Rich Mathematical Task – Grade 5 – *Saving for a Bicycle*

Task Overview/Description/Purpose:

- In this task, students will use problem solving strategies and operations with whole numbers to determine possible combinations that will result in earning a given amount of money.
- The purpose of this task is for students to develop mathematical reasoning and communication skills as they apply a variety of problem solving strategies to find at least three possible ways to earn enough money for a bicycle from mowing lawns and washing cars.

Standards Alignment: Strand – *Number and Number Sense*

Primary SOL: 5.4 The student will create and solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of whole numbers.

Related SOL: 4.4abcd, 3.3ab, 3.4abcd

Learning Intention(s):

- **Content** - I am learning to estimate and apply strategies to solve multistep practical problems.
- **Language** - I am learning to use language that explains my reasoning and justifies my thinking.
- **Social** - I am learning to listen and respond to my peers' explanations in appropriate ways and make connections between different strategies for solving a problem.

Success Criteria (Evidence of Student Learning):

- I can identify the multiple steps needed to solve the problem and use estimation to make sure my solution is reasonable.
- I can explain my reasoning and communicate my thinking for solving the problem clearly, using appropriate vocabulary.
- I can determine at least three ways to earn enough money for the bicycle using a combination of mowing lawns and washing cars. I can justify my solutions using pictures, numbers, and words.
- I can give specific feedback to my peers and use suggestions to clarify my thinking.

Mathematics Process Goals

Problem Solving	• Students will identify the steps needed to solve the problem and determine strategies for finding at least three combinations that will result in earning enough money for the bicycle. • Students will accurately apply operations with whole numbers to find at least three ways to earn enough money for the bicycle using a combination of mowing lawns and washing cars.
Communication and Reasoning	• Students will clearly communicate their thinking process for determining three different possible ways to earn enough money to their peers. • Students will justify their solutions process using pictures, numbers, and words. • Students will use appropriate mathematical language to express ideas with accuracy and precision.
Connections and Representations	• Students will use an appropriate representation to explore the problem and justify their solution. • Students will describe connections between their representations and the representations of their peers.

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Standards Alignment: Strand – *Number and Number Sense*	
	• Students will connect and/or extend thinking to other mathematical ideas such as patterns.

Task Pre-Planning	
Approximate Length/Time Frame: 60 minutes	
Grouping of Students: Students will begin working independently, then will be purposefully partnered based on teacher monitoring of strategies.	
Materials and Technology: • copy of task for each student • pencil, grid paper • dry erase boards/markers • chart paper	**Vocabulary:** • addition: sum • subtraction: difference • multiplication: product • multi-step
Anticipate Responses: See the Planning for Mathematical Discourse Chart (columns 1-3).	

Task Implementation (Before) 10 – 15 minutes

Task Launch:

- **Engage students in making sense of the problem:** The teacher will display only the first part of the task for students:
  Gus wants to buy a new bicycle. He mows lawns and washes cars for people in his neighborhood to earn extra money.
- The teacher will lead students through a Notice/Wonder discussion about the information given. Record student ideas on chart paper.
- Some important ideas to listen for to support the context of the problem:
  - Wondering how much the bicycle costs
  - Wondering how much money he will earn for each job
- Next, the teacher will add a little more information about the task:
  Gus earns $24 for each lawn he mows.
  He earns $15 for each car he washes.
- The teacher will ask students what they Notice/Wonder with the additional information. Record student ideas on chart paper.
- Some important ideas to listen for to support the context of the problem:
  - Noticing that he earns almost $10 more for mowing lawns than washing cars
  - Wondering how much the bicycle costs
  - Look for students to begin making combinations ($48 for mowing two lawns, $30 for washing two cars, etc.) and questioning if that would be enough for the bicycle
- At this point, the teacher will ask students what other information is needed to be able to solve the problem.
- The teacher will reveal the remainder of the task to students, reading it aloud.
- **Ensure understanding of task:** The teacher will ask questions to make sure the task is understood: "What are we trying to figure out?" "What do you already know that can help you get started?" "Who has a strategy for finding one way Gus can earn the money he needs for the bicycle?" Allow students to turn and talk to a partner.
- **Establish clear expectations:** The teacher will read and discuss the Learning Intentions and Success Criteria. Review rubric with students as a tool for monitoring their proficiency. Review classroom expectations for

Task Implementation (Before) 10 – 15 minutes

working independently and in groups. Support materials and manipulatives should be accessible for student use.

Task Implementation (During) 20 – 30 minutes

- Monitor – Teacher will listen and observe students as they work on task and ask assessing or advancing questions (see the Planning for Mathematical Discourse chart on next page).
- Select – Teacher will decide which strategies will be highlighted (after student task implementation) that will advance mathematical ideas and support student learning.
- Sequence – Teacher will decide the order in which student ideas will be highlighted (after student task implementation).
- Connect – Teacher will consider ways to facilitate connections between different student responses.
    - Students work in purposefully planned groups for 20-25 minutes to explore strategies, share ideas and transfer their ideas to paper using pictures, words, and symbols.
        - As the teacher is monitoring, teacher will look for strategies used by students and record on Planning Chart.
        - The teacher should use questions to assess or advance student thinking.
    - Students should be encouraged to explore different strategies for solving and evaluate effectiveness.

Suggestions for Additional Student Support

May include, among others:

- Sentence frames to support student thinking and discourse:
    - I agree/disagree with _____'s strategy because _____.
    - The strategy I used to solve is _____.
    - If Gus mowed ____ lawns and washed _____ cars, he would earn _____ money.
- Input/Output table or chart to organize amount of money earned for mowing ____ lawns, washing ____ cars
- Adjust task to have students work with smaller numbers
- Variety of manipulatives available for students to choose to use:
    - Base 10 blocks
    - Two-color counters
    - Money

Task Implementation (After) *20 minutes*

Connecting Student Responses (From Anticipating Student Response Chart) and Closure of the Task:

- Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion. Some possible big mathematical ideas to highlight could include:
    - a common misconception;
    - trajectory of sophistication in student ideas (i.e. concrete to abstract)
    - different solutions with reasoning
    - different representation of same solution
- Connect student responses and connect the responses to the key mathematical ideas to bring closure to the task. Possible questions to connect student strategies:
    - How are these strategies alike? How are they different?
    - How do these connect to our Learning Intentions?
    - Why is this important?
- Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion, such as a gallery walk to allow feedback on all strategies.
- Close the lesson by returning to success criteria. Have students reflect on their progress related to the criteria.

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Teacher Reflection About Student Learning:

• Teacher will use the *Planning for Mathematical Discourse Chart* (anticipated student solutions) to monitor which students are using specific strategies. This will include: possible misconceptions, learning trajectories and sophistication of student ideas, and multiple solution pathways. Next steps based on this information could include:
  ○ Informing sequence of tasks. What will come next in instruction to further student thinking in determining equivalent measures of liquid volume?
  ○ Informing small groups based on misconceptions that are not addressed in sharing.
• After task implementation, the teacher will use the Rich Mathematical Task Rubric criteria to assess where students are in their mathematical understanding and use of the process goals. This could be a focus on one category. Next steps based on this information could include:
  ○ Informing small groups based on where students are in engagement in the process goal(s).

Planning for Mathematical Discourse

Mathematical Task: Saving for a Bicycle

Content Standard(s): SOL 5.4

Teacher Completes Prior to Task Implementation			**Teacher Completes During Task Implementation**	
Anticipated Student Response/Strategy *Provide examples of possible correct student responses along with examples of student errors/misconceptions*	**Assessing Questions** *Teacher questioning that allows student to explain and clarify thinking*	**Advancing Questions** *Teacher questioning that moves thinking forward*	**List of Students Providing Response** *Who? Which students used this strategy?*	**Discussion Order - sequencing student responses** ○ *Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion* ○ *Connect different students' responses and connect the responses to the key mathematical ideas* ○ *Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion*
Anticipated Student Response: Student is unable to start the problem.	• Tell me what you are thinking. • What do you know? • What are you trying to figure out?	• What if we worked with different numbers? (Ex: Change numbers in the problem to $5 for lawns, $2 for cars, and $15 for bicycle) • How much would Gus earn if he mowed two lawns? Washed two cars? Mowed one lawn and washed one car?		
Anticipated Student Response: Student pulls all numbers out of the problem and performs an operation with them that doesn't fit the context of the problem	• Look back at our Notice/Wonder chart. What do each of the numbers in the problem represent? • What do you know? • What are you trying to figure out?	• How much would Gus earn if he mowed two lawns? Washed two cars? Mowed one lawn and washed one car? • How much does Gus need to earn to buy the bicycle? • What does your solution tell you? How can you model your thinking?		

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Teacher Completes Prior to Task Implementation			**Teacher Completes During Task Implementation**	
Anticipated Student Response/Strategy *Provide examples of possible correct student responses along with examples of student errors/misconceptions*	**Assessing Questions** *Teacher questioning that allows student to explain and clarify thinking*	**Advancing Questions** *Teacher questioning that moves thinking forward*	**List of Students Providing Response** *Who? Which students used this strategy?*	**Discussion Order - sequencing student responses** ○ *Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion* ○ *Connect different students' responses and connect the responses to the key mathematical ideas* ○ *Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion*
Anticipated Student Response: Student is able to find only one possible way for Gus to earn enough money for the bicycle.	• Tell me about your thinking. • Explain how you solved the problem. • How do you know this solution works?	• Can you use the same strategy to determine another way Gus could earn the money? • How can you organize your thinking on paper?		
Anticipated Student Response: Student doesn't understand that it is possible for Gus to earn more than $300 – thinks his earnings must equal $300 exactly	• Tell me about your thinking. • Explain how you solved the problem. • What information does the problem tell you?	• Could Gus use a different combination of mowing lawns and washing cars to earn enough money? • How can you organize your thinking on paper? • How much money would Gus earn if he mowed one lawn and washed one car? Two lawns and two cars? Three lawns and three cars? • Do you notice a pattern? What would happen if the pattern was extended? • What happens if Gus earns less than $300? What happens if he earns more than $300?		

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Rich Mathematical Task Rubric

	Advanced	Proficient	Developing	Emerging
Mathematical Understanding	Proficient Plus: • Uses relationships among mathematical concepts or makes mathematical generalizations	• Demonstrates an understanding of concepts and skills associated with task • Applies mathematical concepts and skills which lead to a valid and correct solution	• Demonstrates a partial understanding of concepts and skills associated with task • Applies mathematical concepts and skills which lead to an incomplete or incorrect solution	• Demonstrates no understanding of concepts and skills associated with task • Applies limited mathematical concepts and skills in an attempt to find a solution or provides no solution
Problem Solving	Proficient Plus: • Problem solving strategy is well developed or efficient	• Problem solving strategy displays an understanding of the underlying mathematical concept • Produces a solution relevant to the problem and confirms the reasonableness of the solution	• Problem solving strategy displays a limited understanding of the underlying mathematical concept • Produces a solution relevant to the problem but does not confirm the reasonableness of the solution	• A problem solving strategy is not evident • Does not produce a solution that is relevant to the problem
Communication and Reasoning	Proficient Plus: • Reasoning or justification is comprehensive • Consistently uses precise mathematical language to communicate thinking	• Demonstrates reasoning and/or justifies solution steps • Supports arguments and claims with evidence • Uses mathematical language to communicate thinking	• Reasoning or justification of solution steps is limited or contains misconceptions • Provides limited or inconsistent evidence to support arguments and claims • Uses limited mathematical language to partially communicate thinking	• Provides no correct reasoning or justification • Does not provide evidence to support arguments and claims • Uses no mathematical language to communicate thinking
Representations and Connections	Proficient Plus: • Uses representations to analyze relationships and extend thinking • Uses mathematical connections to extend the solution to other mathematics or to deepen understanding	• Uses a representation or multiple representations, with accurate labels, to explore and model the problem • Makes a mathematical connection that is relevant to the context of the problem	• Uses an incomplete or limited representation to model the problem • Makes a partial mathematical connection or the connection is not relevant to the context of the problem	• Uses no representation or uses a representation that does not model the problem • Makes no mathematical connections

Name_____ Date_____

Saving for a Bicycle

Gus wants to buy a new bicycle. He mows lawns and washes cars for people in his neighborhood to earn extra money.

- Gus earns $24 for each lawn he mows.
- He earns $15 for each car he washes.

Gus needs to earn $300 to buy the bicycle. Find at least three possible ways Gus could earn enough money from mowing lawns and washing cars. Explain and justify your thinking using pictures, numbers, and words.