Modeling Our World With Mathematics (MOWWM)

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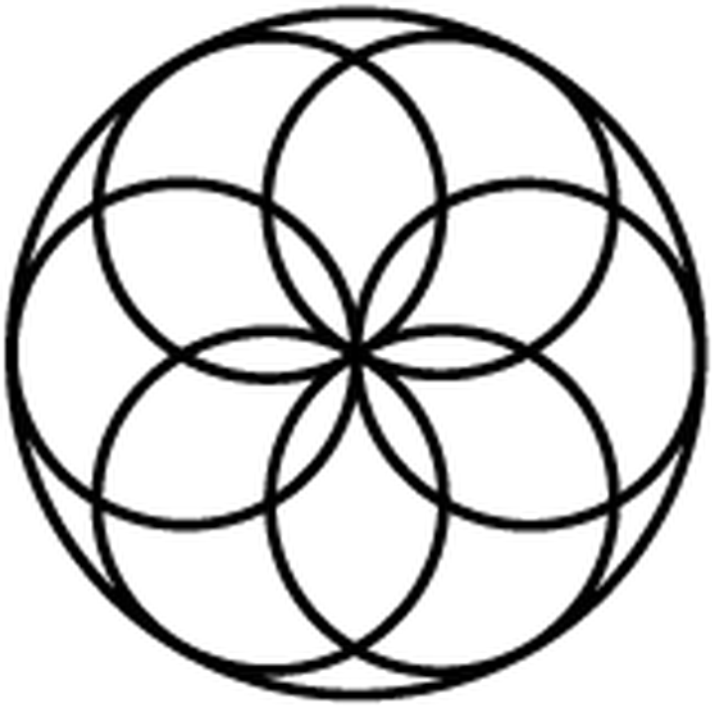

Overview

Modeling Our World with Mathematics (MOWWM) is a modularly-designed mathematics course developed by the Washington Office of Superintendent of Public Instruction (OSPI) with input from educators across Washington. The course is designed to follow Geometry.

Units include: Health and Fitness, Civic Readiness, Finances for Life, Environmental Science, and the Arts

Course Description and Topic Progression

Modeling Our World with Mathematics (MOWWM) is a modularly-designed mathematics course developed locally by OSPI with input from educators across Washington, and is designed to follow Geometry. It contains career-connected thematic units where students use high school mathematics to analyze everyday life and work. The content and instructional strategies support increased attainment of the common core high school content standards while developing the standards for mathematical practice.

Thematic Units

Unit	Topic	Content
Getting Started	Lessons and activities to get your students ready for the Modeling Our World with Mathematics (MOWWM) course as well as suggested resources to adapt the course to an online learning environment.	
Health and Fitness	Topic 1: A Healthier You!	Linear Functions & Line of Best Fit
	Topic 2: Sports & Fitness	Linear Functions, Systems of Equations & Inequalities
Environmental Science	Topic 1: Air Quality	Represent & interpret data
	Topic 2: Sustainable Forestry	Sampling, Geometry
Civic Readiness	Topic 1: The United States Census	Represent & interpret data
	Topic 2: Gerrymandering	Represent & interpret data, Modeling with Geometry
Finances for Life	Topic 1: Introduction to Finance	Linear & Exponential Functions, Statistics
	Topic 2: Loans and Consumer Credit	Linear & Exponential Functions
	Topic 3: Business	Linear & Quadratic Functions
Digital World	Topic 1: Digital Presence	Linear & Exponential Functions, Graphing, Best Fit
	Topic 2: Coding	Linear & Exponential Functions, Graphing, Best Fit
The Arts	Topic 1: Catch a Wave with Music	Right Triangle Trigonometry
	Topic 2: Congruence with Art	Congruence, Similarity, Perspective
	Topic 3: Perspective Drawing	Congruence, Similarity, Perspective

Note: The available modules include more material than can be covered in a single course (See BREAKDOWN OF INSTRUCTIONAL DAYS). In selecting which topics to engage with, consider student interest and prioritize topic(s) from **Health and Fitness, Environmental Science, Civic Readiness and Finances for Life** for their inclusion of standards related to essential concepts in high school mathematics. Digital World and The Arts provide additional topics and synthesis of those earlier modules and can be implemented as time permits

.

Related resources

MOWWM Topic Progression 2020-21

Standards Chart

The following table gives a breakdown of what standards appear in each Module. Many of these standards have multiple components. Identification of a standard within a module does not guarantee all parts are addressed.

Standard	Health & Fitness	Environ. Science	Civics Readiness	Finances for Life	Digital World	The Arts
A-APR.1						
A-APR.2						
A-APR.3						
A-APR.4						
A-APR.6						
A-CED.1	x			x	x	
A-CED.2	x			x	x	
A-CED.3	x			x	x	
A-CED.4	x					
A-REI.1	x				x	
A-REI.2	x					
A-REI.3	x	x				
A-REI.4						
A-REI.5	x					
A-REI.6	x			x		
A-REI.7				x		
A-REI.10	x			x	x	
A-REI.11				x		
A-REI.12	x					
A-SSE.1	x	x		x	x	
A-SSE.2					x	
A-SSE.3				x		
A-SSE.4					x	
F-BF.1	x			x	x	

Standard	Health & Fitness	Environ. Science	Civics Readiness	Finances for Life	Digital World	The Arts
F-BF.2	x					
F-BF.3				x		
F-BF.4						
F-IF.1	x			x	x	
F-IF.2	x			x	x	
F-IF.3						
F-IF.4	x			x		
F-IF.5	x			x		
F-IF.6	x			x		
F-IF.7	x			x		
F-IF.8				x	x	
F-IF.9	x			x	x	
F-LE.1	x			x	x	
F-LE.2	x			x	x	
F-LE.3				x	x	
F-LE.4						
F-LE.5				x	x	
F-TF.1						
F-TF.2						x
F-TF.5						x
F-TF.8						
G-CO.1						x
G-CO.2						
G-CO.3						x
G-CO.4						x
G-CO.5						x
G-CO.6						
G-CO.7						

Standard	Health & Fitness	Environ. Science	Civics Readiness	Finances for Life	Digital World	The Arts
G-CO.8						
G-CO.9						
G-CO.10						
G-CO.11						
G-CO.12						
G-CO.13						
G-SRT.1						x
G-SRT.2						x
G-SRT.3						
G-SRT.4						
G-SRT.5						
G-SRT.6						x
G-SRT.7						x
G-SRT.8		x				x
G-C.1						
G-C.2						
G-C.3						
G-C.5		x				
G-GPE.1						
G-GPE.2						
G-GPE.4						
G-GPE.5						
G-GPE.6						x
G-GPE.7						
G-GMD.1		x				
G-GMD.3		x				
G-GMD.4		x				x
G-MG.1		x	x			x

Standard	Health & Fitness	Environ. Science	Civics Readiness	Finances for Life	Digital World	The Arts
G-MG.2		x				
G-MG.3		x	x			x
N-RN.1						
N-RN.2						
N-RN.3						
N-Q.1	x	x		x		x
N-Q.2		x	x	x		
N-Q.3		x	x	x		x
S-ID.1		x	x	x		
S-ID.2		x	x	x		
S-ID.3	x	x	x	x		
S-ID.4						
S-ID.5		x				
S-ID.6	x	x	x		x	
S-ID.7	x	x	x		x	
S-ID.8		x	x		x	
S-ID.9	x					
S-IC.1			x			
S-IC.2			x			
S-IC.3						
S-IC.4						
S-IC.5						
S-IC.6						
S-CP.1						
S-CP.2						
S-CP.3						
S-CP.4						
S-CP.5					x	

Standard	Health & Fitness	Environ. Science	Civics Readiness	Finances for Life	Digital World	The Arts
S-CP.6						
S-CP.7						
S-CP.9					x	
S-MD.1						
S-MD.6			x			
S-MD.7					x	

Related resources

MOWWM Standards Chart 2020-21

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Breakdown of Instructional Days

The following table gives a breakdown of the anticipated number of instructional days* per module. These numbers do not include days for assessments or supplementation. In a typical school year most high school courses would include 130-150 instructional days (or their equivalent), so you will want to select from these available units.

Module	Days for Topic	Total Days
Getting Started		**9**
Health and Fitness		**22**
Topic 1: A Healthier You!	10	
Topic 2: Sports & Fitness	12	
Environmental Science		**32**
Topic 1: Air Quality	21	
Topic 2: Sustainable Forestry	11	
Civic Readiness		**29**
Topic 1: The United States Census	17	
Topic 2: Gerrymandering	12	
Finances for Life		**37**
Topic 1: Introduction to Finance	14	
Topic 2: Loans and Consumer Credit	9	
Topic 3: Business	14	
Digital World		**23**
Topic 1: Cell Phones	16	
Topic 2: Digital Presence	7	
The Arts		**37**
Topic 1: Catch a Wave with Music	12	
Topic 2: Congruence with Art	12	
Topic 3: Perspective Drawing	13	
Total		**189**

* **Note:** When calculating the anticipating number of instructional days, if a lesson lists a range, the greater number was used.

Related resources

MOWWM Instructional Days 2020-21

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Course Philosophy

Vision of Mathematics Education

In July 2011, Washington adopted the Common Core State Standards for Mathematics (CCSS-M) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) as the new Washington State K–12 Learning Standards for Mathematics. These standards replaced the state's 2008 Mathematics Learning Standards. The Washington State K–12 Learning Standards for Mathematics are built on an intentional progression of the skills and knowledge necessary for all students to be ready for career, college, and life when they exit high school. The progressions of learning provide specific focus for each grade level. The standards lay the groundwork for this vision of mathematics that better fits the skills students need to be productive members of society. Building on the work of the National Council of Teachers of Mathematics (NCTM), the vision of mathematics education requires students to be problem solvers, to reason quantitatively and to understand and analyze data. Previously, mathematics programs emphasized computation and memorization. Today, students not only need to be fluent and flexible with numbers and operations, students need the capacity to apply concepts and skills to novel situations, to approach real-world problems with stamina, and to understand that there may be multiple viable solution paths and solutions, depending on the context of the problem and the assumptions of the problem-solver.

Success in mathematics is not reserved for an elite few.

A key component of the Washington State K–12 Learning Standards for Mathematics are the Standards for Mathematical Practice. These standards reflect a key shift in mathematics education and describe the mathematical habits of mind that educators at all levels should seek to develop in their students. The Standards for Mathematical Practice are:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Mathematics instruction, then, should use the mathematical practices to engage students in the mathematics content and develop students as "practitioners of the discipline of mathematics.

Standards for Mathematical Practice (Links to an external site.)

Additionally, the mindset that success in mathematics is reserved for an elite few contradicts mathematics educational research. Many adults assume that differences in mathematics performance reflect differences in innate ability, rather than differences in individual effort or opportunities to learn.

These expectations profoundly underestimate what students can do. The basic principles, concepts, and skills of mathematics are within reach of all students. When parents and teachers alike believe that hard work pays off, and when mathematics is taught and learned by using the knowledge, skills, abilities, and beliefs that constitute mathematical proficiency, mathematics performance improves for all students. Research has demonstrated that mathematical proficiency is an obtainable goal. (The National 29 Academies, p. 30) It is our duty, therefore, to authentically engage all students in the discipline of mathematics as a foundation for reasoning quantitatively, solving rich problems, and analyzing data to make meaning of information and gain proficiency in analyzing and solving problems.

Focus, Coherence, and Rigor

The Washington State K–12 Learning Standards call for shifts in the way we approach mathematics education. The shifts are: •Greater focus on fewer topics•Coherence: Linking content and thinking across grades•Rigor: Pursue conceptual understanding, procedural skills and fluency, and application with equal intensity“Focus” means deep engagement with the major work within each high school course. Rather than racing to cover many topics superficially, the standards ask mathematics teachers to deepen the way time and energy are spent on fewer, key math concepts. “Coherence” requires that content be carefully connected across high school courses, intentionally building on prior knowledge. “Rigor” refers to deep understanding of mathematics concepts. Students must have the opportunity to access concepts from multiple entry points and perspectives. Students must also be fluent with calculations and procedures so they can access more complex concepts and procedures. Finally, students must have the opportunity to apply concepts and procedures to novel situations (Common Core State Standards Initiative, 2015).

Mathematical Representations and Manipulatives

Instruction at all grade levels should incorporate the progressive use of concrete manipulatives, representational models, and abstract symbols (Forbinger & Fuchs, 2014). Much of traditional mathematics instruction focuses on computation and students’ ability to apply procedures quickly and accurately. According to the National Council of Teachers of Mathematics (NCTM), procedural fluency, however, includes “the ability to apply procedures accurately, efficiently, and flexibly; to transfer procedures to different problems and contexts; to build or modify procedures from other procedures; and to recognize when one strategy or procedure is more appropriate to apply than another” (NCTM, 2014b, p.1). This definition of procedural fluency pushes the bounds of traditional mathematics instruction, as it requires foundational knowledge of concepts, reasoning strategies, properties of numbers and operations, and problem-solving methods (NCTM, 2014b). The rigor of the state standards includes balancing conceptual understanding, procedural fluency, and problem solving. Instruction, then, must be balanced to address the mathematics content and practice standards through a variety of approaches.

The use of models or representations to manipulate and communicate about mathematical ideas supports students in making connections among mathematical ideas, understanding computations and procedures, and solving problems. The more ways that students have to think about and test ideas, the better their ability to integrate them into their current conceptual understanding to develop a deep relational understanding. “Strengthening the ability to move between and among representations improves students’ understanding and retention of ideas” (Van de Walle, 2013, p. 22). Mathematical representations can include words, manipulatives, pictures, models, diagrams, equations, and tables and graphs of functions and relationships.

Mathematics Teaching Practices

In 2014, NCTM published a book, Principles to Actions: Ensuring Mathematical Success for All. The principles in this text represent “strongly recommended, research-informed actions for all teachers,

30 coaches, and specialists in mathematics” (NCTM, 2014a, p. 4) including any interventionists who will be working to assist children in their mathematics study. These eight mathematics teaching practices reflect the range of instructional strategies and approaches necessary to promote deep learning of mathematics.

1. **Establish mathematics goals to focus learning.**
“Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions” (NCTM, 2014a, p. 12).
2. **Implement tasks that promote reasoning and problem solving.**
“Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies” (NCTM, 2014a, p. 17).

3. **Use and connect mathematical representations.**
“Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving” (NCTM, 2014a, p. 24).
4. **Facilitate meaningful mathematical discourse.**
“Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments” (NCTM, 2014a, p. 29).
5. **Pose purposeful questions.**
“Effective teaching of mathematics uses purposeful questions to assess and advance students’ reasoning and sense making about important mathematical ideas and relationships” (NCTM, 2014a, p. 35).
6. **Build procedural fluency from conceptual understanding.**
“Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems” (NCTM,2014a, p. 42).
7. **Support productive struggle in learning mathematics.**
“Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships” (NCTM, 2014a, p. 48).
8. **Elicit and use evidence of student thinking.**
“Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning” (NCTM, 201a4, p. 53).

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Related resources

Mathematically Productive Instructional Routines

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