NGSS Lesson- Periodic Table Patterns

Grade/ Grade Band: 9-12	**Topic:** Periodic Table Patterns	**Lesson #** 1 **in a series of** 1 **lessons**
Brief Lesson Description: Students will use cards, representing elements to build a build of the periodic table.		
Performance Expectation(s): 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.		
Specific Learning Outcomes: Students will develop an understanding that the periodic table of the elements is organized based on the number of protons and similar properties.		
Narrative / Background Information		
Prior Student Knowledge: This lesson will follow the introduction/review of the basic parts of the atom including the nucleus and electron cloud as well as the locations and properties of Protons, Neutrons and Electrons.		
Science & Engineering Practices: ***Developing and Using Models*** Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model to predict the relationships between systems or between components of a system.	**Disciplinary Core Ideas:** ***PS1.A: Structure and Properties of Matter*** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. 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.	**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.
Possible Preconceptions/Misconceptions: The periodic table is just a collection of element abbreviations.		

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:
Show students examples of chemical reactions, ex. Sugar and sulfuric acid and Sodium and water. Students may be used to seeing water as something that puts out fire plus reacting with water is one of the characteristics in the Mendeleyev's Card game that they will complete next. This will give them an example of what reacting with water looks likes.
Water and sodium videos if real demonstration is not practical: https://www.youtube.com/watch?v=dmcfsEEogxs and https://www.youtube.com/watch?v=HBYOeN155vo

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:
Student groups are given a deck of cards and will play a version Mendeleyev's Card Game where students will try to organize cards with element names and properties into logical groupings. The cards list many different properties for each element. (Card sheets at end of lesson.)
Reference video example of a similar exercise: Mendeleev's Game of Cards and the Birth of the Periodic Table: https://youtu.be/_yR3I8Lqx0o

EXPLAIN: Concepts Explained and Vocabulary Defined: Short explanation of how the modern periodic table is organized. Compare with what students are finding in their arrangements.

Vocabulary: Groups, metal, nonmetal, periodicity, noble gases, valence electrons, atomic mass

ELABORATE: Questions:
Answer the following questions and be prepared to share with the class:

1. What characteristics did you use for sorting the cards?
2. What patterns appear in your arrangement?
3. Where did you put H and He? What was your reasoning for their placement?
4. Did you notice any cards that didn't quite fit or seemed out of order? Explain

EVALUATE:
Formative Monitoring (Questioning / Discussion): How did the students recognize the patterns and relationships between the cards? Have students do a walking tour of the room and see how other groups organized their element cards.

Elaborate Further / Reflect: Enrichment: Give student groups a chance to change they way they have organized the cards based on what they have seen from other groups. Wrap up with a whip-around discussion where groups share what patterns they focused on in organizing their cards and explain what they changed, if anything, after seeing how other groups organized their cards.

Watch this short video about Mendeleyev's life and who he organized the elements. It also discusses how the patterns he identified allowed him to predict the properties of yet undiscovered elements to a very high level of precision.
The Periodic Table: Crash Course Chemistry #4 https://youtu.be/0RRVV4Diomg

Name:_____

Dmitri Mendeleyev's Card Game
A Card Sort Activity

Instructions:

1. Working in your group with one set of cards.
2. Find Be, Mg, Ca, and Sr in the deck of cards, and arrange them in columns the way Mendeleyev did. These cards are yellow. Look for similarities and differences in these cards. Find at least one pattern or trend and describe it to your group.
3. With your group, decide to organize the rest of the Cards into a table. Trying to organize them in a way that reduces as many patterns as possible.

Answer the following questions and be prepared to share with the class:

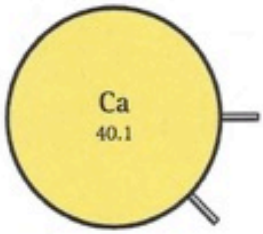
1. What characteristics did you use for sorting the cards?

2. What patterns appear in your arrangement?

3. Where did you put H and He? What was your reasoning for their placement?

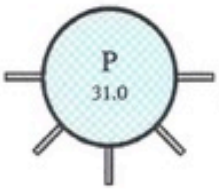
4. Did you notice any cards that didn't quite fit or seemed out of order? Explain.

Calcium — moderately hard, silvery solid *metal*



reacts with water — found in solid $CaCl_2$

Phosphorus — red solid *nonmetal*

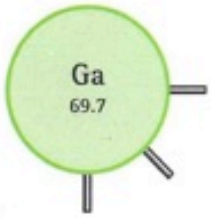


does not react with oxygen — found in PH_3 gas

Chlorine — greenish yellow gas *nonmetal*

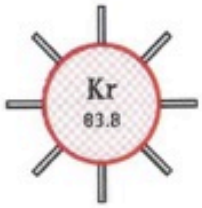
reacts violently with metals — found in HCl gas

Gallium — silvery liquid *metal*



does not react with oxygen — found in solid $GaCl_3$

Krypton — colorless, odorless gas *nonmetal*

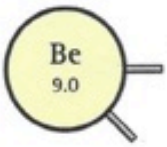


unreactive

Iodine — bluish black solid *nonmetal*

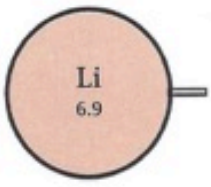
reacts with metals — found in HI gas

Beryllium — hard, dull gray solid *metal*



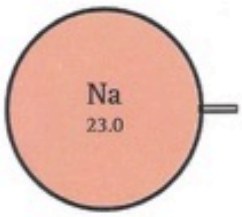
does not react with water — found in solid $BeCl_2$

Lithium — silvery solid *metal*



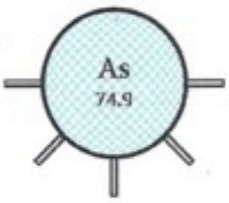
reacts with water — found in solid LiCl

Sodium — soft, silvery solid *metal*



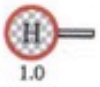
reacts vigorously with water — found in solid NaCl

Arsenic — brittle, steel gray solid *metalloid*



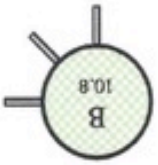
reacts very slowly with oxygen — found in AsH_3 gas

Hydrogen — colorless, odorless gas *nonmetal*



explodes in air when sparked — found in HCl gas

Boron — hard, black solid *metalloid*

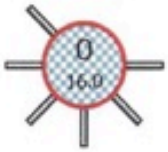


does not react with oxygen — found in BCl_3 gas

Fluorine — pale yellow gas *nonmetal*

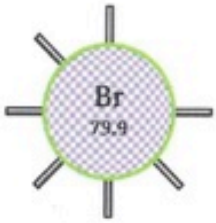
explodes upon contact with metals — found in HF gas

Oxygen — colorless, odorless gas *nonmetal*



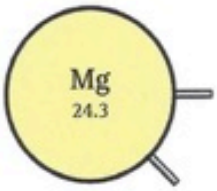
reacts slowly with metals — found in H_2O liquid

Bromine — reddish brown liquid *nonmetal*



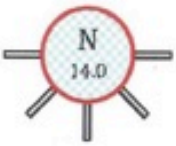
reacts vigorously with metals — found in HBr gas

Magnesium — moderately hard, silvery solid *metal*



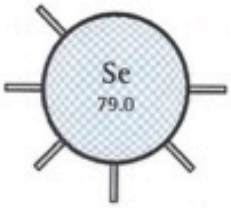
reacts only slightly with water — found in solid $MgCl_2$

Nitrogen — colorless, odorless gas *nonmetal*



not very reactive — found in NH_3 gas

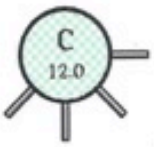
Selenium — gray solid *nonmetal*



reacts slowly with metals — found in H_2Se gas

Carbon

hard, clear solid (diamond) *nonmetal*
or soft, black solid (graphite) *metalloid*



does not react with oxygen

found in CH_4 gas

CREATE A TABLE

Card sort activity

1. Work in your group with one set of cards.
2. Find Be, Mg, Ca, and Sr in the deck of cards, and arrange them in a column the way Mendeleyev did. These cards are all yellow. Look for similarities and differences in these card . Find at least one pattern or trend, and describe it to your group.
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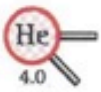
Neon

colorless, odorless gas *nonmetal*

unreactive

Helium

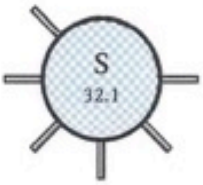
colorless, odorless gas *nonmetal*



unreactive

Sulfur

brittle, yellow solid *nonmetal*

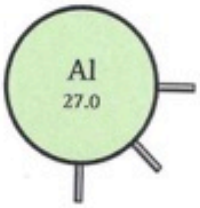


reacts slowly with metals

found in H_2S gas

Aluminum

soft, silvery solid *metal*



does not react with oxygen

found in solid $AlCl_3$

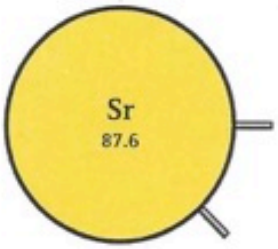
Argon

colorless, odorless gas *nonmetal*

unreactive

Strontium

moderately soft, silvery white solid *metal*

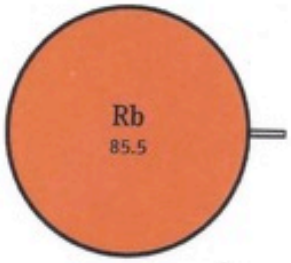


reacts vigorously with water

found in solid $SrCl_2$

Rubidium

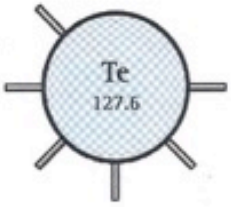
extremely soft, silvery solid *metal*



explodes upon contact with water

found in solid RbCl

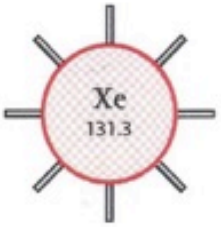
Tellurium — silvery gray solid, *metalloid*



reacts slowly with metals

found in H_2Te gas

Xenon — colorless, odorless gas, *nonmetal*



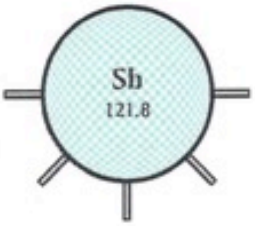
unreactive

Silicon — moderately hard, silvery solid, *metalloid*

reacts very slowly with oxygen

found in SiH_4 gas

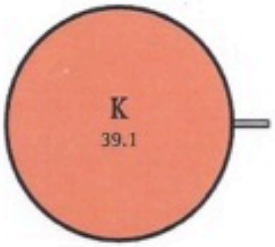
Antimony — very brittle, bluish white solid, *metalloid*



reacts very slowly with oxygen

found in SbH_3 gas

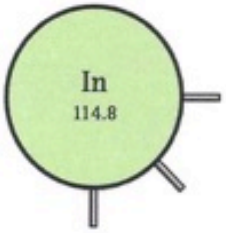
Potassium — very soft, silvery solid, *metal*



reacts violently with water

found in solid KCl

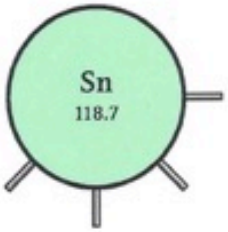
Indium — very soft, silvery solid, *metal*



reacts very slowly with oxygen

found in solid $InCl_3$

Tin — moderately soft, silvery gray solid, *metal*



reacts very slowly with oxygen

found in SnH_4 gas