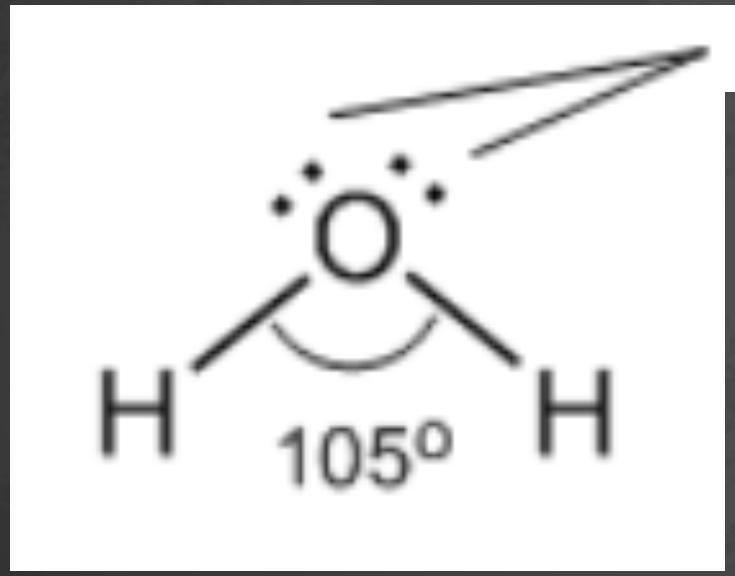
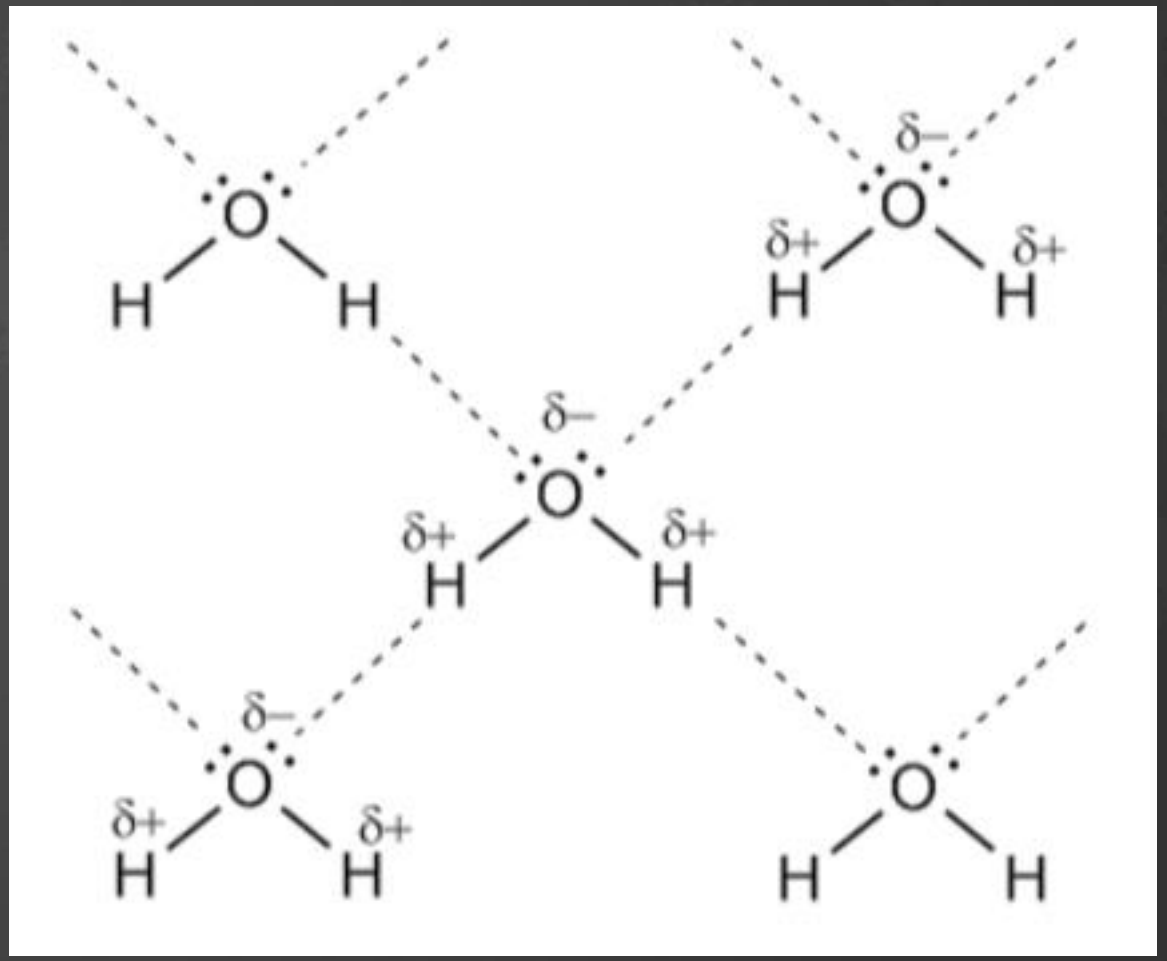
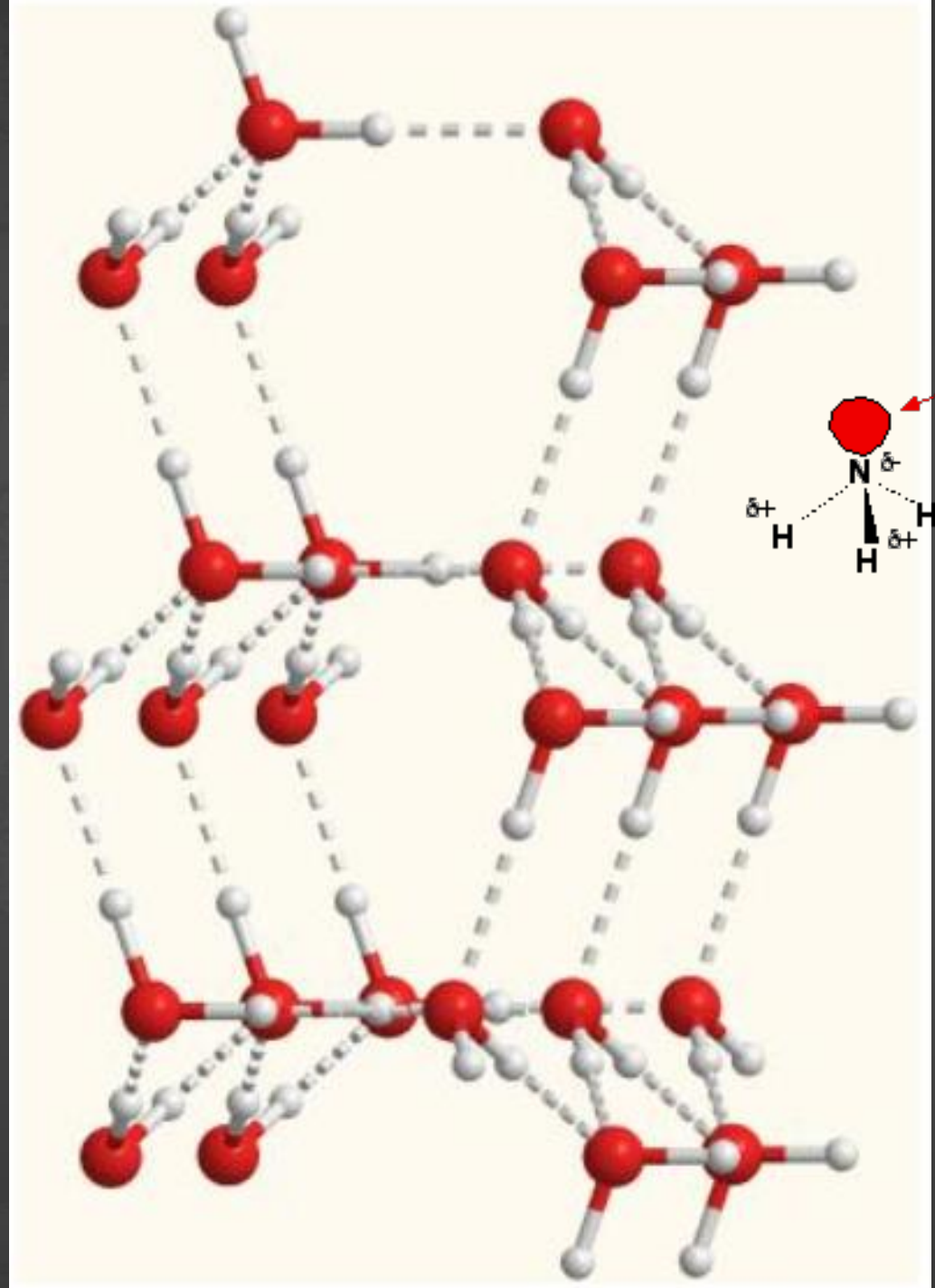
water, hydrogen bond

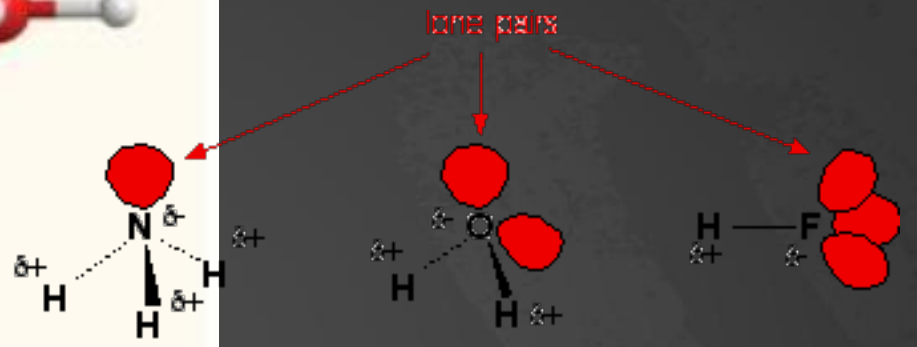


A water molecule is called a dipole, because it has two electric poles.

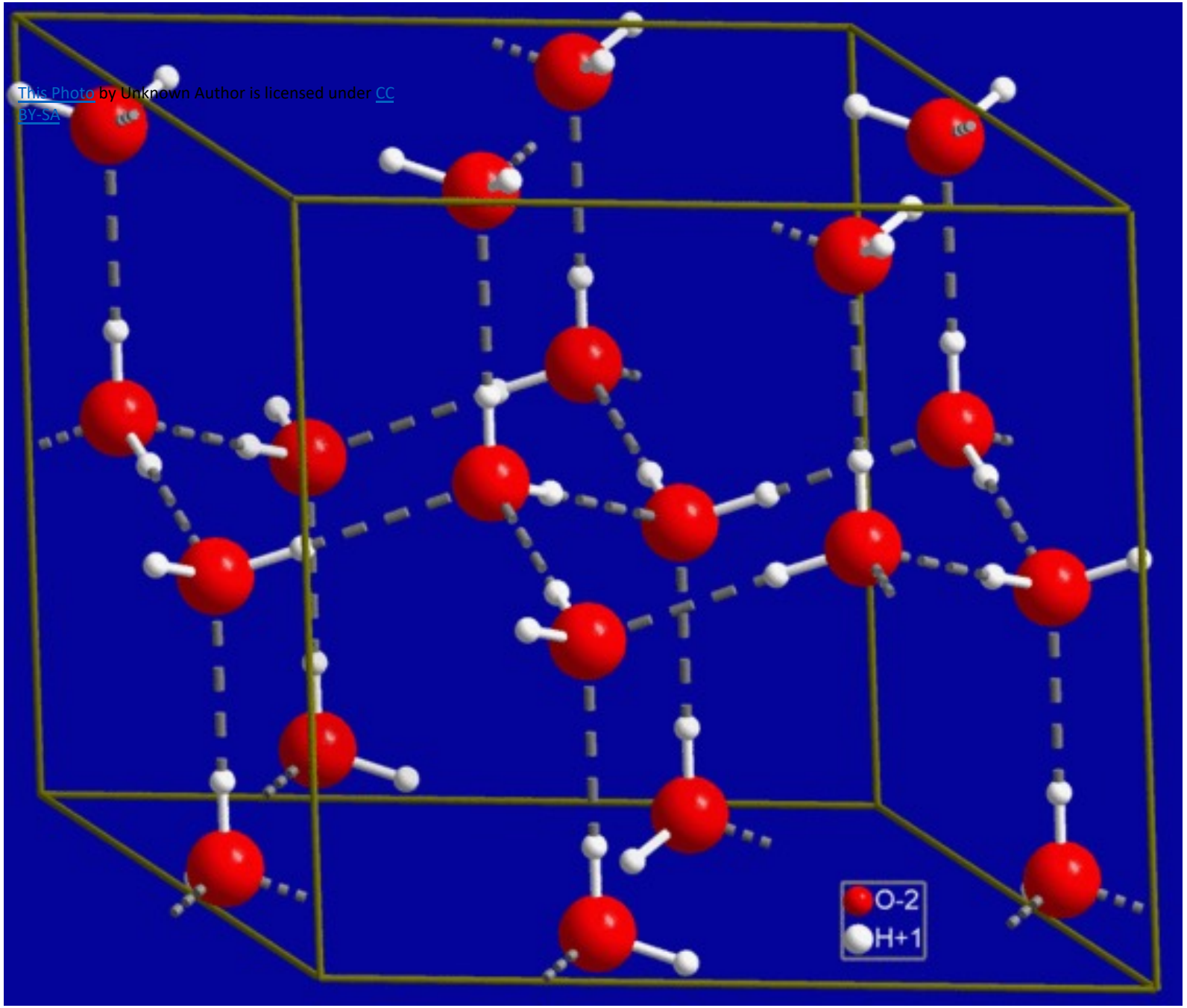


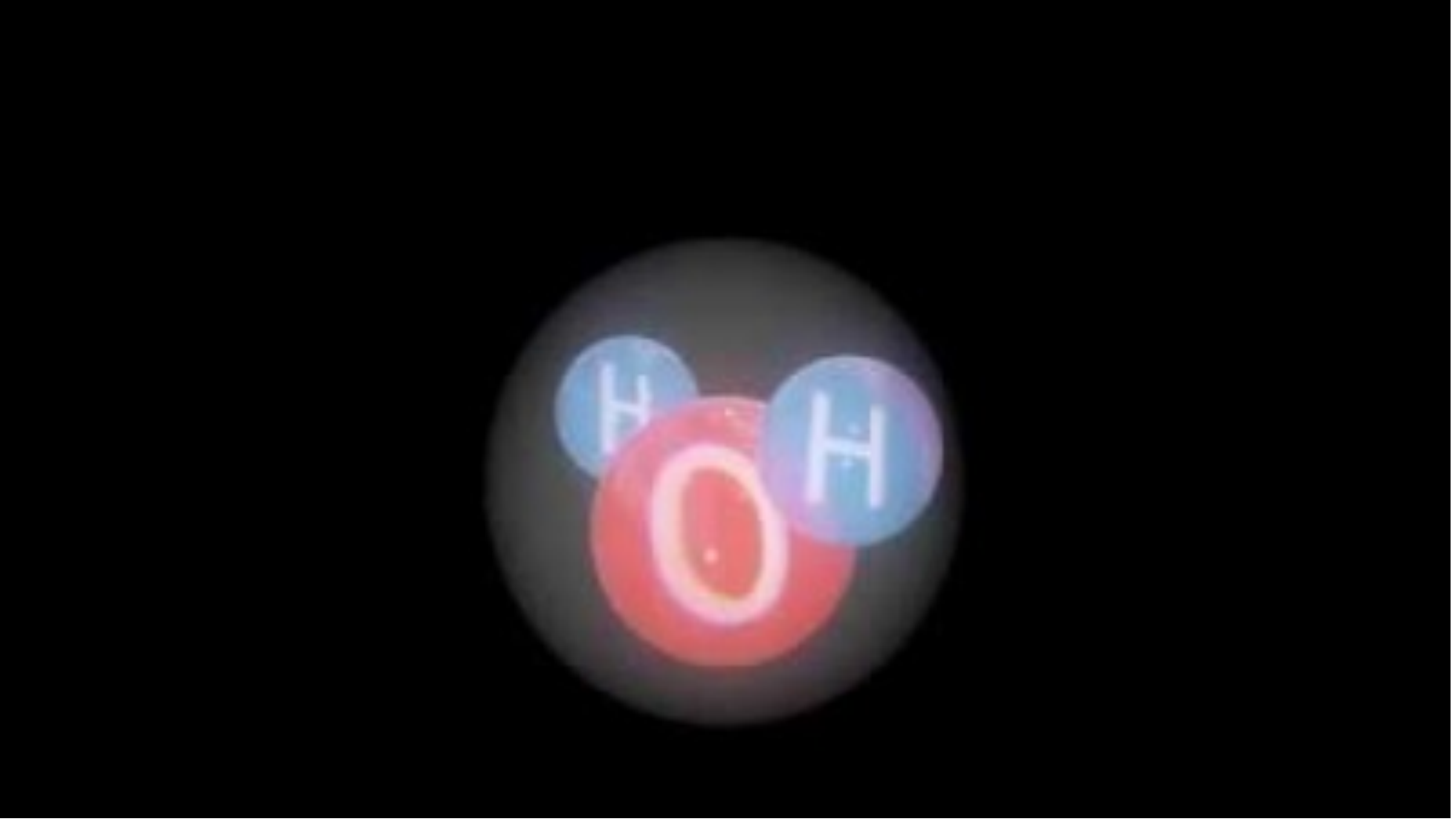
Hydrogen bond is the strongest of the intermolecular forces, but it is much weaker, than covalent bond.





Ice





https://youtu.be/dHJmOH38agY

Chemical properties of water

1. Reactions with metals and non-metals with release of hydrogen

$$2Na + 2H_2O = H_2 + 2\ NaOH$$

$$2K + 2\ H_2O = H_2 + 2\ KOH$$

$$3Fe + 4\ H_2O = 4H_2 + Fe_3O_4 \text{ (when heated)}$$

$$C + H_2O = H_2 + CO$$

$$CH_4 + 2\ H_2O = 4H_2 + CO_2$$

2. Water decomposes into oxygen and hydrogen under electrical current

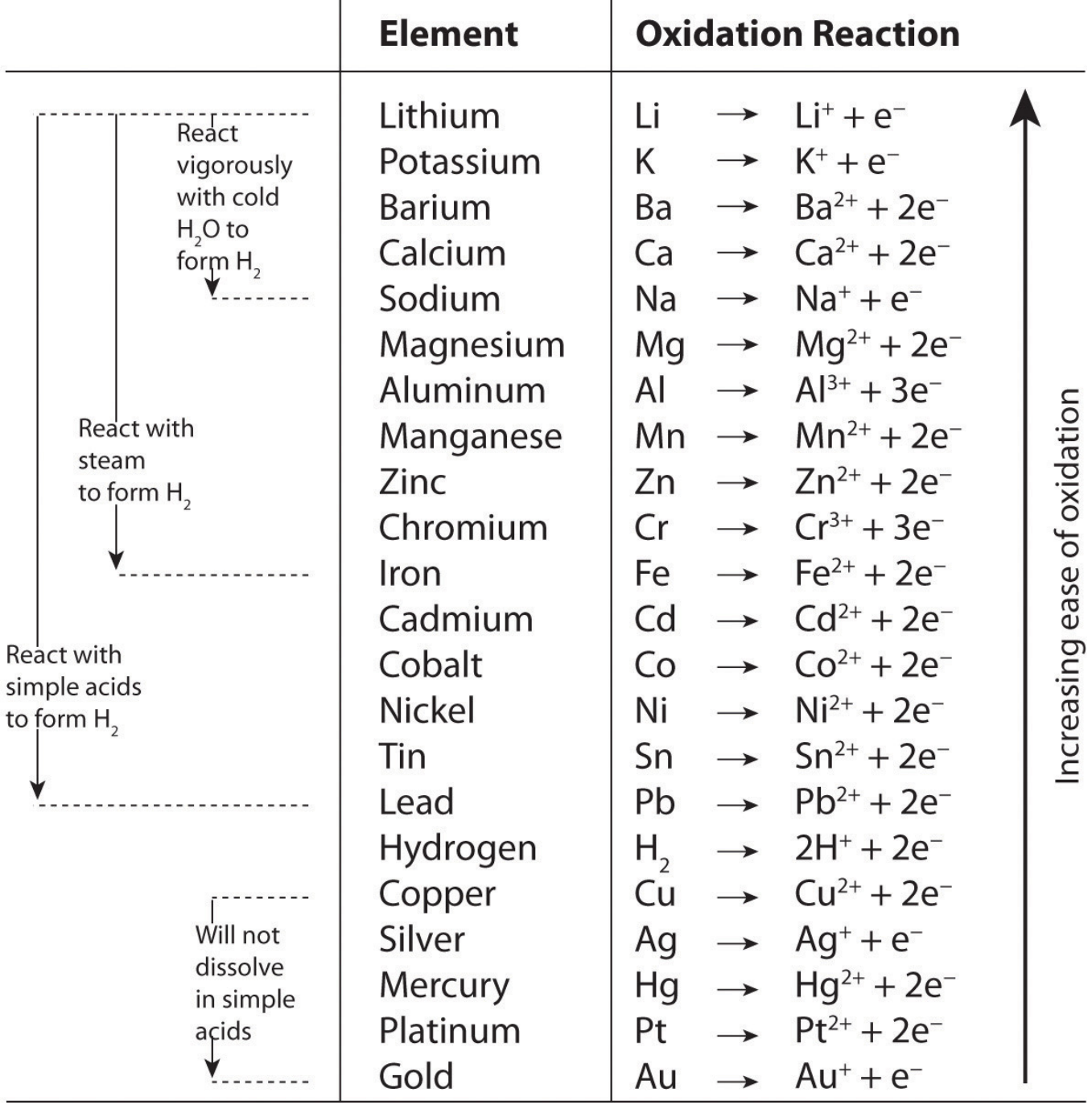
https://youtu.be/oqMN3y8k9So

$2K^0 + 2H^{-1}{}_2O \rightarrow 2K^{+1}OH + H^0{}_2$

$K^0 \rightarrow K^{+1} + e$ oxidation

$H^{-1} + 2e \rightarrow H^0{}_2$ reduction

Only active metals can participate in redox reactions with water



Element	Oxidation Reaction
Lithium	$Li \rightarrow Li^+ + e^-$
Potassium	$K \rightarrow K^+ + e^-$
Barium	$Ba \rightarrow Ba^{2+} + 2e^-$
Calcium	$Ca \rightarrow Ca^{2+} + 2e^-$
Sodium	$Na \rightarrow Na^+ + e^-$
Magnesium	$Mg \rightarrow Mg^{2+} + 2e^-$
Aluminum	$Al \rightarrow Al^{3+} + 3e^-$
Manganese	$Mn \rightarrow Mn^{2+} + 2e^-$
Zinc	$Zn \rightarrow Zn^{2+} + 2e^-$
Chromium	$Cr \rightarrow Cr^{3+} + 3e^-$
Iron	$Fe \rightarrow Fe^{2+} + 2e^-$
Cadmium	$Cd \rightarrow Cd^{2+} + 2e^-$
Cobalt	$Co \rightarrow Co^{2+} + 2e^-$
Nickel	$Ni \rightarrow Ni^{2+} + 2e^-$
Tin	$Sn \rightarrow Sn^{2+} + 2e^-$
Lead	$Pb \rightarrow Pb^{2+} + 2e^-$
Hydrogen	$H_2 \rightarrow 2H^+ + 2e^-$
Copper	$Cu \rightarrow Cu^{2+} + 2e^-$
Silver	$Ag \rightarrow Ag^+ + e^-$
Mercury	$Hg \rightarrow Hg^{2+} + 2e^-$
Platinum	$Pt \rightarrow Pt^{2+} + 2e^-$
Gold	$Au \rightarrow Au^+ + e^-$

3. Water reactions with non-metal oxides (combination)

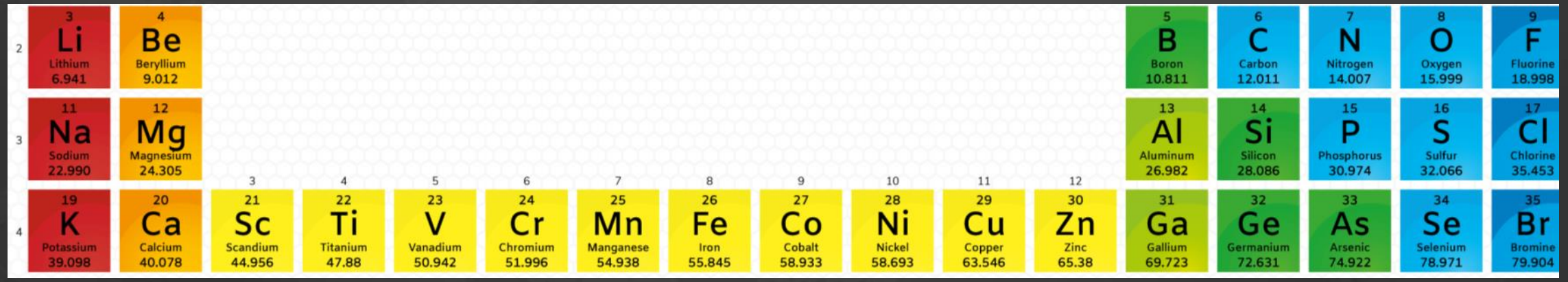
$SO_2 + H_2O = H_2SO_3$ (sulfurous acid)

$SO_3 + H_2O = H_2SO_4$

$CO_2 + H_2O = H_2CO_3$ (carbonic acid)

4. Some metal oxides also can react with water (combination)

$CaO + H_2O = Ca(OH)_2$



5. Water forms compounds where its molecule does not decompose (hydrates)

$$CuSO_4 + 5H_2O = CuSO_4 \cdot 5\,H_2O$$
$$H_2SO_4 + H_2O = H_2SO_4 \cdot H_2O$$
$$NaOH + H_2O = NaOH \cdot H_2O$$

Hydrate is the most abundant type of structure, it is supported by hydrogen bonds. It absorbs water from the surrounding very easily.

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