

2<sup>nd</sup> Place Winner  
Structure of Matter  
**Brendan Casey**  
Joan MacQueen Middle School  
Alpine, CA

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Simple as Beans and Rice:  
Reading the Periodic Table

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**Grade Level(s):** Grades 4-8

**Subject(s):** Physical Science

**OBJECTIVE:**

Students will be able to identify the general atomic structure of any element represented on the periodic table.

**PURPOSE:**

The student will have a foundation from which they can begin to use the periodic table as a tool for understanding atomic structure.

**OVERVIEW:**

In this inquiry based activity, students will carefully examine bean and rice patterns that have been created by the teacher and posted around the room. After noting the locations and numbers of the various beans and rice patterns, students are given simplified periodic table information (only atomic symbol, mass, and number are displayed). The students then attempt to match the periodic table information with the bean and rice patterns. As other students review the class work, the matching becomes refined and corrections are made until all of the periodic table information has been matched properly to the appropriate bean and rice patterns. Without ever having looked at a periodic table of the elements, students will have discovered a foundation from which to understand what the periodic table of the elements really means in relation to atomic structure. This lesson has been used with students as young as 4<sup>th</sup> grade and as high as 8<sup>th</sup> grade with exceptional results.

## **MATERIALS NEEDED:**

Teacher created rice patterns for elements in the first three periods.

- Red beans
- Black beans
- White rice
- Blue food coloring
- Glue
- Yellow construction paper

Teacher created periodic table entries for the elements in the first three periods.

- Black marker
- Construction paper in any color other than yellow

## **ACTIVITIES:**

1. The teacher must use red beans to represent protons, black beans to represent neutrons, and white rice, dyed blue with food coloring, to represent electrons. The teacher will create visual patterns of each of the elements of the first three periods. The beans will be in the dense core of the pattern and bunched together. The rice will be away from the center surrounding the nucleus of beans and representing the electrons. These patterns should be created on yellow paper to help display the beans and rice best.
2. The teacher must also create, on a different color of construction paper, a simplified version of the periodic table of elements in the first three periods as represented on the table itself. The simplified entry will only include the rounded atomic mass, atomic number, and the atomic symbol. For example, Lithium would only be represented with 3, Li, 7.
3. To begin, the teacher needs only to randomly hang the bean and rice patterns around the room. Do not reveal the periodic table information.

Student Activity:

1. Students make observation of the bean and rice patterns. This information should be recorded in their science notebooks or similar area. Hint: Some students will be hasty and assume certain trends (i.e. red beans and black beans are always equal), and others may not notice the locations of the parts. Feel free to prod if needed, but only if NO ONE is making the connections.
2. Students then confer with partners as to what they recorded. The students will notice numbers, but should also notice locations and

sizes. For example, rice is smaller than beans. Rice is always on the outside. The black beans are mostly the same as the red beans, but not always, etc.

3. Students will then be given the simplified periodic table entries (see teacher preparation example) to match the patterns. Explain that each of these elements match with one of the patterns. Assign one student per element to tape these next to the pattern they think it represents. Allow students to discuss why they feel their element is at the proper location if two or more kids come to the same pattern. Regardless of the result, allow the students to place their element entries in the locations they believe to be correct.
4. As a class the students will be given the opportunity to discuss reasons why they feel some of the entries should be switched. Many of the seated students will be dying to share their thoughts. Students may then decide if they would like to move any of the entries with the appropriate pattern.
5. When consensus is reached, and they discover the connection between the patterns and the entries, the students will draw the periodic table information next to each of the patterns they observed and recorded in their notebooks.
6. Now ask the students to describe the “rules” of reading a periodic table entry and its corresponding patterns. Students should be able to discover the following:
  - a. Red (protons) and black beans (neutrons) are always in the center (nucleus).
  - b. Red (protons) and black beans (neutrons) are represented by the lower number on the entry (atomic mass).
  - c. The number of red beans (protons) and the number of rice (electrons) are represented by the upper number (atomic number).
  - d. The beans (protons and neutrons) are much larger than the rice (electrons).
  - e. The rice (electrons) is always on the outside and spread apart.
7. Students will then be given a periodic table to look at. They will immediately start to see the connections. Give the students a cup full of red beans, black beans, and rice. Allow the students to create the patterns represented by the information on the elements of the fourth period. This is your chance to go around and monitor the progress of the students. If some are struggling, ask them to make the atoms of

the second or third period again and point out the connections between the numbers and the patterns. Hint: If you are using a periodic table of the elements that has un-rounded atomic masses, just tell the students to round up before creating the pattern. The students just need to work on this first concept.

8. The students will now create drawings in their notebooks of the elements listed in the 4<sup>th</sup> period of the periodic table using the appropriate colors (red for protons, black for neutrons, and blue for electrons).
9. At this point, the students are feeling somewhat comfortable with the connection, as well as a swelling confidence that they can understand something that they perceive as very complex. The teachers and students are now well armed to approach the information on the periodic table in any way they feel is most appropriate.

#### **MODIFICATIONS OR EXTENSIONS:**

1. Students can now be able to create any atomic structure by looking at the periodic table. Students can be asked to draw the elements of the fifth period.
2. Students can work as partners and race to create heavier elements.
3. This activity leads well into the three dimensional structure of atoms. Students can now create models using three colors of clay and toothpicks.
4. The teacher could use different colored construction paper to color code the simplified periodic table entry information to indicate metals, non-metals, and metalloids. This color coding might easily lead older students into discussions of metals, metalloids, and non-metals.