Short Performance Assessment: **HS-PS1-1**

Grade Level: **High School**

Adapted from SNAP[1]

Title	**Ordering Reactivity**		
Designed by	**Paul Andersen** Inspired by *Periodic Trends* by CREATE for STEM at Michigan State University	Course(s)	**High School NGSS**

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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 Boundary**: 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 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 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. Components of the model 2. Relationships 3. Connections

Image / Video Sources:
Lithium in Water - YouTube - nickbhalo - https://www.youtube.com/watch?v=vRKK6pliejs
NovaElements - https://www.novaelements.com/

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

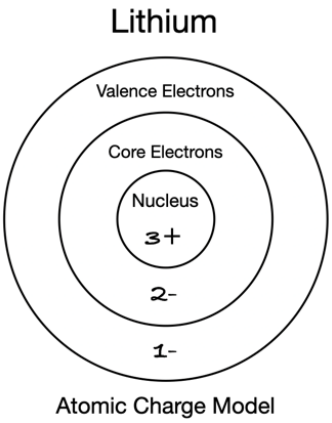
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Name_____

Ordering Reactivity

Alex recently ordered some lithium from NovaElements. A sample of the metal was added to a bucket of water and it reacted as shown below. The lithium produced bubbles before completely dissolving in the water. Alex has learned in chemistry class that the relative ease with which an electron is transferred away from a metal determines how reactive that metal is with water.

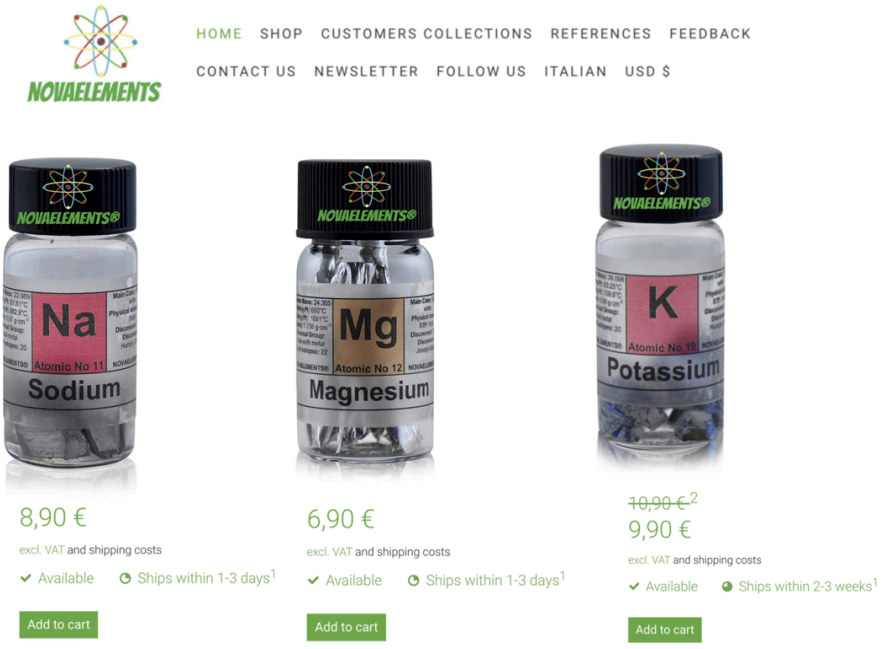






Three Act Magic Show

Alex orders three additional elements for a chemistry magic show. Alex will add samples of each of the elements to water using appropriate safety precautions. Alex hopes to have the three reactions increase in reactivity throughout the show from least to most reactive. Your goal is to help Alex plan the show by ranking the reactivity of the metals using your understanding of **patterns** in the periodic table.

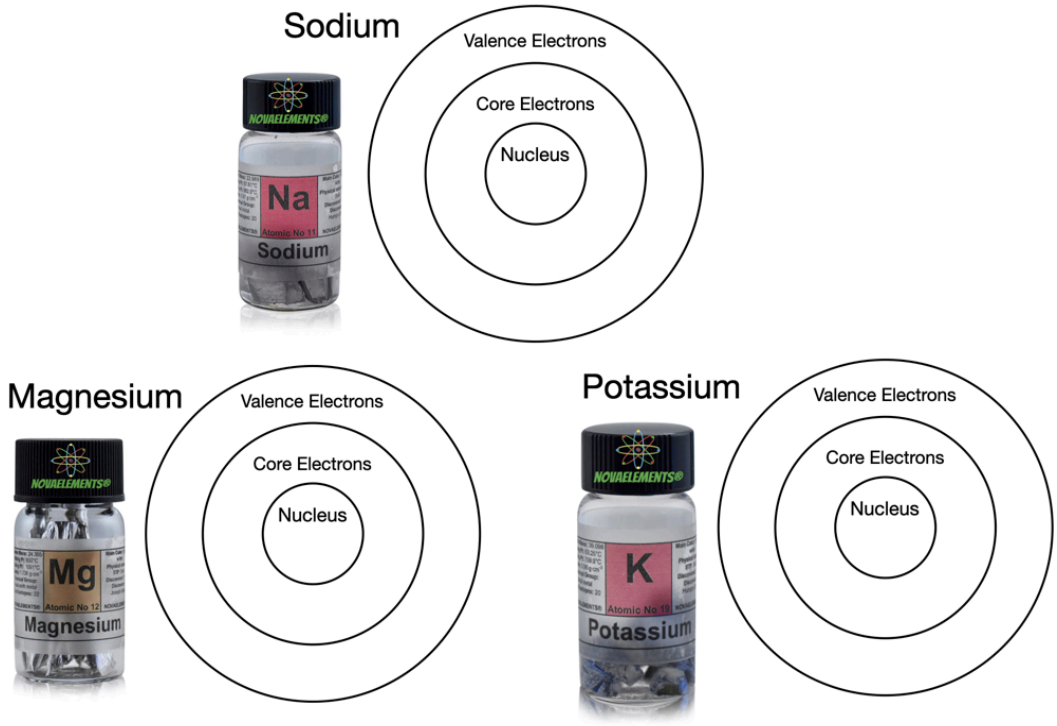


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Atomic Charge Models

To help you rank the reactivity of the three metals you will be creating atomic charge models for each of the elements. You may use the periodic table as a model to help you complete these individual models.

1. Complete the atomic charge models to show the charged substructure of sodium, magnesium and potassium.



2. Use the **pattern** of charge distribution to draw the relative size of the atoms in the space below.

Element	Sodium	Magnesium	Potassium
Relative size			
Explain your relative size drawings using the forces and interactions that govern the size of each atom.			

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3. Predict whether the energy required to remove an electron from magnesium and potassium would be more or less than that required to remove an electron from sodium. Explain your prediction in terms of the forces and interactions involved in this process.

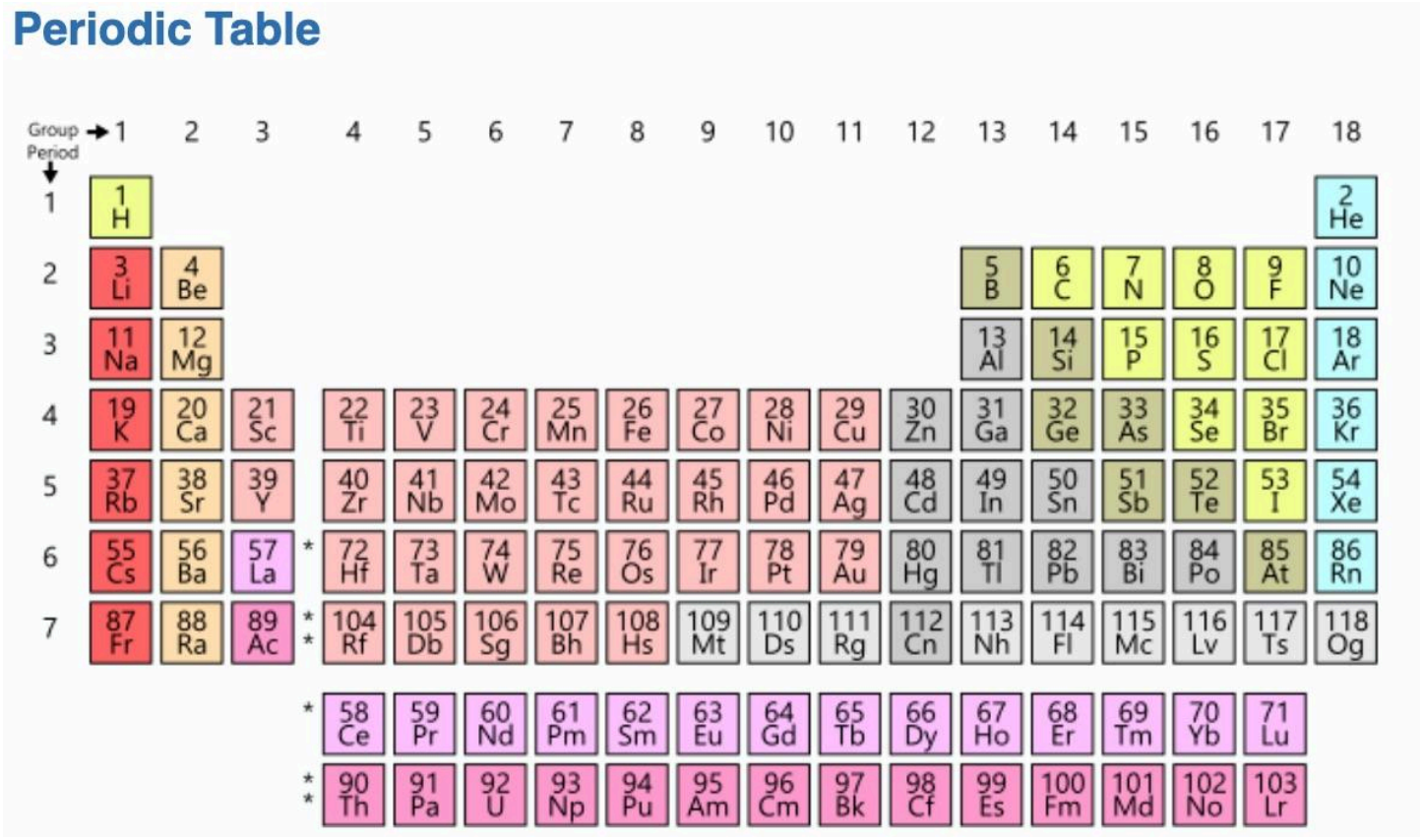
Magnesium	Potassium
❏ More energy required ❏ Less energy required	❏ More energy required ❏ Less energy required
Explanation:	Explanation:

4. Use your understanding of charges in the metals to plan the three act chemistry magic show.

Act	One Least reactive	Two Slightly reactive	Three Most reactive
Metal			
Explain your ranking using the forces and interactions that govern the reactivity of the atom.			

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Periodic Table



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