[Chem1311Ch2Ep4.mp4]

Transcript

00:00:00

Hello, and welcome to episode four of atoms, molecules and ions.

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Previously, in atoms, molecules and ions.

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We practiced naming and writing formulas to several ionic compounds.

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And we conversed on the assignment to firm up our naming and formulating skills.

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I just made up a word.

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In today's episode:

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We will learn the difference between empirical and molecular formulas.

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We will use molecular formulas to represent molecular compounds.

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We will learn to name molecular compounds.

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And we will learn to name acids and hydrates.

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There are several ways to represent molecular compounds.

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The molecular formula is by far the simplest.

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But the space filling model is the most accurate representation.

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The stick and ball model emphasizes the shared electron pairs which form the bonds and are represented by the sticks.

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This is a favorite of organic chemists along with the structural formula, which shows which atoms are bonded.

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We will use the molecular formula in this class.

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A molecular formula shows the exact number of atoms of each element.

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In the molecule or polyatomic ion.

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An empirical formula,

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Shows the smallest whole number ratio of atoms in a substance.

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You may remember that we only use empirical formulas to represent ionic compounds.

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Because that is all they have.

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But molecular compounds have both empirical and molecular formulas.

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If you know the molecular formula of a compound, you can figure out its empirical formula.

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Sometimes they are the same.

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But sometimes they are not.

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Here is glucose, that's blood sugar.

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Because all the subscripts are divisible by six, we can reduce it to.

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“C H 2 0”

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For the empirical formula.

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Hydrazine. The subscripts of hydrazine are all divisible by two.

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So, we can divide them by two for their empirical formula and get “NH2.”

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Here we have a.

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Ball and stick model of methylamine.

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Write down the molecular formula for it.

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Unexpected roadblock:

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When there are no cations or anions, you may wonder.

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Which element goes first?

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We have a guideline.

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The guideline is, the non-metal furthest left.

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And or.

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Lowers down in the periodic table.

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Goes first. So, carbon goes first.

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Yes, I know hydrogen should be first, but it almost never is.

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So, both the molecular and empirical formula are.

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“CH5N”.

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When dealing with some molecules, especially organic molecules, you may see the hydrogens split based on which atom they are bonded to.

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It's an organic thing. Don't worry about it too much.

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Here we have the molecular formulas of three compounds.

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Write down the empirical formulas for each one.

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Pause the video and write down your answers.

00:05:19

Then come back and check on them.

00:05:29

Welcome back.

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Our first answer is simply “CH.”

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We divided each one of their subscripts by two.

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Our next answer is “CH2O”. As a result of dividing our subscripts by 12.

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And finally, “N2O” which we were not able to reduce any further.

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If you have any questions on any of these, please drop by using the office hours link or the discussion link in canvas.

00:06:23

Naming molecular compounds requires the use of Greek prefixes.

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These Greek prefixes will indicate the number of atoms of each species in the compound.

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Remember that these rules will apply only to molecular compounds.

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That is, compounds formed by two nonmetals.

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Some common molecules are usually called by their common names, their street names, if you will.

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Water, Ammonia and methane are examples of such.

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To name them using the Greek prefixes you would call them a dihydrogen monoxide.

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Nitrogen trihydride

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And carbon tetrahydride respectively.

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Like we mentioned before.

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The element furthest left in a period and further down in a group goes first.

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There are some compounds that do not require prefixes.

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Such as those of hydrogen with any group 17 element.

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Called also hydrogen-halogen compounds.

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They do not require prefixes because they only form a single compound.

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Another rule to keep in mind, the prefix mono is never used on the 1st element.

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And finally, the last element name takes on an “-ide” ending, just like before.

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The prefixes are not part of your reference materials, so you will have to remember them.

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Let's look at some examples.

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This compound does not require a prefix.

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It's just hydrogen iodide.

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Because it is a compound between hydrogen and a group 17 element.

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This compound reminds us that we never start the name with mono.

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So, it's nitrogen trifluoride.

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The same is true for this one.

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Sulfur dioxide

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This next one is.

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Dinitrogen tetrachloride

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And this other one.

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Is nitrogen dioxide.

00:09:58

And finally.

00:10:04

We have dinitrogen monoxide.

00:10:14

Now let's try the following.

00:10:18

Pause the video.

00:10:20

Write down your answers for the name of these two molecular compounds and then come back.

00:10:30

Welcome back.

00:10:31

Let's have a look first at.

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Silicon tetrachloride

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And tetraphosphorus decoxide.

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Let's now write the formulas for each of these compounds.

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Pause the video.

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Write down your answers, then come right back.

00:11:08

Welcome back.

00:11:11

Our first formula is “CS2.”

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And our second formula.

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Is “Si2Br6.”

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Here's a diagram to remind you that.

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The first thing to figure out is whether a compound is ionic or molecular.

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If it is ionic.

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You next will need to determine if the metal is a Group One or two, or if it is aluminum, zinc, cadmium or silver.

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Because if it is not, you will have to use a Roman numeral as part of its name to indicate its charge.

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Because it will be polyvalent.

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For molecular compounds you will use Greek prefixes.

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With a few exceptions.

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But with hydrogen.

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The line between Ionic and molecular gets a little blurry.

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When you consider hydrogen halogen compounds for example.

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An acid can be defined as a substance that yields hydrogen ions when dissolved in water.

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Because it forms ions, it would be.

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An ionic compound rather than molecular.

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An example of this blurry line.

00:13:07

Is hydrogen chloride

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Hydrogen chloride is a gas and it is a molecular compound.

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But when you dissolve it in water.

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It is an ionic compound and an acid.

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As a gas it is a substance.

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But in water it is an ionic acid.

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Hydrochloric acid

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Different name, same formula. Talk about confusing.

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The only way to tell them apart.

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When writing them, of course you can tell by looking, but.

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When writing down the formulas is by noticing the state of matter.

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That “g” that follows the compound indicates.

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It's a gas.

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The “aq” indicates it's an aqueous or water solution.

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Little side note.

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The letters “S” for solid and “L” for liquid can also be used to indicate whether an object is solid or liquid.

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If you see the letters CR used to indicate state or matter, then that book is older than my grandfather, so put it away, get a new one.

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All acids have hydrogen in them as the cation.

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But they are named based on the ending of the anion name.

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These are the three possible endings for anions.

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We mentioned this before “-ide”.

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“-ate” and “-ite”

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This is going to result in three formats for naming compounds based on the ending of the anion.

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If the anion name ends in “-ide”.

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The acid will be named hydro, the root, -ic acid.

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If the anion name ends in “-ate”.

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The acid will be named by the anion’s root, -ic acid.

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And if the anion name ends in ite.

00:16:02

The acid will be named by the anion’s root, and then -ous acid.

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Let's look at some examples to clarify this.

00:16:22

The acid of fluoride.

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Is hydrofluoric acid.

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Hydro___ic.

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With “fluor” being the root for fluoride.

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The acid of chloride is hydrochloric acid.

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Hydro__ic again.

00:16:48

The acid of bromide is hydrobromic acid.

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The acid of iodide.

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Is hydroiodic acid.

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The acid of cyanide.

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It's hydrocyanic acid.

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The acid of sulfide.

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Is hydrosulfuric acid.

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Here we have the acids of three polyatomic ions. We have their.

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Ball and stick models.

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The acid of nitrate is nitric acid.

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The acid of carbonate is carbonic acid.

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And the acid of phosphate is phosphoric acid.

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A small side note.

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For acids containing sulfur or phosphorus.

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You will notice that we slipped an R in their name just because sulfuric and phosphoric sounds sexier than sulfic and phosphic.

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So don't forget the R.

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Here are four acids containing chlorine.

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The acid of perchlorate.

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Is perchloric acid

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The acid of chlorate.

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Is chloric acid.

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The acid of chlorite is chlorous acid.

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And the acid of hypochlorite.

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Is hypochlorous acid.

00:19:09

Let's try naming these acids.

00:19:12

Pause the video, write down your answers, and then come right back.

00:19:22

Welcome back.

00:19:25

The first acid.

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Is the acid of phosphite.

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And therefore.

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It is called phosphorus acid.

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You did remember to slip in the extra “R”, right?

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The second is the acid of iodate.

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And therefore it is iodic acid.

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The last item in the agenda for today. Hydrates.

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Hydrates are ionic compounds which absorb a fixed number of water molecules into their crystal structure.

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They are not wet because the water molecules are part of the crystal.

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These compounds are named using the rules for ionic compounds and then adding the Greek prefix for the number of water molecules and the word hydrate.

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Their formula.

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Has a dot at the end with the number of water molecules involved.

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This is important.

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It must be a dot, please.

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Stick to the convention.

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So the name of this first one is barium chloride dihydrate.

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This other one, lithium chloride monohydrate

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Magnesium sulfate heptahydrate.

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Strontium nitrate tetrahydrate.

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And finally.

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A striking example of how the crystal structure of copper (II) sulfate pentahydrate.

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Collapses when you remove the water molecules.

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And here we have a list of commonly used substances which you might not have realized were compounds.

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Recognize anyone?

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And that's all there is.

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There isn't any more.