GRADE 8 - MODULE 1 - PROBLEM SOLVING

Big Idea
SOLVE is a problem-solving paradigm that can be applied to support students in understanding and solving mathematical and real-world problems.

Vocabulary
S-Study the Problem, O-Organize the Facts, L-Line Up a Plan, addition, subtraction, multiplication, division, equals, together, add, plus, and, increase, incline, deposit, sum, total, rises, grow, above, take away, difference, minus, withdraw, write a check, decline, subtract, fewer, decrease, left over, "How much more?", "How many?", below, times, product, each, of groups, items, per, double, triple, multiplied, quotient, per equal groups, cut into, altogether, divvy, split, is, divide, same, balanced, equivalent, is equal to, all together, V-Verify Your Plan with Action, E-Examine Your Results, rational numbers, integers, additive inverse, percent, markdowns, algebraic expression, inequality, survey, trials, data collections, percent, tree diagram, compound probability

Prior Learning
Standards for Mathematical Practice as applied to Grade 7 Content Standards (SMP 1, 2, 7 and 8)

Essential Questions
• Why is it important to have a problem-solving strategy?   • What do the S and O in SOLVE represent?   • Why is it important to know that the problem is asking?   • Why is it important to organize the facts in a word problem?   • What does the L in SOLVE represent?   • Why is it important to write your plan in words before completing the math?   • Why is it important to determine the operation in the L Step?   • What do the V and E in SOLVE represent?   • Why is it important to estimate the answer?   • Why is it important to examine the results of your problem?   • Why is it essential to understand the steps of solving a problem and not just give an answer?   • How can SOLVE be used to solve problems other than contextual or real-world situations?

Competencies
Apply SOLVE as a problem-solving paradigm to support integration of the Standards for Mathematical Practice throughout all Grade 8 Content Standards.

S: Underline the question.
This problem is asking me to find_____.

O: Identify the facts.
Eliminate the unnecessary facts.
List the necessary facts.

L: Write in words what your plan of action will be.
Choose an operation or operations.

V: Estimate your answer.
Carry out your plan.

E: Does your answer make sense? (Compare your answer to the question.)
Is your answer reasonable? (Compare your answer to the estimate.)
Is your answer accurate? (Check your work.)
Write your answer in a complete sentence.

SOLVE Modifications for ELL or ESL students:
(**Example shown**)

> Jason has 345 model cars and 487 model trucks. **How many model vehicles does he have in all?**

S: TPIAMTF (this problem is asking me to find) – the **total vehicles.**
(The students cannot just restate the question if the response starts with "the.")

O: Be as brief as possible and teach the students abbreviations right away ($, #, lb., cm, pkg, etc.,)

L: ___# of cars___ + ___# of trucks___ = ___total___

___345___ + ___487___ = ___832___

V: Estimate (use familiar strategies) then fill in blanks in the "L" step   **About 800**

E: No modifications necessary

Misconceptions
• Students may attempt to solve word problems by computing with given values instead of reading and applying a step-by-step problem-solving paradigm. • Students may think that SOLVE can only be used with real world problems. • Students may not understand the importance of a problem-solving paradigm that can be used at any grade level and with any concept.
Resources from The Key Elements to Mathematics Success - KEMS Grade 8 **for Building the Conceptual Understanding of this Module**
LESSON 1 – SOLVE – S and O Additional Activities: Quiz T17 − T19 Foldable: "SOLVE" foldable (5 flap) LESSON 2 – SOLVE – L Additional Activities: Quiz T36 – T38 Foldable: "SOLVE" foldable (5 flap) LESSON 3 – SOLVE – V and E Additional Activities: Quiz T57 – T58 Foldable: "SOLVE" foldable (5 flap)

Standards for Mathematical Practice	Examples:
1. Make sense of problems and persevere in solving them.	In grade 8, students solve real world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"
2. Reason abstractly and quantitatively.	In grade 8, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.
3. Construct viable arguments and critique the reasoning of others.	In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like "How did you get that?", "Why is that true?" "Does that always work?" They explain their thinking to others and respond to others' thinking.
4. Model with mathematics.	In grade 8, students model problem situations symbolically, graphically, tabularly, and contextually. Students form expressions, equations, or inequalities from real world contexts and connect symbolic and graphical representations. Students solve systems of linear equations and compare properties of functions provided in different forms. Students use scatter plots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context.
5. Use appropriate tools strategically.	In grade 8, students may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the relationships between the angles created by a transversal.
6. Attend to precision.	In grade 8, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays.
7. Look for and make use of structure.	In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.
8. Look for and express regularity in repeated reasoning.	In grade 8, students use repeated reasoning to understand algorithms and make generalizations about patterns. Students use iterative processes to determine more precise rational approximations for irrational numbers. They analyze patterns of repeating decimals to identify the corresponding fraction. During multiple opportunities to solve and model problems, they notice that the slope of a line and rate of change are the same value. Students flexibly make connections between covariance, rates, and representations showing the relationships between quantities.

Works Referenced in the Development of the Module	
Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parcconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	

Other Strategies for using SOLVE problems
• Pass Back Activity: This activity works if students are sitting in rows or it can be adapted to sitting in groups. Each row or group is given a SOLVE problem. The first student completes the S Step and then passes the paper back or to the next student. The second student checks the "S" Step and then marks it with their initials and completes the "O" Step. The SOLVE problem is then passed to the next person who checks and initials the "S" and "O" steps and completed the "L" step. This continues until the problem goes back to the first person who reviews all steps. Student groups can then share their responses as a whole group. • Have students work in groups of 4 or 5 and assign them one of the SOLVE problems to complete as a group. Students can then transfer answers to chart paper and present to the whole group for discussion and feedback. • Have a copy of one of the SOLVE problems at each table or group (5 groups). Have students complete the S Step and then pass the problem on to the next group when you give a signal. Students will continue this process until they get back their original problem. • SOLVE Gallery Walk: Post each SOLVE problem on a chart around the room. Have students work in 5 different groups, each group having a different color marker. Student groups can start at one poster and complete the "S" step. After a few minutes, have student groups move to the next poster, read the "S" step (noting any corrections as necessary with their marker), and then complete the "O" step. (**Note:** Each time a group moves to a new station they should read the steps that were completed by the previous group(s) and note any comments/corrections using their color marker. This helps to guide the discussion of any differences at the end of the activity.) After a few minutes, have students move to the next poster, read the "S" and "O" steps, and complete the "L" step. Continue with this procedure until student groups have returned to their original problem. Students can also present their problem to the whole group and guide the discussion about student responses.

Additional real-world problems to use for SOLVE

1. A jacket at the mall had an original price of $49.99. The store had a sale where everything was 20% off. Mr. James had a coupon for an additional 10% off the sale price. What did Mr. James pay for the jacket? (7.RP.3)

2. An undersea diver starts his descent from the surface and dives down 20 feet below sea level. He rests and then dives down another 13 feet before resting again. At the deepest point of his dive, he is 57 feet below sea level. What is the difference between the second point he rested and his deepest point during the dive? (7.NS.3)

3. Danielle goes to the movies with her friends. She has $20.00, but wants to save $8.00 to go to the game arcade after the movie. Her movie ticket costs $5.00 and she wants to buy some new snacks they are selling at the movie for $1.75 each. How many snacks can she buy? (7.EE.4b)

4. There are three seventh grade classes working on a project about surveys and data collection. The classes each surveyed a group of 20 to determine if students preferred writing with a pen or a pencil. The results are as follows: Class 1- 25% of the 20 students they surveyed preferred writing with a pen; Class 2 - $\frac{2}{5}$ of the 20 students preferred writing with a pencil; Class 3 - 0.2 of the 20 students preferred writing with a pen. Which class had the highest number of students who preferred writing with a pen? (7.EE.3)

5. During a probability experiment, Sarina tosses a fair number and flips a coin. What is the probability of tossing an even number and flipping a head on the coin? (7.SP.8a)