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MATH 10X
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Reasoning with Equations and Inequalities: *Represent and Solve Equations and Inequalities Graphically*.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

I will connect the standard above to Rene Descartes concept of axis and coordinates from France during the 16th century. I will help to illustrate that Descartes played an important role in developing the system we now use today, while contrasting its very obvious differences. Further, I will show that Descartes also concluded that Algebraic equations could be represented geometrically on his coordinate system. I will seek to point how Descartes's system allowed for the conversion from geometry to Algebra, and I will highlight the importance this system had for mathematics moving forward. The problem set includes the plotting of parabolas and conic sections and will directly tie to the script. It will ask students to compare and contrast the plotting of equations as opposed to Descartes idea of constructing a curve.

Script Intro: The following scene includes a dialogue between two Algebra 1 students and the famed mathematician, Rene Descartes. Descartes appears and explains his contributions to the Cartesian coordinate system and the significance of his work to the two students.

Sally and Johnny are completing their Algebra 1 problem set at their school's library. They are practicing graphing lines and curves on the Cartesian coordinate plane. The are struggling a little but are generally finding solutions to the problems.

Johnny: Man, these equations are abstract and hard to understand! Like, what's the point of them anyways?
Sally: Good thing we can graph them as lines and curves. Pictures always help me!
Johnny: Yes! Thank God almighty for the coordinate system!!
Creepy synth music begins playing and the library begins shaking. Books fall from their shelves. Sally and Johnny hold each other, looking frightened.
Sally: What's happening?!
Johnny: **(*still holding Sally*)** I don't know!
The cartesian coordinate system on Sally's paper begins to morph into a face.
Sally: Look! **(*She points at her paper and pulls away*)**
Johnny: What the hell is that?
The face of Rene Descartes emerges from the paper. Rene stares angrily at Johnny.
Descartes: Johnny! Why on earth would you thank God for the *Cartesian* coordinate system!? Thank me, Rene Descartes!
The library stops shaking.
Johnny: Wow **(*visibly bummed out*).** A big intro for very little reward. **(*He sulks*).**
Sally: No, Johnny! This is incredible! Descartes came up with the Cartesian Coordinate System. I was reading online about it and...
Descartes: No, no, no… that's incorrect. People on the internet have a tendency to lie about my *Geometry.*
Both Sally and Johnny look at Descartes, confused. Johnny is frustrated. There is an awkward pause.
Sally: Oh… Well, what are you doing here then?
Descartes: Ah! I am glad you asked!
Johnny: **(*rolling his eyes*)** Oh no.
Descartes: As it turns out, I, originally, used and developed **(*Descartes smirks)*** the coordinate system in a subtly different way then you do today. My work does not represent coordinate geometry as you understand it. However, the methods I laid out in *La Geometrie* were crucial for giving geometric meaning to the solutions of algebraic equations.
Sally is perplexed but interested. Johnny doesn't seem to care.
Sally: Woah, woah, woah, but the coordinate system is named after you. How did you contribute to it?
Johnny: No, don't ask more quest…
Descartes: **(*ignoring and interrupting Johnny)*** Well, you see Sally, I was more concerned with the constructability of curves and other various problems in geometry. The problems are much too complex for your level of mathematics, but, essentially, when posed with various

geometrical problems, I would construct lines and curves such that the geometric solution represents an algebraic equation. This was important for the developing relationship between algebra and geometry.

Johnny is at this point asleep. Sally is inquisitive.

Sally: Well, that's all really cool, but you said you contributed to the coordinate system. How?

Descartes: That really isn't the real important part of my work. Have I told you about the constructability of curves?

Sally: But have you seen this problem set? It's all about coordinates.

Descartes: Ahh fine… I developed a coordinate system to help solve various locus problems proposed by Apollonius and Pappus. Loci are the set of all points, lines, or surfaces that satisfy a given requirement. I was not concerned with plotting the points of the loci based on x and y axis. I would, however, use coordinates and axis, placed on the geometric representation, to highlight the equation of the loci and the equation's constructability. I hardly even plotted any lines. My ideas and the importance of my work as a whole were adopted into the Cartesian system you know today!

Sally: Oh! Now I get it. Johnny wake up! **(*She violently shakes Johnny)*.**

Johnny: **(*He wakes up very startled*)** Ahh what…. What happened?!

Sally: Descartes just explained everything to me! Descartes tell him!

They both look back at the page, but the face is no longer there. All that remains is a coordinate plane.

Sally: He was just here! Where did he go?

Johnny: I swore that was a dream. What's real?! What's not?! **(*Johnny becomes very worried and scared*).**

Scene cuts to black.

Bibliography for further Reading

Boyer, Carl. “Fermat and Descartes.” In *History of Analytic Geometry*. New York: Scripta Mathematica, 1956. 74-102.

Hellman, Hal. “Descartes Versus Fermat: Analytic Geometry and Optics.” In *Great Feuds in Mathematics*. New Jersey: John Wiley and Sons Inc., 2006. 26-50.

Motz, Lloyd and Weaver, Jefferson. “Analytic Geometry: The Geometrization of Arithmetic and Algebra.” In *The Story of Mathematics*. New York: Plenum Press, 1993. 103-124.

Problem Set

1.) Plot the following equation: $(X^2)+(Y^2)=4$
2.) Plot the following equation: $(X^2)+2X+1=Y$
3.) How does plotting the problems listed above compare and contrast with the way that Descartes constructed equations and curves?