



**Reading Supports**

**Teacher’s Guide:**

**“The Periodic Table’s   
Final Four”**

*April/May 2019*

<http://www.acs.org/chemmatters>



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# Reading Supports

The pages that follow include reading supports in the form of an Anticipation Guide, a Graphic Organizer, and Student Reading Comprehension Questions. These resources are designed to help students prepare to read the article and then locate and analyze information from the article.

* **Anticipation Guide (page 5):** The Anticipation Guide helps to engage students by activating prior knowledge and stimulating student interest before reading. If class time permits, discuss students’ responses to each statement before reading each article. As they read, students should look for evidence supporting or refuting their initial responses.

**Or** consider the following ideas to engage your students in reading:

**The Periodic Table’s Final Four**

* Before reading, ask students how many elements are in today’s Periodic Table. Ask student when the last four elements were added, how they were created, and where they are found on the Periodic Table.
* As they read, students can find information to confirm or refute their original ideas.
* **Graphic Organizer (page 6):** The Graphic Organizer is provided to help students locate and analyze information from the article. Student understanding will be enhanced when they explore and evaluate the information themselves, with input from the teacher, if students are struggling. Encourage students to use their own words and avoid copying entire sentences from the article. The use of bullets helps them do this.

If you use the aforementioned organizers to evaluate student performance, you may want to develop a grading rubric such as the one below.

|  |  |  |
| --- | --- | --- |
| **Score** | **Description** | **Evidence** |
| 4 | Excellent | Complete; details provided; demonstrates deep understanding. |
| 3 | Good | Complete; few details provided; demonstrates some understanding. |
| 2 | Fair | Incomplete; few details provided; some misconceptions evident. |
| 1 | Poor | Very incomplete; no details provided; many misconceptions evident. |
| 0 | Not acceptable | So incomplete that no judgment can be made about student understanding |

* **Student Reading Comprehension Questions (page 7):** The Student Reading Comprehension Questions are designed to encourage students to read the article (and graphics) for comprehension and attention to detail, to provide the teacher with a mechanism for assessing how well students understand the article and/or whether they have read the assignment, and, possibly, to help direct follow-up, in-class discussion, or additional, deeper assignments.

Some of the articles in this issue provide opportunities, references, and suggestions for students to do further research on their own about topics that interest them.

To help students engage with the text, ask students which article **engaged** them most and why, or what **questions** they still have about the articles. The “Web Resources for More Information” section of the Teacher’s Guide: Tools and Resources provides sources for additional information that might help you answer these questions.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Anticipation Guide

**Directions: *Before reading the article*,** in the first column, write “A” or “D,” indicating your agreement or disagreement with each statement. As you read, compare your opinions with information from the article. In the space under each statement, cite information from the article that supports or refutes your original ideas.

|  |  |  |
| --- | --- | --- |
| **Me** | **Text** | **Statement** |
|  |  | 1. The last row of the Periodic Table was completed in 2018. |
|  |  | 1. All of the final four elements were named for the places where they were created. |
|  |  | 1. The first list of modern elements was published in the early 1800s. |
|  |  | 1. Most naturally occurring elements were discovered before 1900. |
|  |  | 1. Elements are defined by the number of protons and neutrons. |
|  |  | 1. Creating new elements requires overcoming strong repulsive forces between positively charged particles. |
|  |  | 1. No practical uses have been found for synthetic elements. |
|  |  | 1. Elements are officially named before the discovery is confirmed in a different laboratory than where they are discovered. |
|  |  | 1. All of the newest elements have half lives of less than one second. |
|  |  | 1. The last row of the Periodic Table was completed in 2018. |

## Graphic Organizer

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions**: As you read the article, complete the graphic organizer below to compare naturally occurring elements to synthetic elements.

|  |  |  |
| --- | --- | --- |
|  | **Natural Elements** | **Synthetic Elements** |
| **Examples** (at least 5 for each) |  |  |
| **When discovered** (range) |  |  |
| **Atomic Number** (range) |  |  |
| **Location on the Periodic Table** |  |  |

Use the graphic organizer below to describe an alpha particle:

|  |  |  |  |
| --- | --- | --- | --- |
|  | ***Structure*** | ***Charge*** | ***Role in creating new elements*** |
| **Alpha Particle** |  |  |  |

**Summary:** On the bottom or back of this paper, write a short (2-3 sentence) explanation of the role of IUPAC in confirming and naming new elements.

## Student Reading Comprehension Questions

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Directions**: Use the article to answer the questions below.

* 1. When were the four last open spots in the periodic table filled?
  2. Complete the table below for the four elements most recently added to the periodic table.

|  |  |  |
| --- | --- | --- |
| **New elements** | | |
| **Atomic number** | **Name** | **Origin of name** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

* 1. (a) Who was the scientist who first published a textbook containing a table identifying 33 simple substances later recognized as the first list of modern elements, and (b) when was it published?
  2. When and by whom was the first organization of elements that resembles the current periodic table established?
  3. How many elements occur naturally on Earth?
  4. What defines any given element?
  5. What is required for creating a new element?

**Student Reading Comprehension Questions, cont.**

* 1. Give the name and atomic number, and the location and date of discovery of the first synthetic element produced.
  2. What are the three main standards IUPAC proposed in regards to naming elements?
  3. What are the most fascinating properties of the new superheavy elements?
  4. Which element is associated with the production of three of the four newest elements?

**Critical-Thinking Questions**

***Write your answers on another piece of paper.***

* 1. Propose a possible procedure for making element 120.
  2. Based on its expected position on the periodic table (directly under radium, element 88), what properties (e.g., outer energy-level electron arrangement) oxidation number, the formula of its compound with chlorine, reactivity with water, nuclear stability, and density) would you predict for element 120 (unbinilium, Ubn)? Explain your predictions.

## Answers to Reading Comprehension Questions

1. **When were the four last open spots in the periodic table filled?**

The four last spots in the periodic table were filled in 2016.

1. **Complete the table below for the four elements most recently added to the periodic table.**

|  |  |  |
| --- | --- | --- |
| **New elements** | | |
| **Atomic number** | **Name** | **Origin of name** |
| 113 | nihonium | Japanese word “nihon”, meaning “land of the rising sun” |
| 115 | moscovium | Discovered in Moscow, Russia |
| 117 | tennessine | Tennessee, site of scientists’ discovery |
| 118 | oganesson | In honor of Yuri Oganessian, nuclear physicist, for his role in discovering heavy elements |

1. **(a) Who was the scientist who first published a textbook containing a table identifying 33 simple substances later recognized as the first list of modern elements, and (b) when was it published?**
2. Antoine Lavoisier published a textbook identifying 33 substances in a “Table of Simple Substances”, later recognized as the first list of modern elements.
3. It was published in 1789.
4. **When and by whom was the first organization of elements that resembles the current periodic table established?**

In 1869, Dmitri Mendeleev organized the elements in a table that resembles the current periodic table of the elements.

1. **How many elements occur naturally on Earth?**

There are 94 known naturally occurring elements on Earth.

1. **What defines any given element?**

Any given element is defined by its number of protons, its atomic number.

1. **What is required for creating any new element?**

Any new element created must have a new and unique number of protons.

1. **Give the name and atomic number, and the location and date of discovery of the first synthetic element produced.**

The first synthetic element produced was curium, atomic number 96, made by scientists at the University of California, Berkeley, in 1944.

1. **What are the three main standards IUPAC proposed in regards to naming elements**?

IUPAC proposed that naming elements should follow these guidelines:

1. The element will be named five years after the initial announcement of its discovery, to allow confirmation by other laboratories, preferably in other countries.
2. The element’s discoverers will choose the name for the element within prescribed IUPAC guidelines.
3. In cases where multiple discoverers claim the right to name the element, IUPAC will ultimately decide who will have the honor of naming the element.
4. **What are the most fascinating properties of the new superheavy elements?**

The most fascinating properties of the new superheavy elements are that they are

1. extremely radioactive and
2. unstable.
3. **Which element is associated with the production of three of the four newest elements?**

Calcium was used to create moscovium, tennessine, and oganesson.

**Critical-Thinking Questions**

1. **Propose a possible procedure for making element 120.**

Although the procedure should be the same for all answers (use of a cyclotron to bombard elements together), the elements students choose to make element 120 will vary. Based on information in the article on three of the four most recently created elements (the use of calcium for three of the four), one likely possibility for students to propose would be to bombard atoms of fermium (element 100) with calcium atoms (element 20) inside a cyclotron to produce an element with an atomic number of 120. (Or they could hypothetically offer any other combination of two elements whose atomic numbers add up to an atomic number of 120.)

1. **Based on its expected position on the periodic table (directly under radium, element 88), what properties (e.g., outer energy level electron arrangement, oxidation number, the formula of its compound with chlorine, reactivity with water, nuclear stability, and density) would you predict for element 120 (unbinilium, Ubn)? Explain your predictions.**

|  |  |
| --- | --- |
| **Description of property** | **Element 120’s property** |
| Outer energy level  electron arrangement | 8s2 – two electrons in its outer energy level, just as other group 2, alkaline earth, elements; they all have *n* s2 arrangements |
| Oxidation number | +2 as it easily loses those 2 outermost electrons |
| Formula of compound with chlorine | UbnCl2, just as other group 2 elements (e.g., MgCl2) |
| Reactivity with water | Reacts vigorously with water, as other group 2 elements react with water, with the trend in reaction rate increasing |
| Nuclear stability | Radioactive, just as radium is radioactive |
| Density | 6.5–7 g/cm3, as the trend increases dramatically with the last (heaviest) few elements in group 2 |