Winchester Math Curriculum Grade 5

Subject	Mathematics
Grade/Course	Grade Five
Unit of Study	Unit Eight - Solar Design
Pacing	May / June
Unit Summary	In this final unit of the year, students design and build scaled model houses that incorporate solar energy features. They begin by investigating different aspects of solar energy—reflection, absorption, concentration—and ways to collect and store the sun's rays. They analyze their data to inform their own design, using both spreadsheet software and paper and pencil methods. While students investigate these science principles, they apply many math skills they've learned throughout the year, including work with fractions, decimals, volume, surface area, conversions within measurement systems, and coordinate graphing. Student teams build model houses that incorporate passive and active solar features, and then test the models to see which designs allow the most collection and storage of solar energy. They create scaled side-view drawings and floor plans and use the plans to build the rooms in their model houses. Finally, students reflect on their learning and prepare for a showcase of their work to share with friends and family.

Overarching Mathematical Practices

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

Unit CT Core Content Standards

5.NBT.B.5
Fluently multiply multi-digit whole numbers using the standard algorithm.

5.NBT.B.6
Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

5.NBT.B.7
Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

5.NF.B.4.A
Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$.

5.NF.B.4.B
Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.

5.NF.B.6
Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

5.NF.B.7.C
Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem.

5.MD.A.1
Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

5.MD.C.5.A
Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.

5.MD.C.5.B
Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.

5.G.A.2
Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

“Unwrapped” Standards	
Skills	**Content**
Fluently multiply	multi-digit whole numbers
Find	● whole-number quotients using strategies ● area of a rectangle with fractional side lengths by tiling
Illustrate and explain	division calculation by using equations, rectangular arrays, and/or area models
Add, subtract, multiply, and divide	decimals to hundredths using concrete models or drawings and strategies

Relate	strategy to a written method
Explain	reasoning used for computation with decimals
Interpret	the product *(a/b)* x *q* as a parts of *a* partition of *q* into *b* equal parts (*a* x *q* ÷ *b*)
Show	area by tiling is the same as multiplying side lengths
Multiply	side lengths to find area of rectangles
Represent	fraction products as rectangular areas
Solve	● real world problems involving multiplication of fractions and mixed numbers ● real world problems involving division of unit fractions by whole numbers and division of whole numbers by unit fractions

Essential Questions	Corresponding Big Ideas
1. What is computational fluency?	1. Computational fluency includes conceptual understanding, the appropriate use of numerical operations and strategies to efficiently determine answers.
2. What are fractions?	2. Fractions are a part of a whole, part of a set, part of an area, and values on a number line.
3. How does explaining my process help me to understand a problem's solution better?	3. A problem solver understands what has been done, knows why the process was appropriate, and can support it with reasons and evidence.

Evidence of Learning - Assessment

Pre/Post Assessment	Interim Assessment	Additional Evidence of Learning
● May - Number Corner Checkup 4 ● June - Comprehensive Growth Assessment		Options ● Exit Tickets Observational Assessments ● Choosing Our Materials - M3, S4 ● Student Model House Design - M3, S5 ● Testing Out Final House - M4, S1 ●

Smarter Balanced Interim Assessment

Smarter Balanced General Scoring Rubrics - 4 Rubrics included - Score Pt 4 to Score Pt 1

· **Smarter Balanced Interim Blocks**

· Interim assessment blocks may be used for a variety of assessment purposes, including: pre/post, interim and formative (additional evidence of learning).

· The Style Guide, which aligns with the expectations of Smarter Balanced Assessments, will support the creation of unit- and standard-aligned items for instructional use.

· The items on the interim assessments are developed under the same conditions, protocols, and review procedures as those used in the summative assessments. Therefore, they assess the same Common Core State Standards, adhere to the same principles of Universal Design in order to be accessible to all students, and provide evidence to support Smarter Balanced claims in mathematics and ELA/literacy. The interim assessment items are non-secure but non-public. This means that educators may view the items, however, they should not be made public outside of classroom, school or district.

· **Unit-aligned Smarter Balanced Interim Assessment Block (IAB)*:**

Interim Assessment Block - access through CSDE Assessment Portal

- IAB - N/A

· **Some interim blocks show clear, strong alignment to priority standards within the unit. Other blocks have been placed in one specific unit but could be aligned to the priority standards of several units. Blocks have been spread out over the course of all units for a more balanced approach to assessment throughout the school year. These interim blocks, used in partnership with the Style Guide, will support the creation of unit- and standard-aligned items for instructional use.*

Learning Plan

Researched-based Instructional Resources and Methods

Sequence of Instruction:
Number Talk/Number Corner → Problem + Investigations →Work Places → Math Forum*→Daily Practice or Home Connection

Bridges Number Corner for Unit 8:

Geometry

- Identifying and writing coordinate pairs
- Locating points on a coordinate grid

Measurement and Data

- Customary units of liquid volume measure
- Conversion between measurement units

Computational Fluency

- Multiply whole numbers and unit fractions
- Find the sum of products
- Multiple fractions using arrays
- Divide whole numbers by fractions using bar models

Problem Solving

- Solving problems with focus on reasoning and working backwards to find a solution
- Justify solutions and strategies

Bridges - Whole Group, Small Group and Independent Problem Centered Activities

Module 1	Module 2	Module 3	Module 4

Problem + Investigation ● Sessions 1-6 Problem String ● None Work Place ● None Math Forum ● None Daily Practice ● Sessions 1-6 Home Connection ● Sessions 1,3,5	Problem + Investigation ● Sessions 1-6 Problem String ● None Work Place ● None Math Forum ● None Daily Practice ● Sessions 1-5 Home Connection ● Sessions 1,3,5	Problem + Investigation ● Sessions 1-5 Problem String ● None Work Place ● None Math Forum ● None Daily Practice ● Sessions 1-5 Home Connection ● Sessions 1,3,5	Problem + Investigation ● Sessions 1-3 Problem String ● None Work Place ● None Math Forum ● None Daily Practice ● Sessions 1-3 Home Connection ● Session 2

Possible Misconceptions	**Teacher Moves**
1. Students become confused with regrouping in multi-digit multiplication.	1. These students need additional experiences with the partial product algorithm.. Once they are proficient multiplying using partial products, they can begin to consider how using regrouping can save several steps. Scaffold examples for these students and give them time to understand how both the partial product and the regrouping algorithms are alike.
2. Division is a complex operation and students who depend on following rote steps cannot determine whether their answer is reasonable.	2. Emphasis on place value and connections to multiplication will help students to develop a deeper understanding of division. All division experience should be developed in the context of asking questions such as: “How many groups of 20 can you make from 700?” and then allowing students to estimate and identify the number of objects. Such reasoning will help students to hone in on a good estimate and use partial products to determine the exact quotient.
3. Students who struggle to understand the importance of context on remainders.	3. Students may still need additional experiences with the meaning of the remainder built on previous work from 4th grade. Problems in which the remainder is the answer, in which the remainder is dropped, or in which the quotient should be one more because of a remainder

	should be included in division problems students are asked to solve.
4. Students misconceptions when working with decimal numbers are usually based on place value. Simply telling students to line up the decimal points when adding and subtracting decimals does not build the important understanding that similar place values are to added or subtracted.	4. Building on whole number experiences using concrete materials and place value charts will help students to relate previous work with composing and decomposing whole numbers to composing and decomposing decimals.
5. Students move decimal points when it is convenient rather than when it is necessary.	5. Place value understanding allows students to determine whether answers are reasonable. It is far more meaningful to students when they can generalize rules after many experiences and good questions from the teacher.
6. Watch for students who have difficulty determining the fractional part of a unit square of the area of rectangle.	6. Thinking in terms of the whole rectangle will help them define the number of parts when the dimensions are fractional parts of the whole. Reinforcing when they multiply a fraction by a fraction they are taking part of a part will help students to see that the "overlap" is the number of pieces or numerator, and the total number of pieces in the whole is the denominator.
7. Watch for misconceptions from previous multiplication standards.	7. Students who struggle understanding why they should multiply in these problems need more experience using visual representations. It is helpful to have them break the problem into smaller parts and explain their thinking as they complete each part of the problem.
8. Watch for students who are having difficulty identifying what operation to use in solving problems with fractions. Using key words is not helpful and removes sense making sense from the process.	8. Have students model the problem using pictures, and ask supporting questions, such as; a. "What do you know? b. What do you want to find out c. How can you show that in your picture?" As students solve mixed problems, adapt your questions to help students think about the meaning of the operations and how it can help them determine which operation to use. Give students a variety of problems and ask them to model and write an expression they would use to solve the problem. Ask them to explain their model and expression.

9. Students may struggle determining which number goes where in the division problem. “Am I dividing a fraction by a whole number or a whole number by a fraction?”	9. Drawing a picture using the information in the problem and focusing on what they want to find out will help. Model asking questions and encourage them to ask themselves similar questions, such as: a. What is being divided or broken up? b. Am I trying to determine how much in a group or how many groups? c. What visual representations can I use to show the actions of the problem?
10. Some students may think only about one of the dimensions needed to find volume. Some students may believe that because an object is tall, it will have lots of volume, ignoring the other two dimensions.	10. Provide additional experiences for students to measure and compare a variety of objects by using all three dimensions to address this misconception.
11. Fifth graders may not realize how important the order is in plotting a coordinate point.	11. A reminder of the order in ordered pairs may help. Additional experiences for the students to plot the coordinates correctly may be necessary.
12. Some students may not realize that a coordinate system differs from a grid system.	12. Provide students opportunities to talk about the fact that in coordinate system, the lines, not the area surrounding the lines, are labeled.

Vocabulary and Representations	
Tier 2 (Academic Vocabulary)	**Tier 3 (Domain Specific Vocabulary**
absorption active solar design active solar home awning caulking circulate collection concentrate concentrated solar power conversion convert customary coordinate direct eaves format formula+	algorithm average (mean) axis* dimension factor pair* horizontal axis line graph* partial product* partial quotient* photovoltaic cells (pv) rectangular prism* scale factor+ scale (multiplication) surface area+ thermal storage wall variable vertical axis*

highlight insert insulation insulator layout orientation passive solar design passive solar home overlap reflect reflection scale solar collection solar energy solar water heater slope + space heating storm windows temperature thermometer tick marks weatherstripping	volume* *Smarter Balanced Vocabulary is focused on major mathematical concepts. (Not all possible words have been identified by SBAC) + Students are not responsible for these vocabulary words at this grade level, however they should have some understanding of the mathematical concept.

Mathematics Teaching Practice Resources

1. **Bridges** - Reference Math Practices in Action Notes - The notes identify how particular mathematical practice is employed in a specific activity.
    - additional resources will be able to be linked with the purchase of Bridges.
2. Developing Positive (Growth Mindset) Norms in the Classroom
3. Mistakes are Powerful - Resource to develop students' perseverance through mistakes
4. Grade 5 Standards + Practices Examples and Explanations
5. **Math Practices Teacher Question Starters**
6. **Implementing the Standards of Mathematics Practice**
7. Illustrating the Standards of Mathematical Practice
8. Math Practice Standards Posters Gr. 4-5
9. Number Talks Matter - Number Talks at a Glance and Fluency without Fear
10. Three Act Math Tasks
11. Standards + Mathematical Practices - Examples and Explanations - Grade 5
12. Open Middle
13. National Library of Virtual Manipulatives
14. Accountable Talk Moves
15. Contribution Checklist
16. Building a Mathematical Mindset Community
17. Journal Prompts for Math
18. Bridges Interactive Math Manipulatives
19. Illustrative Math – Grade 5 - Resources and activities for the grade aligned by standard.
20. Bridging Practices - UCONN – Training and a Task Repository to develop and support student

capacity for argumentation in mathematics

21. Sentence Frames that Can Build Metacognitive Thinking
22. Sample Language Frames for Mathematics
23. Building a Mathematical Mindset Community
24. Teacher/Student Actions
25. Fletcher Three Act Tasks
26. Vocabulary Development Frayer Model – Elementary and secondary video and resources.
27. Use Model to Identify Part of Coordinate Plane

Suggestions for Differentiation, Scaffolding and Intervention

Differentiation or Intervention

Any teacher moves/strategies that address misconceptions can be used in differentiation or as intervention.

Math Teaching Practice Resources contain resources that provide opportunities for differentiation, intervention, or extension aligned to the strategies below.

- How to Select Math Intervention Content
- Coherence Map in Math – The coherence map shows how standards within and across grades build upon each other. You can use the map to assist you in to build student understanding by linking together concepts within and across grades and identify gaps in a student's knowledge by tracing a standard back through its logical prerequisites.
- CT Dept. of Education Evidence-based Practice Guides – These guides provide links to "evidence-based activities, strategies and interventions (collectively referred to as 'interventions')."
- Evidenced-based strategies for supporting struggling students (U.S. Dept. of Education – What Works Clearinghouse)
- Ensure instructional materials are systematic and explicit. In particular, they should include numerous clear models of easy and difficult problems, with accompanying teacher think alouds.
- Provide students with opportunities to solve problems in a group and communicate problem-solving strategies.
- Teach students about the structures of various problem types, how to categorize problems based on structure, and how to determine appropriate solutions for each problem type.
- Students should work with visual representations of mathematical ideas.
- If visual representations are not sufficient for developing accurate abstract thought and answers, use concrete manipulative first. (Include the next line for middle school and older students only) Although this can also be done with students in upper elementary and middle school grades, use of manipulatives with older students should be expeditious because the goal is to move toward understanding of and facility with visual representations and finally to the abstract.
- Provide carefully constructed questions to help direct students in determining what to do to solve problems, but they shouldn't be told how to reach the solution.
- Instruction during the intervention should be explicit and systematic. This includes providing models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, and frequent cumulative review.

Intervention for facts

- Provide about 10 minutes per session of instruction to build quick retrieval of basic arithmetic facts. Consider using technology, flashcards, and other materials for extensive practice to facilitate automatic retrieval.
- For students in K -2 explicitly teach strategies for efficient counting to improve the retrieval of mathematics facts.
- Teach students in grade 2-8 how to use their knowledge of properties, such as commutative, associative, and distributive to derive facts in their heads.
- How to Promote Acquisition of Math Facts – Intervention for struggling students
- National Center on Intensive Intervention - Basic Facts
- Once a strategy has been taught, it is important to reinforce it. The reinforcement or practice exercises should be varied in type and focus as much on the discussion of how students obtained their answers as on the answers themselves.
- Having students work in groups (as opposed to handing your bright students a workbook to work on when the classroom material isn't challenging enough) with other children ready for advanced material shows them that mathematics is not a solitary discipline -- mathematics is exciting and vibrant and creative and fun.
- Struggles with basic facts - need more experience with concrete and pictorial representations, including describing what their models represent to make connection to basic facts. Time and experience with developing strategies that are based on patterns and properties will help support learning the facts. It is important to give students time to learn and understand these concepts before procedural skill practice takes place.
- Concrete, Representational, Abstract Progression

EL Strategies

- Colorin Colorado – A Bilingual site for educators and families of English learners
- Stanford University - Principles for Mathematics Instruction of ELs
- CT State Dept. Of Education English Learner Standards and Resources
- Nonverbal responses, such as thumbs up, will help you check for understanding without requiring students to produce language. ELLs can participate and show that they understand a concept, or agree or disagree with an idea, without having to talk. This is especially important for students whose comprehension of English is more advanced than their ability to speak the language.
- Pre-teach vocabulary in ways that connect to students' prior knowledge.
- Display posters of graphic representations of vocabulary words.
- http://www.cal.org/siop/lesson-plans/
- Provide support to assist in explaining thinking with sentence starters and work banks.
- Use Work Place Sentence Frames or other sentence frames to assist students in math discourse.
- Speak slowly and use clear articulation. Reduce the amount of teacher talk and use a variety of words for the same idea. Exaggerate intonation and place more stress on important new concepts or questions. After asking a question, wait for a few moments before calling on a volunteer. Writing the question on the board will also help.
- English language learners are not always able to answer the questions posed to them, especially when the questions are open-ended. Provide support for and improve the participation of students with lower levels of English proficiency by using a prompt that requires a physical response, like "Show me a half, a third, etc.." or "Touch the larger number."
- Increase academic language knowledge for English learner success.

Extension

- Student pairs can design and conduct experiments to test their ideas for making thermometer absorb even more solar energy. Advise students to change only one variable in the original experiment for each idea they test. This way, they can determine what factor increases the absorption of solar energy.
- Students can run a longer version of the experiment in Module 2, Session 2. Place the cups in the sun for half a school day to determine the temperature gain, and then place them in the shade and monitor every hour to see how long it takes them to lose their heat.

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Interdisciplinary Connections

Children's Literature

The Solar Energy Infobooks - National Energy Education Development Project
Solar Energy! How Does It Work - Science for Kids - Children's Energy Books - IQ Builder Books
*The Kids Solar Energy Boo*k by Tilly Spetgang

ELA

CCSS.ELA-LITERACY.SL.5.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.5.1.A
Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
CCSS.ELA-LITERACY.SL.5.1.B
Follow agreed-upon rules for discussions and carry out assigned roles.
CCSS.ELA-LITERACY.SL.5.1.C
Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.
CCSS.ELA-LITERACY.SL.5.1.D
Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions

Science - (these connections are included in this unit.)

- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- Obtain and combine information about wys individual communities use science ideas to protect the Earth's resources and environment.
- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- Plan an investigation to determine the relationships among the energy transferred, the types of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.