogen? 1
11. How many electrons does Hydrogen have? 1
12. What is the atomic number for Helium? 2
13. How many electrons does Helium have? 2
14. Why do you think these are the only two elements on the first row? (hint: think about shells) They only have electrons on the first shell (which can hold only 2 electrons)

For this section of our program we want to deal with only elements with these two atomic numbers. How can we specify only these two possible numbers: 1 or 2? If n<3

Let's code it! In the programming window, erase *print n* and type: *if n<3:*

To have the program deal with hydrogen, whose atomic number is 1… on the next line, indent with one push of the tab key and type *If n==1:* and push return to get to next line (note: putting a colon after the if statement will help it automatically indent). On this line code*: print "I'm not*

happy. I have one electron in a two-possible shell. My valence is positive or negative 1 electron. I'd be happy to give or get one"

To have the program deal with helium, whose atomic number is 2… on the next line, indent with one press of the tab key and type *else:* and on the next line: *print "I am very happy. I have two electrons in a two possible shell. I don't want to give or get any electrons."*

Now let's make the program find the valence for the elements on the **second** row of the periodic table. For this section of our program we want to deal with only elements with two atomic

numbers between 3 and 10 (inclusive).

What this does:
This specifies a range of atomic numbers for the second row which will be dealt with by code written next.

15. Why do we only go up to 10 in this row? They only have electrons on second shell (plus 2 on the first)
16. How can we specify ONLY numbers in this range? elif 2<n<11

Let's code it! In the programming window, on the next line, backspace (twice) to back up to line up with the first if statement, so that we can specify an alternative to *if n<3* and type: *elif 2<n<11:*

Make sure they backspace to outdent.

17. If we know how many total electrons our elements has, how can we get rid of the electrons on the first shell in order to determine how many are left over for the second shell? v=n-2

Let's code it! On the next line type: *v=n-2*

There are eight possible electrons on this shell. Only one is "happy", but there are three possible types of "unhappy".

18. Can you think of what the three possible types of unhappy elements there could be? - Ones that want to gain electrons, lose electrons and one that would be happy to gain or lose.

Now, let's think about the one "happy" element…….

19. If we want the program to deal with the one "happy" valence element, we need help the program to recognize it. How many electrons would a "happy" element in this row have in its outer shell? 8

NOTE: We CANNOT use *if v=8* to test what is currently held in v because *v=8* would put 8 in v no matter what had currently been there. We CAN use *v==8* which test to see if it is TRUE. We also need to put a colon after the test to signal an action is going to be performed – in this case print.

20. How can we write a conditional if statement to verify that? v==8

Code it on the next line.

And put this on the next line: *print "I am very happy. I have 8 electrons in an eight-possible outer shell."*

Let's think about one of the three "unhappy" types elements that will want to give away electrons (which will give them a positive valence)…….

21. If we want the program to recognize the "unhappy" **positive** valence elements, we need help the program recognize them. How many electrons would a positive valence "unhappy" element in this row have in its outer shell? There are several possibilities… v=1, 2 or 3

22. How can we write a conditional if statement to verify any of those possibilities? v<4

Code it on the next line. Use *elif* and a: as this is the second conditional test in a series. AND backspace once to outdent to line up with *if v==8:*


It is very important to get the quotations and commas correct in the print code.

Put this on the next line: *print "I'm not happy. I have", v, " electrons in an eight-possible outer shell. My valence is plus", v, "electrons. I want to give", v," electrons away and when I do I will be more positively charged."*

NOTE: The, *v,* inserted a various point in between quoted text will tell the program to print the value held in the v variable, at those points in the printed text. Make sure the commas and quotation marks are exact.

Let's think about another of the three "unhappy" types of elements that will want to gain electrons (which will give them a negative valence)…….

23. If we want the program to recognize the "unhappy" **negative** valence elements, we need help the program recognize them, too. How many electrons would a negative valence "unhappy" element in this row have in its outer shell? There are several possibilities… v=5, 6 or 7

24. How can we write a conditional if statement to verify any of those possibilities? v>4

Code it on the next line. Use *elif* and a: as this is another conditional test in a series. Don't forget to backspace once to outdent to line up with *if v>4:*

And put this on the next line: *print "I'm not happy. I have", v," electrons in an eight-possible outer shell. My valence is negative ", 8-v,". I want to get ", 8-v," electrons and when I do I will be more negatively charged"*

Let's think about the last of the three "unhappy" types of elements. It would be happy to lose or gain electrons (which would give it positive OR negative valence)…

25. If we want the program to recognize with the “unhappy” valence elements, we need help the program to recognize it. How many electrons would a positive OR negative valence “unhappy” element in this row have in its outer shell? 4

26. How can we write a conditional if statement to verify that? v==4

Code it on the next line. Use *elif* and a: as this is another conditional test in a series. AND backspace once to outdent to line up with *if v==8:*

And put this on the next line: *print "I'm not happy. I have 4 elections in an eight-possible outer shell. My valence is positive AND negative 4. I want to get OR give 4 electrons."*

We're done for the second row possibilities. You can save and run it. Your program should look like this

```
n = input("What is the element's atomic number?")

if n<3:
    if n==1:
        print "I'm not happy. I have one electron in a two-possible shell.  My valence is plus or minus 1 electron. I'd
    else:
        print "I am very happy.  I have two electons in a two possible shell.  I don't want to give or get any electrons
elif 2<n<10:
    v=n-2
    if v==8:
        print "I am very happy. I have 8 electrons in an eight-possible shell."
    elif v<4:
        print "I'm not happy. I have", v, " electrons in a eight-possible outer shell.  My valence is plus", v, "electr
    elif v>4:
        print "I'm not happy.  I have", v," electons in a eight-possible outer shell.  My valence is negative ", 8-v,".
    elif v==4:
        print "I'm not happy.  I have 4 electons in a eight-possible outer shell.  My valence is positive AND negative
```

27.
27.
27.
27.
27.
27.

What do you think would be a quick way of creating code for the third row? Copy and paste

Outdent all the way, before you paste.

Recycling code by copying and pasting is done often. It saves lots of typing time!

28. What do we need to change here *elif 2<n<11*:? Change to *elif 10<n<19:*

Code it. Save and run it, using a (atomic) number for any element in the third row.

29. What's wrong? Need to change *v=n-2* to this *v=n-10*

This copying/coding error was included to illustrate what can happen if a line of code is not correct and the need to "debug" it. It can be included or changed (by inserting the correct instruction in the worksheet) to eliminate it.

We need to fix something in the programs code. This is called de-bugging.

30. What do we need to fix? Need to change *v=n-2* to this *v=n-10*

Code it. Save and run it, using a (atomic) number for any element in the third row?

Now the last thing we need to do is write a line that will deal with numbers beyond the third row. We don't really need to test or set up an *if* condition. All we need to do to catch all the atomic numbers we have not already recognized is out dent all the way and put *else:*

And put this on the next line *print "I'm not on the first three rows so you don't need to know now."*

Code it. Save and run it!

In our program we had to tell the computer how to recognize and identify valence for any of the elements in first three periods of the table.

31. How did we initially set up the section that dealt with ONLY items on the first row (the code)? if n<3:
32. The second? elif 2<n<11:
33. The third? elif 10<n<19:
34. How did we enable the program to identify any of several elements in either the second or third row, which would have a negative valence? v>4
35. A positive valence? v<4
36. A positive or negative valence? v==4
37. Why did we not have to go through such elaborate programming for the first row? We had just two possibilities

If you want you can email the file to yourself, so you can use it to check any valence problems you practice at home. To use your program, you'll need the Python shell (IDLE comes in the bundle), which you can download for free at http://python.org/download/

CA 8th Grade Science Standards
Structure of Matter
3. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements.
As a basis for understanding this concept:
a. Students know the structure of the atom and know it is composed of protons, neutrons, and electrons.

The ISTE - National Educational Technology Standards (NETS•S)
1. Creativity and Innovation
Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students:
a. apply existing knowledge to generate new ideas, products, or processes.
3. Research and Information Fluency
Students apply digital tools to gather, evaluate, and use information. Students:
d. process data and report results.
6. Technology Operations and Concepts
Students demonstrate a sound understanding of technology concepts, systems, and operations. Students:
a. understand and use technology systems.
b. select and use applications effectively and productively.
c. troubleshoot systems and applications.