Letter

Previous Article | Next Article | Table of Contents

Black Panther, Vibranium, and the Periodic Table

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Abstract

In this activity, we describe how the movie *Black Panther* provides a unique opportunity for students to think critically about the arrangement of the periodic table. The fictional African nation, Wakanda, led by King T'Challa, has a thriving STEM economy based on the production and use of vibranium, which has amazing chemical and physical properties. In addition, the movie *Black Panther* also provides an important platform to address the roles of women and people of color in the STEM disciplines.

Keywords: Communication/Writing; Inquiry-Based/Discovery Learning; Minorities in Chemistry; Periodicity/Periodic Table; Physical Properties; Student-Centered Learning

The movie *Black Panther* provides a unique opportunity for students enrolled in general chemistry and inorganic chemistry courses to think critically about the arrangement of the periodic table. The periodic table remains an important tool for engaging chemistry students.(1) *Black Panther*, which is based on the Marvel Comic series, is a blockbuster hit with moviegoers, surpassing $1 billion in global sales. King T'Challa (Black Panther), played by the actor Chadwick Boseman, is a superhero with a body suit made from material that contains the fictional metal vibranium. The fictional African nation, Wakanda, led by King T'Challa, has a thriving STEM economy based on the production and use of vibranium, which has amazing chemical and physical properties. In fact, vibranium is described as a metal that dissolves other metals, absorbs all sound, and is a strong mutagen.(2)

In 2016, four elements were added to the periodic table to complete the seventh row, namely, nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og).(3) Both Mendeleev and Moseley(4) would likely be very pleased with the discovery new elements. However, if the metal vibranium actually existed, where would it appear in the periodic table? We posed the following questions on an exam administered to students enrolled in two sections of general chemistry courses (University Chemistry I, CHM1213) at Lawrence Technological University (LTU), which is a private institution established in 1932 adjacent to Henry Ford's Model T factory.(5)

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In the movie Black Panther, Wakanda's economy focuses on the production and use of a fictional metal known as vibranium, which has amazing chemical and physical properties. If this metal actually existed, where do you think the metal would be placed in the periodic table, and why? What would be the shorthand electron configuration? What would be the elemental symbol? Briefly explain your answer.

The student responses (N = 39) varied and were quite interesting! Many of the students proposed that the fictional vibranium metal would have the elemental symbol Vb, since the symbol for vanadium is currently in use. A few student responses focused on placing the fictional element in the f-block:

> I believe it should be placed between group 5 and group 6 after uranium in period 7. This is because in the movie, vibranium glows a blueish purple, which resembles a radioactive element like uranium. Wakanda is able to harness the energy given off by vibranium. I placed vibranium near the same group as Cr because it is the hardest metal, and vibranium is said to be the hardest metal that exists in the movie. Also, [the] same group elements are said to have similar properties.

> Vb: $[Rn]7s^25f^4$

> If the metal existed, I think it would be placed at the bottom left of the periodic table, in a whole new row because I imagine it as being very heavy. The elemental symbol would be Vb.

> Vibrainium would be placed under the main body of metals of the periodic table near our currently unnamed elements. Its symbol would be Vb, and its shorthand electron configuration would be $[Rn]7s^27f^{14}7d^5$.

We also asked this question to an expert inorganic chemist teaching at a small PUI (predominantly undergraduate institution), who indicated that Vb should be placed in "radioactive land" and would likely be in the boron (B) family, which allows it to form elaborate structures that may be sound absorbing.

Given that the seventh row is complete in the periodic table and based on the properties of the fictional Vb metal, it would likely be placed in the superactinide series (121–157). The superactinides are metals, which are characterized by the filling the 6f and 5g subshells.(6) Fricke proposed that elements 120, 124, or 126 would likely be more stable due to filled shells.(7) For example, element 120 belongs to the alkaline earth metal group and would be similar to Ba or Ra, with a stable oxidation state of +2. Element 120 is predicted to have an atomic ground state of $7s^26d^{10}7p^68s^2$. Fricke writes, "Also, beginning with element 121, every element has a different ground-state configuration than that predicted by simple extrapolations. The main reason for this behavior is that, unexpectedly, an 8p electron state becomes occupied at element 121, and at least one of these electrons remains bound through all the following elements."

The question of where the fictional Vb metal should be placed allows the students to think critically about the arrangement of the periodic table. In general chemistry courses, when we discuss electron configurations, we tell the students there are simply two anomalies, Cu and Cr, because of the stability of half-filled and filled subshells. (In more advanced courses students learn the truth that there are far more exceptions than Cu and Cr!) This discussion allows students to be creative and build on their knowledge base of the periodic table. Students do not typically think beyond the seventh row of the periodic table or the possibility of electrons filling the 6f and 5g subshells. This activity is really asking one key question: What happens when we begin to fill the eighth period of the periodic table?

Furthermore, the movie *Black Panther* also provides a unique opportunity to address the roles of

research and development advances for Wakanda. Thus, Shuri, played by actress Letitia Wright, is a shining example for the next generation of STEM leaders.

The authors declare no competing financial interest.

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