Our research focuses on investigating and developing novel metal complexes with specific structural demands for modeling biological inorganic molecules and for certain applications in material sciences.

**Bioinorganic Chemistry**

- **First area** which we are moving on now depends on Designing Polynuclear metal complexes derived from tripod amines and polyucleating Agents based cyclen and triazine to be used as Effective and Selective Promoters for DNA. A variety of Cu(II) and cobalt(III) complexes as well as lanthanide compounds are tested to establish the rapid selective hydrolytic cleavage of the P-O bonds in DNA and in phosphodiester compounds. Some dinuclear Cu(II)-based triazine are shown below.

\[
[Cu_2(BDPACTz)(\mu-OH)]_2(H_2O)_2^{2+}
\]

- **Second area** includes Catalytic Hydrolysis of Biological Polyphosphates (ATP, GTP) and phosphate esters. Kinetics and mechanistic studies for the role of “Metal ions” in promoting the hydrolysis of polyphosphates and phosphate diesters using novel aqua-tetraamine-cobalt(III) complexes. Also, the study is extended to include substitution and complex formation reactions. We were able to synthesize a number of symmetric and asymmetric tripod tetraamine ligands containing different pyridyl arms and/or amino-ethyl and amino-propyl groups attached to the tertiary nitrogen. The aqua-cobalt(III) complexes of these amines will be used to promote the hydrolysis of ATP and phosphate diesters in an attempt to reach the enzyme level activity.

\[
[Co(pmap)CO_3]^+ 
\]

**Inorganic Chemistry**

We are also interested in the design and characterization of polynuclear inorganic molecules with novel magnetic properties. These molecules may utilize useful applications in Material Sciences and in the field of condensed matter physics. The strategy for synthesizing these compounds depends on the assembly of
paramagnetic centers (Cu$^{2+}$, Ni$^{2+}$, Co$^{2+}$) via bridging ligands such as pseudohalides (N$_3^-$, SCN$^-$ and dicyanamide), polycarboxylic acids, squarate dianion, croconate dianion, di-pyridyl derivatives and 3,5-pyrazine dicarboxylates. The bridging ligands selected for this study allow a wide separation range between the metal ions (3-11Å) and hence the resulting complexes mediate different magnetic interactions. We are hoping to correlate the structural parameters of the bridging compounds (geometrical factor, the M$^{2+}$-X-M$^{2+}$ torsion angle, the axial M-ligand bond lengths, the intradimer M···M distances) to their magnetic properties.

Different techniques are used to characterize the synthesized complexes including $^1$H and $^{13}$C NMR, FAB/MAS, UV-VIS.-NIR and IR spectrophotometry. My laboratory is well equipped with the facilities required to synthesize the designed complexes and for studying the kinetics of substitution reactions and phosphate hydrolysis: Agilent 8453 HP diode array UV-VIS. spectrophotometer with a thermostated bath and could be connected to SFA-20 unit for rapid kinetic measurements, Visco Alpha Titroline Easy for automatic titration, pH meter, Mark II JM balance for measuring magnetic susceptibility at room temperature, rotary evaporators, vacuum pump, water purification system, computers with software installed to analyze the kinetic data.

**Collaboration (beyond UL Lafayette)**

- Prof. Franz Mautner (Graz University of Technology, Graz/Austria)
- Prof. Ivan Bernal (University of Houston/USA)
- Prof. Roger Lalancette (Rutgers University/USA)
- Prof. Franc Meyer (Georg-August-Universität Göttingen/Germany)
- Prof. Masahiro Mikuriya (Kwansei Gakuin University, Sanda/Japan)
- Prof. Gordon Yee (Virginia Tech., Blacksburg/USA)
- Prof. Ramon Vicente (University of Barcelona, Barcelona/Spain)
- Dr. Janusz Grebowicz (University of Houston, Downtown-Houston/USA)