Transformation 2013 PBL 5E Planning Form Guide

PBL Title: The Periodic Table Game

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School: Education Service Center, Region XIII

Subject: Chemistry I

Abstract: In this design challenge, students will learn about and teach, through their Periodic Table game, the many physical and chemical characteristics of the elements. This will include the characteristics of subatomic particles and atoms involved in chemical bonding.

MEETING THE NEEDS OF STEM EDUCATION THROUGH PROBLEM BASED LEARNING

Begin with the End in Mind

The theme or "big ideas" for this PBL:

Through a periodic table game, students will teach and assess other students' knowledge of the physical and chemical traits of the elements, including the properties of the subatomic particles and the characteristics of atoms involved in chemical bonding and the concepts of periodicity.

TEKS/SEs that students will learn in the PBL:

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:

(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(B) collect data and make measurements with precision;

(D) organize, analyze, evaluate, make inferences, and predict trends from data; and

(E) communicate valid conclusions.

(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;

(C) evaluate the impact of research on scientific thought, society, and the environment;

(D) describe the connection between chemistry and future careers.

(4) Science concepts. The student knows the characteristics of matter. The student is expected to:

(D) describe the physical and chemical characteristics of an element using the periodic table and make inferences about its chemical behavior.

(6) Science concepts. The student knows that atomic structure is determined by nuclear composition, allowable electron cloud, and subatomic particles. The student is expected to:

(A) describe the existence and properties of subatomic particles;

(B) analyze stable and unstable isotopes of an element to determine the relationship between the isotope's stability and its application; and

(C) summarize the historical development of the periodic table to understand the concept of periodicity.

(8) Science concepts. The student knows how atoms form bonds to acquire a stable arrangement of electrons. The student is expected to:

(A) identify characteristics of atoms involved in chemical bonding.

Key performance indicators students will develop in this PBL:

Develop vocabulary (element, atom, nucleus, proton, electron, neutron, energy levels, electron cloud, nucleons, isotopes, atomic mass, mass number, atomic number, Bohr models, family names, group numbers, valence electrons, periods, energy levels, electronegativity, atomic radii, ionization energy, electron affinity, photon, quantum, ground state, excited state, oxidation numbers, ions, cations, anions, ionic bond, covalent bond), describe the physical and chemical characteristics of an element, identify independent variables, constants, and dependent variables in experiments, form hypotheses, find patterns, solve atomic math problems, read, interpret and use the periodic table of the elements, identify key theorists of the atomic theory, identify characteristics of atoms involved in chemical bonding, create an interactive game based on properties of chemical and physical characteristics of elements, periodicity and bonding (ionic and covalent).

21st century skills that students will practice in this PBL:
www.21stcenturyskills.org

Creativity, innovation, communication, collaboration, media technology, ICT technology, flexibility, adaptability, social, productivity, accountability, leadership and responsibility skills

STEM career connections and real world applications of content learned in this PBL:

Careers: General chemistry, nuclear chemistry, laboratory technology, scientific research, chemical engineering, marketing, gaming development, educational learning marketing,
STEM Connection: Science, math, engineering, and technology.
Real world connection: Patterns and trends are found throughout the universe. Recognizing patterns and problem solving are essential skills for survival in the 21st century.

The Problem

The Periodic Table Game

Scenario

Every time you say you like or don't like something, you are putting it into a category. You have probably developed categories for many things in your life. You may have categories for food you eat for breakfast, as opposed to dinner, or for clothes you wear to school, as opposed to at home. Can you imagine what your life would be like if nothing were sorted into categories? What if you went shopping in a supermarket that displayed milk next to shoe polish, next to oranges, next to oatmeal, next to hams, next to orange juice, next to detergent? Where would you look for yogurt, shoelaces, corn flakes, ground beef, lemonade, and soap?

That kind of supermarket display pretty much describes the state of chemistry in the mid-19th century. By then chemists had identified and isolated a large number of chemical elements, but they needed a way to sort them into categories – much as a supermarket groups milk with yogurt, shoe polish with shoe laces, oatmeal with corn flakes, ham with ground beef, orange juice with lemonade, and detergent with soap.

Like similar items in a supermarket, some chemical elements were recognized to share similar chemical properties. The first chemist to arrange these elements successfully into a pattern according to their properties was the Russian, Dimitri Mendeleev.

One of the things Mendeleev did was to write down everything that was known about each element on a small card. Then he moved the cards around until he got an arrangement that showed the groups of elements with similar properties.

In Mendeleev's time the periodic table was developed as a way to arrange elements according to their chemical behavior. Surprisingly, it then revealed information about the structure of the atoms of those elements as well.

By writing the properties of the elements onto separate cards and arranging them,

Mendeleev created a puzzle, and he solved that puzzle when he arranged the first version of what is now known as the Periodic Table of the Elements. The German, Julius Lothar Meyer, independently created the table at the same time.

Unit Challenge

Your challenge in this unit is to develop a game related to Mendeleev's Periodic Table of the Elements. **How the game is played, whether on a table, with cards, on a computer, or with equipment that only you might choose is up to you.** You might even choose to emphasize some aspects of the periodic table over others, or to focus on some types of information presented by the table rather than others. However, you need to keep in mind the ***rubric that is given to you by your teacher.***

Rubric

How will your game be graded? What qualities should a good game have? A rubric will be used to grade your game according to the following factors:

- Incorporating a variety of chemistry concepts related to the periodic table
- Correctly and sufficiently addressing the concepts
- Providing clear and concise explanations for the concepts presented
- Integrating the concepts into the game in a ***creative way***
- Appropriateness for high school
- Allowing players to practice learned concepts
- Creating rules that are straightforward and making the game easy to play
- Making the game interesting and entertaining!!

(SEE ATTACHED RUBRIC!!!!!!)

Map the PBL

Performance Indicators	Already Learned	Taught before the project	Taught during the project
1. Vocabulary: element, atom, nucleus, proton, electron, neutron, energy levels, electron cloud, nucleons, isotopes, atomic mass, mass number, atomic number, Bohr models, family names, group numbers, valence electrons, periods, energy levels, electronegativity, atomic radii, ionization energy, electron affinity, photon, quantum, ground state, excited state, oxidation numbers, ions, cations, anions, ionic bond, covalent bond		X	X
2. Describe the physical and chemical characteristics of an element		X	X
3. Describe the existence and properties of subatomic particles		X	X
4. Identify independent variables, constants, and dependent variables in an investigative lab and create/form hypotheses	X	X	X
5. Summarize the historical development of the periodic table and atomic theory		X	X
6. How to solve atomic math problems		X	X
7. How to find patterns	X	X	X
8. Analyze stable and unstable isotopes		X	X
9. How to read, interpret and use the periodic table of the elements		X	X
10. Identify characteristics of atoms involved in chemical bonding		X	X
11. Create an interactive game based on properties of chemical and physical characteristics of elements, periodicity and bonding		X	X

5E Lesson Plan

PBL Title: The Periodic Table Game
TEKS/TAKS objectives: 1A,B; 2A,B,D,E; 3,A,D,E; 4D; 6A,B,C; 8A
Engage Activity

Attention grabber:

1. Pass out copies of the Periodic Table (see below).
2. Play the "Element Song" for the students. http://www.teachertube.com/view_video.php?viewkey=f102e07a6c8c7333b685&page=15&viewtype=&category. Click on the far right icon on the bottom of play screen to expand to full screen.
3. Bring out some of your favorite board games. Try some modern ones like Cranium, Pop 5, Quelf, etc. Ask the students what are the most important aspects to any game they like to play. Ask them what keeps them wanting to play the game again and again. What tires them of playing a game? Why do they lose interest in some games?

Focus: For the next few weeks, our project will be focusing on learning about (and eventually teaching about) the periodic table through a game that you and your team will design. The concepts of the atom, its structure, the physical and chemical characteristics of the elements of the periodic table and the concepts of periodicity will also be explored.

Introduce students to the project:

The Periodic Table Game

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Like similar items in a supermarket, some chemical elements were recognized to share similar chemical properties. The first chemist to arrange these elements successfully into a pattern according to their properties was the Russian, Dimitri Mendeleev.

One of the things Mendeleev did was to write down everything that was known about each element on a small card. Then he moved the cards around until he got an arrangement that showed the groups of elements with similar properties.

In Mendeleev's time the periodic table was developed as a way to arrange elements according to their chemical behavior. Surprisingly, it then revealed information about the structure of the atoms of those elements as well.

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- Making the game interesting and entertaining!!

(SEE ATTACHED RUBRIC!!!!!!)

Engage Activity Products and Artifacts

None

Engage Activity Materials/Equipment

Teacher Computer, Internet, Periodic Table Game Handout, Periodic Tables (TAKS version), Various board games

Engage Activity Resources

http://www.teachertube.com/view_video.php?viewkey=f102e07a6c8c7333b685&page=15&viewtype=&category The Element Song

Explore Activity

Foldable: Students will create a *Dina Zikes* Foldable of the "Seven Dead Chemists of the Atomic Theory" as you go through slides 1-19 of the attached "Atom History & Structure" PowerPoint (see Transformation 2013 website).

Activity: Students will then get into groups of two to play "Atomic Battleship". Instructions and Battle ship grids templates are below.

- **Atomic Battleship Activity**
  1. Partner activity
  2. Each partner receives 2 grids—one of their "battleship" and another to monitor hits/misses of partner's "battleship"
  3. To save time, have different partner pairs use 5 squares, 3 squares, and two squares
  4. **Compare results and relate to Rutherford's Gold Foil experiment**

Explore Activity Products and Artifacts

- Student Foldable of the "Seven Dead Chemists of the Atomic Theory"
- Atomic Battleship Grids

Explore Activity Materials/Equipment

Colored Paper, Teacher computer, LCD projector, PowerPoint: "Atom History & Structure", "Atomic Battleship" Instructions and Battleship grids

Explore Activity Resources

Dina Zikes Foldables Book or use your own version of a foldable, http://www.chalkbored.com/lessons/chemistry-11/atomic-models-handout.pdf

Explain Activity

Debrief: "Atomic Battleship" –Emphasize the connection between the difficulty of discovering the traits of the subatomic particles with the "Atomic Battleship" activity. Bring in Rutherford's Gold Foil Experiment as the main connection.

Students go to Brain Pop: Atomic Model & History
http://www.brainpop.com/science/matterandchemistry/atomicmodel/

Quiz: "The Seven Dead chemists of the Atomic Theory" –**Teacher generated.*

- Students could take the quiz on Brain Pop for the Atomic Model and email it to you as one option.

Explain Activity Products and Artifacts

Quiz: "The Seven Dead chemists of the Atomic Theory" –**Teacher generated*

Explain Activity Materials/Equipment

Chemistry journals/spirals, Computer Lab, Internet, Quiz (Brain Pop's or teacher generated)

Explain Activity Resources

http://www.brainpop.com/science/matterandchemistry/atomicmodel/ -Brain Pop (Atomic Model & History)

Explore Activity

Students log on to computers and open "Atomic Structure" PowerPoint (see Transformation 2013 website). Using the handout titled "Atomic Structure" (see below) they will complete the very brief PowerPoint on their own and take the directed notes on the handout.

Brain Pop: Atoms http://www.brainpop.com/science/matterandchemistry/atoms/

Practice: Complete "Anatomy of an Atom" Reading and Worksheet (see Transformation 2013 website).

LAB: BEANIUM Isotope Lab (see Transformation 2013 website)*:* Teams of 2-3 lab partners complete activity, IVCDV chart, hypothesis, calculations and conclusion. Generate a lab report as a final product.

Practice: "Isotopic Notations" Worksheet (see Transformation 2013 website)

Explore Activity Products and Artifacts

- "Atomic Structure" handout, filled out with notes from PowerPoint.
- Practice: "Anatomy of an Atom" Worksheet (read and answered, see 2013 website).
- Practice: "Isotopic Notations" (completed, see 2013 website)

Explore Activity Materials/Equipment

Teacher computer, LCD projector, Computer Lab, Internet, "Atomic Structure" Handout, "Anatomy of an Atom" worksheet, "Isotopic Notations" worksheet, "Beanium Lab", plastic cups and/or Ziploc bags of dried beans (black, brown, & white); electronic balance

Explore Activity Resources

PowerPoint: "Atom History & Structure", PowerPoint: "Atomic Structure"
http://www.brainpop.com/science/matterandchemistry/atoms/ -Brain Pop (Atoms)

Explain Activity

- Debrief: "Beanium Isotope Lab"- Emphasize Hypothesis, IVCDV's, Results, Analysis and Conclusions.

- Students will work within their teams to create a Word Wall of the following terms: **element, atom, nucleus, proton, electron, neutron, energy levels, electron cloud, nucleons, isotopes, atomic mass, mass number, atomic number, Bohr model**

- These words need to be defined in simple terms in their chemistry journals/spiral as well. Students should use slides 20-29 of the "Atom History & Structure" PowerPoint to aid them in defining and grasping the concepts of the above terms.

- Brain Pop: Isotopes
http://www.brainpop.com/science/matterandchemistry/isotopes/

- Quiz: Atomic Structure and Isotopes –**Teacher generated.*
    - Students could take the quiz on Brain Pop for the Atomic Model and email it to you as one option.

Explain Activity Products and Artifacts

- Beanium Lab Report

- Atomic Word Wall

- Quiz: Atomic Structure and Isotopes –**Teacher generated or Brain Pop's*

Explain Activity Materials/Equipment

Chemistry journals/spirals, Computer Lab, Internet, Card stock, Printer, Laminator, Quiz (Brain Pop's or teacher generated)

Explain Activity Resources

PowerPoint: "Atom History & Structure", PowerPoint: "Atomic Structure"
http://www.brainpop.com/science/matterandchemistry/isotopes/ -Brain Pop (Isotopes)

Explore Activity

- Students given blank periodic table (see below), map pencils & markers. *–For use later…*
- Ask them how they think the Periodic Table is organized or why it is shaped the way it is.
- Play **"History of the Periodic Table" PPT** and talk about Dmitri Mendeleev.
- ***Team Building Activity: Periodic Table Puzzle (optional)-** *purchase at…*
  http://www.amep.com/standarddetail.asp?cid=586
- **Teachers take one card out of set for each team. Do not give the students hints or clues, but ask them "How do you think Dmitri Mendeleev found the patterns that he used to organize the modern periodic table?"**
- While going over & taking notes regarding **"The Periodic Table" PPT**, students are to color in and label the blank periodic table. Starting on slide 6 draw a thick black line along the stairstep that divides the metals from non-metals. Label the table metals, non-metals, and metalloids. Label the Alkali Metals, the Alkaline Earth Metals, the Boron Family, Carbon Family, Nitrogen Family, Oxygen or Chalcogens, the Halogens and the Noble Gases. Number the Groups and Periods (if not already done). Draw arrows indicating which way the groups/families and periods run. Label the Transition Metals and the Rare Earth/Inner Transitions Metals. Stop notes at "electron configuration" slide 17.
- Practice: "Mendeleev's Math" Worksheet

Explore Activity Products and Artifacts

- Student results for "Periodic Table Puzzle Activity"
- Completed "Blank" Periodic Table includes: families names, group #s, period #s, stair-step line, metals, metalloids, and non-metals (sections labeled)
- Practice: "Mendeleev's Math" Worksheet (completed)

Explore Activity Materials/Equipment

Teacher computer, LCD projector, Computer Lab, Internet, Chemistry journals/spirals, "Blank" Periodic Table, "Mendeleev's Math" worksheet,

Explore Activity Resources

PowerPoint: "History of the Periodic Table", PowerPoint: "The Periodic Table"
http://www.amep.com/standarddetail.asp?cid=586 -Where to purchase "Periodic Table Puzzle"
http://www.teachertube.com/view_video.php?viewkey=35e3f32c487236668155 -The Families/Groups
http://modelscience.com/PeriodicTable.html -The Families/Groups (interactive)

Explain Activity

Debrief: Periodic Table Puzzle Activity. Make connection to trends and patterns found in nature and in the periodic table.

Brain Pop: The Periodic Table of the Elements
http://www.brainpop.com/science/matterandchemistry/periodictableofelements/

Review: **Family names, group numbers/valence electrons, periods/energy levels** from last classes colored and labeled periodic tables. Place these terms on the Word Wall.

Practice: "It's Elemental" Worksheet

Practice: Draw and label Bohr Models. Teacher led for first 2 examples. (Lithium, Sodium). Students complete last four on their own (Neon, Carbon, Sulfur, Chlorine) Teachers may want to give students another sheet to practice more Bohr models. Make connections between: valence electrons and group number, energy levels and periods, protons and atomic number, mass number and total # of nucleons.

PBL PROJECT UPDATE: Students brainstorm within their teams about "Periodic Table Game" concept.

- Check off what concepts have been covered already.
- Discuss types of games to be executed.
- Develop strategies to divide the workload.
- Begin to fill out the Periodic Table Update. Due 2 classes from today.

Quiz: Bohr Model/ E-Quiz: The Periodic Table (see below)

Explain Activity Products and Artifacts

- Practice: "It's Elemental " Worksheet (see 2013 website)
- Updated Word Wall
- Bohr models (6-12 examples) (see below)
- **PBL PROJECT UPDATE** brainstorming notes in project journal.
- Quiz: Bohr Model/ E-Quiz: The Periodic Table (see below)

Explain Activity Materials/Equipment

Chemistry journals/spirals, Card stock, Printer, Laminator, Blank Bohr model worksheet, Periodic Table Game Handout, Periodic Table Game Update Sheet, Teacher and Student Evaluation Sheet/Rubric, Project Journals, Quiz: Bohr Model/ E-, Quiz: The Periodic Table

Explain Activity Resources

http://www.chemicalelements.com/ -Elements/Bohr Models
http://www.bu.edu/gk12/angela/addematom.htm - Brief Bohr Model Lab
http://chemistry.about.com/library/PeriodicTableallcolor.pdf -Color coded periodic table
http://www.brainpop.com/science/matterandchemistry/periodictableofelements/ -Brain Pop (Periodic Table)

Explore Activity

Introduce **electron configuration**.
http://ims.ode.state.oh.us/ODE/IMS/Lessons/Content/CSC_LP_S03_BC_L12_I12_01.pdf

Complete "Periodic Table" PPT (Slides 17-36) –Electron configuration. Use another E-configuration, Blank Periodic Table, Map Pencils to fill-in/color s, p, d, f sub-levels.

Practice: Electron Configuration Worksheet* *Teacher generated or use one provided.*

More Practice: Electron Configuration Lesson …see site below and worksheets provided
http://www.bu.edu/gk12/angela/electron.htm#slides

Explore Activity Products and Artifacts

Electron Configuration/Sub-levels Periodic Table
Practice: Electron Configuration Worksheet* *Teacher generated or use one provided.*
Practice: Electron Configuration Lesson (competed worksheets)

Explore Activity Materials/Equipment

Teacher computer, LCD projector, Computer Lab, Internet, Chemistry journals/spirals, "Blank" Electron Configuration Periodic Table, " Electron Configuration" worksheets," Electron Configuration Lesson" worksheet

Explore Activity Resources

PowerPoint: "The Periodic Table", PowerPoint: "Electron Configuration",
http://ims.ode.state.oh.us/ODE/IMS/Lessons/Content/CSC_LP_S03_BC_L12_I12_01.pdf (E- Config. Teacher instruct, lesson, & wrkshts)
http://www.bu.edu/gk12/angela/electron.htm#slides -Electron Configuration instructions with PPT and Worksheets
http://webs.rps205.com/curriculum/science/images/987174146C2241C393023F3318186CAF.JPG -Blank Periodic Table
http://www.nisd.net/communicationsarts/pages/chem/docs/pertable_ho.pdf - Sublevels/Blocks Periodic Table

Explain Activity

Debrief: Electron Configuration- Review & practice more problems.

Quiz: Bohr Model and E^- Configuration

Explain Activity Products and Artifacts

Quiz: Bohr Model and E^- Configuration

Explain Activity Materials/Equipment

Chemistry journals/spirals, Electron Configuration Worksheets, Quiz: Bohr Model and E^- Configuration

Explain Activity Resources

PowerPoint: "The Periodic Table", PowerPoint: "Electron Configuration",
http://ims.ode.state.oh.us/ODE/IMS/Lessons/Content/CSC_LP_S03_BC_L12_I12_01.pd

f (E- Config. Teacher instruct, lesson, & worksheets)
http://www.bu.edu/gk12/angela/electron.htm#slides -Electron Configuration instructions with PPT and Worksheets
http://webs.rps205.com/curriculum/science/images/987174146C2241C393023F3318186CAF.JPG -Blank Periodic Table
http://www.nisd.net/communicationsarts/pages/chem/docs/pertable_ho.pdf - Sublevels/Blocks Periodic Table

Explore Activity

Notes: Periodic Trends "The Periodic Table" PPT (slides 37-49)
- *Teachers*…Print Slide 42 as a handout for students.

Students visit these websites on Periodic Trends:
Electronegativity:
http://www.teachertube.com/view_video.php?viewkey=92f0fad2f13e29e1762e
Ionization Energy:
http://www.teachertube.com/view_video.php?viewkey=3254b7afa62e020447c8
Atomic Radii:
http://www.teachertube.com/view_video.php?viewkey=3b7f034269ad747c93a4

LAB*: *Flame Test (see Transformation 2013 website)
- Complete pre-lab
- Students will use Bunsen burners to create own emission spectrums using chemical salts or solutions (teacher discretion)
- Answer lab questions

DUE: PBL PROJECT UPDATE: *Students brainstorm within their teams about "Periodic Table Game" concept.*
- *Check off what concepts have been covered already.*
- *Discuss types of games to be executed.*
- *Develop strategies to divide the workload.*

Explore Activity Products and Artifacts

LAB: Flame Test
DUE: PBL PROJECT UPDATE

Explore Activity Materials/Equipment

Teacher computer, LCD projector, Computer Lab, Internet, Chemistry journals/spirals, LAB: Flame Test, Materials for Lab: Inoculation loop, Bunsen burner, Dilute HCl, Distilled H_2O, Spot plates, 8 Chloride test solutions, Safety goggles, Aprons

Explore Activity Resources

PowerPoint: "The Periodic Table",
Electronegativity:
http://www.teachertube.com/view_video.php?viewkey=92f0fad2f13e29e1762e
Ionization Energy:
http://www.teachertube.com/view_video.php?viewkey=3254b7afa62e020447c8
Atomic Radii:
http://www.teachertube.com/view_video.php?viewkey=3b7f034269ad747c93a4
http://www.chemistry.wustl.edu/~courses/genchem/Labs/IonExchange/Flame.htm -Pics of Flame Test

Explain Activity

Debrief: Flame Test Lab-Discuss with students their observations of the unique emission spectrums given off by movement of electrons in the chloride compounds in response to heat energy.

Review: Electronegativity, atomic radii, ionization energy, electron affinity, photon, quantum, ground state, excited state. Place these terms on the Word Wall.

Explain Activity Products and Artifacts

Lab Report: Flame Test Lab
Updated Word Wall

Explain Activity Materials/Equipment

Chemistry journals/spirals, Card stock, Printer, Laminator

Explain Activity Resources

None

Explore Activity

Brain Pop: Ions
http://www.brainpop.com/science/matterandchemistry/ions/

Oxidation Numbers: Place Oxidation #s above Groups 1, 2, 13, 14, 15, 16, 17 on the students Periodic Table (TAKS version). **Fold up (hide) the Actinide/Lanthanide series, and fold in (hide) the transition metals so only Groups 1,2,13,14,15,16,17.**

Practice: Compare Atoms to Ions

- Using Blank Bohr Model Sheets (see below) have students draw:
- **Li** and **Li^{+}, Mg** and **Mg^{+2}, Al** and **Al^{+3},**
- **Cl** and **Cl^{-}, O** and **O^{-2}, Ne and Ne (**explain why there are no **ions** for the **Noble gases)**

- Discuss**: Cations (+) and Anions (-)** and how they pair up.
    - Use "Chemical Bonds" PPT (Slides 1-31)
    - Handout "Bonding and Naming Notes" (Emphasis on bonding. *Naming will be discussed in future lessons*) (see Transformation 2013 website)
    - Practice**: Lewis Dot Diagram Worksheet & How Atoms use E- to Bond** (see Transformation 2013 website)

Prepare: Students will bring materials to work on *about "Periodic Table Game"* project next class.

Explore Activity Materials/Equipment

Periodic Table –Labeled w/ oxidation numbers
Practice: Atoms vs. Ions Bohr Models (2 Pages)
Practice**:** Lewis Dot Diagram Worksheet
Practice: How Atoms use E- to Bond

Explore Activity Products and Artifacts

Teacher computer, LCD projector, Computer Lab, Internet, Chemistry journals/spirals, Periodic Tables, Blank Bohr Model Worksheets (2 per student), "Lewis Dot Diagram" Worksheet, "How Atoms use E- to Bond" Worksheet

Explore Activity Resources

http://www.brainpop.com/science/matterandchemistry/ions/ - Brain Pop (Ions)
PowerPoint: "Chemical Bonds"

Explain Activity

Review: Bonding Ionic vs. Covalent Bonds from last class' notes and labeled periodic tables. Place the terms oxidation number, ion, cation, anion, ionic bond, and covalent bond on the Word Wall.

Review Concepts of Atomic Structure, Periodicity, Ionic and Covalent Bonding,

Quiz: Periodic Table Concepts (see Transformation 2013 website)

Explain Activity Products and Artifacts

Updated Word Wall
Quiz: Periodic Table Concepts

Explain Activity Materials/Equipment

Chemistry journals/spirals, Card stock, Printer, Laminator, Quiz: Periodic Table Concepts

Explain Activity Resources

None

Elaborate Activity

Remind students by saying, "*Remember, your players will be high school Chemistry I students. A creative, colorful, educational (concepts well covered with different levels of difficulty), entertaining, and original game are essential to grabbing and keeping your players' attentions. And don't forget to test your instructions on someone who knows Periodic Table concepts, but is NOT in your group. Poorly written or overcomplicated directions will lead to a poor grade.*"

Teachers: Coach and guide the teams as you observe the teams work. *Give them specific guidance as where they may be heading in the wrong direction. Give them tips of what they can do to make each team's game better.*

Students will work within their teams to finish Periodic Table games.

Students will evaluate what refining, redoing of cards, boards, computer work is needed to complete the game.

Students will generate a list of who in the team completed or worked on each task or job and how much time was dedicated to those tasks. Due next class.

Elaborate Activity Products and Artifacts

Check team notes on necessary changes and refining needed to complete project.
The teacher should review the games and give brief/quick feedback for last minute improvements.

Elaborate Activity Materials/Equipment

Students need to provide all the materials necessary to finish the entire game.

Elaborate Activity Resources

Peer/Teacher Evaluation forms/rubrics, Teacher feedback

Evaluate Activity

Students and teacher will rotate playing and evaluating games using the evaluation/rubrics provided.

As a team read and have a brief discussion over the evaluations/rubrics from the teacher and from the student teams that played their games.

Teams will strategize as to how to fix the problems with their games. These changes will need to be made for replay/reevaluation by the beginning of the class after next. This is an important part of the engineering process.

EXAM: Atomic Structure, Periodic Table Concepts, and Bonding (see Transformation 2013 website)…See the provided Atomic Structure, Periodicity, and Chemical Bonding Test Banks to create your own exam.

Evaluate Activity Products and Artifacts

List or data table (ex. Excel spreadsheet) of tasks and time spent by each team member.
Periodic Table Games
Peer Evaluation forms/rubrics
Teacher Evaluation forms/rubrics
EXAM: Atomic Structure, Periodic Table Concepts, and Bonding

Evaluate Activity Materials/Equipment

Student's/Team's Periodic Table Games, Computers (if needed by teams), Teacher evaluation rubrics, Peer evaluation forms, Self-evaluation forms, Exam: Atomic Structure, Periodic Table Concepts, and Bonding

Evaluate Activity Resources

Peer Evaluation forms/rubrics, Teacher Evaluation forms/rubrics

Elaborate Activity

Students will work on refining, redoing of cards, boards, computer work etc. that is needed to fix the game.

The teacher should discuss the games and elaborate, if necessary, by giving detailed constructive feedback for improvements.

Students will generate a list of who in the team completed or worked on each task or job and how much time was dedicated to those tasks. Due next class.

Students need to come up with a brief marketing strategy for their games. Due next class.

Elaborate Activity Products and Artifacts

Check team notes on necessary changes and refining needed to fix project.

Elaborate Activity Materials/Equipment

Students need to provide all the materials necessary to finish/fix the entire game.

Elaborate Activity Resources

Peer/Teacher Evaluation forms/rubrics, Teacher feedback

Evaluate Activity

Students and teacher will rotate playing and evaluating games using the evaluation/rubrics provided.

As a team, read and have a brief discussion over the evaluations/rubrics from the teacher and from the student teams that played their games.

Lead a class discussion about what the students learned and discovered during this project. Ask them what they discovered about working in teams and what they discovered about themselves. Have them share what they would do differently for their next project.

Lead a class discussion about the different teams' marketing strategies.

Have each student fill out a self-reflection form.

Evaluate Activity Products and Artifacts

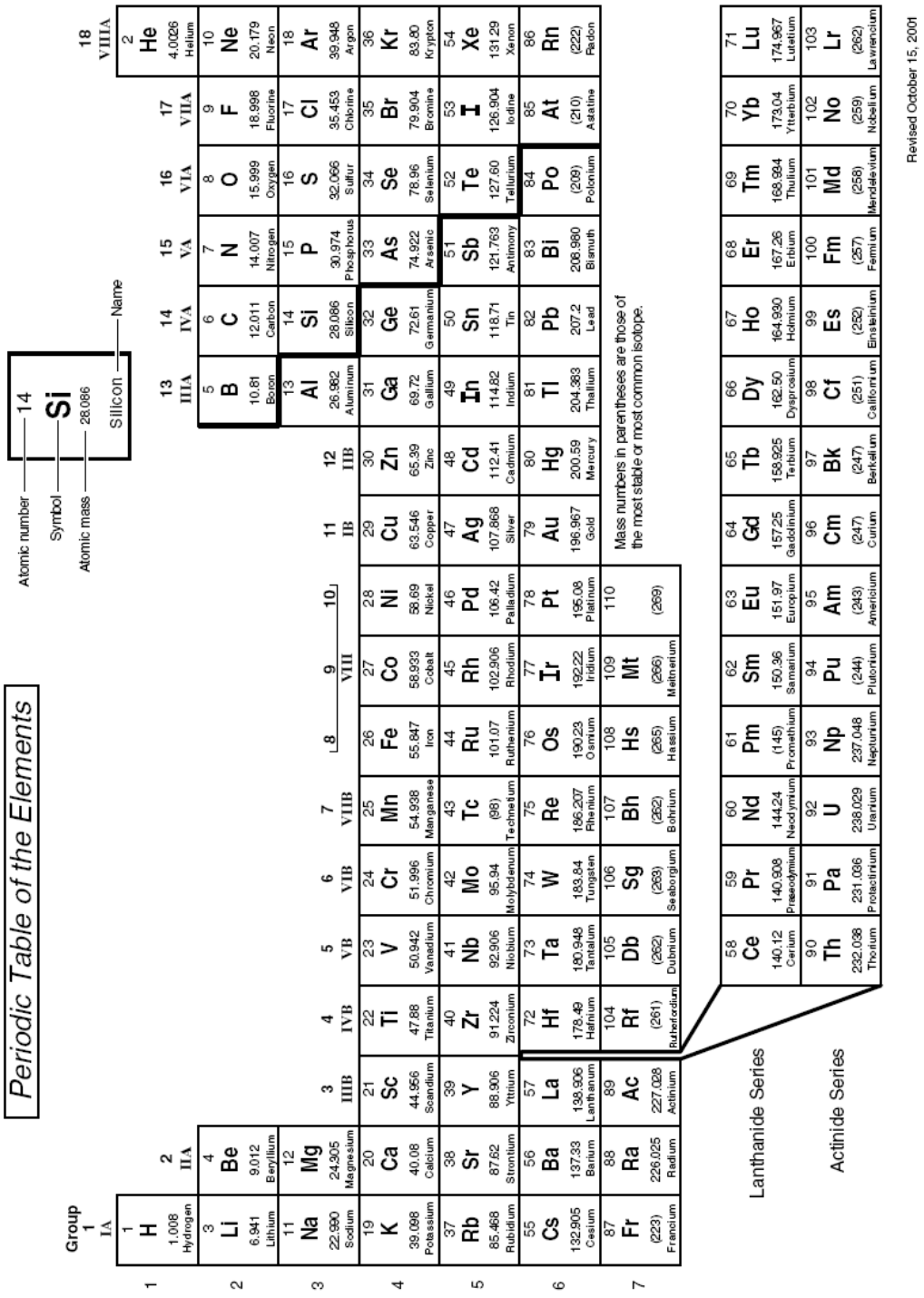
List or data table (ex. Excel spreadsheet) of tasks and time spent by each team member.
Periodic Table Games
Peer Evaluation forms/rubrics
Teacher Evaluation forms/rubrics
Self-Reflection forms
Team Marketing Strategy

Evaluate Activity Materials/Equipment

Student's/Team's Periodic Table Games, Computers (if needed by teams), Teacher evaluation rubrics, Peer evaluation forms, Self-evaluation forms

Evaluate Activity Resources

Peer Evaluation forms/rubrics, Teacher Evaluation forms/rubrics, Self-Reflection forms



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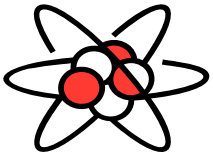
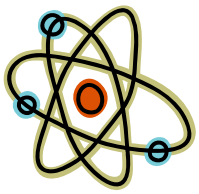
p. 78



Atomic Battleship



Directions: Work with a partner. Each partner will receive 2 battleship grids. You must not let your partner see your grids!

Using the **1st** grid, color in 10 squares. However, the squares must be touching! Sorry—no diagonals! Once each partner has completed their first grid, let the game begin! Call out coordinates until one partner finds all of the other's ten squares.

Using the **2nd** grid, color in only 3 squares. Again, use the same rules, play until a winner is determined.

	A	B	C	D	E	F	G	H	I	J
1										
2										
3										
4										
5										
6										
7										
8										

	A	B	C	D	E	F	G	H	I	J
1										
2										
3										
4										
5										
6										
7										
8										

Atomic Structure

Complete these notes from the Atomic Structure PowerPoint.

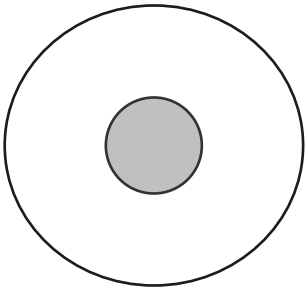
Slide 1: Define element.

Give two examples of elements: slide 1_____

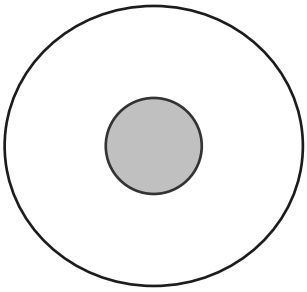
slide 5_____

Slide 4: Define atom.

Slide 6: Label the 2 structures common to all atoms.

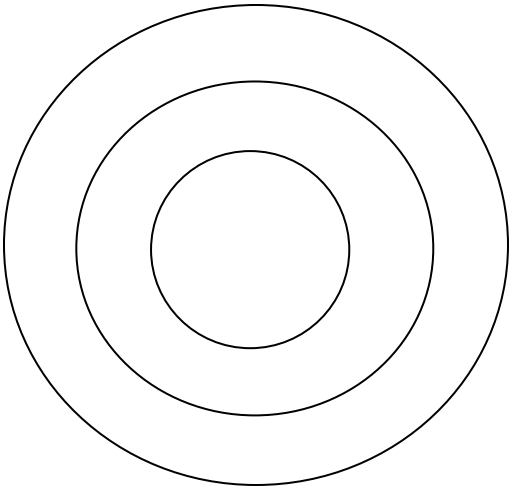
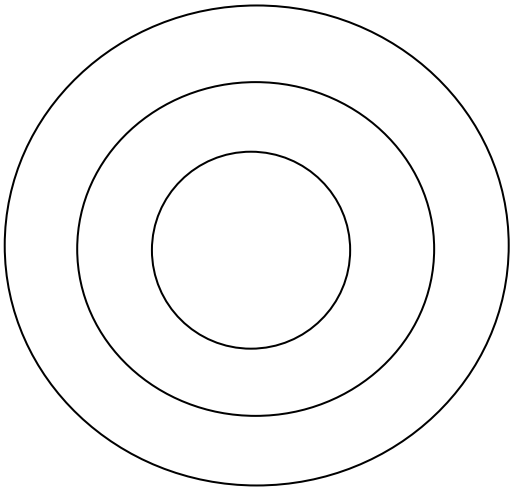
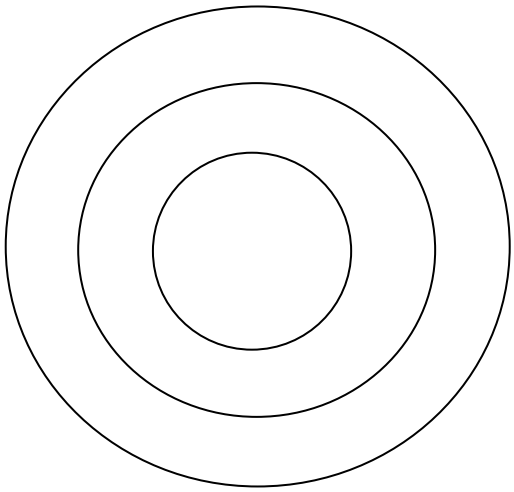
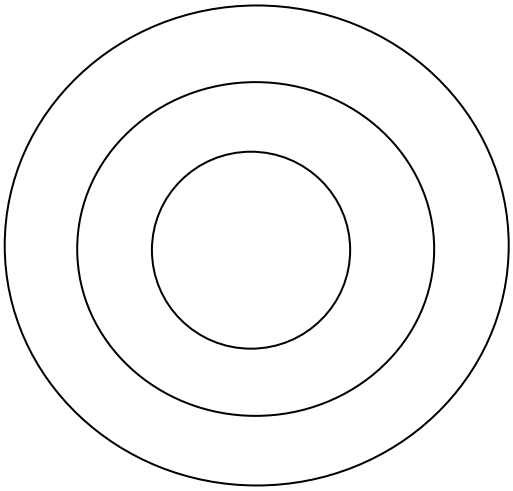
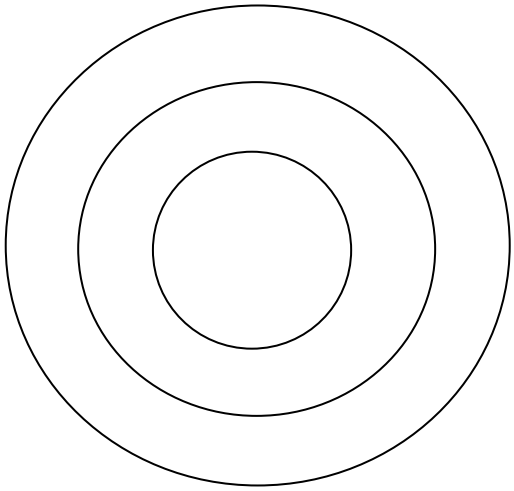
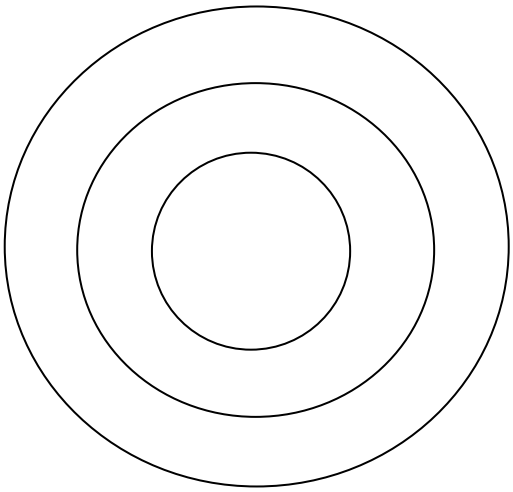


Slide 7: Draw and label the substructures of an atom.



Slide 8: Define atomic number.

Define atomic mass.

Name _____ Period _____ Date _____

Atomic Structure

Part A – Subatomic Particles

The table below contains information about several elements. In each case, enough information has been provided for you to fill in the blanks. Assume all atoms are neutral.

Isotope Name	Nuclear Symbol	Atomic Number	Mass Number	# of Protons	# of Electrons	# of Neutrons
1. calcium-40						
2.		12	24			
3.				1		2
4.	$^{197}_{79}Au$					
5.					26	30
6.			201	80		
7.		17				18

PART B – AVERAGE ATOMIC MASS

8. Calculate the average atomic mass for neon if its abundance in nature is 90.5% neon-20, 0.3% neon-21, and 9.2% neon-22.

9. Calculate the average atomic mass of silver if 13 out of 25 atoms are silver-107 and 12 out of 25 atoms are silver-109.

10. Distinguish between mass number, relative atomic mass, and average atomic mass.

Mini-Quiz: Bohr Model and e-

Name _____ Per _____ Date _____

Element	Atomic #	Total # of Electrons	Bohr Model	Electrons in Each Energy Level			
				1	2	3	4
Helium							
Lithium							
Beryllium							
Boron							
Sodium							

Electron Configurations Lesson –Teacher Instructions

Prerequisite knowledge/skills: Students have learned some of the basics of the periodic table (groups, periods, atomic number, etc) and have learned about electron shells/energy levels.

Description of New Content: Introduce electron subs-levels.

Goals: Students will learn how to write electron configurations.

Materials Needed:

Computer
Projector
Clean periodic table
Electron Configuration Slides.ppt (see Transformation 2013 website) or
http://www.bu.edu/gk12/angela/electron.htm#slides
Markers (4 different colors)
Worksheets (*teacher generated…make from slides 7-10)

Procedure:

Opener:

- Pass out a clean periodic table.
- Review with students that rows are called periods and are equal to the # energy (nrg) levels and columns are called groups and are equal to the # valence electrons.
- Have students label their periodic table according to slide 1.

Development:

1. Introduce sub-levels s, p, d, and f. Have students color code their periodic table according to slide 1. Ask students to name an element with a sub-level of s, p, d, and f.
2. Pass out 1st worksheet (slide 7). Introduce how to write an electron configuration (explain the large number is the row # = # energy (nrg) levels, according to slide. Challenge students to determine which element has a $1s^1$ configuration.
3. Pass out 2nd worksheet (slide 8). Explain to students that if they are asked to write electron configuration, answer these 7 questions. Have students complete this example on their own. Go over the answers (slide 3).
4. Pass out 3rd worksheet (slide 9) for more practice. Answers on slide 4.
5. Pass out 4th worksheet (slide 10). Explain to students that electron configurations do not go in "order". Rather, it goes in order of the periodic table from left to right, top to bottom (don't forget the lanthanoids and actinoids). Slide 5 shows a diagram of the order. Have students draw arrows on their worksheet and rewrite the full electron configuration.
6. Use slide 6 to explain why writing does not go in order (subshells d and f are special). Have students label their periodic table.

Closure: Review the 4 sub-levels.

On the spot evaluation: Ask students to pick another element and write the electron configuration.

Extensions: Students can pick a lanthanoid or actinoid element.

Electron Configurations

Name _____ Date _____ Per _____

PART A – ORBITAL DIAGRAMS & LONGHAND ELECTRON CONFIGURATION

Use the patterns within the periodic table to draw orbital diagrams and write longhand electron configurations for the following atoms.

	Symbol	# e^-	**Orbital Diagram and Longhand Electron Configuration**
1.	*Mg*		
2.	P		
3.	V		
4.	Ge		
5.	Kr		
6.	O		

PART B – SHORTHAND ELECTRON CONFIGURATION

Use the patterns within the periodic table to write the shorthand electron configurations for the following elements.

	Symbol	# e^-	**Shorthand Electron Configuration**
7.	Ca		
8.	Pb		
9.	F		
10.	U		

Electron Configuration Practice Worksheet

In the space below, write the unabbreviated electron configurations of the following elements:

1) sodium _____

2) iron _____

3) bromine _____

4) barium _____

5) neptunium _____

In the space below, write the abbreviated electron configurations of the following elements:

6) cobalt _____

7) silver _____

8) tellurium _____

9) radium _____

10) lawrencium _____

Determine what elements are denoted by the following electron configurations:

11) $1s^2 2s^2 2p^6 3s^2 3p^4$ _____

12) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ _____

13) [Kr] $5s^2 4d^{10} 5p^3$ _____

14) [Xe] $6s^2 4f^{14} 5d^6$ _____

15) [Rn] $7s^2 5f^{11}$ _____

Determine which of the following electron configurations are not valid:

16) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$ _____

17) $1s^2 2s^2 2p^6 3s^3 3d^5$ _____

18) [Ra] $7s^2 5f^8$ _____

19) [Kr] $5s^2 4d^{10} 5p^5$ _____

20) [Xe] _____

Electron Configurations - Solutions

Note: The electron configurations in this worksheet assume that lanthanum (La) is the first element in the 4f block and that actinium (Ac) is the first element in the 5f block. If your periodic table doesn't agree with this, your answers for elements near the f-orbitals may be slightly different.

1) sodium **$1s^2 2s^2 2p^6 3s^1$**

2) iron **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$**

3) bromine **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$**

4) barium **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2$**

5) neptunium **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^5$**

6) cobalt **[Ar] $4s^2 3d^7$**

7) silver **[Kr] $5s^2 4d^9$**

8) tellurium **[Kr] $5s^2 4d^{10} 5p^4$**

9) radium **[Rn] $7s^2$**

10) lawrencium **[Rn] $7s^2 5f^{14} 6d^1$**

11) $1s^2 2s^2 2p^6 3s^2 3p^4$ **sulfur**

12) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ **rubidium**

13) [Kr] $5s^2 4d^{10} 5p^3$ **antimony**

14) [Xe] $6s^2 4f^{14} 5d^6$ **osmium**

15) [Rn] $7s^2 5f^{11}$ **einsteinium**

16) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$ **not valid (take a look at "4d")**

17) $1s^2 2s^2 2p^6 3s^3 3d^5$ **not valid (3p comes after 3s)**

18) [Ra] $7s^2 5f^8$ **not valid (radium isn't a noble gas)**

19) [Kr] $5s^2 4d^{10} 5p^5$ **valid**

20) [Xe] **not valid (an element can't be its own electron configuration)**

Quiz: Bohr Model and e- configuration

Name _____ Per _____ Date _____

Element	Atomic #	Total # of e-	e- configuration	Bohr Model	e- in each NRG level			
					1	2	3	4
B								
Argon								
Ca								
Cobalt								

Plan the Assessment

Engage Artifact(s)/Product(s): None
Explore Artifact(s)/Product(s): Foldable: "Seven Dead Chemists of the Atomic Theory", Atomic Battleship Grids, "Atomic Structure" handout, "Anatomy of an Atom" wrksht, "Isotopic Notations" wrkshts, Lab: Beanium Isotope, Student results for "Periodic Table Puzzle Activity", Completed "Blank" Periodic Table includes: families names, group #s, period #s, stair-step line, metals, metalloids, and non-metals (sections labeled), "Mendeleev's Math" wrkshts, Electron Configuration/Sub-levels Periodic Table, Electron Configuration wrkshts 1 & 2, E- Config shorthand wrksht, Electron Configuration Lesson (competed worksheets), LAB: Flame Test, PBL PROJECT UPDATE, Periodic Table –Labeled w/ oxidation numbers, Atoms vs. Ions Bohr Models (2 Pages), Lewis Dot Diagram wrksht, How Atoms use E- to Bond wrkshts
Explain Artifact(s)/Product(s): Quiz: "The Seven Dead Chemists of the Atomic Theory" –**Teacher generated,* Beanium Isotopes Lab Report, Atomic Word Wall, Quiz: Atomic Structure and Isotopes –**Teacher generated or Brain Pop's,* "It's Elemental " Wrksht, Updated Word Wall, Bohr models (6-12 examples), **PBL PROJECT UPDATE** brainstorming notes in project journal, Quiz: Bohr Model/ Electrons, Quiz: The Periodic Table, Quiz: Bohr Model and E^- Configuration, Flame Test Lab Report, Updated Word Wall, Quiz: Periodic Table Concepts
Elaborate Artifact(s)/Product(s): List or data table (ex. Excel spreadsheet) of tasks and time spent by each team member, Team notes on necessary changes (both before projects played first time and after projects modified/fixed for play second time)
Evaluate Artifact(s)/Product(s): *For First Game Play:* Periodic Table Games, Peer Evaluation forms/rubrics, Teacher Evaluation forms/rubrics, EXAM: Atomic Structure, Periodic Table Concepts, and Bonding, *For Second Game Play (revised versions):* List or data table (ex. Excel spreadsheet) of tasks and time spent by each team member, Periodic Table Games, Peer Evaluation forms/rubrics, Teacher Evaluation forms/rubrics, Self-Reflection forms, Team's Marketing Strategy

Rubrics

Student Rubric for Periodic Table Game

Name of Game _____

Period_____

DIRECTIONS: While playing the game, consider the criteria listed in the table. Each item is to be graded on a scale of **1** to **5** (1 is the lowest and 5 is the highest score). Discuss each item as a group before deciding on the score for each category. Use the discussion questions provided to help determine the score. All scores for each game will be averaged. The averaged score will count as a quiz or test grade for each member of the game's creative team. Be fair and follow the guidelines in the table. Fill out the strength/weakness and comment section so students may improve their games. **Remember the *maximum* score in *each* category is a 5.** Leave this sheet face down when done.

Interesting/Entertaining • Did the game hold your interest? • Were you actively engaged? • Was the game creative? • Would you recommend this game to friends? • Was the game fun to play?	
Chemistry Concepts • Was chemistry terminology used correctly? • Are there a large variety of chemistry concepts used in the game? • Does the game enable players to use chemistry knowledge previously learned in class? • Was the game challenging?	
Directions/Rules • Are the directions clear and easily understood? • Are there ways to play the game to challenge advanced learners? • Is the game reasonable to play in the time allotted—(too much time, not enough time, just right?)	
Appropriate/Satisfies the Purpose of the Assignment • Is the game designed to appeal to high school students? • Does the game enable players to use learned chemistry concepts? • Does the design of the game include all types chemistry I students or are there limitations? • Does the game *challenge* the player's mastery of concepts covered in class?	
Total Score (maximum of 20)	

This games greatest strength was…_____.

This games worst feature was…_____.

Comments:

Date: _____

Period: _____

Periodic Table Game Teacher Evaluation Grading Form						
Requirements	**5 (Excellent)**	**4 (Good)**	**3 (AVG)**	**2 (Below AVG)**	**1 (Poor)**	
Creative Name of Game						
Colorful						
Creative Look of Board, Cards, and/or Computer Layout						
Overall Physical Design of Game						
Clear & Concise Game Play Directions/Instructions						
Basic Atomic Structure/ Periodic Table Concepts Integrated into Game (#s1-6 of Concept List)						
Intermediate Periodic Table Concepts Integrated into Game (#s7-12 of Concept List)						
Advanced Periodic Table/Periodidcity Concepts Integrated into Game (#s13-17 of Concept List)						
Concepts Correctly Addressed						**FINAL GRADE**
Concepts Sufficiently Addressed						
Concepts Clearly Explained						
Concepts Integrated Creatively						
Game approprate for Play by High School Chemistry Students						
6-10 minutes play time allows all players at least 3-5 turns						
Game allows players to reinforce learned concepts						
Game challenges the player's mastery of concepts covered in class						
Entertaining/Creative Penalties for Player's Wrong Answers						
Original Game (not an exact copy of an existing game)						
Easy to Play						
Fun to Play						
TOTALS						

Story Board

	Day 1	Day 2	Day 3	Day 4	Day 5
Week 1 Activities	▪ **Engage:** Play: "The Element Song", Talk about Games, Distribute Periodic Tbls & **"The Periodic Table Game" Handout/Rules** . (20 min) ▪ **Explore:** Foldable: "Seven Dead Chemists of the Atomic Theory" ("Atom History & Structure" PPT,(slides 1-19)), Activity: "Atomic Battleship" Game (50 min ▪ **Explain:** Debrief: "Atomic Battleship" (20 min)		**Explain:** *Brain Pop*: Atomic Model & History, Quiz: "Seven Dead Chemists of the Atomic Theory" (15 min) ▪ **Explore:** Notes: "Atomic Structure " PPT w/ handout (10 min), *Brain Pop*: Atoms, Practice: 'Anatomy of an Atom" (15 min), Lab: BEANIUM Isotope (35 min), Practice: "Isotopic Notations" Worksheet (15 min)		▪ **Explain:** Debrief: "Beanium Isotope Lab" & Turn in Lab Report (20 min), Create: Atomic Word Wall, Finish "Atom History & Structure" PPT (slides 20-29) (30 min), *Brain Pop*: Isotopes, Quiz: Atomic Structure and Isotopes (20 min) ***If time permits incorporate a team building activity.***
	Day 6	**Day 7**	**Day 8**	**Day 9**	**Day 10**
Week 2 Activities		▪ **Explore**: Discuss "History of the Periodic Table" PPT (Mendeleev) (15 min), Lab/Activity : Periodic Table Puzzle (35 min), Color and label: Blank Periodic		▪ **Explain:** Debrief: Periodic Table Puzzle Activity (5 min), *Brain Pop*: The Periodic Table, Review: Periodic Table concepts covered last	

		Tbls w/ families, groups, metals, non-metals, metalloids, etc. -Use "Periodic Table" PPT (slides 1-16) (30 min), Practice: Mendeleev's Math (10 min)		class (10 min), Word Wall (20 min), Practice: It's Elemental (10 min), Practice: Bohr Models (15 min), **PBL Project TEAM Meeting** (25 min)	
	Day 11	**Day 12**	**Day 13**	**Day 14**	**Day 15**
Week 3 Activities	▪ **Explain**: Quiz: Bohr Model/E- (10 min), Quiz: The Periodic Table (10 min), ▪ **Explore**: E-Configuration Lesson w/blank periodic tbl, Practice: E-config wrksht, Practice: E-config Lesson (online) (70 min)		• **Explain**: Debrief: E-Configuration, Quiz: Bohr Model and E^- Configuration (25 min) • **Explore:** Notes: Periodic Trends, Students visit websites on Periodic Trends (20 min), Lab: Flame Test (45min), **Due: PBL Project Update**		▪ **Explain:** Debrief: Flame Test Lab, (5-10 min), update Word Wall ▪ **Explore**: *Brain Pop*: Ions, Periodic Tables labeled w/oxidation #s (15 min), Activity : Atoms vs Ions (15 min), Notes: Ionic vs. Covalent Bonds (30 min), Practice: Lewis Dot Diagrams & Bonding Wrkshts (20 min).
	Day 16	**Day 17**	**Day 18**	**Day 19**	**Day 20**
Week 4 Activities		▪ **Explain:** Review: Bonding: Ionic vs. Covalent Bonds, Review: Concepts of		▪ **Elaborate: Prepare Project:** Students will use class to work in their teams on the "Periodic	

		Atomic Structure, Periodicity, Ionic and Covalent compounds, Quiz: Periodic Table Concepts (40-50 min) **Elaborate: Prepare Project:** Students will use class to work in their teams on the "Periodic Table Game" Project.(40-50 min)		Table Game" Project (90 min) ▪ **PBL Project Due next class**	
	Day 21	**Day 22**	**Day 23**	**Day 24**	**Day 25**
Week 5 Activities	▪ **Evaluate**: Students and teacher will rotate playing and evaluating games using the evaluation/rubrics provided.		▪ **Evaluate**: Exam: Atomic Structure, Periodicity & Bonding ▪ **Elaborate**: After Exam, Students continue to rework/refine the problems with their games. ▪ **Students will perfect their games problems and correct before next class.**		▪ **Evaluate**: Students and teacher will rotate playing and evaluating reworked/fixed games. ▪ **Discuss marketing strategies to educational companies.**