Mendeleev's Pursuit

To save paper, please do not write on this handout.

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg							

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No

After assembling the periodic table with your classmates, make observations of trends by discussing with your neighbors. Consider trends in both group and period.

On a blank piece of paper record your clue from the notecard, your determined element, and two observations in periodic trends you made during the assignment.

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Instructor notes

Goal (Chem 120): To better understand/ visualize the composition of the periodic table. To understand better the historical motivations of Mendeleev and others to group elements by chemical behavior. Finally, to observe trends in electron configuration to predict placement on the table.

Goal (Chem 150): To visualize the periodic table with a similar method Mendeleev (he used cards to visualize the elements). Practice identifying elements using atomic trends such as: size, IE, subsequent IE trends, metallic nature, condensed electron configuration, quantum numbers, electronegativity, bond length. Observe trends in atomic behavior to predict placement on table.

Instructions: Count the students and obtain that number of cards starting from H. Shuffle cards and pass one to each student. With adequate space (outside the classroom), allow students to begin to organize themselves into the periodic table. Encourage them to use H and He as a scaffold for the rest of the table. They can use the handout to guide the shape of the table and identify their element.

Discussion: The students should be encouraged to discuss with their neighbors the differences between the elements. How do elements change their electron configuration (Chem 120) or their atomic trends (Chem 150) as we progress down a group or across the period. What other observations can be noted- what shortcuts in determining location on the table? (Nobel gasses all end in np^6 etc.).

Write Up: The students are prompted to write their clue, the determined element, and two observations made during the discussion. The write up is mostly a participation motivator.

Nitinol Demo

Instructor notes

Goal: To observe solid state phase changes in a metal. Discuss and consider applications for this advanced material. Allow students a hands-on experience deforming and reforming the nitinol.

Instructions: The thick gauge wire has an austenite "memory" form as a straight wire, the smaller gauge has a memory as a helix. Both wires can be deformed and heated, in water or flame, to return to the austenite phase. Students can take turns doing this or as they leave the classroom for the day if time is a constraint.

Notes: When nitinol is heated is aligns in the square lattice austenite phase. As it cools, it eases into the lower energy twinned martensite phase (exothermic). In this phase you can deform the material. This deformation does not cause the usual edge dislocations as bonds break and the lattice shifts creating permanent plasticity, instead, the deformation causes the crystal structure to shift into an equal energetic detwinned or regular martensite structure. When heating the detwinned martensite, the structure returns to the austenite phase. As there were no dislocations, each atom can move to its original bonding location attributing to the "memory" effect.

Discussion: Dialogue about the demonstration can focus on the "memory" of the material. Emphasis on how the lack of edge deformations allow the atoms to maintain an energetic placement with its original location. Do we expect these changes to be exo- or endo- thermic? Permanent? Another approach to the conversation can be applications of this advanced material. Current uses are airless and puncture-proof tires, solid state Numatics (flaps on plane, lifting masses), enthalpy heat pump, and medical stints. Can students imagine other applications?

X Marks the Spot

Instructor notes

Goal: To practice and emphasize the role subatomic particles (protons, neutrons, electrons) have on the identity and nomenclature of elements.

Instructions: Shuffle cards and walk the room asking for volunteers to "pick a card". The student should attempt to identify the "X" element using the clues provided of atomic number and mass. Students should consider whether the element is in its polyatomic form if applicable (O is elemental oxygen, while O_2 diatomic environmental oxygen).

Discussion: A follow up question can be posed, depending on the question, to further probe understanding. If the species in an ion, ask the number of electrons; number of neutrons if atomic number and mass are known; total molecular mass if species is polyatomic; etc.