

# Discrete Mathematics Unit 1: Logic

## Desired Results (Stage 1)

### Established Competencies

Students will demonstrate the ability to use mathematical reasoning in order to comprehend and construct mathematical arguments.

### Acquisition

*Students will know...*

1. The rules of logic give precise meaning to mathematical statements and are used to distinguish between valid and invalid arguments.
2. Predicate logic can be used to express the meaning of a wide range of statements in mathematics and computer science in ways that permit us to reason and explore relationships between objects.
3. Existential, universal, and nested quantifiers can be used to represent mathematical statements and can be used to translate English sentences into mathematical statements.

*Students will be skilled at...*

1. Students will analyze mathematical statements using propositional and predicate logic.
2. Students will apply propositional logic to translations of English sentences and to Boolean searches, logic puzzles, and logic circuits.
3. Students will analyze and construct tautologies and contradictions.
4. Students will apply the rules of inferences in propositional logic and for quantified statements in order to produce valid arguments.

<b>Evidence (Stage 2)</b>	
<b>Evaluative Criteria</b>	<b>Assessment Evidence</b>
open-response test with partial credit awarded using the Marzano rubric	<i>Final Summative Assessment for the unit is an open-response test.</i>
truth table accuracy check, translations accuracy check, School-wide problem-solving rubric, cooperative work rubric, activity mini-rubric	<p>Other Evidence</p> <p>Truth table constructions, mathematical translations of English arguments, logic puzzles, small group poster-activity on logic circuits, small group Lewis Carroll's <i>Symbolic Logic</i> activity</p>

## **Discrete Mathematics Competencies**

Competency 1: Students will demonstrate the ability to use mathematical reasoning in order to comprehend and construct mathematical arguments.

Competency 2: Students will demonstrate the ability to perform combinatorial analysis in order to solve counting problems and analyze algorithms.

Competency 3: Students will demonstrate the ability to work with discrete structures, including sets, permutations, relations, graphs, trees, and finite-state machines.

Competency 4: Students will demonstrate an ability to model with discrete mathematics in order to solve problems across diverse areas of study, such as chemistry, business, computer science, and linguistics.

## Competency Rubrics for Discrete Mathematics

**Competency 1: Students will demonstrate the ability to use mathematical reasoning in order to comprehend and construct mathematical arguments.**

1 - Novice	2 - Developing	3 - Effective	4 - Advanced
<ul style="list-style-type: none"> <li>• recognizes the application of logic to practical applications</li> <li>• knows the vocabulary &amp; notation of logic</li> <li>• knows the components of proofs</li> <li>• comprehends the reasoning behind simple proofs</li> </ul>	<ul style="list-style-type: none"> <li>• applies logic to an application similar to one already modeled</li> <li>• writes propositions</li> <li>• distinguishes between valid and invalid arguments</li> <li>• understands logical equivalences</li> <li>• constructs mathematical arguments using a few methods of proof</li> <li>• comprehends simple proofs</li> </ul>	<ul style="list-style-type: none"> <li>• applies logic to a similar application already modeled</li> <li>• uses compound and conditional propositions and propositional equivalences</li> <li>• creates and adapts valid and invalid arguments</li> <li>• constructs mathematical arguments using some methods of proof</li> <li>• comprehends complex proofs</li> </ul>	<ul style="list-style-type: none"> <li>• applies logic to varied practical applications</li> <li>• constructs new logical equivalences</li> <li>• applies quantifiers to practical applications</li> <li>• constructs mathematical arguments using many different methods of proof</li> <li>• modifies and adapts a proof to a new situation</li> </ul>

**Competency 2: Students will demonstrate the ability to perform combinatorial analysis in order to solve counting problems and analyze algorithms.**

<b>1 – Novice</b>	<b>2 – Developing</b>	<b>3 – Effective</b>	<b>4 – Advanced</b>
<ul style="list-style-type: none"> <li>• understands the basic rules of counting</li> <li>• solves formulae when provided the data</li> <li>• understands the terminology of combinatorics</li> <li>• identifies various counting principles</li> </ul>	<ul style="list-style-type: none"> <li>• performs simple exercises using the techniques of counting</li> <li>• applies formulae to solve modeled problems</li> <li>• evaluates principles being studied for given values</li> </ul>	<ul style="list-style-type: none"> <li>• performs complex exercises using the techniques of counting</li> <li>• applies counting techniques to problems similar to those modeled for the student</li> <li>• explains how counting rules can be used to solve problems</li> <li>• determines which principle should be applied to solve a problem</li> </ul>	<ul style="list-style-type: none"> <li>• applies the techniques of counting to new situations</li> <li>• performs unguided combinatorial analysis to solve counting problems</li> <li>• performs unguided combinatorial analysis to analyze algorithms</li> </ul>

**Competency 3: Students will demonstrate the ability to work with discrete structures, including sets, permutations, relations, graphs, tress, and finite-state machines.**

<b>1 – Novice</b>	<b>2 – Developing</b>	<b>3 – Effective</b>	<b>4 – Advanced</b>
<ul style="list-style-type: none"> <li>• uses a function to build a set</li> <li>• calculates a given summation</li> <li>• performs basic operations of matrices</li> </ul>	<ul style="list-style-type: none"> <li>• uses a function to determine the size of a set</li> <li>• evaluates a given summation</li> <li>• evaluates expressions involving matrix operations</li> </ul>	<ul style="list-style-type: none"> <li>• uses a function to represent the computational complexity of an algorithm</li> <li>• determines what summations are appropriate in various situations</li> <li>• models discrete structures with matrices</li> </ul>	<ul style="list-style-type: none"> <li>• determines the best type of function to apply to a problem</li> <li>• uses summations to analyze problems</li> <li>• uses matrices as a tool in evaluating relations and graphs</li> </ul>

**Competency 4: Students will demonstrate an ability to model with discrete mathematics in order to solve problems across diverse areas of study, such as chemistry, business, computer science, and linguistics.**

1 – Novice	2 – Developing	3 – Effective	4 – Advanced
<ul style="list-style-type: none"> <li>• uses provided discrete mathematic tools to solve simple word problems</li> <li>• states answers with proper units</li> </ul>	<ul style="list-style-type: none"> <li>• uses provided discrete mathematic tools to solve clearly defined word problems</li> <li>• uses multiple steps to solve word problems</li> <li>• states answer in the context of the problem</li> </ul>	<ul style="list-style-type: none"> <li>• determines what discrete mathematics tools are appropriate to solve a given problem</li> <li>• determines if an answer is reasonable</li> <li>• explains to others how the mathematics is an appropriate representation of the problem</li> </ul>	<ul style="list-style-type: none"> <li>• when faced with a complex problem, determines what tools will most efficiently provide a solution</li> <li>• as part of a problem analysis, decides how many and what types of solutions are possible</li> <li>• provides written justification for the use of a chosen mathematical model</li> </ul>



Total \$0 – contingent on budgetary approval for Geography of Life

Documents needed upon submission

- Course Description
- Course Scope and Sequence
- Course Syllabus
- Course Competencies
- Course Curriculum Outline in UBD format
- List of standards (NH and National) addressed
- List of suggested text and support materials needed to carry out curriculum

Signature of Applicant \_\_\_\_\_ Date \_\_\_\_\_

Signature of Teacher Leader \_\_\_\_\_ Date \_\_\_\_\_  
(This course approval has been submitted to and approved by the department.)

Signature of Curr Co. \_\_\_\_\_ Date \_\_\_\_\_

Signature of Principal \_\_\_\_\_ Date \_\_\_\_\_