TITLE
Molecule Polarity

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COURSE
General Chemistry I

TYPE
In-Class Guided-Inquiry Activity

TEACHING MODE
Facilitated Group Inquiry

LEARNING GOALS
Students will be able to:

- Explain the relationship between bond dipoles and molecule dipole.
- Accurately predict and explain the bond dipoles and molecule dipoles of simple, real molecules.

PhET INTERACTIVE SIMULATIONS

MOLECULE POLARITY

PART I: TWO ATOMS SCREEN

1. Explain **all the ways** you can change the polarity of the two-atom molecule.

2. **Record your ideas** in the table below.

Representation	How does each change as electronegativity changes?	How does each help you understand the polarity of molecules?
Bond Dipole		
Partial Charges		
Electrostatic Potential		

PART II: THREE ATOMS SCREEN

3. Explain any **new** ways to change the molecule polarity of the three-atom molecule.

4. How does the **ABC-bond angle** effect molecule polarity? Tip: Try changing the bond angle in the simulation.

5. Explain the relationship between the **bond dipoles** and the **molecule dipole**.

6. Can a non-polar molecule contain polar bonds? Use an **example** to explain your answer.

Commented [EM1]: This style of question encourages students to complete a full exploration of the sim and to articulate their findings, without having to give instructions for each interaction. The teacher could ask students to share out their list with the class.

Commented [TH2]: Part 1 and 2 are focus on students exploring the simulation. The instructor should allow for free exploration of the simulation in this section of the activity with minimal intervention with the student groups. A brief reporting out of student groups can occur after part 2 to make sure that all students understand the concepts.

Commented [EM3]: This is an example of a Concept Table. Here, students are prompted (with minimal wording) to explore the relationships between representations in the sim and the content topic. This question provides the opportunity to formalize interpretations of each representation, and to ensure students explore representations most relevant to the learning goals – without having to write out repetitive questions. Student responses can be reviewed by the teacher in class and discussed.

Commented [EM4]: This question prompts students to compare sim tabs. Tabs are used in sims to scaffold student learning, with 2nd and 3rd tabs providing access to different or increased conceptual challenges. This prompt asks students to determine what new complexity is being addressed that they can explore.

Commented [EM5]: Rather than telling students why and how to interact with the "ABC-bond angle change" feature, this question simultaneously asks students to find the feature, and relate what they learn from using the feature to the activity's learning goals.

Commented [EM6]: Here, students are prompted to explain a key idea in the sim, and one of the learning goals. The teacher could lead a discussion around student responses.

Commented [EM7]: The sim provides the opportunity to explore a dynamic model to aid in constructing an answer to a particularly challenging component of the concept. The teacher could lead a discussion around student responses.

PART III: REAL MOLECULES SCREEN

Commented [TH8]: This section models the scientific method. Encourage students to draw their prediction and explain their reasoning. Have students report some of their predictions and reasoning before they are tested. Later have students disucss some differences between prediction and experiment and provide explanations for the differences.

7. **Predict** the polarity of four real molecules in the simulation. Explain your reasoning before you check your predictions with the simulation.

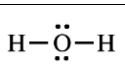
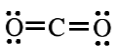
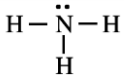
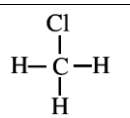
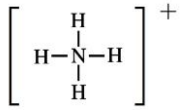
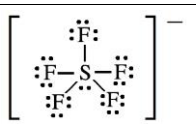
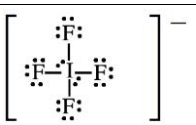
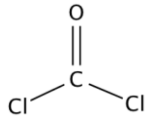
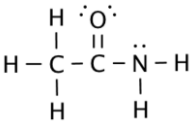
YOUR PREDICTION		CHECK Your Prediction
Draw Molecule - Include Bond Dipoles & Molecule Dipole	Explain Your Reasoning:	Correct? Explain any differences.

8. Discuss with your group the method(s) that you used to determine the bond dipoles and the molecule dipole. Write your method(s) in complete sentences below.

Commented [TH9]: Have a few groups share-out and write their methods on the board.

EXERCISES

Determine the Molecule Geometry and Polarity of the following molecules.

Molecule	Molecule Geometry	Is the Molecule Polar? Explain Why or Why Not.
		
		
		
		
		
		
		
		
		

Commented [EM10]: The following is a link to a complete VSEPR table.

http://upload.wikimedia.org/wikipedia/commons/a/a9/VSEPR_geometries.PNG

In the interest of time, it may be best to have students use the table to complete the molecule geometry column here. This way students can focus their in-class time and discussion on molecule polarity.

Completing the molecule geometry column with the link does still give an opportunity to practice VSEPR so it is a valuable exercise.

CHALLENGE PROBLEMS:

For each molecule below: Determine the Lewis structure and molecule geometry. Draw the molecule using wedges to show three-dimensionality. Finally, determine if the molecule is polar. If so, draw an arrow to show the molecule dipole.

1. CHO_2^{-1}

2. PF_3

3. $AlCl_3$

4. $CHBr_3$

5. H_2S

6. $SiCl_4$

7. HCCBr

8. $CH_2CHCHCH_2$

9. BrF_4^+(Br is central atom and has $10e^-$ in its valance shell)

Commented [TH11]: These challenge problems may be best left for homework.