

Educational Resources from *Phenomenon Science Education*

Student Proficiency Goals for **NGSS HS-PS1-1**



Information about HS-PS1-1

NGSS Performance Expectation 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.

Clarification Statement.

Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.

Assessment Limits.

Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.

Science and Engineering Practice (Developing and Using Models)

- Use a model to predict the relationships between systems or between components of a system.

Disciplinary Core Idea (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 Concept (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.

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Student Proficiency Goals

SEP (Developing and Using Models):

- Students use the periodic table to identify and describe the relationships among atoms in the same column and the pattern of electrons in the outer electron state of each element within that column.
- Students use the periodic table to identify and describe the relationships among atoms in the same column and the pattern of types and number of bonds formed with other atoms.
- Students use the periodic table to identify and describe the relationships among atoms in the same column and the pattern of reactivity with other atoms.
- Students use the periodic table to identify and describe the relationships among atoms in the same row and the pattern of electrons in the outer electron state of each element within that row.
- Students use the periodic table to identify and describe the relationships among atoms in the same row and the pattern of types and number of bonds formed with other atoms.
- Students use the periodic table to identify and describe the relationships among atoms in the same row and the pattern of reactivity with other atoms.
- Students use the periodic table as a model of atomic structure to predict the reactivity of elements, the types and number of bonds formed during reactions, and properties of elements, based on the elements' positions in the periodic table.

DCI (PS1.A Structure and Properties of Matter):

- Students know that atoms consist of a nucleus which is made of protons and neutrons, surrounded by electrons.
- Students know that elements are arranged in the periodic table horizontally by the number of protons in the atom's nucleus.
- Students know that elements with similar chemical properties are arranged in columns within the periodic table.

CCC (Patterns):

- Students consider how the placement of elements in columns of the periodic table reflect the patterns of electrons in the outer electron state of each element.
- Students consider how the placement of elements in rows of the periodic table reflect the patterns of electrons in the outer electron state of each element.

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| <ul style="list-style-type: none">• Students know that the repeating patterns found in the periodic table reflect the patterns of outer electron states.• Students know that the bond(s) formed and reactivity of an atom depends on its outer electron state. | <ul style="list-style-type: none">• Students consider how the pattern of outer electron states of atoms can relate to the pattern of bonds formed on one scale and reactivity with other atoms on another scale.• Students consider how the pattern of electrons in the outer electron state of atoms as shown in the periodic table can be used to explain certain phenomena. |
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