CORPS
Central Oklahoma Rural Partnership For Science

PHENOMENON-BASED INSTRUCTIONAL TASK | **GRADE LEVEL:** High School Physical Science/Chemistry

DON'T OVERREACT!

TARGETED DCI AND ASSOCIATED PE

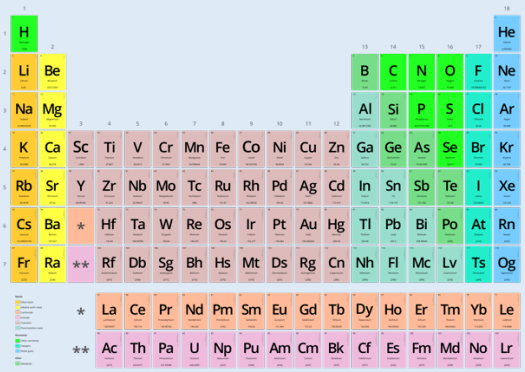
PE | HS-PS1-1

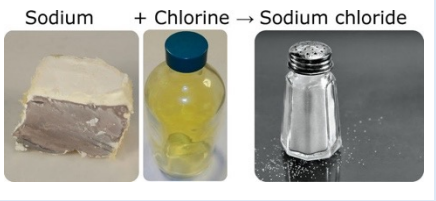
Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

DCI | 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.

POSSIBLE DRIVING PHENOMENA





Example of a common compound (table salt) and the elements that compose it.

Student observation or initial interaction

Students watch videos* or carefully controlled teacher demonstrations of different elements from groups 1, 2, 6, and 7 reacting and not reacting and observe the elements' locations on the periodic table. Additionally, students can research the elements that compose common compounds, such as salts, and locate the elements that compose these compounds on the periodic table.

*Videos can be found by searching "periodic table and chemical reactions" or "periodic table and reactivity"

COMMON IONIC COMPOUNDS

Compound Name	Formula	Cation (positive)	Anion (negative)
Lithium Fluoride	LiF	Li^+	F^-
Lithium Chloride	LiCl	Li^+	Cl^-
Lithium Bromide	LiBr	Li^+	Br^-
Lithium Iodide	LiI	Li^+	I^-
Sodium Fluoride	NaF	Na^+	F^-
Sodium Chloride	NaCl	Na^+	Cl^-
Sodium Bromide	NaBr	Na^+	Br^-
Sodium Iodide	NaI	Na^+	I^-
Beryllium Oxide	BeO	Be^{2+}	O^{2-}
Beryllium Sulfide	BeS	Be^{2+}	S^{2-}
Beryllium Selenide	BeSe	Be^{2+}	Se^{2-}
Sodium Selenide	Na_2Se	Na^+	Se^{2-}
Sodium Oxide	Na_2O	Na^+	O^{2-}
Calcium Chloride	$CaCl_2$	Ca^{2+}	Cl^-
Magnesium Bromide	$MgBr_2$	Mg^{2+}	Br^-

Student observation or initial interaction

Students view a list* of elements and the common chemical compounds that they form. Students make observations about the placement of the elements on the periodic table and look for patterns.

*List is included in appendix

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Phenomenon explanation for teachers:
The arrangement of the elements on the periodic table is based on the characteristics of the atomic structure of each element. The elements are ordered from left to right based on the number of protons in the atom's nucleus. Additionally, the number of electrons found on the outermost level of the atom increases as you move from left to right. The elements in the first column (group 1) all have one valence electron, so they have similar chemical properties and react similarly with other elements. The elements in the second column (group 2) have two valence electrons. The elements in group 13 have three valence electrons; group 14 have four valence electrons; group 15 have five valence electrons; group 16 have six valence electrons; group 17 have seven valence electrons; and group 18 (except Helium) have 8 valence electrons. Helium has two valence electrons and belongs in group 18 because all the elements in this group have a full outer shell. The elements in the first row (period 1) have only one electron level (shell or orbital), and the elements in the second period have two electron levels. This pattern continues down the periodic table. Knowledge about these patterns in the arrangement of the elements on the periodic table is useful for predicting how elements will interact with other elements, which makes it possible to predict the outcome of chemical reactions.

HOW DOES THE PHENOMENON CONNECT TO THE DCI OR PE?

All atoms have a specific composition that determines their structure. The structure results in specific chemical and physical properties for each unique substance. Students can use models to understand the structure of each atom, which will contain a nucleus of protons and neutrons surrounded by electrons. Students can then analyze models of different elements to discover patterns found in the periodic table, (i.e. atoms ordered horizontally by the number of protons in the nucleus and vertically by similar chemical properties and the arrangement of valence electrons, or the electron orbitals). Matter has the ability to interact, and many substances can react with other substances and undergo a chemical change that creates new substances. Patterns on the periodic table can assist students in explaining an element's reactivity with other elements. Students can then establish a claim supported with evidence about the reactivity of several different elements using the understanding that elements are arranged in the periodic table based on their properties and that this arrangement forms patterns. It is essential to understand that the properties associated with each element affect its ability to react chemically with other elements and substances.

GATHERING AND REASONING IN ORDER TO CONSTRUCT AND REFINE EXPLANATIONS:

How could students gather evidence using SEPs and CCCs that will help them construct/refine a supported explanation of the phenomenon?

1. INITIAL ENGAGEMENT WITH THE PHENOMENON:

- Students make and record observations of the phenomenon and the placement of the elements on the periodic table. Students can formulate questions based on their observations. Present students with the overarching question: Why are the elements arranged the way they are in the periodic table?
- Students develop additional questions that would help them to investigate the overarching question.

Guiding Questions:

- What evidence would you need to answer your questions?
- What patterns do you observe in the reactions and compounds presented?
- What can you conclude about the periodic table based on the patterns that you observe?
- What do you think caused the patterns you observed in the periodic table?
- How does knowing about the patterns and the characteristics of the elements allow you to make predictions about a given element and how it might react?
- How does the structure of the atom affect where it would be placed on the periodic table?

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2. CONTINUING EXPLORATION

- Students can research and collect information about the characteristics of specific elements.
- Students can look for patterns in the characteristics of the elements that might help them explain their arrangement on the periodic table.
- Students can construct models to both understand and communicate their understanding of the patterns in the periodic table.

COMMUNICATE FINAL EXPLANATION OF THE PHENOMENON

How might students communicate their understanding of the targeted DCI or PE in an explanation supported by evidence?

Students can construct and communicate an explanation about the patterns found in the periodic table and the causes of those patterns.

Possible formats for constructing explanations of this phenomenon

- Students can develop models to explain the relationships of the elements to each other as they are found on the periodic table.
- Students can construct an argument for how the periodic table is arranged and/or how different elements might react with each other based on evidence from the periodic table.

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