

Rich Mathematical Task – Geometry – *Lines & Tigers & Bears – Oh My!*

Task Overview/Description/Purpose:
<ul style="list-style-type: none"> In this task, students will apply the knowledge of parallel lines cut by a transversal and the relationships of the angles formed by those lines intersecting in order to create a design for a zoo. Students will also use applications of slope and writing equations of lines to justify why the lines created are parallel and perpendicular. This task may be used reinforce the concepts addressed in SOL G.2 by allowing students to apply their knowledge. The task could also be used as an exploratory task after students have received instruction regarding the concepts to allow for hands-on modeling. Use of geometry software is encouraged.

Standards Alignment: Strand – Reasoning, Lines, and Transformations
<p>Primary SOL: G.2 The student will use the relationship between angles formed by two lines intersected by a transversal to:</p> <ol style="list-style-type: none"> prove two or more lines are parallel; and solve problems, including practical problems, involving angles formed when parallel lines are intersected by a transversal. <p>Related SOL (within or across grade levels/courses): G.3b, A.6</p>

<p>Learning Intention(s):</p> <ul style="list-style-type: none"> Content - I am learning how to solve practical problems, involving intersecting and parallel lines, by using the relationships between pairs of angles formed by the intersection of two or more parallel lines and a transversal. I am learning how to use slope to determine whether lines are parallel or perpendicular. Language - I am learning to explain my thinking when describing the relationships among angles in lines that are parallel. Social - I am learning how to engage in productive discussions about how my peers made their decisions, including their reasoning and modeling of the scenario.
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<p>Success Criteria (Evidence of Student Learning):</p> <ul style="list-style-type: none"> I can solve practical problems involving intersecting and parallel lines by using the relationships between pairs of angles formed. I can use slope to determine if two lines are parallel or perpendicular. I can explain my thinking and process for how my mathematical evidence supports my claims to my peers.
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Mathematics Process Goals	
Problem Solving	<ul style="list-style-type: none"> Students will find the slope of a line to determine when two lines are parallel or perpendicular in a real-world scenario. Students will apply angle relationships formed by parallel lines and a transversal in a real-world scenario.
Communication and Reasoning	<ul style="list-style-type: none"> Students will demonstrate reasoning and justify their solutions with mathematical language that describes the relationship between angles formed by parallel lines intersected by a transversal. Students may use DESMOS and/or a coordinate grid to create their diagram and calculate the slope of the lines.
Connections and Representations	<ul style="list-style-type: none"> Students will provide multiple representations of the situation, which may include a physical model, graph, or equation.

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- Students will provide.....a verbal/written explanation for the location of the exhibits.

Task Pre-Planning

Approximate Length/Time Frame: 75 minutes

Grouping of Students:

First, students could work on the task individually to create the model for the zoo and answer the pertinent questions. If time allows, students could then trade their diagrams with another student and use sentence frames to locate specific exhibits. Students can also check the calculations of slope and how their partner determined if the lines were parallel/perpendicular.

Materials and Technology:

- Graph Paper
- Pencils
- Ruler
- Colored Pencils
- Graphing Utility/Desmos

Vocabulary:

- Slope
- Transversal
- Parallel
- Perpendicular
- Same-side (consecutive) interior angles
- Same-side (consecutive) exterior angles
- Corresponding angles
- Alternate interior angles
- Alternate exterior angles

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

Task Implementation (Before)

Task Launch :

- Explore maps from various zoos to allow students the opportunity to create a vision of what they might wish to include in their individual zoo map. ([San Diego Zoo Map](#); [Denver Zoo Map](#), [Smithsonian National Zoo – D.C. Map](#))
- Encourage student dialogue to brainstorm about the maps that they will make and encourage the use of appropriate geometric vocabulary to describe the location of exhibits and other components of the zoo being created. Consider how the VDOE Vocabulary Word Wall Cards might support use of geometric language.
- Students would benefit from using dynamic Geometry software such as [Geogebra](#) or the [Desmos Geometry Tool](#) to help create the geometric figures in the zoo map and explore the relationships between the angle measures and orientations.

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 chart on the next page).
- Select – The teacher will decide which models and diagrams will be highlighted (after student task implementation) that will expound upon the various angle relationships and concepts.
- 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.

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Task Implementation (During)

Suggestions For Additional Student Support:

- Possible use of sentences frames to support student thinking or justifications might include:
 - (Name of Exhibit) is located at a (Name of Angle Relationship) from (Name of Another Exhibit).
 - I know that the line representing (Street A) is parallel to the line representing (Street B) because the angles located at (Name of Exhibit) and (Name of Exhibit) are (Angle Relationships) and thus congruent.
 - Since the angle located at (Name of Exhibit) and the angle located at (Name of Exhibit) are supplementary, I know that the line representing (Street C) is parallel to the line representing (Street D).
- Students might make a chart of relationships between the angle measures where exhibits are located in the map, using the appropriate geometric vocabulary to describe the relationships.

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
- 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

Teacher Reflection About Student Learning:

- How will student understanding of the content through the use of the process goals be assessed (i.e., task rubric)?
- How will the evidence provided through student work inform further instruction?
- Do students need additional development of the vocabulary used during the task?
- What common errors and misconceptions were students making during the task that provided insight into their thinking?
- Are students able to justify the maps created and the angle relationships formed in the diagram?
- How might student dialogue be better structured to facilitate deeper understanding?

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Planning for Mathematical Discourse

Mathematical Task: Lines & Tigers & Bears – Oh My!

Content Standard(s): G.2a, b

Anticipated Student Response/Strategy <i>Provide examples of possible correct student responses along with examples of student errors/misconceptions</i>	Assessing Questions – Teacher Stays to Hear Response <i>Teacher questioning that allows student to explain and clarify thinking</i>	Advancing Questions - Teacher Poses Question and Walks Away <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"> • <i>Based on the actual student responses, sequence and select particular students to present their mathematical work during class discussion</i> • <i>Connect different students' responses and connect the responses to the key mathematical ideas</i> • <i>Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion</i>
<p>Anticipated Student Response: Student may be unable to begin creating three parallel lines and two transversals to represent streets on the zoo map.</p>	<ul style="list-style-type: none"> • Look at some of the maps we reviewed from zoos across the country. What is the relationship between some of the streets on the map? Do you see any that are parallel? How do you know? • What are some ways we can determine that lines are parallel? 	<ul style="list-style-type: none"> • How might you create a diagram with three parallel lines and two transversals intersecting them that represent streets in your zoo? How will you know that the lines are parallel? 		
<p>Anticipated Student Response: Student may be unsure how to create a street perpendicular to one of the transversal streets.</p>	<ul style="list-style-type: none"> • What is the relationship between the slopes of lines that are perpendicular? • How can we create a line perpendicular to another line? 	<ul style="list-style-type: none"> • How can use dynamic software to create a perpendicular line to one of your transversal streets? How will you know that they are perpendicular to one another? 	Student X	
<p>Anticipated Student Response: Student makes errors in identifying the relationships</p>	<ul style="list-style-type: none"> • What does it mean when angles are corresponding? 	<ul style="list-style-type: none"> • How can you determine where to place two animal exhibits on your map so 	Student X	

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between angles when describing where animal exhibits are located.	<ul style="list-style-type: none"> • When are angles supplementary? • How can you identify alternate interior angles? • How can you identify alternate exterior angles? 	that the angles formed by the streets where they are located form congruent angles? How would you describe the relationships between those angles? <ul style="list-style-type: none"> • What other angle relationships can you identify on your map using your knowledge of parallel lines cut by a transversal? Where would you put other animal exhibits so that their location can be described using those relationships? 		
Anticipated Student Response: Student makes errors in describing where the food court, restrooms, water fountain, gift shop and parking lot are located using angle relationships from the map.	<ul style="list-style-type: none"> • What angle relationships allow us to determine that two angles are congruent given parallel lines cut by a transversal? • What angle relationships allow us to determine that two angles are supplementary 	<ul style="list-style-type: none"> • Where can you locate two congruent angles on your map? How do you know that they are congruent based on their relationship to one another? 	Student X	

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	<p>given parallel lines cut by a transversal?</p>	<ul style="list-style-type: none"> • Where can you locate two supplementary angles on your map? How do you know that they are supplementary based on their relationship between one another? 		

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NAME _____

DATE _____



You work for a graphic design company and your next assignment is to design a map of a zoo with the following characteristics:

- Three parallel streets (each street must be named and clearly labeled)
- Two transversal streets which intersect all three parallel lines but are not parallel to each other (each street must be named and clearly labeled)
- One additional street perpendicular to any one of the transversals (clearly named and labeled)
- Create and label at least six different animal exhibits with at least one exhibit on each of the three parallel lines. Describe the location of each exhibit in relationship to another. Use at least 3 different angle relationships of your choice.
- A food court, restrooms, and a water fountain positioned in angle relationships that are congruent.
- A gift shop and parking lot positioned in an angle relationship that is supplementary.

You will demonstrate your knowledge of parallel lines with a transversal and your knowledge of angle pairs formed by the intersection of the lines. You are creating the initial map of a zoo and justifying the design of the lines and the position of the different exhibits in anticipation of a new zoo being built.

Once you have created a map of the zoo, answer the following questions:

- How do you know the three lines you drew are parallel?
- How do you know the street that intersects one of the transversals is perpendicular to it?

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Rich Mathematical Task Rubric

	Advanced	Proficient	Developing	Emerging
Mathematical Understanding	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Uses relationships among mathematical concepts or makes mathematical generalizations 	<ul style="list-style-type: none"> Demonstrates an understanding of concepts and skills associated with task Applies mathematical concepts and skills which lead to a valid and correct solution 	<ul style="list-style-type: none"> Demonstrates a partial understanding of concepts and skills associated with task Applies mathematical concepts and skills which lead to an incomplete or incorrect solution 	<ul style="list-style-type: none"> 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	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Problem solving strategy is well developed or efficient 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> A problem solving strategy is not evident Does not produce a solution that is relevant to the problem
Communication and Reasoning	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Reasoning or justification is comprehensive Consistently uses precise mathematical language to communicate thinking 	<ul style="list-style-type: none"> Demonstrates reasoning and/or justifies solution steps Supports arguments and claims with evidence Uses mathematical language to communicate thinking 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<p>Proficient Plus:</p> <ul style="list-style-type: none"> Uses representations to analyze relationships and extend thinking Uses mathematical connections to extend the solution to other mathematics or to deepen understanding 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Uses no representation or uses a representation that does not model the problem Makes no mathematical connections