ATOMS AND ANGLES

TEACHER GUIDE

LAUNCH

PLANNING

Here's a suggested schedule for this kit! The activities are designed to be completed in order, but you can decide when to do them over time. Required times are estimated.

ACTIVITY INFORMATION	SECTION (S)	TIME REQUIRED	DAY/ LESSON
ACTIVITY 1: BENDS AND BONDS Look closely at the surprising shapes of molecules and make paper models of them, too. **Time required: 2 h 30 min**	☐ Bent Out of Shape ☐ Structure and Stability	90 minutes	Day 1
	☐ Paper with a Purpose	60 minutes	Day 2
ACTIVITY 2: THAT'S REPULSIVE! Investigate the attraction and repulsion behind molecular structure using tape and balloons. **Time required: 3 h 15 min**	☐ Tricky Tape	75 minutes	Day 3
	☐ Electron Elbow Room	75 minutes	Day 4
	☐ Show What You Know	45 minutes	Day 5
ACTIVITY 3: POLARITY PARTY Do some unusual dissolving to find out how polarity affects the properties of molec **Time required: 3 h**	☐ C		

activity 1

BENDS AND BONDS

The hidden world of atoms and molecules can be surprising, as your student will see when they zoom in on the shapes of water and carbon dioxide particles.

LEARNING GOALS:

I can develop a model to describe the three-dimensional arrangements of atoms in molecules and explain the relationship between molecular geometry and the repulsion between electrons.

BENT OUT OF SHAPE

Shaping Up

- Your student will compare the molecular structures of water and carbon dioxide, using images of both ball-and-stick and space-filling models.
- The vocabulary term bond is defined to introduce the concept of electrostatic attraction (which will be explained in more detail later).
- If your student has their own molecular model set, or you purchased the version of the kit which includes a molecular model set, encourage them to begin to use it in this activity. They can make the structures of water and carbon dioxide and explore them in a tactile, 3D way.

THINK ABOUT IT!

Question 1: Why do you think a water molecule is not shaped in a straight line like carbon dioxide?
Answer: Answers will vary.
How to Help:
• Your student should not know yet why the structures are different.
• Later, they will learn how water has two additional lone pairs of electrons that repel its two single bonds, pushing them down at an angle.

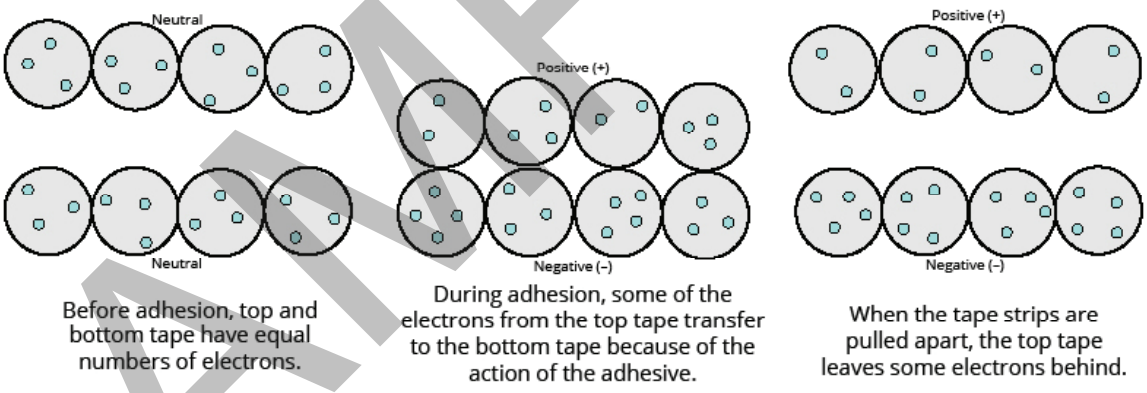
Question 2: What do you think determines the shapes of molecules?
Answer: Answers will vary.
How to Help:
• This is also a speculative question that the student should not yet be sure about.
• The shapes of molecules are determined by the types and numbers of each atom, and the number and types of bonds.

Question 3: What questions do you have about these molecules?
Answer: Answers will vary.
How to Help:
• Your student may be wonder why water has two single bonds while carbon dioxide has two double bonds, what's making the water have its atoms at an angle, and how the sizes of the molecules compare.
• Be sure to guide your student to asking questions involving the molecular or particle level rather than the macroscopic, or visible-to-the-eye, level.

THINK ABOUT IT!

Question 1: Were there any patterns in which strips moved toward and away from each other? Explain.
Answer:
• The student should have observed that two top tapes moved away from each other, and so did two bottom tapes, while a bottom and top tape would move toward each other.
• Both the tapes should have attracted the foil, fabric, and paper. The foil should have been attracted most strongly, followed by the paper, with the fabric having a weak response.

Question 2: Based on your experimental results, draw and label a model for the electrical charges on two pieces of tape that are pulled apart (i.e. a Top tape and Bottom tape). In other words, draw what you think is happening on the particle level.
Note: you will learn more about this in the next subsection, but this will help you identify and expand on your current ideas.
Answer:
• As an initial model, this will vary and does not yet need to be accurate. It should include representations of atoms with negative and positive charges, and it may even show electrons being transferred.
• Here is an accurate model for you to check the accuracy of your student's.



Before adhesion, top and bottom tape have equal numbers of electrons.

During adhesion, some of the electrons from the top tape transfer to the bottom tape because of the action of the adhesive.

When the tape strips are pulled apart, the top tape leaves some electrons behind.

How to Help: *Remind your student they will be learning more to revise their model in the next subsection.*

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Tiny but Strong

• In this subsection, your student will describe in greater detail the interactions between objects with opposite and like charges.
• The vocabulary terms electrostatic attraction and electrostatic repulsion are defined.

Question 1: Draw the electrons in the foil as the foil is approached by the top tape and by the bottom tape.
Answer:

LAUNCH

SCIENCE UNLOCKED

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Kit	SU-ATOMAN
Instructions	IN-ATOMANT
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