Linear Art with Desmos

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Task Overview

Description
Students will explore their cultural background for an artifact they can draw using linear equations in Desmos. This task is an opportunity for students to creatively connect their own identity through the graphical beauty of math. The final product will include an image, a personal reflection on the meaning of their artifact and at least one self-assessment.

This task was adapted and shared with permission by Marieta Angjeli, TDSB.

Big Idea
Changing the numbers in an equation will change what it looks like on the graph in predictable ways.

Duration
Diagnostic - 60 minutes
Task - can be completed periodically over as many days as needed to allow for at least one feedback cycle to occur

Recommended Materials

- Each student will need a chromebook (phones do not work well)
- Desmos ***IMPORTANT*: Student will need to create an account in order to save their progress and share with their teacher.**

Learning Goal(s)

- Students will graph linear equations with technology in various forms (e.g.$y = ax + b$, $x = k$, $y = k$).
- Students will make connections between the parameters in the equation and the characteristics of the graph.
- Students will describe how transformations (translations, reflections and rotations) of lines affects the graph and equation.

Sample Success Criteria

- I can use Desmos to graph a line in various forms
- I can make a line look the way I need to recreate an image by changing parts of the equation
  - I know how change the equation to change the steepness of the line
  - I know how to change the equation to move or translate the line
  - I know how to use inequalities to restrict the line to a ray or segment

Overall Expectations

AA1. Social-Emotional Learning Skills
develop and explore a variety of social-emotional learning skills in a context that supports and reflects this learning in connection with the expectations across all other strands

A1. Mathematical Processes
apply the mathematical processes to develop a conceptual understanding of, and procedural fluency with, the mathematics they are learning

C1. Algebraic Expressions and Equations
demonstrate an understanding of the development and use of algebraic concepts and of their connection to numbers, using various tools and representations

C2. Coding: apply coding skills to represent mathematical concepts and relationships dynamically, and to solve problems, in algebra and across the other strands

C4. Characteristics of Relations
demonstrate an understanding of the characteristics of various representations of linear and non-linear relations, using tools, including coding when appropriate

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Social-Emotional Learning (SEL) Skills*

- Recognizing and Identifying Emotions That Support Mathematical Learning
- Recognizing Sources of Stress That Present Challenges to Mathematical Learning
- Identifying Resources and Supports That Aid Perseverance in Mathematical Learning
- Building Healthy Relationships and Communicating Effectively in Mathematics
- Developing a Healthy Mathematical Identity Through Building Self-Awareness
- Developing Critical and Creative Mathematical Thinking

** This overall expectation is to be included in classroom instruction, but not in assessment, evaluation, or reporting. See **further information** about approaches to instruction that support all students as they work to apply mathematical thinking, make connections, and develop a healthy identity as mathematics learners to foster well-being and the ability to learn mathematics.*

Mathematical Processes

This task gives an opportunity to focus on the **mathematical processes**.

- **Problem Solving:** critical thinking, math identity, knowledge, collaboration, lived reality, creative thinking, confidence
- **Reasoning and Proving:** justification, proportional reasoning, algebraic reasoning, spatial reasoning, numbers, operations, geometric properties, measurement
- **Reflecting:** identify what is working, what isn't working, appropriate strategy, reasonableness of their answer
- **Connecting:** connect different mathematical concepts
- **Communicating:** share ideas, understandings and solutions, provide feedback, pose questions
- **Representing:** represent math relationships using pictures, diagrams, numbers and symbols
- **Selecting Tools and Strategies:** test, revise, confirm reasoning, remembering how they solved a problem, use of technology for determining unknown information

Prior Learning and Placement of Task during Semester

This task is meant to be introduced at the beginning of the learning around graphing linear equations and worked on over the course as these concepts continue to be developed. This creates the need to learn more about the equations of a line and how to modify them to have a particular outcome.

Using Desmos for this task is an opportunity for teachers to learn more about Desmos and how it can be used in the classroom. Before having students work on the Marbleslides activity and the art task, teachers are highly recommended to work through both activities on their own. Teachers will hopefully see that Desmos is a safe place for them and their students to learn and make connections between equations, tables of values and the graphs they create with immediate feedback. It is also a great tool for students to easily extend their learning. Desmos can be used during in person, hybrid and remote learning.

For an introduction to using Desmos Classroom Activities: https://learn.desmos.com/activities

Diagnostic Task & Look Fors

Diagnostic Task

Desmos Marbleslides: This introduces how to use Desmos to graph, including use of restrictions of the domain, as well as various forms of the equation of a line (e.g.$y = ax + b$, $x = k$, $y = k$). This activity has been modified from the original Desmos Marbleslides activity to include horizontal and vertical lines.

Teachers can make a copy of the Desmos Marbleslides and edit it to meet the needs of their classes. For example, use fractions for slope values ($\frac{rise}{run}$) instead of decimal values. This may reinforce the idea of slope as a rate.

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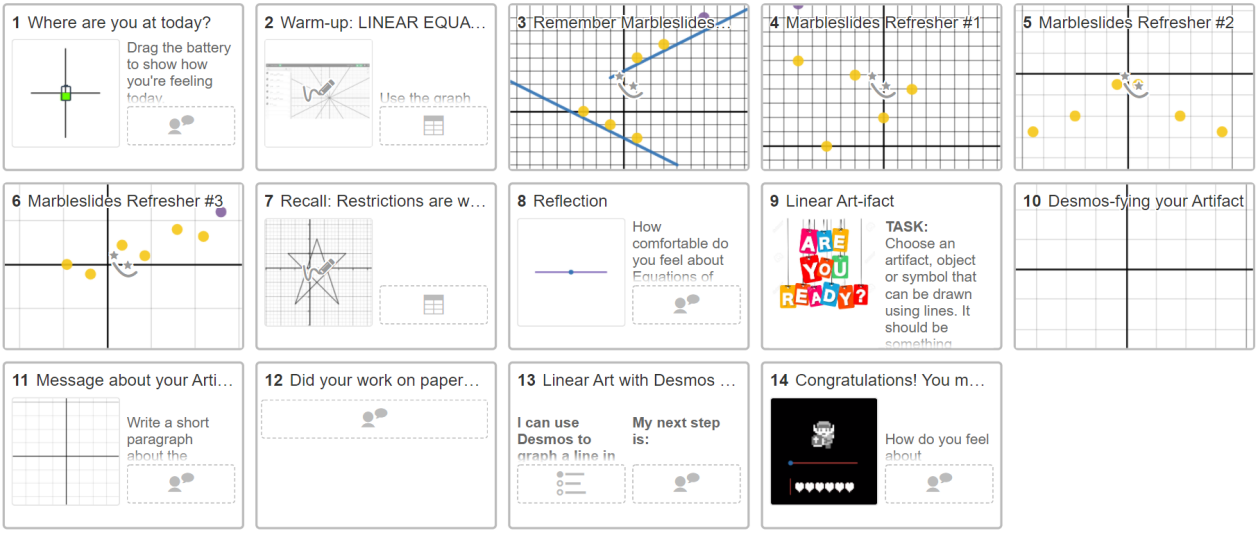
Look Fors

- Sees that increasing "a" in $y = ax + b$ makes the line more steep
- Sees that decreasing "a" in $y = ax + b$ makes the line less steep
- Sees that increasing "b" translates the line up
- Sees that decreasing "b" translates the line down
- Can use inequalities to turn a continuous line into a ray or line segment
- Sees that "$x = k$" graphs a vertical line with a x-intercept at k.
- Sees that "$y = k$" graphs a horizontal line with a y-intercept at k.
- Uses math vocabulary such as variable, rate of change, slope, multiplicative, initial value, constant, intercepts, inequality, horizontal, vertical, positive, negative, steepness, restrictions, domain and range.
- Confidence and willingness to use technology - digital literacy
- Do students make connections to transformations (translations, rotations, reflections)?

The Task

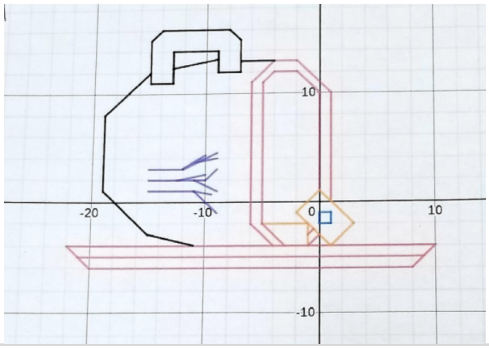
Students will reflect on their cultural background and create a design with lines using Desmos, based on a cultural artifact. Ask students to choose an object or artifact that means something to them and is related to their culture to recreate in Desmos. The final product will include an image, a personal reflection on the meaning of their artifact and at least one self-assessment.

Teacher can choose to assign this task using Desmos Activity Builder Linear Art with Desmos Task, which requires teacher and students to sign-in with their school Gmail accounts. Teachers can make a copy of the Desmsos activity and edit it to meet the needs of their classes.



Student examples

(adapted and shared with permission from a task by Marieta Angjeli, TDSB)



Cultural Heritage and Message of your Design:
For my design, I chose two artifacts that have been passed down through my family for a long time. A teacup from my mom's side & a pair of cufflinks from my dad's. My great-great-grandmother was given the teacup as a gift, & my great-great grandfather worked on a railroad somewhere (I forget) & was given cufflinks as a reward for his family.

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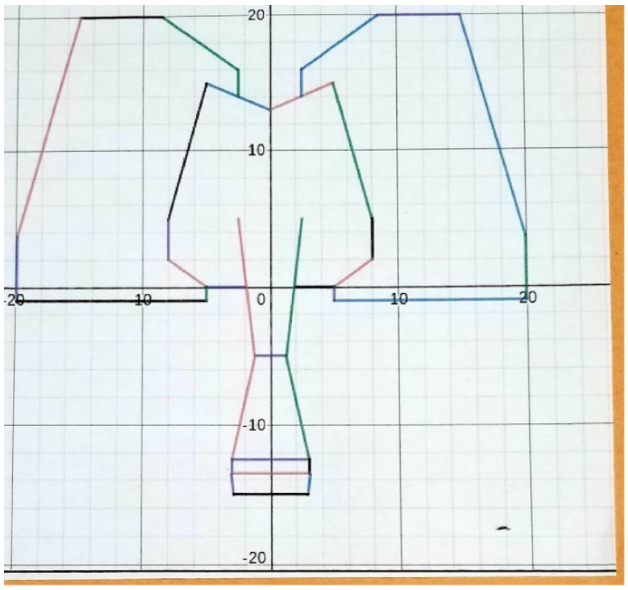
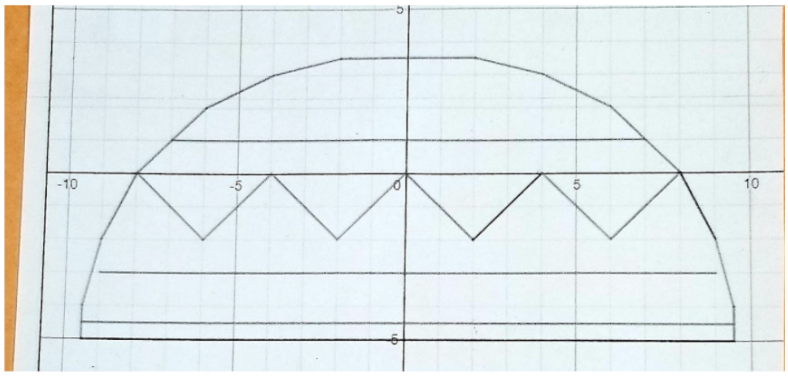


Cultural Heritage and Message of your Design:
I am Sri Lakan so I decided to create a head of an elephant, since elephants are known to be there. As well as elephants being a religious symbol. Elephants are sacred animals. There are about 4,000 - 5,000 elephants left. Not only elephants are a cultural factor it's also a economic factor.



Cultural Heritage and Message of your Design:
I decided for my design to be a "Toupe". It's a special type of hat prevalent in my religion of Islam, meant to cover the hair during religious practises such as praying. It goes by tons of names, but a "Toupe" or "Toupee" is what we call it in Bangladesh. It's also prevalent in other religions such as Judaism.

Teacher notes

This task will help students begin to understand and then consolidate how the graphs of a line change when the values in the equation change.

Teachers will need to differentiate/scaffold for readiness based on the Desmos Marbleslides activity, as it will allow you to identify who may need more support with previous learning.

If students choose a complex artifact to create, an option is to first draw the artifact on a paper/graph paper - this can help simplify the design. If drawing is a challenge, Desmos also has the ability to import a photo into the graphing calculator, so student can create their linear art on top of the image of their artifact. Choosing a complex artifact is an opportunity to discuss and reflect on how to simplify the design to create the 2D representation.

If students are unsure what sort of artifact to use an option could be a flag. For others, their cultural artifact may be something from their lived experience or something that is of personal significance (e.g. if someone grew up near the ocean a shell could be a cultural artifact) .

Consider having periodic whole class sharing/progress updates where students can share tips (strategies that are working for them) or roadblocks they may be encountering. This could be an opportunity for student self-reflection of their own Social-Emotional Learning (SEL) skills.

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Sample self-assessment of SEL skills for students:

SOCIAL-EMOTIONAL LEARNING (SEL) SKILLS

Develop and explore a variety of social-emotional learning skills in a context that supports and reflects this learning in connection with the expectations across all other strands. **(AA1)**

Specific Goals:	Not Yet	Getting There					Got It!		
I can recognize and identify emotions that support my mathematical learning. **(AA1)**	✔								
I can recognize sources of stress that present challenges to my mathematical learning. **(AA2)**	✔								
I can identify resources that will help me to persevere in my mathematical learning. **(AA3)**	✔								
I can build healthy relationships and communicate effectively in mathematics. **(AA4)**	✔								
I have developed a healthy mathematical identity through building self-awareness. **(AA5)**	✔								
I have developed my critical and creative mathematical thinking. **(AA6)**	✔								

Courtesy of Darren Luoma (SCDSB)

Where could we go with this task?

- Use the art to continue learning about transformations, for example the art may have parallel and perpendicular lines which can be connected to rotations and translations.
- Opportunity to connect to inequalities by shading regions of their art.
- If students recreated a physical object there is an opportunity to connect to proportional reasoning through scale diagrams.

Assessment

Although the intent of this task is an assessment for learning, the evidence collected could be used as assessment of learning for students who may need this opportunity to demonstrate their learning. Observations should be collected as needed.

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This table could be used by the student (as a self-assessment or to prepare for an interview/conversation). The self-assessment and teacher feedback should be done as a check-in part way through, and then again at the end of the task to give students the opportunity to use the feedback.

I can use Desmos to graph a line in various forms.	I am not sure.	I think so but I have more questions about this.	Yes, I can graph lines including ones that are horizontal and vertical by inputting equations into Desmos.
I know how to change the equation to change the steepness of the line.	I am not sure.	I think so but I have more questions about this.	Yes, and I can show in my Desmos art where I had to think about this.
I know how to change the equation to move or translate the line.	I am not sure.	I think so but I have more questions about this.	Yes, and I can show in my Desmos art where I had to think about this.
I know how to use inequalities in restrictions to graph line segments.	I am not sure.	I think I can, but I have some questions about this.	Yes, I can use inequalities with restrictions to create line segments, including horizontal and vertical lines.

My next step is: _____

Teacher feedback: _____

The Linear Art with Desmos activity includes the above student self-assessment on screen 9 and requires teachers to provide feedback to students. Click here to learn how to provide written feedback in Desmos.

*This task can be included in the **Student Portfolio of Process Expectations** (Google Slides)*

Additional Resources

Desmos Graphing Calculator
Using restrictions in Desmos

Overview of Culturally Responsive Practices - What is culture and considerations for culture in teaching
What is Culture? An excerpt from Zaretta Hammond's book Culturally Responsive Teaching and the Brain