TRENDSETTER LAB

Deanna Cullen

Whitehall High School, Whitehall, MI

Prepared as part of Target Inquiry Program at Grand Valley State University

Chemistry Course

- All Michigan students are required to take chemistry OR physics (most take chemistry)
- 80% of our students take general chemistry
- 20% take Chem Essentials (Conceptual Chemistry)
- Students are in 10^{th} or 11^{th} grade.
- This lab is used in both courses.

OBJECTIVES

- The student will be able to identify and explain trends of electronegativity, atomic radii and ionization energy on the periodic table.
- The student will recognize similarities of properties based upon location on the periodic table and be able to predict properties of an element based on the location of that element on the table.

PRIOR KNOWLEDGE

- Students should have a working knowledge of the parts of an atom.
- Students should be able to write the noble gas electron configurations of all the elements on the periodic table.
- Students should know the definition and have a basic understanding of ionization energy, electronegativity and atomic radii.

HISTORY OF PERIODIC TABLE

- In 1865, the English chemist, John Newlands arranged the first 16 elements known at that time in order of increasing atomic mass. He placed these elements into two rows and he observed that the elements in each column had similar chemical and physical properties.

MENDELEEV'S TABLE

- In 1870, Dmitri Mendeleev used this and other information to arrange the 63 elements known at that time. He wrote the element symbol, properties and atomic mass of each element onto individual cards. He noticed that if he put the elements in order of atomic mass, he saw a repeating pattern of properties. By making each successive series of properties into a new row, Mendeleev found a workable table for the elements. Mendeleev recognized a pattern of combining ratios or "valency".

PRE-LAB

Define

- GROUP
- PERIOD
- ATOMIC MASS
- IONIZATION ENERGY
- ELECTRONEGATIVITY
- ATOMIC RADII

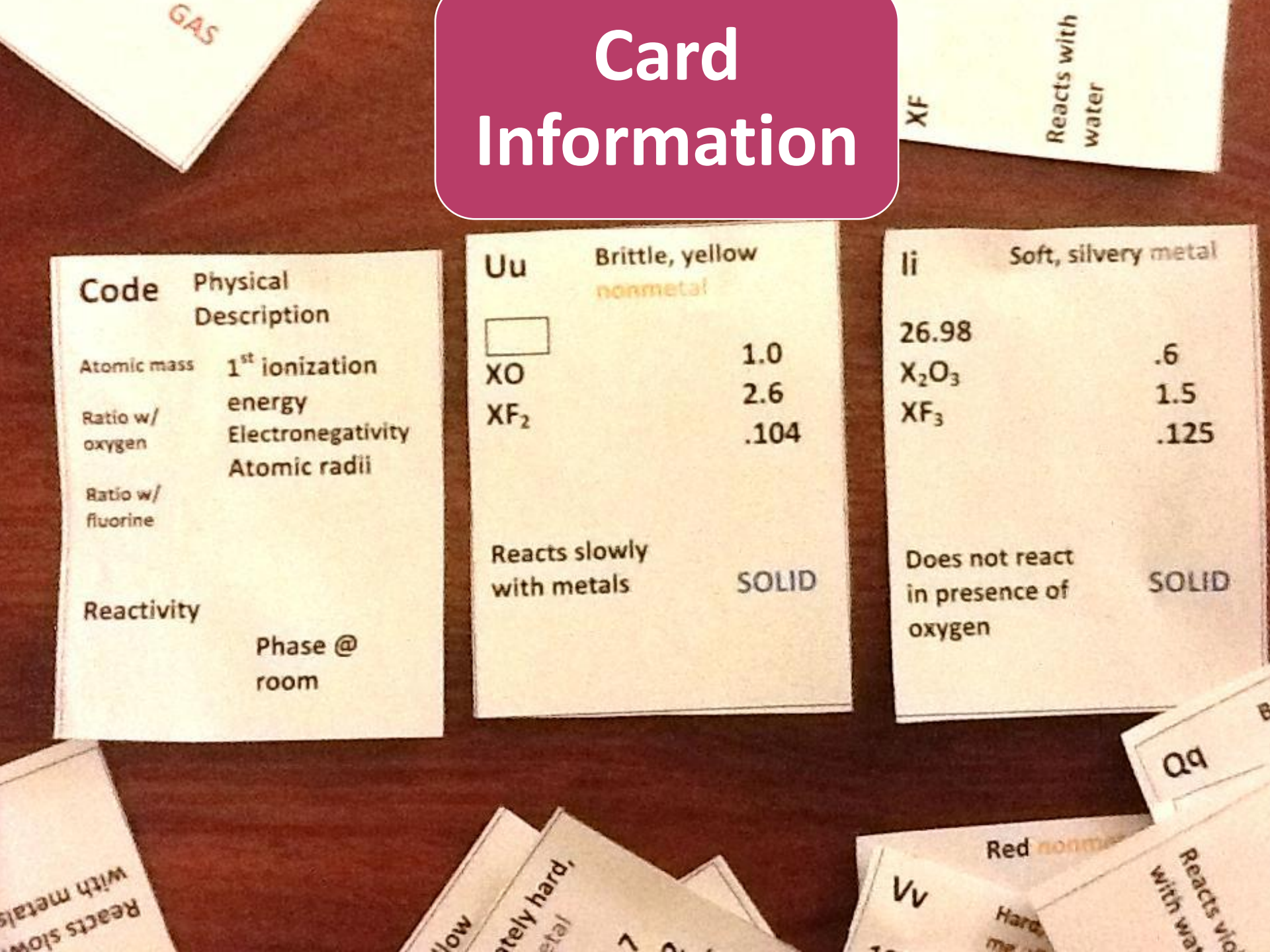
List the properties of METALS….NONMETALS….& METALLOIDS

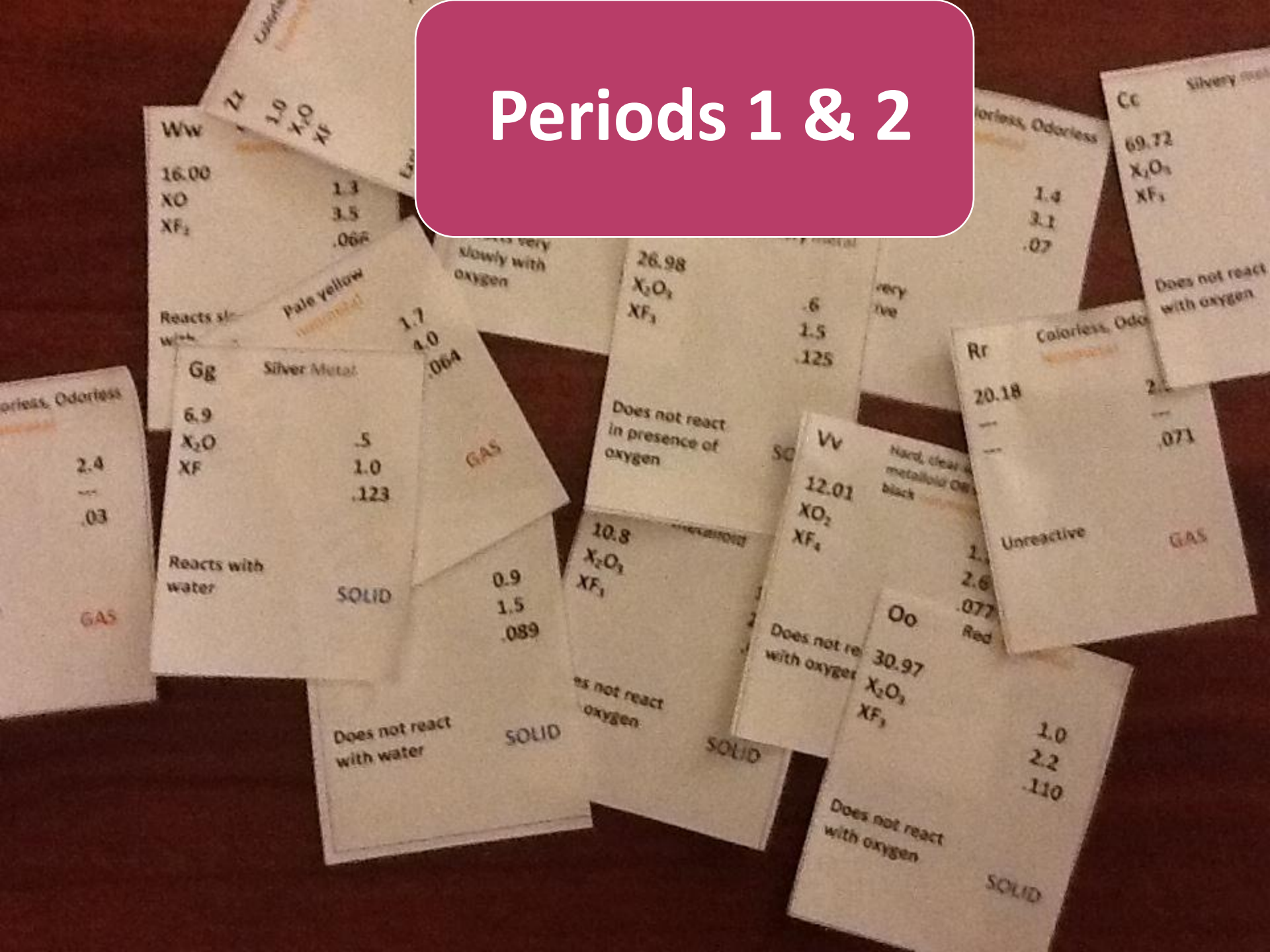
PREDICTIONS

Choose two or three of the listed elements that you feel confident may be grouped together. Explain your answer.

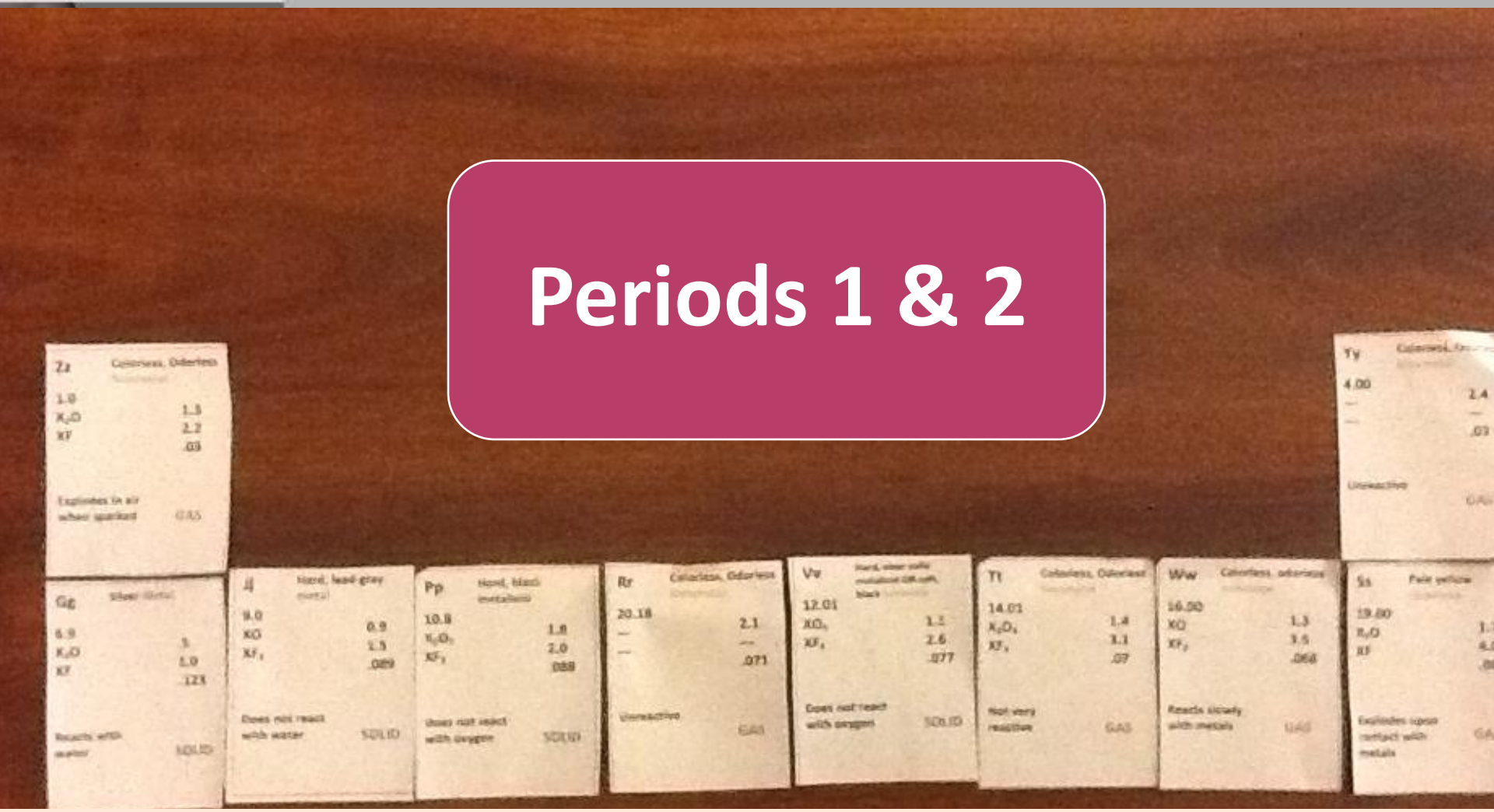
Element A	**Silver colored liquid metal**	**Does not react with water**	**Reacts with Cl to form XCl_2**
Element B	Somewhat hard silvery solid metal	Reacts very slowly with water	Reacts with Cl to form XCl_2
Element C	Purple solid nonmetal	Reacts slowly with metals	Reacts with Cl to form XCl
Element D	Soft silvery solid metal	Reacts very slowly with water	Reacts with Cl to form XCl_2

Card Information



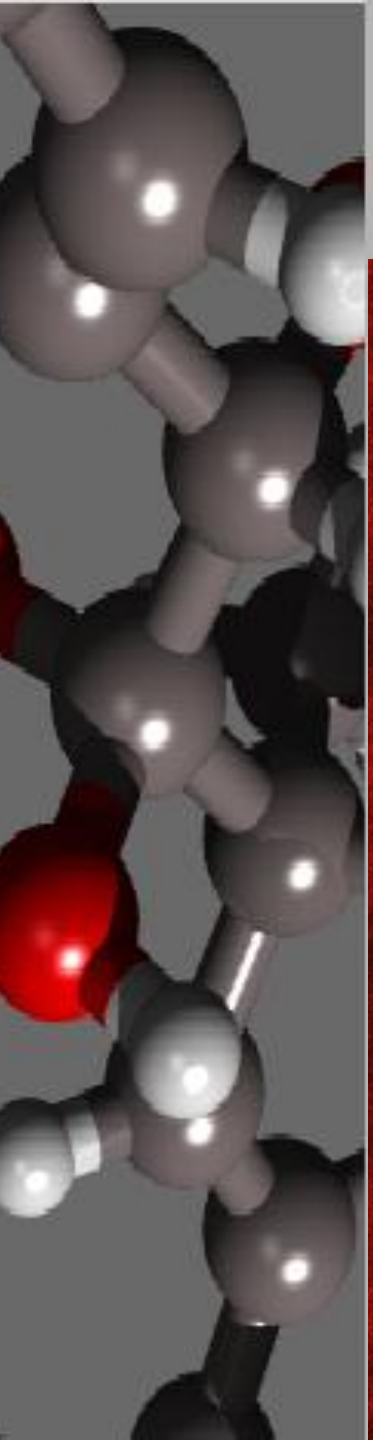

Periods 1 & 2
Ww
16.00
XO
XF2
1.3
3.5
.066
Reacts slowly with oxygen
Pale yellow
1.7
4.0
.064
Gg
Silver Metal
6.9
X2O
XF
.5
1.0
.123
Reacts with water
SOLID
GAS
0.9
1.5
.089
Does not react with water
SOLID
26.98
X2O3
XF3
.6
1.5
.125
Does not react in presence of oxygen
10.8
X2O3
XF3
SOLID
Vv
12.01
XO2
XF4
Does not react with oxygen
Oo
30.97
X2O3
XF3
1.0
2.2
.110
Does not react with oxygen
SOLID
Rr
20.18
.071
Unreactive
GAS
Cc
Silvery
69.72
X2O3
XF3
Does not react with oxygen
1.4
3.1
.07
2.4
.03
GAS

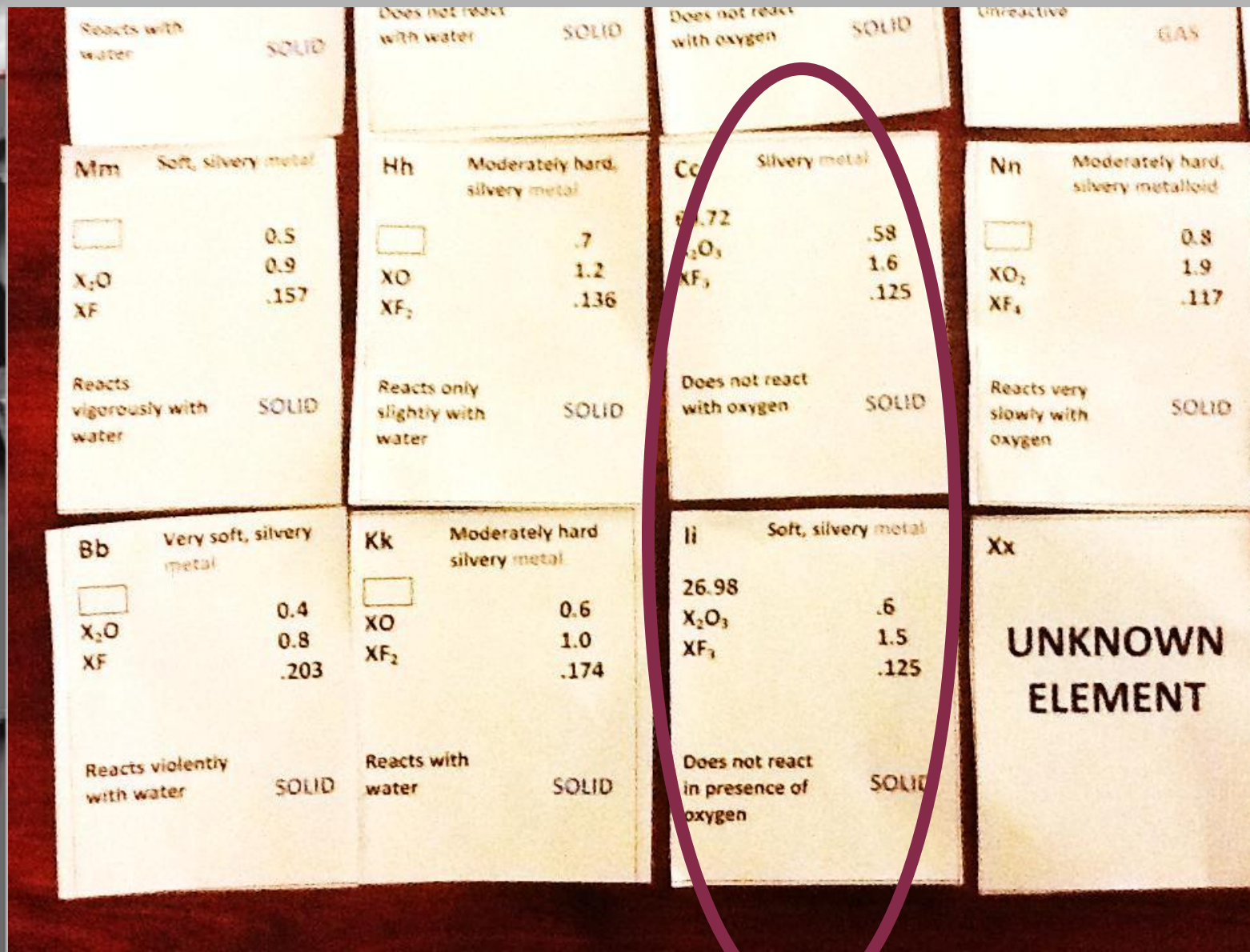
Periods 1 & 2



Once the first 10 elements are arranged, the students are asked to complete the rest of the table (all 26 elements) based on similarities and trends that they see.

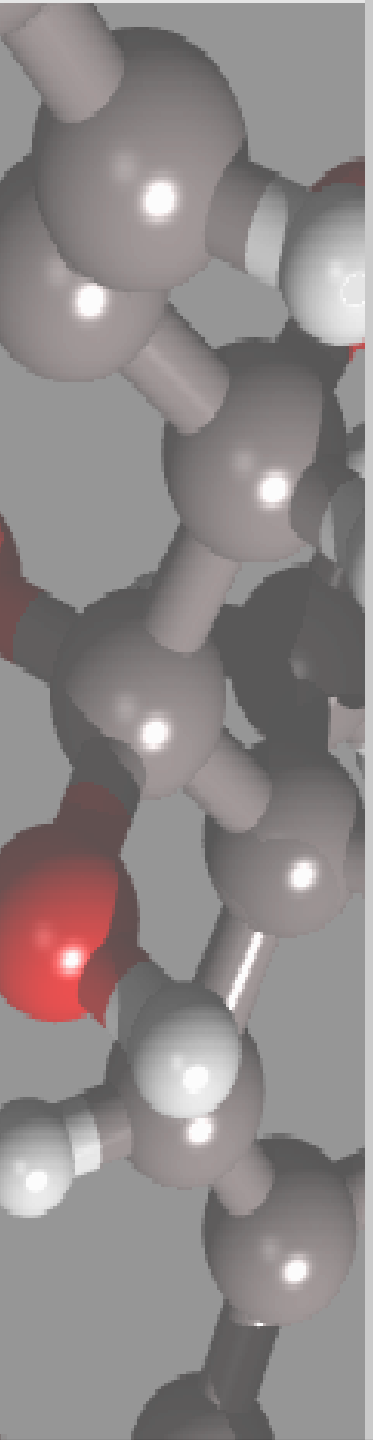
COMMON ERRORS





COMPLETE TABLE

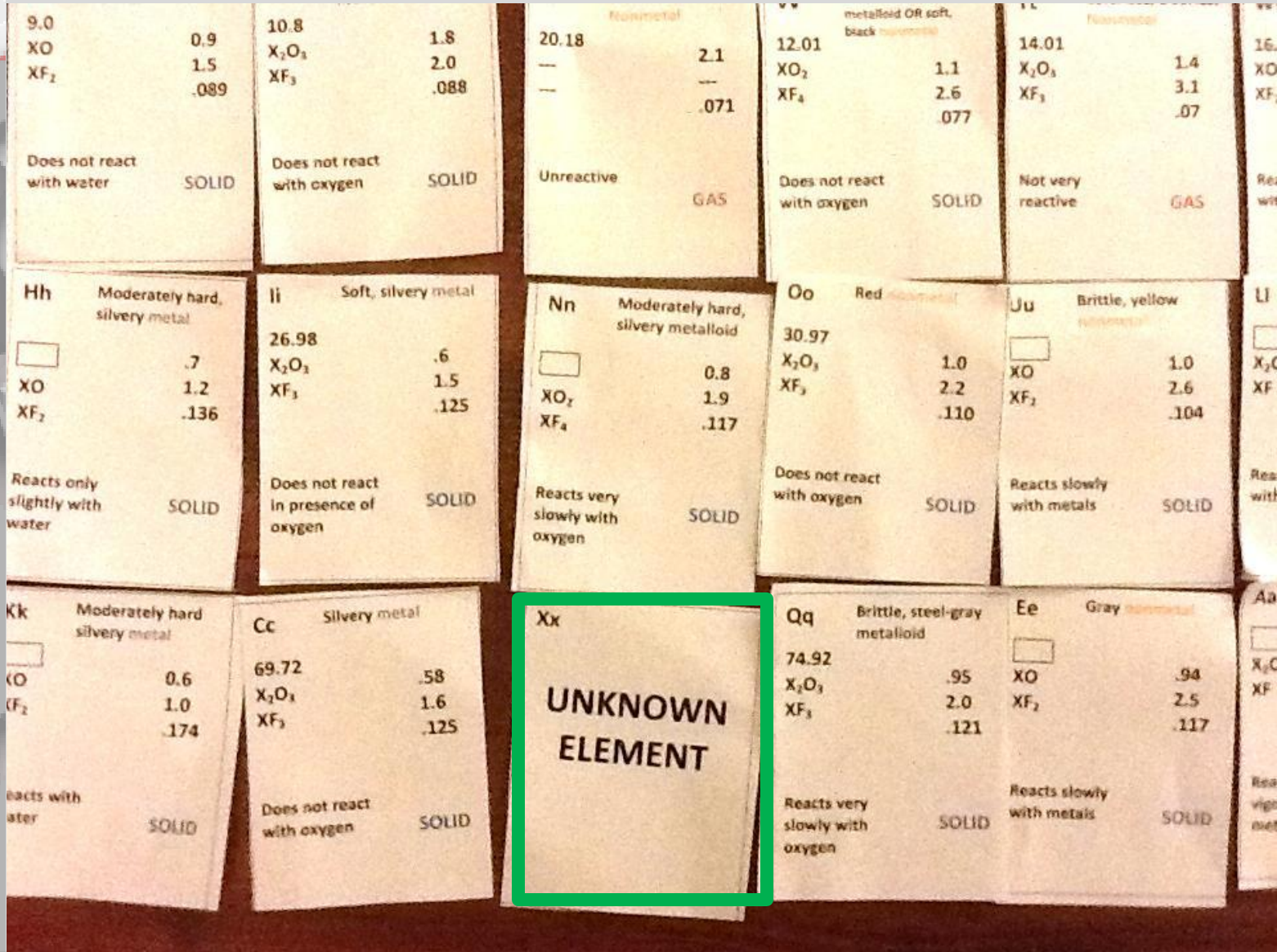
I	II	III	IV	V	VI	VII	VIII
Zz							He
Gg	Jj	Pp	Vv	Tt	Ww	Ss	Rr
Mm	Hh	Ii	Nn	Oo	Uu	Ll	Dd
Bb	Kk	Cc	Xx	Qq	Ee	Aa	Ff



IN THE LAB

- Place samples of CALCIUM and MAGNESIUM into separate beakers of water (with drop of phenolphthalein).
- Observe difference in reactivity.
- Assign Ca and Mg to the cards Hh & Kk.

PREDICTING PROPERTIES OF THE UNKNOWN ELEMENT



Consider the Trends

- Explore trends of atomic radii, ionization energy, electronegativity, etc.
- Teacher explanations may extend to WHY at this point OR that explanation may be saved for later.

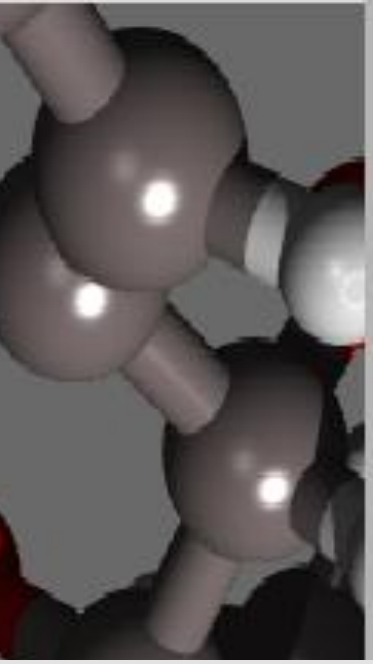
Scaffolding of Questions

- **Look at the table you created. List patterns and/or trends you used while arranging the element cards.**
- **Identify where the metals, metalloids and nonmetals are found on the table.**
- **Identify where most of the gases are found on the table.**

The next level of questions:

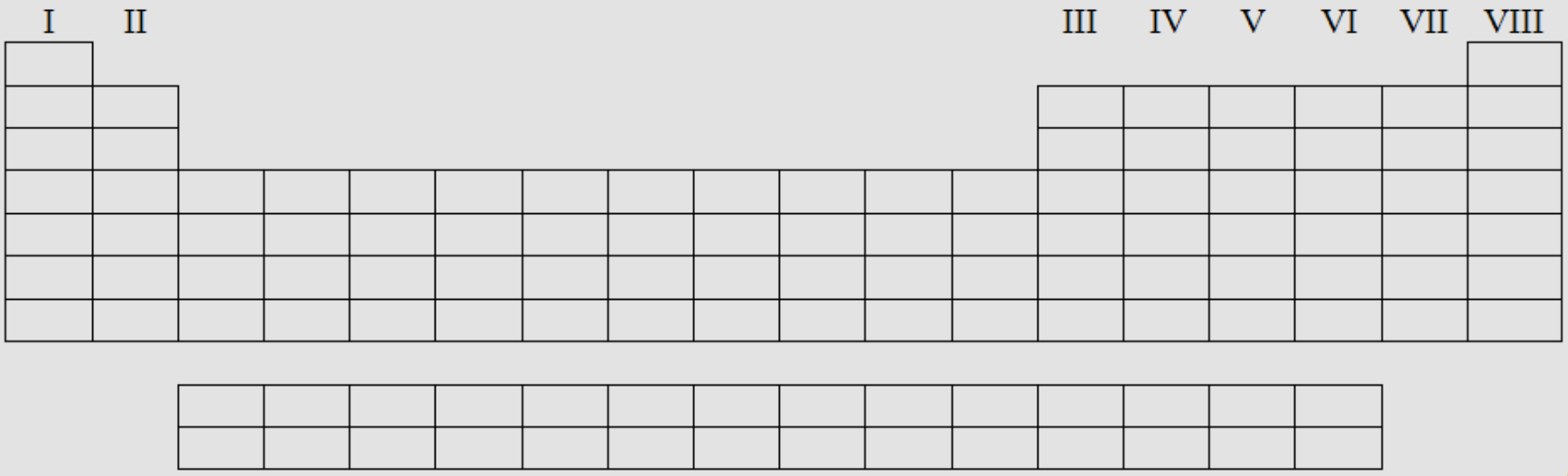
- In which two areas of the table do you find the most reactive elements? What property trends are related to reactivity? Predict an explanation for this.

- Find strontium on the periodic table. Considering Part B of the procedure, predict the reactivity of strontium with water.



ASSESSMENT

Students create a table of their own design to highlight trends and properties of elements.



GOING FURTHER – more scaffolding of questions

1. a) What do you think happens to the size of an atom as the number of electrons increase?

b) Does your explanation correspond to the trend seen for atomic radii? Explain.

2. The 10 groups added between the main group elements are called Transition Elements.

(a) Predict what phase they will be in at room temperature. Explain.

(b) What do the electron configurations of these elements have in common?

REFERENCES

- Stacy, Angelica M., Coonrod, Jan, and Claesgens, Jennifer, Living by Chemistry General Chemistry, Alchemy, Key Curriculum Press, 2003.
- Winter, Mark, WebElements: The Periodic Table on the WWW (http://webelements.com/), University of Sheffield and WebElements Ltd, UK, 2003-2009.

QUESTIONS?

- Check out the materials at the **Target Inquiry** Web site.
- Contact me directly for more information and/or comments.

Deanna Cullen

dcullen@jce.acs.org

Special thanks to Ellen Yezierski of Miami University in Ohio and Debbie Herrington of Grand Valley State University in Michigan for their continued mentorship.