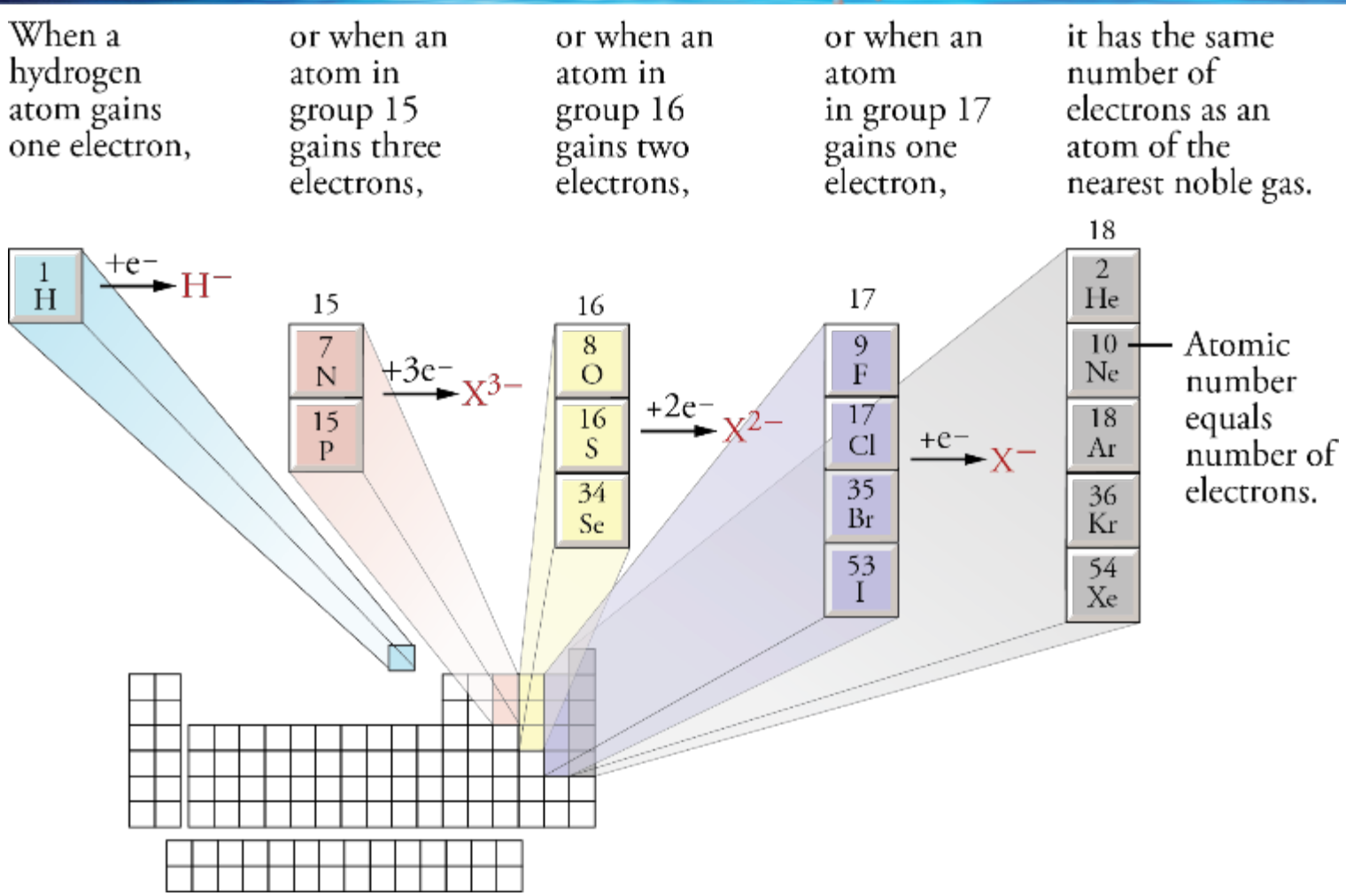
# Cations and Anions

- Atoms of the metallic elements have relatively weak attractions for their electrons, so they tend to lose electrons and form monatomic cations (cations composed of one atom, such as $Na^+$).
- Atoms of the nonmetallic elements have relatively strong attractions for electrons, so they tend to gain electrons and form monatomic anions (anions composed of one atom, such as $Cl^-$).
- Therefore, when metallic and nonmetallic atoms combine, they usually form ions and ionic bonds.

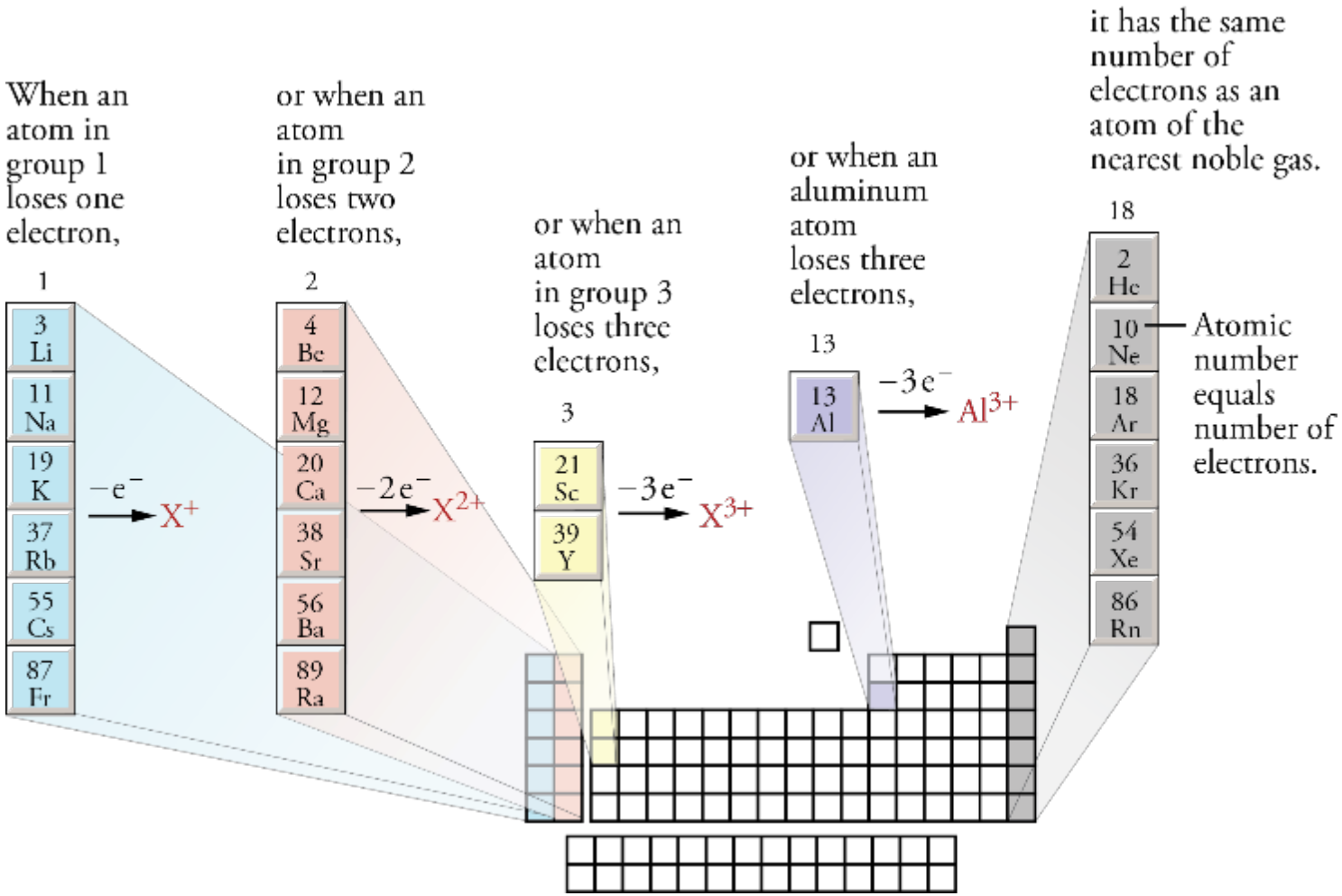
# Predicting Ion Charges

- Noble gas atoms are very stable, so when the nonmetallic atoms form anions, they gain enough electrons to get the same number of electrons as the nearest larger noble gas atom.
- When the aluminum and the metallic atoms in Groups 1, 2, and 3 form cations, they lose enough electrons to get the same number of electrons as the nearest smaller noble gas atom.

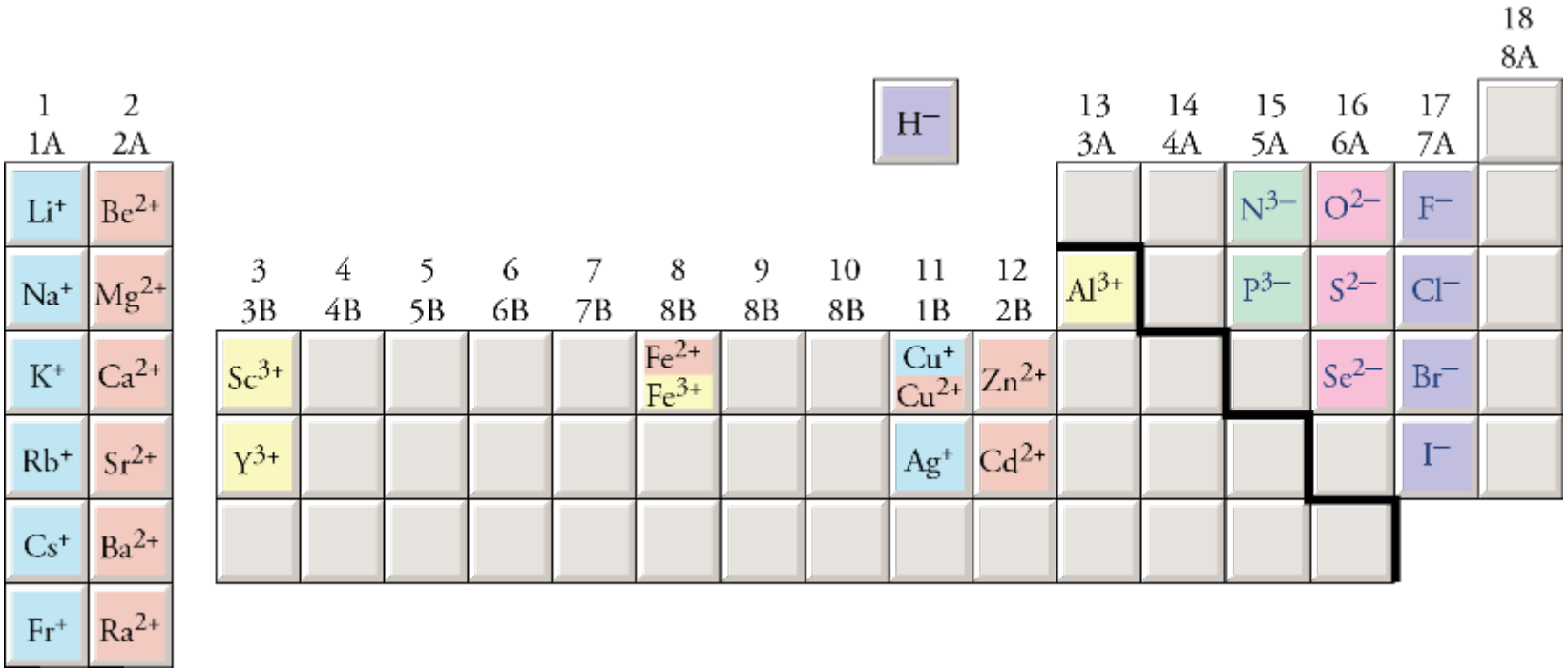
# The Making of an Anion



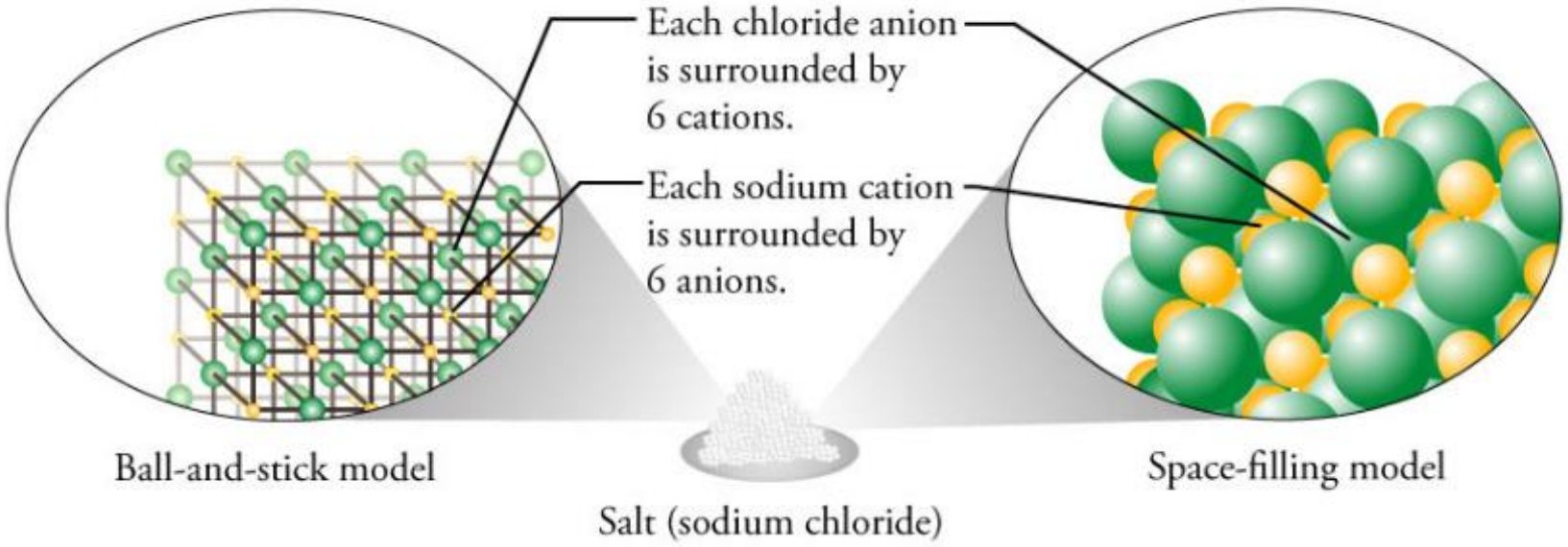
# The Making of a Cation



# Monatomic Ions

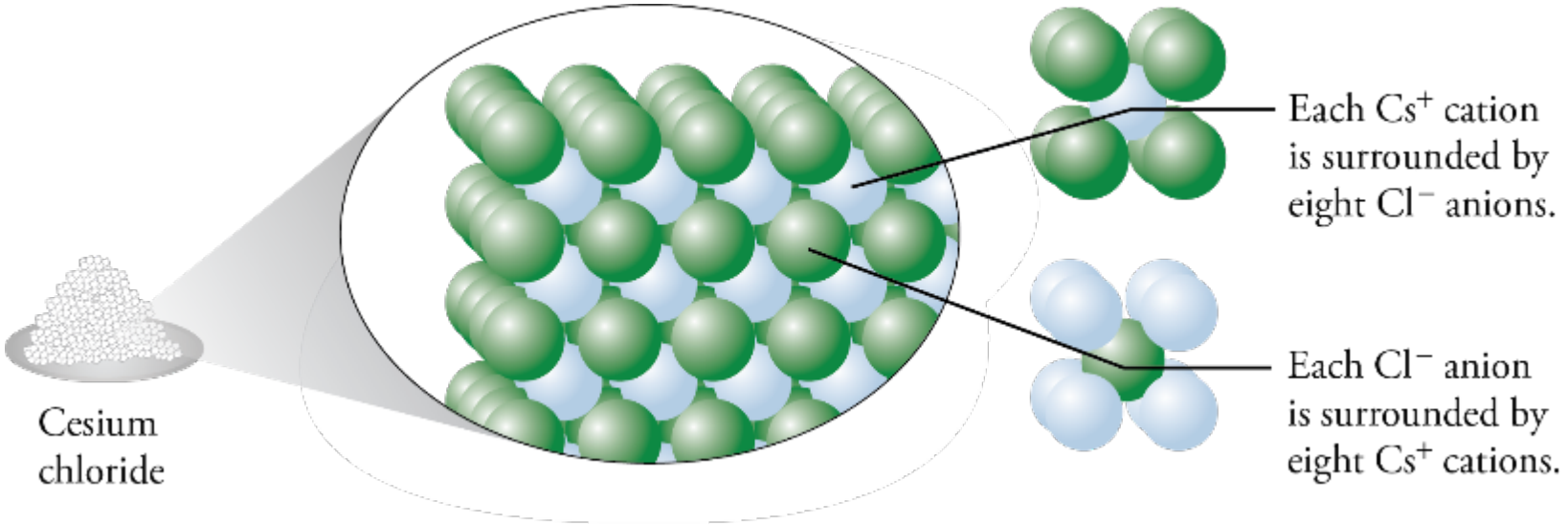


# Sodium Chloride, NaCl, Structure



# Cesium chloride, CsCl, Structure

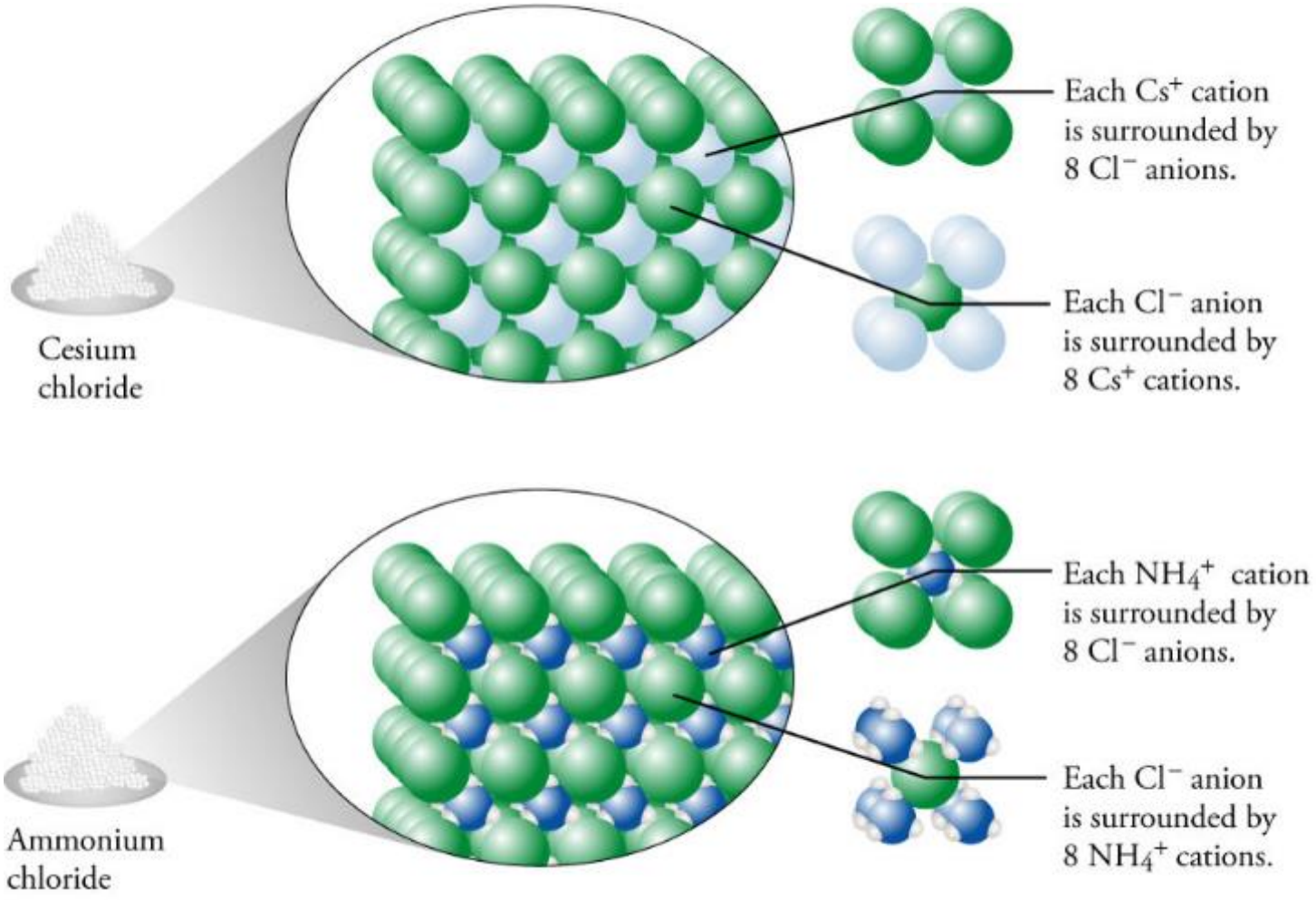
- Because the cesium ions are larger than sodium ions, there is room for eight chloride ions around each cesium ion and eight cesium ions around each chloride ion.



# Polyatomic Ions

- Some anions and cations contain more than one atom.
- **Polyatomic ion** = a charge collection of atoms held together by covalent bonds
- For example, it is possible for a nitrogen atom to form covalent bonds to four hydrogen atoms, but to make this possible the nitrogen atom has to lose an electron, giving the collection of atoms a plus one charge. This will be explained in more detail in a later lesson. This collection of atoms with the formula $NH_4^+$ is called the ammonium ion.

# CsCl and $NH_4Cl$ structure



# Polyatomic Ions

| Ion | Name | Ion | Name |
|---|---|---|---|
| $NH_4^+$ | ammonium | $NO_3^-$ | nitrate |
| $OH^-$ | hydroxide | $SO_4^{2-}$ | sulfate |
| $CO_3^{2-}$ | carbonate | $C_2H_3O_2^-$ | acetate |
| $PO_4^{3-}$ | phosphate | | |