Rich Mathematical Task – Grade *3 – Packing Pencils*

Task Overview/Description/Purpose:
• In this task, students will find multiple ways to package 2,342 pencils using various combinations of ones (singles), tens (bundles), hundreds (boxes), and thousands (cases). • The purpose of this task is for students to explore multiple ways to represent a four-digit number in order to develop their understanding of place value using knowledge of the 10-to-1 relationship. This task could also be adapted for use earlier in the school year by using a three-digit number.

Standards Alignment: Strand – *Number and Number Sense*	
Primary SOL: 3.1a The student will a) read, write, and identify the place value of each digit in a six-digit whole number, with and without models; Note: This task specifically addresses Essential Knowledge and Skill: The student will represent numbers up to 9,999 in multiple ways, according to place value, with and without models. **Related SOL (within or across grade levels/courses):** 2.1	
Learning Intention(s): • **Content** - I am learning to understand how a number can be represented in multiple ways. • **Language** - I am learning how place value language and place value representations can be used to show a number in multiple ways. • **Social** – I am learning to explain my thinking as it relates to creating different combinations. I am learning to listen to and explain my peers' strategies.	
Success Criteria (Evidence of Student Learning): • I can show more than one representation of a four-digit number. • I can show my math thinking about place value through pictures, numbers, and words.	
Mathematics Process Goals	
Problem Solving	• With the parameter of using only one case, students will choose an appropriate and efficient strategy to determine different ways to represent the number 2,342.
Communication and Reasoning	• Students will communicate their thinking process for representing 2,342 in multiple ways through words, picture representations, and numbers. • Students will use appropriate and accurate written and/or oral mathematical language to express ideas. • Students will demonstrate sound reasoning and justify their solutions in an organized and coherent manner.
Connections and Representations	• Students will use clear and appropriate representations to model 2,342 in multiple ways. • Students will make connections between their representations.

Task Pre-Planning
Approximate Length/Time Frame: 60 minutes

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Task Pre-Planning
Grouping of Students: Students should begin the task independently. After actively monitoring student strategies and responses, the teacher should purposefully pair students together.

Materials and Technology:	**Vocabulary:**
• base 10 blocks • connecting cubes • pencils or straws (to use as manipulatives) • place value chart • paper and pencil	• place • value • ones, tens, hundreds, thousands • regroup, ungroup, trade • base ten

Anticipate Responses: See the Planning for Mathematical Discourse Chart (columns 1-3).

Task Implementation (Before)

Task Launch:

- **Anticipate prior knowledge:** The teacher will help students access their prior knowledge about place value by asking "What do you already know about our Base-10 number system?" A KWL (**K**now-**W**ant to Know-What I **L**earned) graphic organizer could be used for students to organize their ideas. Have students share with a partner. (Provide sentence frames or sentence starters as needed.) Then facilitate a whole group discussion and record student ideas. Next, the teacher will review relevant vocabulary prior to the task. Use the vocabulary listed above in addition to any words or phrases that were generated by students. Consider posting the vocabulary where all students can see it (anchor chart, math notebooks, board).
- **Ensure understanding of task:** The teacher will read the task aloud to all students. Discuss the various groupings of pencils, and connect the groupings to place value (singles = ones, bundles = tens, boxes = hundreds, cases= thousands).
- **Establish clear expectations:** Review rubric with students as a tool for monitoring their proficiency. Review classroom expectations for working independently.

Task Implementation (During)

Directions for Supporting Implementation of the Task

- Monitor – The teacher will observe students as they work independently on the task. The teacher will engage with students by asking assessing or advancing questions as necessary (see attached *Question Matrix).*
- Select – The teacher will select students to pair up based on the strategies used. The teacher may decide to pair students who used similar strategies or students who used different strategies. Allow students time to work together in pairs on the task. The teacher will engage with pairs by asking assessing or advancing questions as necessary (see page 4*)*.
- Sequence – The teacher will select 2-3 student strategies to share with the whole group. One suggestion is to look for one common misconception and two correct responses to share.
- Connect – The teacher will consider ways to facilitate connections between different student representations.

Suggestions For Additional Student Support

- Sentences frames:
  - The strategy I will use to solve the problem is _________________.
  - Because there is only one case, I will need to _________________.
  - The value of one (UNIT) is ____ singles or since one (UNIT) equals (VALUE) single pencils, we can have ___ of those.

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  - For 2,342 pencils, we can have ___ case, ___boxes, ___ bundles, and ___singles.
  - You have to have singles because ___.
- Vocabulary development:
  - Use Frayer models to deepen understanding of vocabulary terms.
  - Pair vocabulary with visuals
  - Keep vocabulary on an anchor chart or word wall and reference the visual as needed to reinforce verbal, written, and graphic representations of new vocabulary words.
- Organization:
  - Use of graphic organizer or graph paper or lined paper
  - Prepare student work space with materials required for task
- Possible problem solving strategies:
  - Pictures, numbers, words, tables, equations, place value chart, etc.
  - Encourage students to begin with the representation of 2 cases, 3 boxes, 4 bundles, and 2 singles. Then prompt: "This uses too many cases. How can you still show the same number while only using one case?"
- Extension:
  - Could you show the same number if there were only 2 boxes available?
  - Could you show the same number if there were only 3 bundles available?

Task Implementation (After) ***20 minutes***

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

- Allow students time to walk around and see the strategies of other students (gallery walk).
- Based on the actual student responses, select and sequence particular students to present their mathematical work during class discussion. Consider sharing one strategy that shows a common misconception, and two other strategies that can connect to each other. Facilitate a discussion about similarities and differences between the strategies.
- Connect different students' responses and connect the responses to the key mathematical ideas to bring closure to the task.
- Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion (opportunity for gallery walk or think/pair/share with a partner or small group).

Teacher Reflection About Student Learning:

- How will student understanding of the content through the use of the process goals be assessed?
  - Problem solving
  - Communication & Reasoning
  - Connections & Representations
- How will the evidence provided through student work inform further instruction?
  - Creating small groups to address misconceptions
  - Individualized learning goals related to the standard (based off of proficiency at the task)

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Planning for Mathematical Discourse

Mathematical Task: Packing Pencils

Content Standard(s): SOL 3.1

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: *"I don't know how to do this."*	• How could you represent the number if there were enough cases? • What do the cases, boxes, bundles, and singles make you think of related to place value? • What do you know about the story? Could you use a tool to show what you know about the story?	• How can you show the same number while only using one case?	Student D	
Anticipated Student Response: Student is able to represent the number using 2 cases, 3 boxes, 4 tens, and 2 ones.	• How can you organize your work? • How many cases does the company have to use? • How does your solution connect to the story?	• How can you show the same number while only using one case?		
Anticipated Student Response: Student is able to find one or more ways to show 2,342 but one or more ways has small	• How many thousands (hundreds, tens, ones) do you have there?	• How could you prove how many pencils you have packed so far?	Student F	

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*
errors resulting in an incorrect solution.	• What is the value of that collection?	• How could you organize your work?		
Anticipated Student Response: The student is able to find one different way to show 2,342.	• What strategy did you use to find a different way to package the pencils? • How did you organize your work?	• Could you use a similar strategy to find another way?	Student B	
Anticipated Student Response: Student is able to find three or more different ways to show 2,342.	• Do you notice any patterns in your representations? • Can you explain the pattern that you used to find your representations?	• Can you use that pattern to find more ways to package the pencils? • Can you show your representation using a different strategy? • How many possible ways do you think there are to package the pencils?	Student A, Student C, and Student E	

NAME ____ DATE ____________________

Packing Pencils

The Pencil Company sells pencils in the following quantities:

- Singles (1 pencil)
- Bundles (10 pencils)
- Boxes (100 pencils)
- Cases (1,000 pencils)

The Pencil Company just received an order for 2,342 pencils. However, they currently have only one case of pencils in stock, but they have a large quantity of the other packing sizes.

Show at least three different ways that the pencils could be packed for this order. Explain your thinking using pictures, numbers, and words.

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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

Possible Graphic Organizers

Cases	Boxes	Bundles	Singles