Rich Mathematical Task – Algebra II – *Animate It!*

Task Overview/Description/Purpose:
• Using Desmos sliders to animate an absolute value function, students will explore how the parameters of the function equation affect its graph. • This task would be used at the end of a unit to assess student's understanding of transformations and how different transformations are created from an equation.

Standards Alignment: Strand – *Functions*	
Primary SOL: **AII.6b** For **absolute value**, square root, cube root, rational, polynomial, exponential, and logarithmic functions, the student will b) use knowledge of transformations to convert between equations and the corresponding graphs of functions. **Related SOL (within or across grade levels/courses):** A.7, AII.6a, AII.7, MA.1	
Learning Intention(s): • **Content** - I am learning to create transformations of absolute value functions to create an animation. • **Language** - I am learning explain my thinking using mathematical vocabulary. • **Social** - I am learning to work with my peers to solve a practical problem.	
Success Criteria (Evidence of Student Learning): • I can write an equation of an absolute value function that has been transformed. • I can describe how the parameters of the equation of an absolute value function change based on a transformation.	
Mathematics Process Goals	
Problem Solving	• Students will apply mathematical concepts and skills and the relationships among them and choose an appropriate strategy to solve a problem.
Communication and Reasoning	• Students will explain their reasoning using mathematical vocabulary. • Students will provide work to show how they used their strategy to reach their solution.
Connections and Representations	• Students will provide one or more representations of the situation: drawing, table, graph, and/or equation.

Task Pre-Planning
Approximate Length/Time Frame: 55 minutes
Grouping of Students: • If using this task as a summative assessment, you might choose to have students work independently or in a partner/small group with a group work reflection. • When grouping students, consider their varied strengths to address both the mathematical and creative demands of the task.

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Task Pre-Planning	
Materials and Technology: • White board • Markers • Waxed string or some other manipulative that will allow students to layout their ideas • Graph paper • Desmos Graphing Calculator(see list of tutorials below) • Desmos Version of Animate It!	**Vocabulary:** • Absolute Value Function • Transformation • Vertical Shift • Horizontal Shift • Dilation
Desmos Tutorials Teachers may want to familiarize themselves with features of Desmos they have not used previously. As students progress through the task, if they are requesting assistance with these features, the tutorials could be shared at the teacher's discretion. • Sliders and Animations • Graph Settings • Restricting Domains • Uploading Images **Go to this graph to see an advanced example of what students could create:** https://www.desmos.com/calculator/0pw4uumgu6	
Anticipate Responses: See the Planning for Mathematical Discourse Chart (columns 1-3).	

Task Implementation (Before) ***5- 10 minutes***
Task Launch: • If using as an introductory task, have a class discussion about all of their background knowledge about transformations. • Present this task as a problem for students to solve in any manner that makes sense to them. • Make sure students have access to a variety of materials. • Allow students to pursue different strategies, and do not lead them to using a particular method unless that is what they think of doing on their own. • If using this as a cumulative task, you should expect students to move to create an equation, but have them share their process of creating the equation.
Task Implementation (During) ***35 minutes***
Directions for Supporting Implementation of the Task • Monitor – Teacher will listen and observe students as they work on task and ask assessing or advancing questions (see chart on next page). • 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. • 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.

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Task Implementation (During) ***35 minutes***

Suggestions For Additional Student Support

May include, among others:

- Possible use of sentence frames to support student thinking
  - Another idea I had about a _____ was…
  - I was confused (wondering) about how/why the transformation was used…
  - How or why did you create this equation?
  - I agree (disagree) because…
  - Your answer/strategy reminds me of…
  - Can you explain more about…?
  - I would like to add on…
- Provide highlighters to assist students in interacting with text
- Provide oral instructions
- Allow students to provide oral explanations
- Allow students to discuss their ideas with a peer before sharing whole group
- Possible problem solving strategies questions for non-starters:
  - Can you try some graphs by hand?
  - Can you verbally describe a movement you might like to create?

Task Implementation (After) ***15 - 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 a whole 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; single to multiple transformations)
  - Connection between multiplication and division (could both operations provide the same outcome?)
- 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?
  - __________'s strategy is similar to ________'s strategy because __________
  - How do these connect to our Learning Intentions?
  - Why is this important?
- Highlight student strategies to show the connections, either between different ideas for solutions or to show the connection between levels of sophistication of student ideas (connect strategies according to the types of transformations used). Allow students to ask clarifying questions.
- Consider ways to ensure that each student will have an equitable opportunity to share his/her thinking during task discussion.
  - Students can participate in a Gallery Walk to view all strategies prior to coming together to discuss selected strategies.
  - Students can "Think, Pair, Share" strategies for creating transformations that have the desired effect
  - Close the lesson by returning to the success criteria. Have students reflect on their progress toward the criteria.
- **Post Task Discussion**: Share this graph to help students see the where they could go with their transformations: https://www.desmos.com/calculator/0pw4uumgu6

Teacher Reflection About Student Learning:
• Were the instructional objectives met? • Did the task address the process goals? • Were students able to explain and justify their thinking? • What was the level of student engagement during the task? • Are their strategies that may need additional development with students? • Are there additional supports that may have further helped students with implementation of the task? • What common errors/misconceptions did students have that were not expected? • How might lack of prior knowledge be addressed when implementing this task again?

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Mathematical Task: ___Animate It!____ Content Standard(s): ___AII.6b____

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 creates graphs by hand on graph paper, but is not able to create the corresponding equation.	• What type of movement did you create with your animated transformation? • Can you explain to me how you created your movement? • What evidence do you have to support your solution?	• What type of movement do you want to create with your animated transformation? • How can you model the movement you want on graph paper? • What value in an absolute value equation creates that movement?		
Anticipated Student Response: Student creates equation and graph, but transformation is not the one desired/described.	• What type of movement did you create with your animated transformation? • Can you explain to me how you created your movement? • What evidence do you have to support your solution?	• What type of movement do you want to create with your animated transformation? • How can you model the movement you want on graph paper? • What value in an absolute value equation creates that movement?		

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		• How can you check to see if your transformation is correct?		
Anticipated Student Response: Student creates an equation and transformation matches description.	• What type of movement did you create with your animated transformation? • Can you explain to me how you created your movement? • What evidence do you have to support your solution?	• What type of movement do you want to create with your animated transformation? • How can you model the movement you want on graph paper? • What value in an absolute value equation creates that movement? • Is there anything else you could do to enhance your transformation?		
Anticipated Student Response: Student creates equation matching description and provides other enhancements: • Adjusts window of Desmos	• What type of movement did you create with your animated transformation? • Can you explain to me how you created your movement? • What evidence do you have to support your solution?	• What type of movement do you want to create with your animated transformation? • How can you model the movement you want on graph paper?		

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• Multiple transformations • Restricted domain or range • Uses other functions to add to picture • Inserts an image as a background	• What enhancement did you add to your animation? • How did you create your enhancement?	• What value in an absolute value equation creates that movement? • Is there anything else you could do to enhance your transformation? • What enhancement would you make if you knew how?		

Name___________________________________ Date_________________________

Animate It!

Animation can be done by hand or with the assistance of various computer programs. The process involves recreating figures in different phases of movements and then stringing those images together to create the appearance of seamless movement.

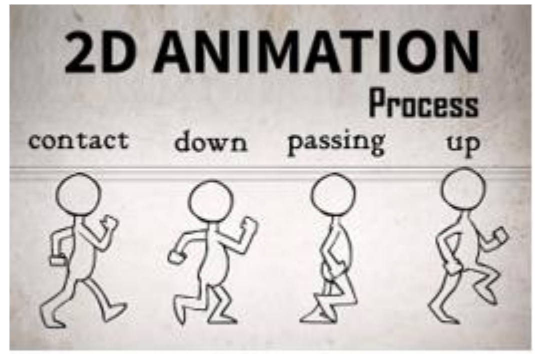

Image Credit: http://arenasurat.com/

Mathematical transformations can also be strung together to create animations. Desmos graphing calculator can actually animate such transformations through a slider.

Your task is to create a character in the form of an absolute value function and animate it through some transformation using a slider in the equation; vertical shift, horizontal shift, or dilation.

Once you have put a slider into an equation, 

, you simply press the  button to start the animation.

Explain each of the following aspects of your character:

- Name and type of character.
- Describe the transformations, including what is being animated.
- Explain your process for creating your transformed equation.
    - How did you start the process?
    - How/why did you change aspects of your creation?
    - Were there any problems in your process that you had to work through? If so, explain.
- Describe ways you would like to be able to enhance your character.

Optional: Explain what and how you created any enhancements to your character beyond the required transformations.

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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