Profiling an Element

Context

Elements are substances that cannot be broken down into simpler forms of matter, and they are the primary constituents of all matter. The elements are the basis of all chemical interactions, and the implications of the ways in which atoms interact are relevant to every aspect of our lives, from health to technology, energy, and the environment.

Essential Questions

- What are the unique properties of different elements?
- How were different elements discovered?
- How do knowledge and understanding of elements impact different aspects of our lives?
- In what ways are specific elements beneficial, useful, or harmful to humans, our technology, and our environment?

Enduring Understandings

- All matter is made of elements.
- Each element has unique properties that affect its behavior and interaction with its environment.
- Atoms can form bonds with other atoms of the same element or different elements, forming molecules.
- Elements each have different properties that are useful to people in different ways.
- Elements can exist in different states of matter. The four basic states of matter are solid, liquid, gas, and plasma.

Time

This activity can be completed in 2–4 class periods of approximately 50 minutes.

Grade Level

Grades 6–12

Differentiation

Activities can be completed as a class guided by the teacher, in groups, pairs, or individually based on students' abilities.

Materials

- Core Concepts: Periodic Table
- Paper/pencils
- Printed Exploration Charts (Supplement 1) for each student or group
- PowerPoint Element Profiles (Supplement 2) or Printable Profile Template PDFs (Supplement 3) for each student or group
- Element Scavenger Hunt PDFs (Supplement 4) for each student or group

Lesson Objectives

- Students will report in-depth on the properties, history, and uses of an element from the periodic table.
- Students will understand that the elements play important roles both in the natural world and in our lives.

Next Generation Science Standards Addressed	
MS-PS1-1.	**Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [*Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.*]
MS-PS1-3.	**Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [*Assessment Boundary: Assessment is limited to qualitative information.*]
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.*]
HS-PS1-3.	**Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.** [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [*Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.*]

HS-PS1-8.	**Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.** [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [*Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.*]
HS-PS2-6.	**Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.** [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [*Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.*]

Common Core ELA Standards Addressed

CCSS.ELA-Literacy.RST.6-8.1, 9-10.1, 11-12.1

Cite specific textual evidence to support analysis of science and technical texts.

CCSS.ELA-Literacy.RST.6-8.2, 9-10.2, 11-12.2

Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-Literacy.RST.6-8.4, 9-10.4, 11.12.4

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8, grades 9-10 texts and topics.

CCSS.ELA-Literacy.RST.6-8.7, 9-10.7, 11-12.7

Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

NGSS Science and Engineering Practices Addressed

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

NGSS Crosscutting Concepts Addressed

- Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
- Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
- Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
- Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
- Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Observation

1. Display the Core Concepts: Periodic Table interactive homepage for students to reference. Ask students to think about information they know or have heard about elements that is not apparent on the periodic table, such as facts about an element's role in nature or human life, the discovery, or the history of the element. Explain some uses for elements that are very easy to see and demonstrate (helium in balloons, the carbon allotrope graphite in pencils, etc.).
2. Explain that students will work together to create an in-depth report on an element in the form of a social network profile.

Hypotheses

1. Print out an Exploration Chart (Supplement 1) for each student/group to use in documenting their exploration of an element. (Note that this is an advanced version of the classic KWL [Know, Want To Know, Learned] chart.)

Prior Knowledge/ Preconceptions	Questions/Hypotheses	Research	Conclusions/ Further Questions

2. Through guided class discussion, fill in the first two columns of the chart; generate a list of things students know, or think they know about specific elements and their roles in human life. Generate a list of questions or hypotheses students have about these roles.

Suggested Prompts

- In what contexts have you heard hydrogen referenced or discussed? (For example, the H in H_2O, household products such as hydrogen peroxide, the composition of the sun, hydrogen bombs, etc.)
- Have you heard the phrase carbon-based? What is the significance of this phrase? (All known life is carbon-based.)
- What are the elements are associated with human health or health risks (e.g., lead)?

Research or Experimentation

LESSON

Explain that students will be working (independently or in groups) to create a social networking profile for an element. The profile can be created digitally using the supplied PowerPoint template (Supplement 2) or as a paper report using the provided template (Supplement 3).

Technology Tip

In creating their element profiles, students are not limited to using the provided PowerPoint templates or printed profile template PDFs. If students have access to a teacher- or school-run Web site or Wiki, they can craft their profiles on these platforms.

As a class, generate a list of things students' profiles should include, and discuss how they could address the element. Be sure to include all of the following, and encourage students to be creative:

- Profile picture that accurately represents the element (this could be a photograph of the element in some form, a drawing, or an atomic model)
- About Me (a brief description of the element, possibly including its usual state of matter, common isotopes, its atomic weight, physical properties, etc.)
- Family (alkali metals, noble gases, transition elements, etc., and the other specific elements that belong in the same family)
- Friends (could include elements that commonly bond, researchers who discovered or work with the element, etc.)
- Job(s) (what are some common roles of the element in nature, industry, the human body, etc.)
- Photo Gallery
- Timeline (including creative descriptions of how an element figures into the real world, its interactions with other elements, molecules it is present in, etc.)

RESEARCH

Assign each student or group an element. Students work independently or in groups to explore the Core Concepts: Periodic Table database to research their assigned element, and note their findings in the **Research** column of their Exploration Charts. Younger students and students who may require more structure can complete the Element Scavenger Hunt (Supplement 4).

MATERIALS:

- Core Concepts: Periodic Table
- Exploration Charts (Supplement 1)
- PowerPoint Element Profiles (Supplement 2) or Printable Profile Template PDFs (Supplement 3) for each student or group
- Element Scavenger Hunt (Supplement 4) (if applicable)
- Pencils

Analysis

Students work independently or in groups to analyze their findings, and note the important conclusions to include in their element profile in the **Conclusions/Further Questions** section of their Exploration Charts. Encourage students to think creatively about how they might incorporate information into their profiles.

Suggested Prompts

- If your element posted to its timeline, what kind of comments would it post? What kind of opinions would it have? What kind of activities might it be doing? (e.g., Hydrogen: "Today I hooked up with Oxygen and formed a water molecule. We get along so well, it'd take electrolysis to make us part!")
- What would you put for your element's "hometown"?
- Your element may play many roles in nature and in human life. What would your element's "job" be? Would it have more than one?
- What would your element's likes and dislikes be?

Report

ELEMENT PROFILE

Using their Exploration Chart notes (and Scavenger Hunt notes, if applicable), students can create their element profile on a computer using the provided PowerPoint template (Supplement 2), on paper using the provided PDF template (Supplement 3), or on a class or school-run Web site or Wiki.

Technology Tip

If students will work online on a class Web site or Wiki, they can use an application like ThingLink (http://www.thinglink.com) to create interactive, media-rich images. If using the provided PowerPoint template, teachers should feel free to adjust the layout to fit the needs of their class.

Assessment Evidence

ONGOING ASSESSMENT

- Guided Discussions and Exploration Chart

SUMMATIVE ASSESSMENT

- Exploration Charts
- Element Scavenger Hunt notes

- Rubric for the Element Profile report:

	Absent 0	Insufficient 1	Sufficient 2	Exceeds Expectations 3	Total Points
Photos and Illustrations	No profile picture or photos/ illustrations	Photo/ illustration sections are incomplete or photos/ illustrations are inappropriate	Profile picture and photos/ illustrations are present and appropriate	Multiple appropriate photos/ illustrations	
About Me	No information in section	Basic information about the element is incomplete or incorrect	All basic information about the element (name, atomic structure, weight, etc.) included	All basic information about the element, plus extra information included	
Family and Friends	No information in section	Family elements are not included or incorrect, no rationale for "friend elements" is provided	All elements in the same family included as well as at least one "friend" element with reasonable rationale for inclusion	All elements in the same family included as well as many "friend elements" with reasonable rationale for inclusion	
Jobs	No information in section	Incomplete or incorrect information	At least one "job" included with reasonable rationale for inclusion	More than one "job" included, thorough rationale	
Timeline	No information in section	Only one status update, or feed is irrelevant	At least 3 relevant status updates	Multiple relative and creative status updates	

Extensions

CONTENT CREATION

Students can use one of Core Concepts: Periodic Table's three interactive content-creation tools to create a multimedia presentation, film a video, or record a podcast about their element. The content creation tools are accessed from the site's Explore, Create, Learn portal. The tools walk students through the production of their digital presentations step-by-step. When completed, the final product may be shared live on the web, or presented to the class. Students can also submit their videos to Core Concepts: Periodic Table by using the Submit a Video page.

Teaching Tip

To reinforce classroom learning, students can study the Quizlet flashcard set to identify elements by chemical symbol and atomic number on the Core Concepts: Periodic Table database or by visiting Rosen Digital's Quizlet page.