Effects of Common Alloying Elements on Steel Properties

Element	Effect on Steel Properties
Carbon (C)	Increases strength but decreases toughness and weldability (most common and important)
Manganese (Mn)	Similar, though lesser, effect as carbon
Silicon (Si)	Similar to carbon but with a lesser effect than manganese (important for castability)
Nickel (Ni)	Improves toughness
Chromium (Cr)	Improves oxidation resistance
Molybdenum (Mo)	Improves hardenability and high temperature strength
Vanadium (V)	Improves high temperature strength
Tungsten (W)	Improves high temperature strength
Aluminum (Al)	Reduces the oxygen or nitrogen in the molten steel
Titanium (Ti)	Reduces the oxygen or nitrogen in the molten steel
Zirconium (Zi)	Reduces the oxygen or nitrogen in the molten steel
Oxygen (O)	Negative effect by forming gas porosity
Nitrogen (N)	Negative effect by forming gas porosity
Hydrogen (H)	In high quantities, results in poor ductility
Phosphorus (P)	Can increase strength but drastically reduces toughness and ductility
Sulfur (S)	Reduces toughness and ductility