# EXAMPLES OF POSSIBLE RESEARCH TOPICS FOR INTERNAL CHEMISTRY ASSESSMENT OR MONOGRAPH.

## TRADITIONAL LABORATORY PRACTICES

- Removal of tarnish from silver objects (redox reactions)
- Aspirin: Synthesis using different approaches such as microwave, purification by melting point and thin layer chromatography, kinetics of aspirin hydrolysis to salicylic acid under various conditions.
- Synthesis of the sweetener Dulcin from the analgesic Tylenol (allows the use of titration).
- Study of nucleophilic substitution reactions (thin layer chromatography quantification can be obtained using a simple flatbed scanner).
- Hydrogen peroxide production with the use of a photo sensitizer such as riboflavin and redox reactions.
- Thermal denaturation of proteins using UV light
- Thermodynamics and kinetics of frozen food.
- Investigation of the kinetics of the bleaching of a dye using a colorimeter.
- Solidification techniques and magterials
- Constant distribution of iodine between aqueous and non-aqueous systems (can be expanded for calculation of ΔG).
- Investigation of gases in water heated in a microwave oven.
- Investigation of EDTA contents in bath cleaners.
- Investigation of the dependence of the overvoltage on the composition of a metal surface on which hydrogen discharges, bubbles and intermolecular forces occur.
- Pharmaceuticals from plants.
- Fluorescence research using turmeric, B complex, mineraesl, household items.
- Iodine content in palm oil compared to other cooking oils.
- Determination of manganese in a paper clip.
- Study of the effectiveness of different salts in the removal of snow from streets.
- Investigation of the kinetics of a specific investigation.
- Transition metal ions (effects of metals, ligands, oxidation states on ion color)
- Natural indicators (sources, stability, acidity constant (ka) values), turning point)
- Spice oil extraction (using different spice sources, different storage conditions)
- Effectiveness of the different water purification methods on ions dissolved.
- Melting point of group 2 metals and the difference in crystal types.
- Nitrogen in fertilizers (by reaction with excess NaOH and subsequent titration with standard HCl)
- Thermodynamic data of ionic compounds (Kps, can be calculated

gravimetrically, enthalpy of solution)

- Use of different fruits to chelate heavy metals (e.g. Cadmium) from contaminated water sources.
- Effect of temperature on vitamin C content in bell pepper juice.
  red.
- Determination of residual chlorine concentration vs. distance from the water treatment plant.
- Determination of the activation energy in a reaction by means of the examination of the relationship between temperature and rate constant of the reaction.
- Effect of cooking method on vitamin C content.
- Henna as an effective indicator.
- Caffeine in coffee vs. various teas
- Effect of roasting on caffeine content in coffee.
- Calcium content in lentils.
- Variation in iron concentration in avocados at different ripening stages.
- Effect of increased carbon dioxide on saltwater acidification.
- Energy content in food / compared to that printed in the nutritional information.
- Effect of temperature on the pH of ascorbic acid solutions.

## SPREADSHEETS

- Artificial saltwater production using spreadsheets
- Study of equilibrium carbonate systems in aquaria using Excel for calculations.
- Calculation of the isoelectric point of proteins.
- Study of reaction kinetics with software such as ChemKinetics, using Excel or Modellus.

## DATA BASE

- NIST or any other database available on the Internet can be used to investigate trends in the enthalpy of dissociation of C-S, N-H and O-H bonds.
- Experimental comparison of data related to the structure of the
  with predicted values using software such as MOPAC, WebMO or GAMESS
- Investigation of intermolecular forces using software such as SAPT
- Investigation of the effect of isotopes on vibration spectra, comparing it with results predicted by programs such as SpartanStudent, Molden or Tinker.
- Analysis of environmental issues with databases such as those of the Environmental Protection Agency, European Environmental Agency, United Nations Environmental Program, databases of organizations related to environmental education in Asian countries or NETROnline.
- Environmental issues offer endless possibilities.
- Comparison of the structure of drugs with their various properties - there are various

databases - e.g. drugbank.ca , http://www.ebi.ac.uk/chembldb/

- List of 64 free databases: http://depth-first.com/articles/2011/10/12/sixty-four-free-four-free-chemistry-databases/
- To explore the relationship between the molecular mass/number of hydroxyl groups in a chemical compound and its solubility in water.

## SIMULATIONS

- Investigate the influence of the chemical environment on NMR spectra using WinDNMR and relate these structures to chemical reactions to establish changes in terms of temperature modifications.
- The information can be exported to databases for further analysis.
- Research with simulations can determine data in a simple way (like a video game), but then the student must use this simulation to process data, or compare with experimental results either collected personally or from a database taking a step beyond the simulation, to new discoveries.
- Students need vision and initiative in using simulations to achieve the depth expected of them.
- Simulations on their own do not meet the requirements of this criterion.
- The student creates his/her own program to simulate a process/reaction/relationship.