Grade 1 Advanced / Gifted and Talented (GT) Mathematics
Oh, the Places You'll Go:
A Problem-Based Learning (PBL) Unit in Operations and Algebraic Thinking

Overview:

This unit uses the Dr. Seuss book *Oh, the Places You'll Go* as an introduction to the PBL task in which students will create the "Our Community" board games that allow players advance by choosing different ways of solving addition and subtraction problems. This unit is aligned with the first and second grade mathematics standards, primarily in the domain of operations and algebraic thinking, but includes some number and operations in base ten. Students will build fluency for addition and subtraction within 20 and apply addition and subtraction by solving word problems within 100 with multiple steps and multiple representations. Differentiation strategies for advanced/gifted and talented students have been embedded into the unit, including problem-based learning creation of authentic products, student choice, curriculum compacting opportunities, higher level questioning and problem solving, and interdisciplinary connections with social studies and science standards from grades 1 and 2. Technology integration is used to enhance students' research skills, communication, and problem solving.

Available Model Lesson Plans		
Standards Addressed	Title	Description/Suggested Use
1.OA.B.3-4; 1.OA.C.6; 1.OA.D.7-8	Grade 1 Advanced/Gifted and Talented Lesson Plan 1: *Oh, the Places You'll Go!*	Three activities center on understanding and applying properties of operations and the relationship between addition and subtraction.
Available Lesson Seeds		
Standards Addressed	Title	Description/Suggested Use
MP1. Make sense of problems and persevere in solving them. MP4. Model with Mathematics.	Lesson Seed 1. Introducing the Problem-Based Learning Scenario	Students will be introduced to the unit task of creating a "My Community: Oh, the Places You'll Go" Board Game. **Complete this Seed after students have completed Lesson Plan One.**
2.OA.A.1, 1.NBT.C.4	Lesson Seed 2. Through Maryland We Will Go	Students will apply strategies to make sense of problems involving unknowns in all positions, with and without multiple

		steps.
2.OA.A.1	Lesson Seed 3. To the Boardwalk We Will Go	Students will use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions.
1.OA.C.6, 2.OA.A.2, 2.OA.B.3	Lesson Seed 4. To the Zoo We Will Go	Students explore the many different combinations of addends result in the same sum and work with even numbers plus even numbers to determine an even sum.
1.NBT.C.4, 2.NBT.C.5, 1.MD.B.3	Lesson Seed 5. Rock Around the Clock	Students use the properties of addition to add 6 numbers in order to find equivalent sums.
2.OA.A.1	Lesson Seed 6. Fundraising We Will Go	Students make sense of quantity and by comparing numbers, taking numbers apart, and combining numbers.
1.OA.A.1-2	Lesson Seed 7. Visit to a Restaurant	Enrichment Lesson Seed with two activities
1.OA.A.2	Lesson Seed 8. Problem Choice Board	Extension Lesson Seed Students will use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions.

Grade 3 Advanced/Gifted and Talented (GT) Mathematics
An Olympic Field Day:
A Problem-Based Learning (PBL) Unit in Numbers and Operations-Fractions

Overview:

Students will develop a workable plan for the school's field day in this Olympics-themed Problem-Based Learning (PBL) unit aligned with the third and fourth grade Maryland Common Core State Standards for Number and Operations—Fractions. Beginning with fractions as numbers, students design flags based upon equal parts of a whole. Investigating further, students use and create number lines to compare fractions with like and unlike denominators. Equivalent fractions and ordering fractions continues through collecting and comparing data in Olympic events. Students use this knowledge to add and subtract fractions and mixed numbers using visual representations to gain a conceptual understanding of combining and separating fractional parts. In a summative performance task that responds to the PBL scenario, students plan and present proposals for the school's themed Olympic Field Day.

Available Model Lesson Plan(s)		
Standards Addressed	**Title**	**Description/Suggested Use**
3.NF.A.1-2 and 3.NF.B.3a-b.	Lesson Plan 1. Develop Understanding of Fractions as Numbers	Students will identify fractions using area, length, and set models, explore recognizing and generating simple equivalent fractions, and create a design that shows specified fractional parts.

Available Lesson Seeds		
Standards Addressed	**Title**	**Description/Suggested Use**
CCSS Math Practice.MP1. CCSS Math Practice.MP4.	Lesson Seed 1. PBL Scenario	Students will be introduced to the Problem Based Learning (PBL) task to develop a plan for an Olympic Field Day.

3.NF.A.2.a, 3.NF.A.2.b, 3.MD.A.1	Lesson Seed 2. Time and Distance on a Number Line	Students use fractions to express time and distance on a number line, create a timeline of events and/or a diagram for a hurdle track for Olympic Field Day.
3.NF.3, 4.NF.2, 4.NF.7	Lesson Seed 3. Silver and Gold	Students determine benchmark units, play a game, compare and order two or more fractions, and create medals to be used in their Field Day Proposal.
4.NF.C.5-7	Lesson Seed 4. The Gymnastics Task	Students use decimal notation for fractions and compare decimal fractions.
4.NF.B.3.a-d	Lesson Seed 5. Designing an Area for Field Day	Students will use knowledge of fraction addition and subtraction, including adding and subtracting mixed numbers with like and unlike denominators to design the area in which the activities will be played for field day. They will submit this design for proposal.

Grade 4 Advanced/Gifted and Talented (GT)
The Third Bridge: A Problem-Based Unit in Operations and Algebraic Thinking

Overview:

This unit includes a model problem scenario in the form of **a Request for Proposals (RFP) from the Maryland Transportation Authority (MDTA)**. Students will explore mathematical concepts and hands on activities that allow students to respond effectively to the problem based scenario. The unit is comprised of one lesson plan and six lesson seeds.

In **Lesson Plan 1,** students will demonstrate an understanding of place value (up to 1,000,000) by creating place value models. Students will recognize the relationship between the different digits in multi-digit whole numbers and will use place value models to solve problems.

Lesson Seed 1 introduces students to the Unit and the PBL scenario by helping students initiate a discussion about the Chesapeake Bay Bridge and the current issues that surround it.

In **Lesson Seed 2**, students will further their number sense by multiplying or dividing to solve word problems involving multiplicative comparisons and be able to distinguish multiplicative comparisons from additive comparisons. Students will develop a sense of ratio concepts and comparisons, ratio language and the relationship between 2 quantities. Students should understand that additive and multiplicative comparisons are two very different ways to compare and evaluate quantities. Finally, students will be able to apply ratio reasoning to solve complex, real world problems and use knowledge to develop their own examples through hands on projects.

In **Lesson Seed 3**, students will continue to work with problems involving numbers, particularly money problems where they will solve multistep word problems involving remainders using the 4 operations. Students will explore estimating and conceptual understanding of problem solving using manipulatives to represent the problem. Students will express calculations and interpretations of numerical expressions. Finally, students will use absolute value concepts in working with money problems to understand the concept of an account balance and debt. Students may express these ideas using order of operations, distributive property and integers.

Lesson Seed 4 culminates in helping students understand patterns and rules for operations given a function and the relationships between corresponding terms. Students will use multiple function rules to populate data tables and graph function table results to understand outcomes and impacts of independent and dependent variables. Students should understand that patterns and rules are related and that analyzing patterns can help us understand the relationship between 2 or more quantities in real world applications.

In **Lesson Seed 5**, students will be introduced to the PBL task by completing a variety of investigations on suspension bridges and examine data from Bay area communities. Students will discuss what makes a good bridge and learn how bridges impact communities. Students will explore data on population, environmental impact, cost, traffic, etc. Students will use Google Earth to locate and take measurements on the Chesapeake Bay Bridge and look for alternative locations for a 3rd Bay Bridge. Students will also be able explore the costs of building a bridge and the potential returns on investment using actual bridge proposals. By the end of the project, team members will be prepared to engage in the PBL scenario in which they will respond to the MTA's RFP to present the location, and impact of a 3rd Chesapeake Bay Bridge in Maryland.

Lesson Seed 6 is an optional extension in which students will design, plan, build and test a popsicle stick bridge. Students will be given a budget to plan and purchase building materials from a company store. Students will practice the four operations to solve problems using whole numbers and decimals. During the planning process, students will explore ratio concepts and relationships (scale drawing). During the building process, students will convert measurements from inches or centimeters to feet as they move from the scaled drawing to building a real model of their bridge. Students will also understand the concept of load and convert load bearing measurments from pounds to kilos. Students will apply ratios, measurements and cost to help calculate the cost of a real bridge. Finally, students will test their bridges to determine how much weight they will hold and make comparisons to actual bridges.

Enduring Understandings:

- Multi-digit numbers can be represented in a variety of forms.
- Between any two place values the 10:1 ratio remains the same.
- Flexible methods of computation involve understanding place value.
- A pattern is a sequence that repeats the same process over and over, and a rule dictates what that process will look like.
- Analyzing patterns can help us to understand the relationship between two or more quantities.
- Ratio, scale and proportion concepts have authentic, real world applications.
- Budgets help us better understand absolute values and integer concepts in real world scenarios.

Essential Questions:

- How can you model, represent and create interpretations of multi-digit numbers?
- What generalizations can be made about place value patterns?
- How can knowledge of place value help with multiplication and division of whole numbers?
- How are patterns and rules related?
- How can cause and effect relationships be applied to mathematics?
- How does estimating, rounding and mental computation help us arrive at a reasonable answer?
- Do different math representations produce different results when showing and solving a problem?
- How can multi-step problems be represented?
- How can order of operations and algebraic thinking be used to help solve multi-step problems?
- How does solving problems involving money and place value relate to a budget?
- How do absolute value concepts help students determine the magnitude of positive and negative numbers in real world problems?
- What generalizations can you make about data relationships?
- What implications do patterns or relationships between variables have in the real world?
- How does the process of moving from the conceptual to the abstract analyze and solve problems and communicate results?

Grade 5 Advanced/Gifted and Talented (GT) Mathematics
Armour For All: A Problem-Based Learning (PBL) Unit in Collecting, Representing and Interpreting Data

Overview:

This unit includes a Problem-Based Learning (PBL) scenario in the form of **a Call for Proposals from Under Armour in Baltimore, MD.** Students will explore mathematical concepts and hands on activities in order to respond effectively to the PBL scenario to conduct a correlational research study and design athletic equipment to help reduce youth athletic injuries.

Students will apply their understanding of measurement and fractions and fraction operations in order to collect, display and interpret data in line plots, bar graphs, box plots and scatter plots. Students will build on their knowledge of equivalent fractions and/or decimals and use central tendency measures to determine intervals to display data points. The unit culminates in a correlation experiment to help students effectively respond to the PBL scenario and task and extend their understanding of displaying and interpreting data from line plots to scatterplots.

The unit is comprised of two Lesson Plans and five Lesson Seeds. After Lesson Seed 1 is used to introduce the unit, the teacher may decide the best order for using the lessons and seeds.

Lesson Seed 1 PBL Scenario is the introduction to the unit and should be completed first before any of the other lessons or seeds. Students will be introduced to the topic of youth sports injuries and to the PBL Scenario, a Call for Proposals for innovative ideas or products to prevent or reduce sports injuries among young persons.

In **Lesson Seed 2**, students will make a line plot to display a set of measurements in fractions of a unit (1/2, 1/4, 1/8). Students will explore fractions of a measurement as they measure and graph gummy worm lengths. Students will use and interpret the data from the line plot to answer questions and solve problems involving information presented in line plots.

In **Lesson Seed 3**, students will learn and practice ratio concepts and use ratio language when analyzing data. In a real world scenario, students will apply ratio concepts to describe a ratio relationship between two quantities. Finally, students will graph and interpret data to solve real world problems involving ratios, fractions, decimals.

In **Lesson Seed 4** students will understand the concept of a ratio and use ratio language to discuss and describe a ratio relationship between two quantities. Students will also collect and display data in a graph to understand relationships between the data and solve problems. Finally students will construct and interpret scatter plots to investigate patterns of association between two quantities. Students will use this investigation to describe patterns in data such as clustering, positive or negative association, linear association and nonlinear association.

In **Lesson Seed 5**, students will create a line plot, bar graph and histogram of a data set of measurements using fractions of a unit. In this seed, students focus on measures of center and variation by graphing. Students will calculate measures of central tendency using real world data.

Finally, students will use graphing and statistical variability to solve an authentic problem.

In Lesson Plan 1, students will develop an understanding of statistical variability as well as displaying and interpreting data to solve problems. Students will explore standard 6.SP.2, to understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread and overall shape. Using standard 6.SP.3, students will develop an understanding of statistical variability and be able to summarize and describe distributions. Specifically, students will be able to recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. Finally, utilizing standard 6.SP.4, students will display numerical data in plots on a number line, including dot plots, histograms and box plots.

In Lesson Plan 2, students will develop an understanding of statistical variability as well as displaying and interpreting data to solve problems by conducting a correlation study. They will understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread and overall shape; construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities; and describe patterns such as clustering, positive or negative association, linear and non linear association. Students will also convert among different sized standard measurement units within a given measurement system. Finally, students will make a graph to display a data set of measurements in decimals and/or fractions of a unit (1/2, 1/4, 1/8).

Enduring Understandings:

Enduring understandings go beyond discrete facts or skills. They focus on larger concepts, principles, or processes. They are transferable and apply to new situations within or beyond the subject.

- Analytical statistics involves a four-step process: formulating questions, collecting/displaying data, analyzing data, and interpreting/communicating results.
- Students can use a variety of graphs to represent data.
- Data can be collected and displayed in order to analyze and solve problems.
- Measures of center can be used to analyze data and create more accurate scales.
- Measures of center help us understand statistical variability.
- Two variables can be analyzed to determine if they have a correlation.
- Scatter plots reflect a positive linear, negative linear or non linear association between the data.