Activity: Planet P-10

FOR THE TEACHER

Summary
In this activity, students will create a periodic table using orbital rules from a newly discovered planet called P-10 and identify periodic trends and bonding rules.

Resource Type: Activity
Grade Level: High School

Objectives
By the end of this lesson, students should be able to
• demonstrate an understanding of electron orbitals by creating a periodic table using orbital rules from an imaginary planet.
• determine which elements on a periodic table are the most and least reactive.
• identify periodic trends.
• classify metals and nonmetals.
• identify which elements will undergo ionic and covalent bonding.

Chemistry Topics
This lesson supports students’ understanding of
• Periodic table
• Trends of the periodic table

Time
Teacher Preparation: 15 minutes
Lesson: 1 class period

Materials
• Student handout

Safety
• No specific safety precautions are needed for this experiment.

Teacher Notes
• Prior to completing this activity, students will need to have an understanding of the structure of the periodic table and its relationship to electron orbitals.

FOR THE STUDENT
Student Activity Sheet: Welcome to Planet P-10

Lesson
Background
March 14, 1997 - An amazing discovery was accidentally made by Washington State University astronomers using the Hubble Space Telescope. While probing dust clouds in what they thought was interstellar medium, these astronomers stumbled across a small, previously unknown planet at the farthest edge of our solar system. This planet has yet to be named and is simply known as P-10 (the tenth planet in our solar system). Soon after its discovery, scientists became frantic to learn more about this long overlooked planet. Plans were soon made to launch a probe in 1999.

October 4, 2021 - It has been several years since data returned from the probe’s survey of P-10 and the WAZU scientists are increasingly perplexed. According to information received from the probe, the elemental composition of P-10 was amazingly exotic. If the data was correct, P-10 was constructed of completely new and never before seen elements. Realizing that the enormity of this discovery was beyond their capabilities to explain, the P-10 project scientists decided to consult with astrophysicists from the University of Washington.

October 7, 2021 - At last a breakthrough! After several days of very hard work, the U. of W. scientists believe they have the answer for the unique elemental structure of P-10. Apparently, a small number of the current quantum mechanical theories do not seem to apply on P-10. For some unknown reason, electron orbitals within atoms on P-10 are confined to spatial orientations which are much more restrictive than those found on Earth. Specifically:

- P orbitals within atoms on P-10 have 2 rather than 3 spatial orientations.
- D orbitals within atoms on P-10 have 3 rather than 5 spatial orientations.
- F orbitals within atoms on P-10 have 4 rather than 7 spatial orientations.

All other postulates of quantum mechanics are found to be the same on P-10 as they are on Earth (the Pauli exclusion principle, the Aufbau principle, Hund's rule, etc...)

Procedure
In order to communicate the significance of this discovery to other scientists, do the following:

1. Construct a new periodic table which demonstrates your findings using existing elemental names and atomic numbers. (Hydrogen should still be atomic number one, Helium atomic number two, etc.) This table should include the first 80 elements (Hydrogen through Mercury) and demonstrate the periodic nature of elements on P-10.
2. Name those elements on P-10 which correspond to noble gases on Earth.
3. Name those elements on P-10 which correspond to the most active metals on Earth
4. Classify metals and nonmetals on P-10 and predict which elements will undergo ionic/covalent bonding.
5. Show the trends in atomic radii and give examples within a group and period.