

Lesson Plan 29

Subject: Chemistry

Topic: Chemical Bonding

Grade: 8

Sub – Topic: Represent Bonding with Lewis Dot Diagrams

Duration: 1 – 2 Hours

If you are required to teach Lewis dot structures, this short lesson can help you extend what students have learned about modeling covalent and ionic bonding. Since there is no hands-on activity component, this lesson is not in a 5-E lesson plan format.

Key Concepts:

- There are shorthand ways to represent how atoms form covalent or ionic bonds.
- Lewis dot diagrams use dots arranged around the atomic symbol to represent the electrons in the outermost energy level of an atom.
- Single bonds are represented by a pair of dots or one line between atoms.
- Double bonds are represented by two pairs of dots or two lines between atoms.
- Triple bonds are represented by three pairs of dots or three lines between atoms.

Summary:

Students will be introduced to the basics of Lewis dot diagrams as they compare the energy level models used in chapter 4 to dot diagrams. Along with the teacher, they will review the Lewis dot diagrams for a few common covalent and ionic compounds.

Objective:

Students will be able to interpret and draw Lewis dot diagrams for individual atoms and both covalent and ionic compounds.

Evaluation:

The activity sheet serves as a formative assessment and gives students practice interpreting Lewis dot diagrams. Download the student activity sheet, and distribute one per student when specified in the activity. The activity sheet will serve as the “Evaluate” component of each 5 - E lesson plan.

Background:

The model of the atom and of covalent and ionic bonding that students have used so far emphasizes the attractions between bonding atoms. The nucleus, electrons, and double-headed arrows show that the protons and electrons from one atom attract the oppositely charged electrons and protons of the other atom, resulting in bonding. The energy levels show that only valence electrons are involved in bonding.

After students understand the important role of attraction of opposite charges, you may introduce them to a common, more symbolic, short-hand way of showing how atoms are bonded

together. This information is offered if you feel that showing students these other models of bonding would be useful or if you need to cover basic information about Lewis dot diagrams to satisfy your curriculum.

Engage

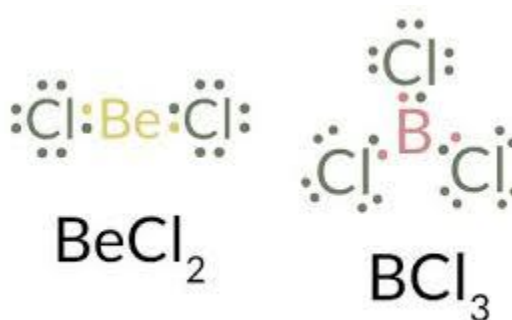
Introduce students to Lewis dot structures

Tell students that one popular method of representing atoms is through Lewis dot diagrams. In a dot diagram, only the symbol for the element and the electrons in its outermost energy level (valence electrons) are shown.

Note: In the energy level diagrams students have been using, the electrons are spread out evenly in each energy level. Some books show them spread out this way and some show them in pairs. For Lewis dot structures, they are always shown in pairs. This is to indicate that electrons are in separate orbitals within each energy level. It is not necessary for middle school students to learn about electron orbitals. This information is offered so that it is clearer to you why electrons are often shown in pairs in energy level diagrams and in dot diagrams. An orbital is a 3-dimensional space within an energy level where there is a high probability of finding electrons. The further the energy level is from the nucleus, the more orbitals it has. There can be a maximum of two electrons in each orbital. This is why the electrons are shown in pairs.

Lewis Dot Structures

PERIODIC TABLE ELEMENTS 1–20							
HYDROGEN 1 H ·							HELIUM 2 He ·
LITHIUM 3 Li ·	BERYLLIUM 4 Be ·	BORON 5 B ·	CARBON 6 C ·	NITROGEN 7 N ·	OXYGEN 8 O ·	FLUORINE 9 F ·	NEON 10 Ne ·
SODIUM 11 Na ·	MAGNESIUM 12 Mg ·	ALUMINUM 13 Al ·	SILICON 14 Si ·	PHOSPHORUS 15 P ·	SULFUR 16 S ·	CHLORINE 17 Cl ·	ARGON 18 Ar ·
POTASSIUM 19 K ·	CALCIUM 20 Ca ·						



Have students look at the activity sheet for chapter 4, lesson 3 or distribute the energy level chart at the end of this lesson. They will need to compare the energy levels for elements 1–20 that they completed with the chart you show them.

Project the image Lewis dot diagrams for elements 1–20

Ask students:

Compare the dots around each symbol with the energy levels in your chart. What relationship do you notice between the dots in these two charts?

The dots represent the electrons in the outer energy level (valence electrons) from the energy level models.

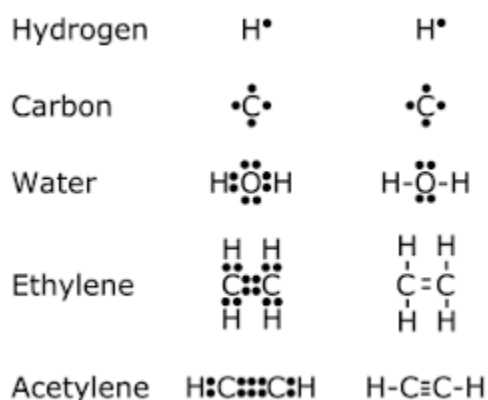
The number of dots near hydrogen and helium are the same as in the energy level chart. Why?

The only electrons hydrogen and helium have are valence electrons. All the other dot structures should have fewer electrons than the energy level model because the dot model only shows the outermost electrons.

4. Help students recognize the similarities between energy level models and Lewis dot structures that show bonding

Project the image covalent bonding in hydrogen

This image shows both the energy level model and Lewis dot structure of two hydrogen atoms before and after bonding.



Explain to students that in a dot diagram, the electrons that are shared in the bond are placed between the symbols for each atom. Remind students that the electrons between the two atoms are shared and are counted as belonging to each atom. Show students that in the energy level model for the hydrogen molecule, two electrons are shared. The Lewis dot diagram for the hydrogen molecule also shows that two electrons are shared. There is an even more shorthand approach that shows the bond as a line. The line represents one pair of electrons.

Project the image covalent bonding in water

Be sure students notice that the number of dots around the oxygen atom in the Lewis diagram is the same as the number of electrons in the outer energy level of the energy level model. Remind students that the electrons between the atoms are shared and are counted as if they belong to each atom. Show students that in the energy level model for the water molecule, two pairs of electrons are shared. The Lewis dot diagram for the water molecule also shows that two pairs of electrons are shared. The line represents one pair of shared electrons.

Project the image covalent bonding in oxygen

Show students that in the energy level model for the oxygen molecule, two pairs of electrons are shared. The Lewis dot diagram for the water molecule also shows that two pairs of electrons are shared. The remaining electrons are shown paired up around each oxygen atom. In the alternate Lewis dot diagram, there are two lines because there are two pairs of electrons that are shared.

Project the image covalent bonding in carbon dioxide.

Show students that in the energy level model for carbon dioxide, two pairs of electrons are shared with each oxygen atom. The Lewis dot diagram for carbon dioxide also shows that two pairs of electrons are shared. The remaining electrons are shown paired up around each oxygen atom. In the alternate Lewis dot diagram, there are two lines between each atom to show that two pairs of electrons are shared.

5. Show how Lewis dot diagrams also represent ionic bonding.

Tell students that dot diagrams can also be used to show ionic bonding.

Project the image ionic bonding of sodium chloride.

Ask students:

In the second dot diagram, why are there no electrons surrounding sodium?

The electron was transferred to chlorine. The dot diagram only shows electrons in the atom's outermost energy level. No electrons are shown since the only electron in the outermost energy level of sodium was transferred to chlorine.



In the final dot diagram of NaCl, the dots between the sodium and chlorine are between the atoms. Are these atoms sharing the electrons?

No. All electrons shown in the dot diagram belong to chlorine. The pair of electrons is between the two letters only because the symbols are shown close to each other to represent the attraction between the oppositely charged ions.

Project the image ionic bonding of calcium chloride

Ask students:

What do you think the 2+ near the calcium means?

Calcium had two electrons in its outer energy level. It gave each chlorine one of these electrons. Because the calcium has two more protons than electrons it has a charge of 2+.

In the final dot diagram of CaCl_2 , the dots between the calcium and chlorine are between the atoms. Are these atoms sharing the electrons?

No. All electrons shown in the dot diagram belong to chlorine. The pair of electrons is between the two letters only because the symbols are shown close to each other to represent the attraction between the oppositely charged ions.