Science Objectives

- Students will be able to distinguish between intermolecular and intramolecular forces.
- Students will understand the differences between dipole-dipole interactions and induced dipole-induced dipole (London dispersion) interactions.

Vocabulary

- dipole-dipole interactions
- dipole moment
- induced dipole-induced dipole interactions
- intermolecular forces
- intramolecular forces
- London dispersion forces
- van der Waals forces

About the Lesson

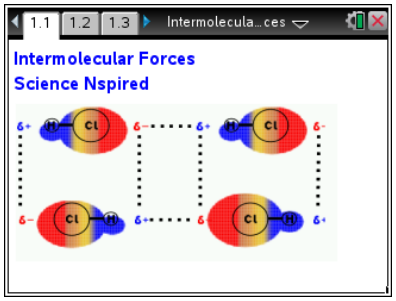
- In this lesson students will first observe the changing charge cloud that surrounds a single polar molecule (HCl) and a single non-polar molecule (Cl_2).
- Next students are shown the lines of force that develop between adjacent HCl molecules and adjacent Cl_2 molecules. These simulations will give students new insights into why molecules attract each other. They will also explore the different types of intermolecular interactions.

TI-Nspire™ Navigator™

- Send out the *Intermolecular_Forces.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Intermolecular_Forces_Student.doc
- Intermolecular_Forces_Student.pdf

TI-Nspire document

- Intermolecular_Forces.tns

Discussion Points and Possible Answers

Move to pages 1.2–1.4.

Have students answer the questions in the .tns file, on the activity sheet, or both.

Q1. The forces within a molecule, for example covalent and ionic bonds, are known as _____ forces.

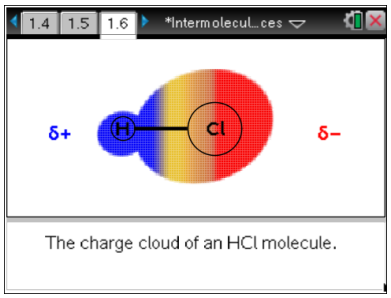
Answer: B. intramolecular

Q2. Intermolecular forces are forces _____.

Answer: A. between two or more molecules

Q3. Intermolecular forces arise from the charge clouds surrounding molecules.

Answer: A. True



The charge cloud of an HCl molecule.

Move to pages 1.5 and 1.6.

1. Students should read and follow the instructions on page 1.5 and observe the simulation on page 1.6.

Move to page 1.7.

Have students answer the question in the .tns file, on the activity sheet, or both.

Q4. In the charge cloud for HCl the positive charge _____.

Answer: A. remains on the left end (H) of the molecule

Move to page 1.8.

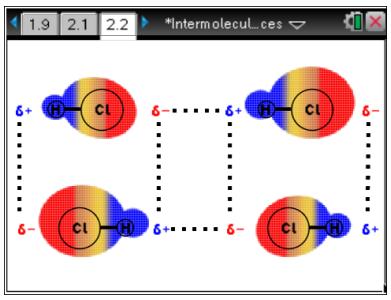
2. Have students read the information on page 1.8.

Move to page 1.9.

Have students answer the question in the .tns file, on the activity sheet, or both.

Q5. HCl _____. (More than one response may be correct.)

Answer: B. is a polar molecule; C. has a permanent dipole moment



Move to pages 2.1 and 2.2.

3. Students should read and follow the instructions on page 2.1 and then observe the simulation on page 2.2.

Move to pages 2.3–2.5.

Have students answer the questions in the .tns file, on the activity sheet, or both.

Q6. The attractive forces are between the ____ end of a HCl molecule and the ____ end of another HCl molecule.

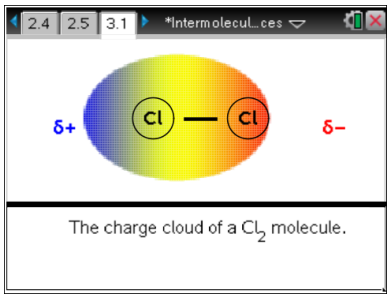
Answer: B. positive, negative

Q7. The lines of force between HCl molecules _____ as the charge cloud changes.

Answer: A. remain constant

Q8. The intermolecular forces between HCl molecules are _____.

Answer: C. dipole-dipole forces



Move to page 3.1.

4. Students should observe the simulation on page 3.1.

Move to pages 3.2 and 3.3.

Have students answer the questions in the .tns file, on the activity sheet, or both.

Q9. The positive charge for Cl_2 _____.

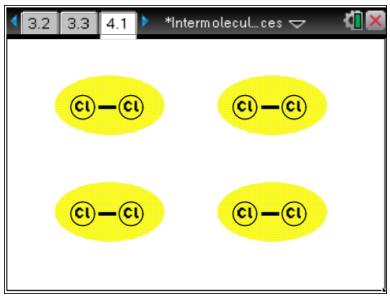
Answer: D. moves randomly between the right and left ends

Q10. Cl_2 _____. (More than one response may be correct.)

Answer: A. is a non-polar molecule; D. has a temporary dipole moment

Move to page 4.1.

5. Have students observe the simulation on page 4.1.



Move to pages 4.2–4.5.

Have students answer the questions on either the device, on the activity sheet, or both.

Q11. The lines of force between Cl_2 molecules _____ as the charge cloud changes.

Answer: B. change

Q12. The intermolecular forces between Cl_2 molecules are _____.

Answer: A. induced dipole-induced dipole (London dispersion) forces

Q13. For molecules of about the same size, I would expect dipole-dipole intermolecular forces to be _____ than induced dipole-induced dipole forces.

Answer: A. stronger

Q14. Explain your answer to the last question.

Answer: Two reasons the dipole-dipole forces are stronger are (1) the lines of force are constant and (2) the positive and negative ends of the polar molecule have larger charges.

TI-Nspire Navigator Opportunities

If students answer the questions within the .tns file, the files can be collected at the end of class and graded electronically and added to the Portfolio. Use TI-Nspire Navigator to display the animations on pages 1.6, 2.2, 3.1, and 4.1 and ask the students discuss what they are observing.

Wrap Up

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the tns file is retrieved by TI-Nspire Navigator. The TI-Nspire Navigator Slide Show can be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test, inquiry project, performance assessment, or an application/elaborate activity.