Bonding Models for Inorganic Molecules and Ions

Model	Strengths	Weaknesses	When to Use
Lewis Structures	• structures are easy to draw • helps predict connectivity of atoms • predicts bond orders • distinguishes between bonding and non-bonding electrons	• does not predict geometry • does not explain how bonds form • does not explain isomers • does not explain what non-bonding electrons are • does not explain resonance	• typically first approach when considering bonding • essential first step for VSEPR
VSEPR	• predicts three-dimensional shape • explains polarity • explains existence of isomers	• does not explain how bonds form • does not explain why double bonds are different from single bonds	• method of choice when predicting geometry
Valence Bond	• explains bonding as am interaction between atomic (hybrid) orbitals • explains why double and triple bonds are different from single bonds	• relies on atomic (hybrid) orbitals, which are properties of free atoms, not molecules or polyatomic ions • cannot explain why some molecules are paramagnetic and others are diamagnetic	• used primarily to explain difference between σ and π bonding • hybrid orbitals are used to indicated geometry; for example, sp^3 hybridization indicates tetrahedral geometry
Molecular Orbital	• explains why some molecules are paramagnetic and why others are diamagnetic • explains bonding in terms of molecular, not atomic orbitals • gives best description of the distribution of valence electrons in molecules	• complex calculations require approximations for all but the simplest systems	• used to explain bond orders in simple diatomic molecules and ions • used to explain magnetic behavior of diatomic molecules and ions • used to explain color of metal-ligand complexes of transition metals