Periodic Table Battleship

Lab Related Activity: *Chemicals of Innovation*

The Tech Museum of Innovation
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This activity is meant to extend your students' knowledge of the topics covered in our Chemicals of Innovation lab. Through this activity your students will develop a greater familiarity with the Periodic Table of Elements.

Grades 5-8
Estimated Time: 10 minutes to put together; 20-30 minutes to play

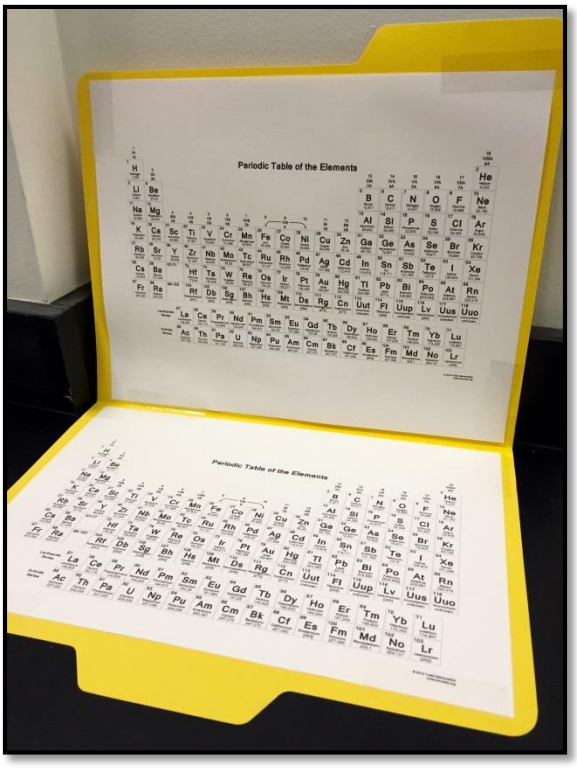
Student Outcomes:
1. Students will be able to identify elements of the periodic table by their atomic symbol and their position in the table (group and period numbers)

Next Generation Science Standards
Physical Sciences Disciplinary Core Idea: PS1.A Structure and Properties of Matter
Common Core ELA Standards
Grade 5: *Speaking and Listening* 5.SL.1b-d
Grades 6-8: *Speaking and Listening* SL.1b-e

California State Science Standards
Physical Sciences/Chemistry
Grade 5: 5.1.d; **Grade 8:** 8.3.f

Vocabulary
Familiarity with these terms and concepts will enhance students' experience in the activity
- Atomic symbol: the atomic symbol is a one or two letter abbreviation for an element.
- Atomic mass: the average mass of an element-the amount of protons plus neutrons.
- Atomic orbital (also called a shell or energy level): the area surrounding the center of an atom where electrons are found. Each orbital can hold a certain number of electrons. More orbitals means there are more electrons.
- Period: rows on the periodic table. Elements in the same period have the same number of atomic orbitals. (Period 1 (row 1) has only 1 orbital; Period 2 (row 2) has 2 orbitals; etc.)
- Valence Electron: an electron in an atom's outer orbital (or energy level) that is able to bond with other atoms.
- Group: columns on the periodic table. Elements in the same group have the same number of valence electrons and act similarly.

Materials
- 2 periodic tables per student (provided)
- 1 manila folder per student
- 1 dry erase marker per student
- Stapler or tape



To make the "game board"
1. Laminate and trim all periodic tables.
2. Hand out 2 periodic tables and 1 manila folder to each student.
3. Staple or tape one periodic table to each side of the folder so that both tables are upright when the folder is open horizontally.

Game Play
1. Before playing, review the above vocabulary terms with students. Give examples of each term with the periodic table at hand so students can reference it.
2. *Atomic orbital*—start with an easy element, Hydrogen. Hydrogen has one electron, so it only has one orbital. Hydrogen is in the first

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row (also called Period) on the periodic table because it has one orbital.

   a. Orbitals can only hold a certain number of electrons
      - The first orbital can only hold up to 2 electrons
      - The second and third orbitals can hold up to 8 electrons
      - Fourth and above orbitals can hold up to 18 electrons.
   b. Orbitals do not need to be full.
   c. Elements with the same number of orbitals are in the same *period* or row.

3. *Valence Electron* – valence electrons are the electrons in an orbital that are able to bond with other atoms. Electrons in an orbital can bond with other atoms if the orbital is not full.
   a. Begin with hydrogen as an example again. Hydrogen has only one electron in its one orbital. Since the first orbital can hold 2 electrons, the orbital is not full. That one electron is considered a valence electron since there is room for additional electrons. If an atom's outermost orbital is full, it does not have any valence electrons.
   b. Elements with the same number of valence electrons are in the same *group* or column on the periodic table.
4. After reviewing the terms, have students label their periodic tables with the terms Group and Period.
5. To play the game, each player should use their dry erase marker to circle a series of elements on the bottom periodic table—this is their game board. (Same basic rules as regular Battleship)
   a. Students should circle 5 "ships" of different element lengths on their board. "Ships" cannot go diagonally across the periodic table; they must be vertical or horizontal.
   b. Ships should be the following lengths:
      - 2 elements
      - 3 elements
      - 2 that are 4 elements
      - 5 elements
   c. Once "ships" are selected, players take turns asking their opponent possible positions for their "ships." Players should ask in the form of Period #, Group # or by asking for atomic symbol.
   d. Players should mark off when they hit or miss their opponent's "ships" on the top periodic table. Players can choose their own marks for hit or miss.
   e. If a player's "ship" is hit, the player should write an X over the element that the opponent has called.
6. The game is over when a player has sunk all of the opponent's "ships."

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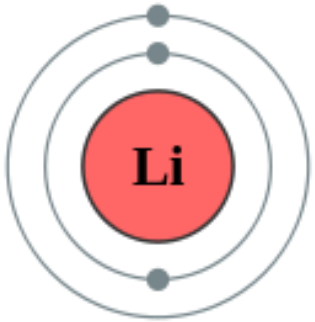
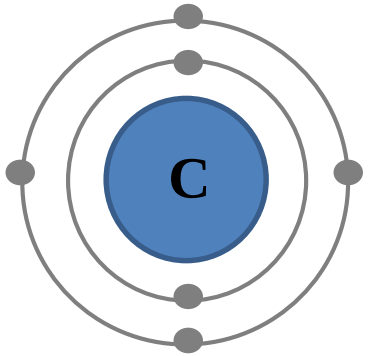
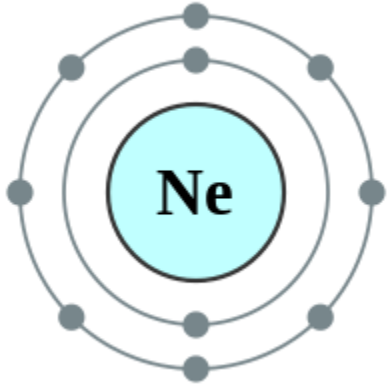
Examples of Elements in the Same Period (same # of orbitals)



Lithium: Period 2; 2 orbitals

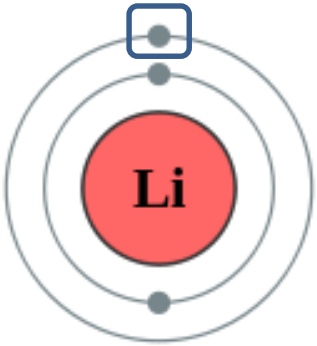


Carbon: Period 2; 2 orbitals

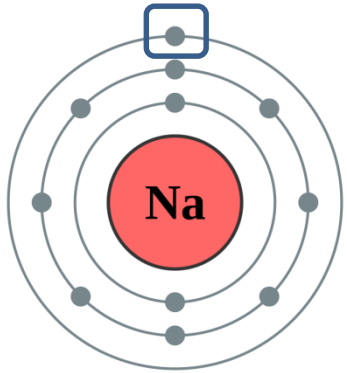


Neon: Period 2; 2 orbitals

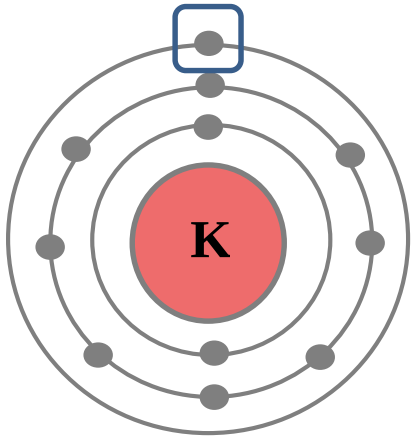
Examples of Elements in the Same Group (Same # of valence electrons)



Lithium: Group 1; 1 valence electron



Sodium: Group 1; 1 valence electron



Potassium: Group 1; 1 valence electron

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 83.798
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.294
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

Lanthanide Series	57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]