CORPS
Central Oklahoma Rural Partnership For Science

Pattern Analysis of Student Thinking (PAST)

HS-PS1-1 PERIODIC TABLE TRENDS – DON'T OVERREACT ASSESSMENT TASK

PE - 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.

DCI - Structure and Properties of Matter:

- 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.

TASK 1 – *Reactivity of Common Metals*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
This task is designed to engage students in the practice of making observations and drawing logical inferences from those observations. Students should be able to infer a pattern of reactivity based on the available observations both written and visual. Students should be able to provide logical reasoning to support the inferred patterns of reactivity.	Students put all reactions in order correctly.	• Ordered from least reactive to most reactive: 1- Copper, 2-Zinc, 3-Magnesium, 4-Calcium.	Provide students the opportunity to view the reactions first-hand either through student investigation, teacher demonstrations, or videos. This allows students to make observations that can then be used to reliably evaluate the reactivity of the different elements involved.
	Students put some of the reactions in order correctly. Students provided a detailed explanation consistent with the correct order of reactivity and observations.	• "Copper did not react at all so it would have no reaction. Copper would be least reactive. Since zinc bubbled a little more than copper but still did not see as much reaction as magnesium and calcium it would be number 2. Both magnesium and calcium made lots of bubbles, but one made a bigger pop. Calcium would be the most reactive number 4 and the only number left is number 3 for magnesium"	
	Students provided an incomplete explanation.	• "I placed the copper 1 because it didn't react at all. And it went up from #4 being the greatest effect with the calcium. It made lots of bubbles , it got warm, made a large pop." • "From biggest reaction to the smallest"	

Focus SEP/CCC: Students are constructing an explanation of the reactivity of different metals using evidence obtained through observation of patterns.

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TASK 2 – *Metal Reactivity Series*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
This task is designed to allow students the opportunity to observe patterns of reactive metals and correlate these observations to the location of these elements on the periodic table. Students begin to identify patterns on the periodic table that relate directly to the reactivity of metals. Students are analyzing data and utilizing models to determine patterns that exist in the relationship of the location of elements on the periodic table.	**Question 3** Students identified logical patterns on the *Metal Reactivity Series*. Students described reactions from the *Metal Reactivity Series* but did not identify any patterns.	• "If you start from the top and go down, it goes from most reactive to least reactive to non-reactive" • "Each reaction started by forming bubbles"	Facilitate student discussions about possible patterns on the Metal Reactivity Series. Help students recognize the patterns and describe them to their peers.
	Question 4 Students correlated observations of metal reactivity based on the location in the periodic table to describe patterns in the locations of the most and least reactive metals on the periodic table. Students described patterns on *Metal Reactivity Series* and not the Periodic Table.	• "Potassium (most reactive) is in the left of the periodic table and platinum (least reactive) is in the middle"	Have students locate and identify the elements on the periodic table. One possible strategy is to have students color code the elements on the periodic table based on reactivity (e.g. most reactive = red, somewhat reactive = orange, least reactive = green). This will allow the opportunity for students to visually recognize the patterns on the periodic table.

Focus SEP/CCC: Students are analyzing data using a representative model to determine patterns observable at the macroscopic level that can be related to properties at the atomic level.

TASK 3 – *Reactivity of Non-Metals*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
This task is designed to allow students the opportunity to observe patterns of reactive nonmetals and correlate these observations to the location of these elements on the periodic table. Students begin to identify patterns on the periodic table that relate directly to the reactivity of nonmetals. Students are analyzing data and utilizing models to determine patterns that exist in the relationship of the location of elements on the periodic table.	**Question 5** Students correlated observations of non-metal reactivity based on the location in the periodic table to describe patterns in the locations of the most and least reactive metals on the periodic table. Students used the wrong data and described patterns on *Non-Metal Reactivity Series* and not the Periodic Table.	• "As you move down or left from the right side of the periodic table (Fluorine) the elements become less reactive." • "On the reactivity chart they get less reactive as you move down."	Have students locate and identify the elements on the periodic table. One possible strategy is to have students color code the elements on the periodic table based on reactivity (e.g. most reactive = red, somewhat reactive = orange, least reactive = green). This will allow the opportunity for students to visually recognize the patterns on the periodic table.

Focus SEP/CCC: Students are analyzing data using a representative model to determine patterns observable at the macroscopic level that can be related to properties at the atomic level.

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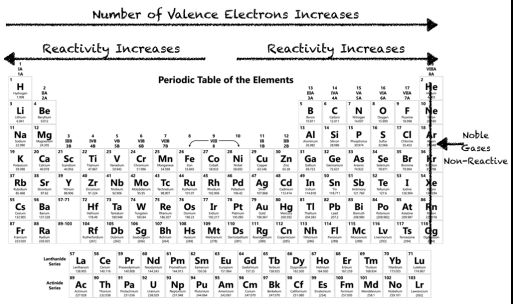
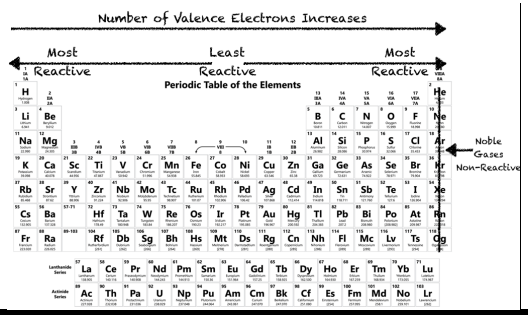
TASK 4 – *Atomic Structure and Periodic Table Patterns*

Purpose	Student Response Themes	Examples of Student Responses	Possible Teacher Instructional Moves
This question is designed to allow students to make observations about the valence electrons of elements and the patterns of the elements' valence electrons on the periodic table. Student should be able to synthesize data about the elements presented in previous models in order to determine predictable patterns that show the relationship of the elements' reactivity, number of valence electrons, and location on the periodic table.	**Question 6** Student used data from both charts to describe patterns.	• "Starting from the left of the periodic table and going right the number of valence electrons increases."	Direct students to the correct chart and have them describe their observations with a peer.
	Question 7 Students applied information from previous questions. Students used data from only one chart to describe patterns and did not synthesize information across the different models.	• "The most reactive either have the fewest valence electrons and are on the left of the periodic table or the most valence electrons and are on the right of the periodic table." • "The reactive elements are on the left and right of the periodic table." • "The ones with more electrons reacted more but the unbalanced ones did not"	Students can draw the valence electrons on the elements on a periodic table that has been color coded for reactivity. This will allow the student to synthesize multiple pieces of information in a way that they can visualize the overall trends and how they are related to each other.
This question is designed to allow students to synthesize data about the elements presented in different models in order to determine predictable patterns in the elements and the properties of those elements in relation to their location on the periodic table. Students should be able to use the location of an element to predict the reactivity, valence electrons, energy levels, and possible types of bonds that can form.	**Question 8** Students draw arrows correctly on the periodic table.	Examples of Correct Models:  	Direct students to look at the patterns that they have been identifying up to this point and have them transfer those trends to the periodic table. This will allow the students to visualize the overall patterns and apply directionality to the trends that are present on the periodic table. Students can also explore patterns on the periodic table through online interactive periodic tables.

			
Students should be able to communicate why some elements are used for specific purposes based on their location on the periodic table.	**Question 9** Students understand that the elements in the middle of the periodic table are least reactive and safer to use for jewelry and medical implants. Students did not reference the middle of the periodic table/least reactive/safer to use as a factor for material choice for jewelry and medical implants.	• "Since the least reactive metals are more in the middle of the periodic table, you would want to use them in medical implants because the metal is least reactive and will last longer." • "I think most medical implants and jewelry are made from metal alloys because they are easy to find and cheap to make."	Facilitate small and whole group discussions about the application of the periodic trends and the reactivity of the elements. During these discussions provide examples of how other elements are commonly used and how their properties relate to their use. This will allow students to share their viewpoints and come to a group consensus about why the elements in the center of the periodic table are used in medical implants and jewelry.
Focus SEP/CCC: Students are using multiple models of the elements on the periodic table to describe patterns both at the atomic and macroscopic scale that can be used to make predictions about the properties of specific elements.			