Short Performance Assessment: **HS-PS1-2**

Grade Level: **High School**

Adapted from SNAP[1]

Title	**Predicting Products**		
Designed by	**Paul Andersen**	Course(s)	**NGSS Chemistry**

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Performance Expectation	**HS-PS1-2**: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. **Clarification Statement**: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen. **Assessment Boundary**: Assessment is limited to chemical reactions involving main group elements and combustion reactions.

Science and Engineering Practice	**Constructing Explanations** • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
Disciplinary Core Ideas	**PS1.A: 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. **PS1.B: Chemical Reactions** • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
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.

Student Performance	1. Articulating the explanation of phenomena 2. Evidence 3. Reasoning 4. Revising the explanation

[1] The Short Performance Assessment (SPA) and the Assessment Rubric adapted from the Stanford NGSS Assessment Project http://snapgse.stanford.edu/

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Name_____

Background:



Estonian science popularizer Maxim Bilovitskiy explodes a balloon filled with hydrogen gas (H_2) in the video to the right. (Source) The hydrogen in the balloon chemically combines with oxygen (O_2) in the air after a spark is added. In addition to a large amount of thermal energy being released, water vapor (H_2O) is a product of this reaction.

1. Write out a balanced chemical equation that represents the process in the space provided.

Because chemical reactions can be dangerous it is important to predict the possible products of a reaction before combining the reactants in the real world. Chemists are able to predict the products of reactions like the one shown above using the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

2. Select one reactant from each of the categories below that you believe will react chemically. You will be predicting the products in a reaction between these two reactants.

Reactant 1		+	Reactant 2	
☐ $C_{(s)}$ Carbon (graphite)	☐ $CH_{4(g)}$ Methane gas		☐ $O_{2(g)}$ Oxygen gas	☐ $Cl_{2(g)}$ Chlorine gas
☐ $Na_{(s)}$ Sodium metal	☐ $N_{2(g)}$ Nitrogen gas		☐ $H_2O_{(l)}$ Water	☐ $H_{2(g)}$ Hydrogen gas

3. Sketch and describe an investigation that would allow you to safely combine the two products in a chemical reaction.

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Predicting the Products:

4. Use the graphic organizer below to construct an explanation for the products of your reaction. You should support your explanation using multiple lines of evidence and reasoning. A periodic table can be found on the next page.

My Explanation: Write out a balanced chemical equation that represents the reaction in the space provided.		
Evidence Type	**My Evidence:** Describe specific evidence that helps support your explanation. Periodic table can be found on the next page.	**My Reasoning:** Describe a chain of reasoning that connects the evidence described to your explanation.
The outermost (valence) electron state of the atoms in the reaction		
The relative electronegativity of the atoms in the reaction		
The patterns of reactivity at the macroscopic level as determined by the periodic table.		
The numbers and types of bonds (i.e., ionic, covalent) in both the reactants and the products of the reaction		
The number and types of atoms before and after the reaction (i.e. conservation of mass)		

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Periodic Table of the Elements

