

## Rich Mathematical Task – Grade 8 – *It's Peanut Butter Time!*

Task Overview/Description/Purpose:	
<ul style="list-style-type: none"> <li>The purpose of this task is to deepen student understanding of creating, using, and analyzing boxplots.</li> <li>In this task, students will compare boxplots showing data for the price per serving of peanut butter sold at two stores.</li> </ul>	

Standards Alignment: Strand – <i>Number and Number Sense</i>	
<p><b>Primary SOL:</b> 8.12 The student will (a) represent numerical data in boxplots; (b) make observations and inferences about data represented in boxplots; and (c) compare and analyze two data sets using boxplots.</p> <p><b>Related SOL (within or across grade levels/courses):</b> 7.9abc, 6.10abc, 6.11b</p>	

<p><b>Learning Intention(s):</b></p> <ul style="list-style-type: none"> <li><b>Content</b> - I am learning to collect, represent, and analyze data using a boxplot.</li> <li><b>Language</b> - I am learning to explain my problem-solving approach verbally and in writing.</li> <li><b>Social</b> - I am learning to explain my problem-solving thinking to my peers.</li> </ul>	
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<p><b>Success Criteria (Evidence of Student Learning):</b></p> <ul style="list-style-type: none"> <li>I can collect and display a data set using a boxplot.</li> <li>I can identify and describe the lower extreme, upper extreme, median, upper quartile, lower quartile, range, and interquartile range from a set of data represented in a boxplot.</li> <li>I can make observations and inferences about data represented in a boxplot.</li> <li>I can compare and analyze two data sets represented in boxplots.</li> <li>I can communicate similarities and differences between my work and a peer's work.</li> </ul>	
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Mathematics Process Goals	
Problem Solving	<ul style="list-style-type: none"> <li>Students will choose an appropriate problem-solving strategy or strategies to compare the prices of peanut butter sold at two different stores.</li> <li>Students will apply their knowledge of box plots to determine how a box plot would change given different parameters.</li> </ul>
Communication and Reasoning	<ul style="list-style-type: none"> <li>Students will justify their solutions verbally and with mathematical evidence.</li> <li>Students will communicate the outcomes in a practical situation and support their thinking with evidence.</li> </ul>
Connections and Representations	<ul style="list-style-type: none"> <li>Students will make a mathematical connection between the data, five number summary and the box plot.</li> <li>Students will represent and describe mathematical ideas using a variety of methods such as list, tables and/or pictures.</li> </ul>

Task Pre-Planning	
<p><b>Approximate Length/Time Frame:</b> 45 minutes</p>	
<p><b>Grouping of Students:</b></p> <ul style="list-style-type: none"> <li>Large group: Set the stage through a series of questions. Be sure that vocabulary has been presented in previous lessons. Set expectations for each part of the task. Present task.</li> </ul>	

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### Task Pre-Planning

- Independent Think Time: Allow students 2 minutes to think about the task without writing.
- Shoulder Partners: Allow students 2 minutes to share their ideas of how to approach the problem.
- Independent: Complete task.
- Large Group: In the closing, consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion. Select individuals to share their strategies.

### Materials and Technology:

- Copies of task
- Calculators
- Graph paper
- Rulers

### Vocabulary:

- median
- interquartile range
- lower quartile
- maximum
- minimum
- upper quartile
- quartile
- range
- boxplot
- skewness
- interval
- range
- five number summary

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

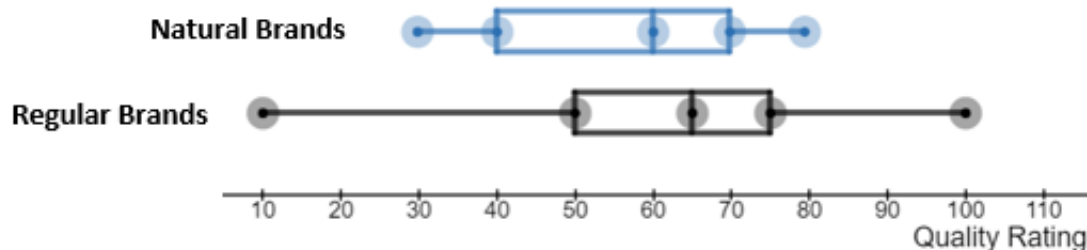
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### Task Implementation (Before)

#### Task Launch:

- Display the parallel box plots below to the class:  
Using the box plots below, tell as much as you can about the information displayed by the graphs.

### Quality Ratings for Natural and Regular Brands of Peanut Butter



- Allow the students to talk to the partner to brainstorm (1 minute). Then report to the class. Do not agree or disagree with their explanations.
- As a whole group, the teacher will introduce the task using a reading strategy (Three Read Protocol) to ensure all students understand what the problem is asking and the vocabulary that is used in the task.
  - First read: Students focus on what the situation is about. Teacher debrief providing clarity to the problem and addressing vocabulary questions.
  - Second read: Students identify what the quantities are in the situation. Teacher debriefs.
  - Third read: Students identify the mathematical question being asked of this situation. Teacher debriefs.
- Provide 2 minutes of independent think time for students without writing.
- Provide 2 minutes for shoulder partners to share their ideas without writing.
- Clarify any questions and provide approximately 15 – 20 minutes for students to complete the task 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.
- Select – The teacher will decide which strategies or thinking (how they matched the Store to the relative box plot) that will be highlighted (after implementation) that will advance mathematical ideas and support student learning.
- Sequence – The teacher will decide the order in which student ideas will be highlighted during the closure discussion (after implementation).
- Connect – The teacher will consider ways to facilitate connections between different student responses.

#### Suggestions for Additional Student Support

- Have resources such as graph paper available to help explore box plots. Graph paper can be used for students to write each number in a square, and then cut and folded in quarters to identify the least value, first quartile, median, third quartile, and greatest value.

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- Some students get stuck at one way of thinking and using one method. Asking questions like “How confident are you?” and “What would convince someone?” will help students get past this point.
- For students with motor processing difficulties, allow them to communicate the reasoning in other ways such as video recording or typing answers.
- For students with attention challenges ask student to restate the problem or important information.
- Students with challenges in memory and language could benefit from word walls or graphic organizers to activate prior knowledge about measures of central tendency and the key components of a box plot.
- For students who need more support in justifying their thinking, you may choose to provide them with the sentence frames below.
  - What I know about box plots is ...
  - I chose this store \_\_\_ for this boxplot \_\_\_\_\_ because....
  - My method for solving the problem was...
- For ELs with first language literacy, try to provide prompt, or parts of prompt, in their home language

### 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. Suggested sequence would be:
  - Students that calculated the five number summaries to solve the problem.
  - Students that used a manipulative or graph paper to assist in solving the problem.
  - Students that used a different method or representation that was not mentioned above.
- Lead the class discourse to identify the similarities and differences between the methods used.
- Have students share their answer to the second question and explain how they made their comparisons using the boxplots.
- During the discussion, ask students to explain the meaning of any terminology they use.
- For each question, ensure students are providing evidence to support their explanations.

#### Teacher Reflection About Student Learning:

- Were the instructional objectives met? Were the students able to apply strategies for comparing and analyzing box plots?
- Were the process goal objectives met? Were students able to explain their work verbally (oral or written)? Does vocabulary need further development?
- Were the students productively engaged?
- Was enough support provided during the task using the chart of anticipated responses? Did additional responses occur that were not anticipated?
- What strategies did the students struggle with the most? Were there reoccurring student misconceptions?
- How will the evidence provided through student work inform further instruction?
- Did the task rubric assist in identifying students who need additional support? What additional assistance and support will be needed for students who are developing or emerging?

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### Planning for Mathematical Discourse

Mathematical Task: It's Peanut Butter Time!

Content Standard(s): SOL 8.12

<b>Anticipated Student Response/Strategy</b> <i>Provide examples of possible correct student responses along with examples of student errors/misconceptions</i>	<b>Assessing Questions</b> <i>Teacher questioning that allows student to explain and clarify thinking</i>	<b>Advancing Questions</b> <i>Teacher questioning that moves thinking forward</i>	<b>List of Students Providing Response</b> <i>Who? Which students used this strategy?</i>	<b>Discussion Order - sequencing student responses</b> <ul style="list-style-type: none"> <li>• <i>Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion</i></li> <li>• <i>Connect different students' responses and connect the responses to the key mathematical ideas</i></li> <li>• <i>Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion</i></li> </ul>
<b>Anticipated Student Response:</b> No approach. Student has no idea where to begin. <i>"I don't know what to do."</i>	<ul style="list-style-type: none"> <li>• What are you thinking?</li> <li>• What facts do you have?</li> <li>• How would you explain the problem in your own words?</li> </ul>	<ul style="list-style-type: none"> <li>• Can you determine a relationship between the data and the box plots?</li> <li>• What data values are represented on a box plot?</li> <li>• What do the vertical/horizontal lines represent?</li> </ul>		
<b>Anticipated Student Response:</b> Student does not understand how to figure out the lower and upper quartiles or the median from the graph.	<ul style="list-style-type: none"> <li>• What does the median represent?</li> <li>• What does the lower quartile represent?</li> <li>• What does the upper quartile represent?</li> </ul>	<ul style="list-style-type: none"> <li>• How can you show the median value on the graph?</li> <li>• How can you show the lower/upper quartile on the graph?</li> </ul>		
<b>Anticipated Student Response:</b> Student does not understand why the top box plot does not have a vertical line inside the box	<ul style="list-style-type: none"> <li>• What numbers are represented in a box plot?</li> <li>• How do we find those numbers represented in a box plot?</li> </ul>	<ul style="list-style-type: none"> <li>• How can we use the numbers that are represented in a box plot to create a box plot?</li> </ul>		

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<b>Anticipated Student Response/Strategy</b> <i>Provide examples of possible correct student responses along with examples of student errors/misconceptions</i>	<b>Assessing Questions</b> <i>Teacher questioning that allows student to explain and clarify thinking</i>	<b>Advancing Questions</b> <i>Teacher questioning that moves thinking forward</i>	<b>List of Students Providing Response</b> <i>Who? Which students used this strategy?</i>	<b>Discussion Order - sequencing student responses</b> <ul style="list-style-type: none"> <li>• <i>Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion</i></li> <li>• <i>Connect different students' responses and connect the responses to the key mathematical ideas</i></li> <li>• <i>Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion</i></li> </ul>
<b>Anticipated Student Response:</b>  Logical Thinking Approach "I just know that the answer is..."	<ul style="list-style-type: none"> <li>• How do you know that is the correct answer?</li> <li>• Can you explain to me how you solved the task?</li> <li>• Walk me through the steps. Where did you begin?</li> <li>• How does this help you answer the question?</li> <li>• What evidence do you have to support your answer?</li> </ul>	<ul style="list-style-type: none"> <li>• Can you use a mathematical model to represent your thinking?</li> <li>• What math terms can you use in your justification?</li> </ul>		
<b>Anticipated Student Response:</b>  Student calculates the five-number summaries in order to compare the box plots	<ul style="list-style-type: none"> <li>• How do you know that is the correct answer?</li> <li>• Can you explain to me how you solved the task?</li> <li>• Walk me through the steps. Where did you begin?</li> <li>• How does this help you answer the question?</li> <li>• What evidence do you have to support your answer?</li> </ul>	<ul style="list-style-type: none"> <li>• Can you think of another way to justify your solutions?</li> <li>• What math terms can you use in your justification?</li> </ul>		

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### It's Peanut Butter Time!

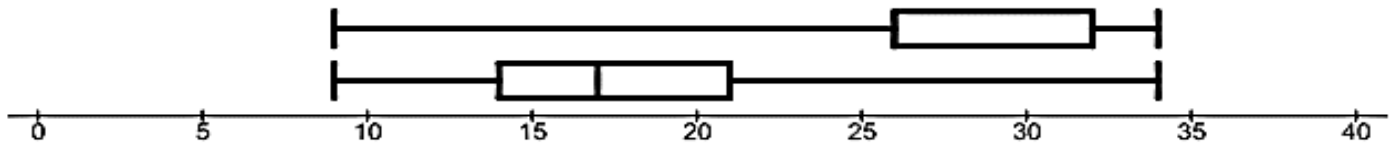
The data below shows the prices per serving in cents for Peanut Butter sold at two grocery stores: Peanut Butter Direct and Peanut Butter Palace.

**Peanut Butter Direct:** 14, 34, 31, 9, 10, 17, 17, 30, 14, 17, 21, 18, 21, 30, 12, 9, 17, 19, 20

**Peanut Butter Palace:** 26, 34, 9, 26, 26, 33, 27, 15, 24, 26, 32, 32, 26, 32

- A. Using the data above and the box plots shown below, decide which plot shows the distribution of prices for Peanut Butter Direct and which plot shows the distribution of prices for Peanut Butter Palace. Explain how you determined your answer.

### Peanut Butter Prices



- B. How do the prices of Peanut Butter Direct compare with the prices of Peanut Butter Palace? Explain how you can make this comparison by using the box plots.
- C. If price were the only factor a buyer considered, would Peanut Butter Direct or Peanut Butter Palace be a better choice for shopping for peanut butter? Explain your reasoning.
- D. How would Peanut Butter Direct's box plot change if the price doubled? Provide evidence to explain your reasoning?

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### Rich Mathematical Task Rubric

	Advanced	Proficient	Developing	Emerging
<b>Mathematical Understanding</b>	<p>Proficient Plus:</p> <ul style="list-style-type: none"> <li>Uses relationships among mathematical concepts or makes mathematical generalizations</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates an understanding of concepts and skills associated with task</li> <li>Applies mathematical concepts and skills which lead to a valid and correct solution</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates a partial understanding of concepts and skills associated with task</li> <li>Applies mathematical concepts and skills which lead to an incomplete or incorrect solution</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates no understanding of concepts and skills associated with task</li> <li>Applies limited mathematical concepts and skills in an attempt to find a solution or provides no solution</li> </ul>
<b>Problem Solving</b>	<p>Proficient Plus:</p> <ul style="list-style-type: none"> <li>Problem solving strategy is well developed or efficient</li> </ul>	<ul style="list-style-type: none"> <li>Problem solving strategy displays an understanding of the underlying mathematical concept</li> <li>Produces a solution relevant to the problem and confirms the reasonableness of the solution</li> </ul>	<ul style="list-style-type: none"> <li>Problem solving strategy displays a limited understanding of the underlying mathematical concept</li> <li>Produces a solution relevant to the problem but does not confirm the reasonableness of the solution</li> </ul>	<ul style="list-style-type: none"> <li>A problem solving strategy is not evident</li> <li>Does not produce a solution that is relevant to the problem</li> </ul>
<b>Communication and Reasoning</b>	<p>Proficient Plus:</p> <ul style="list-style-type: none"> <li>Reasoning or justification is comprehensive</li> <li>Consistently uses precise mathematical language to communicate thinking</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates reasoning and/or justifies solution steps</li> <li>Supports arguments and claims with evidence</li> <li>Uses mathematical language to communicate thinking</li> </ul>	<ul style="list-style-type: none"> <li>Reasoning or justification of solution steps is limited or contains misconceptions</li> <li>Provides limited or inconsistent evidence to support arguments and claims</li> <li>Uses limited mathematical language to partially communicate thinking</li> </ul>	<ul style="list-style-type: none"> <li>Provides no correct reasoning or justification</li> <li>Does not provide evidence to support arguments and claims</li> <li>Uses no mathematical language to communicate thinking</li> </ul>
<b>Representations and Connections</b>	<p>Proficient Plus:</p> <ul style="list-style-type: none"> <li>Uses representations to analyze relationships and extend thinking</li> <li>Uses mathematical connections to extend the solution to other mathematics or to deepen understanding</li> </ul>	<ul style="list-style-type: none"> <li>Uses a representation or multiple representations, with accurate labels, to explore and model the problem</li> <li>Makes a mathematical connection that is relevant to the context of the problem</li> </ul>	<ul style="list-style-type: none"> <li>Uses an incomplete or limited representation to model the problem</li> <li>Makes a partial mathematical connection or the connection is not relevant to the context of the problem</li> </ul>	<ul style="list-style-type: none"> <li>Uses no representation or uses a representation that does not model the problem</li> <li>Makes no mathematical connections</li> </ul>