A new mononuclear Cu(II) complex, *trans*-[Cu(cip)2(OH)2]∙2CH3OH∙6H2O, where cip = ciprofloxacin, has been synthesized and characterized by spectroscopic methods and X-ray crystallography. *In vitro* studies (UV–Vis spectroscopy, emission titration, voltammetric techniques, and gel electrophoresis) show that the complex interacts with calf-thymus DNA (CT-DNA) *via* an intercalative binding mode. In addition, the binding propensity of the complex to BSA was investigated by absorption and fluorescence techniques in combination with computational calculations. The results show that the energy transfer occurs from BSA to the Cu(II) complex. It is important to mention that the Förster’s theory is applicable for the distance below 8 nm or maximum 9 nm.