

Molecules in Motion: Building Our World Atom by Atom!

NGSS Standard: 6-8.PS1.A.1 Develop models to describe the atomic composition of simple molecules and extended structures.

Overall Materials Needed (for all 3 days):

- Printable worksheets (teacher to provide based on daily activities)
- Colored pencils or markers
- Computer with internet access
- Online molecule building simulation (e.g., PhET Interactive Simulations - "Molecule Shapes")
- Modeling kit (e.g., different colored marshmallows/gumdrops and toothpicks, or a commercial ball-and-stick kit)
- Periodic table chart (printable or physical)
- Construction paper
- Glue or tape
- Optional: LEGO bricks or other building toys
- Examples of substances: water, table salt, sugar, a picture of a diamond

Day 1: Meet the Atoms! The Building Blocks of Everything!

Time: 45 minutes

Focus: What are atoms? Elements? Introduction to the periodic table. What is a molecule?

Learning Objectives for Day 1:

- Cora will be able to define atom and element.
- Cora will be able to identify common elements on the periodic table by their symbol.
- Cora will be able to explain that atoms combine to form molecules.

Activities:

- 1. Engage (5 min): "What's the Smallest Thing?"**
 - Discuss: If you could keep breaking something down into smaller and smaller pieces, what would you eventually get?
 - Introduce the idea of atoms as the fundamental building blocks of all matter.
- 2. Explore (15 min): "Periodic Table Scavenger Hunt"**
 - Using a simple periodic table, help Cora find specific elements: Hydrogen (H), Oxygen (O), Carbon (C), Nitrogen (N).
 - Discuss what the symbols mean and that each element is a different type of atom.
 - Talk about how scientists organize all the known types of atoms.
- 3. Explain (15 min): "Atom Anatomy & LEGO Analogy"**
 - Draw a very simple model of an atom (nucleus with protons/neutrons, electrons orbiting – keep concepts basic, focus on it being a tiny particle).
 - Explain that atoms are like LEGO bricks: different colors/shapes of LEGOs represent different elements.
 - You can't see individual atoms, but they make up everything around us!
- 4. Elaborate (5 min): "Meet Molecules"**
 - Introduce molecules as groups of two or more atoms bonded (stuck) together.

- Continue the LEGO analogy: when different LEGO bricks (atoms) click together, they form a LEGO model (a molecule).

5. **Evaluate (5 min): "Quick Check"**

- Ask Cora: "What's an atom? What's an element? How do we make a molecule from atoms?"
- Have Cora try to draw a simple molecule made of two identical atoms (like Oxygen gas, O₂) or two different atoms, and label the atoms.

Day 2: Molecule Mania! Building Simple Structures.

Time: 45 minutes

Focus: Building simple molecules (water, carbon dioxide, ammonia, methanol). Using different model types (drawing, 3D).

Learning Objectives for Day 2:

- Cora will be able to identify the atoms that make up common simple molecules (H₂O, CO₂, NH₃, CH₃OH).
- Cora will be able to construct 2D drawings and 3D models of these simple molecules.
- Cora will be able to explain that different molecules have different arrangements and numbers of atoms.

Activities:

1. **Engage (5 min): "Water Wonders Review"**

- Review: What are atoms and molecules?
- Show pictures of water, ice, and steam. Discuss: "This is all the same molecule, H₂O! How can molecule arrangements make substances look so different?"

2. **Explore (20 min): "Molecule Kitchen!"**

- Using the modeling kit (e.g., gumdrops/marshmallows and toothpicks). Assign colors to represent different atoms (e.g., Hydrogen - white, Oxygen - red, Carbon - black, Nitrogen - blue). Refer to the periodic table symbols learned yesterday.
- Guide Cora to build:
 - **Water (H₂O):** 2 Hydrogen atoms, 1 Oxygen atom. "Formula: H₂O"
 - **Carbon Dioxide (CO₂):** 1 Carbon atom, 2 Oxygen atoms. "Formula: CO₂"
 - **Ammonia (NH₃):** 1 Nitrogen atom, 3 Hydrogen atoms. "Formula: NH₃"
 - **Methanol (CH₃OH):** 1 Carbon atom, 4 Hydrogen atoms, 1 Oxygen atom. "Formula: CH₃OH" (Show how it's written, maybe draw a simple stick structure first).

3. **Explain (10 min): "Shape and Structure"**

- Discuss the shapes of the models Cora built. "Why do they have these particular shapes?" (Briefly explain that atoms bond in specific ways, leading to specific shapes).
- Compare the models. "How are the molecules different in terms of the types and numbers of atoms? How does this make them different substances?"

4. **Elaborate (5 min): "Digital Molecules"**

- Use an online molecule viewer like PhET Interactive Simulations ("Molecule Shapes" - Real Molecules tab, or "Build a Molecule" tab).
- Find and explore digital models of the molecules Cora built. Compare her physical models to the computer representations. Discuss how both are "models."

5. **Evaluate (5 min): "Molecule Match-Up"**

- Cora chooses one molecule she built.
- She then draws it, labels the atoms correctly, and explains its composition (e.g., "This is

water. It has two hydrogen atoms and one oxygen atom.").

Day 3: Big Structures & Super Models! Extended Fun!

Time: 45 minutes

Focus: Extended structures (sodium chloride, diamond). Comparing simple molecules to extended structures. Different types of models.

Learning Objectives for Day 3:

- Cora will be able to describe the repeating pattern of atoms in extended structures like sodium chloride (salt) and diamond.
- Cora will be able to differentiate between simple molecules (like water) and extended structures (like salt) using models.
- Cora will be able to create or represent models of molecular structures in various forms (drawing, physical, digital).

Activities:

1. Engage (5 min): "Crystals vs. Molecules"

- Show table salt crystals (use a magnifying glass if available) and a picture of a diamond.
- Ask: "These look very different from water, right? But they are also made of atoms! How do you think their atoms are arranged compared to a water molecule?"

2. Explore (20 min): "Building Big!"

- **"Salt City (Sodium Chloride - NaCl)":** Using the modeling kit, assign two new colors for Sodium (Na) and Chlorine (Cl) atoms. Explain that salt is made of these two types of atoms in a 1:1 ratio (one Na for every Cl). Show how they form a repeating crystal lattice structure, not a small, distinct molecule. Try to build a small 3D section of this repeating pattern. Emphasize the continuous, ordered arrangement.
- **"Diamond Dazzle (Carbon - C)":** Explain that diamond is made ONLY of Carbon atoms. However, in a diamond, each carbon atom is strongly bonded to FOUR other carbon atoms in a special 3D tetrahedral network. This network repeats over and over, making diamond very hard. Show pictures or diagrams of the diamond structure. Cora can try to make a small unit representing a central carbon bonded to four others, or appreciate its structure through diagrams.

3. Explain (10 min): "Molecules vs. Extended Structures"

- Discuss the key difference:
 - **Simple molecules** (like water, CO₂) have a definite, fixed number of specific atoms bonded together to form a distinct particle.
 - **Extended structures** (like salt, diamond) have a repeating pattern of atoms (or ions) that can extend in three dimensions indefinitely. There isn't a small, individual "salt molecule" in the same way there's a water molecule; it's a continuous lattice.
- Use the models built to illustrate this difference.

4. Elaborate (5 min): "Model Showcase!"

- Cora chooses one simple molecule and one extended structure they've learned about.
- She can:
 - Draw detailed pictures of their atomic arrangement.
 - Ensure her physical models are accurate.
 - Find exciting computer representations or videos showing their structure online (with supervision).
 - Prepare to explain them.

5. Evaluate (5 min): "Model Master Challenge"

- Cora presents her chosen simple molecule and extended structure models.
- She explains the key differences between them, focusing on: what atoms they are made of, how the atoms are arranged, and why one is called a "simple molecule" and the other an "extended structure."

Congratulations, Cora! You're now a Molecule Model Master!