

## Rich Mathematical Task – Grade 6 – *Tracking Sharks*

<b>Task Overview/Description/Purpose:</b>	
<ul style="list-style-type: none"> <li>• In this task, students will use integer operations to determine the distance between a drone and shark as well as the change in depth of a shark at given points.</li> <li>• This task is designed to deepen student understanding of integer operations in practical problems.</li> </ul>	
<b>Standards Alignment: Strand – <i>Computation and Estimation</i></b>	
<b>Primary SOL:</b> 6.6b The student will solve practical problems involving operations with integers.	
<b>Related SOL (within or across grade levels/courses):</b> 5.4, 6.3ac, 6.6a, 7.2	
<b>Learning Intention(s):</b>	
<ul style="list-style-type: none"> <li>• <b>Content</b> - I am learning to solve practical problems involving integer operations.</li> <li>• <b>Language</b> - I am learning to justify how integer operations are used in solving practical problems involving vocabulary terms such as depth, distance, ascending, and descending.</li> <li>• <b>Social</b> - I am learning to communicate my strategy and thinking to others so I can refine my strategies for problem solving.</li> </ul>	
<b>Success Criteria (Evidence of Student Learning);</b>	
<ul style="list-style-type: none"> <li>• I can solve practical problems involving integer operations.</li> <li>• I can model integer operations to solve practical problems.</li> <li>• I can justify my computational process of integer operations and report my conclusions in the context of the problem.</li> <li>• I can make suggestions and utilize suggestions made by my peers to make revisions to my work and thinking.</li> </ul>	
<b>Mathematics Process Goals</b>	
Problem Solving	<ul style="list-style-type: none"> <li>• Students will use integer operations to solve a practical problem dealing with positive and negative integers.</li> </ul>
Communication and Reasoning	<ul style="list-style-type: none"> <li>• Students will justify verbally their solution in the context of the problem. Students will explain their process for determining when the shark can/cannot be detected and changes to the location of the shark that would result in it being detectable/undetectable.</li> </ul>
Connections and Representations	<ul style="list-style-type: none"> <li>• Students will use words, expressions, number lines, tiles, and/or other models to represent the location of the shark and drone at different times. Students will make connections between these representations in order to answer the task questions.</li> </ul>
<b>Task Pre-Planning</b>	
<b>Approximate Length/Time Frame:</b> 60-75 minutes	
<b>Grouping of Students:</b> This task would be best completed with students working collaboratively first to discuss their problem solving process, and then work independently to determine their solution.	
<b>Materials and Technology:</b>	<b>Vocabulary:</b>
<ul style="list-style-type: none"> <li>• Integer Number Line</li> <li>• Two-Color Counters</li> <li>• Algebra Tiles</li> </ul>	<ul style="list-style-type: none"> <li>• Integer</li> <li>• Ascends</li> <li>• Descends</li> </ul>

Task Pre-Planning	
<ul style="list-style-type: none"> <li>• Linking Cubes</li> <li>• Graph Paper</li> <li>• Blank Paper</li> </ul>	<ul style="list-style-type: none"> <li>• Absolute value</li> <li>• Sea Level</li> <li>• Depth</li> <li>• Altitude</li> <li>• Integer Operations</li> <li>• Average</li> </ul>
<b>Anticipate Responses:</b> See Planning for Mathematical Discourse Chart (Columns 1-3)	
Task Implementation (Before)	
<b>Task Launch</b> <ul style="list-style-type: none"> <li>• Ask students who has seen a drone before. What are they used for? Tell students that scientists are using them to find and monitor animals in a way that they are not in danger and does not intrude on the animal's space.</li> <li>• Show students this <a href="#">video</a> of how scientists are using drones to detect sharks in the water.             <ul style="list-style-type: none"> <li>○ Ask students what they wonder about the work of the scientists. What are the benefits of using drones to monitor a species like a shark?</li> </ul> </li> <li>• To help students make sense of the task, it would be beneficial to have students read the task first and circle any words that are confusing to them. You may choose to read the task to students and have them follow along. Then have a class discussion about any words that students circled. Following this discussion, have the students read the task a second time. On the third read through, have students underline any important information.</li> </ul>	
Task Implementation (During)	
<b>Directions for Supporting Implementation of the Task</b> <ul style="list-style-type: none"> <li>• Monitor – Teacher will listen and observe students as they work on task and ask assessing or advancing questions (see chart on next page)</li> <li>• Select – Teacher will decide which strategies or thinking that will be highlighted (after student task implementation) that will advance mathematical ideas and support student learning</li> <li>• Sequence – Teacher will decide the order in which student ideas will be highlighted (after student task implementation) during the closure discussion.</li> <li>• Connect – Teacher will consider ways to facilitate connections between different student responses</li> </ul>	
<b>Suggestions For Additional Student Support</b> <ul style="list-style-type: none"> <li>• Question students, in both assessing and advancing formats, to help students refine their strategies.</li> <li>• Have all of the manipulatives out on a central table so that students can get what they need, as they need it.</li> <li>• 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.</li> <li>• For students with motor processing difficulties, allow them to communicate the reasoning in other ways such as video recording or typing answers.</li> <li>• For students with attention challenges ask student to restate the problem or important information and show one question at a time.</li> <li>• For students who need academic language support, consider the use of a visual word wall or reference sheet for students to use identifying integer, absolute value, ascend, descend, and words that represent positive numbers, negatives, and zero.</li> <li>• For some students who have difficulty getting started, encourage them to draw a picture of the situation.</li> <li>• For students who need more support in justifying their thinking, you may choose to provide them with the sentence frames below.             <ul style="list-style-type: none"> <li>○ What I know about the problem is...</li> </ul> </li> </ul>	

### Task Implementation (Before)

- My method for solving the problem was...
- I know that the shark will be detected by the drone at the hours .....
- Between 12pm and 1pm the shark could change depth by \_\_\_\_\_ to be detected/undetected by the drone. I know this because...
- For ELs with first language literacy, try to provide prompt, or parts of prompt, in their home language

### Task Implementation (After)

#### 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:
  - Common misconceptions
  - Concrete to representational to abstract
- Connect different students' responses and connect the responses to the key mathematical ideas to bring closure to the task. Possible questions and sentence frames to connect student strategies:
  - How are these strategies alike? How are they different?
  - Where do you see \_\_\_\_\_'s strategy in \_\_\_\_\_'s strategy?
  - How does \_\_\_\_\_'s picture relate to \_\_\_\_\_'s symbols?
  - Why is this important?
- Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion. Some possible ways to do this are to-
  - Assign roles like time keeper, task master, material fetcher, and recorder of strategies to each member of the group.
  - Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion. A possible ways to do this is to use "Snowball" in the middle of the task to have students get new ideas/refine their thinking. In groups of 3-5, have students share their ideas related to the task. What strategies are they using? How are they showing their thinking? Give each group 3-5 minutes to share (roughly 1 minute per student). Then have students form a new group of 3-5. They should not be with any of the same people. Repeat this process of sharing again. "Snowball" is a good way to promote discourse as well as help all students generate and refine strategies for approaching the task.

#### Teacher Reflection About Student Learning:

- Teacher should use the chart on the next page with the anticipated student solutions to monitor which students are using each strategy as well as record any additional strategies encountered. The sequence of tasks will inform what will come next in instruction to further student ideas and thinking. Form small groups to address misconceptions that are not addressed in the class debrief.
- Information gathered from the task rubric could identify small groups for later instruction, identifying specific students to partner with one another, and/or identifying students who need more teacher modeling and think alouds.

## Planning for Mathematical Discourse

Mathematical Task: Tracking Sharks

Content Standard(s): SOL 6.6b

Anticipated Student Response/Strategy <i>Provide examples of possible correct student responses along with examples of student errors/misconceptions</i>	Assessing Questions: <i>Teacher questioning that allows student to explain and clarify thinking</i>	Advancing Questions: <i>Teacher questioning that moves thinking forward</i>	List of Students Providing Response <i>Who? Which students used this strategy?</i>	Discussion Order - sequencing student responses <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>  I don't know what to do?	<ul style="list-style-type: none"> <li>What is the question asking you?</li> <li>What information do you have?</li> <li>What do you notice?</li> <li>What do you wonder?</li> <li>What do you predict the solution might look like?</li> </ul>	<ul style="list-style-type: none"> <li>What could you use to model the problem?</li> <li>What do you predict the solution might look like?</li> </ul>		
<b>Anticipated Student Response:</b> Student confuses ascending and descending	<ul style="list-style-type: none"> <li>What is the difference between ascend and descend?</li> </ul>	<ul style="list-style-type: none"> <li>How might you represent that change in depth?</li> </ul>		
<b>Anticipated Student Response:</b> Student does not account for the location of the drone	<ul style="list-style-type: none"> <li>Can you explain to us how you picture the location of the drone and the shark?</li> <li>Where is the drone located in relation to the shark?</li> </ul>	<ul style="list-style-type: none"> <li>What is the maximum depth of the shark the drone would be able to detect from this location?</li> </ul>		

<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>  Student incorrectly determines the average of the first two dives for the last hour	<ul style="list-style-type: none"> <li>• How would you find the average?</li> <li>• What does average mean?</li> <li>• What values represent each of the first two dives?</li> </ul>	<ul style="list-style-type: none"> <li>• How could a model help you determine the average of the first two dives?</li> </ul>		
<b>Anticipated Student Response:</b>  Student correctly determines when the shark is detectable/undetected.	<ul style="list-style-type: none"> <li>• Can you explain your thinking for solving the problem?</li> </ul>	<ul style="list-style-type: none"> <li>• How could you convince someone else that your findings are correct?</li> </ul>		

Name\_\_\_\_\_

Date\_\_\_\_\_

## Tracking Sharks

You are an engineer in charge of testing new equipment that can detect shark trackers from the air. The equipment in the drone can detect the shark tracker within a total distance of 750 feet. Each hour on the hour the tracker sends a signal of its location to the drone. You are flying a drone 250 feet above the surface of the ocean.

- It is 9:00 am when the drone first detects the shark tracker.
- At 9:00 am the shark is 275 feet below sea level.
- At 10:00 am the shark is 392 feet below sea level.
- From 10:00 am to 11:00 am the shark descends 85 feet.
- From 11:00 am to noon, the shark dives again, descending by an amount equal to the average of the first two dives.

a) At which hours will the drone be able to detect the shark? Justify your thinking.

b) What depth change can the shark make from 12pm – 1pm that will allow the shark to be **detectable** by the drone? Explain how you know.

c) What depth change can the shark make from 12pm – 1pm that will allow the shark to be **undetectable** by the drone? Explain how you know.

## 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</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 little or 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 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>• Chooses a problem solving strategy that does not display an 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 or is not complete</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 is organized and coherent</li> <li>• Consistent use of precise mathematical language and accurate use of symbolic notation</li> </ul>	<ul style="list-style-type: none"> <li>• Communicates thinking process</li> <li>• Demonstrates reasoning and/or justifies solution steps</li> <li>• Supports arguments and claims with evidence</li> <li>• Uses mathematical language to express ideas with precision</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 with some imprecision</li> </ul>	<ul style="list-style-type: none"> <li>• Provides little to no correct reasoning or justification</li> <li>• Does not provide evidence to support arguments and claims</li> <li>• Uses little or 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>