Indie's Awesome Adventure: Sublimation, Elements, Compounds, and Mixtures!

Lesson Overview:

Today, Indie, we're going on a scientific journey to explore some super cool concepts in chemistry! We'll uncover the mysteries of sublimation (where solids magically turn into gases!), and learn how to tell the difference between elements, compounds, and mixtures. Get ready for some hands-on fun!

Part 1: What's the Matter? Introducing Key Concepts (15 minutes)

Let's start by defining our key terms. We can write these down or make little flashcards.

- **Matter:** Anything that has mass and takes up space. Basically, everything around us!
- **Element:** A pure substance that cannot be broken down into simpler substances by chemical means. Think of them as the basic building blocks of matter. Examples: Oxygen (O), Carbon (C), Gold (Au). *(Show examples like aluminum foil, copper wire).*
- **Compound:** A substance formed when two or more different elements are chemically bonded together. They have properties different from the elements that make them up. Examples: Water (H_2O - made of Hydrogen and Oxygen), Salt (NaCl - made of Sodium and Chlorine). *(Show examples like salt, sugar).*
- **Mixture:** A combination of two or more substances (elements or compounds) that are physically mixed together but NOT chemically bonded. Each substance in a mixture keeps its own properties, and they can often be separated by physical means. Examples: Air (mixture of gases), Trail Mix (nuts, seeds, chocolate), Saltwater. *(Show examples like trail mix ingredients before mixing).*
- **Sublimation:** The process where a solid changes directly into a gas, without passing through the liquid state.

Discussion: Can you think of anything around you right now that might be an element, compound, or mixture?

Part 2: Sublimation Sorcery! (20 minutes - Adult Supervision Required for Dry Ice)

This is where the magic happens! We're going to see sublimation in action with dry ice. Dry ice is solid carbon dioxide (CO_2 - a compound!).

Safety First, Indie!

- Adults ONLY handle dry ice.
- Always wear insulated gloves and use tongs when handling dry ice. It's extremely cold and can cause frostbite.
- Wear safety goggles.
- Use in a well-ventilated area. Dry ice releases carbon dioxide gas, which can displace oxygen.

The Experiment:

1. Put on your safety goggles, Indie! Your teacher/parent will wear gloves and goggles too.
2. Your teacher/parent will carefully place a few small pieces of dry ice into a clear bowl. What do

you observe? (It should be "smoking" – that's the CO_2 gas).
3. Your teacher/parent will carefully add a little warm water to the bowl with the dry ice. What happens now? (Lots more "smoke" or fog!). This fog is actually water vapor condensing because the CO_2 gas is so cold, mixed with the CO_2 gas itself.
4. **Observation Challenge:** Notice that the dry ice isn't melting into a puddle of liquid like regular ice (which is H_2O). It’s going straight from a solid to a gas! That's sublimation!
5. *Optional:* Your teacher/parent can touch a metal spoon to a piece of dry ice. Sometimes you can hear it "scream" or sizzle as the dry ice rapidly sublimates due to the spoon's heat.

Discussion:

- What did you see happening to the dry ice?
- Why is this called sublimation?
- Can you think of any other examples of sublimation? (Mothballs disappearing over time, frost disappearing on a cold dry day without melting, freezer burn on food).

Part 3: Matter Classification Challenge! (20 minutes)

Let's put your new knowledge to the test, Detective Indie!

1. We'll use our sample substances (aluminum foil, copper wire, water, salt, sugar, baking soda, trail mix ingredients) and some extra pictures or names of substances if you like.
2. Create three labels: "ELEMENT," "COMPOUND," and "MIXTURE."
3. Your job is to look at each substance (or its name/picture) and decide if it's an element, a compound, or a mixture. Place it under the correct label.
4. Explain your reasoning for each classification! For example, "I think water is a compound because it's made of Hydrogen and Oxygen chemically bonded together."

Examples for Classification:

- Aluminum foil (Element - Al)
- Copper wire (Element - Cu)
- Pencil "lead" (graphite) (Element - C)
- Water (Compound - H_2O)
- Salt (Compound - NaCl)
- Sugar (Compound - $C_{12}H_{22}O_{11}$)
- Baking Soda (Compound - $NaHCO_3$)
- Air (Mixture - Nitrogen, Oxygen, etc.)
- Salad (Mixture - lettuce, tomatoes, etc.)
- Lemonade (Mixture - lemon juice, water, sugar)
- Soil (Mixture - sand, clay, organic matter)

Part 4: Mixture Mania! (15 minutes)

Time to get hands-on with mixtures!

1. Let's make a simple mixture: a "Super Indie Trail Mix"!
2. Gather some ingredients: e.g., nuts (check for allergies!), seeds, dried fruit, chocolate chips, pretzels.
3. Indie, you get to choose what goes into your trail mix and combine them in a bowl.
4. **Observe:**
    - Did the ingredients change chemically when you mixed them? (No)
    - Can you still see the individual ingredients? (Yes)
    - Could you (theoretically) separate them again? (Yes, by picking them out – that's physical separation).

5. This shows the key properties of a mixture!
6. Another quick mixture: Add a spoonful of salt to a glass of water and stir. It dissolves! Is it still a mixture? Yes! It's a special kind of mixture called a solution. The salt is still there (you can taste it), and you could get the salt back by evaporating the water. The salt and water are not chemically bonded.

Part 5: Wrap-up and Real-World Connections (10 minutes)

Great job today, Indie! Let's recap:

- What is sublimation? Can you give an example?
- What's the difference between an element and a compound?
- What makes a mixture different from a compound?
- Can you name one element, one compound, and one mixture you encounter every day?

Understanding elements, compounds, and mixtures is fundamental to all of chemistry and helps us understand the world around us, from the air we breathe (mixture) to the water we drink (compound) to the materials used to build things (elements and compounds)!

For Further Exploration (Optional Extension for Indie):

- Research other substances that undergo sublimation (e.g., iodine, naphthalene/mothballs).
- Investigate different types of mixtures: solutions (like saltwater), suspensions (like muddy water), and colloids (like milk or fog).
- Try to separate a more complex mixture (e.g., sand and salt using water and filtration/evaporation – with help!).
- Draw diagrams representing atoms in an element, molecules in a compound, and different substances in a mixture.