Instructional Plan for the Course, *Think Like a Programmer*

SCOPE OF COURSE UNITS

SEQUENCE OF COURSE UNITS

UNIT TITLES	MASS. FRAMEWORK STRAND AND STANDARD	INTENDED LEARNING OUTCOMES "The learners will ..."	ACTIVITIES (Instructional Foci)	GENERAL TEACHING STRATEGIES	ASSESSMENT TOOLS	RESOURCES
Unit 1 **Math Skills**	**3.B Mathematics** 3.B.03C Given the formulas, convert from one system of measurement to another. Use technology as appropriate.	Demonstrate the rudimentary mathematics skills required to find the solutions to word problems.	Instructor will reinforce and re-teach, as necessary, the fundamental math skills necessary to solve problems which in turn serve as the basis for computer programs. Instructor will demonstrate sample problems representative of the types that students will be required to complete. Students will complete worksheets intended to identify areas where students require review or re-teaching. Students will compete in a Jeopardy-style Q&A game intended to develop and exercise their mathematics skills.	Initial instructional activities will consist of **pre-test** to determine the current level of understanding possessed by each student. This will be followed by some **lecturing** by the teacher. The focus of this lecturing will be to **review** and **re-teach** mathematics content and assist students who may not have fully acquired the knowledge. **Instructional Technology** will also be employed through the use of mathematics related websites including **videos** and instructional **games.** **Cooperative learning and Guided practice** will also be used as students work on problems. By allowing students to work in structured groups, it is expected that student engagement will remain high.	Formative assessments will include: • the use of hands-on worksheets where students will work on individually, as well as in small groups. • observation of students working with Instructional Technology. • problem solving through the use of math manipulatives. • Educational game play. Summative Assessments will consist of Tests and Quizzes intended to determine students have gained mastery of rudimentary mathematics skills and are prepared to complete challenging word problems.	*Algebra Teacher's Activities Kit 150 Ready-to-Use Activities with Real World Applications* Judith A. Muschala, Gary Robert Muschala 2003 Websites: *http://www.education.com/activity/high-school/math/* https://www.khanacademy.org/

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Unit 2 **Solving Math Word Problems**	**3.B Mathematics** 3.B.03C Given the formulas, convert from one system of measurement to another. Use technology as appropriate. 3.B.04C Compare, order, estimate, and translate among integers, fractions and mixed numbers (i.e., rational numbers), decimals, and percents. 3.B.05C Solve linear equations using tables, graphs, models, and algebraic methods. 3.B.06C Use linear equations to model and analyze problems involving proportional relationships. Use technology as appropriate.	Select the appropriate theoretical concepts for solving word problems and correctly set up mathematical equations based on the information provided within the problem. Read and comprehend a problem statement (word problem), then synthesize the problem into a mathematical equation or sequence of equations necessary to solve the problem.	Instructor will reinforce and re-teach, as necessary, the problem solving thought process employed to solve word problems representative of those that the students will be required to solve. Instructor will demonstrate sample problems representative of the types that students will be required to complete. Students will complete worksheets intended to identify areas where students require review or re-teaching.	Instructor will **present** a **review** of mathematical problem solving. If necessary, the teacher will **re-teach** the skills that are required to solve math word problems. **Instructional Technology** will also be employed through the use of mathematics related websites including instructional **videos** and examples. **Cooperative learning** and **Guided practice** will be utilized as students work on problems. By allowing students to work in structured groups, it is expected that student engagement will remain high. In some instances, students will be asked to **brainstorm** the process within small groups and then derive their solutions independently.	Formative assessments will include: • the use of hands-on worksheets where students will work on individually, as well as in small groups. • observation of students working with Instructional Technology. • observation of students as they brainstorm within small groups. Summative Assessments will consist of Tests and Quizzes intended to determine students have gained mastery of word problem solving skills. If so, they are prepared to move on to developing logic and reasoning skills which are essential to their ability to develop algorithms which will allow them to computers to solve advanced word problems.	*Make it Simpler: A Practical Guide To Problem Solving in Mathematics* Carol Meyer, Tom Sallee 1983 Websites: *http://www.education.com/activity/high-school/math/* https://www.khanacademy.org/

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Unit 3 **Logic and Reasoning Skills**	**2.B Elements of Software Development** 2.B.01.01 Discover and document a problem. 2.B.01.02 Determine a problem's possible causes. 2.B.01.03 Use known information for problem solving. 2.B.01.04 Use reference materials for problem solving. 2.B.01.05 Apply gathered information to the problem. 2.B.01.06 Formulate possible solutions to the problem.	Select the appropriate theoretical concepts for solving word problems and correctly set up mathematical equations based on the information provided within the problem. Read and comprehend a problem statement (word problem), then synthesize the problem into a mathematical equation or sequence of equations necessary to solve the problem.	Instructor will teach and reinforce, as necessary, the problem solving thought process necessary to develop solutions to logic problems representative of those that the students will be required to solve. Instructor will demonstrate determining solutions to a set of sample problems representative of the types that students will be required to complete. Students will complete worksheets and other activities intended to identify areas where students might require additional instruction and/or practice.	Instructor will **present** an introduction to logical thinking and problem solving. Students will then be presented with increasingly complex logic puzzles to solve. Instructor will moderate discussions regarding the logical thought processes employed by students in solving problems, providing guidance in the form of guiding questions as students reach impasses. **Instructional Technology** will also be employed through the use of logical thinking related websites including instructional videos, logic games and puzzles and examples. **Cooperative learning** and **Guided practice** will be utilized as students work on problems. By allowing students to work in structured groups, it is expected that student engagement will remain high. In some instances, students will be asked to **brainstorm** the process within small groups and then derive their solutions independently.	Formative assessments will include: • the use of hands-on worksheets where students will work on individually, as well as in small groups. • observation of students working with Instructional Technology. • observation of students as they brainstorm within small groups. Summative Assessments will consist of Tests and Quizzes intended to determine students have gained mastery of logic and reasoning skills. If so, they are prepared to move on to developing algorithms to allow computer programs to solve advanced word problems.	Logic Games: http://www.plastelina.net/games/game2.html http://www.indiabix.com/logical-reasoning/questions-and-answers/

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Unit 4 **Developing Programming Algorithms**	**2.N Explain Fundamental Programming Theory** 2.N.06 Analyze a problem identifying desired outputs for given inputs. **2.P Develop Programs** 2.P.04 Explain and apply the use of logical operators. 2.P.05 Explain and apply compound conditions. 2.P.06 Explain and apply control breaks. 2.P.07 Explain and apply methods of calculating subtotals and final totals. 2.P.08 Explain and apply iterative and conditional loops.	Read and comprehend a problem statement (word problem), then synthesize the problem into a mathematical equation or sequence of equations necessary to solve the problem. Formalize their solution strategy by developing a sequence of steps (algorithm)that can be used to solve the problem.	Instructor will provide instruction on the formulation of an algorithm and it's use as a means to solve a problem. During the instruction, the teacher will demonstrate sample problems representative of the types that students will be required to complete. Students will then be asked to complete exercises which will allow them to develop their skills at creating algorithms in response to specific problems. Students will then work in small groups to develop an algorithm to solve a specific assigned programming problem. Students will create a short Powerpoint presentation and report out to the class on the algorithm they have developed.	Instructional Strategies that will be employed during this unit include **lecture** on the formulation of algorithms. This **lecture** will utilize a Powerpoint presentation and be supplemented by handouts and a **demonstration.** **Group discussion** will follow the **lecture,** accompanied by **teacher questions** intended to stimulate student thinking. At the conclusion of the group discussion, students will be broken into small, **cooperative learning groups** for **Problem-based learning** where students are asked to **brainstorm** and apply concepts that they have just been exposed to. Once students have completed the development of an algorithm for their assigned problem they will deliver an **Oral presentation/ exhibition** explaining their algorithm. Students will be asked to develop algorithms for several other problems.	Assessment of students understanding of and ability to comprehend algorithms will be completed by: • Evaluating algorithms developed by the student(s) in response to problems that are provided to them. • Having students complete worksheets where they are asked to select from a group of algorithms and select the one which provides the solution to a problem at hand.	*Think like a programmer : an Introduction to Creative Problem Solving* Author: V Anton Spraul 2012. *Introduction to Flow Charting and Computer Programming Logic* Gary B. Shelly, Thomas J. Cashman https://www.draw.io/

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Unit 5 **Flow Charts and Pseudocode**	**2.N Explain Fundamental Programming Theory** 2.N.08 Design program logic using graphical techniques (flow charts). 2.N.09 Design program logic using pseudocode techniques.	Represent the algorithm/ programming logic graphically, as a flow chart. Represent the programming methods that will be employed to implement the solution depicted by the flow chart, using pseudocode.	At separate times, the instructor will provide instruction on the process of creating flow charts and on the process of converting a flow chart into pseudocode. Instructor will demonstrate the creation of sample flow charts and the writing of pseudocode for a given problem. Students will complete worksheets to verify that they have acquired the skills necessary to produce flow charts and pseudocode. Students will produce flow charts and pseudocode which represent the algorithms they have developed to solve the programming problems.	Instructional Strategies that will be employed during this unit include a **lecture** on the meaning of the symbols used in flow charting. A later lecture will cover the representation of a programming algorithm using pseudocode. Both **lectures** will utilize Powerpoint presentations and will be supplemented by handouts and **demonstrations.** **Group discussion** will follow the **lecture,** accompanied by **teacher questions** intended to stimulate student thinking. Students will then be asked to complete **Problem-based learning** by developing flow charts and pseudocode that represent the algorithms they develop as solutions to the programming problems.	Formative Assessment will consist of the evaluation of the student work product, the flow charts and pseudocode produced by the students. • Flow charts produced by the students should indicate the same processes that were employed when the students solved word problems mathematically. • Pseudocode prepared by the students should employ the processes depicted by the flow chart that corresponds to the particular word problem.	*Introduction to Flow Charting and Computer Programming Logic* Gary B. Shelly, Thomas J. Cashman *Think Python: How to Think Like a Computer Scientist* by Allen B. Downey

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Unit 6 **Writing a Computer Program**	**2.P Develop programs.** 2.P.01 Develop programs using desired language. 2.P.02 Develop programs that use arithmetic operations. 2.P.03 Develop programs that use relational operators. 2.P.04 Explain and apply the use of logical operators. 2.P.05 Explain and apply compound conditions. 2.P.06 Explain and apply control breaks. 2.P.07 Explain and apply methods of calculating subtotals and final totals. 2.P.08 Explain and apply iterative and conditional loops.	Implement the algorithm represented by the pseudocode developed in earlier units using the Python programming language. Execute the application they've developed in the Python interpreter.	Instructor will provide students with basic instruction in programming using the Python language. Students will complete the instructional activities on the Code Academy website. Students will review online course material on the MIT website. Students will develop programs using Python that implement the algorithms they developed and represented using flow charts and pseudocode. Students will test the applications that they've developed to verify that they meet the requirements of the original problem and are also aligned with the flow chart and pseudocode developed by the student.	Instructional Strategies that will be employed during this unit include **lecture** on the Python programming language. This **lecture** will utilize a Powerpoint presentation and be supplemented by handouts and several **demonstrations.** **Problem Based Learning and Project design** are two additional instructional strategies that will be employed as student integrate their skills and knowledge to produce functional software applications that are implementations of the algorithms that they've designed.	Assessment of Unit 5 will consist of the evaluation of how well the student developed programs meet the original problem statement. In addition, the programs will be evaluated against how well they match what is represented by the student's flow charts and pseudocode.	*Think Python: How to Think Like a Computer Scientist* by Allen B. Downey Websites: http://www.codecademy.com/ http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-189-a-gentle-introduction-to-programming-using-python-january-iap-2011/