INDIANA COMMISSION *for*
HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAPs)

Second Round - 2017

INDIANA COMMISSION *for* HIGHER EDUCATION

Table of Contents

INDIANA COMMISSION *for* HIGHER EDUCATION

Introduction

In 2013 the Indiana legislature enacted Senate Enrolled Act 182, thereby establishing the requirements for a Statewide Transfer General Education Core (STGEC) of at least 30 credit hours. The statute states that each educational institution, in collaboration with the Commission for Higher Education, shall, no later than July 1, 2014, work together to create a single articulation pathway for each programmatic area and implement the single articulation pathways no later than May 15, 2015, for students entering state educational institutions in the fall of 2015. The areas for development must be in those which significant numbers of students first achieve an associate of science or an associate of arts degree with the intent of obtaining a related baccalaureate degree.

The degrees that constitute the breadth of the Transfer Single Articulation Pathways (TSAP) are a limited number of the degree programs and articulations between the public 2-year and public 4-year institutions. While the TSAPs have certain guarantees for students who complete the associate degree at the public 2-year institution and who are admitted to the corresponding baccalaureate degree program at a public 4-year campus, the student should be aware of the array of transferrable degrees that are available to them.

TSAPs are competency-based degree tracks designed to promote seamless transfer from a public 2-year to a public 4-year degree program. However, successfully completing a public 2-year TSAP degree track is neither a guarantee of admission to a public 4-year institution nor a guarantee of admission to an aligned degree program and the public 4-year institution, since individual public 4-year degree program requirements are not covered by the TSAP agreements. Students are responsible for working with advisors of the public 4-year program into which they hope to transfer and with their public 2-year advisors in order to increase their chances for successful transfer.

The following TSAPs are available for students in fall 2017:

1. Biology
2. Chemistry
3. Human Services
4. Psychology
5. Sociology

INDIANA COMMISSION for HIGHER EDUCATION

STGEC/TSAP LEADERSHIP TEAM

June 11, 2018

BALL STATE UNIVERSITY

Dr. Kecia Thompson
Acting Associate Provost and
Dean, University College
Ball State University
Phone: 765-285-3717
Email: kdthompson3@bsu.edu

INDIANA STATE UNIVERSITY

Dr. Susan Powers
Associate Vice President for Academic Affairs
Indiana State University
Phone: 812-237-2307
Email: susan.powers@indstate.edu

INDIANA UNIVERSITY

Dr. Carolyn Gentle-Genitty
Assistant Vice President for University Policy; and
Director, University Transfer Office
IU System
Phone: 317-274-3960
Email: cgentleg@iu.edu

Dr. Dennis Groth
Vice Provost for Undergraduate Education
IU Bloomington
Phone: 812-855-8783
Email: dgroth@indiana.edu

Dr. Michael Lundell
Assistant Vice Provost
IU Bloomington
Phone: 812-855-8783
Email: mlundell@indiana.edu

Dr. James Gladden
Associate Vice Chancellor for Undergraduate Education
and Dean of University College
IUPUI
Phone: 317-278-2826
Email: jamglad@iupui.edu

IVY TECH COMMUNITY COLLEGE OF INDIANA

Dr. Russ Baker
Vice President of Academic Affairs and University
Transfer Division
Ivy Tech Community College
Phone: 317-921-4313
Email: rbaker80@ivytech.edu

Dr. Todd Roswarski
Vice Chancellor of Academic Affairs
Ivy Tech Community College
Phone: 765-269-5620
Email: troswars@ivytech.edu

PURDUE UNIVERSITY

Dr. Candiss Vibbert
Associate Provost for Special Initiatives
Purdue West Lafayette
Phone: 765-494-7929
Email: vibbert@purdue.edu

Dr. Rebecca Stankowski
Associate Vice Chancellor for Academic Affairs,
Institutional Effectiveness
Purdue Northwest
Phone: 219-989-8343
Email: stankowski@pnw.edu

INDIANA COMMISSION for HIGHER EDUCATION

STGEC/TSAP LEADERSHIP TEAM

June 11, 2018

Dr. James Hersberger
Associate Chair and Professor in Mathematics
IPFW
Phone: 260-481-5798
Email: hersberg@ipfw.edu

Dr. Jody Dekorte
Dean, School of General Education and Open College
Purdue University Global
Phone: 303-485-0651
Email: jdekorte@purdueglobal.edu

UNIVERSITY OF SOUTHERN INDIANA

Dr. Shelly Blunt
Associate Provost for Curriculum and Instruction
University of Southern Indiana
Phone: 812-465-1617
Email: sblunt@usi.edu

VINCENNES UNIVERSITY

Mr. Michael Gress
Assistant Provost of Curriculum and Instruction
Vincennes University
Phone: 812-888-4275
Email: mgress@vinu.edu

Dr. Laurel Smith
Interim Provost and Vice President of Instructional Services/Dean of the Faculty
Vincennes University
Phone: 812-888-4176
Email: lasmith@vinu.edu

COMMISSION STAFF

Dr. Ken Sauer
Senior Associate Commissioner and Chief Academic Officer
Phone: 317-232-1090
Email: ksauer@che.in.gov

Ms. Jillian Scholten
Director of Academic Affairs
Phone: 317-232-1071
Email: jscholten@che.in.gov

Ms. Dawn Clark
Assistant Director of Academic Affairs
Phone: 317-232-1078
Email: dclark@che.in.gov

TRANSFER INDIANA

Ms. Tari Lambert
Director, Transfer IN Office
Phone: 765-285-5810
Email: tglambert@bsu.edu

INDIANA COMMISSION *for*
HIGHER EDUCATION

Biology TSAP

INDIANA COMMISSION for HIGHER EDUCATION

Biology TSAP Faculty Roster

★Denotes co-chairs for this panel.

BALL STATE UNIVERSITY

Badger, Kem
Email: kbadger@bsu.edu

INDIANA STATE UNIVERSITY

Mulkey, Timothy
Email: timothy.mulkey@indstate.edu

INDIANA UNIVERSITY

IUB
Hardy, Richard
Email: rwhardy@indiana.edu

Bender, Alan
Email: adbender@indiana.edu

IUE
Khurana, Parul
Email: khuranap@iue.edu

IUK
Chauret, Christian
Email: cchauret@iuk.edu

IUN
Spencer Cortwright
Email: scortwr@iun.edu

IUPUI
Anderson, Greg
Email: ga2@iupui.edu

IUS
Taylor, David
Email: dwtaylo2@ius.edu

IUSB
Grens, Ann
Email: agrens@iusb.edu

IVY TECH COMMUNITY COLLEGE

Sobat, Thomas
Email: tsobat@ivytech.edu

Studach, Leo
Email: lstudach@ivytech.edu

PURDUE UNIVERSITY

IPFW
Marshall, Jordan
Email: marshalj@ipfw.edu

PNW
Bates, Scott
Email: bates43@pnw.edu

Choi, Young
Email: ydchoi@pnw.edu

INDIANA COMMISSION for HIGHER EDUCATION

Biology TSAP Faculty Roster

PWL
Sahley, Christie
Email: sahley@purdue.edu

Bartlett, Ed
Email: ebartle@purdue.edu

UNIVERSITY OF SOUTHERN INDIANA

★Summers, Brent
Email: bsummers@usi.edu

VINCENNES UNIVERSITY

★Coffman, Curt
Email: CCoffman@vinu.edu

INDIANA COMMISSION for HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAPs)

Pathway: Biology

Approved: 12.7.16

Preamble:

The courses mapped for this Transfer Single Articulation Pathway (TSAP) associate's degree are based upon a set of competencies agreed upon across all of the public institutions and are the minimum competencies for transfer in this major.

After a statewide review process, some four-year universities may have specific competencies required that are not included in this mapping and **may limit the admission options for TSAP students**. To increase the likelihood of student success, TSAP advisors in the two-year programs are encouraged to contact the academic advising offices in the major area of the TSAPs at the four-year institutions to discuss the minimum criteria for admission.

It is important that individual students review the published TSAP admission criteria at the specific university/campus to which they wish to transfer. This should be done at the beginning of their enrollment as a TSAP student at either Ivy Tech or Vincennes University. Understanding admission and degree requirements will facilitate student success. The universities in the state of Indiana are committed to the success of TSAP students, and student success is a three-way partnership among students and the academic advisors at both institutions.

A lack of communication after students enroll in a TSAP could result in a misunderstanding of the admission requirements to a specific four-year institution and/or TSAP program, such as minimum grades, specific course sequences, etc., and such misunderstanding could affect the time to graduation.

To be eligible, a student must:

- Have met the TSAP and STGEC eligibility guidelines as defined by Indiana Code
- Have graduated with the TSAP associate degree,
- Have met all the admission requirements (e.g., minimum GPA, minimum course grades, etc.) of the TSAP program at the 4-year institution, and
- Have been admitted to the campus AND into the degree program as a TSAP student.

Transfer Single Articulation Pathways (TSAPs)

Required Major-Specific Content Areas:

This agreement requires that any Associates Degree must include competencies from three primary content areas:

1. Biology – Four Semesters of Classes

A. Introductory Biology – Two Semesters

Students must meet the lecture and laboratory competencies covered in a 2-semester sequence of Introductory Biology for science majors. See Section 1: Introductory Biology Competencies

B. Program-Specific Content Areas – Two Semesters

Students must meet the lecture and laboratory competencies in two, and only two, of the following areas:

a. Molecular Biology: See Section 2: Molecular Biology Competencies
b. Genetics: See Section 3: Genetics Competencies
c. Ecology: See Section 4: Ecology Competencies

2. Physical Science (Chemistry & Physics) – Four Semesters of Classes. Students must complete section A and either section B or C of the three sections below:

A. General Chemistry – Two Semesters

Students must meet the lecture and laboratory competencies covered in a 2-semester sequence of General Chemistry for science majors.
See Section 5: General Chemistry Competencies

B. Organic Chemistry – Two Semesters

Students must meet the lecture and laboratory competencies covered in a 2-semester sequence of Organic Chemistry for science majors.
See Section 6: Organic Chemistry Competencies

C. General Physics – Two Semesters

Students must meet the lecture and laboratory competencies covered in a 2-semester sequence of Algebra-based, General Physics for science majors. See Section 7: General Physics Competencies

3. Mathematics – One Semester of Class

A. Students must meet or exceed the lecture competencies covered in General Calculus I. See Section 8: General Calculus I Competencies

Transfer Single Articulation Pathways (TSAPs)

1. Introductory Biology Competencies and Learning Outcomes:

1.1: ***Scientific investigation***

1.1. a. Define, describe, and implement the scientific method.

1.1. b. Describe implications of scientific or technological developments on ethical questions in biology.

1.2: ***Basic biochemistry***

1.2. a. Describe the fundamental properties of water in biological systems.

1.2. b. Describe the four major biomolecules: carbohydrate, lipid, nucleic acid, and protein, and explain their functions and importance in biological systems.

1.2. c. Draw and describe basic synthesis and degradation reactions of the four major biomolecules.

1.2. d. Describe basic enzyme structure and function.

1.2. e. Describe how biological systems are constrained by chemical and physical processes.

1.3: ***Cell structure and function***

1.3. a. Describe the basic structure of a cell and define the functions of the organelles.

1.3. b. Describe the fluid mosaic model structure of biological membranes and the relationships between the membranes, the cytoskeleton, and the extracellular matrix.

1.3. c. Describe the functions of biological membranes, including transport, signal transduction, cell-cell recognition, enzymatic activity, and intercellular joining.

1.3. d. Explain the biochemistry of and factors involved in membrane transport.

1.3. e. Describe the transfer of molecules within a cell and between cells.

1.3. f. Describe the difference between prokaryotic and eukaryotic cell structure.

1.3. g. Describe the structure and function of chromosomes and their role in cell division.

1.3. h. Explain the concept of the cell cycle, how it is controlled, and how it relates to cell division.

1.3. i. Describe and differentiate between the mechanisms of mitosis and meiosis.

1.3. j. Explain the concepts of independent assortment, crossing over, and random fertilization, and relate these to the production of genetic variation within a population.

1.4: ***Energy transfer within biological systems***

1.4. a. Explain the first and second laws of thermodynamics.
1.4. b. Explain the concept of free energy.
1.4. c. Define chemical reaction and contrast exergonic and endergonic reactions.
1.4. d. Explain the concepts of oxidation and reduction.
1.4. e. Describe the structure of ATP and explain how it powers cellular work.
1.4. f. Describe the processes of glycolysis, the citric acid cycle, and electron transport.
1.4. g. Describe the processes of anaerobic respiration/fermentation.
1.4. h. Describe the steps of the light dependent and light independent reactions of photosynthesis.
1.4. i. Discuss the role and molecular details of photosystems and light-harvesting pigments.
1.4. j. Discuss the role of CO_2 metabolism during photosynthesis.

1.5: ***Introduction to molecular genetics***

1.5. a. Explain the processes controlling gene expression: gene regulation, transcription, and translation.
1.5. b. Describe the process of DNA replication in prokaryotes and eukaryotes.
1.5. c. Describe the concept of mutation and explain the various kinds of mutations.

1.6: ***Basic principles of inheritance***

1.6. a. Explain Mendelian genetics and the expression of traits through the solution of simple monohybrid and dihybrid genetics problems.
1.6. b. Explain the concepts of complete dominance, incomplete dominance, codominance, multiple alleles, pleiotropy, epistasis, and polygenic inheritance.

1.7: ***Evolution and natural selection***

1.7. a. Describe the sources of genetic variation within a population and explain why variation is essential for evolution.
1.7. b. Describe and apply the postulates of Darwin's theory of evolution through natural selection.
1.7. c. Define evolution and natural selection, mutation, sexual selection, gene flow, and genetic drift.
1.7. d. Explain the basic principles of population genetics.
1.7. e. Discuss the biological, ecological, morphological, and phylogenetic species concepts, as well as reproductive isolation mechanisms and the process of speciation.

1.7. f. Explain some of the mechanisms behind different scientific hypotheses concerning the origin of life forms.

1.7. g. Explain endosymbiosis and the origin of eukaryotic cells.

1.7. h. Discuss the advantages and disadvantages of multicellularity.

1.7. i. Describe the various lines of evidence for evolution, including DNA and other molecular data, morphology and anatomy, developmental biology, biogeography, fossils, and radiometric dating.

1.8: ***Hierarchical organization of life***

1.8. a. Describe the methods used in the classification of organisms.

1.8. b. Explain how phylogenetic trees are constructed.

1.8. c. Describe the principal characteristics of the major taxa such as Domains/Kingdoms.

1.8. d. Describe basic ecological concepts in regards to the hierarchical organization of life.

1.9: ***Unity and diversity of life***

1.9. a. Describe the use of evolutionary theory in explaining the unity and diversity of life.

1.9. b. Describe the use of genetic evidence to establish evolutionary relationships between organisms.

1.9. c. Describe the key characteristics and groups of viruses.

1.9. d. Describe the biological diversity of plants, animals, fungi, protists, and prokaryotes at the levels of genes, cells, organs, individuals, and populations.

1.9. e. Discuss the key distinguishing features of the prokaryotic domains, Archaea and Eubacteria, including similarities and differences in organisms from various taxonomic groups.

1.9. f. Discuss the key distinguishing features of the eukaryotic clades, including similarities and differences in organisms from various taxonomic groups.

1.9. g. Discuss the key distinguishing features, including similarities and differences, between major groups of Protist clades.

1.9. h. Discuss the key distinguishing features, including similarities and differences, between major groups of fungal phyla, including morphology and reproductive biology.

1.9. i. Discuss the key distinguishing features, including similarities and differences, between plant taxa from bryophytes to angiosperms, including morphology, plant anatomy, plant development, and reproductive biology.

1.10: ***Anatomy and physiology of plants***

1.10. a. Describe and recognize plant cellular and subcellular structures.
1.10. b. Describe basic comparative plant anatomy and morphology.
1.10. c. Describe the characteristics and roles of plant cells and tissues.
1.10. d. Describe and recognize modes of plant reproduction and dispersal.
1.10. e. Describe the mechanism and pathways involved in the transport of water, minerals, and nutrients in plants.
1.10. f. Describe basic soil characteristics and plant mineral nutrition.
1.10. g. Describe the basic developmental processes in plants and the roles of plant hormones in growth and development.

1.11: ***Anatomy and physiology of animals***

1.11. a. Describe the characteristics and roles of epithelium, muscle, connective, and nervous tissue.
1.11. b. Describe examples of homeostatic mechanisms and their regulation.
1.11. c. Describe examples of invertebrate and vertebrate physiological systems.
1.11. d. Describe and recognize a range of structures of invertebrate and vertebrate physiological systems, including but not limited to: exo- and endo-skeletal systems; the structure of skeletal muscle, the structure and function of a sarcomere, and the structure and interaction of actin and myosin myofilaments during relaxation and contraction; the structures and mechanisms involved in nervous signal transmission; the structures and functions of the endocrine system; the structures of the reproductive system; and how hormones affect cells and how cells regulate hormone reception and the response.

1.12: ***Ecology***

1.12. a. Describe the meaning and importance of ecology
1.12. b. Describe the components of the biosphere.
1.12. c. Examine the role of physiological ecology in an organism's success.
1.12. d. Explain the basic principles of population ecology.
1.12. e. Describe several community-level interactions such as competition, predation/herbivory, and symbiosis.
1.12. f. Explain the characteristics and functions of ecosystems.
1.12. g. Apply knowledge of ecology to environmental and conservation problems.

1.13: ***Laboratory skills***

1.13. a. Develop, implement, and evaluate an experimental problem through data collection and analysis.

1.13. b. Properly use a microscope, balance, pipette, micropipettes, and other basic laboratory equipment.

1.13. c. Demonstrate the use of basic computer applications such as Excel for creating graphs and running simple statistical analyses.

1.13. d. Demonstrate the proper technique for weighing and measuring materials using the metric system.

1.13. e. Calculate concentrations and convert units.

1.13. f. Demonstrate familiarity with basic biochemical analysis for organic molecule identification.

1.13. g. Demonstrate the use of spectrophotometric assays for various applications.

1.13. h. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.

1.13. i. Present scientific information orally, with graphical presentation of data using appropriate presentation technology.

1.14: ***Scientific literature***

1.14. a. Locate and critically evaluate scientific information.

1.14. b. Write literature reviews.

2. Molecular Biology Competencies

2.1: *Introduction to molecular biology*

2.1. a. Discuss the history and logic of molecular biology.

2.1. b. Discuss the similarities and differences between molecular biology, biochemistry, and genetics.

2.1. c. Identify applications of molecular biology in a variety of fields.

2.1. d. Discuss examples of standard model systems (phage*, Escherichia coli*, yeast, cultured cells) and why you would use them.

2.2: *Protein structure/function*

2.2. a. Define the structure of an amino acid as well as net charge at physiological pH.

2.2. b. Identify categories of amino acid side groups (hydrophobic, polar, charged) and which amino acids are in each category.

2.2. c. Apply pKa to terminal groups and side groups on amino acids.

2.2. d. Identify special amino acid properties (cysteine, proline).

2.2. e. Describe the 1°, 2°, 3°, and 4° structure of proteins.

2.2. f. Compare biochemical and functional definitions of protein domains.

2.2. g. Understand the role post-translational modifications have on protein function such a proteolytic cleavage, phosphorylation by kinases, dephosphorylation by phosphatases, ubiquitination and glycosylation.

2.2. h. Understand how allosteric regulation, competitive inhibition and cofactors are important for protein function and regulation.

2.3: *Nucleic acid structure/function*

2.3. a. Explain nucleotide base-pairing rules and why only certain base pairs are possible.

2.3. b. Describe why the double helix is thermodynamically favored.

2.3. c. Examine properties of DNA and RNA in solution.

2.3. d. Examine base composition and base distribution.

2.3. e. Discuss the ways to denature DNA and why they cause strands to dissociate; describe A, B, and Z helices.

2.3. f. Examine hybridization kinetics, including C0t curves, dependence of Tm on sequence, and how to read a C0t curve.

2.4: ***Evidence for DNA as the genetic material***

2.4. a. Discuss the tetranucleotide model for the structure of DNA and the importance of data or evidence in scientific reasoning.

2.4. b. Understand the significance of the experiments of Griffith and Avery, Chargaff, and Hershey and Chase in how they relate to DNA's secondary structure and its role as the genetic material.

2.4. c. Describe and identify DNA structures including chromatin and chromosomes, linear vs circular DNA, positive and negative supercoiling, DNA gyrase and Topo II, and behavior of DNA of different topologies in gel electrophoresis.

2.5: ***DNA replication***

2.5. a. Describe how the Meselson-Stahl experiment relates to semi-conservative replication.

2.5. b. Discuss the role of Okazaki experiments, leading and lagging strands, and requirements for DNA polymerase activity.

2.5. c. Discuss the roles of helicase, supercoiling, and the need for gyrase/topoisomerase II as well as single-strand binding proteins.

2.5. d. Examine the mechanism of proofreading, 5' → 3' exo/nick translation, strand displacement, and differences between DNA pol I and DNA pol III.

2.5. e. Discuss the roles of origins of replication and origin binding proteins, primase and primers, primer removal, and ligase.

2.5. f. Discuss the differences between prokaryotic and eukaryotic DNA replication.

2.5. g. Describe the function of telomerase.

2.6: ***Transcription***

2.6. a. Compare and contrast the similarities and differences between DNA replication and transcription.

2.6. b. Understand promoters and terminators, sigma factor and prokaryotic RNA polymerase, TATA boxes and -35/Pribnow boxes, formation of an open complex, elongation, and termination.

2.6. c. Compare and contrast the 3 RNA polymerases in eukaryotes and which classes of RNA molecules each transcribes.

2.6. d. Describe TFII transcription factors, what each one does, and the order in which they bind to a promoter/assembly of a basal transcription initiation complex for RNA pol II.

2.6 .e. Describe the activation of RNA pol II and the switch from initiation to elongation; lack of specificity in termination in eukaryotes; and the role of transcription factors, silencers, and enhancers.

2.6. f. Describe the processing of tRNA, rRNA, and mRNA.

2.7: ***Translation***

2.7 .a. Understand the genetic code and how to read a codon table.

2.7. b. Describe the structure of tRNAs, including charging/aminoacyl-tRNA synthetase.

2.7. c. Describe the structure of a ribosome, including ribosome binding sites.

2.7. d. Discuss translation initiation, A and P sites and the peptidyltransferase reaction, release factor and termination, and polycistronic vs monocistronic mRNAs.

2.7. e. Describe translation: protein processing, EF-Tu and the "proof-reading" function in translation, energetics of translation, and polysomes.

2.8: ***Mutagenesis***

2.8. a. Describe types of mutations, including: single base substitutions, frameshifts caused by insertions and deletions, silent mutations, point mutations, nonsense mutations, spontaneous deamination of cytosine, spontaneous depurination, thymine dimers, and base tautomerization.

2.8. b. Discuss types of mutagens and how they cause mutations.

2.8. c. Explain mechanisms of reversion and repair.

2.9: ***Gene regulation in prokaryotes***

2.9. a. Compare and contrast positive and negative regulation and the role of an inducer.

2.9 .b. Understand regulation of the *lac* operon, the *lac* repressor, and the concept of allosteric regulation.

2.9. c. Understand the *trp* operon regulation at the levels of transcription initiation and attenuation.

2.10: ***Gene regulation in eukaryotes***

2.10. a. Describe histones and their interaction with DNA, understand basic structure of a nucleosome, compare and contrast heterochromatin and euchromatin, and discuss the general role of histone modification in regulation of gene expression.

2.10. b. Discuss higher-order packing of eukaryotic DNA, including the structure and function of centromeres and telomeres.

2.10. c. Describe transcriptional regulation in the context of heterochromatin, euchromatin, histone modifications, and chromatin structure.

2.10. d. Understand HDACs, cancer, hypermethylation of promoters, and transcribability.

2.10. e. Describe types of eukaryotic transcription factors (Zn fingers, homeobox genes, basic-helix-loop-helix proteins) and the importance of relative concentration and relative affinity of multiple factors.

2.10. f. Explain mechanisms of post-transcriptional regulation including alternative splicing and the effects of different splice variants.

2.11: ***Biotechnology***

2.11. a. Demonstrate an understanding of current applications in biotechnology, such as recombinant and transgenic methods in plants, animals, and microorganisms.

2.11. b. Describe the role of selectable markers, DNA ligase, and transformation in recombinant DNA experiments.

2.11. c. Describe recombinant DNA techniques and their uses, including Southern blot, Northern blot, Western blot, in situ hybridization, Sanger sequencing, PCR, and site directed mutagenesis.

2.12: ***Molecular techniques***

2.12. a. Describe basic molecular biological techniques, including chromatography and electrophoresis, and explain how size, shape, and charge play a role.

2.12. b. Explain acrylamide electrophoresis of proteins, including denaturing vs non-denaturing gels.

2.12. c. Describe isoelectric focusing and 2-D gels.

2.12 d. Explain PCR, DNA sequencing, dideoxy sequencing, and acrylamide gels.

2.12. e. Understand how to read a sequencing gel, including fluorescent tagged ddNTPs/automated sequencing and capillary gel electrophoresis, PCR, the importance of Taq polymerase and the thermal cycler, and sources of thermostable polymerases.

2.13: ***Laboratory skills***

2.13. a. Apply investigative laboratory skills relevant to molecular biology, including the microscopic study of chromosomes, electrophoresis, DNA isolation, the handling and genetic analysis of microbes, and basic recombinant DNA techniques such as restriction digests and bacterial transformation in data analysis and in the simulation of biological systems.

2.13. b. Describe molecular exclusion chromatography, ion exchange chromatography, TLC, HPLC, and affinity chromatography.

2.13. c. Apply principles of electrophoresis, including agarose gel electrophoresis of DNA.

2.13. d. Prepare and analyze Southern and Northern blots.

2.13. e. Prepare and analyze PCR, DNA sequencing, dideoxy sequencing, and acrylamide gels.

2.13. f. Design, conduct, statistically evaluate, and interpret the results of a genetic experiment, expanding on one, or more, of the laboratory techniques listed in the previous competency.

2.13. g. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.

2.13. h. Present scientific information orally, with graphical presentation of data using appropriate presentation technolog

3. Genetics Competencies

3.1: *Inheritance*

- 3.1. a. Demonstrate understanding of Mendelian and non-Mendelian inheritance principles.
- 3.1. b. Use current terminology to explain the modern understanding of eukaryotic chromosome structure.
- 3.1. c. Apply an understanding of genetic principles to the analysis of genetic problems and systems.
- 3.1. d. Apply basic probability theory and statistical hypothesis testing techniques to the analysis of genetic problems, including linkage analysis.
- 3.1. e. Explain and discuss the importance of genetics to Biology as a whole and to certain human concerns such as medical and technological innovations, including recombinant DNA technology, genetic engineering, and genetic testing.
- 3.1. f. Discuss how genes and the environment interact to produce a specific phenotype.
- 3.1. g. Explain the cellular activities of mitosis and meiosis as they relate to genetics.
- 3.1. h. Analyze pedigrees to determine patterns of inheritance in families.
- 3.1. i. Describe common genetic disorders.

3.2: *Population genetics and evolution*

- 3.2 .a. Explain evolution in terms of molecular genetics and population genetics.
- 3.2. b. Demonstrate understanding of population statistics, including Hardy-Weinberg equilibrium.
- 3.2. c. Explain perturbations to and deviations from Hardy-Weinberg equilibria and what they mean for the evolution of species.

3.3: *Linkage and mapping*

- 3.3. a. Describe genetic linkage, genetic linkage mapping, syntenic genes, complete genetic linkage, and incomplete genetic linkage.
- 3.3. b. Calculate recombination frequency and discuss how recombination frequency correlates with gene distance.
- 3.3. c. Describe biological factors that affect accuracy of genetic maps and recombination.

3.4: ***DNA replication and repair***

3.4. a. Review DNA structure and function.

3.4. b. Review the evidence of DNA as the genetic material.

3.4. c Describe why replication is semiconservative, bidirectional, and discontinuous.

3.4. d. Describe the process of DNA replication in prokaryotes and eukaryotes.

3.4. e. Explain the role of telomeres in the completion of lagging strand replication.

3.4. f. Describe how mutations arise and how they generate different phenotypes.

3.4. g. Describe the features of base excision repair, nucleotide excision repair, mismatch repair, and double strand break repair (single strand annealing, homologous recombination, non-homologous end joining).

3.5: ***Gene regulation***

3.5. a. Describe negative versus positive control and the role of activator and repressor proteins.

3.5. b. Describe the regulation of prokaryotic genes such as the *lac*, *trp*, and *araC* operons.

3.5. c. Discuss eukaryotic gene regulation mechanisms.

3.6: ***Protein synthesis***

3.6. a. Describe differences between viral, prokaryotic, and eukaryotic chromosomes.

3.6. b. Describe RNA nucleotide structure, RNA assembly, and RNA structure.

3.6. c. Compare and contrast prokaryotic and eukaryotic gene structure and transcription processes.

3.6. d. Compare and contrast structure and composition of prokaryotic and eukaryotic ribosomes.

3.6. e. Compare and contrast prokaryotic and eukaryotic translation, including the molecular factors involved.

3.7 ***Genetic basis of disease***

3.7. a. Examine examples of monogenic disease and compare autosomal dominant versus autosomal recessive genes as well as sex-linked recessive genes.

3.7. b. Understand the mechanism of chromosomal nondisjunction and its contribution to disease such as Down syndrome and sex chromosome disorders.

3.7. c. Understand the role of variation in chromosome number, such as polyploidy and aneuploidy, in the development of human disease.

3.7. d. Understand the mechanism of chromosomal translocations and their contribution to disease.

3.7. e. Solve pedigree analysis to determine dominant and recessive traits and examine their use in predicting human disease.

3.7. f. Examine the role of mitochondrial genes and their role in human disease.

3.7. g. Understand the function of proto-oncogenes and tumor suppressors in the development of human cancer.

3.7. h. Examine the role viruses have in contributing to genetic disease such as cancer.

3.7. i. Recognize other mechanisms that contribute to or prevent human disease such as DNA repair, telomeres and telomerase, control of apoptosis, and transposable elements.

3.7. j. Understand the effect of various mutagens on DNA structure and role they play in mutagenesis.

3.8: ***Biotechnology***

3.8. a. Demonstrate an understanding of current applications in biotechnology, such as recombinant and transgenic methods in plants, animals, and microorganisms.

3.8. b. Describe the role of selectable markers, DNA ligase, and transformation in recombinant DNA experiments.

3.8. c. Describe recombinant DNA techniques and their uses, including Southern blot, Northern blot, Western blot, in situ hybridization, Sanger sequencing, PCR, and site directed mutagenesis.

3.8. d. Demonstrate an understanding of genomics, including genome mapping strategies such as cytogenic, linkage, and physical mapping. Describe possible applications for data gained through genomics.

3.9: ***Laboratory skills***

3.9. a. Apply investigative laboratory skills relevant to basic genetics, including the production and analysis of genetic crosses, the microscopic study of chromosomes, electrophoresis, DNA isolation, the handling and genetic analysis of microbes, basic recombinant DNA techniques such as restriction digests and bacterial transformation, and the use of computers to access information from online databases in data analysis and in the simulation of biological systems.

3.9 .b. Design, conduct, statistically evaluate, and interpret the results of a genetic experiment, expanding on one, or more, of the laboratory techniques listed in the previous competency.

3.9. c. Apply the use of bioinformatics for DNA/protein sequence analysis, genomics, and proteomics.

3.9. d. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.

3.9. e. Present scientific information orally, with graphical presentation of data using appropriate presentation technology.

Section 4. Ecology Competencies

4.1: ***Importance***

4.1. a. Explain the historical importance of ecology to human society.

4.1. b. Describe examples of early ecological studies.

4.2: ***Biosphere***

4.2. a. Describe the effects of the Earth's axial tilt, solar radiation, moisture, and ocean circulation on climate.

4.2. b. Discuss examples of atmospheric circulations and geographic landforms on regional climate.

4.2. c. Examine the relationship between temperature and precipitation with vegetation distribution.

4.2. d. Describe the processes of soil formation, physical and chemical weathering, and biological decomposition.

4.2. e. Describe and compare the geographic locations, geological features, and dominant organisms that are common to the major terrestrial biomes on the Earth.

4.2. f. Describe and compare the physical, chemical, and biological characteristics of freshwater and marine biomes.

4.2. g. Diagram lentic temperature stratification in the summer and winter.

4.2. h. Discuss the influence of climate change on coral bleaching and eutrophication.

4.3: ***Physiological ecology***

4.3. a. Describe the physical, biological, and behavioral factors that influence an organism's ability to grow and reproduce in its habitat and range distribution.

4.3. b. Discuss the importance of tradeoffs as organisms adapt to their environments.

4.3. c. Describe the challenges organisms have adapting to terrestrial, freshwater, and marine environments.

4.4: ***Evolution and population genetics***

- 4.4. a. Review Darwin's theory of natural selection.
- 4.4. b. Describe several examples and mechanisms of natural selection.
- 4.4. c. Describe the mechanisms of speciation and extinction; identify the causes of speciation.
- 4.4. d. Explain coevolution, how it occurs, and what its effects are.
- 4.4. e. Describe examples of bottleneck effect, founder effect, Allee effect, and inbreeding depression.
- 4.4. f. Describe the mechanisms of adaptive radiation.
- 4.4. g. Identify and describe some examples of animal behavior or sexual dimorphism that increase reproductive success.
- 4.4. h. Explain and describe the importance of the environment to evolution, natural selection, and the maintenance of biodiversity.

4.5: ***Populations***

- 4.5. a. Describe and compare logistic and exponential growth models.
- 4.5. b. Explain the role of carrying capacity.
- 4.5. c. Discuss the future impact of human population growth.
- 4.5. d. Discuss how survivorship and fecundity are used to predict the future growth and distribution of a population.
- 4.5. e. Discuss the influence of life history strategies on the growth and distribution of a population.
- 4.5. f. Explain the effects of density independent and density dependent factors on population growth.
- 4.5. g. Explain what intraspecific competition is; provide examples of intraspecific competition.

4.6: ***Communities***

- 4.6. a. Discuss factors that influence the form, structure, or appearance of a plant community.
- 4.6. b. Discuss the concept of species diversity and the indices used to calculate species diversity.
- 4.6. c. Compare and contrast intraspecific and interspecific competition.
- 4.6. d. Explain the principles of competitive exclusion, resource partitioning, and character displacement and their relationship to competition.
- 4.6. e. Examine predation, herbivory, and symbiosis.
- 4.6. f. Describe models of succession for aquatic and terrestrial communities.
- 4.6. g. Recognize similarities among ecological communities inhabiting similar types of environments, and the diverse evolutionary adaptations that influence a species' range, dispersal, and ability to survive in its environment.

4.7: ***Ecosystems***

- 4.7. a. Describe the major biotic and abiotic ecological characteristics that identify a given ecosystem.
- 4.7. b. Describe the biogeochemistry of an ecosystem and explain the cycles of nitrogen, carbon, phosphorous, and water.
- 4.7. c. Explain energy flow in ecosystems, photosynthesis, trophic levels, and biomass pyramids from an ecological perspective.
- 4.7. d. Discuss diverse adaptations for nutrient acquisition in ecosystems, the conversion of these nutrients into biologically useful forms, cycling of nutrients, and the indispensable roles of producers and decomposers.
- 4.7. e. Evaluate the impact of human behavior on earth's ecosystems, particularly as it relates to biological diversity, global climate change, and the ability of ecosystems to sustain life.
- 4.7. f. Recognize the continually changing nature of ecosystems, and discuss factors that impact ecosystems and the evolution of resident species through natural selection.

4.8: ***Environmental biology***

- 4.8. a. Describe and explain the causes and consequences of pollution on the biosphere and the survival of all organisms.
- 4.8. b. Analyze a variety of timely environmental issues in light of their ecological, social, economic, ethical, or cultural implications.
- 4. 8.c. Discuss the impacts of conductivity and fragmentation on ecosystem function and biogeography.

4.9: ***Lab/field experiences***

4.9. a. Collect data and formulate valid scientific conclusions of an ecological nature.

4.9. b. Work as part of a team in field and laboratory investigations of ecological phenomena.

4.9. c. Collect ecological data and apply basic statistical skills for analyzing and presenting quantitative and qualitative data to formulate conclusions.

4.9. d. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific language.

4.9. e. Present scientific information orally, with graphical presentation of data using appropriate presentation technology.

Section 5. General Chemistry Competencies

5.1: ***Chemical toolbox***

5.1. a. Use theory to predict, graph, and interpret experiment observations.

5.1. b. Use math and critical reasoning to organize and manipulate data for meaningful interpretations of data and results, use statistics to judge limitations of error, and discern causes of error. Distinguish between precision and accuracy.

5.1. c. Apply relevant fundamental mathematical relationships in order to carry out accurate calculations related to the specific topics covered.

5.1. d. Apply rules of significant figures and rounding, converting among units, and using dimensional analysis to solve numerical problems.

5.1. e. Use problem-solving skills to reduce complex problems into simpler components, identifying principle objectives.5.1.f. Integrate knowledge of two or more traditional subfields of chemistry to solve complex chemical problems.

5.1. f. Demonstrate computer literacy to use multiple programming, computational, online, and database tools. Utilize computational tools to organize, process, store, and retrieve data.

5.1. g. Understand the major systems of nomenclature used in chemistry for inorganic compounds.

5.2: ***Matter***

5.2. a. Recognize the atomic symbols of the elements and use the periodic table to extract valuable information about atoms and ions, especially concerning bonding.

5.2. b. Classify matter: pure substances (elements and compounds) or mixtures (homogeneous or heterogeneous).

5.2. c. Understand the differences between physical and chemical changes, physical properties properties, and chemical properties.

5.2. d. Describe matter in terms of its physical properties (both intensive and extensive) and chemical properties.

5.2. e. Compare and contrast the three forms of matter: solid, liquids and gas. Compare a gas, a liquid, and a solid using a kinetic-molecular theory description.

5.2. f. Use mathematical relationships (including Boyle's Law, Charles's Law, Avogadro's Law, ideal gas law, and van der Waals equation) to describe gases.

5.2. g. Describe gases with respect to density, vapor pressure, partial pressures, diffusion, effusion, and molecular speed distributions.

5.2. h. Define changes of state physically and pictorially (heating curves and phase diagrams). Apply the Clausius-Clapeyron equation.

5.2. i. Describe liquids with respect to surface tension, viscosity, capillary action, and vapor pressure.

5.2. j. Identify types of solids: molecular solids, metallic solids, ionic solids, and covalent network solids. Identify coordination number, common unit cells (simple cubic, body-centered cubic, and face-centered cubic unit cell), and properties that relate to its structure.

5.3: ***Atomic structure***

5.3. a. Demonstrate a comprehensive knowledge of the structure of the nucleus (including nucleons), atoms, isotopes, ions, and molecules.

5.3. b. Apply a fundamental knowledge of atomic orbitals (s, p, d, and f) to electronic configurations and the explanation of electronic spectroscopy.

5.3. c. Apply the Pauli Exclusion Principle, Hund's rule, and Aufbau principle to write the electron configurations for the elements, identifying diamagnetic and paramagnetic species. Explain how electron configurations relate to electronegativities and bonding properties of these elements. Distinguish between core and valence electrons.

5.3. d. Employ periodic trends (including successive ionization energies, electron affinities, atomic radii, ionic radii, shielding, and effective nuclear charge) to atoms and ions.

5.3. e. Understand the basic mathematical relationships underpinning quantum mechanics, such as the wave function, de Broglie wavelength, the Heisenberg uncertainty principle, and other physical properties of a particle.

5.3. f. Understand the interaction of light with matter. Relate energy of a photon to wavelength, frequency, and to emission and absorption spectroscopy. Understand the relative regions of the electromagnetic radiation.

5.3. g. Describe the shapes of s, p, and d orbitals and apply the rules of quantum numbers to electrons residing in these orbitals.

5.4: ***Chemical bonding***

5.4. a. Predict, compare, and contrast the different types of intramolecular (covalent, ionic, and metallic) and intermolecular bonding (London forces (induced dipole), dipole-dipole, hydrogen-bonding, and ion-dipole) demonstrated in substances. Predict the consequences of these types of bonds on physical properties.

5.4. b. Apply valence bond theory (hybridization, $\sigma + \pi$ bonds) and molecular orbital bonding models to describe bonding at the molecular level.

5.4. c. Develop a fundamental understanding of the behavior and properties of phases of matter (gases, liquids, and solids).

5.4. d. Define and identify ionic and covalent bonding, energetics of bonding, and lattice energy through the Born-Haber cycle.

5.4. e. Describe bonds using single, double, and triple bond notation, coordinate covalent bond, valence bond descriptions (hybrid orbitals), and sigma and pi bond descriptions.

5.4. f. Relate bonding properties (such as delocalized electrons, formal charge, bond length, bond order, and bond enthalpy) and its consequences to molecular structure and reactivity.

5.4. g. Define bonding in metals and metal compounds, metallic bonding, band theory, magnetic properties, conductivity, semiconductors, insulators, and defects.

5.4. h. Describe diatomic molecules using molecular orbital theory, identifying bonding, antibonding orbitals, and bond order.

5.5: ***Molecular structure and function***

5.5. a. Distinguish between structure/reactivity and structure/property relationships.

5.5. b. Relate bond polarity and molecular dipole moment to identify polar and non-polar molecules.

5.5. c. Predict general trends in the boiling points and solubilities of compounds, based on their size, polarity, and ability to form hydrogen bonds.

5.5. d. Distinguish between angle strain, torsional strain, steric strain, and understand their significance to reactivity.

5.5. e. Identify resonance-stabilized structures and compare the relative importance of their resonance forms. Calculate formal charges for different bonding modes.

5.5. f. Relate the dependence of structure and reactivity on context, particularly solvent effects and other non-covalent interactions.

5.5. g. Relate the interplay between electronic, steric, and orbital interactions in the behavior and properties of molecules.

5.6: ***Reactions***

5.6. a. Write accurate, balanced equations for chemical (including redox) and nuclear reactions, including deducing stable products in a nuclear reaction based on the stability of radionuclides. Predict the type of radioactive emission for a nuclear reaction. Distinguish the different classes of nuclear reactions (fission, fusion, artificial vs. natural radioactivity).

5.6. b. Employ the detailed quantitative relationships (moles, molar mass, and molarity) governing chemical reactions, including the ability to perform a variety of stoichiometry calculations (such as limiting reagent, dilutions, theoretical yield, percent yield).

5.6. c. Demonstrate a basic understanding of reaction chemistry, including oxidation-reduction (both inorganic and organic, half reactions, and net ionic equations), acid-base, neutralization, precipitation, substitution (both inorganic and organic), elimination, rearrangements, and addition.

5.6. d. Identify nucleophiles (Lewis bases) and electrophiles (Lewis acids), and write equations for Lewis acid-base reactions using curved arrows to show the flow of electrons.

5.7: ***Energy and thermodynamics***

5.7. a. Define a system (versus surroundings) in terms of kinetic and potential energy, internal energy, work, and heat.

5.7. b. Define chemical and physical processes as exothermic or endothermic processes, calculating ΔH^o and ΔS^o for a reaction based on stoichiometry. Calculate ΔG^o from both ΔH^o and ΔS^o, and from ΔG values of formation.

5.7.c. Manipulate common thermochemical calculations and relationships (including calorimetry, heats of reaction, Hess's Law and standard enthalpies or entropies of formation, calculating for reactions, and phase changes).

5.7.d. Manipulate common calculations and relationships to solutions (such as Henry's Law, calculating solution concentration and converting between the various forms of concentration expression, applying Raoult's Law, and calculating colligative properties).

5.7. e. Calculate and relate E_{cell}, equilibrium constant, and ΔG at various conditions.

5.7. f. Calculate the binding energy in a nuclear reaction.

5.8: ***Kinetics***

5.8. a. Calculate reaction rates, determining reaction orders and rate constants.

5.8. b. Calculate concentrations given the rate law, time, and initial reactant concentrations, relating a reaction half-life to a rate constant.

5.8. c. Use the Arrhenius equation to determine a reaction's activation energy or rate constant at a different temperature.

5.8. d. Determine the molecularity and rate law for an elementary reaction.

5.8. e. Write the overall chemical reaction and rate law for a given mechanism.

5.8. f. Understand the effect of a catalyst. Employing methods of activation, including Brønsted or Lewis acid/base, free radical chemistry, and organometallic catalysis.

5.9: ***Equilibrium***

5.9. a. Calculate and interpret values of equilibrium constants, writing equilibrium constant expressions and using them to calculate equilibrium constant values.

5.9. b. Calculate free-energy changes from equilibrium constants, and calculate the position of reaction equilibrium from the free-energy changes.

5.9. c. Predict reaction direction based on comparing Q and K.

5.9. d. Describe and employ the reversibility of reactions. Apply Le Châtélier's principle for changes in equilibrium concentrations, temperature, and pressure.

5.10: ***Experimentation***

5.10. a. Demonstrate a basic ability to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions.

5.10. b. Apply major concepts, theoretical principles, and experimental findings in general chemistry lectures to the solution of laboratory problems.

5.10. c. Demonstrate creative and independent thinking in a laboratory setting.

5.10. d. Demonstrate knowledge of chemical, instrumental and workplace safety. Know and follow the proper safety procedures and regulations for safe handling and use of chemicals.

5.10. e. Employ appropriate, safe, and ethical research methodologies to collect, analyze, and interpret data critically (error analysis) toward the solution of a problem.

5.10. f. Critically evaluate methodologies, data, and conclusions of one's own and others' technical work.

5.10. g. Use technology for computations, data acquisition, and database searching.

5.10. h. Demonstrate ability to maintain an organized and well-documented laboratory notebook.

5.10. i. Interact effectively in a group to solve scientific problems and work productively with a diverse group of peers.

5.10. j. Present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in communications.

5.10. k. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific formalisms.

5.10. l. Demonstrate the responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results.

5.10. m. Find and evaluate the validity and usefulness of chemistry information in the scientific literature.

5.10. n. Demonstrate proper conceptual and mathematical knowledge upon which chemical instrumentation is based.

5.10. o. Collect empirical data through the safe and effective physical manipulation of materials, equipment, and instrumentation in a face-to-face instructional setting.

5.11: ***Visualization***

5.11. a. Understand the relationship between symbolic and particulate representations.

5.11. b. Predict molecular geometry, shape, and ideal bond angles at the molecular level using VSEPR theory.

5.11. c. Employ the concept of the mole to relate the macroscopic and microscopic views of chemical reactions.

5.11. d. Use mathematical equations to provide a tool to visualize chemical and physical processes.

5.11. e. Draw and interpret Lewis, condensed, and line-angle structural formulas. Convert these drawings to accurate Newman projections, Fisher projections, Haworth projections, or chair conformations as appropriate, envisioning these representations as space filling diagrams.

5.11. f. Visualize the movements of the microscopic world using a qualitative description of the gas laws based on the kinetic molecular theory.

5.11. g. Develop a basic understanding of the microscopic point of view, especially for thermodynamic quantities such as entropy. Section 6. Organic Chemistry Competencies

6.1: ***Chemical toolbox***

6.1. a. Use theory to predict, graph, and interpret experiment observations.

6.1. b. Use math and critical reasoning to organize and manipulate data for meaningful interpretations of data and results, use statistics to judge limitations of error, and discern causes of error. Distinguish between precision and accuracy.

6.1. c. Apply relevant fundamental mathematical relationships in order to carry out accurate calculations related to the specific topics covered.

6.1. d. Apply rules of significant figures and rounding, converting among units, and using dimensional analysis to solve numerical problems.

6.1. e. Use problem-solving skills to reduce complex problems into simpler components, identifying principle objectives.

6.1. f. Integrate knowledge of two or more traditional subfields of chemistry to solve complex chemical problems.

6.1. g. Demonstrate computer literacy to use multiple programming, computational, online, and database tools. Utilize computational tools to organize, process, store, and retrieve data.

6.1. h. Understand the major systems of nomenclature used in chemistry for organic compounds, including stereochemistry (R/S and E/Z).

6.2: ***Matter***

6.2. a. Recognize the atomic symbols of the elements and use the periodic table to extract valuable information about atoms and ions especially concerning bonding.

6.2. b. Classify matter: pure substances (elements and compounds) or mixtures (homogeneous or heterogeneous).

6.2. c. Understand the differences between physical and chemical changes, physical properties, and chemical properties.

6.3: ***Chemical bonding***

6.3. a. Predict, compare, and contrast the different types of intramolecular (covalent, ionic, and metallic) and intermolecular bonding (London forces (induced dipole), dipole-dipole, hydrogen-bonding, and ion-dipole) demonstrated in substances. Predict the consequences of these types of bonds on physical properties.

6.3. b. Apply valence bond theory (hybridization, $\sigma + \pi$ bonds) and molecular orbital bonding models to describe bonding at the molecular level.

6.3. c. Describe bonds using single, double, and triple bond notation, coordinate covalent bond, valence bond descriptions (hybrid orbitals), and sigma and pi bond descriptions.

6.3. d. Relate bonding properties (such as delocalized electrons, formal charge, bond length, bond order, and bond enthalpy) and its consequences to molecular structure and reactivity.

6.3. e. Describe diatomic molecules using molecular orbital theory, identifying bonding, antibonding orbitals, and bond order.

6.4: ***Molecular structure and function***

6.4. a. Distinguish between structure/reactivity and structure/property relationships.

6.4. b. Identify constitutional isomers, stereoisomers, and diastereomers, including cis-trans (geometric) isomers.

6.4. c. Distinguish between angle strain, torsional strain, steric strain, and understand their significance to reactivity.

6.4. d. Identify resonance-stabilized structures and compare the relative importance of their resonance forms. Calculate formal charges for different bonding modes.

6.4. e. Demonstrate a detailed knowledge of structure-function relationships for organic molecules by functional groups, including alkanes, alkyl halides, alkenes, alkynes, arenes, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, and carboxylic acid derivatives.

6.4. f. Relate the interplay between electronic, steric, and orbital interactions in the behavior and properties of molecules.

6.4. g. Draw and describe reactive intermediate structures of carbocations, carbanions, free radicals, and carbenes and the structural features that stabilize them. Explain which are electrophilic and which are nucleophilic.

6.5: ***Reactions***

6.5. a. Demonstrate a basic understanding of reaction chemistry, including oxidation-reduction (both inorganic and organic, half reactions and net ionic equations), acid-base, neutralization, precipitation, substitution (both inorganic and organic), elimination, rearrangements, and addition.

6.5. b. Identify nucleophiles (Lewis bases) and electrophiles (Lewis acids), and write equations for Lewis acid-base reactions using curved arrows to show the flow of electrons.

6.5. c. Demonstrate a comprehensive understanding of reactions and propose logical mechanisms for the major functional groups of organic molecules, including alkanes, alkyl halides, alkenes, alkynes, arenes, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, and carboxylic acid derivatives.

6.5. d. Understand and employ the methodologies of organic synthesis, including retrosynthetic analysis of target molecule.

6.6: ***Experimentation***

6.6. a. Demonstrate a basic ability to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions.

6.6. b. Apply major concepts, theoretical principles and experimental findings in organic chemistry lectures to the solution of laboratory problems.

6.6. c. Demonstrate creative and independent thinking in a laboratory setting.

6.6. d. Demonstrate knowledge of chemical, instrumental, and workplace safety. Know and follow the proper safety procedures and regulations for safe handling and use of chemicals.

6.6. e. Employ appropriate, safe, and ethical research methodologies to collect, analyze, and interpret data critically (error analysis) toward the solution of a problem.

6.6. f. Critically evaluate methodologies, data, and conclusions of one's own and others' technical work.

6.6. g. Use technology for computations, data acquisition, and database searching.

6.6. h. Use appropriate instrumentation for chemical analysis and characterization. Students must have hands-on experience with a variety of instruments, including spectrometers (such as UV/Vis, FTIR, and NMR), and with chemical separation techniques (such as TLC, CC, and GC).

6.6. i. Demonstrate ability to maintain an organized and well-documented laboratory notebook.

6.6. j. Interact effectively in a group to solve scientific problems and work productively with a diverse group of peers.

6.6. k. Present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in communications.

6.6. l. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific formalisms.

6.6. m. Demonstrate the responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results.

6.6. n. Find and evaluate the validity and usefulness of chemistry information in the scientific literature.

6.6. o. Demonstrate proper conceptual and mathematical knowledge upon which chemical instrumentation is based.

6.6. p. Collect empirical data through the safe and effective physical manipulation of materials, equipment, and instrumentation in a face-to-face instructional setting.

6.7: ***Visualization***

6.7. a. Draw and interpret Lewis, condensed, and line-angle structural formulas. Convert these drawings to accurate Newman projections, Fisher projections, Haworth projections, or chair conformations as appropriate, envisioning these representations as space filling diagrams.

6.7. b. Draw and identify the types of stereoisomers for a molecule, identifying the relationship between stereoisomers, and identifying each carbon with the R/S nomenclature.

6.7. c. Draw a reaction-energy diagram for a mechanism, and point out the corresponding transition states, activation energies, intermediates, and rate-limiting steps.

6.7. d. Cultivate the understanding that the way to molecular knowledge is through experimentation: correlating structure with reactivity and function through wet chemical methods, spectroscopy (notably NMR, FTIR, and MS), and use of computational simulations.

6.7. e. Employ spectrometric techniques for the determination of organic structure at the molecular level. Identify the reliable characteristic peaks in provided spectroscopic data, and propose which functional groups are likely to be present in the molecule based on this knowledge.

Section 7. General Physics Competencies

7.1: ***Mechanical sciences***

7.1. a. Understand and convert physical quantities and measurements in the SI and UCSC systems.

7.1. b. Define and compute vector and scalar quantities, such as speed and velocity, and analyze physical systems using the concepts of translational and rotational equilibrium, and kinetic and static friction.

7.1 c. Solve problems using the concepts of moment arm, torque, and center of gravity.

7.1.d. Solve problems that require an ability to apply Newton's Three Laws of Motion and describe the interaction of force, mass, weight, and acceleration due to gravity.

7.1. e. Demonstrate the ability to apply conservation principles (work, energy, linear-momentum, and angular momentum).

7.1. f. Compute the rotational motion, centripetal force and acceleration, moment of inertia, and rotational energy for rotating physical systems.

7.1. g. Measure and/or compute temperature and thermal expansion.

7.1. h. Compute the quantity of heat transferred using the concepts of specific heat capacity and latent heats of fusion and vaporization.

7.1. i. Compute the quantity of heat transferred using the concepts and mathematics of thermal conductivity, convection, and radiation.

7.1. j. Use the gas laws to compute values for volume, temperature, pressure, and amount of a gas.

7.1. k. Use laboratory equipment to demonstrate scientific principles.

7.1. l. Recognize uncertainties in data.

7.1. m. Tabulate and graph data and compute results.

7.1. n. Draw reasonable conclusions from quantitative data and communicate results to others.

7.2: ***Electromagnetic competencies***

7.2. a. Compute key properties of waves, such as amplitude, frequency, period, and wavelength, as related to sound and light.

7.2. b. Electricity: Solve problems involving Electric Fields and Electric Forces.

7.2. c. Solve problems dealing with resistors, capacitors, and inductors in direct and alternating current circuits. This includes series circuits, parallel circuits, and transformers.

7.2. d. Circuit Analysis: Define, explain, or calculate charge, current, voltage, power, energy, and the fundamental principles of Ohm's Law and Kirchoff's Law.

7.2. e. Magnetism: Solve problems dealing with the forces exerted on charges moving in magnetic fields.

7.2. f. Solve problems dealing with induction.

7.2. g. Solve problems dealing with alternating current circuits containing resistors, inductors, and capacitors.

7.2. h. Optics: Solve geometrical optics problems dealing with refraction, reflection, lenses, and mirrors.

7.2. i. Define (1) the major subatomic particles of an atom; (2) radioactivity, the associated nuclear reactions, and the concept of half-life; and (3) fission and fusion reactions.

7.2. j. Use laboratory equipment to demonstrate scientific principles.

7.2. k. Recognize uncertainties in data.

7.2. l. Tabulate and graph data and compute results.

7.2. m. Draw reasonable conclusions from quantitative data and communicate results to others.

Section 8. General Calculus I Competencies

8.1: ***General calculus I***

8.1. a. Examine limits and their properties. Specifically, define the limit and use this definition to evaluate a limit. Identify limits of functions graphically, numerically, and analytically. Use theorems on limits and find limits at infinity. Determine the continuity of a function and a combination of functions, including at a particular point or a removable discontinuity.

8.1. b. Use differentiation to evaluate a derivative. Study includes the definition of a derivative, average and instantaneous rates of change, and average and instantaneous velocity. Find derivatives to various functions by product, quotient, power, chain, and implicit rules. Find tangent and normal lines to curves.

8.1. c. Study applications of differentiation. Related rates and optimization problems will be worked as well as differentials and linear approximations. Intervals of increasing and decreasing, concavity, extrema, inflection points, and horizontal tangents will all be used.

INDIANA COMMISSION *for*
HIGHER EDUCATION

Chemistry TSAP

INDIANA COMMISSION for HIGHER EDUCATION

Chemistry TSAP Faculty Roster

★Denotes co-chairs for this panel.

BALL STATE UNIVERSITY

Sammelson, Robert
Email: resammelson@bsu.edu

INDIANA STATE UNIVERSITY

Glendening, Eric
Email: eric.glendening@indstate.edu

INDIANA UNIVERSITY

IUB
★ Reck, Cate
Email: creck@indiana.edu

IUE
None

IUK
Kasem, Kasem
Email: kkasem@iuk.edu

IUN
DeLeon, Nelson
Email: ndeleon@iun.edu

IUPUI
Nguyen, Marie
Email: mlnguyen@iupui.edu

IUS
Setterdahl, Aaron
Email: asetterd@ius.edu

IUSB
Feighery, Bill
Email: wfeigher@iusb.edu

IVY TECH COMMUNITY COLLEGE

★Goodpaster, Aaron
Email: agoodpaster7@ivytech.edu

Balachander, Malathi
Email: mbalachander@ivytech.edu

PURDUE UNIVERSITY

IPFW
Friedman, Ron
Email: friedmar@ipfw.edu

Steven Stevenson
Email: stevenss@ipfw.edu

PNC
Unger, Laura
Email: lunger@pnw.edu

PUC
Rowberg, Kay
Email: Rowberkl@pnw.edu

PWL
Towns, Marcy
Email: mtowns@purdue.edu

INDIANA COMMISSION for HIGHER EDUCATION

Chemistry TSAP Faculty Roster

UNIVERSITY OF SOUTHERN INDIANA

Seyler, Jeff
Email: jseyler@usi.edu

VINCENNES UNIVERSITY

Peralta, Ivana
Email: IPeralta@vinu.edu

INDIANA COMMISSION for HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAP)

Pathway: Chemistry

Approved: 12.9.2017

Preamble:

The courses mapped for this Transfer Single Articulation Pathway (TSAP) associate's degree are based upon a set of competencies agreed upon across all of the public institutions and are the minimum competencies for transfer in this major.

After a statewide review process, some four-year universities may have specific competencies required that are not included in this mapping and **may limit the admission options for TSAP students**. To increase the likelihood of student success, TSAP advisors in the two-year programs are encouraged to contact the academic advising offices in the major area of the TSAPs at the four-year institutions to discuss the minimum criteria for admission.

It is important that individual students review the published TSAP admission criteria at the specific university/campus to which they wish to transfer. This should be done at the beginning of their enrollment as a TSAP student at either Ivy Tech or Vincennes University. Understanding admission and degree requirements will facilitate student success. The universities in the state of Indiana are committed to the success of TSAP students, and student success is a three-way partnership among students and the academic advisors at both institutions.

A lack of communication after students enroll in a TSAP could result in a misunderstanding of the admission requirements to a specific four-year institution and/or TSAP program, such as minimum grades, specific course sequences, etc., and such misunderstanding could affect the time to graduation.

To be eligible, a student must:

- Have met the TSAP and STGEC eligibility guidelines as defined by Indiana Code (see the attached document published by the Indiana Commission for Higher Education),
- Have graduated with the TSAP associate degree,
- Have met all the admission requirements (e.g., minimum GPA, minimum course grades, etc.) of the TSAP program at the 4-year institution, and
- Have been admitted to the campus AND into the degree program as a TSAP student.

Transfer Single Articulation Pathways (TSAP)

Competencies and Learning Outcomes:

1. Transferrable Skills

1.1. ***Written Communication Skills***

1.1.a. Demonstrate an ability to write effective written reports (both short and long) that are layered (title, executive summary, main report, appendices, references) so the reader can easily go as deep or as shallow as required for their need, recognizing that the report needs to be designed for multiple audiences (peers, supervisors, management, company president, etc.)

1.1.b. Produce texts that use appropriate formats, genres, conventions, and documentation styles while controlling tone, syntax, grammar, and spelling.

1.1.c. Demonstrate an understanding of writing as a social process that includes multiple drafts, collaboration, and reflection.

1.1.d. Read critically summarize, apply, analyze, and synthesize information and concepts in written and visual texts as the basis for developing original ideas and claims.

1.1.e. Demonstrate an understanding of writing assignments as a series of tasks including identifying, analyzing, using, and evaluating useful and reliable outside resources including electronic sources such as visual, electronic, library databases, internet sources, other official databases, federal government databases, reputable blogs, and wikis.

1.1.f. Develop, assert, and support a focused thesis with appropriate reason and adequate evidence.

1.2. ***Oral Communication Skills***

1.2.a. Use appropriate organization or logical sequencing to deliver an oral message.

1.2.b. Adapt an oral message for diverse audiences, contexts, and communication channels.

1.2.c. Identify and demonstrate appropriate oral and nonverbal communication practices.

1.2.d. Advance an oral argument using logical reasoning.

1.2.e. Provide credible and relevant evidence to support an oral argument.

1.2.f. Demonstrate the ethical responsibilities of sending and receiving oral messages.

1.2.g. Summarize or paraphrase an oral message to demonstrate comprehension.

1.3. ***Teamwork***

1.3.a. Demonstrate an ability to work effectively in a team setting, including with other from different perspectives, gender, and cultures.

1.3.b. Be able to identify and acknowledge other collaborators' contributions to the team effort.

2. Mathematics Competencies

2.1. ***Calculus***

2.1.a. Demonstrate fluency in language of functions. Specifically, they will demonstrate proficiency in:

2.1.a.i. Recognizing, calculating with, and modeling with polynomical, rational, algebraic, exponential, logarithmic, and trigonometric functions

2.1.a.ii. Recognizing, calculating with, and modeling with inverse functions

2.1.a.iii. Recognizing, calculating with, and interpreting limits of functions including limits at infinity

2.1.a.iv. Recognizing, establishing, and applying continuity of functions

2.1.b. Demonstrate proficiency in calculating, estimating, expressing, and interpreting average, relative, and instantaneous rates of change of one quantity with respect to another, using the language of differential calculus. This includes situations when the relationship between the quantities takes the form of a table, a graph, a textual description, and a symbolic formula.

2.1.c. Demonstrate proficiency in modeling optimization problems in a variety of contexts, both applied and abstract. This includes creating independent and dependent variables, translating constraint information into an interval of values for the independent variable, solving the resulting optimization problem using techniques from differential calculus, and drawing qualitative conclusions from the numerical solutions.

2.1.d. Demonstrate proficiency in calculating, estimating, expressing, and interpreting the accumulated change of one variable, given its rate of change with respect to another variable, using the language of integral calculus. This includes situations when the relationship takes the form of a table, a graph, a textual description, and a symbolic formula.

2.1.e. Demonstrate proficiency in the expression of mathematical reasoning by stating, applying in appropriate problems, and interpreting the major milestone theorems of one-variable calculus, specifically: the Intermediate Value Theorem, the Mean Value Theorem, and the Fundamental Theorem of Calculus.

2.1.f. Demonstrate understanding of the meaning of the integral and how it is related to derivatives and functions presented in various forms such as algebraic, graphical, and numerical descriptions. This includes the proficiency in relating, calculating and interpreting Riemann sums and similar quantities as approximations to integrals.

2.1.g. Demonstrate mastery in techniques of integration. Specifically:

- 2.1.g.i. Definite and indefinite integration of polynomial, rational, algebraic, exponential, logarithmic, and trigonometric functions as well as improper integrals.
- 2.1.g.ii. How to use different techniques such as integration by parts, function substitution and partial fractions including important special cases such as trigonometric substitutions.
- 2.1.g.iii. Recognizing when to use different techniques and how to combine different techniques with other skills such as the use of trigonometric identities and recursive iteration in order to evaluate integrals.

2.1.h. Demonstrate proficiency in modeling problems in a variety of contexts, both applied and abstract. This includes calculating arclength, surface area and volume of geometric objects by reducing the problem to one of integration, and solving problems stated in “real world” context including optimization.

2.1.i. Demonstrate proficiency in understanding and analyzing sequences and series. Including:

2.1.i.i. Understanding the meaning of sequences and infinite series, and the meaning of convergence and possible ways in which they can diverge.

2.1.i.ii. Understanding how certain tests for convergence are derived, and proficiency in using various test criteria to determine the convergence or divergence for sequences and series.

2.1.j. Demonstrate proficiency in calculating, estimating, expressing, and manipulating power series. This includes calculating and understanding the meaning of Taylor polynomials and Taylor-Maclaurin series for smooth functions at different points, finding and understanding the meaning of the radius of convergence of general power series, using power series to estimate the values of functions and their derivatives and integrals, understanding how to manipulate, add, multiply, and compose a power series and identify certain power series as closed form functions.

3. Physics Competencies

3.1. ***Mechanical Sciences***

3.1.a. Mechanics: Demonstrate the ability to apply a unified approach to the basic principles of linear momentum, energy, angular momentum, and thermodynamics to microscopic and/or macroscopic systems including hands-on laboratory applications and computer simulations

3.1.b. Statics: Demonstrate the ability to apply Newton's Laws of Motion to systems in static equilibrium including general systems, trusses, frames and machines, and systems with friction.

3.1.c. Demonstrate the ability to sketch shear-force and bending moment diagrams and perform "simple" stress calculations (pure axial, shear, torsional, and bending).

3.1.d. Dynamics: Demonstrate an ability to apply Newton's Laws of Motions to systems of particles, rigid body planar motion and systems experiencing 3-D motion with moving reference frames.

3.1.e. Demonstrate the ability to apply conservation principles (work, energy, linear-momentum, and angular impulse-momentum).

3.1.f. Demonstrate an introductory knowledge of 2nd order linear systems.

3.2. ***Electromagnetic Sciences***

3.2.a. Electricity: Solve problems involving Electric Fields and Electric Forces.

3.2.b. Apply Gauss's Law to derive the Electric Field resulting from spherical, cylindrical, planar, and linear charge distributions involving both dielectric materials and conducting materials.

3.2.c. Solve problems dealing with resistors in direct current circuits. This includes series circuits, parallel circuits, and circuits to which Kirchoff's Laws are applied. Calculations include current, equivalent resistance, voltage power, and energy.

3.2.d. Magnetism: Solve problems dealing with the forces exerted on charges moving in magnetic fields.

3.2.e. Solve problems and apply theories of sources of magnetic fields, including the Biot-Savart Law and Amperes Law.

3.2.f. Solve problems dealing with induction, including Faraday's Law, Lenz's Law, self-induction, mutual-induction, and circuits containing inductance.

3.2.g. Solve problems dealing with alternating current circuits containing resistors, inductors, and capacitors.

3.2.h. Solve problems dealing with electromagnetic wave theory.

3.2.i. Optics: Solve geometrical optics problems dealing with refraction, reflection, lenses, and mirrors.

3.2.j. Solve wave optics problems dealing with interference and polarization.

3.2.k. Circuit Analysis: Define and explain the meaning/function of charge, current, voltage, power, energy, R, L, C, and O amp, the fundamental principles of Ohm's Law, KVL and KLC.

3.2.l. Determine the equilibrium equations for a given network, and solve them using appropriate software as needed for the steady state (DC and AC/phasor) solution.

3.2.m. Apply the principles of superposition, linearity, source transformations, and Thevenin/Norton equivalent circuits to analyze circuits and/or determine responses.

3.2.n. Predict (qualitatively) and calculate the step responses of first order (RL and RC) and second order (RLC) circuits.

3.2.o. Calculate the steady state AC responses of basic circuits using the phasor method.

3.2.p. Calculate effective and average values of periodic signals, and calculate the instantaneous and average power delivered to a circuit element.

3.2.q. Calculate the complex power associated with a circuit element, and design a circuit to improve the power factor in an AC circuit.

3.2.r. Determine the conditions for maximum power transfer to any circuit element.

3.2.s. Analyze resistive and RC op amp circuits.

3.2.t. Design simple amplifiers using op amps.

4. Chemistry Competencies

4.1. *Chemical Toolbox*

4.1.a. Use theory to predict, graph, and interpret experiment observations.

4.1.b. Use math and critical reasoning to organize and manipulate data for meaningful interpretations of data and results, use statistics to judge limitations of error, and discern causes of error. Distinguish between precision and accuracy.

4.1.c. Apply relevant fundamental mathematical relationships in order to carry out accurate calculations related to the specific topics covered.

4.1.d. Apply rules of significant figures and rounding, converting among units, and using dimensional analysis to solve numerical problems.

4.1.e. Use problem-solving skills to reduce complex problems into simpler components, identifying principle objectives.

4.1.f. Integrate knowledge of two or more traditional subfields of chemistry to solve complex chemical problems.

4.1.g. Demonstrate computer literacy to use multiple programming, computational, online and database tools. Utilize computational tools to organize, process, store, and retrieve data.

4.1.h. Understand the major systems of nomenclature used in chemistry for inorganic and organic compounds, including stereochemistry (R/S and E/Z).

4.2. ***Matter***

4.2.a. Recognize the atomic symbols of the elements and use the periodic table to extract valuable information about atoms and ions especially concerning bonding.

4.2.b. Classify matter: pure substances (elements and compounds) or mixtures (homogeneous or heterogeneous).

4.2.c. Understand the differences between physical and chemical changes, physical properties and chemical properties.

4.2.d. Describe matter in terms of its physical properties (both intensive and extensive) and chemical properties.

4.2.e. Compare and contrast the three forms of matter: solid, liquids and gas. Compare a gas, a liquid, and a solid using a kinetic-molecular theory description.

4.2.f. Use mathematical relationships (including Boyle's Law, Charles's Law, Avogadro's Law, ideal gas law, and van der Waals equation) to describe gases.

4.2.g. Describe gases with respect to density, vapor pressure, partial pressures, diffusion, effusion, molecular speed distributions.

4.2.h. Define changes of state physically and pictorially (heating curves and phase diagrams). Apply the Clausius-Clapeyron equation.

4.2.i. Describe liquids with respect to surface tension, viscosity, capillary action, and vapor pressure.

4.2.j. Identify types of solids: molecular solids, metallic solids, ionic solids, and covalent network solids. Identify coordination number, common unit cells (simple cubic, body-centered cubic, and face-centered cubic unit cell) , and properties that relate to its structure.

4.3. ***Atomic Structure***

4.3.a. Demonstrate a comprehensive knowledge of the structure of the nucleus (including nucleons), atoms, isotopes, ions, and molecules.

4.3.b. Apply a fundamental knowledge of atomic orbitals (s, p, d, and f) to electronic configurations and the explanation of electronic spectroscopy.

4.3.c. Apply the Pauli Exclusion Principle, Hund's rule, Aufbau principle to write the electron~~ic~~ configurations for the elements, identifying diamagnetic and paramagnetic species. Explain how electron~~ic~~ configurations relate to electronegativities and bonding properties of these elements. Distinguish between core and valence electrons.

4.3.d. Employ periodic trends (including successive ionization energies, electron affinities, atomic radii, ionic radii, shielding and effective nuclear charge) to atoms and ions.

4.3.e. Understand the basic mathematical relationships underpinning quantum mechanics, such as the wave function, de Broglie wavelength, and the Heisenberg uncertainty principle, and other physical properties of a particle.

4.3.f. Understand the interaction of light with matter. Relate energy of a photon to wavelength, frequency, and to emission and absorption spectroscopy. Understand the relative regions of the electromagnetic radiation.

4.3.g. Describe the shapes of s, p, and d orbitals and apply the rules of quantum numbers to electrons residing in these orbitals.

4.4. Chemical Bonding

4.4.a. Predict, compare and contrast the different types of intramolecular (covalent, ionic, and metallic) and intermolecular bonding (London forces (induced dipole), dipole-dipole, hydrogen-bonding, and ion-dipole) demonstrated in substances? Predict the consequences of these types of bonds on physical properties.

4.4.b. Apply valence bond theory (hybridization, σ + π bonds), and molecular orbital bonding models to describe bonding at the molecular level.

4.4.c. Develop a fundamental understanding of the behavior and properties of phases of matter (gases, liquids, and solids).

4.4.d. Define and identify ionic and covalent bonding, energetics of bonding, lattice energy through the Born-Haber cycle.

4.4.e. Describe bonds using single, double, and triple bond notation, coordinate covalent bond, valence bond descriptions (hybrid orbitals), and sigma and pi bond descriptions.

4.4.f. Relate bonding properties (such as delocalized electrons, formal charge, bond length, bond order, bond enthalpy) and its consequences to molecular structure and reactivity.

4.4.g. Define bonding in metals and metal compounds, metallic bonding, band theory, magnetic properties, conductivity, semiconductors, insulators, and defects.

4.4.h. Describe diatomic molecules using molecular orbital theory, identifying bonding, antibonding orbitals, and bond order.

4.5. ***Molecular Structure & Function***

- 4.5.a. Distinguish between structure/reactivity and structure/property relationships.
- 4.5.b. Relate bond polarity and molecular dipole moment to identify polar and non-polar molecules.
- 4.5.c. Predict general trends in the boiling points and solubilities of compounds, based on their size, polarity, and ability to form hydrogen bonds.
- 4.5.d. Identify constitutional isomers, stereoisomers, and diastereomers, including cis-trans (geometric) isomers.
- 4.5.e. Distinguish between angle strain, torsional strain, steric strain, and understand their significance to reactivity.
- 4.5.f. Identify resonance-stabilized structures and compare the relative importance of their resonance forms. Calculate formal charges for different bonding modes.
- 4.5.g. Relate the dependence of structure and reactivity on context, particularly solvent effects and other non-covalent interactions.
- 4.5.h. Demonstrate a detailed knowledge of structure-function relationships for organic molecules by functional groups, including alkanes, alkyl halides, alkenes, alkynes, arenes, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, and carboxylic acid derivatives.
- 4.5.i. Relate the interplay between electronic, steric, and orbital interactions in the behavior and properties of molecules.
- 4.5.j. Draw and describe reactive intermediate structures of carbocations, carbanions, free radicals, and carbenes and the structural features that stabilize them. Explain which are electrophilic and which are nucleophilic.

4.6. ***Reactions***

4.6.a. Write accurate, balanced equations for chemical (including redox) and nuclear reactions, including deducing stable products in a nuclear reaction based on the stability of radionuclides. Predict the type of radioactive emission for a nuclear reaction. Distinguish the different classes of nuclear reactions (fission, fusion, artificial vs. Natural radioactivity)

4.6.b. Employ the detailed quantitative relationships (moles, molar mass, and molarity) governing chemical reactions, including the ability to perform a variety of stoichiometry calculations (such as limiting reagent, dilutions, theoretical yield, percent yield).

4.6.c. Demonstrate a basic understanding of reaction chemistry, including oxidation-reduction (both inorganic and organic, half reactions and net ionic equations), acid-base, neutralization, precipitation, substitution (both inorganic and organic), elimination, rearrangements, and addition.

4.6.d. Identify nucleophiles (Lewis bases) and electrophiles (Lewis acids), and write equations for Lewis acid-base reactions using curved arrows to show the flow of electrons.

4.6.e. Demonstrate a comprehensive understanding of reactions and propose logical mechanisms for the major functional groups of organic molecules, including alkanes, alkyl halides, alkenes, alkynes, arenes, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, and carboxylic acid derivatives.

4.6.f. Understand and employ the methodologies of organic synthesis, including retrosynthetic analysis of target molecules.

4.7. ***Energy & Thermodynamics***

4.7.a. Define a system (versus surroundings) in terms of kinetic and potential energy, internal energy, work and heat.

4.7.b. Define chemical and physical processes as exothermic or endothermic processes, calculating ΔH^o and ΔS^o for a reaction based on stoichiometry. Calculate ΔG^o from both ΔH^o and ΔS^o, and from ΔG values of formation.

4.7.c. Manipulate common thermochemical calculations and relationships (including calorimetry; heats of reaction; Hess's Law and standard enthalpies or entropies of formation; calculating for reactions and phase changes).

4.7.d. Manipulate common calculations and relationships to solutions (such as Henry's Law; calculating solution concentration and converting between the various forms of concentration expression; applying Raoult's Law; calculating colligative properties.)

4.7.e. Calculate and relate E_{cell}, equilibrium constant, ΔG at various conditions.

4.7.f. Calculate the binding energy in a nuclear reaction.

4.8. ***Kinetics***

4.8.a. Calculate reaction rates, determining reaction orders and rate constants.

4.8.b. Calculate concentrations given the rate law, time, and initial reactant concentrations; relating a reaction half-life to a rate constant.

4.8.c. Use the Arrhenius equation to determine a reaction's activation energy or rate constant at a different temperature.

4.8.d. Determine the molecularity and rate law for an elementary reaction.

4.8.e. Write the overall chemical reaction and rate law for a given mechanism.

4.8.f. Understand the effect of a catalyst. Employing methods of activation, including Brønsted or Lewis acid/base, free radical chemistry, and organometallic catalysis.

4.9. ***Equilibrium***

4.9.a. Calculate and interpret values of equilibrium constants. Writing equilibrium constant expressions and using them to calculate equilibrium constant values.

4.9.b. Calculate free-energy changes from equilibrium constants, and calculate the position of reaction equilibrium from the free-energy changes.

4.9.c. Predict reaction direction based on comparing Q and K.

4.9.d. Describe and employ the reversibility of reactions. Apply Le Châtélier's principle for changes in equilibrium concentrations, temperature and pressure.

4.9.e. Apply foundational equilibrium concepts to aqueous equilibria, including acids, bases, salts, buffers, titrations, solubility and complex ion equilibria.

4.10. ***Experimentation***

4.10.a. Demonstrate a basic ability to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions.

4.10.b. Apply major concepts, theoretical principles and experimental findings in general and organic chemistry lectures to the solution of laboratory problems.

4.10.c. Demonstrate creative and independent thinking in a laboratory setting.

4.10.d. Demonstrate knowledge of chemical, instrumental and workplace safety. Know and follow the proper safety procedures and regulations for safe handling and use of chemicals.

4.10.e. Employ appropriate, safe, and ethical research methodologies to collect, analyze and interpret data critically (error analysis) toward the solution of a problem.

4.10.f. Critically evaluate methodologies, data and conclusions of one's own and other's technical work.

4.10.g. Use technology for computations, data acquisition, and data base searching.

4.10.h. Use appropriate instrumentation for chemical analysis and characterization. Students must have hands-on experience with a variety of instruments, including spectrometers (such as UV/Vis, FTIR, NMR), and with chemical separation techniques (such as TLC, CC, and GC).

4.10.i. Students will be able to maintain an organized and well-documented laboratory notebook.

4.10.j. Interact effectively in a group to solve scientific problems and work productively with a diverse group of peers.

4.10.k. Present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in their communications.

4.10.l. Write scientific reports, with graphical presentation of data (technical writing skills) using appropriate scientific formalisms.

4.10.m. Communicate and store scientific information and experimental data correctly by keeping a well-documented laboratory notebook or other written records.

4.10.n. Demonstrate the responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results.

4.10.o. Find and evaluate the validity and usefulness of chemistry information in the scientific literature.

4.10.p. Demonstrate proper conceptual and mathematical knowledge upon which chemical instrumentation is based.

4.10.q. Collect empirical data through the safe and effective physical manipulation of materials, equipment, and instrumentation in a face-to-face instructional setting.

4.11. ***Visualization***

4.11.a. Understand the relationship between symbolic and particulate representations.

4.11.b. Predict molecular geometry, shape and ideal bond angles at the molecular level using VSEPR theory.

4.11.c. Employ the concept of the mole to relate the macroscopic and microscopic views of chemical reactions.

4.11.d. Use mathematical equations to provide a tool to visualize chemical and physical processes.

4.11.e. Draw and interpret Lewis, condensed, and line-angle structural formulas. Convert these drawings to accurate Newman projections, Fisher projections, Haworth projections, chair conformations as appropriate, envisioning these representations as space filling diagrams.

4.11.f. Draw and identify the types of stereoisomers for a molecule, identifying the relationship between stereoisomers, identifying each carbon with the R/S nomenclature.

4.11.g. Draw a reaction-energy diagram for a mechanism, and point out the corresponding transition states, activation energies, intermediates, and rate-limiting steps.

4.11.h. Visualize the movements of the microscopic world using a qualitative description of the gas laws based on the kinetic molecular theory.

4.11.i. Cultivate the understanding that the way to molecular knowledge is through experimentation; correlating structure with reactivity and function through wet chemical methods, spectroscopy (notably NMR, FTIR, and MS), and use of computational simulations.

4.11.j. Employ spectrometric techniques for the determination of organic structure at the molecular level. Identify the reliable characteristic peaks in provided spectroscopic data, and propose which functional groups are likely to be present in the molecule based on this knowledge.

4.11.k. Develop a basic understanding of the microscopic point of view, especially for thermodynamic quantities such as entropy.

INDIANA COMMISSION *for*
HIGHER EDUCATION

Human Services TSAP

INDIANA COMMISSION for HIGHER EDUCATION

Human Services TSAP Faculty Roster

★Denotes co-chairs for this panel.

BALL STATE UNIVERSITY

Not Offered

INDIANA STATE UNIVERSITY

Not Offered

INDIANA UNIVERSITY

IUPUI
Carolyn Gentle-Genitty
Email: cgentleg@iupui.edu

IVY TECH COMMUNITY COLLEGE

★Micon, Joyce
Email: jmicon@ivytech.edu

Phillips, Joann
Email: jphillips148@ivytech.edu

PURDUE UNIVERSITY

IPFW
Eber, Patricia
Email: eberp@ipfw.edu

PNC
Not Offered

PUC
Not Offered

PWL

★Dobbs-Oates, Dr. Jennifer
Email: jendo@purdue.edu

UNIVERSITY OF SOUTHERN INDIANA

Not Offered

VINCENNES UNIVERSITY

Not Offered

INDIANA COMMISSION for HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAPs)

Pathway: Human Services

Approved: 9.12.2016

Preamble:

The courses mapped for this Transfer Single Articulation Pathway (TSAP) associate's degree are based upon a set of competencies agreed upon across all of the public institutions and are the minimum competencies for transfer in this major.

After a statewide review process, some four-year universities may have specific competencies required that are not included in this mapping and **may limit the admission options for TSAP students**. To increase the likelihood of student success, TSAP advisors in the two-year programs are encouraged to contact the academic advising offices in the major area of the TSAPs at the four-year institutions to discuss the minimum criteria for admission.

It is important that individual students review the published TSAP admission criteria at the specific university/campus to which they wish to transfer. This should be done at the beginning of their enrollment as a TSAP student at either Ivy Tech or Vincennes University. Understanding admission and degree requirements will facilitate student success. The universities in the state of Indiana are committed to the success of TSAP students, and student success is a three-way partnership among students and the academic advisors at both institutions.

A lack of communication after students enroll in a TSAP could result in a misunderstanding of the admission requirements to a specific four-year institution and/or TSAP program, such as minimum grades, specific course sequences, etc., and such misunderstanding could affect the time to graduation.

To be eligible, a student must:

- Have met the TSAP and STGEC eligibility guidelines as defined by Indiana Code
- Have graduated with the TSAP associate degree,
- Have met all the admission requirements (e.g., minimum GPA, minimum course grades, etc.) of the TSAP program at the 4-year institution, and
- Have been admitted to the campus AND into the degree program as a TSAP student.

Transfer Single Articulation Pathways (TSAPs)

Competencies and Learning Outcomes:

1. Knowledge, Theory, Skills, and Values

Outcome: Human Services professionals must have knowledge of how different human services emerged and the various forces that influenced their development.

1.1.a. Understand the historical roots of human services.
1.1.b. Recognize the factors that lead to the creation of the human services profession.
1.1.c. Be aware of historical and current legislation affecting services delivery.
1.1.d. Be aware of how public and private attitudes influence legislation and the interpretation of policies related to human services.

2. Human services

Outcome: Human Services professionals must have an understanding of the structure and dynamics of organizations, communities, and society as well as the nature of individuals and groups.

2.1.a. Recognize and describe theories of human development.
2.1.b. Demonstrate an understanding of small groups including how small groups are used in human services settings, recognize theories of group dynamics, and demonstrate basic group facilitation skills.
2.1.c. Demonstrate knowledge and awareness of changing family structures and roles.
2.1.d. Recognize and describe basic awareness of the organizational structures of communities.
2.1.e. Demonstrate an understanding of the capacities, limitations, and resiliency of human systems.
2.1.f. Apply an awareness and understanding of the context and role of diversity (including, but not limited to ethnicity, culture, gender, sexual orientation, learning styles, ability, and socio-economic status) in determining and meeting human needs.

3. Human Services Delivery Systems

Outcome: Human Service professionals must have knowledge and understanding of the scope of conditions that promote or inhibit human functioning.

3.1.a. Recognize the range and characteristics of human services delivery systems and organizations.
3.1.b. Recognize the range of populations served and needs addressed by human services.
3.1.c. Recognize, describe, and apply the major models used to conceptualize and integrate prevention, maintenance, intervention, rehabilitation, and healthy functioning.
3.1.d.

4. Information Management

Outcome: Human Service professionals must have knowledge and skills in information management.

4.1.a. Demonstrate the knowledge and ability to obtain information through interviewing, active listening, consultation with others, library or other research, and the observation of clients and systems.
4.1.b. Demonstrate the ability to record, organize, and assess the relevance, adequacy, accuracy, and validity of information provided by others.
4.1.c. Demonstrate the ability to appropriately compile, synthesize, and categorize information.
4.1.d. Demonstrate the ability to disseminate routine and critical information in a written or oral form to clients, colleagues, or other members of the related services system in a timely manner.
4.1.e. Demonstrate the ability to maintain client confidentiality and appropriately use client data.

5. Planning and Evaluation

Outcome: Human Services professionals must have knowledge and skills in systematic analysis of service needs; planning appropriate strategies, services, and implementation; and evaluation.

5.1.a. Demonstrate the knowledge and skills to analyze and assess the needs of clients or client groups.
5.1.b. Demonstrate the skills to develop goals and design and implement a plan of action.
5.1.c. Demonstrate the skills to evaluate the outcomes of the plan and the impact on the client or client group.

6. Interventions and Direct Services

Outcome: Human Services professionals must have knowledge and skills in direct service delivery and appropriate interventions.

6.1.a. Describe and apply theory and knowledge bases of prevention, intervention, and maintenance strategies to achieve maximum autonomy and functioning.
6.1.b. Demonstrate skills to facilitate appropriate direct services and interventions related to specific client or client group goals.
6.1.c. Demonstrate knowledge and basic skill development appropriate to their level of training in the following areas:
1.1.a. Case management,
1.1.b. Intake interviewing,
1.1.c. Individual counseling,
1.1.d. Group facilitation and counseling,
1.1.e. Location and use of appropriate resources and referrals, and
1.1.f. Use of consultation

7. Interpersonal Communication

***Outcome: Human Services professionals must have interpersonal skills that include the ability to create genuine and empathic relationships with others*.**

7.1.a. Demonstrate the ability to clarify expectations, deal effectively with conflict, and establish rapport with clients.
7.1.b. Demonstrate the ability to develop and sustain behaviors that are congruent with the values and ethics of the profession.

8. Client-Related Values and Attitudes

Outcome: Human Service professionals must have knowledge, understanding, and the ability to apply Human Services ethical principles.

8.1.a. Students will recognize, understand and apply the National Organization for Human Service's Ethical Standards for Human Service Professionals as the standards for human service practice.

9. Self-Development

Outcome: Human Service professionals must develop awareness of their own values, personalities, reaction patterns, interpersonal styles, and limitations.

9.1.a. Demonstrate the ability to gain self-awareness and to receive feedback in order to decrease the influence of personal biases, values or personality styles in working with clients.
9.1.b. Clarify personal values as they relate to professional values.
9.1.c. Recognize and show awareness of the importance and impact of diversity.

10. Field Experience

Outcome: Human Services professionals will successfully perform human services skills in an internship setting.

10.1.a. Students will satisfactorily complete no less than 250 clock hours of supervised field experience maintaining work and behavior consistent with the ethical standards of the Human Service profession.

11. Families and Communities

Outcome: Human Service professionals will have an understanding of family life cycles, interpersonal dynamics and the impact of community and cultural variations.

11.1.a. Demonstrate the ability to identify and analyze the stages of the family life cycle.
11.1.b. Demonstrate the ability to identify and analyze the child in the family from the family systems approach.
11.1.c. Demonstrate the ability to analyze and discuss principles and techniques of culturally sensitive interpersonal skills for working with families.
11.1.d. Recognize impact of cultural variations upon the family's ability to function.
11.1.e. Describe and reflect upon family strengths model.

12. Behavior Modification

Outcome: Human Service professionals will have an understanding of theories of behavior modification.

12.1.a. Demonstrate ability to identify and analyze models of behavioral change.
12.1.b. Demonstrate ability to apply and evaluate techniques of behavior modification.

13. Understanding Diversity

Outcome: Human Services professionals must have cultural awareness and an appreciation of diversity.

13.1.a. Define and discuss the meaning of culture and cultural diversity.
13.1.b. Evaluate the impact of cultural variations on client populations.
13.1.c. Demonstrate culturally sensitive interpersonal skills.

14. Social and Behavioral Ways of Knowing

14.1. Introduction to Psychology

14.1.a. Identify and differentiate theoretical perspectives of psychology.
14.1.b. Demonstrate a basic knowledge of research methods.
14.1.c. Demonstrate a basic knowledge of the major theories of personality.
14.1.d. Demonstrate a basic knowledge of symptoms, classification, treatment and causes of psychological disorders.

14.2. Introduction to Sociology

14.2.a. Define sociology, sociological concepts, and explain the major theoretical perspectives.
14.2.b. Describe the principal social research methods.
14.2.c. Describe the process of socialization.

14.3. Lifespan Development

14.3.a. Describe and discuss the prenatal, child, adolescent, and adult stages of human development.
14.3.b. Compare, contrast, and evaluate the major theoretical perspectives as they apply to the stages of development.
14.3.c. Identify the effects of sociocultural contexts and diversity on human development.

NOTE: The accomplishment of key competencies in the domains of Written Communication, Speaking and Listening, Quantitative Reasoning, Scientific Ways of Knowing, and Humanistic and Artistic Ways of Knowing will be demonstrated through the completion of the statewide transfer general education core (STGEC). The domain of Social and Behavioral Ways of Knowing requires more specific and narrow competencies than are defined in the STGEC. Those competencies are specified above.

INDIANA COMMISSION *for*
HIGHER EDUCATION

Psychology TSAP

INDIANA COMMISSION for HIGHER EDUCATION

Psychology TSAP Faculty Roster

★Denotes co-chairs for this panel.

BALL STATE UNIVERSITY

★Gaither, George
Email: ggaither@bsu.edu

INDIANA STATE UNIVERSITY

Schriver, Jennifer
Email: jennifer.schriver@indstate.edu

INDIANA UNIVERSITY

IUB
Busey, Tom
Email: busey@indiana.edu

IUE
Loshek, Eevett
Email: eloshek@iue.edu

IUK
Holcomb, Kathy
Email: kmholcom@iuk.edu

IUN
Mary Ann Fischer
Email: mfischer@iun.edu

IUPUC
Poulsen, Joan
Email: jpoulsen@iupuc.edu

IUPUI
Contino, Lisa
Email: lcontino@iupui.edu

Neal-Beliveau, Beth
Email: bnealbe@iupui.edu

IUS
Willie, Diane
Email: dwille@ius.edu

IUSB
Ritchie, Kathy
Email: kritchie@iusb.edu

IVY TECH COMMUNITY COLLEGE

★James, Michael
Email: mjames@ivytech.edu

Rahschulte, Rebecca
Email: rrahschulte@ivytech.edu

PURDUE UNIVERSITY

IPFW
Lawton, Carol
Email: lawton@ipfw.edu

PNC
DeLeon, Cheryl
Email: cdeleon@pnw.edu

PUC
Pick, David
Email: Pick@pnw.edu

INDIANA COMMISSION for HIGHER EDUCATION

Psychology TSAP Faculty Roster

PWL
Swithers, Susie
Email: swithers@purdue.edu

UNIVERSITY OF SOUTHERN INDIANA

McKibban, Amie
Email: armckibban@usi.edu

VINCENNES UNIVERSITY

Drysdale, Mike
Email: MDrysdale@vinu.edu

INDIANA COMMISSION for HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAPs)

Pathway: Psychology

Approved: 11.4.2016

Preamble:

The courses mapped for this Transfer Single Articulation Pathway (TSAP) associate's degree are based upon a set of competencies agreed upon across all of the public institutions and are the minimum competencies for transfer in this major.

After a statewide review process, some four-year universities may have specific competencies required that are not included in this mapping and **may limit the admission options for TSAP students**. To increase the likelihood of student success, TSAP advisors in the two-year programs are encouraged to contact the academic advising offices in the major area of the TSAPs at the four-year institutions to discuss the minimum criteria for admission.

It is important that individual students review the published TSAP admission criteria at the specific university/campus to which they wish to transfer. This should be done at the beginning of their enrollment as a TSAP student at either Ivy Tech or Vincennes University. Understanding admission and degree requirements will facilitate student success. The universities in the state of Indiana are committed to the success of TSAP students, and student success is a three-way partnership among students and the academic advisors at both institutions.

A lack of communication after students enroll in a TSAP could result in a misunderstanding of the admission requirements to a specific four-year institution and/or TSAP program, such as minimum grades, specific course sequences, etc., and such misunderstanding could affect the time to graduation.

To be eligible, a student must:

- Have met the TSAP and STGEC eligibility guidelines as defined by Indiana Code
- Have graduated with the TSAP associate degree,
- Have met all the admission requirements (e.g., minimum GPA, minimum course grades, etc.) of the TSAP program at the 4-year institution, and
- Have been admitted to the campus AND into the degree program as a TSAP student.

Transfer Single Articulation Pathways (TSAPs)

Competencies and Learning Outcomes:

1. Knowledge Base in Psychology

1.1.a. Use basic psychological terminology, concepts, and theories in psychology to explain behavior and mental processes.
1.1.b. Explain why psychology is a science, with the primary objectives of describing, understanding, predicting, and controlling behavior and mental processes.
1.1.c. Interpret behavior and mental processes at an appropriate level of complexity.
1.1.d. Recognize the power of the context in shaping conclusions about individual behavior.
1.1.e. Identify key characteristics of major content domains in psychology (e.g. cognition and learning, developmental, biological, and sociocultural).
1.1.f. Recognize major theoretical perspectives and corresponding figures in psychology.
1.1.g. Provide examples of unique contributions of content domain to the understanding of complex behavioral issues.
1.1.h. Describe examples of relevant and practical applications of psychological principles to everyday life.
1.1.i. Correctly identify antecedents and consequences of behavior and mental processes.
1.1.j. Predict how individual differences influence beliefs, values, and interactions with others, including the potential for prejudicial and discriminatory behavior in oneself and others.

2. Scientific Inquiry and Critical Thinking

2.1.a. Identify basic biological, psychological, and social components of psychological explanations (e.g., inferences, observations, operational definitions, interpretations)
2.1.b. Use psychology concepts to explain personal experiences and recognize the potential for flaws in behavioral explanations based on simplistic, personal theories.
2.1.c. Ask relevant questions to gather more information about behavioral claims.
2.1.d. Describe common fallacies in thinking (e.g., confirmation bias, post hoc explanations, and implying causation from correlation) that impair accurate conclusions and predictions.
2.1.e. Read and summarize general ideas and conclusions from psychological sources accurately.

2.1.f. Describe what kinds of additional information beyond personal experience are acceptable in developing behavioral explanations (i.e., popular press reports vs. scientific findings).
2.1.g. Identify and navigate psychology databases and other legitimate sources of psychology information.
2.1.h. Articulate criteria for identifying objective sources of psychology information.
2.1.i. Interpret simple graphs and statistical findings.
2.1.j. Describe research methods used by psychologists including their respective advantages and disadvantages.
2.1.k. Discuss the value of experimental design (i.e., controlled comparisons) in justifying cause effect relationships.
2.1.l. Define and explain the purpose of key research concepts that characterize psychological research (e.g., hypothesis, operational definition).
2.1.m. Explain why conclusions in psychological projects must be both reliable and valid.
2.1.n. Explain why quantitative analysis is relevant for scientific problem solving.
2.1.o. Describe the fundamental principles of research design (e.g., sampling, biases, correlation vs causation, and ethics).
2.1.p. Describe how individual and sociocultural differences can influence the applicability/generalizability of research findings.
2.1.q. Identify under what conditions research findings can be appropriately generalized.

3. Ethical and Social Responsibility in a Diverse World

3.1.a. Describe key regulations in the APA Ethics Code for protection of human or nonhuman research participants.
3.1.b. Identify obvious violations of ethical standards in psychological contexts.
3.1.c. Discuss relevant ethical issues that reflect principles in the APA Ethics Code.
3.1.d. Explain how individual differences, social identity, and worldview may influence beliefs, values, and interaction with others and vice versa.
3.1.e. Recognize how multiple aspects of diversity influence perceptions and individual experience.
3.1.f. Recognize potential for prejudice and discrimination in oneself and others.
3.1.g. Explain how psychology can promote civic, social, and global outcomes that benefit others.
3.1.h. Describe how psychology is related to issues of global concern.

Transfer Single Articulation Pathways (TSAPs)

4. Communication

- 4.1.a. Express ideas in written formats that reflect basic psychological concepts and principles.
- 4.1.b. Recognize writing content and format differ based on purpose (e.g., blogs, memos, journal articles) and audience.
- 4.1.c. Use Standard English, including generally accepted grammar.
- 4.1.d. Write using APA style.
- 4.1.e. Recognize and develop overall organization (e.g., beginning, development, ending) that fits the purpose.
- 4.1.f. Interpret descriptive statistical data displayed in graphs and tables.
- 4.1.g. Use expert feedback to revise writing of a single draft.
- 4.1.h. Deliver brief presentations within appropriate constraints (e.g., time limit, appropriate to audience).
- 4.1.i. Pose questions about psychological content.

5. Professional Development

- 5.1.a. Recognize the value and application of research and problem-solving skills in providing evidence beyond personal opinion to support proposed solutions.
- 5.1.b. Identify range of possible factors that influence beliefs and conclusions.
- 5.1.c. Expect to deal with differing opinions and personalities in the college environment.
- 5.1.d. Describe how psychology's content applies to business, health care, educational, and other workplace settings.
- 5.1.e. Describe how ethical principles of psychology apply to business, health care, educational, and other workplace settings.
- 5.1.f. Incorporate feedback from educators and mentors to change performance.
- 5.1.g. Collaborate successfully on small-group classroom assignments.
- 5.1.h. Describe settings in which people with backgrounds in psychology typically work.

INDIANA COMMISSION for HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAPs)

Pathway: Psychology

Approved: 11.4.2016

Preamble:

The courses mapped for this Transfer Single Articulation Pathway (TSAP) associate's degree are based upon a set of competencies agreed upon across all of the public institutions and are the minimum competencies for transfer in this major.

After a statewide review process, some four-year universities may have specific competencies required that are not included in this mapping and **may limit the admission options for TSAP students**. To increase the likelihood of student success, TSAP advisors in the two-year programs are encouraged to contact the academic advising offices in the major area of the TSAPs at the four-year institutions to discuss the minimum criteria for admission.

It is important that individual students review the published TSAP admission criteria at the specific university/campus to which they wish to transfer. This should be done at the beginning of their enrollment as a TSAP student at either Ivy Tech or Vincennes University. Understanding admission and degree requirements will facilitate student success. The universities in the state of Indiana are committed to the success of TSAP students, and student success is a three-way partnership among students and the academic advisors at both institutions.

A lack of communication after students enroll in a TSAP could result in a misunderstanding of the admission requirements to a specific four-year institution and/or TSAP program, such as minimum grades, specific course sequences, etc., and such misunderstanding could affect the time to graduation.

To be eligible, a student must:

- Have met the TSAP and STGEC eligibility guidelines as defined by Indiana Code
- Have graduated with the TSAP associate degree,
- Have met all the admission requirements (e.g., minimum GPA, minimum course grades, etc.) of the TSAP program at the 4-year institution, and
- Have been admitted to the campus AND into the degree program as a TSAP student.

Transfer Single Articulation Pathways (TSAPs)

Competencies and Learning Outcomes:

1. Knowledge Base in Psychology

1.1.a. Use basic psychological terminology, concepts, and theories in psychology to explain behavior and mental processes.
1.1.b. Explain why psychology is a science, with the primary objectives of describing, understanding, predicting, and controlling behavior and mental processes.
1.1.c. Interpret behavior and mental processes at an appropriate level of complexity.
1.1.d. Recognize the power of the context in shaping conclusions about individual behavior.
1.1.e. Identify key characteristics of major content domains in psychology (e.g. cognition and learning, developmental, biological, and sociocultural).
1.1.f. Recognize major theoretical perspectives and corresponding figures in psychology.
1.1.g. Provide examples of unique contributions of content domain to the understanding of complex behavioral issues.
1.1.h. Describe examples of relevant and practical applications of psychological principles to everyday life.
1.1.i. Correctly identify antecedents and consequences of behavior and mental processes.
1.1.j. Predict how individual differences influence beliefs, values, and interactions with others, including the potential for prejudicial and discriminatory behavior in oneself and others.

2. Scientific Inquiry and Critical Thinking

2.1.a. Identify basic biological, psychological, and social components of psychological explanations (e.g., inferences, observations, operational definitions, interpretations)
2.1.b. Use psychology concepts to explain personal experiences and recognize the potential for flaws in behavioral explanations based on simplistic, personal theories.
2.1.c. Ask relevant questions to gather more information about behavioral claims.
2.1.d. Describe common fallacies in thinking (e.g., confirmation bias, post hoc explanations, and implying causation from correlation) that impair accurate conclusions and predictions.
2.1.e. Read and summarize general ideas and conclusions from psychological sources accurately.

2.1.f. Describe what kinds of additional information beyond personal experience are acceptable in developing behavioral explanations (i.e., popular press reports vs. scientific findings).
2.1.g. Identify and navigate psychology databases and other legitimate sources of psychology information.
2.1.h. Articulate criteria for identifying objective sources of psychology information.
2.1.i. Interpret simple graphs and statistical findings.
2.1.j. Describe research methods used by psychologists including their respective advantages and disadvantages.
2.1.k. Discuss the value of experimental design (i.e., controlled comparisons) in justifying cause effect relationships.
2.1.l. Define and explain the purpose of key research concepts that characterize psychological research (e.g., hypothesis, operational definition).
2.1.m. Explain why conclusions in psychological projects must be both reliable and valid.
2.1.n. Explain why quantitative analysis is relevant for scientific problem solving.
2.1.o. Describe the fundamental principles of research design (e.g., sampling, biases, correlation vs causation, and ethics).
2.1.p. Describe how individual and sociocultural differences can influence the applicability/generalizability of research findings.
2.1.q. Identify under what conditions research findings can be appropriately generalized.

3. Ethical and Social Responsibility in a Diverse World

3.1.a. Describe key regulations in the APA Ethics Code for protection of human or nonhuman research participants.
3.1.b. Identify obvious violations of ethical standards in psychological contexts.
3.1.c. Discuss relevant ethical issues that reflect principles in the APA Ethics Code.
3.1.d. Explain how individual differences, social identity, and worldview may influence beliefs, values, and interaction with others and vice versa.
3.1.e. Recognize how multiple aspects of diversity influence perceptions and individual experience.
3.1.f. Recognize potential for prejudice and discrimination in oneself and others.
3.1.g. Explain how psychology can promote civic, social, and global outcomes that benefit others.
3.1.h. Describe how psychology is related to issues of global concern.

4. Communication

- 4.1.a. Express ideas in written formats that reflect basic psychological concepts and principles.
- 4.1.b. Recognize writing content and format differ based on purpose (e.g., blogs, memos, journal articles) and audience.
- 4.1.c. Use Standard English, including generally accepted grammar.
- 4.1.d. Write using APA style.
- 4.1.e. Recognize and develop overall organization (e.g., beginning, development, ending) that fits the purpose.
- 4.1.f. Interpret descriptive statistical data displayed in graphs and tables.
- 4.1.g. Use expert feedback to revise writing of a single draft.
- 4.1.h. Deliver brief presentations within appropriate constraints (e.g., time limit, appropriate to audience).
- 4.1.i. Pose questions about psychological content.

5. Professional Development

- 5.1.a. Recognize the value and application of research and problem-solving skills in providing evidence beyond personal opinion to support proposed solutions.
- 5.1.b. Identify range of possible factors that influence beliefs and conclusions.
- 5.1.c. Expect to deal with differing opinions and personalities in the college environment.
- 5.1.d. Describe how psychology's content applies to business, health care, educational, and other workplace settings.
- 5.1.e. Describe how ethical principles of psychology apply to business, health care, educational, and other workplace settings.
- 5.1.f. Incorporate feedback from educators and mentors to change performance.
- 5.1.g. Collaborate successfully on small-group classroom assignments.
- 5.1.h. Describe settings in which people with backgrounds in psychology typically work.

INDIANA COMMISSION *for*
HIGHER EDUCATION

Sociology TSAP

INDIANA COMMISSION for HIGHER EDUCATION

Sociology TSAP Faculty Roster

★Denotes co-chairs for this panel.

BALL STATE UNIVERSITY

Gong, Fang
Email: fgong@bsu.edu

INDIANA STATE UNIVERSITY

★Steiger, Tom
Email: thomas.steiger@indstate.edu

INDIANA UNIVERSITY

IUB
Jackson, Pam
Email: pjackson@indiana.edu

IUE
Bullock, Denise
Email: debulloc@iue.edu

IUK
Nancy Greenwood
ngreenwo@iuk.edu

IUN
Mcelmurry, Kevin
Email: kmcelmur@iun.edu

IUPUI
Strong, David
Email: dastrong@iupui.edu

IUS
No Representative

IUSB
Wells, Joshua
Email: jowells@iusb.edu

IVY TECH COMMUNITY COLLEGE

Howell, Matthew
Email: mhowell1@ivytech.edu

Shirzadi, Simin
Email: sshirzad@ivytech.edu

PURDUE UNIVERSITY

IPFW
Steiner, Sherrie
Email: steiners@ipfw.edu

PNC
Rogalin, Christabel
Email: crogalin@pnw.edu

PUC
Cherry, Ralph
Email: cherry@pnw.edu

PWL
Perrucci, Carolyn
Email: perruccic@purdue.edu

UNIVERSITY OF SOUTHERN INDIANA

Schroer, Todd
Email: tschroer@usi.edu

INDIANA COMMISSION for HIGHER EDUCATION

Sociology TSAP Faculty Roster

VINCENNES UNIVERSITY

★ Schmitt, Tracy
Email: TSchmitt@vinu.edu

INDIANA COMMISSION for HIGHER EDUCATION

Transfer Single Articulation Pathways (TSAPs)

Pathway: Sociology

Approved: 11.4.2016

Preamble:

The courses mapped for this Transfer Single Articulation Pathway (TSAP) associate's degree are based upon a set of competencies agreed upon across all of the public institutions and are the minimum competencies for transfer in this major.

After a statewide review process, some four-year universities may have specific competencies required that are not included in this mapping and **may limit the admission options for TSAP students**. To increase the likelihood of student success, TSAP advisors in the two-year programs are encouraged to contact the academic advising offices in the major area of the TSAPs at the four-year institutions to discuss the minimum criteria for admission.

It is important that individual students review the published TSAP admission criteria at the specific university/campus to which they wish to transfer. This should be done at the beginning of their enrollment as a TSAP student at either Ivy Tech or Vincennes University. Understanding admission and degree requirements will facilitate student success. The universities in the state of Indiana are committed to the success of TSAP students, and student success is a three-way partnership among students and the academic advisors at both institutions.

A lack of communication after students enroll in a TSAP could result in a misunderstanding of the admission requirements to a specific four-year institution and/or TSAP program, such as minimum grades, specific course sequences, etc., and such misunderstanding could affect the time to graduation.

To be eligible, a student must:

- Have met the TSAP and STGEC eligibility guidelines as defined by Indiana Code
- Have graduated with the TSAP associate degree,
- Have met all the admission requirements (e.g., minimum GPA, minimum course grades, etc.) of the TSAP program at the 4-year institution, and
- Have been admitted to the campus AND into the degree program as a TSAP student.

Transfer Single Articulation Pathways (TSAPs)

Competencies and Learning Outcomes:

1. Understanding of the Sociological Perspective

- 1.1.a. Distinguish between sociological, psychological, and biological explanations of human behavior.
- 1.1.b. Describe key factors in processes of primary and secondary socialization.
- 1.1.c. Identify and illustrate key dimensions and consequences of social stratification in society.
- 1.1.d. Provide examples of variation in beliefs and behavior based on differences in social location.
- 1.1.e. Describe and provide examples of sociological imagination.

2. Familiarity with major sociological concepts and theories.

- 2.1.a. Summarize major theoretical arguments: functionalist theory, conflict theory, symbolic interactionism, and social constructionism.
- 2.1.b. Describe key concepts of the major theoretical arguments as outlined in 2.1.
- 2.1.c. Apply the key concepts of the major theoretical arguments as outlined in 2.1.
- 2.1.d. Compare and contrast the elements of each theoretical argument.

3. Ability to describe basic social phenomenon with quantitative measures.

- 3.1.a. Understand the relationship between concepts and variables
- 3.1.b. Provide examples of variables commonly found in sociological explanations.
- 3.1.c. Develop a basic understanding of reading tables and charts.

4. An awareness of basic sociological research methods.

- 4.1.a. Describe the steps in the scientific method, including the processes of induction and deduction.
- 4.1.b. Identify sociological methods of data collection, quantitative and qualitative, primary and secondary sources.

4.1.c. Demonstrate an understanding of logic of causality and describe the key terms used in discussing causality (e.g., independent variable, dependent variable, spuriousness, and correlation).
4.1.d. Summarize the basic ethical considerations for conducting sociological research.

5. Demonstrate possession of knowledge of important sociological concepts related to social structure, institutions, culture, society, social change, human agency, etc.

5.1.a. Describe key components of culture.
5.1.b. Explain the influence of culture on individual behavior.
5.1.c. Demonstrate knowledge of social institutions and functions provided to society by each institution.
5.1.d. Explain social change in both social institutions and culture.
5.1.e. Describe and provide examples of how individual and collective behavior can effect social change.

6. Ability to evaluate claims and evidence

6.1.a. Identify the major claims in scholarly writing.
6.1.b. Describe how well the major claims are supported by evidence.

7. Understanding of practical-applicable sociological skills

7.1.a. Describe the skill sets of sociology majors.
7.1.b. Articulate the transferable skills sociology majors bring to the workplace.
7.1.c. Recognize how sociology can inform decision making.

8. Acquisition of Mathematical Skills

8.1.a. Interpret information that has been presented in mathematical form (e.g. with functions, equations, graphs, diagrams, tables, words, geometric figures).
8.1.b. Represent information/data in mathematical form as appropriate (e.g. with functions, equations, graphs, diagrams, tables, words, geometric figures).

8.1.c. Demonstrate skill in carrying out mathematical (e.g. algebraic, geometric, logical, statistical) procedures flexibly, accurately, and efficiently to solve problems.

9. Written Communication Skills

9.1.a. Addressed at the AS level through the general education core.

10. Oral Communication Skills

10.1.a. Addressed at the AS level through the general education core

11. Scientific Skills

11.1.a. Addressed at the AS level through the general education core

.