Degree Learning Outcome	DLO Subtopic	Course(s) where covered
Describe, recognize, draw, and name, important classes of atoms, functional groups, and molecules.	**nomenclature** and structure of important compounds	
	types of matter	100, 100L
	ions	100, 200
	main group inorganics	100L
	nucleotides and nucleic acids	560
	amino acids	560
	carbohydrates	560
	lipids	
Demonstrate the ability to quantify and interpret the reliability of measured physical and chemical properties of molecules and mixtures employing dimensional and appropriate statistical analysis.	**measurement** of physical properties	
	units and amounts	100, 100L, 200, 251, 251L, 417
	error and uncertainty	100, 100L, 251, 251L, 417
	statistical analysis	251
	physical properties	100, 200, 417
	chemical calculations	100, 200, 417
Demonstrated knowledge of the important techniques employed to separate, purify, identify, and quantitate chemical compounds.	**chemical analysis**	
	titrations	251
	gravimetry	251
	standardization and calibration	251
	electrochemistry	200, 251
	spectroscopy	251,410a
	chromatography	251
	DNA sequencing	560
	protein purification and sequencing	560
	atomic structure and props	

Describe the atomic and subatomic structure and properties of matter.	atomic theory	100
	atom properties	100, 200
	periodic table	100, 100L, 432
	quantum mechanics	200, 410a
	electronic structure of atoms	100, 200, 432
	electronic structure of one-electron atoms	410a
	electronic structure of many-electron atoms	410a

Describe the origin and properties of chemical bonding and the influence on structure and properties of the molecules.	**molecular structure and props**	
	chemical bonds	100, 200, 432
	Lewis structures	100, 100L, 200, 201, 432,
	molecular shape	100, 100L, 200, 201, 432,
	hybrid orbitals	200,
	molecular orbital theory	200, 432
	electronic states	410a
	vibrational states	410a, 417
	rotational states	410a
	ions	100, 201
	main group inorganics	
	aromaticity	432
	conjugation	432
	organic structure function relationship	432
	DNA and RNA	560
	amino acids	560
	protein structure	560
	protein structure function relationship	560
	carbohydrates	560
	lipids	560

Describe how the macromolecular properties of matter are determined by the molecular characteristics.	**molecules to macro props**	
	physical states	100, 200
	intermolecular forces	100, 560
	gasses	100, 560
	solids	100
	liquids	200
	phase transitions	100, 410b
	solutions	100, 200, 410b, 560
	membrane transport	560
	statistical mechanics principles	410b
	statistical mechanics applications	410b
	mass transport	410b
	energy transport	410b

Predict the outcome of, and describe the mechanisms for, various chemical reactions.	**chemical reactions**	
	chemical equation	100, 200
	thermodynamics	200, 201, 417, 560
	equilibrium	100, 201, 410b, 417
	kinetics	100, 201, 410b, 417
	acid-base reactions	100, 200, 201, 251
	ionic solubility	200, 201, 251
	metal-ligand complexation	201, 560
	redox reactions	200, 201, 251, 432
	electrochemistry	201
	nucleophilic addition (organic)	432
	electrophilic addition (organic)	432
	kinetic/thermodynamic products	432
	microscopic reversibility	432

	synthesis	432
	biochemical reactions	560
	enzyme catalysis	560
	enzyme kinetics	560
	nuclear reactions	100, 201
Demonstrate the ability to perform safe and accurate laboratory procedures.	**laboratory** techniques	
	use of basic lab glassware, equipment	100L
	measurement of physical props	100L
	quantitatively measuring out chemicals	251L, 417
	instumentation	251L, 417
	calibration	251L, 417
	chemical analysis	251L
	independent work	417
	scientific method	
	scientific method overview	100, 200
	recording and **presentation** of chemical data	
	laboratory notebook	251L, 417
	writing	251L, 417