Activity: Modeling Bond Polarity

FOR THE TEACHER

Summary
In this activity, students will model the pull of electrons in a bond between two elements, demonstrating covalent bonding. In particular differentiating between polar and nonpolar bonds.

Grade Level
High School

NGSS Alignment
This activity will help prepare your students to meet the performance expectations in the following standards:
- Scientific and Engineering Practices:
  - Developing and Using Models

Objectives
By the end of this activity, students should be able to
- Understand the role of electronegativity in determining bond polarity.
- Determine the difference in polarity given the electronegativity values for two elements in a bond.
- Differentiate between non-polar covalent bonds and polar covalent bonds.
- Identify the partial charges for each element in a polar bond.

Chemistry Topics
This activity supports students’ understanding of
- Covalent Bonding
- Polarity
- Electronegativity

Time
Teacher Preparation: 10 minutes
Lesson: 45 minutes

Materials
- Element cards (one card per student)
- String (approximate 3ft in length), 1 per 2 students
- Styrofoam Balls, one

Safety
- No specific safety precautions need to be observed for this activity.

Teacher Notes
- Prior to this activity the students have already learned about electronegativity and how to calculate a difference in electronegativity (ΔEN).
- Teachers need to prepare a set of element cards in advance of the activity. These are available for download/printing. After printing the cards put them in to plastic sleeves or laminate them so that students can fill in the information using a dry erase marker and they can be reused between classes.
- Each string should be threaded through the center of a Styrofoam ball by the teacher, prior to the activity. One string and Styrofoam ball combination will be needed for each pair of students.
• Begin by giving each student an element card and have them fill in the electronegativity value for the element.
• Next, direct the students to stand up and partner with another student in the class. Then have the student pairs fill in the rest of the information on their element card.
• The bond information from all students is compiled in a table on the board, or in a shared Google Document. The column headings should read: Element A, Element B, ΔEN, and Bond Type (as shown in Figure 2). This allows the entire class to see the many types of interactions that resulted from the student partnerships.
  
  Note: If you feel your students will mistake the heading “Element B” for the element “Boron,” feel free to use an alternative column heading such as Element 1 or Element 2.

![Element Chart](image)

• Next, provide each pair of students with a Styrofoam ball threaded onto a piece of string about 6 feet long. In this model, the string represents the bond between the two elements and the ball represents the electron pair.
• Instruct the students to stand about five feet apart and move their ball along the string to approximately represent the electronegativity difference and the specific type of bond in their example. If the electronegativity difference is nonpolar, the ball would be in the halfway point of the string. If the electronegativity difference is polar, the ball will be moved closer to the more electronegative element. Since they are not yet comparing themselves to other pairs in this step, the balls will be in different locations along the strings of the various student pairs.
• When the students are satisfied with their models, ask all of the pairs of students in the class to arrange themselves in two rows (partners across from each other) so that the models are placed in order of decreasing electronegativity difference.
• Students should recognize two types of bonds:
  o If the bond is nonpolar covalent, the ball will be held in the middle of the string, demonstrating equal sharing of electrons.
  o If the bond is polar covalent, the ball will be held closer to the more electronegative atom, demonstrating the greater pull and unequal sharing.
  o The instructor should lead a discussion to help the students compare their electronegativity difference to the pair next to them, and the location they chose for their ball. Based on their observations, have the students adjust the location of their Styrofoam ball. The students will hopefully see a trend forming: that the stronger the
electronegativity difference, the closer the ball is to the element with the higher electronegativity.

- Finally, the students should determine which elements in each of the polar bonds will have partial charges.
- Follow-up this activity with a complimentary activity called, Modeling Molecular Polarity. It builds on the concepts presented in this activity, and apply it to a whole molecule.