Baccalaureate Degree in Biology - Transfer Pathway

Overview
In accordance with the Laws of Minnesota 2015, Chapter 5, Article 3, Section 21 all Minnesota State Colleges and Universities agree to the following principles governing the transfer pathways for baccalaureate degrees. This transfer pathway specifically ensures that a student who successfully completes an Associate of Science (AS) in Biology can transfer the full degree into a parallel baccalaureate degree program in Biology at a MnSCU university.

At Bemidji State University:
- Biology – General Biology, B.S.
- Biology – Ecology, Biodiversity, and Evolutionary Biology, B.S.
- Biology – Environmental Science, B.S.

At Metropolitan State University:
- Biology, B.A.

At Minnesota State University, Mankato:
- Biology, B.A.
- Biology, B.S.

At Minnesota State University, Moorhead:
- Biology, B.A.
- Ecology, B.A.

At Southwest Minnesota State University:
- Biology Concentration, B.A.

At St. Cloud State University:
- Biology, B.A.

At Winona State University:
- Biology, B.A.

Transfer Pathways will:
I. Be associate degrees, comprised of 60 semester credits, excluding any required developmental or remedial courses, or career, technical or applied courses. All pre-requisite courses are included in the 60.
II. Meet all lower division major content and competency requirements needed to prepare students to enroll in the major at the university.
III. Identify and require inclusion of pre-requisite courses, including the designation of Minnesota Transfer Curriculum courses, as needed.
IV. Include lower division experiential learning activities required by direct entry university students. Examples include but are not limited to: service-learning, internships, undergraduate research etc.
V. Encompass at least 16 credits of the major’s specific coursework as outlined in this transfer pathway.

Responsibilities of the Associate Degree Institutions (Colleges)
1. The AA, AS, or AFA leading to a parallel baccalaureate degree will include the minimum number of credits and competencies of major-specific coursework as
defined in the transfer pathway. Institutional partnerships may be necessary in order to offer all courses at a college.

2. By awarding the transfer pathway AS in Biology, the degree granting institution is validating that the student has met the competency requirements outlined in the transfer pathway.

Responsibilities of the Baccalaureate Degree Institutions (Universities)

3. The baccalaureate degree institution will recognize all competencies attained within the transfer pathway AS degree and accept the transfer student who has earned the transfer pathway associate degree with full junior standing.

4. For open-enrollment majors, students will be accepted into a parallel baccalaureate degree program as long as enrollment capacity is available.

5. Transfer and direct entry students will be treated in the same manner with regard to university policy and procedure including, admission to the university major, minimum GPA and course work grade requirements. For example: The transfer of coursework with a grade less than a “C” (2.0 on a 4.0 scale) in the AS transfer pathway will be consistent with the policies of direct entry students at the university.

Transfer Appeal Process

6. Each bachelor degree institution shall have a procedure through which a transfer student can appeal a decision that he/she believes is not consistent with this transfer pathway.

7. The transfer appeal process shall be published, at a minimum, in the institution’s information (catalog, website).

REQUIRED Content Areas

1. This pathway will not necessarily be a perfect fit for all possible tracks within the field of biology. Careful choice of electives may be needed to cover specific courses required for transfer into some specific fields.

2. The 16 biology credits will prepare students to transfer with adequate training to succeed at the upper division. C or better grades will be transferable into the major.

3. Campus autonomy ensures that a campus’s course offerings and sequencing best serves their students’ academic backgrounds, future job and career paths, and individual professorial strengths and content knowledge.

<table>
<thead>
<tr>
<th>Required Major-Biology Specific Content Areas</th>
<th>Course Credits</th>
<th>Typical MnTC Goal Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Credit Minimum</td>
<td></td>
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</tr>
<tr>
<td>General biology I (Required for all subsequent biology courses)</td>
<td>4-5 credits</td>
<td>3</td>
</tr>
<tr>
<td>General biology II</td>
<td>4-5 credits</td>
<td>3</td>
</tr>
<tr>
<td>Genetics with lab</td>
<td>4-5 credits</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required General Electives Content Areas</th>
<th>Course Credits</th>
<th>Typical MnTC Goal Area</th>
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</thead>
<tbody>
<tr>
<td>Students transferring under the Biology transfer pathway must complete the following content areas</td>
<td></td>
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<tr>
<td>Written Communication</td>
<td>3-4 credits</td>
<td>1</td>
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<tr>
<td>Oral Communication</td>
<td>3-4 credits</td>
<td>1</td>
</tr>
<tr>
<td>College Algebra or higher (Depending on receiving institution and program)</td>
<td>6-8 credits</td>
<td>4</td>
</tr>
<tr>
<td>Goal 5 elective</td>
<td>3 credits</td>
<td>5</td>
</tr>
<tr>
<td>Goal 6 elective</td>
<td>3 credits</td>
<td>6</td>
</tr>
<tr>
<td>General Chemistry I</td>
<td>4-5 credits</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry II</td>
<td>4-5 credits</td>
<td>3</td>
</tr>
<tr>
<td><strong>Restricted biology electives – choose 1 of the 3 based on transfer University destination, and Biology track into which you intend to transfer</strong></td>
<td>Course Credits</td>
<td>Typical MnTC Goal Area</td>
</tr>
<tr>
<td>General Ecology with lab</td>
<td>4 credits</td>
<td>3 and possible 10</td>
</tr>
<tr>
<td>Microbiology with lab</td>
<td>4 credits</td>
<td>3</td>
</tr>
<tr>
<td>Cell Biology with lab</td>
<td>4 credits</td>
<td>3</td>
</tr>
</tbody>
</table>

*Goal area requirements for the AS requires 6 of 10 goal areas (30 credit minimum).
**A course may satisfy more than one goal area – common for Goal areas 7, 8, 9, and 10
Non-binding suggestions for useful elective courses within the sciences – should be tailored to specific major track and transfer University.

- GIS/Geography
- Geology or Earth sciences
- Higher level math courses such as Calculus, Applied statistics, Biostats, Regression analysis
- Anatomy and Physiology
- Organic Chemistry I and II
- Physics
- Environmental science
4. It should be stressed that these are not course designs, but rather suggested content lists that a campus will use to ensure their students have the suggested skills by the time of transfer – covered within the 16 credits of biology courses.

I. Cell Biology

A. Biological Molecules
   1. Structure and Properties of proteins, nucleic acids, carbohydrates and lipids
      a. Types of each category
      b. Monomer/polymer
      c. Structural modifications
      d. Synthesis
      e. Cellular destinations of biomolecules
   2. Molecular interactions
   3. Functions of each group of biologic molecules
   4. Assembly of complex macromolecules

B. Metabolism
   1. Laws of Thermodynamics
   2. Aerobic, anaerobic respiration and fermentation
   3. Photosynthesis
   4. Role of enzymes in cellular processes
   5. Cellular regulation of metabolic processes

C. Cell Types
   1. Prokaryotes
   2. Eukaryotes
      a. Animal, plant and fungi
   3. Achaea
   4. Microscopic appearance of cells

D. Structure of Cellular Components
   1. Cytoplasm
   2. Cellular organelles
      a. Membrane bound
      b. Non-membrane bound
   3. Cytoskeleton
   4. Extracellular matrix
   5. Microscopic appearance of cellular structures

E. Function of Cellular Components
   1. Transport across membranes
   2. Intracellular membrane transport
3. Functions of cellular organelles  
4. Functions of cytoskeleton, extracellular matrix

F. Cellular Communication  
1. Receptor pathways  
2. Types of cellular signaling  
3. Cellular junctions  
4. Cellular adhesions

G. Cell Cycle  
1. Stages of cell cycle  
2. Regulation of the cell cycle  
3. Cellular differentiation  
   a. Stem cells

H. Apoptosis  
1. Extrinsic and intrinsic pathways

I. Lab Skills unique to cell biology  
1. Microscopy  
2. Sterile/Aseptic Techniques  
3. Centrifugation  
4. Spectroscopy

II. Organismal and Evolution

A. Describe Evolution by Natural Selection as the engine of organismal diversity  
1. Explain the history and misconceptions surrounding Darwin's Theory of Natural Selection  
2. Define characteristics of populations that allow natural selection (variation, etc.)  
3. Explain the Hardy-Weinberg Principal and associated “agents of evolutionary change”  
4. Describe mechanisms of reproductive isolation

B. Explain the classification of organisms  
1. Define the Domains  
2. Distinguish between Prokaryotes and Eukaryotes; single cell and multi-celled organisms  
3. Explain endosymbiotic acquisition of mitochondria and chloroplasts  
4. Describe Protists  
5. Explain paraphyly and ramifications (i.e. Supergroups)  
6. Define the Kingdoms
C. Describe diversity
   1. Compare and contrast Plantae, Fungi, and Animalia - Including as applicable:
      a. life cycles,
      b. structure/anatomy,
      c. adaptations,
      d. physiology,
      e. co-evolution
      f. Ecological and population interactions

D. Lab Skills unique to organismal evolution

III. Genetics

A. Nature of Genetic Information
   1. Compare and contrast DNA and RNA molecules.
   2. Compare and contrast eukaryotic and prokaryotic genes and chromosomal organization.
   3. Differentiate between a gene and an allele, and recognize that genes may have many alleles.
   4. Eukaryotic DNA packaging
   5. Ploidy
   6. DNA replication, transcription, and translation.
   7. Genetic information flows from DNA to mRNA to protein, but that there are important exceptions.

B. Gene Expression
   1. Genes and the environment interact to produce a specific phenotype.
   2. Types of RNA and their roles
   3. Different types of cells express different genes, even though they contain the same DNA.
   4. Roles of DNA modification, histone modification, and non-coding RNA in epigenetic inheritance.

C. Inheritance
   1. Compare and explain the inheritance of germline and somatic mutations and epigenetic states.
   2. Cell cycle events in meiosis
   3. Explain how meiosis is different from mitosis.
   4. Synapsis and crossing over vs. assortment in generating diversity of gametes
   5. Aneuploidy.
   6. Probability of a particular gamete being produced from an individual,
      a. assuming independent segregation.
      b. random union of gametes between two individuals using Punnett squares and other approaches.
   7. Nuclear and non-nuclear genetic information.
8. analyze pedigrees
9. “Dominant” and “recessive” are context dependent and may differ at the cellular or organismal levels.
10. Test crosses, back crosses, and complementation tests.
11. The biochemical and genetic mechanisms behind epistasis, pleiotropy, and quantitative traits.
12. Perform a chi-square test.
13. Gene linkage and genetic map distances

D. Variation
1. Molecular mechanisms of random mutations.
2. Role of mobile DNA in driving evolution or gene changes.
3. All living organisms share a common ancestor.
4. Species evolve over time,
5. New species can arise when allele frequencies change due to mutation, natural selection, gene flow, and genetic drift.
6. Hardy-Weinberg Equilibrium (HWE), and how non-random mating affects allele and genotype frequencies.
7. Deviations from Hardy-Weinberg equilibria and what they mean for the evolution of species.
8. Model organisms, such as yeast, nematode worms, and fruit flies to study human genes and human genetic diseases.

J. Lab Skills unique to genetics
1. Production and analysis of genetic crosses,
2. Cytogenetics
3. DNA isolation and electrophoresis
4. Handling and genetic analysis of microbes,
5. Basic recombinant DNA techniques such as restriction digests and bacterial transformation,
6. Use of computers to access information from online databases, in data analysis and in the simulation of biological systems.
IV. Ecology

The Nature of Ecology

1. Explain the development of ecology as a sub-discipline in the field of biology and its role in investigating and providing insight into current problems faced by society.

Evolutionary Ecology

1. Explain the role that ecological interactions play in producing evolutionary change (e.g., adaptation and natural selection).

Physical Environment

Describe the key elements of the physical environment (climate, water, and soil) that shape the lives of organisms.

Physiological Ecology and Life History

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

Explain the factors that influence the development of an organism’s life history.

Population Ecology

Explain and apply principles and mechanisms of population growth and population regulation,

- Properties of population
- Population growth
- Life history
- Intraspecific regulation
- Species interactions and population dynamics

Community Ecology

Describe the principle interactions that operate in communities and their implications on biodiversity

- Interspecific competition
- Predation
- Symbioses
- Community structure and dynamics

Ecosystem Ecology

Explain energy flow through food webs with regard to primary, secondary productivity, and decomposition.

- Ecosystem energetics
- Decomposition and nutrient cycling
Biogeochemical cycles

Ecosystem survey

Societal Implications and Applications
Social, economic, ethical, and cultural issues

Lab Skills unique to ecology

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

Formulate testable hypotheses, collect and analyze ecological data, and express quantitative conclusions
V. Skills (cross-cutting across the curriculum)

A. Scientific Method
Science is a process of trial and error by which we hope to improve our understanding of the natural world incrementally, by making predictions, testing them, and improving their accuracy. The Scientific Method includes the ability to propose testable hypotheses and carry out experiments to test them, and relies on standardized international systems of measurement.

B. Data Interpretation and Statistical Analysis
Students should be able to analyze simple data sets using appropriate descriptive and inferential statistics.

C. Navigating and Reading the Scientific Literature
Students should be able to use public literature databases to find appropriate published material, and should be able to read, understand, and evaluate the validity and importance of the scientific literature and to integrate new concepts into their existing knowledge frameworks.

D. Scientific Communication
Students should be able to communicate their own and others data and analysis in oral and written format, using computers where necessary to visualize data or to create clear and compelling papers, posters, or presentations.

E. Science and Society/Civic Engagement
Students should be able to analyze scientific studies in light of their ecological, social, economic, ethical, and cultural implications.

F. Collaboration

G. Interdisciplinary nature of science

H. Microscopy
Transfer Pathway Revision and Assessment

1. Once a statewide transfer pathway has been approved, no amendments to the agreement will be considered within the initial six (6) months of the transfer pathway. After that time, an institution may send a proposed amendment to the Transfer Pathways Coordinating Team (TPCT) for review.

2. Any amendment to the approved pathway must be forwarded to the TPCT. If the TPCT determines the change to be substantive, they will recall the discipline TPT for review. If the amendment is not substantive, the TPCT will have at least thirty (30) days to review, comment and approve or deny the proposed amendments.
   a. The TPCT will exercise the responsibility for monitoring the effectiveness of the transfer pathway and its implementation.
   b. The system office shall collect data annually from the institutions that will enable the TPCT to assess the effectiveness of the transfer pathways in fostering a seamless transfer process and the academic success of the transfer students at the senior institutions.

3. Institutional Resolution of Disputes
   a. In the event that an associate degree institution considers the decision of a bachelor degree institution to be inconsistent with this transfer pathway, the associate degree institution shall consult directly with the bachelor degree institution and attempt to resolve the matter.
   b. If the institutions are unable to resolve the issue, the associate degree institution may submit their concern to the system office. The system office will act according to the policies and procedures developed by the TPCT as part of the statewide transfer pathways to baccalaureate degree. The determination made by the system office will be binding upon the parties.

4. Implementation Date and Availability
   a. Having fulfilled the requirements outlined in the transfer pathway to baccalaureate degree, students transferring with an AS degree from a participating institution will be considered by the receiving baccalaureate institution to have received adequate preparation in the field of study at the foundation level and therefore eligible to transfer as a junior into advance major coursework.
   b. Participating institutions will enact the transfer pathway in accordance to the timeline outlined by the TPCT, but no later than fall 2017.
   c. Continuation of the agreement remains in effect until such time as all cooperating institutions of the statewide transfer pathways to baccalaureate degree finally approve any revisions.

5. It’s proposed that there should be an annual discipline meeting among representatives from all community colleges and universities in the system to review agreement, objectives, and alignment.
GLOSSARY OF TERMS

Advanced Coursework: Courses with advanced depth of content knowledge in the field of study and carry the expectation of more complex competencies identified in the expected student learning outcomes is referred to as advanced coursework. These courses often have prerequisites and are usually beyond the “Introduction to…” or “Foundation of…” level.

Associate of Arts (AA), Associate of Science (AS) Degree, Associate of Fine Arts (AFA) Degree: A degree consisting of at least 60 college-level credits and designed for transfer into a baccalaureate degree program.

Career, Technical or Applied Courses: Courses that are part of a career degree that are very specific and normally do not have an equivalent course at the university.

Competency: Includes knowledge, skills, and demonstrated abilities the student develops from studying the required coursework and engaging in the experiential learning experiences of the degree.

Content: Specific topic areas and depth of instruction of the topic areas that need to be addressed for the student to be successful upon transfer. The content should align with competencies and be delineated in the agreement.

Direct Entry Student: A student who entered a given college or university without first matriculating at another college.

Foundation Coursework (Core/Beginning): Courses at a level of comprehension usually associated with freshman and sophomore students and typically offered during the first half of a baccalaureate degree program. Such coursework typically does not have course prerequisites or if they do, it is a lower division course.

MnTC Framework: The number of credits and goal areas required for each associate degree type: AA – 40 credits and 10 goal areas; AS – 30 credits and 6 goal areas; AFA Theatre - 40 credits and 10 goal areas; AFA Music - 30 credits and 6 goal areas; AFA Art and all others – 24 credits and 6 goal areas.

Parallel Baccalaureate Degree: A bachelor degree program in a comparable field of study and with similar foundation-level major-specific competencies as an associate degree program.

Pathway(s): The aligning of curriculum between institutions of higher education to ensure the efficient and effective movement of students among those institutions.

Receiving Institution: The college or university where a transfer student plans to enroll and to apply previously earned credit toward a degree program.

Transfer: The process by which a student moves from one postsecondary institution to another. Also refers to the mechanics of credit, course and curriculum exchange between institutions.

Transfer Credit: The credit granted by a college or university for college-level courses or other academic work completed at another institution.

Transfer Student: A student who enters a participating college or university after earning college-level credit at another college or university.
APPENDIX:

*Hypothetical schedule for a student who follows the criteria listed above

<table>
<thead>
<tr>
<th>Community College (Biology AS) — 60 Credits</th>
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<tbody>
<tr>
<td><strong>Semester One (14 - 18 Credits)</strong></td>
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<tr>
<td>Written communication</td>
</tr>
<tr>
<td>College Algebra [or higher level math]</td>
</tr>
<tr>
<td>General Chemistry I</td>
</tr>
<tr>
<td>General Biology I</td>
</tr>
<tr>
<td><strong>Semester Two (14-17 Credits)</strong></td>
</tr>
<tr>
<td>Oral communication</td>
</tr>
<tr>
<td>College Algebra [or higher level math]</td>
</tr>
<tr>
<td>General Chemistry II</td>
</tr>
<tr>
<td>General Biology II</td>
</tr>
<tr>
<td><strong>Semester Three (14-16 Credits)</strong></td>
</tr>
<tr>
<td>MnTC goal 5 elective</td>
</tr>
<tr>
<td>Genetics</td>
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<tr>
<td>Elective for transfer destination</td>
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<tr>
<td>Elective for transfer destination</td>
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<tr>
<td><strong>Semester Four (14-16 Credits)</strong></td>
</tr>
<tr>
<td>MnTC goal 6 elective</td>
</tr>
<tr>
<td>Restricted Biology elective</td>
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<tr>
<td>Elective for transfer destination</td>
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<tr>
<td>Elective for transfer destination</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>University — Exact coursework depends on track within the major. 60 Credits</th>
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<tbody>
<tr>
<td><strong>Semester Five (16 Credits)</strong></td>
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<tr>
<td><strong>Semester Six (16 Credits)</strong></td>
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| **Semester Seven (16 Credits)** |
| **Semester Eight (12 Credits)** |

<table>
<thead>
<tr>
<th>Credit Breakdown</th>
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<tbody>
<tr>
<td><strong>MnTC Electives at Community College</strong></td>
</tr>
<tr>
<td><strong>Transfer Biology/Chemistry/Math at CC</strong></td>
</tr>
<tr>
<td><strong>Elective CC Courses</strong></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>Upper Division Major credits</strong></td>
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<tr>
<td><strong>Lower Division Major credits</strong></td>
</tr>
<tr>
<td><strong>MnTC credits</strong></td>
</tr>
<tr>
<td><strong>Electives</strong></td>
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<tr>
<td><strong>TOTAL</strong></td>
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</tbody>
</table>
APPENDIX A – UNIVERSITY GPA and COURSE GRADE TRANSFER REQUIREMENTS

Bemidji State University - 2.25 GPA; Major courses with a “C” or higher

Metropolitan State University - Foundation Courses with "C-" or higher

Minnesota State University, Mankato – minimum cumulative GPA of 2.2, with a cumulative GPA in Biology courses of 2.0

Minnesota State University, Moorhead

Southwest Minnesota State University – Students must have an overall GPA of at least 2.0 in Biology courses applied towards the major or minor requirements. Students must have an overall GPA of at least 2.0 in Related Fields courses required for the Biology major.

St. Cloud State University – 2.5 GPA

Winona State University - GPA 2.0, completion of specific courses with "C" or higher